7TH CONFERENCE ON OCCUPATIONAL HAZARDS TO HEALTH CARE WORKERS

April 10-12, 1996

Center for Urban Horticulture
University of Washington

Sponsored by the

Northwest Center for Occupational Health and Safety
Department of Environmental Health
School of Public Health and Community Medicine
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ACCREDITATION

The University of Washington School of Medicine is accredited by the Accreditation Council for Continuing Medical Education (ACCME). The University of Washington School of Medicine designates this continuing medical education activity for 14.5 hours in Category 1 of the Physician's Recognition Award of the American Medical Association.

This course has been approved for 20 contact hours by the American Nurses Association.

This course has been approved for 2.0 CM points by the American Board of Industrial Hygiene.

Application for credit has been made to the Washington State Board of Registered Sanitarians.

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ADVISORY COMMITTEE

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Assistant Chair for Community Outreach
Department of Environmental Health
University of Washington

Carol Hicks, RN, MPH
Occupational Health Nurse
Ambulatory Services
Employee Health Services
University of Washington Medical Center

Stephen M. Hurley, MSPH
Manager
Health Care Risk Management Services
Johnson and Higgins, Inc.
Seattle, Washington

Matthew Keifer, MD, MPH
Assistant Professor
Departments of Medicine and Environmental Health
University of Washington

Kathryn Maher, RN, MSN
Employee Heath Nurse
Employee Health Services
Harborview Medical Center

Mary K. Salazar, EdD, COHN
Assistant Professor and Director
Occupational Health Nursing
School of Nursing
University of Washington

Bernadette Stringer, RN, MSc(A)
PhD Candidate
Department of Occupational Health
Faculty of Medicine
McGill University
Montreal, Quebec

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FACULTY

Sharon Morris, Course Director
Assistant Chair for Community Outreach
Department of Environmental Health
University of Washington

Nancy Beaudet, CIH
Industrial Hygienist
Occupational and Environmental Medicine
Department of Environmental Health/Harborview
University of Washington

Linda Chiarello, RN, MS, CIC
Director
Infection Control Program
New York Department of Health
Albany, New York

Linda H. Clever, MD, FACP
Chair
Occupational Health Department
Presbyterian Hospital/Pacific Medical Center
San Francisco, California

Jamie Cohen
Assistant Director
Health and Safety Department
Service Employees International Union (SEIU)
Washington, D.C.

Bradley Evanoff, MD, MPH
Assistant Professor and Head
Occupational and Environmental Medicine
Washington University School of Medicine
St. Louis, Missouri

FACULTY *(continued)*

June Fisher, MD
Clinical Associate Professor of Medicine
University of California at San Francisco
San Francisco, California

Bryan Hardin, PhD
Acting Deputy Director
NIOSH/CDC
Atlanta, Georgia

Steve Hecker, MSPH
Associate Professor
Labor Education and Research Center
University of Oregon
Eugene, Oregon

Carol Hicks, RN, MPH
Occupational Health Nurse
Ambulatory Services
Employee Health Services
University of Washington Medical Center

Stephen M. Hurley, MSPH
Manager
Health Care Risk Management Services
Johnson and Higgins, Inc.
Seattle, Washington

Ron M. Kaplan, ARNP, MN, COHN
Coordinator
Employee Health Program
VA Puget Sound Health Care System
Seattle, Washington

Jane Lipscomb, PhD, RN
Senior Scientist
Office of the Director
NIOSH/CDC
Washington, D.C.

FACULTY *(continued)*

Kathryn Maher, RN, MSN
Employee Heath Nurse
Employee Health Services
Harborview Medical Center

Jeff Minzel, JD
Attorney-at-Law
Davis, Wright, Tremaine
Seattle, Washington

Gilbert S. Omenn, MD, PhD
Dean and Professor
School of Public Health and Community Medicine
University of Washington

Bernice Owen, PhD, RN
Professor
School of Nursing
University of Wisconsin at Madison
Madison, Wisconsin

Teresa A. Seitz, MPH, CIH
Supervisory Industrial Hygienist
HETAB/DSHEFF
NIOSH/CDC
Cincinnati, Ohio

Bernadette Stringer, RN, MSc(A)
PhD Candidate
Department of Occupational Health
Faculty of Medicine
McGill University
Montreal, Quebec

Wava Truscott, PhD
Vice President of Scientific Affairs
SAFEskin Corporation
San Diego, California

PROGRAM SCHEDULE

Wednesday, April 10 **Chair: Sharon Morris**

8:00 am *Registration and Continental Breakfast*

8:30	Welcome and Introduction	G. Omenn
8:40	Surfing the Wave of the Health Care Revolution	L. Clever
9:20	An Ergonomic Approach to Reducing Back Stress While Transferring Hospitalized Patients	B. Owen
10:00	*Break*	
10:20	Ergonomic Training for Supervisors and Workers	B. Evanoff
11:00	Preventing Musculoskeletal Disorders: An Ergonomics Curriculum for Dental Hygienists	S. Hecker
11:40	Managing Your Total Cost of Risk	S. Hurley

12:30 pm *Lunch (provided)*

1:30 Workshops

B. Owen Evaluating Lifting Devices	S. Hecker/B. Evanoff Ergonomics Training	N. Beaudet/S. Hurley R. Kaplan Surviving Health and Safety Compliance Inspections

3:00 Workshops Repeated

4:30 Adjourn

Thursday, April 11 **Chair: Carol Hicks**

8:00 am *Continental Breakfast*

8:30	Update on TB: NIOSH Health Hazard Evaluations	T. Seitz
9:15	TB Respirators	B. Hardin
10:00	*Break*	
10:15	Selection of Needlestick Prevention Devices	L. Chiarello
11:00	Evaluating the Hands Free Technique During Surgery	B. Stringer
11:45	Latex Allergies	W. Truscott

12:30 pm *Lunch (provided)*

1:30 Workshops

B. Hardin/T.Seitz K.Maher Respirators: Dialogue with NIOSH	L. Chiarello Selecting Safer Sharps	W. Truscott Latex Allergies

3:00 Workshops Repeated

4:30 Adjourn

5:00 Social Event: Dinner at the Faculty Club

Friday, April 12 **Chair: Kathryn Maher**

8:00 am *Continental Breakfast*

8:30 Violence in Health Care Facilities — J. Lipscomb

9:15 The FMLA, ADA and Workers Compensation Laws — J. Minzel

10:00 *Break*

10:15 Involving Workers in the Process — J. Cohen

11:00 Moving Ahead in Difficult Times — J. Fisher

12:00 Adjourn

Introduction

INTRODUCTION

Gilbert S. Omenn, MD, PhD
Dean and Professor
School of Public Health and Community Medicine
University of Washington

Please see following materials.

Ann. Rev. Public Health. 1988. 9:273–303

HAZARDS FOR HEALTH CARE WORKERS

Linda Hawes Clever

Department of Occupational Health, Pacific Presbyterian Medical Center, San Francisco, California 94115

Gilbert S. Omenn

School of Public Health and Community Medicine, University of Washington, Seattle, Washington 98195

INTRODUCTION

America's nearly seven million health care workers (54a) face essentially all of the hazards found throughout our nation's business and industry, and more. These workers confront dangers normally associated with the construction and manufacturing industries, restaurants, research laboratories, boiler rooms, print shops, and even agriculture. Thus, they contend with heavy lifting, asbestos, and ethylene oxide (ETO); cuts, burns, and hepatitis; radiation, exotic chemicals, and infectious organisms; noise and corrosives; solvents; and pesticides. They also face the very special challenges presented by patient care. And they may work in shifts that sometimes rotate. It is not surprising then, that 6.23 per 100 full-time health care workers had occupational injuries or illnesses in 1984 with a loss of 57.1 work days per 100 full-time workers. These figures are high, compared to other service occupations, except, for example, hotel workers (14b).

These data represent all health care workers, including those in ambulatory settings who have a low incidence of accidents. Sixty-five percent of health care personnel work in nursing and personal care facilities and hospitals: 11.6 per 100 full-time nursing and personal care facilities workers and 7.3 per 100 full-time hospital workers are hurt or sickened by work per year and lose 121 and 63 work days per 100 full-time workers, respectively. The high incidence

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of illnesses and injuries in nursing and personal care facilities is surpassed by the construction industry (15.5 injuries and illnesses per 100 full-time workers per year) and some other heavy trades but is greater than agriculture, mining, manufacturing, and transportation (14a). As the number and type of home health workers increases, injury trends may worsen.

Recent reviews (30, 31, 82a, 109a, 109b) have called attention to health care workers' problems. National professional organizations such as the American Occupational Medical Association (AOMA) (3a) and the American Hospital Association (83) have developed guidelines, as has the National Institute of Occupational Safety and Health (NIOSH) (36a, 100a). Recommendations for healthy and safe dental offices have been made (126). The Centers for Disease Control (CDC) has suggested useful workplace precautions regarding a new risk, AIDS (17, 19, 26, 28). Unfortunately, only a few worker education issues are covered in the Joint Commission on Accreditation of Health Care organization's (JCAHCO) *Plant, Technology, and Safety Management Handbook* Series (73). There are virtually no reviews about or guidelines for employees who work in nursing homes or in patients' homes.

Research on all health care workers is scanty, especially considering the number at risk and the magnitude of their work-related problems. The relative silence of regulatory agencies such as the Occupational Safety and Health Administration (OSHA) and the Joint Commission may partially reflect the paucity of research in the field. Conversely, the lack of research may be partially attributed to lack of regulatory pressures.

Unlike more comprehensive reviews (30, 31, 82a, 109a, 109b), this paper focuses on topics chosen because of their high prevalence, potential severity, widespread current concern, or significant body of scientific study. Examples of infectious disease, chemical, ergonomic, and psychosocial hazards are discussed. In addition to reviewing and analyzing a few key papers on each topic, recommendations for future activity are made.

AIDS

Overview

The Acquired Immunodeficiency Syndrome (AIDS) epidemic is international, multi-generational, and, one way or another, threatens the human race. Even if the spread of the virus can be limited, it appears that most of the millions already infected will be affected. Although much of the published American AIDS experience originates from a few locales (New York City, San Francisco, Newark, Miami, and Los Angeles), health care professionals in all parts of the country and world will soon need to deal with the devastation of AIDS. Since virtually all patients with AIDS or other related

problems will need medical care, health care workers will have substantial experience with these patients. Problems that workers face include protection from contagion, and emotional, attitudinal, and ethical issues.

Infection Control and Risk of Work-related Infection

The Centers for Disease Control and others have made useful and effective suggestions for infection control from the very earliest months of the epidemic through the present (17, 19, 26, 28, 29b, 34, 35, 38, 52, 66, 91, 135). Fortunately, Human Immunodeficiency Virus (HIV) is difficult to transmit in the health care setting, partly because the virus is killed by common disinfectants. Most studies have shown no proven seroconversions after simple or even repeated needlesticks or mucous membrane or skin exposures in physicians, laboratory assistants, nurses, and dental professionals, including dentists, hygienists, and chairside assistants (20, 21, 24, 25, 47, 98). Even in Zaire, hospital studies have shown that the 6.4% incidence of seropositivity among hospital workers is not related to patient, blood, or needle exposure (87).

Unfortunately, accidents can cause acute illness and/or HIV antibody response (92). Early reports documented that two nurses who received intramuscular injections of HIV-contaminated blood (105, 128) and one mother who eschewed gloves and hand washing when caring for her infant with AIDS and bloody stools (27) developed HIV antibodies. Both nurses had brief flu-like illnesses before antibody conversion. Another nurse who had an apparently more superficial needlestick while recapping a thoracentesis needle from an HIV-positive patient developed fever, fatigue, and hepatitis weeks later. All findings except a positive HIV antibody cleared (109). More recently, three nurses had non-needlestick exposures to HIV-antibody positive patients and developed HIV antibodies themselves (29a). Doubtless, other reports will describe HIV-seroconversion and illness in health care workers with only work-related exposure to HIV.

The risk of the unknown is always present in health care. It should be assumed that "every patient has everything" and appropriate infection control measures taken. This is particularly true with AIDS, since seroconversion may require at least one year, and seronegative patients can transmit the virus. The "body substance isolation"/"universal precautions" approach (25, 28, 29b) will help protect health professionals from AIDS and also from hepatitis A and B, cytomegalovirus, herpes viruses, the Jacob Kreutzfeldt agent, and other to-be-discovered dangers. Safe work practices are the only protection now available against job-related AIDS. Prospects for a vaccine seem dim and distant. It should be noted that AIDS patients may also have common infectious complications, such as tuberculosis, that require worker safeguards (29).

Safe, effective vaccines have been developed for hepatitis B virus (HBV),

an agent frequently present in AIDS patients and others (18, 22, 40). There are several reasons to make vigorous efforts to prevent hepatitis B infection.

1. It has well-known acute and chronic effects.
2. The increasingly widespread, savage delta virus can cause disease only in the presence of HBV (23, 36).
3. It is far more infectious than the AIDS virus.

Less than 1% (0.2%) of health care workers with parenteral AIDS exposures studied by six research groups had possible work-related HIV antibody conversions, whereas 9–24% with similar exposures to HBV acquired HBV (52). This amounts to a 45–120 times increased risk of infection after HBV exposure than after HIV exposure. Many more observations and much more long-term follow-up is necessary, of course, before precise comparisons can be made. In the meantime, since 5000 to 10,000 health care workers are infected with HBV per year (56a), effective vaccination programs are vital. Health care workers can be remarkable deniers and noncompliers, however. Cost can be a barrier. Also, legal complexities such as the need for informed consent and conflicts with collective bargaining agreements may delay HBV vaccine programs (6). Most hospital occupational health departments ruefully agree with published reports of apparent high cost and unsatisfactory results from HBV vaccine efforts (23–57% completion of all three doses of free vaccine in two studies, for example) (48, 75). There are encouraging reports, however, of up to 90% participation in HBV vaccine projects (57, 138). These results seem to be associated with strong medical staff leadership, good interdisciplinary teamwork, and intensive inservice education. The advent of recombinant DNA HBV vaccine may also increase the acceptability of vaccine.

Emotional Problems

In addition to grief and exhaustion, health care workers faced with the mounting AIDS emergency may experience fear, guilt, isolation, anger, and frustration. Some may become callous or indifferent or otherwise mask their pain or aversion. There are demands from patients, the press, patients' family members, and workers' own family members (65, 125, 137). Among the most poignant patients are health care workers who develop AIDS secondary to lifestyle. They know well the grim prospects and therefore have even less reason for hope than other AIDS patients, yet face the same remorse, loss of income and status, isolation, and suffering. Not surprisingly, health care professionals who are HIV antibody positive, with or without symptoms, have faced job discrimination. Numerous suits have been filed by nurses, physicians, and technicians who have been demoted, suspended, or fired after their HIV status was discovered (95). Being sick, weary, apprehensive, and unemployed is especially devastating for these service-oriented professionals.

Some emotional reactions to AIDS are based on pre-existing beliefs. Ignorance breeds fear: bias and bigotry breed dislike and hatred. Health professionals are not free of these preconceptions. One study showed that 12% of nurses and 3% of physicians at a large hospital felt that "homosexuals who contract AIDS are getting what they deserve" (43, p. 1309). Other studies have shown negative attitudes toward gay patients by both physicians and nurses (J. A. Kelly et al, personal communication). Whether these feelings will change with experience and as the disease extends throughout all segments of society remains to be seen. Acknowledging, confronting, and setting aside narrow beliefs or outright prejudices will be important to assuring both good patient care and good mental health of health care workers.

The picture is not entirely bad: Good things can develop during the worst catastrophes. Working with respected colleagues, making new discoveries, solving problems, receiving recognition can be gratifying. Confronting AIDS—the enemy—and not retreating builds self-esteem and composure. Fulfilling the public's expectations can be a point of honor; Guy de Chauliac said during the Black Plague, ". . . and I, to avoid infamy, dared not absent myself but with continual fear preserved myself as best I could." (85, p. 1364). During the AIDS plague, new skills are learned, new strengths and satisfactions developed, and new goals formulated ("assuring safe passage" instead of "seeking cure," for example).

Ethical Considerations

The American Medical Association Code of Ethics states that a physician has no obligation to care for a patient except in emergencies (2a). Plumeri outlines actions that a physician could take in order to avoid accusations of patient abandonment when refusing to provide for an AIDS patient (110). Other authors and organizations have made strong statements mandating care of AIDS patients (15, 34, 59). The American College of Physicians states, "Denying appropriate care to sick and dying patients for any reason is unethical" (59, p. 576). Zuger & Miles (142) have reviewed the historical and philosophical underpinnings of medical ethics and feel that "patients' rights" and "contract" models are not strong enough. Rather, *virtue* should be the overarching value and AIDS patients should therefore receive care. Pellegrino has observed that because physicians have nonproprietary knowledge that must be made available to highly vulnerable, suffering patients and because physicians have taken an oath of service, physicians have a moral obligation to care for AIDS patients (109c). Loewy (85) feels that the social contract between physicians and society holds physicians free from taking unreasonable risks and that the AIDS risk is small. The willingness of physicians to function in the face of uncertainty, however, helps maintain social underpinnings that can bolster an entire society during a crisis.

The needs of individuals and society will continue to challenge health professionals. We face the very small but real risk of infection and the very substantial risks of conflict, derision, division, and loss of face and trust.

Recommendations

1. New equipment and safer work practices must be designed to avoid and protect against needlesticks, lacerations, aerosols, and splashes.
2. Infection control guidelines must be stringently followed.
3. Post-exposure health and antibody surveillance should be arranged for HIV and HBV.
4. The use of HBV vaccine should increase.
5. Policies must be established to deal with health care professionals who are infected with the AIDS virus, whether they are sick or well. A case-by-case approach aimed at keeping the person at work but away from parenteral exposure while assuring confidentiality (if the worker wishes) is best.
6. Policies regarding work assignments with AIDS patients need to be considered for pregnant workers.
7. Educational programs for board members, administration, medical, nursing, technical, and blue collar staffs, and the general public must be undertaken. These must cover not only work-related issues but also lifestyle information such as IV drug use and safe sex.
8. Insurance plans must cover home and hospice care.
9. Sensitive and sophisticated grief management programs should be established.
10. Discussions must continue and decisions about professional ethics must be made.
11. More research is essential. We must evaluate the impact of AIDS exposure on health professionals' health, attitudes, effectiveness, work practices, and retention in the profession. We must document successful and unsuccessful methods of education and coping.

CHEMICAL HAZARDS

Overview

In this section, evidence for hazards to health care workers from the common sterilizing agent, ethylene oxide, and from widely used antineoplastic drugs is presented together with measures to prevent exposures and adverse effects. Current failures to achieve stringent exposure controls reflect disputes over the significance of animal and epidemiologic results and a passive regulatory climate.

Ethylene Oxide

Ethylene oxide is an indispensible, antimicrobial, sterilizing agent, widely used in hospitals and other health care facilities and in production facilities for medical supplies and medical equipment. It is used primarily for materials that are sensitive to heat or moisture, including such equipment as fiberscopic instruments, plastic goods, parts of heart-lung machines, cardiac pacemakers, artificial joints, drugs, and other medications.

NIOSH has estimated that approximately 140,000 US workers in 67 nonagricultural industries are potentially exposed to ethylene oxide in their routine work; of these, about 75,000–100,000 are employed in sterilization in the health care industry, even though only 0.24% of US production (estimated at 6 billion pounds per year) is consumed in hospitals and medical-product industries. More than 99% of the ethylene oxide produced is used as chemical intermediate to manufacture ethylene glycol, glycol ethers, non-ionic surfactants, ethyleneamine, and other products.

Exposures of hospital workers tcnd to be intermittent and short term. In a limited survey of hospitals, NIOSH (102) found that ethylene oxide (EtO) concentrations near malfunctioning or improperly designed sterilizing equipment may reach peak levels of hundreds to thousands of mg/m^3. Time-weighted eight-hour average concentrations generally were below 990 mg/m^3 (equivalent to 50 ppm). Emissions of EtO were reported to occur mainly following the opening of the door of the sterilization equipment during the changing of gas cylinders and when freshly sterilized materials were unloaded. Sterilized material must be kept unused for 24 hours to 30 days to allow for off-gassing of residual EtO.

Given its antimicrobial and pesticide applications, it is predictable that ethylene oxide is a highly reactive and toxic agent. It is a known mutagen in many test systems. Its epoxide reacts directly with DNA to alkylate (ethylate) the DNA. It also attacks sulfhydryl, amino, carboxyl and hydroxyl moieties of proteins. High doses produce acute irritation of skin and eyes, headache, vomiting, dyspnea, diarrhea, and lymphocytosis. Both animal studies and human studies of long-term effects from low exposures indicate mutagenic, carcinogenic, and fetotoxic effects, though not all animal bioassays have shown carcinogenic effects. Dose-related increase in mononuclear cell leukemias in female rats (120) is used to extrapolate upper-bound risk estimates for humans.

Most epidemiologic studies have not investigated hospital workers; rather, workers in medical-equipment production facilities using EtO as sterilizing agent have been studied (68). Studies in Sweden (63) revealed 8 cases of leukemia among 733 ethylene-oxide exposed workers (0.8 expected) and 6 cases of stomach cancer (0.6 expected). Even if the initial 4 leukemia/

lymphoma cases were excluded as a cluster with ascertainment bias, the remaining 4 cases represent a statistically significant excess (0.4 expected, $p < 0.01$). A study of 767 employees of a Texaco chemical plant in Texas was negative, though exposure levels were probably less than 10 ppm and no allowance for latency period was made in the analysis (97).

Two major cytogenetic studies have been undertaken using chromosome aberrations and sister-chromatid exchanges (SCE) as markers of genetic damage and/or chemical exposure, presumably both indicating risk for malignancy. Studies (114) at nine plants of the American Hospital Supply Corporation using EtO for sterilization of medical devices found significant differences in the numbers and types of chromosomal aberrations between exposed workers and nonexposed controls. Air concentrations of EtO were estimated to range from 1 to 40 ppm per eight-hour time-weighted average (TWA), with short-term excursions not exceeding 75 ppm. Nearly all of the cytogenetic abnormalities occurred among workers in three high-concentration facilities. At three Johnson and Johnson facilities, dose-related increases in SCE frequencies (127) and in chromosome observations (50) occurred among workers with high TWA exposures (5–200 ppm EtO). Adjustments for age, sex, and cigarette smoking did not alter the conclusions. SCE frequency appears to be a useful biological dosimeter for past EtO exposure of groups of workers. Unfortunately the range of values for individuals has tremendous overlap. Chromosome aberrations and SCEs could not be used to predict each other, partly because of sampling variations (50). Both are responses to alterations induced in DNA, but their mechanisms differ (140).

We should always be alert that health care workers may also suffer, on a cumulative or accidental basis, significant exposures of the same sort that produces adverse reactions in patients. Immediate type hypersensitivity reactions were diagnosed in 6 of 600 donors who underwent automated plateletpheresis procedures, probably due to ethylene oxide gas used to sterilize plastic components in disposable apheresis kits (81).

EtO has well documented reproductive and prenatal toxicity in animal studies (68, 80). Hemminki et al (60) reported a retrospective study on 1443 pregnancy outcomes that occurred between the early 1950s and 1981 among female sterilizing staff in hospitals in Finland. Nursing supervisors from approximately 80 hospitals identified the study participants and the exposure status of each with regard to specific sterilizing agents, which included ethylene oxide, glutaraldehyde, and formaldehyde. A control group comprised 1179 pregnancies among female nursing auxiliaries who had no exposure to sterilizing agents, anesthetic gases, or x-rays. The rate of spontaneous abortions (adjusted for age, parity, decade of pregnancy, coffee consumption, alcohol consumption, and smoking habits) was significantly increased in pregnancies exposed to EtO alone (16.1% versus 7.8% for unexposed preg-

nancies). Similar results were found (61) after applying a stricter age adjustment and restricting pregnancies among controls to those that began during hospital employment. Also, for sterilizing staff and controls identified from hospital discharge registries in Finland from 1973 to 1979, rates of spontaneous abortion were 22.6% among ethylene oxide-exposed pregnancies and 9.2% among control pregnancies (61).

PREVENTIVE MEASURES Regulation, training, monitoring, and enforcement are necessary to protect workers against unnecessary exposures to ethylene oxide. At least 20 countries have set national occupational exposure limits for ethylene oxide (68). In the United States, OSHA in 1977 set the permissible exposure limit (PEL) for EtO in the workplace at 50 ppm of air averaged over an eight-hour shift. In 1984 OSHA lowered the PEL to 1 ppm (134). Health care administrators should have an active program to monitor the amount of time that employees work in areas where EtO is used; to educate employees using sterilizers, as well as managers and department heads; to test air samples every three months and whenever a sterilizing unit is moved; to assure effective ventilation, preventing recirculation that may expose unsuspecting workers and patients; and to keep records of employees who have been exposed to EtO for many years after termination of employment (139).

The most unsatisfactory aspect of the regulatory regime is the lack of a short-term or peak limit, given the intermittent nature of exposures to ethylene oxide as a sterilizing agent. The Public Citizen Health Research Group and four unions petitioned the US Court of Appeals in April 1987 to order OSHA to comply with a previous court order of July 1986 to adopt a short-term exposure limit for EtO, or else explain why not.

Unfortunately, laboratory research has neglected the problem of intermittent exposure for EtO and most other chemicals. Ironically, an experimental analysis of dose rate and dose fractionation is routine in radiation biology, but has yet to penetrate protocols in toxicology. One study can be cited. Generoso et al (51) exposed male mice to 300, 400, or 500 ppm of EtO six hours per day for four consecutive days as a dose-response study; in a parallel dose-rate study male mice were exposed to a daily total dose of 1800 ppm, delivered 300 ppm for six hours, 600 ppm for three hours, or 1200 ppm for 1.5 hours. All of the exposed mice were then mated with females to determine a dominant lethal effect. A clear dose-related effect was observed for both the dose-response and dose-rate groups, even though the total dose delivered per day in the dose-rate groups was the same. Percentage of dominant lethals increased from 10% at 300 ppm to 30% at 600 ppm to 60% at 1200 ppm. These bioassay results heighten concern about the need for short-term standards and controls.

FUTURE DIRECTIONS AND RECOMMENDATIONS Research on dose rate and intermittent exposures in animals can be helpful for setting short-term standards for peak exposures. Meanwhile, careful delineation of the detection limits for monitoring exceedances and establishment of criteria for statistical treatment of variation in those low levels are essential steps in making an eight-hour PEL of 1 ppm or less workable. Cytogenetic monitoring for individuals exposed to EtO is likely to be proposed, but should be limited to a research mode in well-defined groups. Thus, protection of workers will continue to depend upon engineering controls, excellent work practices, and much improved environmental monitoring.

Antineoplastic Drugs

Antineoplastic drugs are a family of chemically unrelated agents that inhibit the growth of tumors by killing actively growing cells or disrupting cell division and cell growth. The family includes alkylating agents such as cyclophosphamide, antimetabolites such as fluorouracil and methotrexate, spindle poisons such as vincristine, antibiotics such as doxorubicin, and hormones such as diethylstilbestrol. Embryos and fetuses are especially vulnerable to toxic effects of these agents.

Many antineoplastic drugs have been found to be carcinogenic, mutagenic, and/or teratogenic both in treated patients and in animal bioassays (118). Intermediate markers of these effects include increased frequency of sister-chromatid exchanges, increased frequency of cells with chromosomal aberrations, and increased frequency of specific locus mutations such as those detected with antisera directed at specific hemoglobin mutants. Cyclophosphamide, in fact, is commonly utilized as a positive control in experimental studies of teratogenesis.

In 1979 Falck et al used bacterial mutagenesis assays (both the Ames test with histidine auxotroph strains of *Salmonella typhimurium* and the bacterial fluctuation test with tryptophan-dependent *E. coli* strain WP2 uvr) on urine from cancer chemotherapy patients, nurses, and controls. All patients receiving cytostatic drugs exhibited detectable mutagenicity in urine; cyclophosphamide required microsomal S9 preparation for activation, while such drugs as doxorubicin and nitrosoureas did not require activation. Mutagenic activity in urine from nurses administering these drugs was significantly above that in controls ($p < .001$), but much lower than for patients (46).

The potential routes of exposure during preparation and administration of these drugs are primarily through inhalation of the aerosolized drug and by direct skin contact. Various manipulations may result in aerosol generation, spraying, and splattering, including withdrawal of needles from drug product vials, use of syringes or needles or filter straws for drug product transfers,

breaking open of ampules, and expulsion of air from a syringe when measuring the precise volume of a drug to be administered to the patient (136). Besides the risk for pharmacists, the actual administration of the drug to the patient by the nurse can lead to aerosol generation or accidental skin contact during clearing of a syringe or infusion line and from leakage at tubing, syringe, or stopcock connections. Finally, disposal of the unadministered drug, of trace-contaminated gloves, gowns, needles, syringes, and vials, and of patient excreta may expose health professionals and housekeeping personnel.

HEALTH EFFECTS STUDIES A case-control study of nurses in 17 Finnish hospitals analyzed pregnancy outcomes from 1973 through 1980 (118). The same research group previously had reported from a study of nurses exposed to anesthetic gases, that first-trimester exposure also to antineoplastic drugs was significantly more common among nurses who gave birth to malformed infants than among those who delivered normal infants (62). Exposures to anesthetic gases, x-rays, and ethylene oxide were analyzed for 124 cases with fetal losses and 321 matched controls (118). First-trimester exposures were associated with fetal loss for all antineoplastic drugs as a group (odds ratio 2.3 increasing to 3.3 when the analysis was restricted to women without prior fetal losses) and for cyclophosphamide, doxorubicin, and vincristine individually by conditional logistic regression.

This pregnancy outcome study seems to find adverse clinical outcomes reinforcing the many studies reporting increased sister-chromatid exchanges, chromosomal gaps, and mutagenic activity in urine in pharmacy personnel and nurses working with antineoplastic drugs and in animal cell lines so exposed (118).

Nevertheless, the relationship is far from established. Criticisms have been raised about the likely exposures and because of lack of confirmation from other still-limited clinical/epidemiological observations. Mulvihill & Stewart (99) argued that pregnant women treated with high doses for cancers, especially during the first trimester, should show much higher incidence of excess spontaneous abortions and of malformations than the hospital nurses. They reviewed 169 published reports of pregnancies in women receiving cytotoxic agents. Among 99 pregnancies in women exposed at least in the first trimester there were only four spontaneous abortions. This incidence is not higher than expected, and none of the four women received cyclophosphamide or doxorubicin. Another compilation (117) included four malformations among offspring of 33 pregnant patients who received very high doses of doxorubicin, cyclophosphamide, fluorouracil, or MOPP (mechlorethamine HCl, vincristine, procarbazine, and prednisone). Kalter (71) estimated the

likely average doses received in the Finnish hospitals to have been as low as 0.004 gm/day for the pregnant women, with far lower exposures presumably for pharmacy or nursing personnel.

URINE MUTAGENICITY Uncertainty also surrounds the use of urinary mutagen assays in individual health care workers. When 17 antineoplastic drugs were assayed in the Ames test with two standard Salmonella strains, the most highly mutagenic drugs were doxorubicin and cisplatin, with mechlorethamine, carmustine, dacarbazine, and cyclophosphamide also positive (133). For the other 11 drugs, no increase in mutagenic activity was observed above background rates, at least partly because many were toxic to the bacteria. Urine from patients treated with doxorubicin or cyclophosphamide showed mutagenicity, but the results suggested that the quantity of these drugs that would have to be absorbed to produce a definite increase in urinary activity is unlikely to be achieved by drug handlers who use standard precautions. Specifically, these amounts were estimated to be 0.6 mg for doxorubicin and 24 mg for cyclophosphamide. Urine mutagenicity is known to be increased after ingestion of port or bacon, by cigarette smoking, by use of hair dyes, and by presence of histidine or histidine-like substances not removed by the extraction procedure. In summary, urinary tests for mutagenic activity suffer from poor sensitivity and common extraneous confounders, causing poor specificity. Thus, we cannot recommend routine biological monitoring of nurses or pharmacy personnel with this approach. For research purposes, however, urinary mutagenic activity holds considerable promise, so long as careful longitudinal studies are done, confounding factors are investigated, and group comparisons are made. Mean mutagenic activity may decline after better protective measures and practices are adopted (108).

PREVENTIVE MEASURES Good pharmaceutical practice requires use of aseptic techniques and a sterile environment for preparing injectibles (1, 103, 141). Many pharmacists utilize a horizontal laminar-flow clean work bench. However, this type of unit exposes the operator and other room occupants; it is designed to protect thc product. A class II vertical laminar-flow biological safety cabinet is needed to provide both product and operator protection and is now universally recommended. The cabinet filters incoming and exhaust air.

Knowing the routes of exposure, one can surmise the necessary preventive measures. These are a combination of a well-selected vertical laminar flow biological saftey cabinet for drug preparation and excellent technique with gloves and gowns and prompt washing of any contamination during both preparation and administration (16, 108, 136). Obviously, eating, drinking,

or smoking in an area where the drugs are mixed must be prohibited, to avoid exposure by ingestion.

FUTURE DIRECTIONS AND RECOMMENDATIONS Further research is needed, combining sensitive ambient and personal exposure measures with epidemiologically sound prospective studies of health care workers and appropriate comparison groups of unexposed, similar workers. The importance of accidental exposures makes such studies quite difficult to organize or perform, though acute symptoms of light-headedness, dizziness, nausea, headache, or skin injury from liquid contact may indicate such accidents, especially in inadequately ventilated areas. Impairment of liver function, measured with the usual liver enzyme assays, has been suggested as a sign of toxic exposure (108, 122). A registry of nurses and pharmacists working with these drugs might prove useful for future studies.

In the meantime, adherence to good practice guidelines remains the best protective approach. Based upon a 1982 survey of 21 comprehensive cancer centers (82) and the comments submitted to OSHA in preparation of its 1986 guidelines (108), use of biological safety cabinets, gloves, and appropriate eating, drinking, and disposal rules were still quite limited. If such is true for large oncology centers, then surely physicians' offices and small pharmacies must need attention as more and more cancer chemotherapy is administered on an outpatient basis.

BACK INJURIES

Overview

Back injuries are among the most persistent, common, expensive, and vexing occupational problems of all workers, including health care workers. Three hundred years ago, Ramazzini noted the high incidence of muscle strains and back pain in workers, including "those who work when standing" (113, p. 175) and porters (113, p. 311). In a classic work, Hult (67) noted that 80% of the population has low back pain at some time and that, unfortunately, most of the pain occurs during a person's working years. Horal (64) reported that nearly two thirds of workers who had not lost work secondary to back pain suffered from it. An American study found that 10.2% of outpatients reported back pain in a four-year period (49). Nursing home and hospital workers in West Virginia were second only to underground coal miners in the frequency of lost-time injuries, many of which were back injuries (55). Stubbs et al estimated that back pain caused 16.2% of sick leave and over 750,000 lost work days per year among British National Health Service nurses (128a).

Health Care Professionals

Research interest on back injury in health care workers has been low, especially in the United States, and virtually all published work has been retrospective. Harber et al (58) recently surveyed 1000 nursing staff members at an urban university hospital. Based on a 55% response rate, 37% recalled occupation-related back pain in the previous two weeks and 52% recalled it in the previous six months. These findings are quite similar to Stubbs et al (128a), who estimated a 43% prevalence of back pain per year in nurses in the UK. Similarly, Dehlin et al (36c) found a 47% lifetime incidence in nursing aides. These findings do not appear to be consistent with those of Videman et al (136) and Arad & Ryan (4), who found an 80–87% prevalence of back pain in nursing staff members. Fallibility of memory and differences in survey methods may explain these discrepancies. It is clear, however, that back pain is a significant complaint in nurses and may even lead to job change. Another Stubbs report (129) found that 3.5% of nurses gave back pain as one reason for leaving nursing or changing assignments; 1.3% gave back pain as the sole reason for leaving the profession.

Generalizations are difficult because of the variety of health professionals. For example, two Canadian studies (8, 39) showed that about 60% of dentists have had back and/or neck pain during their lives. The musculoskeletal demands of dentistry are quite different from those of nursing, with a twisted, static post posture predominating in the former and lifting a far more important element in the latter. Overall, it is fair to say that we bipeds have back problems related to life and to work. Understanding the genesis of these symptoms is crucial to their prevention.

Causes and Targets of Injury

How do injuries occur? Which health care workers get injured?

Since so little research is available on American health care workers, per se, it is useful to look at heavy-industry studies that may provide data for comparison. Bigos et al (11) in a masterful and exhaustive retrospective study of a large aircraft company's files, found that new employees (less than 25 years old) tended to have the largest number of back injury claims. Of special interest was the correlation of a poor evaluation by a supervisor in the previous six months with the incidence of back injuries ($p < 0.005$). Other analysis by this group (10) showed that 47% of back injury claimants had injuries related to lifting and 10% had injuries related to slips and falls.

California State statistics, one of the best sources of information regarding hospital workers' health, showed that about one-quarter of all disabling injuries to nonregistered nurses were caused by lifting on the job and about 20% by slips and falls (42). Registered nurses had a similar incidence of slips and falls; 37% were lifting patients when injured; and nearly 40% of all

lost-time injuries affected the nurse's back (41). Statistical differences between studies can be accounted for by different data collection methods, but the message is the same: Lifting and slips and falls are dangerous. They are not the only problem, however, since clinical experience and studies have shown that more than half of back pain attacks may not be associated with any identifiable incident (132).

Several studies have evaluated injuries to health professionals by category. Nursing aides and qualified nurses in Finland (136) had similar prevalences of back pain during their lives (85% and 79%, respectively). The aides, however, had statistically significant more constant pain, more severe pain, and more pain interference with daily tasks. The aides reported more than twice the amount of time spent in lifting (16.7 vs 7.5 hours per week). Harber et al (58) found that 52% of nurses complained of occupational back symptoms in a six-month period, while only 20% of unit service coordinators of approximately the same age did so. The California State studies showed that licensed vocational nurses (LVNs), aides, attendants, and orderlies had more work injuries than any other occupational group in California private hospitals. Patients are a major but not the only source of injury: only 26% of injuries to non-RNs and less than half of injuries to RNs involve patient care (41, 42). Harber, by direct observation of job responsibilities, has found that although nurses frequently reported pain associated with patient care responsibilities, isometric, nondynamic, non-patient contact activities are also often associated with pain (personal communication). Housekeepers, kitchen workers, clerks, engineers, and others had a high incidence of back injury when lifting and via slips and falls (42). An Australian study evaluated back injuries to various types of nurses ranging from students through administrators (4). In terms of job responsibilities, those with the most lifts per shift (students) had the highest "incidence" (90%) and one-month prevalence (51%). Not surprisingly and perhaps related to Bigos et al's report of the association of poor supervisorial evaluation and back injury (11), the highest incidence (91%) and prevalence (57%) of back symptoms was in that group which reported "heavy" alcohol intake (3% of total group).

Prevention

Patients do not have corners or handles and can't always be pressed close to the body in an ergonomically sound fashion. Further, patients do have emotions and excretions, and may be excitable, compounding the challenge. Unfortunately, despite the studies cited, we know very little about the causes of low back pain in health care workers and therefore even less about its prevention.

Because of the complexity of the issue, it is not surprising that rhetorical

wars have been waged and reams of papers have been written on the prevention of back injury (121). Questions include:

1. Should pre-placement screening be done? If so, can back X-rays be excluded as unreliable in the evaluation (115, 116)?
2. What are the highest risk activities for health care workers, and how can these be reduced?
3. What is the optimum number of staff members per unit?
4. What assistive equipment is most desirable, and how can workers be induced to use it?
5. How should "proper" lifting techniques be taught? By whom? How often?
6. What are the proper techniques?

Recommendations

In order to address the problem, long-term, interdisciplinary, prospective studies are needed. A standard questionnaire would be useful (86). Many different sources of information should be correlated, such as direct observation of jobs, employee health visits, OSHA reports, workers' compensation claims and costs, employee questionnaires, personnel records regarding sick leave and absences, and/or state health department figures. More research needs to be done in the United States, since findings from other countries may not apply here because of different payment systems for disability, different traditions regarding litigation, and different esprit de corps within the profession. Finally, quantification is important, especially since back pain is subjective, intermittent, and dependent upon life, not just work.

In the meantime, health care workers have back pain and injuries. Prompt evaluation of these workers' symptoms and working conditions is necessary in order to design appropriate treatment. Bed rest, immobilization, and surgery are rarely indicated but may be necessary for very specific problems and after second opinions and, usually, psychiatric/sociologic evaluation. Temporary job modification and accommodations often speed recovery and return to work.

VIDEO DISPLAY TERMINALS

The office workplace has been changed notably by the introduction of on-line video display terminal (VDT) connections to computer systems and microcomputers. At first the VDT was used to send instructions and receive status messages from central computer systems, so the devices were few in number and operator exposure was brief and intermittent, intermixed with numerous other tasks. Since the development of on-line and time-sharing systems, increasingly large numbers of office workers, including those in offices and

clinics of health care facilities, are spending long periods in continuous use of VDTs. According to a clearinghouse known as the Center for Office Technology, about 15 million VDTs were in use in the United States as of 1986, with projections to 70 million by 1990 and 100 million by year 2000 (3). An estimated 10 to 14 million workers in the US and Canada, about half of whom are women of childbearing age, spend part or all of their working days at VDTs.

Questions about possible adverse health effects have been prominent, generating considerable labor-management bargaining and a variety of legislative actions. The first studies on health effects focused on how design of the VDT and its work environment might cause visual fatigue and ocular complaints. Studies of visual and musculoskeletal symptoms remain a prominent focus. Subsequently, based upon reports of clusters of affected persons, concerns were raised of possible relationships between VDT use and cataracts, birth defects, spontaneous abortions, and other effects attributed to electromagnetic radiation and field effects. Finally, VDT use is part of the general stress of the working environment. Numerous reviews of this topic have appeared (3, 9, 53, 76, 90, 104).

Visual Effects

Effects of VDT use on vision have been investigated extensively. Complaints include eyestrain, irritation, blurred vision, headaches (3, 14, 76, 90, 107), and a peculiar after-effect that gives white letters and lines on a contrasting background an apparent pink color or pink fringe (74). Eyestrain is a complex of symptoms reflecting visual fatigue. These symptoms may be classified (104) as visual (especially blurring), ocular (eyes red, hot, uncomfortable, or painful), referral (headache), and functional (behavioral). The causes may be environmental, ocular, or constitutional. The environment factors comprise illumination, the visual task, and the characteristics of the objects viewed (77).

Most VDTs are based on cathode ray tubes (CRT), although plasma, liquid crystal, and electroluminescence forms of display may become increasingly popular. For current purposes, all advice is tied to alphanumeric characters displayed in dot-matrix form on a CRT. Image quality, resolution, display stability, color, polarity, luminance, contrast, and hard copy quality are important characteristics of the VDT itself. The features that distinguish the VDT from a printed page are brightness, contrast, flicker, color, and reflections (90). Reflections from light sources external to the equipment—luminaries, inadequately shielded task lighting from adjacent desks, windows, and even the operator's clothing—are particularly troublesome. The keyboard may be an irritating source of visual discomfort from shiny concave keys. The operator's vision, in terms of acuity, accommodation, and eye-

glasses worn, introduces variables. After age 40 most people begin to lose accommodation; thus, persons who find their spectacles excellent for normal reading distances (about 0.2 m) may not focus clearly on a VDT screen at 0.5 m or more from their eyes. Bifocals and multifocals complicate the picture further.

The indoor climate has been suspected of creating problems, especially from low relative humidity or positive ions in the air. Thermal loading of a working environment with VDTs can be 30–150% greater than without VDTs. The accepted minimal humidity should probably be increased from 20 to 30% to eliminate electrostatic charge accumulation (not as high as 60%, which introduces other problems in the physical environment). Noise may be a problem from the printer or other sources and may be a source of distraction for visual function.

Numerous studies have reported higher rates of visual complaints in VDT users than non-users, even when job satisfaction and various stresses have been thought to be minimal or not different between the groups (14, 76, 104, 107, 131). In general, these complaints are thought to be transitory, but long-term follow-ups are not available. They are preventable through lighting arrangements, eye examinations before starting heavy use and whenever notable symptoms arise, and well-designed equipment and work stations.

Musculoskeletal Symptoms

Rader (112) cites a pre-VDT source that states that a well-constructed chair may add as many as 40 productive minutes to each workday for productive individuals; the key is the adjustability of the chair. In many office environments the desk and chair have not been changed to accommodate the computer terminal. As a result, the worker has to reach and stretch in awkward positions to write, enter data, do word processing, and do general desk work. Efforts to relate specific postures to symptoms quantitatively have not been successful. For example, Starr et al (124) photographed working postures of 100 telephone operators and measured viewing distance, viewing angle, and neck, trunk, upper arm, forearm, hand, and elbow angles. Essentially none of the symptoms of headache, nausea or cramps, blurred vision or difficulty focusing, double vision, burning eyes, after-images, and neck, shoulder, upper back, lower back, wrist, elbow, or upper arm discomfort correlated with these postural features. Thus, these authors oppose the development of recommendations or regulations for VDT use in terms of static angles and distances.

Respecting individual comfort requirements, Marriott & Stuchly (90) do propose certain fundamentals: The feet must be firmly and comfortably supported on the floor or a foot rest; there must be ample room to move the legs; the thighs must be supported without pressure on the popliteal area, hence the front edge of the chair must be curved downwards; the seat should

be padded and suitably shaped; the back must be supported at least up to the angles of the scapulae; the hands and wrists should be comfortable; the viewing distance should be between 0.45 and 0.7 m, depending upon the size of the characters; orientation of the screen should be adjustable; the keyboard should be separate; and the document holder should place the hard copy at the same height as the screen, close to the screen at the same viewing distance and at right angles to the line of vision. Highest priority should go to adjustability of the chair, screen, and keyboard.

Typical musculoskeletal symptoms involve the neck, shoulders, back, and wrists, followed by arms, hands, and legs: shooting pains in the arms; acute pain or stiffness in the arms, legs, neck, shoulders, and/or back; wrist or finger pain; paresthesias or other sensory changes in the extremities; and chronic pain in the neck, shoulder, back, and extremities (3).

Often musculoskeletal symptoms are an additional manifestation of various stressors in the workplace. Other symptoms are nervous disorders, cardiovascular, gastrointestinal, or endocrine imbalances. Some of the stresses may be off-the-job, of course. Fear of new technology or automation has been noted (3). The worker may feel a loss of control, reduced status, fear of job loss, and less opportunity or need to participate in the affairs of the organization. The tasks become more repetitious, boring, and impersonal; there may be a real or imagined sense of work overload; and one's peformance may be paced or measured by the machine. In one survey at Southern New England Telephone, three fourths of those reporting symptoms of dizziness, headaches, and muscle aches were assigned to tasks that were monitored. Machine malfunctions are particularly frustrating in such work.

There is general agreement, incorporated into legislation or regulations in several countries and states, that periodic rest breaks are desirable, with their nature and limits best determined by the task. For example, a 15-minute rest or alternative task is suggested after two hours of continuous work under moderate visual demands and after every hour of high visual demands or with repetitive tasks. If possible, such breaks should be taken at the worker's convenience, and the work on the VDT should be interspersed with other less demanding tasks.

Reproductive Disorders

Clusters of birth defects and/or spontaneous abortions in offspring of VDT operators have been reported, generally in newspaper articles. Given the early and rapid diffusion of VDTs into newsrooms, newspaper persons were alert to potential adverse effects. Several investigations have been carried out to assess these important potential risks, both epidemiologically and in a search for possible causative mechanisms. Kurppa et al (78) sent interview forms to mothers of 1475 children reported consecutively to the Finnish Register of

Congenital Malformations to have defects of the central nervous system, orofacial clefts, skeletal defects, or cardiovascular malformations and the same number of paired referents. There were 490 mothers with occupational titles indicating potential exposure to VDTs, 235 in the case group, and 255 in the referent group. Analysis of first-trimester work history and potential confounders did not indicate any teratogenic risk.

Ericson & Kallen (45) in Sweden investigated three cohorts of women identified with the aid of occupational codes in the census and then linked to the Medical Birth Registry and an Inpatient Registry for Somatic Care. The three cohorts were selected to have high, medium, or low likelihood of video screen work: computer operators, travel agency clerks, and social insurance clerks; secretary/typists in insurance companies; and post office assistants, bank cashiers, librarians, and women working in museums, respectively, all from the same range of social strata. Their registry study (45) found no significant differences in total pregnancy outcomes and no increase in spontaneous abortions or in congenital malformations within the groups between 1976–1977 and 1980–1981 as VDT use increased sharply.

Ericson & Kallen (45) then carried out a case-control study on 522 cases of women with spontaneous abortions or whose infants had died, had severe malformations, or had birthweight below 1500 gm, and 1032 controls. All were from the 1980–1981 pregnancy period. Chemical exposures, stress, heavy lifting, smoking, work in smoky rooms, and work with video screen equipment were all analyzed. All factors but smoking gave crude odds ratios greater than 1.0 (up to 1.5), but only stress reached statistical significance. There was a tendency to dose-related (hours/week) effect associated with video screen work; however, no significant effect was found of video screen work (more than 10 hours/week) after stratification for smoking and stress, both of which were associated with video screen work. Finally, no pattern of type of birth defect was found among the cases of congenital malformations.

After a review of these and other studies, the American College of Obstetricians and Gynecologists (13) concluded that 50 clusters of the sizes reported in the media (3–13 cases in 5–27 births) could be expected to occur by chance over a three-year period in the US. Also, they pointed out that 10–20% of all pregnancies terminate naturally as recognized spontaneous abortions and 2–4% of all live births have major congenital malformations.

Besides the clusters of cases, evidence from experiments with chick embryos has suggested that extremely low frequency (ELF) magnetic fields with relatively low intensity might disturb embryonal development (37, 69). A waveform similar to that produced by a VDT has not been used in these biological experiments, sinusoidal, square, and pulsed waveforms appear to have quite similar effects in the chick embryo (69). Extrapolation of these findings to humans is totally speculative.

Nevertheless, extensive characterization of all types of potential radiation

emitted from VDTs has been reported (3, 70, 90, 111). Public alarm was triggered also by reports that certain color TV sets manufactured in 1970 emitted x-rays. In addition to x-rays, VDTs have been thought to emit harmful levels of ultraviolet, infrared, microwave, and very low and extremely low frequency electromagnetic radiation. The sources of each are well-defined: ionizing (low-energy x-rays), ultraviolet, visible, and infrared radiation are produced as the electron beam strikes the phosphor on the inner surface of the video screen (x-radiation is absorbed by the glass of the cathode ray tube), while the horizontal deflection and high-voltage flyback transformer circuitry produce the VLF and ELF radiation. Microwaves most likely are not present. Radiation levels are well below accepted standards of exposure even when devices have been tested under "worst-case" conditions; often levels are lower than around ordinary household appliances. No generally accepted exposure limits or emission standards exist for low-frequency magnetic fields. At 1 Å/ms, the maximum rate of change of the magnetic field of the ELF waveform used in the vertical deflection coil is about 4×10^3 Å/ms, or several orders of magnitude below the theoretical and empirical thresholds for biological effects induced by magnetic fields via induction of electrical currents in the tissues (69).

Other physical phenomena include audible and inaudible sound waves from the flyback transformer and possible air ions from an electrostatic field set up between the operator and the VDT screen. The first seems inconsequential and the latter, if related to unconfirmed facial dermatitis (84, 106), can be eliminated by ventilation and upward adjustment of relative humidity.

Future Directions and Recommendations

VDT use is definitely associated with musculoskeletal and visual symptoms and overall work stress that can be ameliorated through reasonable training, choices of equipment, and work schedules. Reports of possible reproductive hazards and radiation-associated effects are unconfirmed and very unlikely. Research should proceed with cohorts established to investigate the reproductive outcomes of women with multiple risk factors, including VDT use (3), and research should be encouraged on the effectiveness of various training, scheduling, and equipment parameters. The workers should be involved in the definition and development of such research efforts to assure better understanding of the questions being investigated and better designed studies.

STRESS

Overview

Stress is not only part of life, but is a major topic of conversation, speculation, and research in the health care world. Although the main focus has been on nurses and physicians, scattered reports have been published about dentists,

medical technologists, and others. A major report from NIOSH evaluated death certificates and hospital and mental health center admissions of 22,000 workers in 130 occupations (101). Seven of the top 40 occupations with the highest incidence of "stress-related disease" (coronary disease, hypertension, ulcers, and "nervous diseases") were health care fields (clinical laboratory technician, health technology technician, licensed practical nurse, nurses' aide, dental assistant, health aide, and registered nurse). Five of the 12 occupations with the highest mental health admissions were in health care (health technology technician, licensed practical nurse, clinical laboratory technician, nurses' aide, and dental assistant). The bulk of research, of course, has been done on non-health workers and tends to describe stress from the standpoint of the workers rather than the environment. Baker, in one of the most important reviews and conceptualizations of work-related stress (5), observes that "most stress research has focused on individual perceptions and susceptibility, and most interventions have been toward individual coping strategies. This emphasis . . . is quite different from that of most other areas of occupational health [which are] oriented primarily toward identifying workplace conditions that are deleterious" (p. 367). Baker notes that more research is necessary to identify workplace stressors that can be readily modified.

One such reputed stressor is shift work, in which 37% of hospital workers are engaged (33). Opinions conflict regarding the impact of shift work on physical and emotional health. Many feel that shift work is associated with stress (52a). On the other hand, Milne & Watkins (96) reported a three-month study of 18 nurses (nine rotating, nine fixed shift) and found that nurses with rotating shifts had no change in their stress levels and had increased ability to cope, less strain, and improved work performance. Small numbers and short follow-up times make firm conclusions impossible but confirm the observation that more research will need to accumulate before this puzzle is solved and decisions are made whether to modify this possible "stressor."

Two other definite stressors are well known in industry and yet newly arrived in health care: job abolishment and corporate take-overs. Even good administration and artful planning will not keep all hospitals and health care organizations afloat or all excellent highly-trained health professionals employed. The stresses of uncertainty and fear accompanying these dramatic changes will need intervention because they are unavoidable. Distress may be ameliorated by good communication. Special programs should be established to deal with the depression, anger, and decreased self-esteem occurring in individuals who lose jobs (89). A National Academy of Sciences report has emphasized the value of advance notification of layoffs and closings (36b).

Increasingly, research done in other settings may be applied to health professionals as health care delivery becomes more "business-like" and the

pace of change accelerates. The pressures that physicians feel may be among the most difficult to address, since physicians often do not have supportive organizational or institutional structures.

Nursing

"Burnout," characterized by emotional exhaustion, depersonalization, and reduced personal accomplishment" (7, p. 147), can follow "stress." Effects can include low job satisfaction and high turnover. Investigators have therefore been eager to understand determinants of stress. Some have evaluated work assignments and conditions, as recommended by Baker; others have studied personal characteristics. Both kinds of observations are useful, since they identify high-risk groups and suggest interventions. For example, Gray-Toft & Anderson (54) describe job circumstances that most bothered 122 nurses: high workload, dying patients, and inadequate preparation to meet the emotional needs of patients and families. Staffing changes, rotation of patient or unit assignments, and education could help with these complaints. Bartz & Maloney (7) studied 89 US Army ICU nurses and found that young Army (vs civilian) nurses with at least a baccalaureate degree and short duty time were at risk of higher burnout than others. These nurses might benefit from increased counseling and inservice education.

Other investigators have taken a direct treatment approach. For example, Murphy (100) presented biofeedback and muscle relaxation programs to 28 nurses (ten were taught biofeedback, nine progressive relaxation, and nine were controls). Three months later, the trained groups felt more able to cope with stress and had less job dissatisfaction than controls. The Hawthorne effect may be an element here, but the approach may be useful nonetheless, if primary problems cannot be alleviated.

Physicians

Stress begins early in careers for physicians. The goal-directedness and competitiveness necessary for admission to medical school may play havoc with personal relationships, which could provide needed support and diversion. One study of young trainees found that 40% of all house officers reported significant "major problems with their spouse or partner" (79, p. 656). Seventy-two percent thought this was related to their residency and not to themselves. Fortunately, some had found ways to decrease stressful feelings: seeing friends, frequent visits with family, and regular exercise. Since there were no controls, the impact of time pressures, two-career families, trainee gender, and sleep deprivation on these findings is unclear; other young, well-educated, upwardly mobile families may well have similar problems.

On the bright side, training is not always a negative experience for physicians. Although ICU rotations are reputed to be extremely difficult, Eisen-

drath et al (44) found that 26 residents and fellows on an eight-week ICU rotation felt that their experience was at least on a par with other rotations and was basically a positive experience. (This finding parallels that of some ICU nursing studies.) Some elements of the work experience may have led to a decrease of expected stress: short rotation; very strong faculty leadership; social work, nursing, and psychiatric support; and opportunities for recovery of lost sleep. From the "coping" standpoint, trainees found that humor, talking with other staff, plus hobbies and exercise outside of the hospital were helpful.

Studies have shown that physicians in practice have substantial problems with suicide and drug abuse. Male and female physicians have two to three times the suicide rate of the general population and use tranquillizers and sedatives regularly two to three times more often as well (32). McCue (93, 94) points out the many intrinsic, societal, business, legal, and personal stresses physicians must face. The impact of these stresses and maladaptive reactions to them include withdrawal from family, avoidance of social contacts, and ignoring of problems. There are no easy answers to changing or coping with these problems, but acknowledging them is a first step.

Other Health Professionals

Just as other health professionals have done, dentists have cited stress factors that are "unique" to their field. Shurtz et al (119) noted dentists' drives for technical perfection and needs to "resolve all of the patient's dental needs" (119, p. S59). Their practice is traditionally associated with anxiety and pain (not so different from physicians, actually); they may be isolated professionally by solo practice. They may see themselves as "second class health professionals" (119, p. S59), not as interesting, heroic, economically successful, or bright as physicians. They (and physicians) are not trained to manage office scheduling, coordination, or finances. These factors may be elements in the high suicide rate in dentists found by Blachly et al (12). Dentists can cope well, however, as Katz discovered (72). Among approximately 300 dentists, he found that beliefs and attitudes, not circumstances, determined satisfaction: (*a*) a feeling of control over one's life; (*b*) a commitment to the profession; and (*c*) the perception of change as an opportunity rather than a threat.

After studying yet another group of health professionals, Griffin & Klun (56) reported that 94 medical technologists felt that the three major stresses were (*a*) physicians, (*b*) "STAT" requests, and (*c*) the need for accuracy. Because of their high ranking on NIOSH stress-related illness scores (101), further studies of this group are particularly important. The role of physicians as "carriers" of stress for technologists and nurses also needs additional evaluation.

Recommendations

Much of the work on stress, as mentioned above, has been marked by few subjects and short follow-up. Furthermore, definitions vary. For example, "shift work" may include split shifts, rotating shifts, and flex time. Studies are usually unidimensional and may evaluate only health effects or workers' compensation, company medical files, absenteeism, turnover, or mortality. They virtually never investigate family, social, economic, or pre-existing personality or chemical dependency problems. The studies are almost never prospective or longitudinal, and assay methods are often idiosyncratic and poorly validated. More interdisciplinary work is needed and a much better understanding of work-related and non–work-related stress, since lives and work and health all interact. Finally, we should learn about the impact of a "stressed" health professional on the healing of a "stressed" patient. All of this information could be helpful in developing approaches to reducing and coping with stress for health professionals.

CONCLUSIONS AND RECOMMENDATIONS

Existing research tends to be descriptive, retrospective, time-limited, and confined to small groups. It is tantalizing but not definitive. Its deficiencies point to the need for increased attention to working conditions and the health of health care workers, including increased research funding, personnel, and vigor. Multidisciplinary and interinstitutional research would be useful; there may be a special place for NIOSH Educational Resource Centers. In addition to increased research, there must be increased recruitment and training of hospital health and safety personnel. Above all, of course, there must be high level commitment to assuring health care workers' health. These measures are all particularly important as the health care world is battered by vast ebbs and flows in financing, staffing, and technology and as the health needs and demands of the United States population change.

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Occupational Hazards to Health Care Workers: Report of a Conference

Gilbert S. Omenn, MD, PhD, and Sharon L. Morris, BA

Health care workers are exposed to an array of physical, chemical, biological, and psychosocial hazards. At a national conference in Seattle May 11–13, 1983, hospital occupational medicine programs were characterized as lagging far behind those in industries with comparable illness and injury rates. Participants and speakers recommended that health care workers be trained to recognize occupational hazards; that epidemiologic, laboratory, and clinical studies be undertaken to discern trends and establish the mechanisms of effects from hazardous exposures; and that adequate employee health and safety programs be established in health care settings.

Key words: health care workers, employee health and safety programs, anesthetic gases, ethylene oxide, laboratory infections, hospital infections

INTRODUCTION

Workers in the health care industry are generally viewed as "providers," not as "workers," yet they are exposed to a remarkable array of physical, chemical, biological, and psychosocial hazards.

NIOSH Director J. Donald Millar, the keynote speaker for a national conference in Seattle,* reported data from the National Occupational Hazards Survey showing 179 known skin and eye irritants and 135 carcinogenic, mutagenic, or teratogenic agents present in hospitals. Injury rates in hospitals are twice the average for other service industries, about the same as for blue-collar workers. According to Robert Lewy (Columbia Presbyterian), occupational medicine programs in industry are "light-years" ahead of such programs in hospitals. The National Occupational Exposure Survey completed during 1980–83 found that only 46% of 174 hospitals have employee health and safety services; 44% have monitoring for fumes, dusts, or other physical and chemical hazards; 80% have radiation monitoring; and less than 60% require various basic protective controls (Millar, NIOSH).

Regulations governing hospitals are usually designed to protect patients, not workers. The Joint Commission on Accreditation of Hospitals simply urges that

Department of Environmental Health, University of Washington, Seattle.

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Address reprint requests to Dr Gilbert S. Omenn, Dean, School of Public Health, University of Washington, Mail Stop SC-34, Seattle, WA 98195.

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employees be free of common diseases and be physically able to perform their tasks, without requiring protocols or appropriate hospital staff and services. Except for radiation safety requirements, OSHA's general industry standards have no special application to hospitals. Similarly, among the 25 state occupational safety and health plans, there is little more than minimal preemployment and periodic examination requirements, as for tuberculin skin tests.

Health care workers are a substantial fraction of the workforce. The Bureau of Labor Statistics (BLS) estimates growth from 4.6 million workers in 1970 to 11 million workers in 1990, with hospital-based workers increasing in numbers in the same period from 3 million to 5.9 million [BLS, 1981]. Thus, there is even more rapid growth in numbers of health care workers based outside of hospitals, where it is more difficult to establish adequate prevention programs.

In his keynote address, Millar stated, "This conference is an unprecedented opportunity to discuss the hazards of a much neglected industry, whose workers deserve our best in epidemiology and protection." The conference was organized into research-oriented and prevention-oriented sessions. The interaction within and across these sessions was lively and highly constructive. Some of the highlights are summarized here.

ANESTHETIC GASES: NITROUS OXIDE

Few current pharmaceuticals have been used regularly in medicine for a longer period than nitrous oxide (N_2O). There can be considerable exposures to health personnel from N_2O, because it is used in high concentrations (50–60%) compared with halothane (1–2%), for example. As has been stated so many times for aspirin and other well-established agents, if nitrous oxide were proposed as a new drug today, it would probably not be approved for release.

Significant health hazards are associated with employment in operating rooms. A study which examined the specific role of N_2O in occupationally related dental exposures showed that N_2O exposures were associated with increased rates of adverse reproductive outcomes; liver, renal, and neurological disease; and possibly increased cancer of the female genital tract [Cohen et al, 1980]. Wives of dentists had increases in spontaneous abortions. Female dental assistants gave birth to children with an increased incidence of congenital abnormalities. Anesthesiologists and operating room nurses also have higher incidences of spontaneous abortion and congenital abnormalities in their offspring.

Recent biochemical research has shown that N_2O oxidizes vitamin B_{12}, thereby inactivating it (Brodsky, Stanford). This mechanism of action decreases methionine synthetase activity; methionine, uridine, and thymidine levels; and DNA synthesis. The hematopoietic, immune, reproductive, and central nervous systems are affected. One thousand parts per million of N_2O for 1 hour can inactivate B_{12} and cause megaloblastic changes in the bone marrow. N_2O reduces production, chemotactic activity, and cytotoxicity of white blood cells. In rats, exposed males have decreased numbers of sperm and abnormal giant multinucleated sperm cells; teratogenicity is demonstrated in exposures of pregnant animals.

The American Society of Anesthesiologists has issued a pamphlet on control of waste gases, and NIOSH has recommended a standard calling for routine use of a series of control measures to keep maximal concentrations of N_2O below 25 ppm in

surgical operating rooms and below 50 ppm in dental operatories. For halogenated anesthetics, the recommended limit is 2 ppm alone and 0.5 ppm in combination with N_2O [NIOSH, 1977a].

Control strategies include low-leakage anesthetic equipment (an acceptable leakage rate is 100–200 cc/min), effective scavenging and venting with no recirculation of air, low-leakage work practices especially involving proper choices of face masks and effective handling of struggling children, and appropriate air monitoring (Whitcher, Stanford). NIOSH recommends time-weighted samples, representative of the worker's breathing zone, obtained during use of the inhalation anesthetics. Unfortunately, the relationships between peak and short-term exposures and time-weighted average have not been investigated. An easily worn, chemical dosimeter is now available, which may facilitate personal monitoring.

Health hazard evaluations in hospitals, dental offices, and veterinary hospitals were described by Gunter of NIOSH. Gross overexposures of anesthesiologists, scrub nurses, and surgeons were documented, with levels frequently exceeding 200–300 ppm N_2O, with enflurane or halothane also present [NIOSH, 1977b]. Excessive exposures were documented also in recovery rooms, up to 100–150 ppm, compared with 2–5 ppm in recovery rooms with good ventilation and no recirculation [NIOSH, 1980]. Values over 500 ppm were recorded in veterinary clinics; some veterinarians were observed to breathe from the tube (500,000 ppm) to make sure it was working [NIOSH, 1977c]! Very high breathing zone measurements have been obtained also for surgeons performing laparoscopy for tubal ligation or diagnostic purposes, with peak measurements as high as 1,200 ppm, and for dentists administering N_2O [LeRoux et al, 1983].

Improvements have been achieved through better scavenging systems on anesthetic carts, cleaner techniques, and lower flow rates. Nevertheless, pregnant and immunosuppressed patients probably should be protected from exposure to N_2O. Regional anesthesia may suffice in many cases. Nitrogen, air, or xenon could replace N_2O as a diluent. In the long term, more nearly inert agents must be sought.

STERILIZING AGENTS: ETHYLENE OXIDE

Ethylene oxide is the chemical of greatest regulatory interest in hospitals at the present time. Under intense pressure from the Public Citizen Health Research Group and the American Federation of State, County, and Municipal Employees, OSHA has proposed reducing the permissible exposure limit from 50 ppm to 1 ppm, 8-hour time-weighted-average, with an action level at 0.5 ppm (1983). However, no standard for peak short-term exposures has been proposed by OSHA.

Ethylene oxide is a highly reactive epoxide with potent sterilizing activity. It binds directly to DNA, alkylating the N-7 of guanine, and has increased mutation rates in numerous species. It has caused dose-related increases in leukemias and other tumors in rats; reductions in sperm count and function in monkeys; and increased frequency of sister chromatid exchanges, an indicator of repaired chromosomal damage, in lymphocytes of rabbits, monkeys, and humans. Epidemiologic studies implicate ethylene oxide as a possible cause of leukemia deaths in exposed workers in Sweden. These findings are reviewed in detail in the accompanying paper by Landrigan et al [1984]. As they note, NIOSH [1981] now recommends a much stricter limit on average exposures (0.1 ppm), with a 10-minute peak limit of 5 ppm.

It is clear that work practices greatly influence individual exposures to ethylene oxide. The highest exposures occur upon opening the sterilizing unit. The University of Washington Department of Environmental Health and Group Health Cooperative of Puget Sound have prepared and distributed a 28-minute film for health care workers involved in any phase of sterilizing with ethylene oxide. For others workers, exposures depend primarily upon ventilation systems. The critical question of the relationship between high-concentration short exposures and low-concentration time-weighted exposures could be investigated productively in animals, since test species and humans do seem to show highly analogous toxicities. A practical question which received emphasis at the conference is the sensitivity of monitoring equipment required to demonstrate compliance with a 1-ppm PEL and a 0.5-ppm action level. Because of statistical variation in recorded exposure levels, it would be necessary to maintain an average level of between one-fourth and one-half of the limit to be sure of staying within that limit.

INFECTIOUS HAZARDS

Biosafety in hospitals and laboratories is especially important, because of the well-established potential for bidirectional transmission of infectious diseases from staff to patients and from patients and contaminated specimens, materials, and equipment to staff. Too often, nurses, doctors, and others behave as through their credentials gave them some sort of "immunity" to omnipresent infectious agents. Microbiologists used to have a certain bravado about the various exotic or uncommon diseases they had contracted in the course of their research! At last, there is an organized effort to identify and prevent such infections (Dowdle, CDC).

Frequently reported, lab-associated infections include brucellosis, Q fever, typhoid fever, tularemia, tuberculosis, dermatomycosis, psittacosis, coccidioidomycosis, histoplasmosis, and hepatitis. In reported series, 65% of the personnel infected were trained workers; 59% occurred in research laboratories and 17% in diagnostic laboratories, presumably reflecting the higher concentrations and more hazardous techniques used in research labs. Samples of *Salmonella typhimurium* used for laboratory proficiency testing were frequently implicated as sources of infections [Pike, 1976]. The CDC and NIH have collaborated on a manual, "Biosafety in Microbiological and Biomedical Laboratories," [CDC, 1983].

Infectious diseases acquired in hospitals include tuberculosis, staphylococcal and streptococcal infections, hepatitis, viral respiratory infections (especially influenza), nonrespiratory viral infections (rubella, measles, etc), and meningococcal infections. Agents of emerging concern are cytomegalovirus, herpesvirus, scabies, and any putative agent of the acquired immune deficiency syndrome (AIDS). Good infection control procedures and fastidious laboratory techniques are the best ways to protect hospital and laboratory workers. Seemingly harmless accidents such as needle sticks or scalpel nicks can be extremely dangerous when dealing with contaminated specimens. Janitorial staff and others unaware of the nature or source of the specimens may be at special risk, as are those with open skin lesions.

Tuberculosis remains an important problem, especially among health care workers serving migrant, immigrant, and other low-income populations. Lunn (St Mary's Hospital, London) analyzed the extensive experience with BCG vaccine in England since 1959. Overall evaluation of the efficacy of BCG is complicated by the continuing

decline in the incidence and prevalence of tuberculosis in most population groups. In England, BCG is given to all 13-year-olds who give negative responses to the TB skin test; immunity (as reflected in positive skin tests for tuberculin) develops within 6 weeks. In the London borough of Brent, infants are given BCG vaccinations because of the extremely high prevalence of TB in the Asian immigrant population. Among physicians and laboratory workers in Britain, the incidence of TB was three times higher than the national average in the 1950s and early 1960s; now it is about the same as the national incidence. All new hospital staff, including medical students, are given TB skin tests, and BCG vaccine is administered to those with negative skin tests. At the same time, chest X-rays have been reduced in frequency from annual to once every 3 years, possibly putting the 10–20% who fail to develop detectable immunity to BCG at increased risk for unrecognized infection.

The familiar TB skin test has many problems as well. Viral illnesses, live viral vaccines, sarcoidosis, Hodgkin disease, and corticosteroid therapy suppress normal responses to the skin test. Other false negatives occur owing to faulty technique or improperly dosed tines.

Hepatitis B Virus

With the availability of an effective but expensive hepatitis B vaccine, policies for vaccination of health care workers and students have come to the fore. The risk of transmission of hepatitis B virus (HBV) is particularly high among health care workers, despite isolation of known patients, because about 75% of HBV carriers are clinically asymptomatic and 5–10% of hepatitis B patients become chronic carriers (Hargiss, University of Washington). About 90% of such chronic carriers are not identified on admission to hospitals. Virtually all babies exposed to HBV by their asymptomatic HBsAg and HBeAg positive mothers become chronic carriers, unless prophylactic measures are taken promptly. About half of the babies born to HBsAg positive but HBeAg negative mothers become chronic carriers unless preventive measures are taken.

Various antigens and antibodies can be detected in the serum of exposed and/or infected individuals and can be used in diagnosing the degree of risk for contracting or transmitting hepatitis B. The HBV vaccine is a human source vaccine, consisting of noninfectious Hepatitis B surface(s) antigen component which has been treated by a series of biophysical and chemical processes to render it 99% free of detectable contaminants. No cases of hepatitis A or B or of AIDS have been associated with the vaccine. Effectiveness of the vaccine is estimated at 95% for healthy adults and 100% for healthy children; there is no apparent interference with other vaccines. However, the series of three injections costs about $100 for the vaccine alone. The duration of protection is projected for 5 to 7 years at least.

Among a broad spectrum of workers at the University of Washington Hospital, assays of serum for anti-HBs-antigen antibodies indicated that 11% had been infected, including 25% in endoscopy, 15% in laboratories, 12% of dialysis personnel, and 11% in surgery and dentistry. Extremely low incidence among obstetric ward personnel was attributed to organized worker education precautions. Women are tested during pregnancy for HBV markers, permitting immunization of the infant at birth to prevent the chronic infectious state. When there is not time for screening before delivery, the baby is vaccinated at birth and the series is completed if subsequent screening of the mother is positive. There does not appear to be much prospect of

reducing the cost of the vaccine, since the laborious inactivation procedures are considered essential. Even if recombinant DNA and hybridoma technologies permit more efficient production of antigens and vaccines, such products will not be on the market for several years, and their prices may be no lower.

RADIOLOGICAL HAZARDS

X-ray devices, particle accelerators, and an increasing array of radionuclides are of diagnostic and therapeutic value in hospitals and clinics. Individual dosimeters, strict policies on exposure monitoring, and a long history of radiation safety committees and licensing procedures make protection against radiological hazards a model for other types of hazards. On the other hand, just as familiarity with aseptic conditions and reliance on antibiotics led over time to overconfidence and neglect of antiseptic principles, there is a continuing need to be vigilant about radiological hazards. Disposal of radioactive scintillation vials and various other radioactive wastes has become a significant problem for hospitals and laboratories.

HAZARDS IN DENTISTRY

In addition to anesthetic and sterilizing gases noted above, dentists and dental laboratory assistants may be subject to pneumoconiosis or fibrosis from such substances as nickel, chromium, cobalt, free silica, methyl methacrylate, asbestos, and nonprecious metals [Kronenberger et al, 1981]. Rom (Utah) described three cases of berylliosis in dental lab technicians, presenting with hypoxemia and shortness of breath and an X-ray picture of viral pneumonitis, with all cultures negative. The risk of hepatitis B infections is considered so high among dental personnel, and especially among dental students, that the University of Washington School of Dentistry has required all students to obtain (at their own cost) HBV vaccination, after serological screening.

PSYCHOSOCIAL STRESS, ERGONOMICS, AND BACK INJURIES

"Burnout" has become a dominant issue among nurses, but definitions and quantitation of stress have proved awkward (Wolf-Wilets, University of Washington). Work overload; emotional drain in oncology, burn units, and ICU units; shift work schedules; dual supervision; and ambiguous job roles all contribute to stressful working conditions. Several organized programs for identifying and coping with stress and for modifying working conditions were presented.

Health care workers have a serious work injury risk from mundane hazards like back, neck, and shoulder strains and cuts from various objects (Ginnold, Oregon). In Oregon, for 1980, nurses and nurse aides ranked just behind truck drivers, warehousemen, and loggers, and ahead of construction laborers, carpenters, welders, sawyers, and various other so-called high-hazard occupations. Preemployment screening is of limited value, especially for prevention of back injuries. Training is gaining prominence, though there needs to be much more instruction in real situations. Modern ergonomics emphasizes job design strategies, including equipment to handle heavy or dangerous materials, redesign of storage and work areas, and getting help with lifting, as well as appropriate worker selection, training, and conditioning.

Back injuries nationally cost about $20 billion per year in lost productivity, medical care, compensation, and disability. Some 80% of adults have symptomatic back pain at one time or another, and nearly all of these individuals note recurrences. However, an etiologic diagnosis is reached in only 12–15% of cases. X-ray changes seldom correlate with symptoms. Even in cases of proved herniation of intervertebral disks, symptoms tend to recede in 50% of the cases within a month and in more than 90% within 3–6 months; with low back pain unassociated with a herniated disk, relief is more rapid, with 90% relieved within 6 weeks. Patient education ("back school") seems to be effective in hastening return to work. Surgery is best reserved for those (about 1%) with severely symptomatic spondylolisthesis, instability, stenosis, lumbar scoliosis, or clearly herniated disk, and even among these subjects, surgical results, in terms of return to work, are often disappointing (Bigos, University of Washington).

STRATEGIES FOR ENHANCING OCCUPATIONAL HEALTH AND SAFETY PROGRAMS

Implementation of adequate health and safety programs is lagging somewhat behind the increasing awareness of hazards. Reasons hospitals have been slow in establishing employee health and safety programs include the primacy of patient care, emphasis on treatment rather than prevention, and ready access to corridor consultations, which may interfere with a more systematic recognition of the extent of the injury and illness problem (Hecker, University of Oregon).

Many hospitals and clinics are marketing health promotion and occupational safety and health programs to industry. Clearly, effective programs of these kinds should be directed at their own employees as well. Occupational health and safety should be viewed as major components of overall health promotion efforts. In both of the Surgeon General's reports on health promotion and disease prevention, "Healthy People" [PHS, 1979] and "Objectives for the Nation" [PHS, 1980], there is a specific chapter dealing with occupational safety and health; of 20 objectives, even though none specifically addresses health care workers, at least 15 have some relevance to this industry. As was amply demonstrated at the conference, health professionals and other health workers are increasingly interested in taking steps to improve their own health and working conditions. Principles that have guided occupational medicine programs in industry need to be consciously adapted to meet the special needs of health care settings.

Seven characteristics of successful programs were identified by Dr Linda Clever of Presbyterian Hospital in San Francisco: 1) commitment and financial support from the highest levels; 2) precise knowledge of workplace hazards, plus the ability to modify them and to provide proper medical and environmental surveillance; 3) health and safety training of new employees with periodic in-services courses; 4) adequate records on injuries and illnesses, so problem areas can be identified and remedied; 5) effective safety committees with representatives from all hospital sectors; 6) coordination of occupational health and health promotion programs, with an awareness of the interaction of lives, health, and work; and 7) incorporation of health and safety considerations in building and equipment plans.

As in industry, a successful hospital health and safety program requires involvement at all levels. It is obvious that the more prominently placed the program is within the organization, the more impact it will have. What may be less obvious is

the need for involvement and cooperation from those responsible for renovating the building, ordering equipment and supplies, and disposing of wastes. Another crucial element to successful programs is the involvement of those most at risk in the elimination of hazardous conditions (Berek, New York). Industrial hygienists often observe that workers getting the highest exposures have no authority to make necessary changes. As the ability to make changes increases, the risk of personal exposure declines. An effective Director of Employee Health Services will become familiar with all departments within the health care facility and enlist broad support in carrying out the goals of the program.

Eunice Cole, President of the American Nurses Association, reported that nurses are beginning to recognize the hazards of their profession and are taking necessary steps to create a more secure working environment: "Perhaps we could not see the potential threats to our welfare because our uppermost concern has been for our patients. We now realize that the welfare of the nursing profession and the welfare of the patient are interdependent. We must safeguard ourselves in order to be able to provide the quality of nursing care our patients deserve." The ANA has adopted a resolution on occupational hazards and will assist its members in identifying and reporting hazards to appropriate agencies.

RECOMMENDATIONS

The closing session of the Conference elicited the following recommendations:

1. Heightened awareness among health care workers and administrators of the significant hazardous exposures encountered in the health care industry. Information on such occupational hazards should become a part of the basic curriculum in the training and education of all health care workers.

2. Epidemiologic surveillance to discern trends in the incidence and prevalence of illnesses and injuries among these workers and to relate any changes to environmental factors. With the rapid introduction of new drugs and new technologies, it is critical to be on the alert for new hazards both to workers and to patients. The sentinel health event approach of Rutstein et al [1983] could be used very effectively.

3. Laboratory and clinical studies to establish the existence and mechanisms of chronic effects from hazardous exposures and to identify markers for the pathogenic processes.

4. Well-organized employee safety and health programs in health care settings that include medical evaluation, industrial hygiene, health physics, ergonomics, worker education, and a reliable and confidential record-keeping system.

5. Training for the staff of employee health and safety programs on specific hazards associated with health care facilities, utilizing the graduate and continuing education programs offered at the 15 NIOSH-funded Educational Resource Centers at universities throughout the United States.

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SURFING THE WAVE OF HEALTH CARE REVOLUTION

Linda Hawes Clever, MD
Chair, Department of Occupational Health
California Pacific Medical Center
San Francisco, California

The fear and disruptions occasioned by health care revolution can be tempered by analysis, attitude, and action. This presentation will review the effects of rapid change on health care workers and patients, institutions, and on the health of the public. These effects include the potential for decreased trust and eroded values. Practical approaches to current challenges will be outlined such as personal and professional renewal, gathering information, adjusting expectations, and engaging in conflict resolution.

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Linda Hawes Clever, MD, FACP
California Pacific Medical Center
San Francisco, California

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Commentary

Personal Renewal

JOHN W. GARDNER, PhD, *Stanford, California*

EDITOR'S NOTE: *After John Gardner's presentation on "Self-Renewal" to* THE WESTERN JOURNAL OF MEDICINE *Editors' Meeting,* Joseph Murphy, MD, Special Editor for Wyoming, asked the former Secretary of Health, Education, and Welfare, "Where are you in your life's cycle?" Dr Gardner, who is 80 years old, answered, "When Chief Justice Oliver Wendell Holmes, Jr, was in his 90s, he was asked a similar question and said, 'I'm like a race horse cantering along after the race is over, cooling down.' Well, I'm nowhere near cantering! I'm still in the race, pushing the world."*

John Gardner, who received his undergraduate degree from Stanford and PhD from the University of California, Berkeley, taught at the college level for several years before he joined the Carnegie Foundation. As president of Carnegie Corporation and Carnegie Foundation for the Advancement of Teaching, he began to "push the world" toward education and in 1964 received the country's highest civilian honor, the Presidential Medal of Freedom. He has also pushed it toward political reform by founding Common Cause, toward grass-roots political action by founding the Urban Coalition, toward leadership training by founding the White House Fellows program, and toward volunteerism by founding the Independent Sector (a coalition of for-profit and not-for-profit organizations and foundations). His books, including Excellence, Self-Renewal, No Easy Victories, *and* On Leadership, *have pushed readers to new understanding of themselves and of organizations and to higher levels of creativity and energy to get important work done. His current research focuses on discovering and defining the characteristics of healthy, vital communities. His call to "keep on keeping on," indeed, to push the world, leads to constructive change. Active people become effective people, infused with the energy and optimism that good hard work inspires. I think you will find this paper as invigorating to read as it was to hear.*

LINDA HAWES CLEVER, MD

*San Francisco, Calif, April 4, 1992.

I once wrote a book called *Self-Renewal* that deals with the decay and renewal of societies, organizations, and individuals. I explored the question of why civilizations die and how they sometimes renew themselves and the puzzle of why some men and women go to seed while others remain vital all of their lives. It's the latter question that I shall deal with at this time. I know that you personally are not going to seed. But the person next to you may be in fairly serious danger.

Not long ago, I read a splendid article on barnacles. I do not want to give the wrong impression of the focus of my reading interests. Sometimes days go by without my reading about barnacles, much less remembering what I read. But this article had an unforgettable opening paragraph. "The barnacle," the author explained, "is confronted with an existential decision about where it's going to live. Once it decides . . . it spends the rest of its life with its head cemented to a rock. . . ." For a good many of us, it comes to that.

Some men and women seem to run out of steam in midcareer. You have known such people—feeling secretly defeated, maybe somewhat sour and cynical, or perhaps just vaguely dispirited.

We have to face the fact that most men and women out there in the world of work are more stale than they know, more bored than they would care to admit. Boredom is the secret ailment of modern life. A successful executive said to me the other day, "How can I be so bored when I'm so busy?" And I said, "Let me count the ways." Logan Pearsall Smith said that boredom can rise to the level of a mystical experience, and if that's true I know some very busy adults who are among the great mystics of all time.

I have watched a lot of midcareer people, and Yogi Berra says you can observe a lot just by watching. I have concluded that most people enjoy learning and growing. And many are clearly troubled by the self-assessments of midcareer.

Such self-assessments are no great problem when you are young and moving up. The drama of your own rise is enough. But when you reach middle age, when your energies are not what they used to be, then you will begin to wonder what it all added up to, you will begin to look for the figure in the carpet of your life. I have some simple advice for you when you begin that process. Don't be too hard on yourself. Look ahead. Someone said that "Life is the art of drawing without an eraser." And above all, do not imagine that the story is over. Life has a lot of chapters.

I said in *Self-Renewal* that we build our own prisons and serve as our own jailkeepers. I no longer completely agree with that. I still think we are our own jailkeepers, but I have concluded that our parents and the society at large have a hand in building our prisons. They create roles for us—and self-images—that hold us captive for a long time. The person intent on self-renewal will have to deal with ghosts of the past—the memory of earlier failures, the remnants of childhood dramas and rebellions, and the accumulated grievances and resentments that have long outlived their cause. Sometimes people cling to the ghosts with something almost approaching pleasure—but the hampering effect on growth is inescapable.

The more I see of human lives, the more I believe the business of growing up is much longer drawn out than we pretend. If we achieve it in our 30s, even our 40s, we are doing well. To those of you who are parents of teenagers, I

(Gardner JW: Personal renewal. West J Med 1992 Oct; 157:457-459)

From the Graduate School of Business, Stanford University, Stanford, California.
Reprint requests to John W. Gardner, PhD, Stanford University School of Medicine, GSB L281, Stanford, CA 94305.

can only say, "Sorry about that." For this generation of kids, the rule is, "Out of the house by 40."

There's a myth that learning is for young people. But as the proverb says, "It's what you learn after you know it all that counts." The middle years are great, great learning years. Even the years past the middle years. I took on a new job after my 77th birthday—and I'm still learning.

It's a good idea to pause occasionally for an *inward* look. By midlife most of us are accomplished fugitives from ourselves. Sooner or later you have to come to terms with yourself. You have to grasp what S. N. Behrman meant when he said, "At the end of every road you meet yourself." You may not get rid of all of your hang-ups, but you learn to control them to the point that you can function productively and not hurt others.

You have to come to understand your impact on others. It's interesting that even in the first year of life you learn the impact that a variety of others have on you, but as late as middle age many people have a very imperfect understanding of the impact they have on others. The hostile person keeps asking, "Why are people so hard to get along with?"—never reflecting on the fact that he's creating his own environment. In some measure we all create our own environments. You may not yet grasp the power of that truth to change your life.

Of course, failures are a part of the story, too. Everyone fails. Joe Louis said, "Everyone has to figure to get beat some time." The question is not did you fail but did you pick yourself up and move ahead? And there is one other little question: "Did you collaborate in your own defeat?" A lot of people do. Learn not to.

But there is something I know about you that you may or may not know about yourself. You have within you more resources of energy than have ever been tapped, more talent than has ever been exploited, more strength than has ever been tested, more to give than you have ever given.

You know about some of the gifts that you have left undeveloped. Would you believe that you have gifts and possibilities you don't even know about? It's true.

It isn't possible to talk about renewal without touching on the subject of motivation. Someone defined horse sense as the good judgment horses have that prevents them from betting on people. But we have to bet on people—and I place my bets more often on high motivation than on any other quality except judgment. There is no perfection of techniques that will substitute for the lift of spirit and heightened performance that comes from strong motivation. The world is moved by highly motivated people, by enthusiasts, by men and women who want something very much or believe very much.

The nature of one's personal commitments is a powerful element in renewal, so let me say a word on that subject.

I once lived in a house where I could look out a window as I worked at my desk and observe a small herd of cattle browsing in a neighboring field. And I was struck by a thought that must have occurred to the earliest herdsmen tens of thousands of years ago. You never get the impression that a cow is about to have a nervous breakdown. Or is puzzling about the meaning of life.

Humans have never mastered that kind of complacency. We are worriers and puzzlers, and we want meaning in our lives. I am not speaking idealistically; I am stating a plainly observable fact about men and women. It's a rare person who can go through life like a homeless alley cat, living from day to day, taking its pleasures where it can, and dying unnoticed.

That is not to say that we have not all known a few alley cats. But it is not the norm. It just is not the way we are built.

For many this life is a vale of tears; for no one is it free of pain. But we are so designed that we can cope with it if we can live in some context of meaning. Given that powerful help, we can draw on the deep springs of the human spirit, to see our suffering in the framework of all human suffering, to accept the gifts of life with thanks and endure life's indignities with dignity.

We tend to think of youth and the active middle years as the years of commitment. As you get a little older, you are told you have earned the right to think about yourself. But that is a deadly prescription! People of every age need commitments beyond the self, need the meaning that commitments provide. Self-preoccupation is a prison, as every self-absorbed person finally knows. Commitments to larger purposes can get you out of prison.

Another significant ingredient in motivation is one's attitude toward the future. Optimism is unfashionable today, particularly among intellectuals. Everyone makes fun of it. Someone said, "Pessimists got that way by financing optimists." But I am not pessimistic and I advise you not to be. As the fellow said, "I'd be a pessimist but it would never work."

I can tell you that for renewal, a tough-minded optimism is best. The future is not shaped by people who do not believe in the future. Men and women of vitality have always been prepared to bet their futures, even their lives, on ventures of unknown outcome. If they had all looked before they leaped, we would still be crouched in caves sketching animal pictures on the wall.

But I did say tough-minded optimism. High hopes that are dashed by the first failure are precisely what we do not need. We have to believe in ourselves, but we must not suppose that the path will be easy. It's tough. Life is painful, and rain falls on the just, and Mr Churchill was not being a pessimist when he said, "I have nothing to offer but blood, toil, tears, and sweat." He had a great deal more to offer, but as a good leader he was saying it was not going to be easy. He was also saying something that all great leaders say constantly—that failure is simply a reason to strengthen resolve.

We cannot dream of a utopia in which all arrangements are ideal and everyone is flawless. Life is tumultuous—an endless losing and regaining of balance, a continuous struggle, never an assured victory.

Nothing is ever finally safe. Every important battle is fought and re-fought. We need to develop a resilient, indomitable morale that enables us to face those realities and still strive with every ounce of energy to prevail. You may wonder if such a struggle—endless and of uncertain outcome—is more than humans can bear. But all of history suggests that the human spirit is well fitted to cope with just that kind of world.

Remember I mentioned earlier the myth that learning is for young people. I want to give you some examples to counter the myth. In a piece I wrote for *The Reader's Digest* not long ago, I gave what seemed to me a particularly interesting true example of renewal. The man in question was 53 years old. Most of his adult life had been a losing struggle against debt and misfortune. In military service he received a battlefield injury that denied him the use of his left arm. He was also seized and held in captivity for five years. Later he held two government jobs, succeeding at neither. At 53 he

was in prison—and not for the first time. Would you bet on this man? You can see all the personnel directors you have ever known shaking their heads gloomily. But there in prison, he decided to write a book, driven by heaven knows what motive—boredom, the hope of gain, emotional release, creative impulse—who can say? And the book turned out to be one of the greatest ever written, a book that has enthralled the world for over 350 years. The prisoner was Cervantes; the book, *Don Quixote*.

Another example is Pope John XXIII, a serious man who found a lot to laugh about. The son of peasant farmers, he once said, "In Italy there are three roads to poverty—drinking, gambling, and farming. My family chose the slowest of the three." When someone asked him how many people worked in the Vatican, he said, "Oh, about half." He was 76 years old when he was elected Pope. Through a lifetime in the bureaucracy, the spark of spirit and imagination had remained undimmed, and when he reached the top he launched the most vigorous renewal that the Catholic Church has known in this century.

Still another example is Winston Churchill. At age 25, as a correspondent in the Boer War, he became a prisoner of war, and his dramatic escape made him a national hero. Elected to Parliament at 26, he performed brilliantly, held high cabinet posts with distinction, and at 37 became First Lord of the Admiralty. Then he was discredited, unjustly, I believe, by the Dardanelles expedition—the defeat at Gallipoli—and lost his admiralty post. There followed 24 years of ups and downs. All too often the verdict on him was, "Brilliant but erratic . . . not steady, not dependable." He had only himself to blame. A friend described him as a man who jaywalked through life. He was 66 before his moment of flowering came. Someone said, "It's all right to be a late bloomer if you don't miss the flower show." Churchill did not miss it.

From those examples I have given, I hope it is clear that the door of opportunity does not really close as long as a person is reasonably healthy. The question is what lies ahead. A person may not go to jail and write a novel, or become Pope. But as long as the spirit is undimmed, new and rich patterns of meaning in life can be created as you grow older.

Many years ago in a speech to high school graduates, I concluded with a paragraph on the meaning in life. The speech was reprinted over the years, and 15 years later that final paragraph came back to me in a rather dramatic way, really a heartbreaking way.

A man wrote to me from Colorado saying that his 20-year-old daughter had been killed in an auto accident some weeks before and that she was carrying in her billfold a paragraph from a speech of mine. He said he was grateful because the paragraph—and the fact that she kept it close to her—told him something he might not otherwise have known about her values and concerns. I cannot imagine where or how she came across the paragraph, but here it is.

Meaning is not something you stumble across, like the answer to a riddle or the prize in a treasure hunt. Meaning is something you build into your life. You build it out of your own past, out of your affections and loyalties, out of the experience of humankind as it is passed on to you, out of your own talent and understanding, out of the things you believe in, out of the things and people you love, out of the values for which you are willing to sacrifice something. The ingredients are there. You are the only one who can put them together into that unique pattern that will be your life. Let it be a life that has dignity and meaning for you. If it does, then the particular balance of success or failure is of less account.

OCCASIONAL NOTES

MODERN TIMES

IN April 1994, my confidence and sense of security in my professional status and competence were shaken to the core. In that month, for reasons too complex to elaborate, I lost my new job a mere 10 working days after my arrival in Norfolk, Virginia. Two months later, my wife, also a physician, lost her administrative job. She received several offers of positions in other cities relatively soon. I, however, entered a trying and debilitating one-year period during which, despite my best efforts, I could not find a job.

I had long recognized that there was a cyclically poor job market for many other professions. The periodic rise and fall of employment opportunities for teachers, engineers, and nurses, among others, was well known to even casual observers of the job market. It had always been comforting to believe that this could never happen to physicians because there was always a need for our services (no lack of work if you're a physician or an undertaker, so the joke went). Although we were frequently taken to task as a group by the media, politicians, and society in general, physicians were individually respected by our patients. This respect and the very nature of our job, we thought, would protect us from unemployment.

True, I had begun to notice portents of a declining job market for physicians more than 20 years earlier. For example, when I first entered private practice in Tucson, Arizona, the Pima County Medical Society gave a yearly party for new physicians, which was attended by the rest of the town and county doctors. In 1970, I was one of only nine new physicians who had entered practice in Pima County. By 1974, this tradition was halted because the number of incoming physicians had made the party logistically unwieldy. In 1978, I heard Dr. John Benson say at the annual meeting of the American Gastroenterological Association that training programs in gastroenterology would go through hard times because trainees would settle in the community and compete with their teachers. He suggested that we consider decreasing the number of gastroenterology fellowships to prevent overpopulation in our specialty.

I disregarded Dr. Benson's remarks then, viewing them as academically interesting but without relevance for me. I was certainly not alone in disregarding those prescient remarks, however. When I entered private practice in 1970, I was the third gastroenterologist in Tucson and only the second in private practice. By the time I left the city in 1982, 21 gastroenterologists were practicing there. During that period, the population of Tucson had risen from 325,000 to slightly more than 500,000, clearly not enough to account for the increase in the number of gastroenterologists. As a corollary of the excessive increase in physicians in my field, I noticed an increase in professional competition and, most disturbingly, a decrease in professional collegiality. After moving to Worcester, Massachusetts, in 1982, I continued to note, dutifully but somewhat uninterestedly, the growing numbers of articles in our major medical journals about the surplus of physicians and its effects on medical economics. I also read that young trainees graduating from noted fellowship programs were having difficulty finding jobs, but it did not affect me.

And then the blow fell. I had had an active gastroenterology practice in Tucson for 13 years and another in Worcester for 12 years. I had published more than 50 medical articles while in private practice, had served as the chief of internal medicine at two hospitals and as the governor of the Massachusetts chapter of the American College of Physicians, and had been recognized as a Master of the College. Could this loss of a job and inability to find another one really have happened to me?

The sudden and unexpected loss of my professional position and status ushered in a new period of introspection for me. I initially felt angry and degraded and even doubted my medical competence, something I had worked hard to attain. For about a month after I lost my job, I continued to come to morning report daily and to take an active part in the discussions. I also continued to conduct small-group teaching sessions on pathophysiology and clinical problem-solving for medical students and house officers. However, I gradually became persona non grata. My colleagues still said hello to me but increasingly regarded my attendance with indifference and neither called nor asked for me when I missed several morning reports in a row. Eventually, without an official position, I found it increasingly difficult to get out of bed in the morning and step out of our apartment. I read *TV Guide* more often than my medical journals. I tried to find employment with several gastroenterology groups in Norfolk but was informed that my best opportunities lay 1 to 1½ hours either north or south of the city. When my wife lost her position, virtually all of our so-called friends dropped away and avoided us. Practically overnight, we went from desirable guests to embarrassments and pariahs. Professionally, the one bright spot in this initial six-month period was the gracious offer of a nonpaying teaching position in gastroenterology that was made to me by Dr. Stephen Beuttel, the chief of internal medicine at the nearby Portsmouth Naval Hospital. This job gave me the opportunity to feel useful and to keep up my clinical skills.

Three months after my wife lost her position, we moved to Philadelphia, thinking that that city would offer me a better chance to find a permanent job as a gastroenterologist. I called the chiefs of medicine and gastroenterology at the hospitals in and around Philadelphia as well as in neighboring New Jersey and Delaware and also sent them my résumé. Many of these physicians told me over the telephone that there was no need for the services I was capable of performing at their institutions. Some invited me for an interview but

only to tell me personally that there was no place for me on the staff. Several never called me back.

As the months passed without the wisp of an opportunity, I realized that I might never work again. The prospect of living for the rest of my life (I had just turned 56), supporting our children through graduate education, and paying our routine living expenses on my wife's salary alone depressed me. Moreover, we knew before moving to Philadelphia that my wife's job would last for just one year. Consequently, I couldn't tell whether I was more depressed by living on my wife's salary or by the prospect of not having it at all (we had previously enjoyed a double income during our married life).

Each morning, my wife left the house to work, while I remained at home. She would encourage me to dress before she left and gave me space and a desk in her office where I could sit, read, and make calls for interviews. When someone phoned her office and asked for Dr. Stillman, my wife instructed her secretary to answer, "Which Dr. Stillman?" However, despite my wife's best intentions and my attendance at weekly gastroenterology conferences at medical schools in Philadelphia, my depression deepened as I felt the gastroenterologic skills that I had enjoyed so much and at which I had been so proficient diminishing without the opportunity for direct patient care.

When the possible permanence of my enforced inactivity sank in, I realized that if I was ever to work again, I would need to give up gastroenterology and work in general internal medicine. Nine months after losing my job, I began to call hospitals and local health maintenance organizations requesting positions in general internal medicine. Gaining interviews now proved considerably easier. Dr. James Clark, chief of internal medicine at Crozer–Chester Medical Center, offered me a job at my first interview. I was so desperate for any job at that time that I accepted without inquiring about salary, vacation, benefits, or a wide array of other issues that would ordinarily have interested me or any other job applicant. Between the time my position was assured and the time my credentials were approved, I began to read books on cardiovascular, pulmonary, and renal pathophysiology, to study the American College of Physicians Medical Knowledge Self-Assessment Program, and to attend morning report daily. Also, for the first time in many years, I began to read medical journals for their total medical content (rather than just their articles on gastroenterology). I rediscovered with a thrill why I had originally opted for internal medicine: the consuming and endless attempt to master the workings, in both disease and health, of the entire human organism.

During the first three months at my new job, I still considered myself a subspecialist at heart, a gastroenterologist in generalist's clothing. The turning point in my perception of myself occurred when a generalist colleague, Dr. Karen Scoles, suggested that I read a tract on spouse abuse. The next day, armed with interview techniques to uncover this problem, I diagnosed a case of physical abuse and gave the grateful patient an emergency telephone number to call for help. I had previously considered myself a thorough historian and sensitive interviewer, but I had never before diagnosed and dealt with a case of spouse abuse. How many abused women might I have missed during evaluations for irritable bowel syndrome or inflammatory bowel disease? At last, I felt that I was really a generalist — though a novice, to be sure, who would require years to acquire generalist skills with the same energy and attention that I had previously devoted to gastroenterology.

This past year has given me time to reflect on my situation and to make contact with others like me. An indefinite number of older specialist physicians, rightly or wrongly, feel deprived of what they considered almost a birthright — an expected professional safe haven that should have given them income, status, and an opportunity and obligation to stay mentally alert and to remain a source of service and comfort to others. It is also not surprising that an increasing number of physicians are not doing what they were trained to do — not by choice, but because of factors outside their control, such as politics, lack of opportunity for training in newer aspects of their fields, or competition with aggressive younger colleagues in their specialties. If they have retrained in a different medical area, they have had to relearn or master a totally new body of knowledge — a daunting task for anyone, but particularly for people whose careers are largely behind them. They are neither prepared for nor resigned to retirement and have many years during which to share their rich experience with patients, younger physicians and medical students, members of other health care professions, and organizations concerned with health care.

I suspect that my history and remarks will be read with surprise and shock by some but with affirmative nods and a sense of grim familiarity by others. If so, I will have accomplished my purpose: to shake the complacency of some and to galvanize others to repair their damaged lives and careers.

106 W. 15th St.
Chester, PA 19013 ALFRED E. STILLMAN, M.D.

bridization to a previously sequenced KSHV probe from a sample of Kaposi's sarcoma. Cloning and direct sequencing of the PCR product revealed that the KSHV sequence found in the angiosarcoma sample was nearly identical to the originally described sequence in Kaposi's sarcoma. It differs only in two C→T substitutions at positions 1033 and 1168.

Our findings represent at least the second report of a non–Kaposi's sarcoma tumor that was KSHV-positive in an HIV-negative, nonimmunocompromised patient. Our result suggests that this novel viral agent may be implicated in the pathogenesis of other malignant angiomatous tumors as well. This would weaken the hypothesis that KSHV is only lymphotropic and would support the assumption that the virus also has angiotropic properties. Further studies are necessary, however, to confirm the suspected causative role of KSHV in the development of these different lymphomatous and angiomatous neoplasms.

ROLLAND GYULAI, M.D.
LAJOS KEMÉNY, M.D., PH.D.
MÁRIA KISS, PH.D.
Albert Szent-Györgyi Medical University

ÉVA ÁDÁM, PH.D.
FERENC NAGY, PH.D.
Hungarian Academy of Sciences

ATTILA DOBOZY, M.D., PH.D., D.SC.
Albert Szent-Györgyi Medical University

H-6701 Szeged, Hungary

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UNEMPLOYED PHYSICIANS

To the Editor: What are the lessons from Stillman's essay describing his efforts to practice gastroenterology in Philadelphia (Oct. 19 issue)[1] and from the article by Billi et al. on the decreasing revenues from specialty practice at the University of Michigan (Oct. 12 issue)?[2] Stillman could not find a subspecialty job in Philadelphia — right in the middle of the Boston–Washington corridor, the area with the highest density of physicians in the nation (accounting for 28 percent of all physicians in the United States but serving only 21 percent of the U.S. population).[3] Yet, as he learned while still in Norfolk, Virginia, subspecialists are needed in areas other than big cities. One lesson of Stillman's experience is his rediscovery of Peabody's dictum, "The care of the patient is caring for the patient."[4] But the larger lesson is a corollary to Sutton's law (named after the bank robber Willy Sutton, who also spent time in Philadelphia): Go where the patients are. That is what specialists will have to do if they want to practice with reasonable panels of patients. Moreover, if they do go where the patients are, the long-heralded surplus of specialists[3] will be minimized.[3]

Billi et al. tell the other half of the story.[2] It is really no surprise that health maintenance organizations pay less. But it is preposterous to believe that specialists would obligate themselves to treat ever larger panels of patients — panels 35 percent or more in excess of current workloads — to maintain their income levels.[2] There just is not enough time to do so responsibly and still "lavishly dispense the time, sympathy and understanding" that Peabody recognized was so important to patients,[4] unless, of course, these time-consuming aspects of patient care are delegated to nonphysician clinicians. But it is just this quality of empathetic care that forms the foundation of our relationship of trust with our patients and our bond with society. If we are to maintain our position as a profession and ensure that care is properly dispensed by members of our profession, the result of lower reimbursement will, unfortunately, be a lower income — for ourselves and our academic health centers.

What Stillman and Billi et al. have shown is that the implied guarantee of full employment that physicians have taken for granted — at whatever location and income level they have desired — is no longer possible. But on the basis of current projections of the supply of physicians and the demand for their services[3] and in the absence of a major delegation of responsibility to other professionals, physicians will find employment in locales throughout America where patients want and need their services and where caring for patients is still medicine's highest reward.

RICHARD A. COOPER, M.D.
Medical College of Wisconsin
Milwaukee, WI 53226

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3. Cooper RA. Perspectives on the physician workforce to the year 2020. JAMA (in press).
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5. Council on Medical Education. Improving access to health care through physician workforce reform: directions for the 21st century. Washington, D.C.: Department of Health and Human Services, 1992.

Dr. Stillman replies:

To the Editor: I acknowledge Dr. Cooper's contribution to our understanding of medical demographics. However, I was trying to describe a personal, humanistic aspect of medical economics that cannot be portrayed by statistics.

I received many letters after the publication of my article, most of which related similar (or worse) experiences. These letters came from doctors at all levels, house officers through retirees, represented all the medical specialties, and were drawn from the entire population of U.S. physicians (those in urban and rural areas, academia, and private practice). Several correspondents had unwillingly left clinical medicine and pursued other careers. Others confided that their personal lives had suffered terribly as a result of these difficulties.

Because of these letters, I feel like the child in the Hans Christian Andersen tale who blurted out that the emperor was not wearing any clothes. We all know colleagues who have suffered similarly. However, because of their shame and unwillingness to admit professional adversity and our embar-

rassment about confronting this problem in others, it remains unmentionable.

My recent experience suggests that subspecialty internists wishing to retrain as generalists will meet several obstacles. First, older physicians in solo or small-group practices may have difficulty adjusting to managed care or large organizational environments. Second, many section chiefs in general internal medicine are a generation younger than potential retrainees and may be impatient with their older colleagues' progress or threatened by their more extensive clinical experience. In addition, older physicians may have difficulty mastering a new body of knowledge. Finally, there may be unspoken but pervasive age discrimination. A cautionary note: some of those who wrote to me suggest that the shrinking job market for physicians is not merely due to maldistribution among specialties or geographic areas but may also be caused by an absolute glut of physicians.

My correspondents represent a minuscule portion of the physicians who have been displaced by the new economic realities of American medicine. Much effort has been expended to train these physicians and provide them with the level of experience and knowledge so universally respected. Surely, American ingenuity can find a way to use displaced physicians, a veritable national treasure, with respect, responsibility, and advantage to society.

ALFRED E. STILLMAN, M.D.
3831 The Oak Rd.
Philadelphia, PA 19129

Kamari, Santorini

Articles

Physician-Patient Communication in Managed Care

GEOFFREY H. GORDON, MD; LAURENCE BAKER, PhD; *and* WENDY LEVINSON, MD, *Portland, Oregon*

The quality of physician-patient communication affects important health care outcomes. Managed care presents a number of challenges to physician-patient communication, including shorter visits, decreased continuity, and lower levels of trust. Good communication skills can help physicians create and maintain healthy relationships with patients in the face of these challenges. We describe 5 communication dilemmas that are common in managed care and review possible solutions suggested by recent literature on physician-patient communication. We also describe ways that managed care plans can promote more effective communication between physicians and patients.

(Gordon GH, Baker L, Levinson W: Physician-patient communication in managed care. West J Med 1995; 163:527-531)

The physician-patient relationship, characterized by mutual respect and understanding, is the cornerstone of medical care.[1] Good physician-patient communication, using skills that best express these characteristics, improves biologic and psychosocial health care outcomes and enhances patient satisfaction.[2-4] A breakdown in communication is frequently cited by patients as a reason to change physicians, disenroll from health care plans, or initiate malpractice litigation.[5-8]

Managed care presents a number of new challenges to physician-patient communication.[9-11] First, long-standing relationships may be restricted or nullified as patient and physician groups "change hands" in the managed care market. Second, productivity requirements may reduce the amount of time physicians spend with patients, eliminating or curtailing effective communication. Third, patients may join managed care plans with unrealistic expectations and a sense of entitlement. If patients expect their "money's worth" while the plan encourages physicians to limit costs and use, both parties may lose trust in each other, feel "trapped" by the plan, and seek administrative rather than clinical solutions to problems. Finally, some managed care physicians are less satisfied than those in fee-for-service settings, in part because of frustrations with physician-patient communication.[12-14]

The following are brief statements made by patients to their physicians. Each statement portrays a common dilemma in communication between physicians and patients that is especially problematic in managed care. Following each statement is a brief description of techniques and procedures suggested by recent literature on physician-patient communication. The goal of these techniques and procedures is to preserve the essential features of the physician-patient relationship in the face of challenging managed care environments.

Too Many Problems, Too Little Time

"Oh, by the way, Doctor, I still have a few other things bothering me. You're not going to rush out the door again, are you? Can't we talk for more than 10 minutes?"

This patient expects to talk with the physician for more than ten minutes, the usual time allotted for a return visit in many managed care settings. The physician's goal in this situation is to help the patient feel "heard" without sacrificing efficiency. Sitting down, making eye contact, and removing physical barriers to communication simply but powerfully facilitate rapport.[15] Allowing patients to finish their opening statements without interruption rarely takes more than several minutes and establishes the importance of their concerns and subsequent participation in care.[16,17] Many patients tell brief stories about their illnesses; allowing them to proceed without interruption helps them to feel understood and respected, an important first step in care.[18,19]

Because some patients save the most serious or difficult problems for last, inviting patients to "put all their cards on the table" early in the visit can improve patient satisfaction and reduce the chance of new symptoms being introduced at closure.[20,21] Once all of a patient's concerns and requests are aired, a realistic agenda for the visit can usually be consensually negotiated. One way to help patients prioritize is to ask them which concerns are most important to address before they leave the office that day.

For patients with emotionally distressing problems, physicians' empathic skills can be therapeutic without sacrificing efficiency. Five elements of empathic communication have been described[22]:

- Reflection: "You're really feeling overwhelmed by all these symptoms";

From the Medical Service, Portland Veterans Affairs (VA) Medical Center (Drs Gordon and Baker), and the Legacy Good Samaritan Hospital (Dr Levinson), the Oregon Health Sciences University School of Medicine, and the Northwest Center for Physician-Patient Communication, Portland.

Reprint requests to Geoffrey H. Gordon, MD, VA Medical Center, Medical Service (111P), 3710 SW US Veterans Hospital Rd, Portland, OR 97201.

- Legitimation: "I can imagine how upsetting it must be";
- Respect: "You've been doing your best to cope";
- Support: "I'd like to help"; and
- Partnership: "Maybe we can work on these one at a time."

Contrary to some physicians' fears, patients' expressions of emotion are often brief, self-limited, and responsive to direction by their physician.[23] Physicians' use of empathic skills does not prolong the visit substantially and is associated with greater patient satisfaction.[24,25]

Finally, some patients who expect more time need an initial orientation and subsequent redirection to the process of the visit. The following illustrates this approach: "When our time together is limited, it's even more important that we work as a team. Right now we need to decide early on what to work on today and what can wait. I'll make sure you have time to tell me your concerns and also to hear what I think we should do."

Interruptions, repetitions, and stereotyping—"So you're *that* kind of doctor [or patient] . . ."—by either party are early warning signs of communication breakdown. If they occur, consider acknowledging that a problem exists and inviting the patient's input: "I think we both want to understand each other, but we're having trouble doing it. How can we get back on track?"

Misguided Requests

"I always need antibiotics to get over these colds. I can't miss any more time at work, and the wife says, 'Don't come home without the pills.' That's why we signed up for this health plan."

This patient has specific ideas about what is wrong and what needs to be done about it. His wife acts as an informal health advisor. Finally, he feels entitled to request services as a subscriber to his health plan.

Most patients have beliefs or concerns about the meaning of their symptoms, based on folk knowledge, lay literature, or experiences with friends and family.[26] Asking about these is important because patients will be unable to listen to new information until they feel that they have been heard and understood. Ask patients what they think is wrong: "Most patients already have some ideas about what could be wrong. What thoughts or concerns have you had?" Patients may respond with new information: "They told my brother it was just a cold, but it was really pneumonia. He wound up on a breathing machine." Before examining patients, ask "What would you like me to pay particular attention to?" Ask patients what they think should be done for them: "What have you already tried? What else do you need?" Asking patients what others have said about the problem can also help reveal hidden concerns.[27] Most patients have an informal health advisor—often a family member, friend, or neighbor—who has suggested possible diagnoses or treatments. Finally, patients who change from fee-for-service to managed care may find that tests and treatments that were provided without question are now viewed as misguided requests.

A next step is to find ways to work with patients when their assessments and plans conflict with your own.[28,29] Acknowledge that a disagreement exists: "We seem to be disagreeing about whether you need antibiotics to get over this cold," but remain open to caring for the patient within your limits: "If you feel that you can work with me despite this disagreement, I'd still like to be your doctor and help you manage your health." Empathize with the patient's dilemma: "I can see this hasn't worked out at all like you wanted. No wonder you're frustrated." Provide a rationale for your decision: "The group of doctors I work with have reviewed the medical literature on this topic, and we all agree that there is no proven benefit of antibiotics for this condition." Consider sharing decision-making responsibility with the patient: "The chance that this is bacterial is about the same chance of your getting a side effect from an antibiotic. How do you think we should proceed?" Reaffirm the goals of the visit, which can sometimes be met more appropriately through other means (for example, in the case above, with a note to the employer or a phone call to the spouse). Physicians may reasonably choose to prescribe antibiotics in this case and save negotiations for larger issues: "I have a terrible sinus headache with this cold. I brought in this clipping about CT scans of the sinuses in people with colds. I'm covered for that, aren't I?" At times a mutually agreeable solution cannot be found, leaving both parties dissatisfied.

You Fix It Now

"You're not going to be happy with me today. This darn diabetes is just going crazy. The sugar is always up no matter what I eat or do. I wish you doctors could find some way to control it."

This patient seems puzzled by her diabetes mellitus, as though it has a life of its own. Although the condition is chronic, incurable, and best managed by the patient herself, she seems to want a "quick fix" by her physician. Because of the extra time and energy involved in communicating with her, she represents a financial risk in a capitated health care plan, where the primary physician receives a fixed amount for her care. Rather than become angry and frustrated with such patients, consider using empathy: "I can see that this diabetes is really a struggle for you. You'd really like us to take care of it for you, like a broken bone. But you're finding that diabetes isn't like that. It requires a lot of work on your part. I'll bet that's really disappointing." This statement goes beyond empathy by making clear to the patient that she has responsibilities as well as rights in receiving safe and effective health care.

The next step is to find out what keeps her coming to the physician. What goals or gains does she hope for—to feel better? to avoid heart attacks? or to appease her family? Exploring these goals takes some time but demonstrates to her that her ideas and participation are

important. Clarifying her goals can lead to a discussion of what she already knows about her diabetes, what she is ready to do differently, and what she needs next to change her behavior.[30] Once goals are established, strategies to reach them become clearer: "If our goal is to reduce your risk of blindness, your job is to keep a blood sugar diary, and my job is to advise you on how much food, exercise, and insulin to take." A patient's noncompliance can be put into the context of a normal response: "Many of my diabetic patients have trouble keeping track of food and blood sugars. What trouble have you had?" and then explored: "What else could you do to remember to take your blood sugar when you first get up?" Noncompliance can be presented as a choice that rests with the patient: "You've told me that you really enjoy smoking and don't want to stop. But you also worry that smoking increases your risk for another heart attack. How is this a problem for you?"[31] For patients with many problems—for example, obesity, diabetes, hypertension, and hyperlipidemia—small, incremental changes toward one goal at a time are most likely to be successful.[32]

Seeing the Specialist

"I know how my insurance works. If you don't send me to the gynecologist, then you get to keep the money. But the one who took out my cancer said I should see him every 3 months. He really understood my care."

This patient's previous gynecologist is not a member of her new managed care plan. In her new plan, the primary physician receives a fixed amount for her care, from which expert consultant expenses are deducted. The continuity relationship she enjoyed with her previous gynecologist is gone, her new physician is cost-conscious, and she feels cheated and abandoned.

An early goal for the physician in this visit is to keep the focus on the provision of quality health care rather than on the managed care plan. Address the patient's feelings of loss and frustration, but explain her current plan in realistic, unbiased terms: "I can understand how upsetting it must be to have your previous care interrupted. On the other hand, you've got a good plan. It allows you good medical care, but it restricts the use of specialists. It requires that I do things for you that we normally do in the office, such as pelvic exams and Pap smears. If something comes up that you and I decide needs the input of a specialist, I'll help you get it."

The patient's ability to trust her new physician can also be dealt with explicitly: "It sounds as though you're not sure I'll have the knowledge or skills to take care of you properly, or worse, that I wouldn't act in your best interests. I want you to know that my goal, like yours, is to provide the very best care we can. If at some point you feel that we're not meeting that goal, I hope we can talk about it and reach a solution together." Then do a thorough and careful examination as evidence of your competence and concern.

As managed care plans expand, referral patterns between primary care and specialist physicians can change rapidly. Primary care physicians help specialists by formulating specific questions and defining roles and tasks for follow-up. Specialists can help by being brief and specific, anticipating problems, and identifying contingency plans.[33] Specialists may also wish to identify the primary physician as the patient's "point of contact" for follow-up. This approach is challenging in highly technical specialties—for example, cardiac electrophysiology—where standards of care are constantly being revised.[34]

Bending the Rules

"Doc, I haven't seen a dentist in years, and I can't afford to now. Could you make a referral saying that I need it because of my diabetes? Then the plan will pay for it."

In some managed care plans, coverage for certain types of care, such as dental, optometric, preventive, or mental health, is minimal or absent depending on the level of coverage purchased. Physicians working in such plans should be familiar with the types of care that are covered and denied, what specialists are available and their qualifications, and the physician's role if specialty treatment is denied by the plan.

This physician has a number of options, reflecting his or her various roles. Administratively, he or she can refer the patient to an eligibility office, write in support of the patient's request, or ensure that the eligibility committee has appropriate input from both patient and physician. Clinically, the physician can request specialty consultation to evaluate the effect of the dental condition on diabetes—for example, "rule out dental infection." Investigators found that physicians are willing to use deception in recording the reason for ordering a mammogram in a setting where mammograms ordered for "screening" are denied but those ordered to "rule out breast cancer" are approved.[35] Ethically, a physician's duty to advocate for the individual patient conflicts with his or her duty to work within the guidelines of the plan, which provides cost-effective care of a population of patients. Current ethical guidelines clearly support the physician's role as an advocate for individual patients.[36,37] Legally, if a plan denies care that a physician strongly feels is indicated, he or she may have an obligation to contest or appeal the decision on the patient's behalf and to discuss all options with the patient, including getting care outside the plan at the patient's expense. Although managed care plans may be held liable for a physician's actions, courts may also hold physicians responsible for upholding community standards of treatment, even when denied by a patient's plan.[38,39]

In responding to patients' requests to bend the rules, physicians' actions—and related communications with patients—can be impulsive, depending on their feelings about the individual patient, the ease of dealing with the managed care plan, and the time available to think about it. Such requests rarely require immediate action. Physicians should take time to consider the issues just outlined, their personal responses to them, and what messages they want to convey to their patients. Then

they should communicate the message clearly: "I'd like to help you, but I don't think your teeth are aggravating your diabetes, and I'm not comfortable bending the rules that way."

How Managed Care Organizations Can Facilitate Physician-Patient Communication

Managed care plans can help physicians and patients communicate more effectively. For patients, the plan can describe what to expect regarding time with a physician, use of the telephone and emergency room, and the roles of other health care professionals in enhancing physician-patient communication. The plan can also describe policies regarding referrals to specialists, handling of grievances, and physicians' role as patient advocates if financial conflicts of interest arise. For physicians, the plan can provide opportunities to review how its promises and limitations are marketed to possible subscribers and its development of resource allocation guidelines to avoid "bedside rationing" by physicians.[36] Programs should be available to educate and coach patients in the management of common health problems and to educate providers in population-based and traditional dyadic medical care.[40]

Second, there should be a well-defined, physician-generated, prospective internal policy for dealing with difficult physician-patient relationships, including a means for terminating a patient's relationship with an individual provider or with the entire plan.

There should also be a strong, sensitive central administrative physician to deal directly with patients who have insistent demands and contentious behaviors. This frees up primary care professionals to be advocates for good medical care and to negotiate about medical rather than administrative issues.[9] Some administrators and risk managers unwittingly undermine physicians' efforts to provide safe, effective health care when it involves setting limits on patient demands, by tracking patient complaints as the only relevant outcomes, or by administratively reversing physicians' decisions regarding patients' requests. Managed care plans may reasonably decide that for some patients unable to cooperate with their physicians in obtaining safe, effective care, disenrollment is administratively preferable to providing substandard care.[9,41]

Finally, managed care plans should provide training in physician-patient communication. Plan administrators and risk managers should work collaboratively with physicians to identify mutual goals for such training and to ensure that the plan's policies and measures of quality of care support those goals. Goals for administrators and risk managers could include greater patient satisfaction and retention and fewer complaints or lawsuits. Goals for physicians could include fewer frustrating patient encounters, improved treatment adherence, and improved job satisfaction. All of these outcomes are demonstrably related to physicians' communication skills. Skills training is best conducted in workshop format, with opportunities to review recent research findings in physician-patient communication, practice new skills in relevant and realistic situations, and work in small groups with a free exchange of ideas and feedback. Such training is increasingly part of medical school, residency, and continuing education curricula.[42-44]

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Ethical Issues in Managed Care

Council on Ethical and Judicial Affairs, American Medical Association

A PRIMARY concern of medical ethicists for some time has been the absence of any meaningful analysis of the impact of health care delivery marketplace changes and current legislative reforms on the essential tenets of the physician-patient relationship. Although President Clinton's original reform proposal addressed in broad terms the ethical imperatives supporting universal access, it left virtually unexamined the more fundamental question of the role of the physician in a reformed system in which the incentives are dramatically changed and budgets determine the amount of health care spending and services.

See also pp 323 and 338.

In June 1990, the Council issued a report, "Financial Incentives to Limit Care: Financial Implications for HMOs and IPAs,"[1] which described the financial incentives that managed care plans offer physicians to limit their provision of care. The report concluded that patient welfare must remain the first concern of physicians working in health maintenance organizations (HMOs) and independent practice associations (IPAs) and that physicians must disclose all relevant financial inducements and contractual restrictions that affect the delivery of health care to patients.

With its emphasis on managed care and managed competition, health system reform will greatly increase the salience of the ethical concerns raised by managed care. It is therefore essential that the profession and society act now to ensure that managed care techniques are implemented in a way that protects patients and the integrity of the patient-physician relationship.

In this report, the Council reiterates the physician's commitment to patient welfare first and updates its previous recommendations for physicians. This report discusses in greater detail the potential conflicts of interest faced by physicians practicing in the managed care environment. It then recommends measures to preserve the fundamental duty of physicians as patient advocates by reducing the risk of rationing and inappropriate financial incentives.

BACKGROUND

As health care costs have risen and calls for more cost-conscious health care have been made,[2] health care insurers increasingly have adopted principles of managed care.[3] Several different types of managed care arrangements have gained prominence in the American health care system, including group- and staff-model HMOs, IPAs, and preferred provider organizations. Fee-for-service plans are also using many of the cost-saving techniques of managed care.

Managed care plans use a number of techniques. Some of them are directed at physician behavior. Others are directed at subscribers to the plan.[4,5] For example, managed care plans typically encourage subscribers to seek health care when it is still possible to prevent the development of illness by covering a broad range of preventive and primary care services. In addition, they restrict subscribers to panels of physicians who have agreed to accept lower reimbursements or who may have exhibited a history of practicing lower-cost care. Managed care plans can also control their subscribers' behavior by denying access to the services of medical specialists until the subscriber has obtained the approval of a primary care physician.

Managed care plans constrain the costs of participating physician practices in several ways as well. The plans may restrict the ability of physicians to perform certain procedures or to order certain medications or diagnostic tests. For example, a physician may need the approval of a radiologist before ordering a diagnostic imaging test, or a managed care plan might exclude some expensive drugs from the plan's formulary. Managed care plans aggressively use programs of utilization review to detect what they consider medically inappropriate or unnecessarily costly practice patterns.

Managed care plans can also reduce costs by creating economies of scale, by coordinating care among physicians and hospitals, by mandating the use of guidelines or parameters of care (*Chicago Tribune.* November 10, 1993:A1), and by establishing advanced information systems that provide an improved basis on which to measure quality and efficiency.

Managed care plans also encourage

From the Council on Ethical and Judicial Affairs, American Medical Association, Chicago, Ill.

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physicians to make cost-conscious treatment decisions through the use of financial incentives. The plans often compensate physicians with capitation fees or a salary. In addition, plans typically use incentives for physicians to limit their use of diagnostic tests, referrals to other physicians, hospital care, or other ancillary services. For example, managed care plans often pay bonuses to physicians, with the amount of the bonus increasing as the plans' expenditures for patient care decrease. Or plans often withhold a fixed percentage of their physicians' compensation until the end of the year to cover any shortfalls in the funds budgeted for expenditures on patient care. If there is no shortfall, or the shortfall can be covered by part of the withheld fees, the remaining withheld fees are returned to the physicians.[1]

While efforts to contain costs are critical and while many of the approaches of managed care have an impact, managed care can compromise the quality and integrity of the patient-physician relationship and reduce the quality of care received by patients. In particular, by creating conflicting loyalties for the physician, some of the techniques of managed care can undermine the physician's fundamental obligation to serve as patient advocate. Moreover, in their zeal to control utilization, managed care plans may withhold appropriate diagnostic procedures or treatment modalities for patients. Indeed, the US Department of Health and Human Services recently expressed concerns about practices at a major HMO after receiving eight allegations of insufficient patient care (*Wall Street Journal*. October 3, 1994:A1).

THE PATIENT-PHYSICIAN RELATIONSHIP

Before discussing the potential impact of managed care on the patient-physician relationship, it is important to consider what is at stake. The foundation of the patient-physician relationship is the trust that physicians are dedicated first and foremost to serving the needs of their patients. In the oath of Hippocrates, trust is a central element in almost all the ethical obligations of physicians: physicians must keep patients' private information confidential, avoid mischief and sexual misconduct, and give no harmful or death-causing agent. Patients can expect that physicians will come to their aid even if it means putting the physician's own health at risk,[6] and they can trust that physicians will do everything in their power to help their patients. It is this trust that enables patients to communicate private information and to place their health, and indeed their lives, in the hands of their physicians.[1] Without trust, the success of the healing process would be seriously diminished.

No other party in the health care system has the kind of responsibility that physicians have to advocate for patients, and no other party is in a position to assume that kind of responsibility. Physicians care for patients directly, are in the best position to know patients' interests, and can advocate within the health care system for patients' needs. Without the commitment that physicians place patients' interests first and act as agents for their patients alone, there is no assurance that the patient's health and well-being will be protected.

ETHICAL CONCERNS

Managed care involves at least two conflicting loyalties for the physician, conflicts that are not unique to managed care. First, physicians are expected to balance the interests of their patients with the interests of other patients. When deciding whether to order a test or procedure for a patient, the physician must consider whether the slot should be saved for another patient or not used at all to conserve the plan's resources. Second, managed care can place the needs of patients in conflict with the financial interests of their physicians. Managed care plans use bonuses and fee withholds to make physicians cost conscious. As a result, when physicians are deciding whether to order a test, they will recognize that it may have an adverse impact on their income.

Some commentators argue that market forces will ensure that patients are protected from undue conflicts of interest. Because subscribers are theoretically free to choose their managed care organization based on quality of coverage, performance record, and other factors, they can theoretically drive those managed care organizations with the least impressive records out of business. However, it is unlikely that these consumer choices alone will ensure high-quality managed care organizations. As stated in a recent editorial, "patient satisfaction depends more on visible amenities and personal relations than on the quality and appropriateness of medical services. . . ."[7]

The following two sections address the potential conflicts of interest for physicians under managed care.

Conflicts Among Patients

While some cost containment can be achieved by eliminating waste and inefficiency, it is also being achieved by limiting the availability of tests or procedures that offer only small or uncertain benefit or that provide a likely benefit but at a great expense. Because managed care plans generally work within a limited budget and, increasingly, are for-profit companies that compete to report favorable results to shareholders,[7,8] the cost of a service will influence whether the service is offered to patients who might benefit from it. Allocation rules are developed by the plans to deal with this issue.

Managed care plans can make these allocation decisions in a number of ways: by developing guidelines that determine for a physician when the service should be offered, by instructing physicians to provide medically necessary care and delegating to the physicians the allocation decisions, or by some combination of allocation guidelines, physician discretion, and oversight.

An example of an allocation decision might involve the use of high-osmolar contrast media (HOCM) and low-osmolar contrast media (LOCM) in diagnostic imaging procedures.[9] Both HOCM and LOCM produce images of similar quality and are approved by the Food and Drug Administration as safe and effective. Adverse reactions, including "changes in cardiac performance, alterations in renal function, depression of the central nervous system, pain at the site of injection, flushing, nausea, and vomiting,"[9] are somewhat more likely with the use of HOCM. In addition, fatal adverse reactions with both media are extremely rare and no more likely with HOCM than LOCM.[10(p616),11] However, there is a significant difference in the cost of the two media: LOCM are considerably more expensive than HOCM. Whereas a peripheral arteriography procedure would use about $10 worth of HOCM, the same procedure would use about $180 worth of LOCM, an increase of 18 times the HOCM cost.[9]

It is not obvious which contrast medium should be used. In fact, the decision to use HOCM or LOCM is essentially a value judgment about the relative costs and benefits of the two different media. While medical expertise is necessary to determine what benefits and risks are associated with the two media, the weighing of those benefits and risks with financial costs is not simply a medical decision but also a social judgment about the value of spending additional resources to lower health risks in this manner. A more difficult allocation case involves the use of bone marrow transplants for certain kinds of advanced cancer. The stakes for the patient are high—a prolonged life if successful—but the costs are great and the likelihood of success uncertain. Some plans will restrict or discourage the treatment; others may make it available

under some circumstances.[12]

Ethical Problems With Bedside Rationing.—Physicians make cost benefit judgments every day as a part of their professional responsibility in treating patients. It is unethical to knowingly provide unnecessary care or to be wasteful in providing needed care.

Allocation judgments about costs and services that approach a "rationing" decision—the denial of a procedure that benefits a patient—are not part of the physician's traditional role and, indeed, conflict with it. Although physicians have traditionally served as de facto gatekeepers to the health care system, overseeing the public's use of medical care, the cost-primacy environment of managed care significantly complicates this role.[13] As Pellegrino has written, "This [gatekeeper] role is morally dubious because it generates a conflict between the responsibilities of the physician as a primary advocate of the patient and as guardian of society's resources."[13] While this responsibility to guard society's resources is an important one, physicians must remain primarily dedicated to the health care needs of their individual patients.

The primary care physician's role in managed care illustrates the ethical problems associated with bedside rationing. The physician-gatekeeper determines whether the patient will be granted further access to the health care system, including referrals to specialists and diagnostic tests. At the same time, the physician is required by rules and encouraged by incentives to be aware of the overall financial limitations of the managed care entity for which he or she works.[4] The physician knows that there are other patients who have subscribed to the managed care plan and who are owed a certain level of health care.[14] These competing concerns mean that a patient's further treatment depends not only on the physician's judgment about the legitimacy of that patient's present medical need but also on the relative weight of that need in comparison with the organization's need to serve all patients and control costs. Inconsistent and uninformed decisions are inevitable.

The primary care physician has the greatest responsibility within the managed care organization to assess the seriousness of patients' conditions accurately. A keen understanding of common and uncommon health problems is therefore required, as it is of all primary care physicians. However, the pressures of cost containment may encourage some physicians to try to manage cases longer than they should. Physicians may feel compelled to stretch their competence to keep patients at the primary care level and conserve resources. Inappropriate treatment and improper or missed diagnoses are potential outcomes of such decisions to delay or deny referral.

Preserving the Physician's Role.—The physician is obligated to provide or recommend treatment when the physician believes that the treatment will materially benefit the patient and not to withhold the treatment to preserve the plan's resources. Physicians should not engage in bedside rationing.

But many allocation decisions are within arguable ranges or gray areas of at least minimally acceptable treatment. There are two steps to reducing physician-patient conflict in these circumstances. First, allocation decisions should be determined not by individual physicians at the bedside but according to guidelines established at a higher policymaking level. Physicians should contribute their expertise in the development of the guidelines and should advocate for the consideration of differences among patients. For example, it might be advisable for a certain group of patients at high risk to be offered LOCM while others who are not in this group are offered HOCM. Physicians can help ensure that all medically relevant information is considered and that no group of patients is put at an unfair disadvantage.

Second, and more importantly, even if the use of the LOCM were prohibited by a guideline for all or a particular class of patients, it remains the physician's duty to recommend its use and to advocate for the patient's right to the treatment in any case in which material benefit to a particular patient would result.

The structure through which physicians offer their expertise in policy-level decisions is very important. To help define this structure, the American Medical Association (AMA) recently proposed legislation[15] that would require managed care organizations to establish a medical staff structure, much like that in existence in every hospital in the United States. This proposal includes a governing board for the managed care organization that would include at least three physician members as representatives of participating physicians and a medical board composed entirely of participating physicians. Physicians on the medical board would be responsible for periodically reviewing restrictions on services to subscribers and other issues related to health care coverage. They would also review quality of care and physician credentialing on a periodic basis and disclose their review criteria to subscribers. The governing board would be ultimately responsible for the activities of the managed care organization, but participating physicians would have formal mechanisms for input and responsibilities on crucial medical practice issues.

In addition to the physician's role in making rationing decisions, there is an equally critical role for patients. The decision-making process should include some mechanism for taking into account the preferences and values of the people whom the rationing decisions will most directly affect.[14] Accurate and full disclosure is most important. In addition, a managed care organization could use "town meetings" and other mechanisms whereby subscribers could voice their preferences or "vote" on what treatments should be included in their benefits package.

Once guidelines and criteria are developed at the policy level, physicians are free to make clinical decisions based on those guidelines and criteria. For example, if a managed care plan decided to offer LOCM only to patients at high risk for an adverse reaction to HOCM, physicians would decide which patients are at high risk.

In addition to the development of appropriate procedures for making allocation decisions, there are other steps that must be taken to protect patient welfare when the allocation procedures are implemented. For example, as part of the process of giving patients informed consent to treatment, physicians should disclose all available treatment alternatives, regardless of cost, including those potentially beneficial treatments that are not offered under the terms of the plan. As described in the Council's report on financial incentives to limit care,[1] obligations of disclosure always apply to the physician practicing in managed care. With full understanding of the limitations affecting their treatment, patients will have the opportunity to make alternative arrangements for care that is not available in their health plan. Thus, for example, if the health plan did not cover a particular pharmaceutical that the physician might otherwise have prescribed, the patient could choose to pay out-of-pocket for the pharmaceutical.

It is also critical for managed care plans to have a well-structured appeals process through which physicians and patients can challenge the denial of a particular diagnostic test or therapeutic procedure. Such a process should afford the physician an opportunity to advocate on the patient's behalf before the plan's medical board or governing board. Appeals mechanisms for treatment denials are essential because policy-level allocation decisions can never fully account for all contingencies and will sometimes underserve individual patients. Managed care plans, as institutions, have an ethical re-

sponsibility to allow patients to challenge treatment decisions that directly affect their health and well-being.

In some circumstances physicians have an obligation to initiate appeals on behalf of their patients. Cases may arise in which a health plan has an allocation guideline that is generally fair but in particular circumstances results in unfair denials of care, ie, denial of care that would materially benefit the patient. In such cases, the physician's duty as patient advocate requires that the physician challenge the denial and argue for the provision of treatment in the specific case. Cases may also arise in which a health plan has an allocation guideline that is generally unfair in its operation. In such cases, the physician's duty as patient advocate requires not only a challenge to any denials of treatment from the guideline but also advocacy at the health plan's policymaking level to seek an elimination or modification of the guideline.

Conflicts Between Physician and Patient

Ethical Problems With Financial Incentives to Limit Care.—As discussed herein, managed care plans encourage physicians to be more cost conscious by using bonuses, fee withholds, and other financial incentives to limit care. With these incentives, physicians recognize that they may reduce their income when they order tests, hospitalize patients, or provide other services. The incentives are not inherently unethical, but they can be depending on their design and intensity.

There are two important ways in which financial incentives to limit care compromise the physician's duty of loyalty to patient care. First, physicians have an incentive to cut corners in their patient care, by temporizing too long, eschewing extra diagnostic tests, or refraining from an expensive referral. Several studies have tried to measure the health outcomes of patients in managed care or prepaid settings against the health outcomes of patients in fee-for-service arrangements. Although disturbing anecdotes abound, these studies have found largely mixed results[16]: harm or inadequate health outcomes have not been conclusively demonstrated in managed care arrangements,[17,18] although these patients may be at an increased risk of harm.[19-21] Second, even in the absence of actual patient harm, the incentives may erode patient trust as patients wonder whether they are receiving all necessary care or are being denied care because of the physicians' pecuniary concerns.

Physicians must place patients' interests ahead of their own interests, including financial remuneration.[1] Financial conflicts are inherent in the practice of medicine, regardless of the system of delivery, and physicians generally have been able to maintain their duty to patient welfare despite those conflicts. However, incentives to limit care are more problematic than incentives to provide care.

First, financial incentives to limit care exploit the financial motive of physicians, making the physician's financial self-interest indispensable for the success of the managed care organization. Second, financial incentives to limit care are less likely than financial incentives created by fee-for-service to coincide with patients' interests, because patients generally prefer the risk of too much care to the risk of too little care. Third, the effects of incentives to limit care are less likely to be noticed by patients. When a physician recommends a course of action under fee-for-service reimbursement, the patient can seek a second opinion. However, when a physician does not offer an intervention under managed care, the patient may have no idea that a treatment option was withheld and therefore not recognize the need for a second opinion.[8]

Not all financial incentives to limit care create the same conflict of interest between the physician's and patient's interests. In general, the greater the strength of the incentive, the more likely it will create a serious conflict of interest that could lead to patient harm. The strength of a financial incentive to limit care can be judged by various factors, including the percentage of the physician's income placed at risk, the frequency with which incentive payments are calculated, and the size of the group of physicians on which the economic performance is judged.[22]

If the managed care plan places 20% of a physician's income at risk, the physician likely will be much more conscious of costs than if the plan places 5% of income at risk. Similarly, if a physician's incentive payments are based solely on his or her treatment decisions, there is a strong incentive to limit services for each patient. When payments are based on the performance of a group of physicians, on the other hand, the incentive is diminished. When physicians are placed at risk together, they have an incentive to ensure that their colleagues are practicing in a cost-effective manner and the incentive payments will be based on costs incurred by a large patient pool. When the patient panel is small, there is a risk that treatment costs will be skewed by an unrepresentative group of patients that have unusually high-cost needs for medical care.

The strength of a financial incentive can also vary with the frequency of incentive payments. If payments are made on a monthly basis rather than a yearly basis, the physician receives rapid feedback on the economic consequences of treatment decisions and is therefore likely to be more sensitive to those consequences. In addition, when incentives are calculated on a monthly basis, there is less of an opportunity for the costs of cases that are above average to be offset by the costs of cases that are below average. Accordingly there is a stronger incentive not to incur unusually high expenses in any one case. Because of this concern, the Health Care Financing Administration, in its proposed rules, would permit managed care plans to place less of their physicians' income at risk if the plans calculate their incentive payments more frequently than once a year.[23]

Preserving the Physician's Role.—Before the Council discusses its recommendations for dealing with financial incentives to limit care, it is important to mention that the AMA is precluded from issuing restrictive guidelines in this area. A Federal Trade Commission order that was upheld by the US Supreme Court prohibits the AMA from "regulating" or "advising on the ethical propriety of... the consideration offered or provided to any physician in any contract with any entity that offers physicians' services to the public."[24]

The most effective way to eliminate inappropriate conflicts is to create the use of financial incentives based on quality rather than quantity of services. Reimbursement that serves to promote a standard of "appropriate" behavior helps to maintain the goals of professionalism. Unlike incentives based on quantity of services, which punish the provision of both appropriate and inappropriate services, incentives based on quality of care punish only inappropriate services.

Judgments about the quality of a physician's practice should reflect several measures. First, it is essential to consider objective outcomes data, including data about mortality and morbidity, corrected for caseload. Second, because outcomes are often beyond the physician's control, it is important to consider the degree to which the physician adheres to practice guidelines or other standards of care. Third, patient satisfaction should be considered. Although patients are limited in their ability to evaluate physician competence, they are the best judges of one critical quality of physician care, the physician's bedside manner. In addition, patient satisfaction reflects the extent to which the physician has accommodated the goals of the patient, as required by the patient's right to exercise self-determination in medical care. Fourth, the judgments of a physician's peers should be

considered; these judgments provide an important assessment of quality that may be particularly useful "in areas that are difficult to assess reliably with other measures."[25(p1658)]

Because measurements of quality are still in the rudimentary stages of development, it is important to ensure that other safeguards are in place to prevent abuse from incentives based on quantity of care. Reasonable limits should be placed on the extent to which a physician's ordering of services can affect his or her income. For example, quantitative financial incentives should be calculated on groups of physicians rather than individual physicians.

PATIENT AUTONOMY AND RESPONSIBILITY

Many commentators argue that managed care threatens patient autonomy because it curtails patients' freedom of choice. Patients are usually limited in their choice of primary care physicians and, to a much greater degree, specialists, and they are sometimes limited in their choice of treatments. Patients may not be able to receive a desired diagnostic test or referral, and their freedom to personally tailor treatment can be thwarted. In addition, continuity of care may be disrupted if a patient is forced, for a variety of reasons, to change physicians to keep their health care benefits.[26]

Public participation in the formulation of benefits packages may resolve some of these concerns about limited autonomy. Legislation reasonably protecting patients' rights to be informed and to choose and protecting physicians' rights to remain professionals is also essential. Patients can exercise their autonomy by participating in the decisions of their health plan or in government processes that may restrict their choices or benefits. In addition, patients have a responsibility to learn as much as they can about their choices of plans, including the exact nature of the different benefits packages and their limitations. Patients have a responsibility to make sure they know and understand the terms of their own health care plan.

As patient advocates, physicians continue to have duties of disclosure. They must ensure that all treatment alternatives, regardless of cost, are disclosed. They must also ensure that the managed care organization has fulfilled its obligation to disclose the terms of the benefits package, including all limitations and restrictions.

Patient autonomy does not guarantee the right to have all treatment choices funded. Some limits on personal freedom are inevitable in a society that tries to provide all of its members with adequate health care. The desire for accurate diagnosis and use of technological medical care, no matter how little the benefit, has been cited as a major factor in increasing health care costs in this country.[27] Moreover, patient autonomy entails patient responsibility, including a responsibility to abide by societal decisions to conserve health care and to make an individual effort to use resources wisely and lead a healthy lifestyle.

While physicians must remain patient advocates, patients do not have an unlimited claim to physicians' obligation to provide health care. Physicians should not manipulate or "game" the system to answer patients' demands.[28]

To fully exercise their autonomy, patients need to be fully informed about the philosophy and goals of managed care. In an earlier report, the Council stated that the physician's responsibilities under managed care include a duty to disclose to the patient conflicts of interest that may affect patient care and medical alternatives that cannot be offered because of the restrictions of the managed care plan. That report specifically states that physicians have a duty to disclose financial incentives, to disclose contractual agreements restricting referral, and to ensure that the managed care plan makes adequate disclosure of the details of the plan to subscribers.[1,29]

GUIDELINES

For the reasons described in this report, the Council on Ethical and Judicial Affairs issues the following guidelines:

1. The duty of patient advocacy is a fundamental element of the physician-patient relationship that should not be altered by the system of health care delivery in which physicians practice. Physicians must continue to place the interests of their patients first.

2. When managed care plans place restrictions on the care that physicians in the plan may provide to their patients, the following principles should be followed:

(*a*) Any broad allocation guidelines that restrict care and choices—which go beyond the cost-benefit judgments made by physicians as a part of their normal professional responsibilities—should be established at a policymaking level so that individual physicians are not asked to engage in ad hoc bedside rationing.

(*b*) Regardless of any allocation guidelines or gatekeeper directives, physicians must advocate for any care they believe will materially benefit their patients.

(*c*) Physicians should be given an active role in contributing their expertise to any allocation process and should advocate for guidelines that are sensitive to differences among patients. Managed care plans should create structures similar to hospital medical staffs that allow physicians to have meaningful input into the plan's development of allocation guidelines. Guidelines for allocating health care should be reviewed on a regular basis and updated to reflect advances in medical knowledge and changes in relative costs.

(*d*) Adequate appellate mechanisms for both patients and physicians should be in place to address disputes regarding medically necessary care. In some circumstances, physicians have an obligation to initiate appeals on behalf of their patients. Cases may arise in which a health plan has an allocation guideline that is generally fair but in particular circumstances results in unfair denials of care, ie, denial of care that, in the physician's judgment, would materially benefit the patient. In such cases, the physician's duty as patient advocate requires that the physician challenge the denial and argue for the provision of treatment in the specific case. Cases may also arise in which a health plan has an allocation guideline that is generally unfair in its operation. In such cases, the physician's duty as patient advocate requires not only a challenge to any denials of treatment from the guideline but also advocacy at the health plan's policymaking level to seek an elimination or modification of the guideline. Physicians should assist patients who wish to seek additional appropriate care outside the plan when the physician believes the care is in the patient's best interests.

(*e*) Managed care plans must adhere to the requirement of informed consent that patients be given full disclosure of material information. Full disclosure requires that managed care plans inform potential subscribers of limitations or restrictions on the benefits package when they are considering entering the plan.

(*f*) Physicians also should continue to promote full disclosure to patients enrolled in managed care organizations. The physician's obligation to disclose treatment alternatives to patients is not altered by any limitations in the coverage provided by the patient's managed care plan. Full disclosure includes informing patients of all their treatment options, even those that may not be covered under the terms of the managed care plan. Patients may then determine whether an appeal is appropriate or whether they wish to seek care outside the plan for treatment alternatives that are not covered.

(*g*) Physicians should not participate in any plan that encourages or requires

care at or below minimum professional standards.

3. When physicians are employed or reimbursed by managed care plans that offer financial incentives to limit care, serious potential conflicts are created between the physicians' personal financial interests and the needs of their patients. Efforts to contain health care costs should not place patient welfare at risk. Thus, financial incentives are permissible only if they promote the cost-effective delivery of health care and not the withholding of medically necessary care.

(*a*) Any incentives to limit care must be disclosed fully to patients by plan administrators on enrollment and at least annually thereafter.

(*b*) Limits should be placed on the magnitude of fee withholds, bonuses, and other financial incentives to limit care. Calculating incentive payments according to the performance of a sizable group of physicians rather than on an individual basis should be encouraged.

(*c*) Health plans or other groups should develop financial incentives based on quality of care. Such incentives should complement financial incentives based on the quantity of services used.

4. Patients have an individual responsibility to be aware of the benefits and limitations of their health care coverage. Patients should exercise their autonomy by public participation in the formulation of benefits packages and by prudent selection of health care coverage that best suits their needs.

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Ergonomics

AN ERGONOMIC APPROACH TO REDUCING BACK STRESS WHILE TRANSFERRING HOSPITALIZED PATIENTS

Bernice D. Owen, PhD, RN
Professor, Nursing
School of Nursing
University of Wisconsin-Madison
Madison, WI

Nursing personnel continue to be at great risk for occupationally related back pain. The PURPOSE of this study was to decrease back stress experienced by hospital personnel while carrying out the tasks of transferring patients in and out of bed, on and off gurneys and cardiac chairs, lifting patients up in bed, and toileting patients in bed.

METHOD: In preintervention, and through the use of two scenarios, nursing personnel from 2 rural hospitals (control and experimental) ranked selected patient handling tasks according to perceived stressfulness and then rated each task for amount of stress they perceived they would endure to the lower back, upper back, and shoulders while carrying out each task within the scenarios. Intervention for the control site was the provision of a routine inservice for body mechanics. Intervention for the experimental setting included: introduction of assistive devices for lifting/transferring, an education/training program for skill in using these devices, random observation to evaluate correctness and frequency of use of assistive devices, assessment of patient care needs for lifting/transferring so correct devices if any are used, and management support techniques. In postintervention, a rating of perceived exertion/stress scale was used in experimental and control sites after each selected patient handling task was completed with patients. Back injury data were collected pre and post intervention.

RESULTS: Perceived stress was reduced significantly between preintervention scenario ratings and post intervention patient care lift/transfer ratings in the experimental setting. Also, there were significant differences between the experimental and control groups when comparing the postintervention ratings with actual patient care. The back injury rate and lost work days due to back pain were reduced in the experimental setting. Nursing personnel indicated a favorable impact on patient care also.

CONCLUSION and APPLICATION: An ergonomic approach focussing on reducing the job demands of hospital nursing personnel was effective in reducing perceived back stress while carrying out various patient handling tasks. Back injuries and lost time were also decreased.

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Four methods for identification of most back-stressing tasks performed by nursing assistants in nursing homes

Bernice D. Owen [a], Arun Garg [b], and Roger C. Jensen [c]

[a] *School of Nursing, University of Wisconsin-Madison, 600 Highland Avenue, Madison, WI 53792, USA*
[b] *Dept. of Industrial and Systems Engineering, University of Wisconsin-Milwaukee, P.O. Box 784, Milwaukee, WI 53201, USA*
[c] *Dept. of Safety Science, University of New South Wales, Australia*

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Abstract

Ergonomists are often asked to evaluate selected jobs because of excessive back injury rates. One key step in the evaluation process is identification of specific tasks that impose the largest stresses on the backs of workers who perform the job. Four techniques for identifying the most back-stressing tasks were used in an ergonomic study of nursing assistants working in a nursing home. Two techniques were based on worker perceptions and two were based on a static biomechanical model. The rank order of tasks was similar for each technique. It was concluded that when the purpose is to identify which of several tasks should be evaluated in greater detail, the most programmatic technique is a rating scale.

Relevance to industry

Identification of stressful tasks within all industries is a vital part of any back injury prevention program. Various methods are presently being used to identify these tasks. A rating scale used by employees to rate physical stressfulness to the back resulted in approximately the same ratings as more complicated, time consuming, and expensive methods. Hence, rating scales are recommended.

Keywords

Back stress, identifying stressful tasks, methods to determine stress, rating of perceived exertion.

Introduction

The health care industry is one of the largest employers in the United States. In 1988 there were 8.8 million civilians working in the health care industries (Bureau of Labor Statistics, 1989). Hospitals employed 4.5 million, nursing homes and other long-term care facilities employed about 1.4 million, and another 2.8 million were employed in specialized clinics and offices of health care providers such as physicians, chiropractors, and dentists.

Injury rates for these major sectors of the health care industry differ. According to annual figures for 1988 reported by the U.S. Bureau of Labor Statistics, the largest employee injury rates were found in 'nursing and personal care facilities' with an annual injury rate of 14.8 per 100 full-time equivalent (FTE) employees, compared to hospitals with 8.4 per 100 FTE (Bureau of

Labor Statistics, 1990). The average for all industries was 8.3 injuries per 100 FTE.

Within the major sectors of the health care industry, occupation-specific rates for back injury compensation claims have been compared (Jensen, 1987). The occupational classification 'nursing aides, orderlies, and assistants' (NAs) employed in the nursing home industry had a larger incidence rate of claims per 100 employees than any other occupation-by-industry group (Jensen, 1987). Other investigations have confirmed the conclusion that NAs working in nursing homes are particularly vulnerable to back injury (Personick, 1990; Valles-Pankratz, 1989).

According to the National Center for Health Statistics (NCHS) the 19,000 nursing homes in the U.S. employed 501,000 FTE nursing assistants in 1985 (Hing, 1987; Strahan, 1987). The actual number of nursing assistants employed in nursing homes is larger than the NCHS figure because many are employed part time. Between the years 1988 and 2000 there is a projected increase of 32 percent in jobs for nursing assistants (Silvestri and Lukasiewicz, 1989).

Starting around the year 2020 there will be an even more impressive increase in the number of nursing assistants needed as the baby boom population reaches old age and expands the nursing home industry. Before this increase in employment level for nursing assistants begins, it is imperative that more effective ways of preventing back injuries among nursing assistants be found.

The traditional approach to prevent back injuries among nursing personnel is *training*. This typically involves instruction in body mechanics, personal back care, and 'proper' lifting techniques. Unfortunately there is a lack of scientific investigation into the possible effectiveness of this approach. The small amount of literature on the subject suggests that training might lead to some improvements in procedures used to transfer patients. But, training is only one component of a comprehensive approach to back injury control program (Jensen, 1990a). Another approach to back injury control is the ergonomic approach which involves a systematic process leading to changes in the job demands.

The ergonomic approach to reducing back injuries in an employment setting may be described as a four-step procedure (Jensen, 1990b). *First* is the identification of jobs with the greatest back injury problems. This is usually based on rates calculated from either reported injuries or workers' compensation claims for back injuries. Consideration is also given to total frequency of back injuries among workers performing the various jobs. For the jobs with greatest back injury problems, the *second* step is the identification of the specific tasks which impose the largest stresses on the workers' backs. Then, for the most back-stressing tasks, the *third* and most creative step, is to look for ways to change the task demands. This may involve *elimination* of the stressful task, *substitution* of lifting equipment for the back muscles of the worker, or *control* of the exposure level. The *fourth* step is implementation of change.

The second step, identification of the most back-stressing tasks, is critical. Yet the ergonomics literature fails to reflect an interest in comparing the different methods possibly useful for ranking tasks in terms of stressfulness to the backs of workers. The material presented in this article begins to fill this gap in the ergonomics literature on the very practical subject of methods for identifying the most back-stressing tasks of a particular job.

An investigation was conducted in which four methods were used to identify the most back-stressing tasks performed by nursing assistants working in a nursing home. Two methods were based on employee perceptions. The other two were based on biomechanical measures.

The two methods based on employee perceptions were derived from the assumption that workers are able to feel differences in the level of stresses on their lower back when performing different tasks. One method used a rating scale, using the 6–20 scale developed by Borg (1978). The second method used a simple ranking technique developed for this investigation.

The two biomechanical methods are based on static equilibrium equations that estimate forces on the lower back. One method estimates compressive force on the L5/S1 disc, the second method estimates the tensile force on the erector spinae muscles. These models require the same input information, and both computed force val-

ues serve as quantitative indices of the relative load imposed on the lower back when performing a manual load-handling task.

The purpose of this paper is to describe the four methods, and compare results obtained with each method based on experiences using each method in one nursing home.

Method

Setting

The study took place in a nursing/personal care facility located in Southeastern Wisconsin, U.S.A.; it is owned and managed by county government. On the two floors selected for the study there were 140 patients (residents) requiring help with body movements, and there were 57 nursing assistants (NAs) employed at least half-time.

Subjects

Of the 57 NAs, 38 volunteered as subjects; 36 were females and two were males. They ranged in age from 19 to 61 years with a mean of 32.8 years ($sd = 10.8$ years). The average length of employment as an NA was 7.8 years ($sd = 4.7$ years, range 0.5–20 years). Sixty-one percent ($n = 23$) stated they lost no worktime within the past three years due to back problems perceived to be related to work; 16 percent ($n = 6$) missed one to seven days; and 24 Percent ($n = 9$) lost eight days or more.

Perceptual measures

As a preliminary step, the NAs were each asked to list the patient-handling tasks they perceived as most stressful in their patient care duties; 153 were listed. These 153 tasks were then grouped by the investigators into 16 task categories. These are listed in order of frequency of response:

- transferring patient from wheelchair or geriatric chair (chair) to toilet (geriatric chair was similar to a recliner but with four wheels),
- transferring patient from chair to bed,
- transferring patient from toilet to chair,
- transferring patient from bed to chair,
- lifting patient up in bed,
- repositioning patient within bed (e.g., turning from side to side),
- making bed with patient in it,
- transferring patient from bathtub to chair,
- repositioning patient in chair,
- undressing patient,
- transferring patient from chairlift (water pressure lift in shape of chair attached to bathtub) to chair,
- changing the 'attends' worn by patient (diaper-like absorbable pads),
- weighing patient (transferring patient from chair to and from scale chair. The scale chair sat on a weight platform; the platform was 15 cm in height, 51 cm in width and 69 cm in length),
- tying 'supports' (soft gauze-like ties used to secure patient in wheelchair or geriatric chair),
- feeding bed-ridden patient, and
- making bed when patient is not in it.

A ranking and rating form was then prepared with the 16 patient-handling task categories listed on the left; a ranking column was adjacent to the tasks. On the right half of the form, four columns were established so the subjects could enter the amount of perceived exertion they envisioned they would feel in four areas of the body (shoulder, upper back, lower back, and whole body) for each of the 16 patient handling tasks. Therefore, there were 64 spaces for the rating of perceived exertion. Attached to the form was a drawing of a body model depicting the four areas of the body and the rating scale ranging from six which is 'very, very light' to 19 which is 'very, very hard'.

The ranking/rating form was explained to each nursing assistant on an individual basis. The subject was asked to study the 16 tasks on the left side of the paper and then use the ranking column to rank each task according to the stressfulness they envisioned they would feel while performing the task. The *most* stressful task was ranked '1' and the *least* stressful '16'. Then the rating scale and body model were explained and the subject was directed to rate the amount of exertion felt in each of the four body areas while envisioning the performance of each of the 16 patient-handling tasks. The investigators felt the subjects in this study could rate perceived stress without actually carrying out the tasks at the time

because of the frequency with which these nursing assistants performed these tasks. For example, the task of transferring a patient from bed to chair was completed by each nursing assistant an average of nine times a shift and the average number of years these subjects had worked at this job was 7.8 years (range = 0.5 to 20 years).

Biomechanical measures

Video tapes were then taken of these same NAs while performing patient-handling tasks. The video tapes were studied to approximate the body joint angles. These angles were estimated by stopping the tape when the NAs were performing each patient-handling task and viewing the NAs posture through a large plastic protractor. The angles were measured when the NA appeared to be exerting the greatest force. For transfer and reposition tasks this moment was at the beginning of the transfer/reposition. Under normal circumstances this is when the largest compressive force on the L5/S1 disc typically occurs.

Most transfers were performed by two NAs. Thus, an individual NA would only support part of the body weight of the resident. It was not feasible to measure the actual percentage of the resident's weight supported by an individual NA. Since the biomechanical model requires the force applied at the hands as an input, it was estimated that half of the mean body weight of the resident was the magnitude of the force applied at the hands of the NA.

A 3-dimensional static biomechanical model developed by Garg and Chaffin was used (Garg and Chaffin, 1975). Inputs consisted of body joint angles, gross body posture, direction and estimated magnitude of the hand forces, and anthropometric data for average male and female link lengths and link weights. In many places where the transfers took place it was not possible to find a location for the video camera that would provide an ideal side view of the NA and get a full body shot of the NA. Consequently, the angle data used for input to the model was often based on estimates.

Outputs included tensile force on the erector spinae muscles, compressive force and torque moments on the L5/S1 disc, and moments at other joints. The forces and moments at these joints were compared to volitional forces and moments to estimate the percentage of male and female working populations that could be expected to occasionally perform the task without

Table 1

Rank-ordering of patient-handling tasks for stressfulness.

Task	Rank order	Range	Value of rank	
			Mean	*sd*
Transferring patient from toilet to chair	1	1–7	3.2	(1.7)
Transferring patient from chair to toilet	2	1–9	3.4	(1.9)
Transferring patient from chair to bed	3	1–8	3.7	(2.1)
Transferring patient from bed to chair	4	1–9	4.0	(2.0)
Transferring patient from bathtub to chair	5	1–10	5.1	(2.8)
Transferring patient from chairlift to chair	6	2–16	6.2	(3.3)
Weighing patient	7	1–16	7.7	(4.0)
Lifting patient up in bed	8	1–15	7.8	(2.9)
Repositioning patient in bed (e.g. side to side)	9	1–14	8.4	(2.9)
Repositioning patient in chair	10	1–14	9.1	(2.6)
Changing 'attends'	11	1–14	10.2	(2.6)
Making bed with patient in it	12	2–15	11.1	(3.2)
Undressing patient	13	7–15	12.1	(2.1)
Tying 'supports'	14	5–16	13.4	(2.6)
Feeding bed-ridden patient	15	9–16	14.1	(1.7)
Making bed when patient is *not* in it	16	7–16	14.1	(2.1)

Table 2

Amount of exertion felt in four areas of the body while performing patient-handling tasks.

Task [a]	Shoulder			Upper back			Lower back			Whole body		
	Range	Mean	*sd*	Range	Mean	*sd*	Range	Mean	*sd*	Range	Mean	*sd*
1	6–19	12.5	3.2	6–19	13.7	3.0	6–19	14.3	2.7	6–18	12.7	3.1
2	6–18	12.6	3.0	7–19	14.0	2.8	6–19	14.1	2.8	6–18	12.3	2.8
3	6–19	12.7	3.2	6–19	13.8	3.2	7–19	14.2	3.0	6–19	12.2	3.2
4	6–18	11.6	3.0	7–19	13.0	2.9	7–19	14.1	2.9	6–19	11.9	3.0
5	6–17	11.8	3.0	6–17	13.0	3.0	7–19	13.3	2.9	6–19	12.4	3.9
6	6–18	12.0	3.4	7–19	13.2	2.9	6–19	13.4	3.2	7–19	12.3	3.1
7	6–19	13.3	3.9	6–19	13.9	3.2	6–19	13.8	3.9	6–18	12.4	3.6
8	6–19	12.8	3.0	8–18	13.5	2.4	6–19	13.6	3.1	6–16	11.3	2.9
9	6–17	11.9	2.3	8–19	12.7	2.5	6–19	12.9	2.8	6–18	11.7	2.6
10	6–19	12.0	2.8	6–19	12.4	2.8	6–19	12.0	3.1	6–19	11.6	2.8
11	6–14	9.3	2.5	6–18	10.4	3.1	6–19	11.3	3.7	6–19	10.3	3.3
12	6–19	10.8	3.7	6–19	11.2	3.7	6–19	10.9	3.8	6–19	10.9	3.7
13	6–17	10.0	2.8	6–15	9.5	2.7	6–19	10.1	3.2	6–16	9.7	2.7
14	6–15	7.9	2.6	6–19	8.4	3.2	6–19	8.7	3.3	6–17	8.3	3.0
15	6–16	9.3	3.1	6–17	9.3	3.2	6–19	9.7	3.7	6–15	9.2	3.0
16	6–14	8.6	2.0	6–17	8.7	2.4	6–19	9.6	3.0	6–13	8.7	1.9

[a] Tasks are identified using the ranks indicated in table 1.

significantly elevated risk of an overexertion injury.

Results

Perceptual measures

Ranking for stressfulness: Table 1 shows how tasks were ranked by the NAs. Tasks ranked the highest for stress involved those of transferring the patients from one destination to another. The toileting process was ranked as most stressful; this was followed by the tasks of transferring the patient from chair to the bed and from bed to chair.

Rating scale: Table 2 shows how the tasks compared according to the rating scale. No tasks were given an average rating above 14.3 on the rating scale for amount of exertion felt in the shoulder, upper back, lower back, or whole body. For the lower back the greatest amount of exertion was felt while performing the tasks of transferring a patient on and off the toilet and in and out of the chair. For most tasks the lower back had a higher mean exertion score than any of the other body regions. Exceptions were for the upper back which had slightly higher means for weighing a patient, repositioning the patient in bed, and making a bed with the patient in it. The three tasks that received the lowest rankings also received the lowest ratings; these non-transfer tasks were tying 'supports', feeding a bed-ridden patient and making a bed without the patient in it.

Biomechanical data

Several of the tasks which were rated as most stressful by the NAs were then analyzed using the

Table 3

Forces on lower back of NAs when performing various tasks for a 50th percentile patient.

Task	Force (N)	
	Tension in erector spinae	Compression at L5/S1
Patient transfers		
Toilet to chair	4036	4810
Chair to toilet	3048	3676
Chair to bed	4339	4877
Bed to chair	3208	3991
Chairlift to chair	3907	4552
Chair to chairlift	3907	3680
Non-patient transfers		
Reposition in bed	98	107
Reposition in chair	136	196
Change attends	82	97

static biomechanical model. The results indicate the averages from the number of times the tasks were performed by the 38 NAs. Table 3 shows the calculated values for tension on the erector spinae muscles and compressive force on the L5/S1 disc during the part of the task which appeared to impose the largest biomechanical load on the lower back.

The six patient transfer tasks had much greater forces than the three non-patient transfer tasks. Of the six patient transfer tasks, moving the patient from chair to bed involved the largest forces, while the chair to toilet involved the least stress.

Total data

The most back-stressing tasks performed by the NAs may be identified using any of the four methods: subjective rating, subjective ranking, force on the erector spinae, or force at L5/S1. In this investigation the four measures were not in *complete* agreement about which task was most stressful to the NA's lower back.

Table 4 provides a comparison of the rank ordering produced by each of the four methods. Included are the eight tasks for which requisite information was available for each of the four methods. The order for listing the tasks in table 4 is based on the mean of the four ranks.

The rankings determined by each method show a general tendency toward agreement. Spearman correlation coefficients are shown in table 5. Rankings based on the two perceptual methods were quite consistent ($r = 0.95$). The two biomechanical indices produced identical rankings ($r =$ 1.00). Somewhat less consistency was found for rankings produced by perceptual methods compared to the biomechanical methods ($r = 0.83$ and $r = 0.76$). The most notable difference was for the chair to toilet transfer. It ranked 2nd and 3rd according to the perceptual methods; whereas it ranked 5th according to the biomechanical methods.

Table 4

Rank order of task stressfulness using four methods.

Task	Subjective ranking	Rating scale	Back tension	Compression L5/S1
Toilet to chair	1	1	2	2
Chair to bed	3	2	1	1
Chair to toilet	2	3	5	5
Bed to chair	4	3	4	4
Chairlift to chair	5	6	3	3
Reposition in bed	6	6	7	7
Reposition in chair	7	7	6	6
Change attends	8	8	8	8

Table 5

Matrix of Spearman correlation coefficients between four methods for ranking task stressfulness.

Task	Subjective ranking	Rating scale	Back tension	Compression L5/S1
Subjective ranking	1.00			
Rating scale	0.952	1.000		
Back tension	0.762	0.831	1.000	
Compression L5/S1	0.762	0.831	1.000	1.000

Discussion

The ergonomic approach to preventing back injuries among workers in an employment establishment, typically follows logical steps. The first is identification of jobs with the greatest back injury problems, followed by the second step – to determine which tasks within these jobs impose the greatest stress on the backs of workers. This investigation used four methods for determining which tasks impose the greatest stress on the backs of workers.

One limitation to this investigation was that only four methods were tried. There may be many other methods that could be used. Two others deserve some comment. One method would be to ask supervisors for information about specific tasks performed by workers. An approach of this type was used in a study at a large university hospital (Stobbe et al., 1988). Ward supervisors were asked to estimate the frequency of patient lifting performed by nurses on the ward. This was suitable for classifying the nursing jobs on an ordinal scale as involving less frequent or more frequent patient handling. The accuracy of the actual estimated frequencies was not determined, and the method was not used for identifying which tasks are most stressful. Another

approach that might be useful for identifying the most back-stressing tasks is a retrospective analysis of back injury reports. This can be effective in larger establishments with enough back injury cases to permit analysis of patterns, but most injury reports do not provide sufficient information about the task to make this kind of analysis productive. However, these injury report data can be used to direct the investigators to observe the tasks cited in the reports and hence first hand information can be gathered and analyzed for stressfulness.

Each of the four methods included in this study has both advantages and disadvantages. The ranking method appeared relatively simple in concept. However, some of the NAs had difficulty with it. This stemmed from the request to rank based on a 'typical' patient. They tended to think about each task in the context of individual patients. Eventually, after explaining the concept of a typical patient, most of the NAs were able to provide a ranking. It appeared from the results, however, that several NAs did not fully understand, or were unable to distinguish between tasks on the basis of stressfulness on their backs.

The use of rating scale instrument also had pros and cons. Using this instrument the NA had to conceptually consider four elements: the patient-handling task, a typical patient, the part of the body experiencing the stress, and the amount of exertion they envisioned they would feel while carrying out the tasks. Some of the NAs found this to be a difficult exercise, but the difficulty was decreased by having an investigator read through each task with those who needed help. This rating method may not work well if administered in an impersonal manner as is often the case with questionnaires. The rating scale scores correlated well with the other methods for ranking the most back-stressing tasks, and it allowed the NAs to consider different body parts for each task. An additional point to consider is the possibility that the subjects may have rated the tasks differently if they had actually carried out the task at the time of the rating rather than to envision the performance of the task.

The biomechanical methods require detailed studies of every task to determine several body angles, distances, and forces. In nursing homes the rooms tend to be filled with furniture, and bathrooms are small. These features often dictate less than ideal camera placement. As a result the video tape analyst finds it necessary to estimate some of the joint angles in order to obtain values for the required input. Additionally, force at the nurse's hands has to be estimated because of the lack of a practical technique for measuring the percentage of the patient's body weight actually supported by the NA. Thus, accuracy of the input data is crude. With all these difficulties encountered by the research team, it is unreasonable to expect practitioners within a nursing home to be able to obtain accurate data for input to a biomechanical model. Even if they could obtain accurate data, they would need consultation from an expert knowledgeable about biomechanical models in order to understand and interpret the data. Thus, the use of biomechanical models for determining which tasks impose the greatest stress on the backs of NAs is not recommended for routine use in nursing homes. Many other work environments are more amenable to the use of biomechanical models for this purpose.

In conclusion, of the four methods used to identify the most back-stressing tasks performed by NAs in a nursing home, the most practical is the rating scale. It is relatively easy to administer, does not require access to a computerized biomechanical model, and the tasks it identifies as being most stressful to the back are essentially the same tasks identified with the other methods.

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7.34
An ergonomic approach to reducing back stress while carrying out patient handling tasks with a hospitalized patient

B.D. OWEN, K. KEENE, S. OLSON and A. GARG, Wisconsin*

Introduction

Health care workers, especially nursing personnel, are at great risk for occupationally related back problems. Through Worker Compensation claims in the United States, KLEIN, JENSEN and SANDERSON (1984) found nursing personnel were ranked fifth among all occupational groups for back injuries. Those groups surpassing nursing personnel are known to be involved in heavy physical labor activities including frequent lifting (miscellaneous laborers, sanitation workers, warehouse workers and mechanics). Researchers have been successful in reducing back stress and back injury rates through an ergonomic approach within a long term care/nursing home setting [2, 4].

The purpose of this study was to reduce the physical stress for *hospital* personnel while involved in carrying out patient handling tasks and to determine the impact of these ergonomic changes on patient comfort.

Methods

Setting
The experimental and control sites were both 50 bed rural hospitals located in the midwestern part of the United States. Approximately 70 percent of the bed capacity was for medical-surgical patients in both hospitals; the study took place on these medical-surgical units.

Subjects
28 registered nurses and nursing assistants volunteered to be in part I of the study from the experimental site; 24 were involved from the control hospital. They were all female and ranged in age from 21-64 years (experimental) and 20-60 years (control).
In part II of the study, there were 37 volunteers from the experimental site and 20 from the control hospital. All were female and worked on the medical-surgical units of these hospitals.

Instruments
A rating of perceived exertion likert scale was used (0=no exertion, 10=extremely heavy, maximal exertion) to determine the exertion felt to the shoulder/upper back, lower back, and whole body while carrying out a task. A Patient Comfort likert scale was used to deter-

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mine reactions from patients (0=very comfortable, 7=extremely uncomfortable). Injury reports were reviewed to collect injury, lost work day, and restricted or light duty data.

Procedure

Part I. Subjects were asked to delineate their most stressful tasks carried out in a typical day. Sixteen tasks were determined as most stressful from these data. Subjects then ranked each of these 16 patient handling tasks according to the amount of physical stress they felt while carrying out each task. (1=most stressful, 16=least stressful). The tasks were transfers such as in and out of bed, on and off the commode, lifting patients up in bed, and toileting patients in bed. All subjects ranked the tasks twice, once for the patients who could bear weight and also for patients who could not bear weight.

The subjects were also asked to rate the amount of physical exertion they felt to the shoulder/upper back, lower back, and whole body while carrying out each of the 16 patient handling tasks for weight bearing and non-weight bearing patients.

Part II. Ten of the most stressful tasks were selected for study (transferring patients in and out of bed, on and off the commode, on and off a cart/guerney, on and off a cardiac chair, lifting patients up in bed, and toileting patients in bed). Various assistive devices were studied in a laboratory setting with hospital nursing assistants as subjects. Based on the results of the laboratory findings, 6 assistive devices were selected for implementation at the experimental site. These were: the *Medi-Man* lift for transferring non-weight bearing patients in and out of bed and on and off the commode; *Sara* lift and *Posey ergonomic belt* for use with the same above mentioned tasks but with patients who could bear some weight, but needed some assistance; the *Slipp* for the horizontal transfers from bed to cart/guerney and back to bed, cardiac chair to bed and bed to cardiac chair, and lifting patients up in bed; the *Magic Sheet* for lifting patients up in bed; and the *Kimbro Pelvic Lift* for toileting in bed.

Part III. All nursing personnel, including managers, at the experimental site were trained to use the 6 devices. Each staff received 2.5 hours of training. Additional help was available.

The method of transfer for each patient was determined by the head nurses and explicit directions were placed in the patients' chart and at the patients' bedside. After each task, subjects rated perceived exertion and patients rated comfort. The "intervention" at the control site was a one hour inservice on use of body mechanics for transferring patients.

Results

Ranking stressful tasks.

Subjects recorded 16 tasks when asked to delineate the most stressful tasks of a typical day. Each subject then ranked these 16 tasks according to perceived stressfulness; ranking was done using scenarios of weight bearing and non-weight bearing patients. There was general agreement between the experimental and control groups for the following tasks (from most stressful to least stressful): lifting patients from the floor, transferring patients from chair to cart, chair to bed, bed to commode, commode to bed, bed to chair, cardiac chair to bed, assisting to stand up from chair, bed to cart, lifting/holding patient extremities, repositioning from lying to sitting, and toileting in bed. Significant differences were found in the rankings of transferring from cart to bed, bed to cardiac chair, and repositioning patients in bed (experimental site ranked more stressful). The control site subjects ranked lifting patients up in bed as more stressful than the experimental subjects.

Rating of Perceived Exertion (Pre Intervention)
In general, there was agreement between the experimental and control sites for rating of perceived exertion to shoulder/upper back, lower back and whole body while carrying out 12 patient handling tasks. Significant differences were found with lifting/holding the extremities of patients, repositioning patients from lying to sitting, lifting patients up from the floor, and transferring from chair to cart, the control site subjects rated these tasks higher for all body parts.

Rating of Perceived Exertion (Post Intervention)
There were 303 data collection forms completed after carrying out patient handling tasks. Nearly 50% (n=147) involved transferring patients from bed to chair and chair to bed. During data collection, the tasks of transferring patients from cardiac chair to bed and bed to cardiac chair were not performed at the control site. For the remaining 8 tasks, the subjects in the experimental site rated perceived exertion significantly lower than the control site subjects for all body parts. *(Table 1)*. The mean of perceived exertion ranged from .6 to 1.0 for the shoulder by experimental site subjects and from 1.5 to 5.2 for control site nursing personnel. Data from experimental ranged from an average of .4 to .7 for the lower back and 2.0 to 5.0 for control data. The ratings for the whole body were the lowest ($\bar{x}$ = .1 to .7; 1.5 to 4.8). Overall, the task perceived to require the least exertion was transferring the patient from bed to commode; requiring the most was lifting a patient up in bed.

Table 1: Rating of Perceived Exertion for Selected Tasks (Post Intervention)1

Task	Devices	Site	# Observations	Shoulder/Upper Back	Lower Back	Whole Body
Transfer from bed to chair	Mediman Sara Lift Posey Belt	Experimental	59	.6 (.8)*	.5 (.8)*	.3(.8)*
	None	Control	16	3.6 (1.7)	3.8(1.2)	3.2(1.1)
Transfer from chair to bed	Mediman SaraLift Posey Belt	Experimental	53	.9 (1.1)*	.7(1.0)*	.4(.7)*
	None	Control	19	3.7 (1.2)	3.6(1.2)	3.3(1.0)
Transfer from bed to commode	Sara Lift Posey Belt	Experimental	15	.7 (.9)*	.4 (.7)*	.1(.3)*
	None	Control	4	1.5 (1.0)	2.2 (.9)	1.5(1.0)
Transfer from commode to bed	Sara Lift Posey Belt	Experimental	12	.9 (.9)*	.6 (.7)*	.4(.6)*
	None	Control	2	3.0 (.0)	2.0 (.0)	2.5 (.7)
Transfer from cart to bed	Slipp	Experimental	13	.6 (.7)*	.5 (.5)*	.3(.4)*
	Draw Sheet	Control	9	4.6 (1.2)	3.6 (.5)	3.7 (.8)
Transfer from bed to cart	Slipp	Experimental	9	.6 (.6)*	.5 (.8)*	.1(.3)*
	Draw Sheet	Control	10	4.5 (.8)	4.4 (.6)	4.3 (.9)
Lift patient up in bed	Magic Sheet Slipp	Experimental	27	1.0 (1.7)*	.7(1.7)*	.7(1.6)*
	Draw Sheet	Control	30	5.2 (2.4)	5.0(2.3)	4.8(2.2)
Toileting in bed	Kimbro Pelvic Lift	Experimental	12	.6 (.6)*	.7 (.8)*	.4(.6)*
	None	Control	13	3.9 (1.3)	3.3(1.3)	2.9(1.1)

[1] Rating of Perceived Exertion (0 = no exertion, 10 = extremely heavy, maximal exertion)
* Significant at $p < .000$

Patient Comfort

There were 241 patients who responded to feelings of comfort after experiencing a patient handling task. On a scale of 0 (extremely comfortable) to 7 (extremely uncomfortable) the mean for patient comfort at the experimental site ranged from .2 to 1.2; the average was 2.0 to 5.0 for control site patients. All devices with all tasks (experimental site) were very comfortable.

Injury Data

In the 18 months pre intervention, 20 back injuries (lower back and/or upper back/shoulder) were reported on the medical-surgical units of the experimental hospital; all indicated one of the 10 tasks studied to be important to the occurrence of back injury. Also, during these 18 months there were 64 lost work days and 15 restricted or light work days. On the same hospital units and involving the same tasks, the 18 month post intervention investigation showed 12 injuries, 3 lost workdays, and 12 restricted days.

Discussion

The findings of this study reinforce those reported earlier [2, 4]; in these studies the back stress and back injuries were reduced by changing the physical demands of the job. The major strategy was through the introduction of assistive devices. In this study, the stressful tasks were determined by those involved in patient handling and various assistive devices were selected and used. The perceived physical exertion was reduced for all tasks studied. The number of back injuries, lost work and restricted days were decreased. In addition, patients felt more comfortable when assistive devices were used. It is important to gather patient feedback data because BELL [1] and OWEN [3] found nursing personnel were reluctant to use assistive devices because they thought patients would react negatively.

Management support was found to be an important part of success in carrying out this study.

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Reducing back stress to nursing personnel: an ergonomic intervention in a nursing home

A. GARG

Department of Industrial and Systems Engineering, University of Wisconsin–Milwaukee, Milwaukee, WI 53201, USA

B. OWEN

School of Nursing, University of Wisconsin–Madison, Madison, WI 53792, USA

Keywords: Patient transfers; Compressive force; Ratings of perceived exertion; Acceptability rates; Incidence and severity rates.

A prospective epidemiologic study was conducted in two units (140 beds and 57 nursing assistants) of a nursing home to demonstrate the efficacy of an ergonomic intervention strategy to reduce back stress to nursing personnel. The total programme involved the following: determining patient handling tasks perceived to be most stressful by the nursing assistants (NAs); performing an ergonomic evaluation of these tasks; and conducting a laboratory study to select patient transferring devices perceived to produce less physical stress than existing manual patient-handling methods. The intervention phase included training NAs in the use of these devices, modifying toilets and shower rooms, and applying techniques to patient care. Immediately after completing the intervention programme, a post-intervention analysis (which lasted eight months in unit 1 and four months in unit 2) was performed.

A biomechanical evaluation of the physical demands required to perform stressful patient-handling tasks showed that the mean compressive force on the L5/S1 disc, the mean hand force required to make a transfer, and the strength requirements (expressed as percentage female population capable) were 1964 N, 122 N, and 83% after intervention as compared to 4751 N, 312 N, and 41% before intervention. Subjectively, the mean rating of perceived exertion was less than 'very light' after intervention as compared to between 'somewhat hard' and 'hard' before intervention. Overall, the mean acceptability rates for the walking belt and the mechanical hoist were 81% and 87% for patient transfers. The incidence rate for back injuries prior to the intervention, 83 per 200000 work-hours, decreased to 47 per 200000 work-hours after the intervention. There were no injuries resulting in lost or restricted work days during the last four months of the post-intervention. It is concluded that an appropriate ergonomic intervention programme offers great promise in reducing physical stress and risk of low-back pain to nursing personnel. However, large-scale studies in different nursing homes are needed to confirm the above findings.

1. Introduction

Occupational back injuries are a major problem in the USA (Kelsey 1982, Klein *et al.* 1984, NIOSH 1986). Nursing personnel have both high prevalence rates of back pain (Biering-Sorensen 1985, Cust *et al.* 1972, Dehlin *et al.* 1976, Harber *et al.* 1985, Stubbs *et al.* 1983a,b, Videman *et al.* 1984) and high incidence rates of workers' compensation claims for back injuries (Jensen 1987, Klein *et al.* 1984, Personick 1990). The low-back pain experienced by nursing personnel is greater than the published statistics indicate, and nurses perceive back pain as an inevitable part of nursing practice (Owen 1987, Garg *et al.* 1991c).

The back injury problem appears to be greater in nursing homes than in hospitals (Jensen 1987, Personick 1990, Valles-Pankratz 1989). Further, the rate of reported back injuries per 100 workers in nursing homes is rising at an alarming rate (Personick 1990, Valles-Pankratz 1989). Nursing assistant is the dominant occupation of the injured nursing home worker (Personick 1990).

Several studies have concluded that frequent manual lifting and/or transferring of patients are the primary, or at least the most recognized, causal factor for low-back pain among nursing personnel (Bell *et al.* 1979, Dehlin *et al.* 1976, Ferguson 1970, Greenwood 1986, Harber *et al.* 1985, Jensen 1985, 1990b, Owen 1985, 1987, Personick 1990). Also, many nurses believe that of all tasks performed by them, patient-handling activities are most likely to result in low-back pain (Harber *et al.* 1989). Owen and Garg (1989) reported significantly higher ratings of perceived exertion for patient transfers than for non-transfers. Indeed, a few quantification studies have found high levels of biomechanical stress induced by patient lifting and transferring tasks (Carlson 1989, Gagnon *et al.* 1986, Garg *et al.* 1991a,b,c, Stubbs *et al.* 1983, Torma-Krajewski 1986). In addition, high levels of postural stress (standing, stooping, etc.) are also cause of concern (Baty and Stubbs 1987, Garg *et al.* 1991c).

The problem of lifting a patient is not simply one of overcoming a heavy weight (Bell 1984, Carlson 1989), as the patient's weight and physical condition, including size, shape, and deformities along with any physical impairments of lower limb function, balance and co-ordination affect the way the transfer can be carried out. Some patients can be combative, contracted, and/or unco-operative (Carlson 1989). Further, patients are unpredictable and may suddenly resist movement and/or grab the nursing personnel and throw them off-balance during the transfer. Often, optimum body postures cannot be assumed due to space limitations, equipment interference, and unadjustable beds, chairs, and commodes, etc. These realities prevent nursing personnel from always using the ideal body mechanics they have been taught.

1.1. *Back injury prevention approaches*

The most obvious programmes for back injury prevention among nursing personnel tend to focus on proper lifting techniques, body mechanics, and back care (Fletcher 1981, Greenwood, 1986, Hollis and Waddington 1975, Iveson-Iveson 1979, Jensen 1990b, McMillan 1979, Owen 1980, Raistrick 1981, Scholey 1984, Takala and Kukkonen 1987). A commonly-held belief among nurses is that the primary way to avoid back injuries from patient-handling activities is to always apply proper body mechanics (Harber *et al.* 1989). The facts are that some patient-handling tasks are so stressful that back injuries result even when all the proper techniques are used (Garg *et al.* 1990a,b,c, Gagnon *et al.* 1986, Stubbs *et al.* 1983b, Torma-Krajewski 1986) and some patient handling tasks are not amenable to the use of proper body mechanics. Further, there is a lack of consensus on proper lifting techniques (Garg 1990) and experts are not in complete agreement concerning which procedures are best for specific patient transfers (Venning 1988). Often methods acceptable in one health institution are not considered appropriate in others (Standard Association of Australia 1982).

Although, instruction on manual lifting and transferring patients is widely believed to have prophylactic value, there is no scientific evidence that it alone is effective in reducing the frequency or severity of back pain, especially in nursing

practice (Brown 1972, Buckle 1982, Dehlin *et al.* 1976, Snook *et al.* 1978, Stubbs *et al.* 1983b, Wood 1987). Consequently, some experts believe that training in proper body mechanics and patient handling procedures should not be relied upon as the only component of a back injury prevention programme (Buckle 1982, Dehlin *et al.* 1976, Lloyd *et al.* 1987, Owen 1985, Stubbs *et al.* 1983b, Venning 1988, Wood 1987).

An approach to back injury prevention that goes beyond the traditional employee training approach is known as the ergonomics approach. Instead of focusing on the behaviour of people, ergonomics approach seeks to design work so the physical and mental demands of the tasks are within the capabilities of the workers.

Many researchers have recommended an ergonomic approach for reducing stress on the spine in jobs requiring manual lifting (Bell 1984, Brown 1972, Buckle 1982, Dehlin *et al.* 1976, Garg *et al.* 1991a,b,c, Harber *et al.* 1985, Jensen 1990b, Lloyd *et al.* 1987, Owen 1987, Snook *et al.* 1978, Stubbs *et al.* 1983b, 1986, Videman *et al.* 1984). It has been suggested that application of an ergonomics approach to patient-care jobs could lead to safer and more efficient methods of handling patients which will reduce the present level of low-back stress for nursing personnel (Lloyd *et al.* 1987, Stubbs *et al.* 1983b). This investigation was undertaken to determine if an ergonomics approach applied to a nursing home would be effective.

2. Measuring effectiveness of ergonomic intervention

2.1. *Incidence of low-back pain*

The most obvious and traditional measures of safety performance are the frequency and severity rates of lost time injuries. For measuring the effectiveness of the ergonomic intervention programme, these measures are less than ideal because numerous factors can affect the reporting of injuries and the duration of disability.

2.2. *Intervention acceptability*

When a group of workers are asked to change their established routines, a reluctance to change is often encountered. Their refusal to adopt a work procedure could reflect an unanticipated problem with the recommendation. Thus, in intervention trials it is useful to measure the extent to which workers accept the recommendation.

2.3. *Biomechanical stresses*

The biomechanics of lifting and handling loads provides one basis as to why certain musculoskeletal injuries and, in particular low-back injuries, develop. Two different biomechanical considerations must be met to achieve 'safe levels' for manual materials handling: stress to the low-back should be within the 'safe limit' and the job physical requirements should not exceed workers' strength. Regarding stress to the low back, compressive force is the most widely accepted response measure.

2.4. *Ratings of perceived exertion*

Another measure of the effectiveness of an ergonomic intervention programme is feedback from the workers. Assessing postural discomfort and levels of perceived exertion have been shown as effective methods for identifying and prioritizing musculoskeletal stresses (Corlett and Bishop 1976, Garg and Banaag 1988). In this regard by far the most frequently used scale for determining perceived stresses during physical work is the Rating of Perceived Exertion Scale (RPE Scale) developed by Borg (1962).

In the current study, in addition to objective measures (reportable injuries,

acceptability rates. and biomechanical measures of task demands). it was considered highly desirable to obtain feedback from the nursing assistants to determine if they felt a change in task demands. It is believed that since nursing assistants perform the majority of patient transfers. they are the ones who are being subjected to various kinds of physical stresses and can thus integrate these stresses into a single meaningful response variable.

3. Method

3.1. *Setting*

The study took place in a nursing care facility located in Southeastern Wisconsin: it is owned and managed by county government. Two floors (units) of the facility were selected for the study because many of the 140 patients on these two units required frequent help with patient care activities. They were, in general. mentally incompetent (Alzheimer's disease) and unpredictable: had major health problems (strokes, diabetes or Parkinson's disease); were unable to follow directions; were physically dependent; were spastic and rigid (with contracted joints); and were resistive or combative (grabbing, pinching, hitting, and biting). Their body weight ranged from 38 to 120 kg (X=62 kg). The above characteristics were more prevalent in unit 1 than in unit 2. except major health problems were more prevalent in unit 2. On unit 1. 20% of the patients were independent. 40% required use of a walking belt, and 40% needed a hoist for transfer: on unit 2. 40% were independent. 30% needed a belt. and 30% required a hoist for transfer.

There were four wings on each unit with about 18 patients on each of the wings. Two to three nursing assistants were assigned to each wing during the day and evening shifts.

3.2. *Subjects*

When the pre-intervention observation phase was initiated, 38 of the 57 nursing assistants (NAs) employed at least half-time had volunteered as subjects. All 57 NAs employed on the two units participated during the intervention and post-intervention phases of the study. Ninety-five per cent were females and 5% were males. The mean age, body weight, and length of employment were 33 years (range=19–61 years). 64 kg (range=45–106 kg), and five years (range=0·5–20 years). respectively. When asked about lifetime experience. 75% had suffered from low-back pain and 51% had visited a health care provider for this pain. Sixty-five per cent stated that they lost no work time within the last three years due to back pain perceived to be related to work; 10% lost one to seven days: and 25% lost eight days or more.

3.3. *Procedure*

The study took about four years and was divided into the following phases:

(1) the determination of patient-handling tasks perceived to be most stressful by the NAs (Owen and Garg 1989);
(2) an ergonomic evaluation of the work performed by NA: prior to the introduction of change (Carlson 1989);
(3) a pilot study to identify and locate assistive devices. to establish criteria for their selection. and to perform preliminary trials of these devices (Owen and Garg 1990);

Figure 1. Mechanical hoist used in the study.

(4) a laboratory study to select patient-handling devices that were less stressful than existing methods in the nursing home (Garg *et al.* 1990a.b);
(5) the introduction of selected devices in the nursing home and training of NAs in their use with patients (intervention);
(6) post-intervention measurement of back injury incidence and severity rates, acceptability rates, biomechanical task demands, and perceived level of physical stress.

Details of the pre-intervention phase are given in various references as indicated above. The following is a brief description of the pre-intervention phase to provide continuity with this report on the intervention and post-intervention phases.

Patient-handling tasks perceived as most stressful by the NAs were ranked according to stressfulness and then rated for perceived exertion for shoulder, upper back, lower back, and whole body. Based on these rankings and ratings, the following tasks were selected for intervention: transferring patients from bed to wheelchair and wheelchair to bed, from wheelchair to toilet and toilet to wheelchair, from wheelchair to chairlift and chairlift to wheelchair, into and out of the bathtub, and weighing patients. An ergonomic evaluation was performed to determine such data as patient and NA characteristics; details of each task; method used for transfer; frequency of occurrence for each task; number and degree of trunk flexion, lateral flexion, and axial rotation per transfer; workplace layout, etc. The most frequently used technique for transferring patients was a two-person manual lifting method. The NAs grasped the patient under the axillae and then lifted and carried the patient to the destination.

Patient transfer were simulated in a laboratory using the existing manual lifting method, four different manual pulling methods using slings and belts, and three different mechanical hoists. Eight criteria were used to select devices for intervention

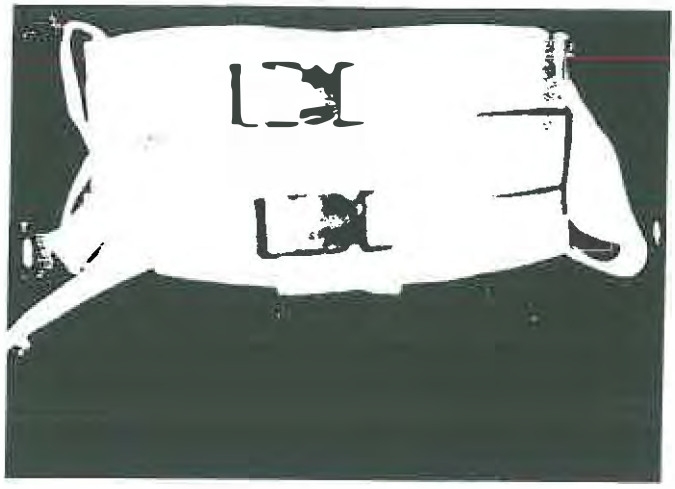

Figure 2. Walking belt with handles used in the study.

Figure 3. Shower chair with removable foot pedals and arm supports used in the study.

(Owen and Garg 1990). These were compressive force on the L5/S1 disc; strength requirements (% capable females); perceived stress ratings; patient comfort ratings; patient security ratings; applicability of a method to different types of patients; overall method preferences of nurses; and transfer time. Based on these criteria, a hoist (figure 1), a walking belt with handles (figure 2), and a shower chair (figure 3) with removable foot pedals and arm supports were selected for inclusion in the

intervention programme. The walking belt utilized gentle rocking and pulling action rather than lifting the patient.

3.4. *Intervention*

Patients were classified into three categories based on their physical ability: dependent. weight-bearing; dependent. non-weight-bearing: and independent. A two-person walking belt (modified by the manufacturer for easy fastening per suggestions of authors) was recommended for transferring dependent. weight-bearing patients with body weights of less than 70 kg. A hoist was recommended for dependent. non-weight-bearing, or heavy patients. Each dependent patient's bed was marked with a blue or red dot to indicate whether a belt or hoist should be used for that patient. Each dependent. weight-bearing patient was provided with an appropriate sized walking belt (small. medium. or large) with the patient's name written on it. Each wing of the two units of the nursing home involved in the study was provided with a hoist (and slings of various sizes) and a shower chair. One hoist had a weighing scale attached to it. In addition. one unit was provided with a ramp-type weighing scale. A separate frame and a sling (modified by the manufacturer per suggestions of authors) were provided for lifting patients from floor level. Commodes in patients' bathrooms were raised to about wheelchair height. Toilet hand rails were adjusted so that the shower chair could fit over the toilet. Adaptive clothing (trousers and dresses) were provided for those patients who were to be toileted using the hoist. Showers in the two units were repaired for water temperature control and were modified to allow easy pushing and pulling of the shower chair into and out of the shower. The head nurses in both units made determinations as to which patients were to be given a bath and which patients were to use the shower.

Hoists. walking belts and shower chairs were first introduced in unit 1. Five months later. after the research team and the nursing home management were satisfied with the devices chosen and after no major problems were encountered with their use. the devices were introduced in unit 2.

The supervisors. the head nurses. the nurses and the NAs were trained by the authors in the use of the hoist. walking belt. and shower chair in groups of four to eight in an empty patient room or in the nursing home (in-service) laboratory with the participants serving both as nursing assistants and passive patients. Fifty-four of the 57 NAs (95%) attended at least two training sessions of 2 h each. First they were trained in the use of the walking belt. followed by the hoist and the shower chair. A given patient transfer task was explained to them. a videotape of the transfer was shown. and then the NAs practised each patient transfer until they felt comfortable with it. and were competent with the task as observed by the authors before moving to the next transfer task. The participants were encouraged to ask questions and give feedback during the training sessions. They were corrected when using the method incorrectly. These training sessions lasted for two to three weeks per unit due to scheduling problems.

Training of NAs on units 1 and 2 differed in relation to room location. the time lapse between training and application. and the addition of a third trainer. On unit 1. training occurred in an in-service education room in an adjacent building and there was a two-week delay between end of training and the application on the patient unit because the custom-made walking belts were late in arriving. On unit 2. the supervisor (trained by the authors) worked with the authors in the training programme. In addition. on unit 2 the training took place in an empty patient room

within the patient case area (rather than in the in-service room) and there was no delay between the time when the NA was judged as competent to apply the techniques to the time when he/she actually applied them to the patients. The strategies used in the actual teaching, the time involved, the written take-home materials, the teaching plans, and methods of evaluation were the same for each unit. The two authors were involved in each step of the training on each unit.

When using the walking belt, the NAs stood facing the patient (as close as possible) with feet apart, one foot placed facing the patient and the other foot in the direction of movement to avoid twisting of the spine while transferring. They were instructed to flex their knees and keep their backs straight (if possible) and to grasp the handle of the walking belt with one hand. In synchronization, using a gentle rocking motion to utilize momentum, the NAs *pulled* the patient toward themselves, shifted their weight to the foot facing the direction of the move, pivoted to avoid twisting, and transferred the patient. The NAs were instructed, 'Pull with your hands and not your back. Do not lift.' When using the hoist, special emphasis was placed on properly applying the sling under the thighs of the patient while keeping the front hook away from the patient and also on being aware of patient safety.

After the NAs felt comfortable with these transfer devices, and were judged to be competent by the authors, they were allowed to use them to transfer patients in their units. For about four weeks, both authors and one of the nursing supervisors frequently worked with the NAs to train them further on proper use of these devices, to answer questions, and to solve unforeseen problems. The head nurses in the two units had the responsibility for training new NAs (5% of total number), for coding new patients, and for equipment maintenance.

3.5. *Post-intervention*

Two independent nurse observers (research assistants) randomly observed the NAs performing routine patient transfers to determine acceptability rates for the walking belt and the hoist. Data collection forms were used to record the unit number, the nature of the transfer task (for example, bed to wheelchair), device used if any, patient code (independent, weight-bearing, non-weight-bearing), number of NAs involved in the transfer, and occasionally to record the amount of time it took for the transfer. Ratings of perceived exertion data were collected after completion of a transfer by asking the NAs to enter the level of exertion felt in four areas of the body (shoulder, upper back, lower back, and whole body). The Borg RPE scale (Borg 1962) was attached to the form as well as a body model depicting the four areas of the body. These data were collected over a period of eight months in unit 1 and four months in unit 2.

At the end of the study, the nursing home's Accident Investigative Report forms and OSHA 200 forms were reviewed to collect injury data for a period of approximately four years prior to the intervention programme: 1986 to 1988 plus the first six months of 1989 for unit 1 and 1986 to 1989 (with the exception of two training months in 1989, July and December) for unit 2. Data were also collected for periods of eight months and four months following intervention in units 1 and 2, respectively.

Task demands before and after intervention were determined from laboratory simulation of the old and the new methods of patient transfer. A three-dimensional, static biomechanical model (Garg and Chaffin 1975) was used to estimate the task demand variables, compressive forces on the L5/S1 disc and strength requirements.

Table 1. Acceptability rates for walking belt for handling dependent, weight-bearing patients.

Task	Acceptability rate (%) Unit 1	Unit 2	Combined
1. Bed to wheelchair (89*,51)	90	82	87
2. Wheelchair to bed (77,45)	94	96	95
3. Wheelchair to toilet (67,36)	78	61	72
4. Toilet to wheelchair (69,48)	81	56	71
5. Wheelchair to chairlift (18,2)	83	50	80
6. Chairlift to wheelchair (15,5)	93	40	80
7. Wheelchair to shower chair (6,4)	100	50	80
8. Shower chair to wheelchair (7,3)	100	67	90
9. Changing attends (25,8)	64	62	64
10. Repositioning in chair (78,28)	41	46	42
11. Repositioning on toilet (18,2)	87	50	80
12. Walk patients (14,0)	86	—	86

* Number of observations in units 1 and 2, respectively.

Task performance times were measured by the nurse observers both before and after the intervention.

4. Results

4.1. *Acceptability rate*

Acceptability rates for the walking belt for different patient handling tasks are summarized in table 1. The task-specific acceptability rates listed in table 1 were computed as follows:

$$\text{Acceptability rate for task belt} = \frac{\text{Number of dependent, weight-bearing patient handlings performed with walking belt for the task}}{\text{Total number of dependent, weight-bearing patient handlings performed for the task}} \times 100$$

Similarly, task-specific acceptability rates were determined for the hoist for handling dependent, non-weight-bearing patients. These are listed in table 2. In general, the acceptability rates for the walking belt were somewhat higher in unit 1 than in unit 2 (table 1). On the other hand, acceptability rates for the hoist were somewhat higher in unit 2 than in unit 1 (table 2). Acceptability rates for both the devices were higher for patient transfers than for non-transfers (such as repositioning in chair, in bed and on toilet, and changing attends [adult absorbent pads]) (tables 1 and 2). For patient-transferring tasks, the combined acceptability rate from the two units ranged from 71% to 95% for the walking belt (table 1), and 50% to 100% for the hoist (table 2). For non-transfers, the combined acceptability rate from the two units ranged from 42% to 86% for the walking belt, and 33% to 72% for the hoist (tables 1 and 2).

It was observed that some dependent, non-weight-bearing patients were transferred using a walking belt instead of the hoist due to a change in physical and mental abilities of these patients from day to day and from morning to evening.

Table 2. Acceptability rates for the hoist for handling dependent, non-weight-bearing patients.

Task	Acceptability rate (%) Unit 1	Unit 2	Combined
1. Bed to wheelchair (52*,67)	79	92	87
2. Wheelchair to bed (70,53)	89	94	91
3. Wheelchair to toilet (16,24)	56	92	77
4. Toilet to wheelchair (19,24)	47	96	74
5. Wheelchair to chairlift (2,6)	50	67	62
6. Chairlift to wheelchair (12,2)	50	50	50
7. Wheelchair to shower chair (2,8)	50	100	90
8. Shower chair to wheelchair (2,12)	100	100	100
9. Bed to shower chair (0,10)	—	100	100
10. Shower chair to bed (0,4)	—	100	100
11. Bed to toilet (0,18)	—	100	100
12. Toilet to bed (0,6)	—	100	100
13. Bed or wheelchair to bathtub (0,6)	—	100	100
14. Bathtub to bed or wheelchair (0,5)	—	100	100
15. Floor to bed (1,0)	100	—	100
16. Weighing patients (7,0)	100	—	100
17. Changing attends (15,3)	80	33	72
18. Repositioning in wheelchair (24,14)	25	29	26
19. Repositioning on toilet (2,1)	50	0	33
20. Repositioning in bed (6,2)	50	100	62

* Number of observations in units 1 and 2, respectively.

Table 3. Acceptability rates from two units for combined the hoist and walking belt for handling dependent, non-weight-bearing patients.

Task	Acceptability rate (%)
1. Bed to wheelchair (119*)	94
2. Wheelchair to bed (123)	96
3. Wheelchair to toilet (40)	87
4. Toilet to wheelchair (43)	98
5. Wheelchair to chairlift (8)	87
6. Chairlift to wheelchair (14)	86
7. Wheelchair to shower chair (10)	100
8. Shower chair to wheelchair (14)	100
9. Bed to shower chair (10)	100
10. Shower chair to bed (4)	100
11. Bed to toilet (18)	100
12. Toilet to bed (6)	100
13. Bed or wheelchair to bathtub (6)	100
14. Bathtub to bed or wheelchair (5)	100
15. Floor to bed (1)	100
16. Weighing patients (7)	100
17. Changing attends (18)	72
18. Repositioning in wheelchair (38)	31
19. Repositioning on toilet (3)	33
20. Repositioning in bed (8)	62

* Total number of observations from two units.

Table 4. Overall acceptability rates.

1. Belt for dependent. weight-bearing patients		
	Transfers	$(n=522)=81{\cdot}2\%$
	Non-transfers	$(n=163)=52{\cdot}8\%$
2. Hoist for dependent. non-weight-bearing		
	Transfers	$(n=413)=86{\cdot}9\%$
	Non-transfers	$(n=69)=42{\cdot}0\%$
3. Hoist or belt for dependent. non-weight-bearing patients		
	Transfers	$(n=413)=95{\cdot}9\%$
	Non-transfers	$(n=69)=47{\cdot}8\%$

Table 3 gives acceptability rates from the two units for combined hoist and walking belt for handling dependent. non-weight-bearing patients. i.e.. a patient handling task performed using either the hoist or a walking belt is included in the numerator for determining acceptability rates. As expected these acceptability rates were somewhat higher than those given in table 2. in particular for the first seven patient transfers. The acceptability rates for combined hoist and walking belt for handling dependent. non-weight-bearing patients ranged from 86% to 100% for transfers (tasks 1 to 16) and 31% to 72% for non-transfers (tasks 17 to 20. table 3).

The mean acceptability rates for walking belt and hoist computed by averaging over various patient handling tasks are summarized in table 4. The mean acceptability rate for these devices ranged from 81·2% to 95·9% for patient transfers. and from 42·0% to 52·8% for non-transfers (table 4).

4.2. *RPEs*

An analysis of variance showed that RPE scores were significantly affected by the unit. the 18 patient-handling tasks. the two devices and the four body parts ($p \leq 0{\cdot}01$) (table 5). In general. the RPEs were somewhat higher for unit 2 than for unit 1 (table 6). However. the differences between the two units were of no practical significance. Overall. lower back was the body part most stressed both for the walking belt and the hoist (table 6). Ratings of perceived exertion for the whole body were a little higher than those for shoulder and upper back (table 6). Neither device was perceived to produce significant stresses on any of the four body parts. The mean lower-backs RPEs of 9·0 and 8·0 for the walking belt and the hoist corresponded to 'very light' and between 'very. very light' and 'very light' on the Borg scale.

Table 5. Analysis of variance of ratings of perceived exertion.

Source	S.S.	df	M.S.	*F*-ratio
Unit	163·6	1	163·6	22·1**
Task	993·6	17	58·4	7·9**
Device	842·6	1	842·6	113·9**
Bodypart	140·5	3	46·8	6·3**
Within	24082	3261	7·4	

** Significant at $p \leq 0{\cdot}01$.

Table 6. Overall ratings of perceived exertion for transferring patients with walking belt and hoist.

Unit	Device	Number of observations	Ratings of perceived exertion: Shoulder	Lower back	Upper back	Whole body
1	Walking belt	313	8·4 ± 3·0 (6–20)	8·8 ± 3·5 (6–20)	8·3 ± 3·1 (6–20)	8·6 ± 3·2 (6–20)
	Hoist	99	7·2 ± 1·8 (6–15)	7·6 ± 2·3 (6–15)	7·2 ± 1·8 (6–14)	7·3 ± 1·8 (6–15)
2	Walking belt	129	8·8 ± 2·8 (6–19)	9·6 ± 3·2 (6–20)	8·8 ± 2·8 (6–19)	9·2 ± 2·8 (6–19)
	Hoist	280	7·7 ± 2·3 (6–18)	8·1 ± 2·7 (6–19)	7·6 ± 2·1 (6–15)	7·0 ± 2·4 (6–18)
Combined units	Walking belt	442	8·5 ± 2·9 (6–20)	9·0 ± 3·4 (6–20)	8·5 ± 3·0 (6–20)	8·8 ± 3·1 (6–20)
	Hoist	379	7·6 ± 2·2 (6–18)	8·0 ± 2·6 (6–19)	7·5 ± 2·1 (6–15)	7·7 ± 2·6 (6–18)

Table 7. Combined ratings of perceived exertion from two units for transferring dependent, weight-bearing patients using walking belt.

Task	Number of observations	Ratings of perceived exertion: Shoulder	Lower back	Upper back	Whole body
1. Bed to wheelchair	129	7·9 ± 2·4 (6–20)	8·6 ± 3·2 (6–20)	8·0 ± 2·8 (6–20)	8·2 ± 2·6 (6–20)
2. Wheelchair to bed	66	8·4 ± 2·3 (6–13)	9·3 ± 3·5 (6–20)	8·7 ± 2·5 (6–15)	9·1 ± 2·9 (6–15)
3. Wheelchair to toilet	93	9·2 ± 3·5 (6–20)	9·5 ± 3·8 (6–20)	8·8 ± 3·5 (6–20)	9·3 ± 3·7 (6–20)
4. Toilet to wheelchair	106	8·3 ± 2·7 (6–17)	8·8 ± 3·2 (6–20)	8·1 ± 2·7 (6–17)	8·6 ± 2·8 (6–17)
5. Wheelchair to chairlift	10	9·4 ± 2·8 (6–15)	9·7 ± 2·9 (6–15)	9·0 ± 2·3 (6–12)	9·9 ± 2·9 (6–15)
6. Chairlift to wheelchair	16	9·4 ± 3·6 (6–19)	9·5 ± 2·7 (6–15)	9·2 ± 3·3 (6–15)	9·1 ± 2·1 (6–13)
7. Wheelchair to shower chair	3	6·0 ± 0 (6–6)	6·0 ± 0 (6–6)	7·0 ± 1·7 (6–9)	6·0 ± 0 (6–6)
8. Shower chair to wheelchair	4	8·5 ± 2·6 (6–12)	8·7 ± 3·1 (6–13)	9·2 ± 4·0 (6–15)	9·2 ± 2·9 (6–13)
9. Changing attends	15	10·7 ± 4·7 (6–17)	10·7 ± 5·0 (6–18)	11·0 ± 5·1 (6–18)	11·2 ± 5·5 (6–20)

Ratings of perceived exertion for different patient handling tasks performed using walking belt and the hoist are summarized in tables 7 and 8, respectively. An examination of table 7 shows that none of the patient handling tasks performed using walking belt was perceived to produce RPE scores over 12 on any of the four body parts. Surprisingly, the highest RPEs were for changing attends, a non-transfer task, probably due to the amount of static effort involved for this task. Even the highest RPEs of about 11 for this task correspond to 'fairly light' effort on the Borg scale. Similarly, none of the patient handling tasks performed using the hoist produced

Table 8. Combined ratings of perceived exertion from two units for transferring dependent, non-weight-bearing patients using the hoist.

Task	Number of observations	Ratings of perceived exertion			
		Shoulder	Lower back	Upper back	Whole body
1. Bed to wheelchair	102	7·7±2·0 (6–15)	8·2±2·5 (6–18)	7·5±1·8 (6–13)	7·8±2·0 (6–11)
2. Wheelchair to bed	94	7·2±1·9 (6–15)	7·6±2·3 (6–15)	7·2±1·8 (6–14)	7·5±2·0 (6–15)
3. Wheelchair to toilet	29	7·1±1·4 (6–10)	7·2±1·9 (6–14)	7·2±2·1 (6–15)	7·2±1·7 (6–13)
4. Toilet to wheelchair	35	8·3±2·8 (6–17)	8·6±3·2 (6–19)	8·3±2·9 (6–15)	8·5±3·0 (6–16)
5. Wheelchair to chairlift	5	7·0±1·7 (6–10)	6·0±0 (6–6)	7·0±1·7 (6–10)	7·0±1·7 (6–10)
6. Chairlift to wheelchair	2	8·5±3·5 (6–11)	6·0±0 (6–6)	6·0±0 (6–6)	6·5±0·7 (6–7)
7. Wheelchair to shower chair	6	7·7±2·0 (6–10)	7·7±2·0 (6–10)	7·0±1·7 (6–10)	7·2±1·2 (6–10)
8. Shower chair to wheelchair	20	7·5±2·3 (6–16)	7·6±2·4 (6–16)	7·1±1·4 (6–11)	7·7±2·3 (6–15)
9. Bed to shower chair	17	7·2±1·3 (6–10)	6·9±1·2 (6–10)	7·2±1·3 (6–10)	7·2±1·2 (6–10)
10. Shower chair to bed	3	12·0±5·2 (6–15)	12·7±5·9 (6–17)	12·0±5·2 (6–15)	12·7±5·9 (6–17)
11. Bed to toilet	22	8·3±2·4 (6–13)	9·1±3·1 (6–16)	8·8±2·7 (6–15)	8·9±3·0 (6–18)
12. Toilet to bed	6	6·3±0·8 (6–8)	6·3±0·8 (6–8)	7·3±2·4 (6–12)	6·3±0·8 (6–8)
13. Wheelchair to bathtub	5	11·4±3·6 (7–15)	14·0±2·0 (11–16)	8·4±1·9 (7–11)	9·6±3·8 (6–15)
14. Bathtub to wheelchair	5	7·0±1·7 (6–10)	10·0±4·1 (6–15)	6·2±0·4 (6–7)	7·0±1·7 (6–10)
15. Floor to bed	3	12·7±4·6 (10–18)	10·0±0 (10–10)	10·0±0 (10–10)	10·0±0 (10–10)
16. Weighing patients	7	6·1±0·4 (6–7)	6·3±0·5 (6–7)	6·1±0·4 (6–7)	6·3±0·5 (6–7)
17. Changing attends	14	7·0±1·4 (6–10)	7·1±1·7 (6–11)	7·0±1·4 (6–10)	7·3±2·0 (6–7)
18. Repositioning in chair	4	6·7±1·0 (6–8)	6·5±1·0 (6–8)	7·0±1·4 (6–9)	6·7±1·0 (6–8)

significant stresses except wheelchair to bathtub and shower chair to bed transfers (table 8). The wheelchair to bathtub transfer resulted in a mean rating of 14 (between 'somewhat hard' and 'hard') for the lower back. The nursing assistants had to manually lift the patient in the hoist to raise patient's buttocks to clear the top of the bathtub. Later, this problem was solved by using the short loop of the sling in place of the long loop. There is no clear explanation for the higher RPEs given for shower chair to bed transfers. However, a sample size of 3 for this transfer is relatively small.

Table 9 compares the RPEs for the lower back from the pre- and post-intervention phases of this study for those tasks common during the two phases of the study. The two-sample *t*-tests with unknown population variances (Miller and Freund 1977) was used to test whether the post-intervention RPEs for the walking

Table 9. Comparison of ratings of perceived exertion for lower back from pre- and post-intervention phases for selected tasks.

Task	Ratings of perceived exertion		
	Pre-intervention (Manual lifting)	Post-intervention Walking belt	Hoist
Bed to wheelchair	14·1	8·6**	8·2**
Wheelchair to bed	14·2	9·3**	7·6**
Wheelchair to toilet	14·1	9·5**	7·2**
Toilet to wheelchair	14·3	8·8**	8·6**
Chairlift to wheelchair	13·4	9·5**	6·0**
Weighing patients	13·8	—	6·3**
Bathtub to wheelchair	13·3	—	10·1*
Repositioning in wheelchair	12·0	—	6·5**
Changing attends in wheelchair	11·3	10·7	7·1**

*significant at $p \leq 0{\cdot}05$.
**significant at $p \leq 0{\cdot}01$.

Table 10. Summary of biomechanical evaluation of transferring patients using manual lifting and walking belt techniques.

Variable	Pre-intervention (Manual lifting)	Post-intervention (Walking belt)
Hand force (N)	312 ± 54 (263–392)	122 ± 16 (98–156)
Percent capable population (%)	41 ± 8 (14–61)	83 ± 9 (69–98)
Compressive force on L5/S1 disc (N)	4751 ± 106 (3693–5414)	1964 ± 71 (1517–2413)

belt and the hoist were significantly lower ($p \leq 0{\cdot}01$) than the pre-intervention RPEs. All post-intervention RPEs were significantly lower except for the task of changing attends in a wheelchair using a walking belt. In general, the mean RPEs were about 14 (between 'somewhat hard' and 'hard') before intervention and 9 ('very light' for walking belt) and 8 (between 'very, very light' and 'very light' for the hoist) after intervention (table 9). Similar trends were found for other body parts.

4.3. *Biomechanical evaluation*

Task demand data for the before and after intervention phases are summarized in table 10. Separate analyses of variance showed that hand force and compressive force were significantly lower and percentage females capable significantly higher ($p \leq 0{\cdot}01$) after intervention as compared to before intervention (Garg *et al.* 1990b). The mean force required to pull the patient after intervention was 39% of the force required to lift the patient before intervention. Based on static strength simulations (Garg and Chaffin 1975), it is estimated that on the average 83% of female workers were capable of pulling patients with the walking belt as compared to 41% with the manual lifting technique used before intervention. The estimated mean compressive force on the L5/S1 disc after intervention (walking belt) was 41% of that before intervention (manual lifting method).

Table 11. Incidence and severity rates for injuries from two units of the nursing home.

Incidence and severity rates	Pre- or post-intervention	Unit 1 Back	Unit 1 Total	Unit 2 Back	Unit 2 Total	Combined Back	Combined Total
Number of injuries per 200000 work-hours	Pre-intervention in both units	81	108	85	120	83	114
	Post-intervention in unit 1	62	103	139	193	—	—
	Post-intervention in both units	31	83	64	86	47	84
Number of lost and restricted work-days per 200000 work-hours	Pre-intervention in both units	765	895	498	674	634	786
	Post-intervention in unit 1	952	952	1596	1596	—	—
	Post-intervention in both units	0	0	0	0	0	0

4.4. *Injury statistics*

Incidence and severity rates per 200000 work-hours for back injuries and total injuries are summarized in table 11. These rates were calculated for each unit and the three comparable periods: pre-intervention phase (1 January 1986 to 30 June 1989); post-intervention in unit 1 and pre-intervention in unit 2 phase (1 August 1989 to 30 November 1989); and post-intervention phase in both units (1 January 1990 to 30 April 1990). In the subsequent discussion, these are referred to as pre-intervention phase, post-intervention phase I and post-intervention phase II. The two months, July and December 1989, were omitted because these were the months when training was being given in units 1 and 2, respectively. In the respective units these months were not clearly pre-intervention or post-intervention.

In unit 1, the incidence rate for back injuries decreased during each of the two post-intervention phases (table 11). The incidence rate for back injuries decreased by 23% and 62% during post-intervention phases I and II, respectively. In unit 2, the highest incidence rate for back injuries occurred during phase I of the post-intervention (table 11). After intervention, the incidence rate for back injuries decreased by 25% from the pre-intervention phase. Based on combined data from the two units, the incidence rate for back injuries was 43% lower during the post-intervention phase II as compared to pre-intervention phase. The incidence rates for total injuries (including all injuries such as those to lower limbs, upper limbs, trunk, back, hernia, etc.) followed the similar patterns as those for back injuries (table 11). In unit 1, the incidence rate for total injuries decreased by 5% and 23% during the post-intervention phases I and II, respectively. In unit 2, the incidence rate for total injuries increased by 61% during the post-intervention phase I and then decreased by 28% during the post-intervention phase II as compared to pre-intervention phase.

Regarding severity of injury, the number of days lost plus restricted per 200000 work-hours (severity rates) increased during post-intervention phase I in both units and for both back as well as total injuries (table 11). This increase was much higher in unit 2 than in unit 1. In unit 1, the increase was 24% and 6% for back injuries and total injuries, respectively. In unit 2, the severity rates for back injuries and total injuries increased by 220% and 137%. During post-intervention phase II, the severity

Table 12. Summary of task performance times after intervention.

Task	Performance time(s) Walking belt	Hoist
1. Bed to wheelchair (32.36)	20 ± 16 (4–60)	69 ± 33 (30–185)
2. Wheelchair to bed (16.31)	19 ± 23 (4–90)	76 ± 38 (10–205)
3. Wheelchair to toilet (24.16)	22 ± 16 (5–58)	92 ± 44 (10–180)
4. Toilet to wheelchair (29.11)	39 ± 30 (4–125)	48 ± 16 (35–70)
5. Wheelchair to shower chair (0.5)	—	71 ± 18 (45–95)
6. Shower chair to wheelchair (0.9)	—	62 ± 26 (45–120)
7. Bed to shower chair (0.9)	—	80 ± 24 (55–116)
8. Shower chair to bed (0.3)	—	58 ± 7 (50–65)
9. Bed to toilet (0.12)	—	90 ± 37 (50–185)
10. Toilet to bed (0.3)	—	73 ± 23 (60–100)

rates in both the units were zero for both back injuries and total injuries. i.e., there was not a single day lost or restricted either due to a back injury or any other injury in either of the two units. The overall back injury severity rate for post-intervention (based on lost plus restricted work days during post-intervention phases I and II from unit 1 and during post-intervention phase II from unit 2) was 317 as compared to 634 before intervention.

There were a total of 15 back injuries and 26 total injuries after intervention (post-intervention phases I and II for unit 1 and post-intervention phase II for unit 2). None of the 26 injuries occurred when the hoist was used. Five injuries (19%) occurred when the walking belt was used for patient transfer. The remaining 21 injuries (81%) occurred during the performance of such tasks as pushing tables together, manually transferring a patient from a wheelchair to examination table in a physician's office or to a cart, grabbing a falling patient, manually lifting a patient from floor level, transferring a patient from a geriatric chair to wheelchair using a gait belt (not the walking belt), and turning a patient in the bed.

A year by year analysis of pre-intervention back injury data showed no consistent pattern in the two units. The pre-intervention incidence rates for back injuries for 1986, 1987, 1988 and 1989 were 93, 89, 59, and 83, respectively, in unit 1 and 89, 86, 100, and 43 in unit 2. Similarly, the pre-intervention severity rates for back injuries for 1986, 1987, 1988, and 1989 were 728, 314, 683, and 1903 in unit 1 and 379, 754, 575, and 71 in unit 2.

4.5. *Task performance time*

Mean performance times for different patient transfers performed using the walking belt and hoist are summarized in table 12. The two-sample t-test with unknown population variances (Miller and Freund 1977) showed that there were significant

Table 13. Number of nursing assistants used for patient transfers after intervention.

Device	Number of observations	% of time 1, 2 and 3 NAs used NAs=1	NAs=2	NAs=3
Walking belt	792	28	70	2
Hoist	530	19	77	4

differences between the walking belt and hoist ($p \leq 0{\cdot}01$). Patient transfer times with hoist were longer than those with walking belt (table 12). On the average, it took 25·8 s to make a transfer with the walking belt and 73·7 s with the hoist. These patient transfer times were substantially longer than the values of about 8 to 18 s for the two-person manual lifting method before intervention (Garg *et al.* 1991a,b,c).

4.6. *Number of NAs*

Most of the patient transfers with the walking belt and hoist were made using two NAs (table 13). About one out of five transfers with hoist were made using one NA. Also, these devices rarely required more than two NAs to transfer patients (table 13). The usual practice in the nursing home before intervention was to use two nursing assistants for patient transfers (Carlson 1989).

5. Discussion

This study showed that with systematic and appropriate ergonomic intervention physical stresses to NAs can be significantly reduced, hence reducing the future risk of musculoskeletal injuries and, in particular, low-back injuries. Four different measures of evaluating the effectiveness of an ergonomic intervention showed highly favourable results.

The approach taken in the present study differed significantly from those used in the past studies. The main focus of this study was on reducing physical stresses to nursing personnel, primarily by providing ergonomically evaluated mechanical hoists and shower chairs and by replacing manual lifting with a pulling technique using a walking belt with handles. Reducing physical stresses to nursing personnel appears to be the most desirable and widely recommended approach, as it reduces the exposure to the hazard. This is especially desirable since lifting of patients is by far the most commonly reported source of injuries (Ferguson 1970, Personick 1990) and there is no relationship between different kinds of lifting techniques and incidence of low-back symptoms (Buckle 1982, Dehlin *et al.* 1976). The ergonomic approach led to new task procedures which eliminated the need for many manual patient lifts. Lastly, with reduced physical stresses, it is possible that some workers may be able to continue performing their job without absenteeism even when suffering from low-back pain (Dehlin *et al.* 1976, Rowe 1983).

5.1. *Acceptability rates*

The overall acceptability rates of 81% to 96% for patient transferring devices observed in this study were very high. The acceptability rates for non-transfer tasks were fairly low (42% to 53%). However, these tasks were not a part of ergonomic intervention. NAs were neither educated nor trained for using walking belt and the hoist for non-transfer tasks. Apparently, some of the NAs started using these devices on their own for patient non-transfer tasks.

The longer transfer time required by the patient-handling devices has been reported as one of the primary reasons for non-compliance with these devices (Bell 1984. Owen 1988. Takala and Kukkonen 1987). The longer transfer times associated with walking belt and hoist. as compared to manual lifting method. did not appear to be a major issue in this study as the acceptability rates were fairly high. Adequate staffing. ability to perform some patient transfers with one nursing assistant. and a reduction in the number of patient transfers (discussed later) may have compensated for longer transfer times associated with these devices.

To the authors' knowledge. there were no major cases of bruises. skin tearing. patient complaints. or patient injury from transferring patients using the hoist. No patients or NAs withdrew their consent even though the option was available to them.

5.2. *Biomechanical stresses*

The ergonomic intervention significantly reduced the biomechanical stresses to the nursing assistants. The mean estimated compressive force of 1964 N after intervention is considerably lower than the 3430 N value for compressive force criteria used to define the action limit recommended by the US Department of Health and Human Services (1981). An exposure to a compressive force of 1964 N appears reasonably safe and represents nominal risk to most workers. The mean pulling force of 122 N required when using the walking belt is substantially lower than the female pulling strength of 179 N to 310 N reported in the literature (Chaffin *et al.* 1983. Snook 1978. Ayoub and McDaniel 1974). Thus. the mean pulling force required with the walking belt is well within female pulling strength.

5.3. *Perceived stresses*

The mean ratings of 8 (between 'very. very light' and 'very light') and 9 ('very light') for hoist and the walking belt suggest that the perceived physical stresses to the nursing assistants after intervention were very low. These ratings of perceived exertion also give credence to the fairly low estimated biomechanical stresses discussed above. On the other hand. RPEs of more than 13 observed for all patient transfers before intervention were comparable to perceived physical stresses associated with lifting very heavy weights (Garg and Banaag 1988. Garg 1989).

5.4. *Injury statistics*

The back injury rate prior to intervention was 83 per 200 000 work hours. After the intervention it was 47 per 200 000 work hours. More importantly. there appears to be a profound decrease in lost and restricted work days. which were reduced to zero in the two units during the last four months of the intervention. This decrease in severity rate might have been due to less serious injuries. Another possible explanation is that back injured employees were able to continue to work because the job demands had been reduced.

It is not clear why there was a dramatic increase in both the incidence and severity rates for back injuries in unit 2 during post-intervention phase I. There were no changes made in unit 2 during this phase. An analysis of injury data for the complete year showed that the incidence and severity rates for back injuries for 1989 in unit 2 were comparable to those from previous three years. Similarly. it is not clear why the severity rate for back injuries in unit 1 increased during post-intervention phase I. As mentioned earlier. most of these injuries occurred during non-patient transfers when

the recommended devices were not used. In spite of some unanswered questions, it is worth mentioning that, as expected, both the incidence and the severity rates for both back and total injuries were considerably lower for unit 1 than those for unit 2 during the post-intervention phase I.

5.5. *Reduction in number of patient transfers*

The use of a shower chair and the mechanical hoist resulted in an elimination or a reduction in the need to perform certain patient-handling transfers. The hoist had a built-in weighing scale and patients could be weighed during any transfer made using the hoist. Before intervention, the patient was manually lifted and transferred from wheelchair to weighing scale chair and from weighing scale chair to wheelchair. Also, toileting and bathing the patient required six transfers: bed to wheelchair, wheelchair to toilet, toilet to wheelchair, wheelchair to chairlift or bathtub, bathtub or chairlift to wheelchair, and wheelchair to bed. After intervention, the same task involved transferring the same patient from bed to shower chair using the hoist or a walking belt; pushing the shower chair over the toilet and then to the shower room, and then back to the patient's room where a transfer from shower chair to bed was made. Thus, the number of patient transfers for toileting and bathing was reduced from six to two. Similarly, the number of patient transfers for toileting, bathing, or showering the patients were reduced from four to two when the hoist or the shower chair was used.

Reducing the number of patient transfers along with the magnitude of physical stress during transfers has an important implication for reducing back injuries to NAs (Jensen 1990a). It appears that each stressful patient-handling event involves some risk of a back injury and this risk can be minimized by reducing the number of stressful patient handling tasks. Further, use of these devices eliminated some of the transfers in patient lavatories (highly confined workspaces) which had necessitated that the nursing assistants assume awkward body postures while transferring patients, an important factor for producing low-back pain.

5.6. *Walking belt and the mechanical hoist*

The walking belt has a tendency to slide up on some of the patients who tend to be smaller at the chest and waist level than at the hip level. Immediately after completion of this study, an experiment was performed in unit 2 of the nursing home where the top end of the walking belt was wedged. The wedged belt appeared to solve the sliding problem.

There were a few verbal complaints from some NAs that they felt some discomfort in their wrists and/or forearms when pulling patients with the walking belt. The walking belt had thin handles made of canvas material. Since such handles can cause a significant reduction in grip strength, cylindrical handles made of 1·9 cm diameter dowel and 10 cm long were securely taped to canvas handles and tried on an experimental basis in unit 2 after the completion of this study. The modified handles were very well received by the NAs.

Because NAs are accustomed to lifting patients, it was observed that their natural reaction is to lift the patient when using the walking belt rather than to make use of momentum and pulling the patient to make the transfer. In general, this lifting action was responsible for most of the injuries associated with the walking belt. To modify this ingrained behaviour would, it is believed, require extensive education and training of nursing assistants in new skills with frequent feedback, encouragement, and long-term commitment on the part of administration.

Informal feedback from the NAs indicated that the hoist was well liked and there were no major problems regarding accessibility, patient comfort and safety, or physical effort required to operate, push, or pull it. However, a word of caution is indicated in that the hoist has small wheels and therefore is very difficult to push/pull and manoeuvre on carpeted floors.

6. Conclusions

An ergonomic intervention was performed in two units of a large nursing home to modify the demands of patient transferring tasks perceived to be most stressful. Among other changes, nursing assistants were provided with mechanical hoists with patient weighing capability, walking belts for each dependent, weight-bearing patient, shower chairs, and additional frames and slings for lifting patients from floor level. In addition, showers and toilets were modified for easy access. The nursing assistants were trained in the use of these devices.

The most physically demanding tasks were changed so that compressive force on the L5/S1 disc was 1964 N after intervention as compared with 4751 N before intervention. The percentage of the female workforce with sufficient strength for performing the most demanding patient transfer tasks improved from 41% to 83% after the changes. On the average, it took 26 s to make a transfer with the walking belt and 74 s with the hoist, and these transfer times were substantially longer than those required with the manual lifting method before intervention. Subjectively, patient transfers were perceived to be 'very light' or less stressful after intervention as compared to between 'somewhat hard' and 'hard' before intervention. The mean acceptability rates for the walking belt and hoist were 81% and 87%, respectively for patient transferring tasks and 53% and 42% for non-transfers. The back injury rate after the intervention was 47 per 200 000 work-hours as compared to 83 before intervention. The severity rate for back injuries was 317 per 200 000 work-hours as compared to 634 before intervention. There were zero lost or restricted work days during the last four months of the post-intervention phase. The statistics for total injuries followed similar patterns as those for back injuries.

In spite of very favourable findings, caution should be used in generalizing these results to other nursing homes. Staffing level, training, workload, and administrative support need to be considered in using the proposed techniques. Large-scale studies in different nursing homes are needed to confirm the above findings.

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ERGONOMIC TRAINING FOR WORKERS AND SUPERVISORS

Bradley Evanoff, MD, MPH
Washington Unversity School of Medicine
St. Louis, MO

Healthcare workers face a number of unique occuaptional health hazards. Only recently have health care occupations been viewed as high-risk jobs for occupational injury and illness. This change in perception has been driven by several factors, including the HIV epidemic and the recognition that nurses and nurses aides are among the highest risk jobs for back injury. Along with this recognition of occupational health hazards have come attempts to decrease these hazards. These have taken the form of regulatory action (OSHA standards on universal precautions to prevent blood-borne pathogen transmission; OSHA standards on tuberculosis control measures) and efforts to improve worker safety.

Worker training is an important part of improving worker health and safety. Other industries have long had comprehensive safety training programs. Health care institutions have traditionally lacked comprehensive safety training programs, but have instead focused on particular hazards (usually infectious diseases). Over the past decade, more safety training has been performed with health care workers, with varying results. Although most safety training programs can demonstrate improvements in workers' knowledge following the training, there is conflicting evidence on the effectiveness of training at actually reducing injuries or illnesses. This talk will review some of the safety training programs and program guidelines used in different health care institutions, as well as the available data on effectiveness.

The latter part of the talk will focus on the use of Employee-Management Advisory Teams (EMATs) and other participatory safety programs. These participatory programs have been used in other industries, notably meatpacking and automobile manufacturing, where active involvement of workers in the safety training and planning process has been successful.

Discussion of EMATs and participatory health and safety programs will include a general overview and a discussion of our experiences at Washington University. Supported by a grant from NIOSH/CDC, we have formed three EMAT groups among employees of a large urban hospital. These EMATs represent three different worker groups - orderlies, intensive care nurses, and laboratory technicians - and consist of 4-6 members each plus external technical advisors. Teams underwent 8 hours of training in ergonomics, and have since met weekly to identify hazards in their work areas and explore solutions. Our evaluation data will eventually include baseline symptom and work satisfaction surveys, costs of implementation, and changes in WRMSD rates and costs. Teams were initiated in 10/95. Economic problems arose immediately because of the time commitment required of team members. All teams have required substantial guidance from their external advisors. Teams have been successful in identifying problems in work practices, work environment, and work organization, and in suggesting solutions to some of these problems. Initial results with EMAT teams have been encouraging, though more labor-intensive than anticipated. At the end of our project period, we will have data on the costs of intervention, changes in rates and costs of illnesses and injuries, and changes in symptom scores and psychosocial factors.

Our experiences to date with EMAT teams are consistent with the major lessons reported in the NIOSH / CDC publication "Participatory Ergonomic Interventions in Meatpacking Plants."

- Sustained participatory efforts require strong in-house direction and support as well as expertise in team-building and ergonomics
- Training in both team-building and ergonomics is important
- Team size should be kept minimal, but should include front-line workers and area supervisors
- Effective team problems solving requires member access to information and sharing of data
- Means for evaluation of team efforts need to be written into the overall plan

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PREVENTING MUSCULOSKELETAL DISORDERS: AN ERGONOMICS CURRICULUM FOR DENTAL HYGIENISTS

Steven Hecker, MSPH
Associate Professor
Labor Education and Research Center
University of Oregon
Eugene, Oregon

Dental hygiene work involves a number of the ergonomic risk factors commonly associated with the development of musculoskeletal cumulative trauma disorders of the upper extremities and trunk. These include forceful exertions, awkward postures, repetition, static loading, and localized contact stressors. The medical and dental professional literature, employee surveys, and workers' compensation statistics suggest that dental hygienists are at significant risk of work-related musculoskeletal disorders. This presentation describes an ergonomics training curriculum that was developed in conjunction with the dental hygiene program of a large health maintenance organization and the labor union that represents its hygienists. The HMO employs about 120 hygienists at eight clinics in Oregon and southern Washington. The project was funded by the Oregon Occupational Safety and Health Division.

The project utilized input from numerous sources in developing the curriculum. These included the HMO's labor-management dental ergonomics committee, practicing dental hygienists, faculty of several of Oregon's university and community college dental hygiene training programs, a dental equipment manufacturer, physical therapists, and an occupational physician. A draft version of the curriculum was tested at a 2-day pilot training program, then revised into a modular format designed for use in the clinics. The curriculum covers multiple approaches to prevention including equipment redesign, modification of work practices, and body mechanics and exercise. It makes use of videotape for task analysis and emphasizes participatory learning techniques.

The presentation will highlight special problems encountered in applying ergonomics to health care occupations, the importance of labor-management cooperation to the success of the project, and how training fits into a comprehensive ergonomics program.

Preventing Musculoskeletal Disorders: A Dental Hygiene Ergonomics Curriculum

University of Oregon
Labor Education and Research Center

in cooperation with the

Oregon Federation of Nurses
and Health Professionals
and
Kaiser Permanente Dental Care Program,
Northwest Region

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Introduction

❑ Development of the Curriculum

This Dental Hygiene Ergonomics Training curriculum is the product of the work of several groups who have been addressing the problem of musculoskeletal disorders among dental hygienists. In 1993 the Oregon Federation of Nurses and Health Professionals (OFNHP) and the Kaiser Permanente Dental Care Program formed an Ergonomics Committee under the terms of the dental hygiene collective bargaining agreement. The committee's charge is to study the ergonomic challenges of instruments, operatory design, work schedules and patient scheduling, and employee fitness promotion as they affect the health and safety of the hygienists. The activities of the committee have included

- a survey of dental hygienists to determine the prevalence of work-related pain
- an ergonomic equipment evaluation survey which has begun to be administered in the Kaiser dental clinics
- planning of an ergonomics education program for dental hygienists, supervisors and administrators, and dental equipment purchasers at Kaiser.

In the summer of 1994 the University of Oregon Labor Education and Research Center (LERC) and OFNHP began discussions concerning the development of a program of ergonomics training for health care employees, including both registered nurses and dental hygienists. In part these discussions had their origins in the attendance of several OFNHP Kaiser dental hygienists at a LERC occupational safety and health course two years earlier, at which these employees described the musculoskeletal disorders of the hands and wrists that seemed to be showing up among hygienists. LERC and OFNHP developed a proposal to create two training curricula on ergonomic hazards and solutions: one focused on cumulative trauma disorders among dental hygienists and the other on back injuries from lifting and patient transfer among registered nurses. The proposal was submitted to the Oregon Occupational Safety and Health Division (OR-OSHA) under its Safety and Health Training Grants program. In January 1995 OR-OSHA approved and funded the proposal.

Since that time the LERC, OFNHP, and the Kaiser Dental Hygiene Ergonomics Committee have worked closely together to develop this curriculum. We tested a pilot version of the curriculum at a two-day training program attended by 20 Kaiser dental program employees at the facilities of A-dec Corporation, the world's largest manufacturer of dental equipment located in Newberg, Oregon. We have revised the manual based on feedback from the participants and others, and we have also reorganized it into modules that will better fit into available time for training at the Kaiser clinics.

❑ Goals of the Curriculum

1) To provide the latest information to Kaiser dental hygienists, hygiene supervisors, and others concerned with the administration of the dental care program on the ergonomic risks of dental hygiene practice and the measures available to reduce those risks. The specific interests of dental hygiene practitioners and administrators in the content of the curriculum may be somewhat different, but the overall goal of reducing musculoskeletal disorders is a common one.

2) To provide a framework in which dental hygienists actively participate in learning about these issues and contribute to the identification of ergonomic problems and solutions in their own work areas.

3) To contribute to the long term effectiveness of the Ergonomics Committee in its implementation of the ergonomic equipment evaluation and in establishing an ongoing ergonomics education and monitoring program within the dental care program.

4) To disseminate information about dental hygiene ergonomics more broadly to clinics throughout Oregon and the U.S. and especially to dental hygiene education programs. We hope that the ergonomics modules prove to be useful tools that can be integrated into community college and university-level education programs.

❑ Training Philosophy

At LERC we are committed to a training method which involves the participants to the greatest degree possible. While this is true of all of our educational programs, there are additional reasons for this method in this curriculum. Dental hygienists work in a specialized field and no one knows dental hygiene better than its practitioners. Since many of the potential risks we will be discussing may be closely tied to specific dental hygiene procedures and techniques, we are very reliant on you as operators to help devise control measures which are practical within the practice of dental hygiene. It serves little purpose to recommend

changes in technique, equipment, or practice which dental hygienists will not adopt because they won't be able to do their jobs as a result.

❑ Living With Uncertainty

We do not have certain answers for all the issues that are raised in this curriculum. This is true of the causes of, treatment of, and control measures for musculoskeletal disorders. The modules provide the best information available on these topics, but be prepared to walk out of the training without having resolved all the uncertainties. We do hope that the training spurs you to look at your job in new ways and continue to strive to improve the working conditions through the mechanisms we will discuss. Perhaps some of you will be involved in resolving these uncertainties through applying the principles learned in the modules to your own work situations.

Module 1

A) Musculoskeletal Disorders Among Dental Hygienists: How Big a Problem?

B) Basic Principles of Ergonomics

C) Risk Factors for Musculoskeletal Cumulative Trauma Disorders

Training Objectives

After completing this module the participant will be able to:

- Achieve an accurate picture of the scope of the problem at Kaiser and in the profession generally, based on available evidence
- Appreciate the human dimension of musculoskeletal disorders
- Define ergonomics and explain some basic applications to the workplace
- Name the specific factors that make jobs/tasks higher risk for CTDs
- Identify elements of their own jobs that constitute risks of these kinds
- Describe the potential interaction of personal and job factors in CTDs

Module 2

A) Understanding Body Mechanics

B) Preventing Musculoskeletal Disorders Through Exercise and Conditioning

Training Objectives

After completing this module the participant will be able to:

- Explain the basic functions of muscles, bones, tendons, and nerves
- Explain and illustrate the various types of joint motions
- Explain the processes involved in the development of carpal tunnel syndrome, tendinitis, and related disorders
- Explain how the benefits of exercise can help reduce and counteract the physical stress of dental hygiene work
- Perform basic exercises to strengthen or increase flexibility in specific joints and muscles

Module 3

A) Ergonomic Task Analysis

B) Solving Dental Hygiene Ergonomic Problems

Training Objectives

After completing this module the participant will be able to:

- Identify dental hygiene task elements with potential ergonomic risks
- Work in a team to carry out the basic steps of job analysis to identify ergonomic risk factors
- Identify the range of equipment, work practice, and work organization factors that contribute to ergonomic risk
- Effectively use the Kaiser equipment evaluation checklist
- Identify and try out modified work practices to relieve ergonomic stresses
- Identify features of tools and equipment that lessen physical stress on particular body parts
- Identify work scheduling factors that relieve ergonomic stressors
- Develop recommended countermeasures to identified ergonomic risks
- Identify methods for evaluating the impact of ergonomic interventions

Module 4

Early Identification and Treatment of Musculoskeletal Disorders*

Training Objectives

After completing this module the participant will be able to:

- Recognize the early symptoms of CTDs and understand the importance of eariy recognition
- Explain the respective roles of employees, supervisors, and managers in disability prevention
- Identify the range of treatment options and know the questions to ask their health care providers about treatment
- Use the Kaiser employee health system to access the services they need
- Explain how job modification is used to return injured workers to work

* Much of the information in this section is adapted from *Fitting the Job to the Worker: An Ergonomics Program Guideline*, Washington Dept. of Labor & Industries, 1994.

Module 5

Establishing and Maintaining an Effective Ergonomics Program

Training Objectives

After completing this module the participant will be able to:

- Understand the reasons for having an ergonomics program
- Identify the key components of an ergonomics program
- Describe the roles of employees, supervisors, managers and the union in an ergonomics program
- identify action items to work on in their own clinic

Carpal Tunnel Syndrome

Risk Factors and Preventive Strategies for the Dental Hygienist

By Linda J. Gerwatowski, RDH, BS; Deborah Bailey McFall, RDH, BS; and Donna J. Stach, RDH, MEd.

Abstract
Carpal tunnel syndrome (CTS) is well recognised as an occupational risk for dental hygienists. The contributing risk factors fall primarily into two categories: medical and occupational. The purposes of this paper are to examine the factors that predispose one to CTS in order to increase awareness among dental hygienists, and to offer preventive strategies that can be incorporated into daily practice.

Description of Condition
Carpal tunnel syndrome (CTS), cumulative trauma disorder (CTD), repetitive strain injury (RSI), upper body pain syndrome, nerve entrapment syndrome, and peripheral nerve dysfunction are terms used to describe the condition when the nerves innervating the hands are compressed. This can occur as the nerves pass through narrow channels between the muscles and ligaments in shoulder, arm, or hand. Any of the three nerves of the hand – median, radial, or ulnar – may be affected. Entrapment of the nerve will typically result in impaired motor function and paresthesia along the distribution of the nerve.[1]
The most common of these nerve compressions for dental hygienists, as well as for the general population, is CTS.[2] This results from an entrapment of the median nerve as it enters the hand and passes through the carpal canal located on the palmar side of the wrist. The eight carpal bones and the strong band of the transverse carpal ligament create the carpal tunnel. Contained within this narrow, confined space are the median nerve, its vascular supply, and nine extrinsic flexor tendons of the fingers.[3] Compression in the canal wil result in disturbances to the more peripheral distribution areas of the nerve which are the thumb, the index and middle fingers, and half of the ring finger.[1]
Although symptoms of CTS may vary among individuals, they typically include hypesthesia (reduced sensation to touch) and/or paresthesia (numbness, tingling, or prickling) along all or parts of the distribution of the median nerve. Weakness and clumsiness of the hands are often gradual but progressive.[4] Pain, tingling, numbness, or burning are particularly prevalent at night. These may be severe enough to cause awakening or to prevent sleep. Vigorous shaking or exercise of the hands, or hanging the hand over the edge of the bed may provide relief. Intolerance to cold in the fingers is also an early symptom. In long-standing cases, [redacted] may be present. This is the diminished size of the thenar muscle at the base of the thumb, and is visible when the hands are compared in profile.[3-6]
Additional findings in many CTS patients are a positive Phalen's test and Tinel's sign.[1,3,4,7] In Phalen's test, wrists are flexed at 90° and held for one minute. The test is positive if it results in tingling or numbness. Tinel's sign is a tingling or shooting sensation when the median nerve area of the wrist is gently tapped. Electrodiagnostic tests are an essential final step in the specific diagnosis of CTS. Electromyography and nerve conduction studies are based on the diminished transmission of the impulses across the trapped segment of the median nerve in the carpal canal. This results in a measurable latency to sensory and motor function in the affected area.[8,9]

Contributing Risk Factors
The contributing risk factors of CTS can be categorised into medical factors and occupational factors. There is an abundance of literature identifying conditions such as rheumatoid arthritis, Paget's disease of the bone, neuromas of the median nerve, neoplasms, gout, myxedema, amyloidosis, multiple myeloma, acromegaly, diabetes mellitus, Raynaud's disease, chronic trauma, maligned fractures, and hypothyroidism, which are linked to the development of CTS.[6,7,15,17,18] Female hormonal changes associated with pregnancy and menopause, and secondary to hysterectomy with bilateral oophorectomy, have also been related to the onset of CTS symptoms.[7,15,17,18] Statistics reveal that the disease is at least three times as common in women as in men.[4] Typically, CTS manifests during middle age. When the relationship between wrist anatomy and carpal tunnel size among 14 male electricians was examined, it was found that those with CTS had statistically significant smaller measurements of the canal areas.[5,17]
Occupational risk factors have been identified in the literature to include repetitiveness, posture, force, mechanical stresses, vibration, and temperature.[9,11-15,21] All of these risks are inherent within the framework of clinical dental hygiene. Armstrong and Lifshitz developed a general check-list to analyse jobs for these risk factors.[25] Table 1 is a modified version of the checklist which is specific to clinical dental hygiene.[25]
By virtue of occupation, dental hygienists experience a high degree of repetitive action, especially in scaling and polishing activities. In a study of 2,400 California dental hygienists, statistically significant correlations were found between CTS symptoms and the numbers of years practiced, number of days worked per week, and number of patients seen per day.[6]
Posture is one of the most frequently cited occupational risk factors.[14] Improper operator/patient positioning which results in raised shoulders and wrist flexion and/or extension can contribute to median nerve

Table 1
CTS: Dental hygiene occupational risk factors.

Risk checklist	Preventive strategies
Repetitiveness • Are you scheduling more than two consecutive root planing appointments? • Are you scheduling more than two consecutive difficult patients? • Within an appointment, are you repeating same hand motion or posture for prolonged periods (e.g., scaling for 30-45 minutes, then doing other procedures)? • Do you use ultrasonic or sonic scalers infrequently or not at all?	**Repetitiveness** • Allow sufficient time to treat the needs of the patient. • Regulate the total number and scheduling of patients requiring hand-intensive motions. • Alternate debridement and root planing within the same appointment. • Vary hand-intensive activities by interspersing procedures such as radiographs, home care instructions, and selective polishing with debridement and root planing. • Use very sharp instruments. • Shorten the patient's recall interval. • Maximise use of ultrasonic scalers.
Posture • Operator posture – Are your shoulders elevated and/or one higher than the other? – Are your wrists flexed or extended during scaling? • Operator/patient position – Are your elbows elevated more than 30°? – Is your back bent and is your head unsupported by your spine?	**Posture** • Relax shoulders; keep them even and parallel to the floor. • Resist elevating elbows above 30°. • Avoid prolonged ulnar deviation. • Reduce wrist flexion and extension; keep wrist in a neutral position with the hand/arm straight (patient height will help control this). • Use full-arm strokes rather than wrist or finger action.
Force • Are you using a constant, pinching grasp during both exploring and working strokes? • Are your instrument handles smooth?	**Force** • Use minimum pressure in instrument grasp. • Increase pressure with grasp only when deposits are engaged or in the early stages of root planing. • Use instruments of adequate weight. • Select instrument handles that are serrated or textured.
Mechanical stresses • What is the diameter of your instruments? • Are your instrument handles hexagonal? • Are the cords on your handpieces short or curly? • Are your handpieces unbalanced? • Are your gloves ill-fitting?	**Mechanical stresses** • Choose larger-diameter, round instrument handles. • Use contraangled instruments in anterior treatment areas if they help maintain neutral wrist position. • Avoid heavy and unbalanced handpieces. • Select contraangled rather than right-angled prophy angles. • Avoid short and curled cords or retractable cords that pull on the wrist. • Wear properly fitted gloves.
Temperature • Is your operatory cold, or is there a cold air vent directed toward you? • Are your instruments cold when you use them? • Do you wash your hands with cold water?	**Temperature** • Avoid cold drafts and air exhaust, especially on cold hands. • Work in warm rooms or wear warm clothing. • Use warm water to wash hands; maintain 77° finger temperature. • Exercise hand for muscle warm-up and to relax muscles between patients.

compression. Phalen, in his studies, recognised the pattern of nerve stretching and compression with exertion in certain positions and developed what is now called the Phalen's test for carpal tunnel syndrome. He stated that "Occupations that require active finger flexion with the wrist flexed should certainly predispose to carpal tunnel syndrome."[14]

The force factor includes such human attributes as the force or pinching pressure on the fingers, tendons, and muscles when grasping and using instruments. The force factors in clinical dental hygiene increase when using a working stroke as opposed to an exploratory stroke. The weight and the slipperiness of the instrument also affect the force factors.[14] More finger force is needed to grasp a slippery instrument, especially if the handle is smooth or has been moistened by saliva or blood. It has been demonstrated that more strength is required to exert the same amount of force when gloves are worn.[14] Anecdotal reports from dental hygienists suggest that gloves reduce tactile sensitivity. This perceived loss of tactile sensitivity could result in a tighter grasp or pinch in order to feel the instrument.

Mechanical stresses are produced when holding objects or instruments with hard, sharp edges which causes digital nerve compression.[14,16] In the practice of clinical dental hygiene, instrument handle size, shape, resistance from retractable or curled cords on dental units, and improperly fitted gloves all contribute to the mechanical stresses.

Vibration has been found to be an etiological factor in the development of CTS in workers using tools vibrating in the frequency band of 20 to 80 hz with an acceleration between 100 and 1,200 m/sec^2.[11-13] Studies have been done on the use of pneumatic hand-held tools and the effects of vibration on the small blood vessels.[13] No studies have been published which examine the relationship between use of ultrasonic and sonic instruments or air driven handpieces and the presence of CTS in dental hygienists.

Low temperatures reduce manual dexterity and accentuate the symptoms of a nerve-end impairment.[14] Within the work environment, low room temperatures, manipulation of cold materials or instruments, and exposure to cold air exhaust can contribute to low finger temperatures. There are no standards for finger temperatures, but it is recommended that they be kept above 25°C or 77°F to avoid detrimental effects of dexterity.[14]

Although a dental hygienist may not be able to avoid medical or anatomical conditions, identifications of occupational risk factors can assist in implementation of preventive strategies to avoid development of CTS symptoms.

Prevention Strategies

Repetitiveness

Repetitiveness is defined as the performance of the same task, motion, or posture more than 50% of the time.[25] In order to decrease the impact of repetitiveness, the dental hygienist should be aware of the significance of scheduling. Adequate time should be allowed for each patient. When pressured for time, hand, wrist, and arm positioning can be compromised. The total number, as well as the spacing of patients requiring intense instrumentation, should be regulated to avoid extreme fatigue of the hands.

Figure 1. *Wrist flexion.*

When scheduling periodontally involved patients who require deep scaling and root planing, quadrant treatment is preferred over full-mouth gross debridement followed by a second appointment for definitive scaling and root planing. This approach not only reduces hand fatigue, but also is the preferred therapeutic approach according to current research.[21]

It is the repetitive scaling procedures that can cause the most damage to the median nerve in the carpal tunnel. Through patient assessment, patient needs can be categorised and individualised. By analysing the sequence of these treatment segments, hand-intensive, repetitive motions can be divided into small segments of time while still providing optimum patient care. For example, a maintenance patient might need the following treatment: data gathering, oral hygiene instruction (OHI), scaling and light root planing, selective polishing, flossing, radiographs, and examination by a dentist. Alternatives to this traditional sequence can be beneficial. OHI, radiographs, and even selective polishing can be interspersed into the scaling and root planing phase of treatment.

The overall goal in the prevention of CTS is to reduce the repetitive finger and wrist motions and avoid a tight, pinching grasp. There are a number of common-sense techniques that can be implemented. Some examples include use of very sharp instruments to ease deposit removal, shorter recall intervals to reduce heavy scaling, and use of sonic and ultrasonic scalers which requires a light grasp and less wrist motion.

Posture

The dental hygienist should analyse posture in relation to shoulder elevation and wrist position. CTS may be potentiated by the combination of shoulder abduction (elevation) of greater than 20° and holding an instrument with the wrist in prolonged ulnar deviation.[10] Positioning the elbows close to the body, at waist level without shoulders relaxed and parallel to the floor, will facilitate this posture.[19,21]

Correct operator/patient positioning also contributes to maintaining correct posture which reduces wrist flexion/tension. The height of operation is determined by the height of the clinician's elbows.[19] The patient should be positioned so that the operator's elbows are down and close to the body, or just slightly elevated by no more than 30°. When accessing different quadrants, the patient's chair should be adjusted so that the operator can maintain body position. At times, it may be necessary to work from the opposite side, behind the chair, or in a standing position for a short

Figure 2. *Ulnar deviation.*

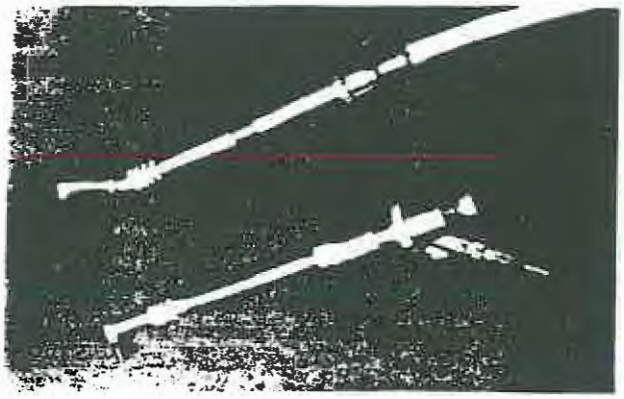

Figure 3. *Top: Balanced handpiece with contraangled prophylaxis angle. Bottom: Handpiece with heavy terminal end from the motor placement with straight prophylaxis angle.*

period of time. A change in position, or periodic stretching provides necessary muscle relaxation to promote good posture.

Neutral wrist position, with the arm and wrist in a continuum, is critical in the prevention of CTS. The most mechanically efficient position is one in which the wrist is extended approximatley 30°, and the fingers are slightly flexed.[10] The two wrist positions that cause the most damage are wrist flexion (Figure 1) and ulnar deviation (Figure 2). Both positions are frequently utilised in standard dental hygiene instrumentation. The use of full-arm strokes, rather than wrist strokes, reduces the rubbing of the median nerve in the carpal tunnel. A full-arm stroke maintains a consistent neutral wrist position and provides more power.[19-21] The stroke motion is generated by a unified action of the shoulder, arm, wrist, and hand while the hand rotates on the fulcrum finger. An extraoral fulcrum may be necessary to achieve this neutral wrist position.

Force

The force of intense digital pressure (pinch) on an instrument especially when combined with postural and mechanical stress factors, may encourage CTS symptoms. The lightest effective pressure should be utilised in instrument grasp.[19] Moderate to heavy pressure should be kept to a minimum, and used only when deposits are engaged and in the initial phases of root planing. The weight of the instrument is also important. If it is too light, there is tendency to increase pinch in order to feel the instrument in the hand. Serration provides for increased retention of the instrument so that less force is required to hold the instrument, thereby reducing muscle crimping.[21]

Instruments are available with contoured finger grips on the handle. Since hand and finger size vary, this type of handle may not provide appropriate fit. The grips do not allow the freedom to move up or down the handle for increased access. Any grips that become tacky through use or sterilisation may result in an increased pinch force.

Unnecessary force can also be experienced during flossing. Nerve endings and blood vessels can be damaged in the finger tips if the floss is wrapped around the fingers too tightly. An alternative is tying the floss in a circle, grasping it with the third and fourth fingers, and using the index finger and thumb to guide the floss interproximally.

Mechanical Stresses

The dental hygienist can reduce mechanical stress factors by a careful analysis of instruments, handpieces, and gloves. Instruments with small-diameter handles are more difficult to control and contribute to muscle fatigue. Larger diameter handles are more easily controlled and reduce muscle cramps; however, this increased size may restrict movement in posterior areas where access is limited.[21] The introduction of the extended shank instruments may relieve the movement restrictions in the posterior areas.

Recent interest in handle design has focused on increasing the diameter, which opens the grasp and therefore decreases pinch. Currently, the No. 4 handle is the largest diameter that is widely available. The instrument handle should have sufficient weight and texture for the operator to feel the instrument's presence, or pinch will be increased. A round handle as opposed to a hexagonal handle with hard edges will reduce the mechanical stress and digital nerve compression.

Straight-shank instruments tend to encourage more wrist flexion when adapting to the lingual of the anterior teeth. To resolve this, a hygienst may consider utilising a contraangled instrument as opposed to one with a straight shank. A key factor in instrument selection should be wrist position during normal use in order to maintain a neutral wrist position.

Figure 4. *Unbalanced handpiece compounded by resistance from a curly cord results in increased wrist flexion and finger pinch.*

Figure 5. A balanced handpiece, straight cord, and contraangled prophylaxis angle maintain neutral wrist position and reduce hand fatigue.

Handpiece and prophy angle design can contribute to CTS. A handpiece should be lightweight, compact, and easily grasped. Unbalanced handpieces with the motor weight at the end require a tighter grasp and increase extension of the wrist. The prophy angle should be short and contraangled rather than traditionally right-angled to maintain a neutral wrist position and allow for easy access to all areas of the mouth (Figure 3).

Any device that causes resistance against the wrist and wrist extension should be avoided. The most common example of this in the operatory is the retractable or curled cords on the dental unit. Tension is built into these cords so that they will retract. This tension is easily transferred to the wrist as the cords are stretched tighter (Figure 4). This is particularly harmful if the wrist is in a flexed position. If a negative resistance is applied to the wrist during handpiece use, a modification is needed. Consider replacement with a straight cord of adequate length, or place the cord over the shoulder to cut down on the stress on the wrist (Figure 5)

A factor in hand fatigue is ill-fitting or poorly designed gloves. The glove should contour to the operator's hand shape and size. Glove fingers which are too short or palm width that is too narrow will restrict movement. A tight wrist band may also cause restriction. Excessively large gloves result in bunching at the fingertips and loss of tactile sensitivity, therefore a tighter pinch. Another problem with fit is the use of ambidextrous or "examination" gloves which place the thumb in an unnatural position in the same plane as the fingers. This results in constant muscle use to counteract the stress.[26]

Temperature

One of the early signs of CTS is an intolerance to cold in the fingers.[13] As stated earlier, a finger temperature of 77°F is recommended.[10] When fingers are cold, circulation is decreased, which can result in pinching, muscle fatigue, and a loss of tactile sensitivity. The use of properly fitted gloves aids in maintaining the proper temperature. Other efforts by the hygienist to maintain this temperature could include warm-water handwashing, redirecting cold air vents or exhaust air away from the practitioner, and wearing warm garments.[27]

Warm-up and in-between-patient exercises can be very beneficial. A ball of hand exercising putty can be used for a variety of exercises. Exercises prior to

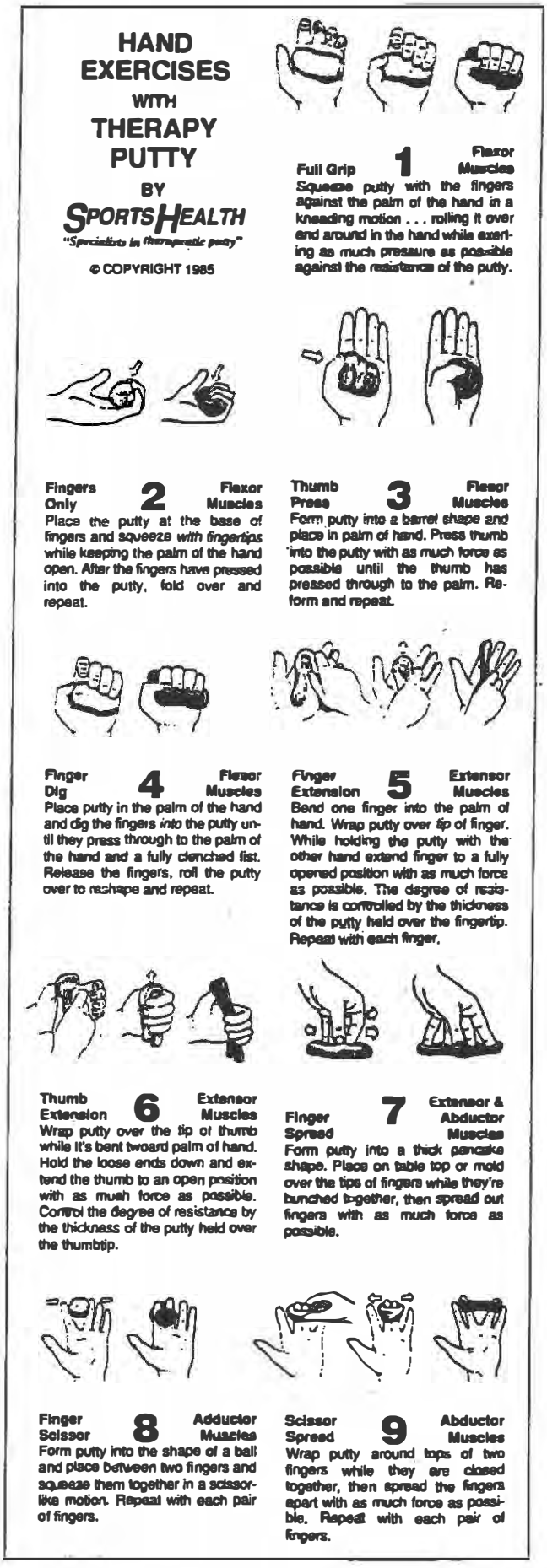

Figure 6. Reprinted with permission of SportsHealth.

patient treatment should concentrate on warming up the muscles as shown in exercises 1 through 4 (Figure 6). The in-between-portion exercises, as demonstrated in exercises 5 through 9, counteract the muscle action utilised in work.[27]

Conclusion

CTS is a multifactorial disease with anatomical and functional components. Some of the contributing factors may be controlled by the individual. Practitioners of clinical dental hygiene are at greater risk for this condition than the general population. This article identified some specific occupational risk factors and offered some techniques which can reduce their impact. The increased awareness and implementation of preventive strategies may minimise the incidence of CTS in the dental hygiene population.

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Linda J. Gerwatowski, RDH, BS, is a private practitioner in Colorado Springs, Colorado. Deborah Bailey McFall, RDH, BS, is a private practitioner in Denver, Colorado and a clinical assistant professor, and Donna J. Stach, RDH, MEd, is an assistant professor; both in the Department of Dental Hygiene at the University of Colorado Health Sciences Center, School of Dentistry, in Denver, Colorado. Both Ms. McFall and Ms. Gerwatowski have returned to private practice following CTS treatment.

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Managing Your Total Cost of Risk

Stephen M. Hurley, MSPH, CIH
Manager, Healthcare Risk Management Services
Johnson and Higgins of Washington, Inc.
Seattle, Washington

Total cost of risk, as used in the insurance industry, views the *direct* costs of risk, including insurance premiums, retained losses, and administrative expenses. Areas typically considered are:

- **Property**
- **Professional liability**
- **General liability**
- **Workers compensation**
- **Administrative expenses (risk management, safety, employee health, claims administration, etc.)**
- **Outside services (consultants, third party claims administrators)**

This way of looking at total cost of risk helps to identify the areas posing the greatest financial risks for an organization, and prioritize efforts to control them.

This perspective also reveals that retained workers compensations losses are a significant portion of the total cost of risk for most healthcare organizations -- nearly one quarter, according to a recent survey of risk managers. Those involved in preventing injuries and illnesses among healthcare workers can use this fact to help demonstrate the value of their programs to an organization.

EVALUATING LIFTING DEVICES

Bernice D. Owen, PhD, RN
Professor, Nursing
School of Nursing
University of Wisconsin-Madison
Madison, WI

OUTLINE

I. Most stressful tasks - lifting/transferring patients

II. Criteria for selection and evaluation of assistive devices
   - A. Appropriate for task
   - B. Safety and comfort of patient/resident
   - C. Safety of nurse
   - D. Able to learn with relative ease
   - E. Able to use with relative ease
   - F. Efficient in the use of time
   - G. Minimal maintenance
   - H. Maneuverable in confined work spaces
   - I. Versatility
   - J. Able to keep clean
   - K. Cost

III. Invite sales representatives/distributors to demonstrate

IV. Pilot several makes/models

V. Staff involved in lifting/transferring should be involved in the evaluation of assistive devices

POWER AND CHANGE

$$\text{POWER} = \frac{\text{MOTIVATION} + \text{CAPACITY}}{\text{RESISTANCE}}$$

POWER = Ability to get others to behave in a way they might not otherwise act

MOTIVATION = Commitment one feels toward achieving a goal

CAPACITY = Access to/development of resources that subdue resistance

RESISTANCE = Force that impedes one from attaining goals

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ASSISTIVE DEVICES FOR USE WITH PATIENT HANDLING TASKS*

Bernice D. Owen
University of Wisconsin-Madison
School of Nursing
600 Highland Avenue
Madison, WI 53792, USA

Arun Garg
University of Wisconsin-Milwaukee
Department of Industrial and Systems Engineering
P.O. Box 784
Milwaukee, WI 53201, USA

Back pain among nursing personnel is common and usually attributed to involvement in patient handling tasks. Nursing assistants in a nursing home ranked the following tasks as most stressful to the back: transferring patients on and off the toilet, in and out of bed, and transfers needed for bathing. Criteria were established for selection of assistive devices to be used to help decrease back stress while carrying out these tasks. Strategies were developed for locating assistive devices. Assistive devices found were limited in number but included hoists, sliding boards, belts, slings, and a turn table. Preliminary trials were conducted to determine which devices should be studied in an attempt to decrease back stress while performing patient handling tasks.

INTRODUCTION

Back problems are prevalent among nursing personnel. Klein et al., (1984) found, through worker compensation data, that nursing assistants ranked fifth for back strains/sprains with an annual incidence ratio of 3.6 claims/100 workers. Only heavy laborer occupations such as miscellaneous laborers, garbage collectors, and warehouse men ranked higher than nursing personnel. Jensen (1987) found that nursing assistants in nursing homes/personal care facilities ranked highest among nursing personnel for worker compensated back problems. Lifting and transferring of patients have been perceived by nursing personnel to be the most frequent precipitating factors or causes of back problems (Harber et al., 1985; Jensen, 1985; Owen, 1989; Stobbe et al., 1988; Stubbs et al., 1981; Valles-Pankratz, 1989; Venning et al., 1987). These researchers concluded that assistive devices for use with patient handling tasks could reduce back stress for nursing personnel. However, few devices have been systematically evaluated to determine if their use would reduce back stress.

As part of a contract with the National Institute for Occupational Safety and Health (NIOSH), Owen and Garg (1989) delineated those patient-handling tasks perceived as most stressful by nursing assistants in a nursing home/personal care facility. An ergonomic evaluation was conducted in this facility which revealed elements important to the use of assistive devices:

*This study was part of a contract funded by the National Institute for Occupational Safety and Health (Contract 200-86-2923). Roger C. Jensen, J.D., Ph.D., PE (Project Officer).

many stressful tasks were completed in confined work space, most wheelchairs and geriatric chairs did not have removable arm rests to facilitate ease of transfer, and brakes on some beds and wheelchairs did not hold. In addition, there were patient characteristics that could impact on use of assistive devices: weakness, combativeness, muscle rigidity, spasticity, pain, obesity, and inability to bear weight.

The next goal was to find assistive devices that had the potential to reduce back stress for nursing assistants while performing stressful patient handling tasks. The purposes of this part of the study were to: 1) establish criteria for selection of assistive devices to be used while carrying out stressful patient handling tasks, 2) develop strategies for locating available devices, 3) implement these strategies, and 4) conduct a preliminary trial to determine which assistive devices should be recommended for systematic laboratory evaluation.

CRITERIA FOR SELECTION OF DEVICES

1. The device must be appropriate for the task to be accomplished. The tasks delineated as most stressful by Owen and Garg (1989) and studied as part of the NIOSH contract are: transferring a patient from wheelchair to toilet and back to wheelchair, from bed to wheelchair and back to bed, and from wheelchair to shower chair (for toileting and bathing) and back to wheelchair. Devices that can only transfer patients in a horizontal position are not useful with these tasks; for example the Dixie Smooth Mover is a light weight polyethylene board 56 cm x 206 cm with cut out areas for hand grips to be used to transfer patients in a horizontal position, such as from bed to cart/stretcher.
2. The device must be safe for both patient and nurse. It must be stable, strong enough to secure and hold the patient, and permit the nurse to use safe biomechanics.
3. The device must be comfortable for the patient; this may also help to allay fears. It should not produce or intensify pain, bruising, or tear the skin.
4. The device should be understood and used with relative ease. Bell (1984) and Owen (1988) found nursing personnel were reluctant to use assistive devices because they could not understand how to use them or lacked experience in their use.
5. The device must be efficient in the use of time. According to Bell (1984) and Owen (1988) the most frequent reason given for not using a device was the time needed for use.
6. Need for maintenance should be minimal. The above two authors found lack of proper functioning a major reason for non use.
7. The device must be maneuverable in a confined work space. Owen (1988) and Valles-Pankratz (1989) found space to be a problem.
8. The device should be versatile. It could be inferred from Bell's findings (1984) that only a few assistive devices should be introduced at a time because the error rate and the need for time to execute the transfer increased when more than two devices were included in a teaching program.

STRATEGIES FOR LOCATING DEVICES

A literature search was conducted to find assistive devices that could be used with selected patient-handling tasks; few were found, and even fewer had been systematically evaluated. Gagnon et al. (1986) studied lifting a "patient" out of a chair with the hands, with forearms behind the patient's back at shoulder level, and with a belt around the patient's waist; they found the belt technique to be the most strenuous. Leinweber (1978) used the belt as a transfer device with 20 patients; she was successful with all but three patients (an uncooperative patient, one with arthritic back pain, and an obese patient). Bell (1984) evaluated seven different mechanical hoists and recommended improvement in the design and manufacture of the

hoists and slings and in the service provided by the manufacturers and their marketing agents. Mechanical hoists were the assistive devices most frequently described in the literature (Gifford, 1966; Kilbom et al., 1985; Lloyd et al., 1987; Takala and Kukkonen, 1987; Waters, 1988). Other devices described were slings, a turn table for pivoting, a walking belt with handles, and sliding boards (Bell, 1984; Hayne and McDermott, 1982; and Lloyd et al., 1987). Most basic nursing textbooks have a chapter relating to body mechanics and lifting/transferring techniques with information about hoists and belts.

A questionnaire was sent to nursing homes/personal care facilities to determine types of transfer assistive devices in use (Owen, 1988) and to seek the opinion of nursing personnel concerning these devices. Gait belts, bathtub lifts, hoists, and lift sheets were the only devices used frequently. Eighty percent (n=99) felt increased use of assistive devices could reduce back problems. The most frequently cited reasons for non use of devices were: too time consuming, staff lack knowledge/experience, inadequate staffing, and lack of availability. Some respondents had diverse but strong opinions about gait belts; thirteen indicated gait belts were required and had reduced back injuries by 75%, while five did not use gait belts due to broken ribs and tearing of skin.

At three medical supply stores, discussions were held with product specialists and consultants, and device catalogs perused.

Product coordinators and rehabilitation specialists (nursing, physical therapy, and occupational therapy) at two hospitals and three nursing homes were consulted about their knowledge and advice about assistive devices.

Nursing personnel experienced in the use of assistive devices were interviewed in three hospitals and five nursing homes/personal care facilities. Most stated they used hydraulic lifts and gait belts most often because of institutional policy; major problems cited were time and loss of independence for patients.

The category of Patient Transfer Unit (General) in the Directory of Products Index was examined at the University Reference Library. A vast array of assistive devices were found that could be used only for horizontal transfers or were stretcher-like devices that converted into a chair. The latter devices did not seem as appropriate as hoists because nursing home/personal care facility patients are generally transferred from chair to toilet and back in addition to transfer from bed to chair.

ASSISTIVE DEVICES

Few assistive devices seemed appropriate for study with the selected patient- handling tasks and fit the established criteria. The most frequently used devices for transfer were the gait belt (Fig. 1) and the Hoyer lift (Fig. 8). The Trans-Aid lift (Fig. 9) and sliding board (not shown) were used by several institutions. The Ambulift hoist (Fig. 10), walking belt with handles (Fig. 2), and MEDesign patient handling sling (Fig. 3) were discussed in the literature and recommended by a rehabilitation specialist. Also, the turn table (patient transfer disc) (Fig. 5) and sling with rings (Fig. 4) were described in the literature.

During an ergonomic study in a nursing home/personal care facility, it was found that several transfers could be eliminated if the patient was transferred from wheelchair to a shower chair that could accommodate the patient for toileting and showering. Two shower/toileting chairs (Fig. 6, Fig. 7) were selected on the advice of rehabilitation specialists.

PRELIMINARY TRIALS TO APPLY CRITERIA

Preliminary trials were conducted by the authors and two nurse research assistants to test the devices against the criteria and to determine which devices should be systematically evaluated in an effort to reduce back stress in nursing personnel. The laboratory was arranged as close as

Fig. 1
Gait Belt
is about 5 cm wide, of vary lengths with adjustable belt-like loop or buckle closure, has no handles, and is made of cotton-canvas or nylon material.. It should fit securely around patient's waist and is grasped with hands.

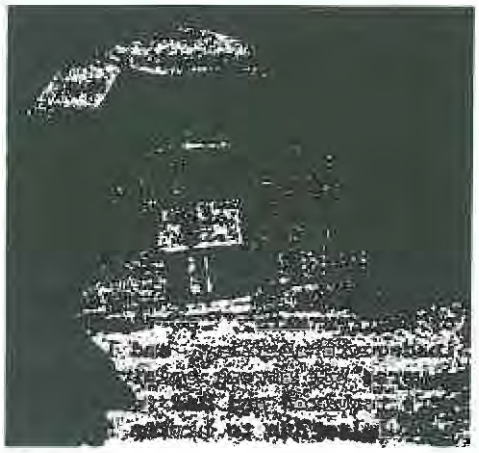

Fig. 2
Walking Belt
is 12.5 cm wide, of varying lengths, has handles on each side, has velcro and two quick-release buckles for closure, is made of cotton-canvas type material, fits snugly around lower abdoman, and is grasped at handles.

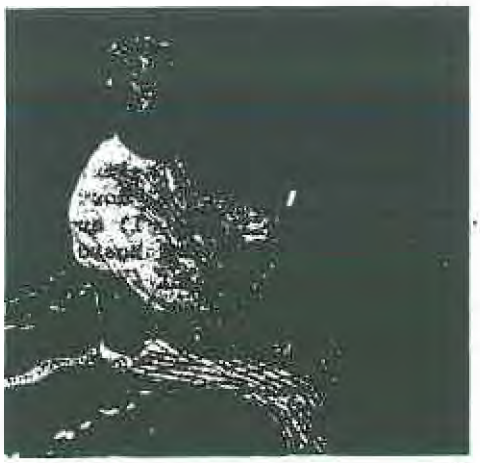

Fig. 3
MEDesign Patient Handling Sling
is 20 cm wide, 50 cm long, has a cut-out at each end allowing a hand grip, is made of flexible polymer material and is tucked securely around patient with bottom at buttock area.

Fig. 4
Patient Sling with Rings
is 23 cm at widest part, 90 cm long, 2 rings with 7 cm diameter attached for hand grip, made of stiff cotton/polyester type material.. Position sling around low back area.

Fig. 5
Turntable
patient transfer disc has rubber threads, rotates, has diameter of 30 or 38 cm, and is placed on floor between transferring locations. Patient places feet on turntable, and is helped to standing position, rotated 90°, and seated in new location.

Fig. 6
Shower/Toileting Chair
is light weight chair with a plastic non-moveable seat and has no foot rests.

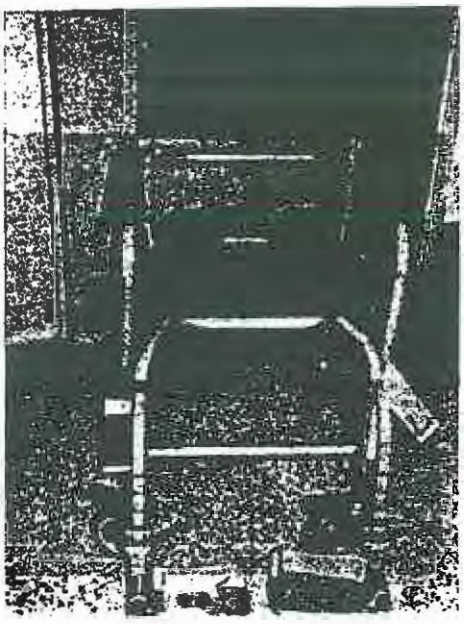

Fig. 7
Shower/Toileting Chair
is a heavy chair with padded removable seat and adjustable/ removable foot rests and arm rests that can be lowered.

Fig. 8
Hoyer Lift
is an hydraulic lift that has an adjustable base; a pump handle for raising and lowering the patient; and a variety of slings that attach through hooks, chains, or web straps.

Fig. 9
Trans-Aid Lift
has a non-adjustable "C" base, a ball- bearing screw lifting mechanism with crank in horizontal plane, and has a variety of slings that attach by hooks and dangling color-coded chains.

Fig. 10
Ambulift (C-3)
has a semi-adjustable base, a mechanical chain-winding mechanism for lifting/lowering with crank in vertical plane, and the sling attaches by loops and hooks.

A sliding board (not shown) is a smooth rectangular piece of wood about 20 cm wide and of varying lengths. It is bevelled at the edges so the patient (with good upper body strength) can slide from one surface to another of similar height.

possible to the patient environment of the nursing home/personal care facility. The research team served as patient and nursing personnel. It was difficult to simulate patient characteristics (combativeness, spasticity) but an effort was made for little or no weight-bearing during transfers.

The most difficult criterion to meet was the safety of the nurse when using the belts and slings. Body position and movement of the nurse were vital for the safe use of these devices. The ability to get close to the patient, keep the back as straight as possible, flex the knees, and keep the feet apart with one foot in the direction of the move so as not to rotate the spine were all important. The transfers were safer when a gentle rocking motion was used to provide the kinetic energy so a pulling (not lifting) action could be used to transfer the patient.

The walking belt and MEDesign patient handling sling met the criteria so were recommended for further study. The gait belt was not as comfortable as the other belts and slings but was studied further because it was used frequently in many nursing homes/personal care facilities (Owen, 1988).

The sling with rings was eliminated as it did not meet the criterion of safety for the patient or nurse (as perceived by nurse and patient). The belt is long so it cannot be "fastened" around the patient, and the large rings are not stable; these features created a feeling of insecurity and eliminated the ability to create a rocking motion.

The sliding board was not recommended for further study because it did not meet the criterion of appropriateness for tasks to be accomplished due to the following patient and environmental characteristics: many patients do not have the upper body strength and cognitive ability needed to make the transfer and the transfer surfaces must be similar in height, but many wheelchairs and geriatric chairs do not have adjustable arm rests so height cannot be equalized. This may be why Owen (1988) found infrequent use of sliding boards in nursing homes/personal care facilities.

The turntable was eliminated for reasons of appropriateness and safety. Many patients cannot bear weight or are unpredictable in their ability to stand; in addition, because of confined work space the turntable may be stored where patients or personnel could stumble over it.

The shower/toileting chairs were specifically selected for study so that toileting and showering could be done sequentially and hence several transfers could be eliminated. To ensure safety with the light-weight chair; it had to be placed against a wall so it did not tip during a transfer.

All three hoists were recommended for further study. During the pilot, the Hoyer was the least comfortable because the patient tended to be in a reclining rather than upright position; also, the patient swayed more during transfer and at times sensed a feeling of tipping over. The Hoyer was included because Owen (1988) found that it was used frequently.

SUMMARY

Use of assistive devices for transferring patients may be helpful in reducing back stress for nursing personnel. Criteria were established for selection of devices, and strategies were developed for locating available devices. A literature search was conducted, a questionnaire sent and visits made to nursing homes/personal care facilities, visits made to hospitals and medical supply stores, and specialists consulted. Slings, belts, sliding boards, turntables, shower/toileting chairs, and hoists were located. Through preliminary trials the walking belt, MEDesign sling, shower/toileting chairs, Trans Aid Lift and Ambulift hoist were recommended for further study. The gait belt and Hoyer Lift were recommended based on their frequency of use through questionnaire (Owen, 1988). The sliding board, sling with rings and the turntable were not recommended. The most difficult criterion to meet was safety of the nurse in relation to body

mechanics while using slings and belts. In the next phase of the NIOSH contract these devices will be systematically evaluated to determine if, with their use, back stress can be reduced when carrying out selected stressful patient handling tasks.

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The Impact of New Lifting Technology in Long Term Care

A PILOT STUDY

by Pamela J. Holliday, MSc, BSc(PT), Geoff R. Fernie, PhD, PEng, CCE, and Suzanne Plowman, BA, RN

Back injury due to lifting is a leading compensation cost in nursing (Charney, 1991). Nursing staff*, particularly nursing aides, orderlies, and attendants in long term care facilities, are at greater risk for lost time due to back injury than other occupations, including construction laborers, garbage collectors, and truck drivers (Jensen, 1987). Back pain contributes to the loss of approximately three quarters of a million working days per year for nurses, a rate twice the U.S. national average (Marchette, 1985).

One in 15 nurses will experience back injury serious enough to interfere with their nursing career (Stubbs, 1983). Lifting and transferring patients have been perceived by nursing personnel to be the most frequent causes of back problems (Owen, 1991; Uhl, 1987). In these times of economic restraint, reductions in staffing levels, along with the admission to hospitals of patients who require more intense care, add to the risk of injury on the job.

Back and lifting education programs have not been effective in reducing injuries to staff who lift and transfer patients (Venning, 1988; Wood, 1987). The loads that nurses lift (i.e., patients) exceed the capacity of the average nurse, as well as the lifting limits set out by the National Institute for Occupational Safety and Health (Garg, 1992a,b; NIOSH, 1981). Thus, there is a need to use mechanical lifting devices to decrease the load lifted by nursing staff. However, not all lifting devices are equally effective (Garg, 1991a,b). Consequently, the authors/researchers decided to develop better lifting technology in an attempt to address the problem of increasing injuries. A new lift system was designed to overcome some of the shortcomings of conventional wheeled mechanical lifts (Bell, 1984; Garg, 1991a,b, 1992a).

The new lift system (SturdyLift®, Lifestyle Innovations, Ontario, Canada [Figure 1]) consists of an overhead track and a portable power unit. The ability to share the portable power unit among several track locations reduces the cost considerably. The power unit is carried to the lift location and attached to an extension strap that hangs from the ceiling track. The patient sling straps are hooked onto the power unit and the caregiver or patient operates a switch on the power unit to control the lift (Figure 2).

Garg (1991a,b) acknowledged that lifting devices are

ABOUT THE AUTHORS:

Ms. Holliday is a research associate, Centre for Studies in Aging, Sunnybrook Health Science Centre, and the Departments of Surgery and Physical Therapy, University of Toronto. Dr. Fernie is Director, Centre for Studies in Aging, Sunnybrook Health Science Centre, and Professor, Department of Surgery, University of Toronto. Ms. Plowman is Nursing Unit Director, Sunnybrook Health Science Centre.

**the use of the terms "nurse" and "nursing staff" refers to all levels of staff, including registered nurses, registered nursing assistants, licensed practical nurses, orderlies (male attendants), etc, unless otherwise stated.*

essential, but found that many existing devices may be as stressful as manual lifting. The authors, therefore, undertook a pilot evaluation to study the impact of the introduction of the new mechanical lift technology in two long term care nursing units in two local hospitals.

METHODS

The Sites

Two nursing units in two local hospitals participated in the pilot evaluation. The hospitals purchased the technology and agreed to participate in the study.

One facility is a 1,319 bed university hospital. The nursing unit chosen was a 45 bed long term care unit with 20 male and 25 female patients. The average age of the resident population was 78 years (range: 64 to 100). The average nursing care required was 4.8 hr/day/patient. The daily staffing complement providing direct resident care was 10 on day shift, 6 on evening shift, and 2 on night shift.

"Primary nursing" was the nursing style at the university hospital. All residents were dressed and out of bed on a daily basis; most residents were returned to bed for an afternoon rest. The nursing unit had 45 beds in 14 resident rooms; each room had an ensuite toilet. At the time of site selection 17 residents were assessed as requiring mechanical lifting. The nursing unit had two wheeled mechanical lifts.

The second site for installation of the new lifting technology is a 406 bed specialized rehabilitation (78 beds) and long term care (264 beds) hospital. The 22 bed nursing unit chosen to receive the new lifting technology was a specialty long term care unit where residents were generally less than 65 years of age, and 80% had a diagnosis of multiple sclerosis. The average age of the residents was 47 years (range: 28 to 79). The average nursing care required was 4.2 hr/day/patient. The staffing complement was 6 on day shift, 4 on evening shift, and 2 on night shift.

"Total patient care" was the nursing style used at the rehabilitation/long term care hospital. Most of the residents were dressed and out of bed. Few residents returned to bed for an afternoon rest. At the time of the study, 13 residents required mechanical lifting for some or all of their transfers. The nursing unit had one wheeled mechanical lift.

Pilot Evaluation of Conventional Versus New Lifting Technology: Before/After Study

The pilot study consisted of comparing lifting of residents using the conventional wheeled mechanical hoist (the type available on the nursing unit prior to the introduction of the new technology) with lifting using the new overhead lift system by:

- Videotaping resident lifts. Consent for photography was received for all caregivers and residents prior to videotaping.
- Self administered caregiver profiles to collect personal and lifestyle information. Caregiver participation in the self administered questionnaires and videotaping was voluntary. No effort was made to ensure that the same staff were present in the before and after phases of the trial due to the pilot nature of the project.
- Administration of a resident profile questionnaire (completed by the primary nurse or a familiar nurse) to collect demographic and functional information. Cognitive impairment, ability to understand/communicate, and presence of unpredictable responses were patient attributes felt to influence patient handling; these attributes were assessed by a primary (or most familiar) nurse in a dichotomous manner.
- Conducting a week long record of each patient lift, including recording of the time taken to complete the lift, the number of staff required, perceived exertion and subjective rating of comfort of the caregiver, and subjective rating of comfort of the resident. The log was left in a ring binder at the side of each bed and completed by the nurse immediately following each resident lift.

A visual analog scale (VAS) was used to record subjective rating of comfort for both the caregiver and the resident; the 10 cm line was labeled "as uncomfortable as it could possibly be" on one end of the scale, and "comfortable" on the other end of the scale. The Borg scale for rating of perceived exertion was used; the scale ranges from 0 or "nothing at all" to 10 which is "very, very strong" (Borg, 1982).

- Non-parametric statistical analysis for paired data (Wilcoxon signed rank test for matched pairs, two-tailed) (Darlington, 1975) was used to compare before/after observations of lift time, caregiver exertion, caregiver comfort, and resident comfort. Descriptive analyses of other observations were conducted. Significance was set at alpha = 0.05.

Planning and Installation of the New Lifting Technology

The university hospital was the first large institutional installation of the new lift system. The lift had been on the market for approximately 3 months at the time of installation in the hospital. Installation at the second institution followed about 9 months later.

Ceiling tracks were installed over each bed at both hospitals, and over each toilet and tub at the university hospital, resulting in 61 track installations at the university hospital and 27 at the rehabilitation/long term care facility. The typical ceiling installation consisted of a single straight section of track at each installation. The 45 bed nursing unit was supplied with eight portable lift power units, and the 26 bed nursing unit (22 beds in use) was supplied with six portable lift power units.

A number of different track layouts were tested before the study began. The most convenient was selected (Figure 1). A straight section of track was placed such that the lift (when hanging from the ceiling extension strap) crossed the center line of the bed at a distance of 30 inches (76 cm) from the headboard. One end of the track ended over one side of the bed and the other end of

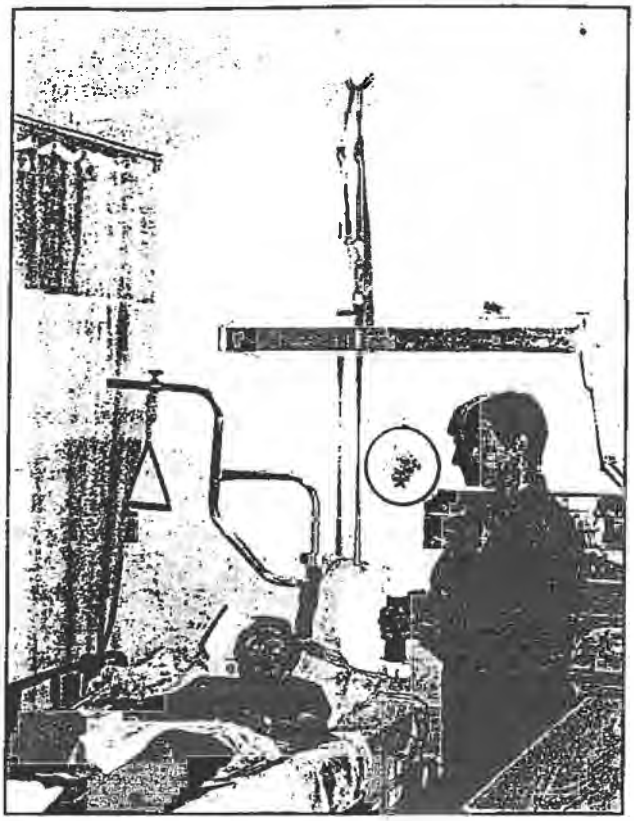

Figure 1: The new overhead lift system.

the track projected beyond the bed toward the center of the room, thus allowing the lift power unit to hang clear of the patient on either side of the bed.

The track was oriented at 45° to the wall so that the patient was moved off the bed and toward the center of the room. This orientation provided for easier maneuverability by avoiding the congested area immediately to the side of the head of the bed. The entire length of an 8 foot (2.44 m) track (the optimal track length over each bed) usually fit within the privacy curtain track perimeter. Sometimes a shorter track (minimum 6 foot [1.83 m]) was used to fit inside the privacy curtain.

Staff Training and Education

Lifting policy and staff education differed at each hospital. The university hospital had no lifting policy, and lifting training was conducted as part of orientation or as part of reeducation on an individual basis. Nurse educators were responsible for most aspects of teaching in nursing practice. Training in the use and operation of the new lift equipment was conducted primarily by one of the research staff.

The rehabilitation facility had a lifting policy and staff on each nursing unit who were designated as resource persons for lift related problems. Training in the use and operation of the new lift equipment was conducted primarily by the manufacturer's representative.

At the university hospital, a 9 month review (audit) of

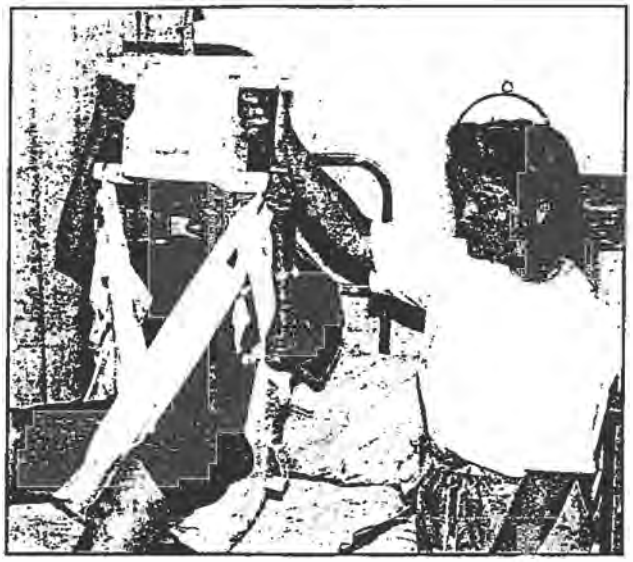

Figure 2: The caregiver or patient operates the switch on the power unit to control the lift.

lifting practice using the new lift system was undertaken. Four areas were observed and discussed with each caregiver: care planning for lifting, sling application, operation of equipment, and demonstration of transfer with real or simulated patients.

Other Observations and Impact

Workers' Compensation Board data for long term care nursing units at the university hospital were reviewed for the 5 year period prior to the installation and use of the new lift system, and following the installation of the new lift for approximately 2 years. The rehabilitation facility lost time injury data for patient handling were not readily available, but follow up of injuries after the installation was available for 1 year.

RESULTS

General

Sixteen residents at the university hospital and 15 residents at the rehabilitation facility required mechanical lifting over the course of the study period. Eighteen residents participated in both before and after phases; the data on these 18 residents were used for the paired statistical comparisons. The number of lifting observations for each individual that were recorded in the log varied from 1 to 24 over the 1 week period.

Eight residents participated in the "before" phase only, and eight residents participated in the "after" phase only. The subset of 18 residents who were used for statistical comparisons did not differ from the complete sample ($N = 24$ in the before phase and $N = 23$ in the after phase) in terms of demographic characteristics.

Nursing duty schedules were not altered to ensure that the same staff were present for the entire week of lift recording, or for both the before and after phases of the study. Twenty-two nursing staff responded in the before

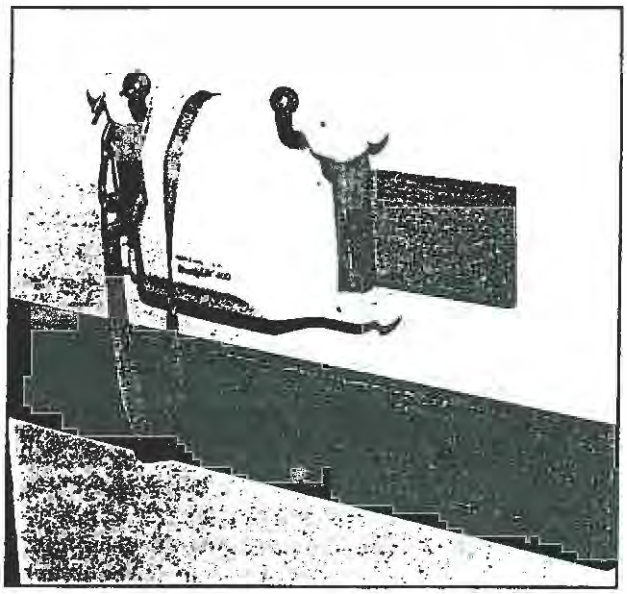

Figure 3: Wall mount for storage of the power unit for the new overhead lift system.

trial and 34 staff in the after trial; only one of the respondents was male. Over half (55%) of the caregivers were between the ages of 31 and 50 years; 20% were between 51 and 65 years of age. The majority (over 70%) of respondents assessed their physical fitness as average. Fifty-eight percent of the caregivers experienced discomfort when lifting or moving residents in their daily work.

Technological Issues

When the research group realized that there was no secure and convenient place to store the lift power units, they designed a storage rack for the portable power unit of the lift system; the nurses at the university hospital tested a prototype of the storage rack and provided feedback on its design, physical location, and function. The design was adopted by the manufacturer. The power units are now hung conveniently on wall mounted brackets along the ward corridor and are easily removed, in a manner similar to fire extinguishers (Figure 3). A security feature allows locking the power unit on the storage rack if necessary.

Some shorter nursing staff had difficulty reaching the ceiling extension strap to attach (hook) the strap of the portable power unit. This caused shoulder discomfort for at least one nurse and required unsafe practice, such as standing on a stool, by others. The problem was solved by the development of an accessory reaching aid that was tested by the nursing staff at the university hospital and subsequently supplied by the manufacturer (Figure 4). The reacher is well liked by the nurses and has resolved the shoulder problem.

Nursing Practice

Significantly fewer staff were required for patient lifting with the new lift system compared to the conventional wheeled mechanical lift ($p<.008$) (Table). Caregiver perceived exertion was significantly less with the new lift system ($p<.01$) (Table); however, the clinical significance of the difference in exertion has not been established. The mean exertion for the conventional lift was 3.8, and for the new lift system was 3.1; the Borg scale rating for "3" is "moderate" and for "4" is "somewhat strong" (Noble, 1983). Significant differences were not detected in caregiver comfort, time taken to do the lift, and resident comfort between the two lift systems.

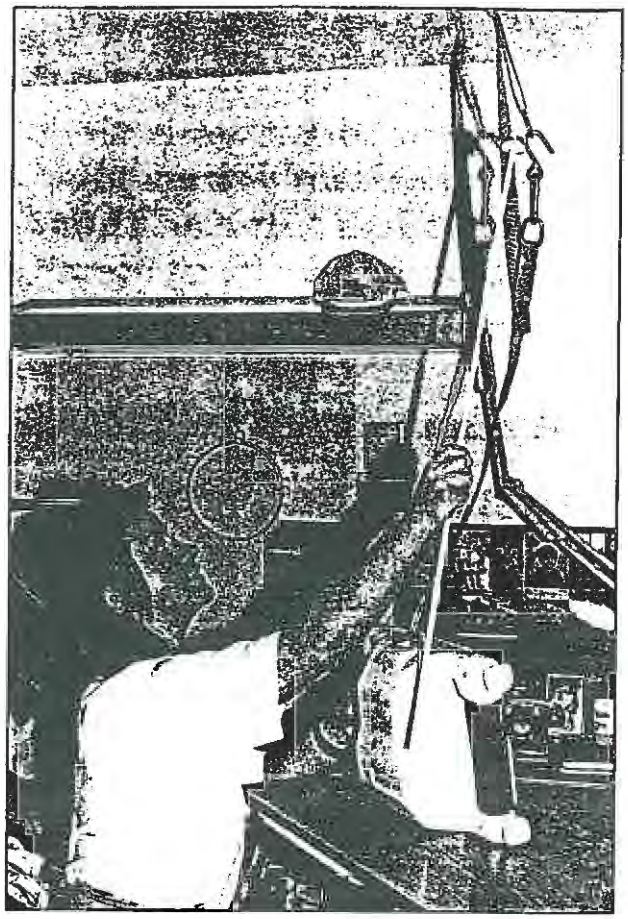

Figure 4: Accessory reaching aid being used to attach the strap of the portable power unit to the ceiling extension strap.

At the rehabilitation hospital, five residents were able to transfer with one or two person assistance in lieu of mechanical lifting at the beginning of the day when their symptoms were less pronounced. For these five individuals, the proportion of transfers observed using the conventional lift was 42% (22/53 observations) compared to 93% (50/54 observations) with the new lift system. There were no other changes in the patients' medical conditions that might account for the much greater use of the new lift system for these five individuals.

The new lifting device was used for nursing care in

TABLE

Comparison Between the Conventional Wheeled Mechanical Lift and the New Overhead Lift System*

	Conventional Lift		New Lift System	
	Mean	SD	Mean	SD
Time taken to lift *(min)*	6.6	1.9	6.9	1.7
Number of staff/lift	1.5	0.3	1.1†	0.2
Staff exertion *(scale 0-10, 10 is maximal)*	3.8	0.8	3.1§	0.7
Staff comfort *(scale 0-100, 100 is comfortable)*	61.7	20.0	60.6	12.3
Resident comfort *(scale 0-100, 100 is comfortable)*	70.9	27.6	69.5	16.3

**for 18 residents for whom data were available for both the "before" (wheeled mechanical lift) and "after" (new overhead lift system) study phases*
†$p<.008$
§$p<.01$

novel ways: residents who were not out of bed for any part of the day were lifted and held in a secure suspended position, in the lift sling, while the bed was changed or made up. The new lift was also used at times to lift and position residents onto a bedpan while in bed. This was accomplished by suspending the resident over the bedpan and lowering the resident on the pan to void while continuing to be supported by the lift in the sling.

Following installation of the overhead track at the tub, the tub chair lift was removed from the tub. This made it possible to bathe more of the severely disabled residents because of the increased space available inside the tub and also because of the support and security afforded by the new sling.

Demonstration of sling application at the 9 month audit revealed several common errors. Despite the time spent training, it appeared that continuous education and focus is required to ensure effective use of the new lifting equipment.

Injury Rate

It is too early since the introduction of the new lift system 2 years ago to determine its effect on injury rate and severity, as lost time injuries are relatively rare events (Garg, 1992b; Wood, 1987). Lost time lift related incidents have occurred at the university hospital since the installation of the new lift system, but none have occurred while using the lift. There have been no lift related client handling injuries on the nursing unit at the rehabilitation facility since using the new lift system.

One of the injured workers (back overexertion injury due to unexpected patient movement during a transfer) returned to the nursing unit on a modified work program and was able to care for her primary patient, who required mechanical lifting, early in her modified work program. She would not have been able to assume patient care duties had the conventional wheeled lift been the mechanical device in use.

One incident involving a resident has been noted with the use of the new lift system. Following use of the mechanical lift, the resident was not properly seated and secured in her wheelchair and slid from the chair to the floor. Both her dress and the lift sling material were slippery and provided too little friction for her to remain in her precarious position in the chair. The resident was not injured, and the new lift system was used to lift the woman into her chair and reposition her properly and securely.

DISCUSSION

One national health promotion and disease prevention objective is to reduce injuries at work, including those resulting in medical care, lost work time, or limited activity, to no more than six cases per 100 full time workers by the year 2000 (U.S. Department of Health and Human Services, 1991). The special target for nursing and personal care workers is a reduction from 12.7 (1983 to 1987 average) to nine cases per 100 full time workers in the year 2000.

Because lifting injuries in nurses constitute a significant proportion of the injuries and absences from work, attempts to reduce and prevent lifting injuries will contribute to achieving the national objectives. By studying the risk factors that cause injury and rigorously examining, in larger controlled trials, the effectiveness of patient lifting devices, occupational health care providers may be better able to target interventions to reduce injuries in nursing staff.

Controlled trials of lifting technologies using lost time injuries as the outcome have not been undertaken. Only a few field studies, using uncontrolled designs and observational techniques, have examined mechanical lifting device use in nurses (Garg, 1992b; Roth, 1993). Only one of these studies observed nursing back injuries (Garg, 1992b).

Although the trial by Garg (1992b) was not controlled, the findings are important for the development of future clinical trials. Studies in hospital settings are complex. The intervention was not only the supply of assistive lifting devices, but also modification of environment and training. The use of outcomes other than injury

data were found to be significant, such as perceived exertion and biomechanical estimates of stress.

The observation that injuries still occur may lead researchers to examine other methods to prevent their occurrence, as well as whether the assistive devices need re-design or revision. Significant differences in estimated loads and perceived stress were found between different hoists. Thus, the selection of hoists will alter study results and will mean that the findings are not necessarily generalizable to all types of patient hoists.

A controlled research trial of the effectiveness of mechanical lifting devices must be very large to have enough power to measure changes in injury rate. Estimates based on a retrospective 5 year (1987 to 1991) analysis of patient lift related lost time injuries in 12 long term care nursing units at the university hospital indicate a need for a sample size of approximately 1700 bed years (e.g., 10, 45 bed nursing units for 4 years) in *each group* of a research study to detect a 50% reduction in lost time injury rate.

Large studies are required for several reasons. Injuries are rare events. In 1992 at the university hospital, there were 1,339 incidents; 164 were lost time incidents (all causes), and 42 of the lost time incidents (all causes) occurred in the long term care beds (670 beds). Also, there is great variability in rates. Considerable variation from year to year, within and between nursing units, has been reported (Garg, 1992b; Wood, 1987), and the university hospital's data support this (Health Care Occupational Health & Safety Association, 1991, 1992).

Owen (1993) reported that 38% of nurses stated they had episodes of occupationally related back problems, but only 34% of those nurses reporting episodes of occupationally related back problems actually filed an incident report. Most accepted back pain as part of the job and took sick days. Stubbs (1981) reported that nurses in England have twice as much sick leave as a result of back problems as the rest of the working population.

Nursing staff are mostly female and perhaps are self selected as nurturing by nature. Nurses "accept pain," "are martyrs," or adopt a "professional attitude" whereby it is not acceptable to take time off—pain is part of the job. In addressing community nurses' attitudes to lifting technology, Friele (1993a,b) coined the "tough nurse" concept. The preliminary data suggest that some nurses have the attitude that *all* patients can be lifted (without mechanical devices) if proper techniques are used, and back education programs actually perpetuate this "tough nurse" syndrome.

Informal interviews with nursing staff have raised several possible factors to explain the comparatively low proportion of injuries resulting in loss of time. Phrases such as "nurses come to work even if dead," "body parts hurt for years and we (nurses) continue to work" kept coming up. Supervisors were perceived as not being supportive of workers' compensation claims—"a guilt feeling" is caused because of the "extra" work generated for the supervisor and other staff members who must compensate.

This study did demonstrate significant time savings related to the fact that the new lift allows lifting to be performed by one nurse alone.

This study represents a pilot trial. Many factors that may have influenced the results were not controlled by the researchers. The 1 week lift log was left at the bedside for the staff to complete at each transfer; thus the information was not blinded and previous entries could have influenced a nurse's recording. The number of transfers recorded in the log book varied due to the individualized schedule for each resident, and due to inconsistencies in nurses' reporting of transfers. The same staff were not necessarily on duty for the entire observation week or for both before and after phases of the study. Other factors such as psychosocial issues, although recognized as important, were not evaluated in this pilot study.

Even though savings from reduced injuries have not yet been proven, this study did demonstrate significant time savings related to the fact that the new lift allows lifting to be performed by one nurse alone. The staff time saved in this study amounted to the equivalent of approximately 50% of one full time equivalent person per nursing unit. The total time for lifting includes the time retrieving the equipment, applying the lift sling and preparing the patient, executing the transfer, and removing the sling and storing the equipment. The assistant is usually recruited for the lift execution only. The actual speed of lifting was unchanged, but nurses found that they could use their time more efficiently by avoiding the need to coordinate the timing of lifts to be sure a second nurse was available.

The focus on injuries to the back may result from their costly nature (Jensen, 1987). However, other body sites contribute to nursing pain and injury due to patient handling.

The researchers' 5 year review (unpublished data) of lost time patient handling injuries in 12 long term care nursing units (534 beds) revealed that 63% (35/56) were back injuries (including neck and thoracic, lumbar, and sacral spine), 13% (7/56) were shoulder injuries, and 18% were other upper extremity injuries (excluding the shoulder). The remaining 7% of injuries occurred in the lower limb and trunk.

CONCLUSION

The new lifting technology in this study provides the advantages of overhead lifting at a reduced cost. The

The Impact of New Lifting Technology in Long Term Care

A Pilot Study.

Holliday, P.J., Fernie, G.R., & Plowman, S.

AAOHN Journal 1994;42(12):582-589.

1. The researchers conducted a pilot study to test a new lifting system developed with the assistance of nurses.

2. The lift system consists of a portable battery operated power unit that the nurse carries to the bedside and attaches to an overhead track; the ability to share the portable power unit among several track locations is economical.

3. The new lifting system was found to reduce the number of staff necessary to execute patient lifts. This staff saving amounted to 50% of one full time equivalent person per nursing unit.

4. Nurses perceived that less effort was required using the new lifting system compared to a conventional floor model wheeled lifting device.

economies result from sharing a portable lift unit among several track locations. Collaboration between nursing and research resulted in improvements to the new lift technology, including convenient wall mounted storage of the lift units.

Caregiver perceived exertion was significantly less with the new lift system although the clinical significance of the difference in exertion has not been established. No difference in caregiver or resident comfort was detected; this may be due to inadequate power to detect a difference, or to the use of instruments that were insensitive.

No injuries occurred in "lifting" tasks where the new lifting technology was relevant. However, injuries to nurses continued to occur related to non-lifting patient handling tasks. A change in injury rate would require a much larger study to achieve statistical significance.

In this study, the nursing staff worked closely with the developers of the lift system. This interaction resulted in many improvements. Although objectivity in evaluation would be more easily demonstrated if there were no relationship, it is felt that the advantages of developing and evaluating technologies in a collaborative way add considerable value to the research, as findings can be implemented prior to conducting a formal clinical trial. A properly controlled large scale clinical trial is planned.

The authors would like to thank the nursing staff and managers on the participating nursing units who participated in the pilot study project: K2 East at Sunnybrook Health Science Centre and 3WD at West Park Hospital.

Dr. Fernie managed the company that manufactured the new lift equipment for a period of time during the start-up phase of the company. This temporary, unpaid appointment was in addition to his primary appointment as Professor, Department of Surgery, University of Toronto, and Director, Centre for Studies in Aging at Sunnybrook Health Science Centre. The Centre for Studies in Aging receives modest royalties from installations of this technology. All revenues from products developed by the Centre for Studies in Aging are applied in support of further research and no revenues are received by individual researchers.

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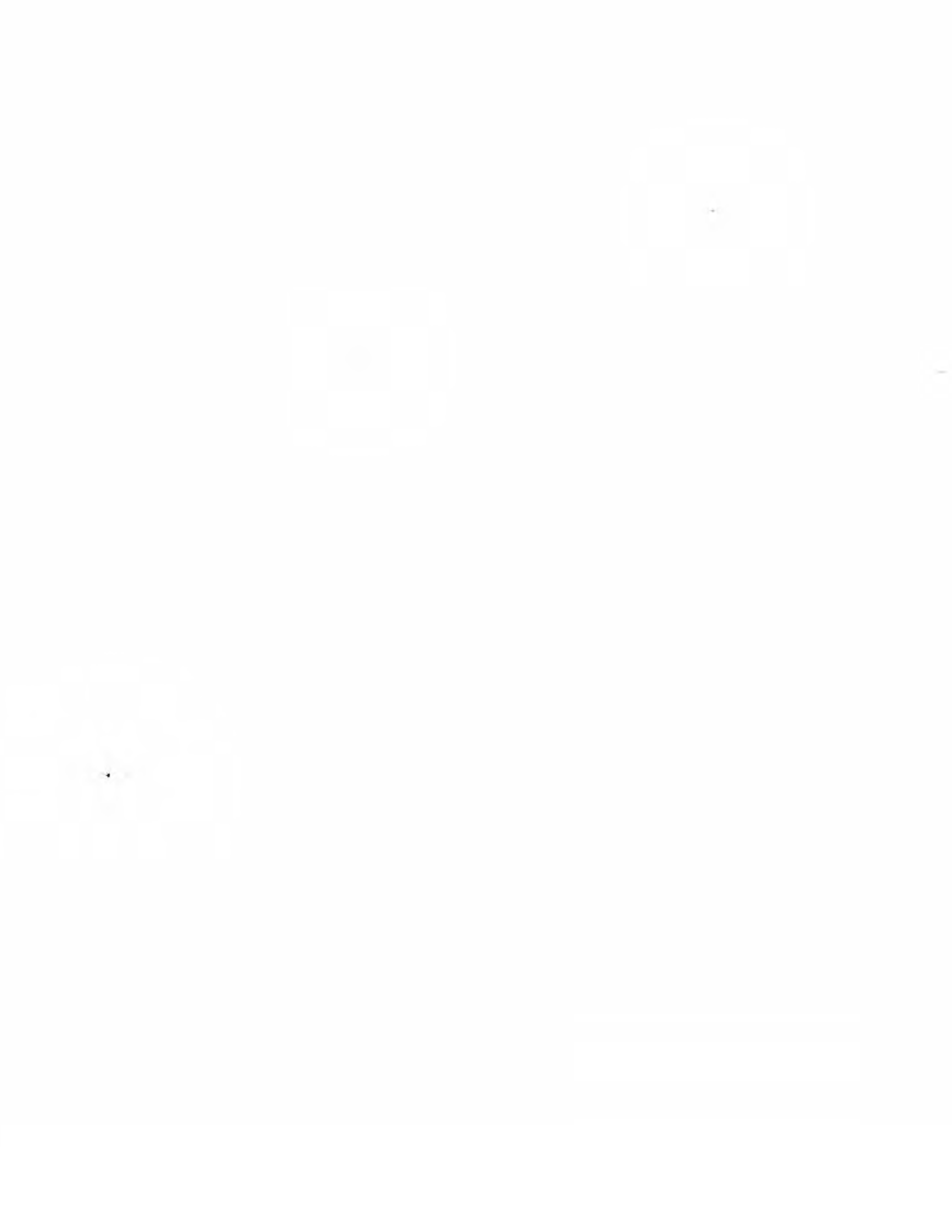

ERGONOMICS TRAINING WORKSHOP

BRAD EVANOFF, MD, MPH
STEVEN HECKER, MSPH

This workshop will cover good training and education principles as applied to ergonomics and the special challenges of ergonomics in the health care work environment. Participants are encouraged to share their own experiences and insights.

I. Training as a component of an overall ergonomics program

- A. Ergonomics program elements
  1. Work site analysis
  2. Hazard prevention through engineering and design
  3. Medical management
  4. Education and training
- B. Limitations of training
- C. Balancing environmental and individual factors in controlling musculoskeletal disorders
- D. Employee involvement in ergonomics training

II. Designing ergonomics training programs

- A. Assessing training needs and the audience(s)
- B. Assessing resources and the social environment in which training will take place
- C. Establishing training objectives and content
- D. Selecting methods and instructors
- E. Implementing the training program
- F. Evaluation
- G. Follow-up and reinforcement strategy

III. Special challenges of ergonomics in the health care workplace

- A. Worker self-protection vs. patient care
- B. Unique, variable, and unpredictable lifting tasks
- C. Down-sizing, restructuring, increasing patient acuity
- D. Language, literacy issues

SURVIVING HEALTH AND SAFETY COMPLIANCE INSPECTIONS

Nancy Beaudet, MS, CIH
Industrial Hygienist
Harborview Occupational and Environmental Medicine Program
Seattle, Washington

Ron Kaplan, MN, ARNP, COHN
Coordinator, Employee Health Clinic
Department of Veterans Affairs Medical Center
Seattle, Washington

Stephen M. Hurley, MSPH, CIH
Manager, Healthcare Risk Management Services
Johnson & Higgins of Washington, Inc.
Seattle, Washington

With the increased promulgation of occupational health and safety standards focused on the healthcare industry, organizations are more likely to face an inspection by regulatory agencies or accrediting organizations. This workshop is designed to help participants understand and prepare for an inspection. The workshop will consist of short presentations on:

- The perspectives of a former OSHA and Washington State compliance officer
- The experiences of a recently inspected medical center
- The role of the Joint Commission in health and safety

The presentations will be followed by an open forum for questions, comments, discussions, and the sharing of ideas and experience.

Compliance Perspective
Nancy Beaudet, MS, CIH
731-3005
3/96

Inspection Trigger
- Imminent Danger
- Fatality/catastrophe
- Employee complaint
- Referral—media, customer, other government agency, physician
- Programmed--high hazard industry (ie blood borne pathogens emphasis program)

Legal criteria for violation
- Hazard
- Employee exposure
- Existing standard (ie ethylene oxide standard) or generic "safe place" standard
- Employer knowledge

Inspection Procedures

Unannounced entry

Opening conference
- Inspection structure
- Employer and employee rights
- Trade and military secrets
- Written program evaluation

Walk around
- Employee interviews
- Photographs
- Chemical/physical/biological hazard sampling/evaluation
- Observation of hazards, work practices, etc (ie look for recapped needles in SHARPS container)

Hazard Communication Standard example of what compliance looks for:
- -written program including chemical inventory list
- -training records
- -process for maintaining MSDSs
- -container labeling
- -employee interview (confidential)
  - -location of MSDSs, how does employee get one?
  - -training on specific chemicals used by employee, long & short term health effects of most hazardous chemicals, signs of exposure (odor, etc)
  - -personal protection equipment--available? when used? does it work?
  - -chemical spill procedures

Closing Conference
- Review proposed violations
- Explore issues. Answer questions.
- Review proposed violations

Compliance Perspective
Nancy Beaudet, MS, CIH
731-3005
3/96

Violation Classification
- General-typically no penalty
- Serious--up to $7000
- Willful-- $5000 to $70,000
- Repeat--(citation proposed-problem corrected-condition reoccurred)--up to $70,000
- Failure to abate original citation--initial penalty multiplied by number of days condition remained unabated for a maximum of 30 days

Factors which effect penalty
- Severity of possible health outcome due to hazardous condition
- Probability of injury/illness occurring

Penalty reduction factors (Up to 90% penalty reduction possible)
- Employer good faith determined by existing programs (Maximum 25%)
- Employer size (Maximum 60% reduction--no reduction >250 employees)
- Previous citation history (No history, automatic 10% reduction)

Criteria for citation appeals (any or all of the reasons listed)
- Disagree with violation content
- Disagree with penalty
- Disagree with abatement date

Appeal Process
- Come to appeal hearing organized and with a strategy.
- Hearing is typically very informal (at least initially) and held in local area office.
- Higher level appeals will be heard by the Board of Industrial Insurance.
- Board of Industrial Insurance decision can be appealed to Superior court system.

Industrial Hygiene and Safety Consultation Services

Consultation services are provided free of charge by the State or Federal Government. Because of the heavy demands placed on consultants, it may take several months before a visit can be arranged for your facility.

Washington

Seattle	(206) 281-5440
Everett	(206) 290-1404
Tacoma	(206) 596-3868
Olympia	(206) 902-5638
Spokane	(509) 324-2682

Alaska	(907) 269-4939
Idaho	(208) 385-3238
Montana	(406) 444-6401
Oregon	(800) 922-2689 (503) 378-3272

For other locations contact your local OSHA (Occupational Safety and Health Administration) office.

SURVIVING AN INSPECTION-

A MEDICAL CENTER PERSPECTIVE

Ron Kaplan, ARNP, COHN
Employee Health Coordinator
VA Puget Sound Health Care System
Seattle WA

1. BACKGROUND
2. AREAS OF INSPECTION
3. THE INSPECTION EXPERIENCE

BACKGROUND

1. Surprise Inspection
2. Generated by a "high injury rate"
3. Wall-to Wall inspection
4. Contact with Director, "Safety Team", Union
5. Process of being constantly inspected:

   JCAHO

   Regional safety/health

   State agencies

INSPECTION PROCESS

1. Approach of inspectors:

    -their safety background
    -emphasis on procedures, outcomes/not on policies
    -OSHA 200 Log
    -committee documents/reports
    -"hands-on" approach
    -will speak with individuals

2. Safety Issues

    -background of inspectors
    -building/plant technology
    -environment of care

3. Ergonomics

    -Specific criteria; meat packing industry

    -Identification of high-risk areas/jobs

        Mechanism of surveillance
            Safety committee, ARB, Union, Injury records

        Program of worksite evaluation

    -Program of prevention

        Job evaluation
        Modification of equipment/procedures
        Training program

    -"Secondary Prevention"

        Reduction of hazards
        Modified Duty

    -Institutional Responsibilities

        Continuous monitoring

        Policy

4. Bloodborne Pathogen Standard

-Level of expertise/experience

-Policy

-Monitoring
individual injury; evaluation/form
aggregate data; numbers, causes, devices

-Prevention efforts
training/ devices

-Talked with employees
-No Hep B vaccination rates, needlebox dumping

5. Tuberculosis

-OSHA
looked at policy
not comprehensive

-JCAHO

EXPERIENCE OF BEING INSPECTED

1. PREPARATION:

   Team development
   Computer information system

2. OSHA Inspectors

   Knowledge/Experience
      safety/industry based

   Previous relations/interaction
      Used in past as resource for information/guidance
      Committees/ workshops

INFECTION CONTROL - OCCUPATIONAL HEALTH PARADIGM

- Effect on training, strategies and goals

- Infection Control- prevent infection, disease transmission

  CDC-

  "Recommendations for Prevention of HIV Transmission in Health-Care Settings."

  "Guidelines for Preventing the Transmission of Tuberculosis in Health-Care Facilities."

- Occupational Health- prevent exposure to risk, to occupational disease.

  OSHA-

  "Occupational Exposure to Bloodborne Pathogens; Final Rule"

  "Enforcement Policy and Procedures for Occupational Exposure to Tuberculosis."

Scientific vs Regulatory Environment

UPDATE ON TUBERCULOSIS: NIOSH HEALTH HAZARD EVALUATIONS

Teresa Seitz, MPH, CIH
Industrial Hygienist
National Institute for Occupational Safety and Health
Cincinnati, Ohio

1 RESURGENCE OF TUBERCULOSIS: A PUBLIC HEALTH AND OCCUPATIONAL HEALTH PROBLEM

- 1994 - 24,361 cases in the United States
  264 cases in Washington State (7.4% decrease over 1993)

- Since 1989 - Outbreaks of MDR-TB at 14 hospitals, with 17 cases of MDR-TB among HCWs, 15 of whom have died. Additionally, hundreds of HCWs have had skin test conversions as a result of occupational exposures.

2 TB TRANSMISSION

- Source is generally a person with TB of the respiratory tract
- Droplet nuclei containing *Mycobacterium tuberculosis* (*M.tb*) are 1-5 microns in diameter, thus they remain airborne for long periods of time
- Risk of infection related to concentration of droplet nuclei in air and duration of exposure
- TB infection vs. TB disease and drug susceptible vs. MDR-TB
- Factors affecting increase in TB morbidity: immigration, HIV/AIDS epidemic, outbreaks in congregate residential settings (hospitals, prisons, homeless shelters)
- Factors contributing to the outbreaks (convergence of immunocompromised persons, delayed isolation precautions, inadequate ventilation, lapses in isolation procedures, and inadequate precautions during high risk aerosol generating procedures).

3 GUIDELINES FOR PREVENTING TB TRANSMISSION IN THE WORKPLACE

- CDC *Guidelines for Preventing the Transmission of Mycobacterium tuberculosis in Health-Care Facilities, 1994*

- OSHA *Enforcement Policy for Occupational Exposure to Tuberculosis*, October 1993 and update September 1995

4 CASE STUDIES: NIOSH HEALTH HAZARD EVALUATIONS

- Since 1990, 64 TB-related HHE requests have been received. The settings parallel those where outbreaks of TB have occurred and/or where groups of people at high risk for TB congregate.

- Evaluation of administrative control measures, engineering controls and respirator use. Case studies of various HHEs conducted primarily in health care facilities will be presented showing examples of the various control measures, evaluation methods, and findings.

CDC
CENTERS FOR DISEASE CONTROL AND PREVENTION

Division of Tuberculosis Elimination Educational and Training Materials

Please indicate desired quantity in the blank provided. All materials are free of charge.

For Health Care Providers

Multidrug Resistant Tuberculosis - 1994
____ (00-6529) *8-page article on the causes, treatment, and control of drug-resistant tuberculosis*

Core Curriculum on Tuberculosis, 3rd Edition - 1994
____ (00-5763) *95-page training guide on important clinical and public health aspects of TB control*

TB Care Guide - 1994
____ (00-6470) *57-page booklet for clinicians on care of TB patients, with a tear-off card for dosage calculation and reference*

TB Treatment: A Clinical Guide - 1994
____ (00-6471) *Fold-out chart with 8 panels with tables on TB treatment and medications for clinicians' reference*

TB Facts for Health Care Workers - 1993
____ (00-5655) *7-page booklet on TB transmission, diagnosis, prevention, and treatment*

Think TB! - *Poster listing the symptoms of tuberculosis*
____ (00-6186) *English language - 1992* ____ (00-6406) *Spanish language - 1993*

Improving Patient Adherence to Tuberculosis Treatment - 1994
____ (00-5988) *55-page booklet on measuring, predicting, and improving compliance*

Mantoux Tuberculin Skin Testing - *Visual aids for training to administer and interpret the Mantoux test*
____ (00-5564) *Wall chart - 1990*
____ (00-5457) *Videotape - 1991*

Reported TB in the United States - 1994
____ (00-6538) *Statistics on tuberculosis cases and case rates reported for 1994*

Controlling TB in Correctional Facilities - 1995
____ (00-6553) *A comprehensive guide that provides a resource to assist correctional officials in controlling tuberculosis among inmates and staff of correctional facilities. Includes case studies, screening algorithms, treatment tables, and sample forms for information management.*

For Drug Treatment Center Staff

What Drug Treatment Centers Can Do To Prevent Tuberculosis - 1991
3-page pamphlet on TB infection, disease, screening, and prevention for drug treatment centers
____ (00-5748) *English language* ____ (00-6038) *Spanish language*

For Correctional Facility Inmates

Tuberculosis Facts - 1991 - *Pad of 40 tear-off sheets providing basic information on the subject specified:*

English language		*Spanish language*	
____ (00-5983)	Exposure to TB	____ (00-6200)	Exposure to TB
____ (00-5984)	The TB Skin Test	____ (00-6201)	The TB Skin Test
____ (00-5981)	You Can Prevent TB	____ (00-6198)	You Can Prevent TB
____ (00-5985)	TB Can Be Cured	____ (00-6202)	TB Can Be Cured
____ (00-5982)	TB and HIV (The AIDS Virus)	____ (00-6199)	TB and HIV (The AIDS Virus)

(January 18, 1996)

GUIDELINES

TB PREVENTION AND CONTROL

____ (00-5856) **Guidelines for Preventing the Transmission of *Mycobacterium tuberculosis* in Health Care Facilities.** *MMWR*, 1994.

____ (00-6410) **Tuberculosis Control Laws -- United States 1993.** *MMWR*, November 12, 1993.

____ (00-6330) **Control of Tuberculosis in the United States.** Reprint from the *American Review of Respiratory Disease*, December 1992.

____ (00-6224) **National Action Plan to Combat Multidrug-Resistant Tuberculosis.** *MMWR*, June 19, 1992.

____ (00-6223) **Prevention and Control of Tuberculosis in Migrant Farm Workers.** *MMWR*, June 5, 1992.

____ (00-6148) **Prevention and Control of Tuberculosis Among Homeless Persons and Prevention and Control of Tuberculosis in U.S. Communities with At-Risk Minority Populations.** *MMWR*, April 17, 1992.

____ (00-5897) **Prevention and Control of Tuberculosis Among Foreign-Born Persons Entering the United States.** *MMWR*, December 28, 1990.

____ (99-3327) **Prevention and Control of Tuberculosis in Facilities Providing Long-Term Care for the Elderly.** *MMWR*, July 13, 1990.

TB SCREENING AND TREATMENT

____ (00-6453) **Treatment of Tuberculosis and Tuberculosis Infection in Adults and Children.** Reprint from the *American Journal of Respiratory and Critical Care Medicine*, May 1994.

____ (00-6225) **Management of Persons Exposed to Multidrug-Resistant Tuberculosis.** *MMWR*, June 19, 1992.

____ (00-6547) **Essential Components of a Tuberculosis Prevention and Control Program. and Screening for**

For Patients and the General Public

Questions and Answers about TB - 1994

____ (00-6469) *16-page booklet about TB transmission, skin test, and treatment, including DOT and side effects of medications*

Stop TB! - 1994

____ (00-6474) *Poster describing the transmission and pathogenesis of TB*

____ (00-6475) *Pad of 50 tear-off sheets duplicating the Stop TB! poster*

Tuberculosis - Get the Facts! - 1990

One-page pamphlet on basic facts about TB transmission, infection, and the tuberculin test

____ (00-5743) *English language* ____ (00-5772) *Spanish language*

Tuberculosis - The Connection Between TB and HIV (the AIDS Virus) - 1990

One-page pamphlet on the risk of HIV-related TB, tuberculin testing, and preventive therapy

____ (00-5738) *English language* ____ (00-5745) *Spanish language*

TB/HIV Double Trouble - 1992

____ (00-6154) *Poster stressing the importance of tuberculin testing for persons with HIV infection*

To order tuberculosis educational and training materials or guidelines, you may (1) call the National Center for HIV, STD, and TB Prevention Voice Information System (recording) at (404) 639-1819; (2) FAX this form to Information Technology and Services Office at (404) 639-8628; OR (3) mail this form to: Information Technology and Services Office, NCHSTP, CDC, 1600 Clifton Road NE, Mailstop E-06, Atlanta, Georgia 30333.

PLEASE NOTE: Large shipments are sent by UPS and require a *street address*. Large packages *cannot* be shipped to PO Boxes.

Name: _____

Address: _____

_____

_____

_____

_____

_____

_____

_____

Phone: ( ) _____

Tuberculosis Among Urban Health Care Workers: A Study Using Restriction Fragment Length Polymorphism Typing

Kent A. Sepkowitz, Cindy R. Friedman, Alice Hafner, David Kwok, Seth Manoach, Michelle Floris, Diana Martinez, Kumar Sathianathan, Esther Brown, Judith J. Berger, Sorana Segal-Maurer, Barry Kreiswirth, Lee W. Riley, and Mark Y. Stoeckle

From the Division of Infectious Diseases and Division of International Medicine, Department of Medicine, Cornell University Medical College; the Tuberculosis Center, Public Health Research Institute; and Collaborating Institutions, New York, New York

Cases of tuberculosis identified during 1992–1994 through an active tuberculosis surveillance network among six hospitals that serve New York City (the TBNetwork) were analyzed according to the occupational status of the patients. Clinical data were obtained by review of medical records, and restriction fragment length polymorphism (RFLP) typing of *Mycobacterium tuberculosis* isolates was performed. No known nosocomial outbreaks of tuberculosis occurred at these hospitals in the study period. Occupational status was known for 142 of 201 patients whose isolates were available for strain typing. Patients infected by organisms with a clustered strain typing pattern, as determined by RFLP analysis, were presumed to have recently acquired disease. RFLP typing revealed that isolates from 13 (65%) of 20 health care workers and 50 (41%) of 122 non–health care workers had a clustered RFLP pattern. The strains infecting eight (89%) of nine health care workers seropositive for human immunodeficiency virus (HIV) had a clustered RFLP pattern. Multivariate analysis of 75 patients with known HIV and occupational status revealed that HIV status ($P = .03$) and health care worker status ($P = .02$; RR = 2.77) were independent risk factors for a clustered RFLP strain. These findings suggest that many of the apparently sporadic cases of tuberculosis among health care workers may be due to unrecognized occupational transmission.

One of the consequences of the resurgence of tuberculosis is a renewed interest in the risk to health care workers [1–3]. Tuberculosis has been reported to be an occupational hazard for nurses and physicians since the 1920s, although the risk was not generally acknowledged until the 1950s [4]. Recognition of the hazard to health care workers prompted institution of hospital-based control programs, including admission chest radiography for all patients (to identify unsuspected cases) and regular tuberculin testing for employees. Despite these programs, reports over the past 3 decades indicate a persistent 2- to 10-fold increased risk of tuberculosis infection and disease among health care workers as compared with the risk among the general population [3–10].

The hazards of occupational tuberculosis were dramatically highlighted during 1990–1991, when several institutional outbreaks due to multidrug-resistant strains of *Mycobacterium tuberculosis* were reported [11–14]. In these outbreaks, there were widespread transmission to patients and staff and several deaths among personnel, prompting issuance of new guidelines for hospital personnel [15–17]. Since then, there have been relatively few reported outbreaks, which suggests that current control measures may be effective [18–20]. However, it is not known whether the apparently sporadic cases of tuberculosis in health care workers are due to occupationally acquired infections or, as a recent study suggested, are more likely due to community-acquired infections [21]. In addition, the risk for HIV-infected personnel is not well defined, although some have suggested that HIV-infected health care workers should have the option of being assigned to an area associated with a low risk of exposure to tuberculosis [22].

In this study we analyzed cases of tuberculosis with use of a laboratory-based active surveillance system for tuberculosis at six hospitals in New York City (the TBNetwork). As determined by molecular genetic typing of the *M. tuberculosis* isolates, most health care workers with tuberculosis appear to have recently acquired infections.

Methods

Tuberculosis surveillance and case identification. The TBNetwork was established in June 1993 by infection control personnel at participating hospitals. The participating institu-

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This work was presented in part at the 34th Interscience Conference on Antimicrobial Agents and Chemotherapy, held 4–7 October 1994 in Orlando, Florida.

Reprints or correspondence: Dr. Kent A. Sepkowitz, Infectious Disease Service, Memorial Sloan-Kettering Cancer Center, 1275 York Avenue, New York, New York 10021.

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1058–4838/95/2105–0003$02.00

tions include 6 acute care hospitals located in 4 boroughs (counties) of New York City (Manhattan, 3; Bronx, 1; Brooklyn, 1; and Queens, 1). The TBNetwork Study Group also includes representatives from the Bureau of Laboratories of the New York City Department of Health and the Tuberculosis Center of the Public Health Research Institute. Cases were defined as all culture-confirmed cases of tuberculosis identified from specimens obtained between 1 January 1992 and 1 March 1994.

Statistical analysis. Clinical data were obtained by review of patients' medical records with use of a standardized questionnaire and were analyzed with Epi Info, version 5.01b (Centers for Disease Control and Prevention), and SAS, version 6.04 (SAS Institute, Cary, NC). Student's *t*-test and χ^2 with Yates correction/Fisher's exact two-tailed test were used to assess univariate risk factors for continuous and respective categorical variables. For each characteristic of interest, those of unknown status were excluded from the analysis. Risk factors associated with a clustered restriction fragment length polymorphism (RFLP) pattern by univariate analysis were then included in multivariate logistic regression models, with health care worker/non–health care worker as the dependent outcome. Odds ratios and the corresponding 95% confidence intervals were calculated manually with use of the results obtained for the maximum-likelihood estimates.

Molecular strain typing. Genetic fingerprinting of *M. tuberculosis* isolates utilized a standardized method of RFLP typing based on the insertion sequence IS*6110* [23, 24]. This typing method has been validated in epidemiological studies and enables identification of disease outbreaks due to clonal spread of *M. tuberculosis* strains [25–33]. Patients from whom the same strain (having an identical RFLP pattern) is isolated are presumed to be recently infected from common or related sources. Patients infected with unrelated strains (having a unique RFLP pattern) are presumed to have a reactivated latent infection acquired from unrelated sources in the past. For performance of RFLP typing, genomic DNA was prepared from liquid cultures of *M. tuberculosis* isolates, digested with *Pvu*II, and separated by electrophoresis on a 1% agarose gel. After capillary transfer to a charged nylon membrane, the filter was hybridized with a ^{32}P-labeled or peroxidase-labeled fragment of IS*6110* as described [23, 24]. RFLP patterns of study isolates were compared with each other and with RFLP reference collections maintained at the TBNetwork and the Tuberculosis Center of the Public Health Research Institute.

Results

Tuberculosis at TBNetwork hospitals, 1992–1994. The six participating hospitals identify 250–300 culture-positive cases of tuberculosis annually, which represents ~8% of the annual total in New York City. For this study, cases identified at TBNetwork hospitals during 1992–1994 were analyzed by means of a standardized questionnaire. Medical records and *M. tuberculosis* isolates were available from 201 cases; 124 (62%) of the patients were male, 71 (35%) were foreign-born, 36 (18%) were white, and 69 (34%) were seropositive for HIV (table 1). Compared with cases in New York City [34], a higher proportion of TBNetwork cases involved Asians and whites and a lesser proportion involved blacks. TBNetwork case patients were also more likely to be foreign-born. The proportion of patients with HIV infection was roughly similar in the two groups.

Table 1. Demographic characteristics of TBNetwork cases of tuberculosis (1992–1994) vs. cases of tuberculosis in New York City (1992) [34].

Characteristic	Cases of tuberculosis: TBNetwork, 1992–1994 (n = 201)	Cases of tuberculosis: New York City, 1992 (n = 3,811)
Male sex	124 (62%)	69%
Country of birth		
United States	55 (27%)	77%
Other	71 (35%)	23%
Unknown	75 (37%)	0
Race		
Asian	35 (17%)	7%
Black	65 (32%)	55%
Hispanic	45 (22%)	27%
White	36 (18%)	11%
Unknown	20 (10%)	0
HIV status		
Positive	69 (34%)	33%
Negative	44 (22%)	16%
Unknown	88 (44%)	51%

RFLP analysis of isolates. RFLP analysis of *M. tuberculosis* isolates revealed that 87 (43%) of the 201 isolates had cluster RFLP patterns, consistent with disease following recent infection (table 2). Each of the 114 noncluster strains had a unique RFLP pattern. Higher rates of RFLP-clustered isolates were recovered from patients who were younger, born in the United States, HIV-positive, black, or health care workers (table 2). Asians had a significantly lower rate of disease due to RFLP-clustered strains.

Tuberculosis in health care workers. Twenty (10%) of the 201 cases involved health care workers. All were actively employed. Characteristics of health care workers and non–health care workers were similar in all respects (table 3). In particular, the distribution of United States–born, Asia-born, HIV-positive, and black patients was roughly similar between the groups. Of the 20 health care workers with tuberculosis, 8 were nurses or nursing aides, 7 were physicians, and 1 each was a social worker, security guard, paramedic, food service employee, and building service employee. Isolates from 6 (86%) of the 7 physicians and from 8 (89%) of the 9 HIV-infected health care workers had an RFLP-clustered pattern.

Table 2. Characteristics of patients with tuberculosis, according to RFLP strain type.

Characteristic	No. (%) of patients, per indicated RFLP strain type: Clustered (n = 87)	Non-clustered (n = 114)	Significance (P value)
Age (y, mean ± SD)	39.6 ± 14.7 (n = 80)	45.26 ± 18.9 (n = 105)	.028
Sex			
M	60 (69.0)	64 (56.1)	NS
F	24 (27.6)	43 (37.7)	...
Unknown	3 (3.4)	7 (6.1)	...
Country of birth			
United States	31 (35.6)	24 (21.1)	.0004
Other	17 (19.5)	54 (47.4)	...
Unknown	39 (44.8)	36 (31.6)	...
Race			
Asian	5 (5.7)	30 (26.3)	.0001
Black	35 (40.2)	30 (26.3)	.042
Hispanic	18 (20.7)	27 (23.7)	NS
White	20 (23.0)	16 (14.0)	NS
Unknown	9 (10.3)	11 (9.6)	...
Occupation			
Health care worker	13 (14.9)	7 (6.1)	.078
Other	50 (57.5)	72 (63.2)	...
Unknown	24 (27.6)	35 (30.7)	...
HIV status			
Positive	40 (46.0)	29 (25.4)	.022
Negative	15 (17.2)	29 (25.4)	...
Unknown	32 (36.8)	56 (49.1)	...

Exploring further the relationship between RFLP and health care worker status through logistic regression, we considered only those patients for whom we had complete information on occupation, sex, race, and HIV status and who were 18–65 years of age. Seventy-five such patients were identified, of whom 12 were health care workers. In this model, health care worker status was significantly associated with RFLP-clustered tuberculosis (P = .018; RR = 2.77; 95% CI = 1.19–6.41). HIV status was also independently associated with RFLP-clustered tuberculosis (P = .029).

Discussion

In this study, we utilized a surveillance network among hospitals in New York City to analyze tuberculosis in urban health care workers. None of the hospitals had a recognized tuberculosis outbreak during the study interval. As determined by molecular strain typing, health care workers were significantly more likely to have disease due to recent infection than were patients in other occupations.

There are several potential explanations for this finding. One plausible explanation is that health care workers are at risk due to occupational exposure. Historical studies indicate an increased risk of *M. tuberculosis* infection and tuberculosis among medical personnel [1, 4]. In recent nosocomial outbreaks, health care workers were found to be at risk for *M. tuberculosis* infection and tuberculosis [11–14]. However, outside of the outbreak setting, few studies have examined the risk of occupational tuberculosis to health care workers.

In our study, 74 (41%) of 181 non–health care workers had disease due to recent exogenous infection, a rate similar to that found in other community-based studies [29–31]. The even higher rate of disease from recently acquired infection observed among health care workers (65%) is in excess of the rate in the TBNetwork community or communities in Berne, Switzerland [29], San Francisco [30], or the Bronx, New York [31]. It therefore seems likely that the risk conferred by caring for patients with tuberculosis may be responsible for the significantly higher rate of disease due to recent infection that we observed among health care workers.

An alternative explanation is that ongoing community-based transmission may account for the higher rate of acute disease among health care workers, as suggested by other investigators who studied the problem at a hospital that treats relatively few cases of tuberculosis [21]. Recent studies have demonstrated unexpectedly high rates of tuberculin reactivity among urban health care workers, ranging from 27% to 40% [10, 35, 36], suggesting that communities where health care workers live may have higher than expected rates of tuberculosis. This, however, would be expected to bias the findings toward an

Table 3. Characteristics of patients with tuberculosis whose occupational status was known.

Characteristic	No. (%) of patients: Health care workers (n = 20)	Non–health care workers (n = 122)	Significance (P value)
Age (y, mean ± SD)	38.11 ± 10.8	42.84 ± 18.0	NS
Sex			NS
M	13 (65.0)	84 (68.9)	...
F	7 (35.0)	38 (31.1)	...
Country of birth			NS
United States	4 (20.0)	46 (37.7)	...
Other	8 (40.0)	51 (48.1)	...
Unknown	8 (40.0)	25 (20.5)	...
Race			
Asian	4 (20.0)	25 (20.5)	NS
Black	6 (30.0)	44 (36.1)	NS
Hispanic	3 (15.0)	32 (26.2)	NS
White	4 (20.0)	21 (17.2)	NS
Unknown	3 (15.0)	0	...
HIV status			NS
Positive	9 (45.0)	45 (36.9)	...
Negative	6 (30.0)	27 (22.1)	...
Unknown	5 (25.0)	50 (41.0)	...

overrepresentation of reactivated disease rather than of disease due to recent exogenous infection.

There are several limitations to our study. The strain typing method may have caused misclassification of some cases. Isolates with identical RFLP patterns could be composed of multiple subtypes, and, conversely, isolates with unique RFLP patterns may represent cluster strains that were not recognized because the reference collections were not of sufficient size. However, either type of misclassification should apply equally, regardless of occupational or HIV status, and therefore would not be expected to affect the conclusions of this study.

Another limitation of the study is the relatively small sample size. Future studies using a larger patient base may allow a more precise definition of the relative risk to health care workers of acquiring tuberculosis.

Following recognition of occupational risk, a number of improvements in infection control have been implemented in hospitals in New York City [18–20]. The cases analyzed in this report are likely to reflect transmissions prior to the time hospitals may have updated infection control procedures, including routine isolation of presumptive cases, use of appropriate respirators, and early institution of empirical multidrug regimens. The specific occupational exposures that may have resulted in transmission of tuberculosis were not identified in this study.

Our data suggest that occupational transmission of tuberculosis occurs in hospitals without recognized outbreaks. Health care workers with HIV infection appear to be at particular risk. Prospective RFLP-based studies will be useful to confirm these findings and may help determine the efficacy of current guidelines [17] for preventing transmission of tuberculosis in health care settings.

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Brief Communications

The Risk for Transmission of *Mycobacterium tuberculosis* at the Bedside and during Autopsy

Gary L. Templeton, MD; Lee Ann Illing, RN, CIC; Lanne Young, MD; M. Donald Cave, PhD; William W. Stead, MD, MACP; and Joseph H. Bates, MD, MACP

■ *Objective:* To emphasize the differing infectious potentials of a patient with tuberculosis.
■ *Setting:* Hospital ward and autopsy room.
■ *Design:* An epidemiologic investigation of tuberculin skin test conversions in a clinical setting and during autopsy when results of tuberculin tests done before exposure were available for all participants.
■ *Measurements:* Tuberculin skin test results after the discovery of tuberculosis exposure from a patient with unsuspected tuberculosis for comparison with the test results before exposure; culture of sputum and autopsy material for *Mycobacterium tuberculosis*; and DNA fingerprinting of organisms.
■ *Intervention:* Preventive therapy for persons with skin test conversion.
■ *Results:* None of the 40 skin test–negative health care workers caring for the patient for 3 weeks on an open medical ward showed a skin test conversion, even though they had not used respiratory precautions. By contrast, among personnel present during the 3-hour autopsy, the test results of all five nonreactors converted from negative to positive (mean reaction, 24 mm). Two of these persons had a positive sputum culture 8 weeks later. The DNA fingerprints of all three isolates were identical.
■ *Conclusions:* A patient who did not transmit tuberculosis before death released a prodigious number of tubercle bacilli during autopsy.

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From the John L. McClellan Veterans Administration Hospital, the University of Arkansas College of Medicine, and the Arkansas Department of Health, Little Rock, Arkansas. For current author addresses, see end of text.

Tuberculosis is generally not considered highly communicable. A recent experience shows the great variation in the infectiousness of a patient with tuberculosis.

Case Report

A 57-year-old man was hospitalized for increasing dizziness, decreased oral intake, and a weight loss of 11 kg within 6 months. His medical history included anemia and adenocarcinoma of the prostate that was treated with radical prostatectomy and radiation. He had abused alcohol and tobacco for many years but denied exposure to tuberculosis.

The patient was cachectic but alert and cooperative. His temperature was 36.4 °C, his pulse was 126 beats/min, his respiration rate was 20 breaths/min, and his blood pressure was 110/70 mm Hg when he was supine and sitting but 90/60 mm Hg when he was standing. Percussion and auscultation indicated that his lungs were clear and that his abdomen was soft and nontender with normal bowel sounds. A chest radiograph showed no abnormality of the heart or lungs. Laboratory findings were as follows: hematocrit, 24.7%; leukocyte count, 5.7×10^9/L; and hemoglobin level, 8.2 g/dL. Admission diagnosis was postural hypotension secondary to autonomic dysfunction, with dehydration playing a contributory role. Comorbid conditions included a normochromic, normocytic anemia. No recognizable infection was present, nor was there evidence for recurrent malignancy.

On the sixth hospital day, a urinary tract infection developed that was caused by *Streptococcus faecalis* and that responded promptly to intravenous antibiotics. On hospital day 16, the patient gradually became dyspneic and less responsive. Moderate ascites was noted, and a chest radiograph showed cephalization of the pulmonary vasculature and diffuse bilateral pulmonary infiltration with bilateral pleural effusions. Examination of the ascitic fluid showed a leukocyte count of 1×10^9/L, an erythrocyte count of 120 cells/mm^3, an amylase level of 0.32 μkat/L, a glucose level of 6.4 mmol/L, a protein level of 24 g/L, and a lactate dehydrogenase level of 5.23 μkat/L. Gram, fluorochrome, and Ziehl-Neelson stains of the ascitic fluid were negative. Intradermal skin tests with 5 tuberculin units of purified protein derivative and two control antigens gave no reaction at 48 hours. The serum was negative for antibody to human immunodeficiency virus. The ascites, pulmonary infiltration, and pleural effusions were thought to be caused by congestive heart failure or hepatic cirrhosis. The patient continued to deteriorate and died on hospital day 21. An autopsy was then done.

Postmortem Examination

Examination of the lungs showed extensive pneumonia with large areas of necrosis, but no granulomas were noted. Hundreds of tubercle bacilli were seen in every oil

See editorial comment on pp 955–6.

Table 1. Duration of Exposure and Results of Clinical Evaluation and Treatment for Staff and Students Present at Autopsy*

Exposed Person	Length of Time in Autopsy Room	PPD Result before Exposure (Date)	PPD Result after Exposure (Date)	Induced-Sputum Culture Result	Chest Radiograph Finding	Treatment	Status 3 Years Later
Pathology resident	2 h	0 mm (6/28/91)	30 mm (8/28/91)	Negative	Normal	Isoniazid	Good health
Pathology resident	2 h	0 mm (6/28/91)	30 mm (8/28/91)	Positive	Normal	Isoniazid and rifampin	Good health
Medical student	2–3 h	0 mm (May 1991)	20 mm (9/3/91)	Positive	Normal	Isoniazid and rifampin	Good health
Medical student	10 min	0 mm (May 1991)	20 mm (9/3/91)	Negative	Normal	Isoniazid	Good health
Laboratory supervisor	20 min	0 mm (6/28/91)	19 mm (9/16/91)	Negative	Normal	Isoniazid	Good health
Pathology technician	3 h	Positive	Not done	Negative	Normal	None	Good health
Pathology technician	10 min	Positive	Not done	Not done	Normal	None	Good health
Pathology technician	5 min	Positive	Not done	Not done	Normal	None	Good health
Faculty member	30 min	Positive	Not done	Not done	Normal	None	Good health
Faculty member	5 min	Positive	Not done	Not done	Normal	None	Good health

* PPD = purified protein derivative.

emersion field of the lung, hilar lymph nodes, spleen, peritoneum, kidneys, testes, brain, and vertebral bodies. Culture of all tissues showed heavy growth of *Mycobacterium tuberculosis*. Cultures of blood and ascitic fluid obtained 5 days before death were positive for *M. tuberculosis* and were sensitive to all drugs tested.

Epidemiologic Investigation

When it was realized that the patient had died of tuberculosis, an epidemiologic investigation was initiated. Fortunately, for several years our medical center has tested all new clinical personnel with the two-step Mantoux method using 5 tuberculin units of purified protein derivative. Nonreactors are retested annually. An induration of greater than 10 mm 48 hours after the test is considered a positive result.

During the patient's 21-day hospital stay, 47 health care workers participated in his care. Of these, 7 (14.9%) were known positive tuberculin reactors and 40 were nonreactors. Because the diagnosis of tuberculosis had not been suspected, no respiratory precautions had been taken. The patient was in a single room with ventilation that provided five fresh-air changes per hour but no upper-air sterilization with ultraviolet irradiation. On repeat tuberculin testing 8 weeks after the patient's death, none of the 40 nonreactors had converted to positive, and none was treated.

The findings for personnel in the autopsy room differed from the findings for the personnel who had cared for the patient (Table 1). Of the 10 persons in the room, 5 were already known to be tuberculin-positive. When the five nonreactors were retested 8 weeks after the exposure, all showed strong reactions to purified protein derivative, with a mean induration of 24 mm. Although all had negative chest radiographs, induced sputum from two of the five grew *M. tuberculosis* on culture. These two were treated with rifampin and isoniazid for 6 months and remain healthy. The three converters with negative sputum cultures were treated with isoniazid, 300 mg/d, for 6 months and remain healthy. The five previous reactors also remain healthy despite receiving no therapy.

DNA Fingerprinting

The *M. tuberculosis* strains isolated from the patient and two health care workers were analyzed by DNA fingerprinting. The three isolates contained 14 copies of the insertion sequence IS6110, and the patterns were identical. These findings support the epidemiologic data indicating that the five tuberculin converters were infected by organisms from the body of the patient during the autopsy.

Environmental Factors

The dimensions of the autopsy room are 6.4 × 7.6 × 2.7 meters, with an air volume of 1.31×10^5 liters. The ventilation provided nine fresh-air changes per hour, but there was no upper-air sterilization with ultraviolet irradiation. The workers and observers wore double-tie, cloth surgical masks and surgical gowns, but no other precautions were taken. An oscillating bone saw was used to open the rib cage and calvarium and to obtain sections of three vertebral bodies. Two of the five tuberculin converters spent 10 and 20 minutes in the room, respectively, as the chest and abdominal cavities were opened and the organs removed.

The contamination of the air can be roughly calculated as follows: If the ventilation of a person is considered to be 10 L/min, then 100 liters or 3.5 cubic feet of room air would have been inhaled in the 10 minutes in which one person was infected. Thus, the air could be said to contain at least one infectious unit per 3.5 cubic feet (100 liters), a greater concentration than Catanzaro (1) found (1 unit per 69 cubic feet [1950 liters]) after bronchoscopy of a patient with tuberculosis.

The two persons who developed positive cultures of induced sputum had spent much more time, 2 to 3 hours, in the room. They thus inhaled perhaps 12 to 18 infectious units. Two of the workers who were known to be tuberculin positive before exposure spent as long as 30 minutes in the room, thus inhaling about three infectious units. One tuberculin-positive technician was in the room all 3 hours, inhaling as many as 18 infectious units with-

out developing disease. However, because of the heavy exposure, this man submitted a specimen of induced sputum that yielded no growth of tubercle bacilli on culture.

Discussion

The difference in the infectiousness of this patient during his last 3 weeks of life and in the 3 hours of the autopsy is striking. During the former period, in which no precautions were taken, no skin test conversions occurred among 40 nonreactors. In contrast, in just 3 hours, all five previously uninfected persons became infected, with two becoming culture positive albeit without symptoms or radiographic abnormality. The concentration of infectious units in the air of the autopsy room appears to be the highest ever reported (2).

Autopsy room workers have long been known to be at considerable risk for acquiring tuberculosis. Both Hedvall (3) and Morris (4) observed an increased incidence of the disease among medical students on completion of a course in pathology, which included participation in postmortem examinations.

Meade (5) reported a decrease in the rate of tuberculin skin test conversions and in the incidence of tuberculosis among students after they were excused from assisting in autopsies. Reid (6) found that tuberculosis is more common among pathologist and laboratory technicians than among other health care workers. Harrington and Shannon (7) noted that members of divisions of morbid pathology had the highest risk for tuberculosis of all laboratory workers.

Little is known about why autopsy room workers are at such increased risk for tuberculosis. One possibility is that autopsy workers can be exposed to patients not suspected of having tuberculosis, particularly when the clinical picture is atypical, as in hematogenous dissemination, peritonitis, and meningitis. This theory is supported by a report that 5.1% of the tuberculosis cases in the United States are first diagnosed at death (8).

Another factor is that certain procedures are done only in autopsy rooms. Studies have shown that cutting an infected lung with a knife or cutting bone with an oscillating saw can generate small particle aerosols (9–11). A band saw used during an autopsy of a patient with a patellar abscess was associated with the development of inhalational coccidioidomycoses (12). Two recently reported outbreaks of tuberculosis suggest that infectious aerosols can be generated during saline irrigation of a tuberculous abscess and while routine care of a tuberculous skin lesion is provided (13, 14).

Several points deserve emphasis. First, in this outbreak of tuberculosis, the autopsy personnel inhaled air containing the highest concentration of infectious particles yet described. The concentration of one infectious unit per 3.5 cubic feet of air is orders of magnitude greater than that reported by Riley and coworkers (15), who studied the air in a tuberculosis ward (they reported a concentration of one infectious unit in 12 000 cubic feet [3.4×10^5 liters] of air). Among nurses working on tuberculosis wards before the chemotherapy era, tuberculin skin test results converted in about 1 year. This rate was calculated to equal one infectious unit per 24 000 cubic feet (6.8×10^5 liters) of air (16).

Second, none of the previously known reactors developed tuberculosis, even though they had not received preventive therapy. Indeed, one pathology technician, a known reactor, was present throughout the 3-hour necropsy and must have inhaled a very large number of organisms, perhaps 18 infectious units. The fact that none of the five known reactors developed tuberculosis suggests that in a healthy person, a previous tuberculous infection is associated with substantial resistance to reinfection.

Third, tuberculosis may run an acute course with a clinical presentation that more closely resembles typhoid fever than it does a chronic pulmonary disease, as noted by Osler (17). Our patient had a normal chest radiograph on admission and 3 weeks later had hematogenous spread and extensive tuberculous pneumonia.

Finally, it must be emphasized that during the autopsy of our patient, the air was inordinately contaminated with tubercle bacilli. Autopsy of a patient with tuberculosis limited to the lung would not pose such a great risk. However, when a patient has died of the acquired immunodeficiency syndrome and tuberculosis, contaminations similar to the one we describe would probably occur.

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Request for Reprints: Joseph Bates, MD, John L. McClellan Memorial Veterans Administration Hospital, 4300 West 7th Street, Little Rock, AR 72205.

Current Author Addresses: Drs. Templeton and Bates and Ms. Illing: John L. McClellan Memorial Veterans Administration Hospital, 4300 West 7th Street, Little Rock, AR 72205.
Dr. Young: University of Arkansas for Medical Sciences, Department of Pathology, Slot 517, 4301 West Markham Street, Little Rock, AR 72205.
Dr. Cave: University of Arkansas for Medical Sciences, Department of Anatomy, Slot 510, 4301 West Markham Street, Little Rock, AR 72205.
Dr. Stead: Arkansas State Department of Health, 4815 West Markham Street, Slot 45, Little Rock, AR 72205.

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Nosocomial Transmission of *Mycobacterium tuberculosis:* Role of Health Care Workers in Outbreak Propagation

Stephanie Zaza,* Henry M. Blumberg, Consuelo Beck-Sagué,* Walter H. Haas, Charles L. Woodley, Maritza Pineda,* Christine Parrish, Jack T. Crawford, John E. McGowan, Jr., and William R. Jarvis

Investigation and Prevention Branch, Hospital Infections Program, and Mycobacteriology Laboratory Section, Emerging Bacterial and Mycotic Diseases Branch, Division of Mycotic and Bacterial Diseases, National Center for Infectious Diseases, Centers for Disease Control and Prevention; Department of Epidemiology, Grady Memorial Hospital; Departments of Medicine (Division of Infectious Diseases) and of Pathology and Laboratory Medicine, Emory University School of Medicine, Atlanta, Georgia

To investigate an outbreak of tuberculosis (TB) among health care workers (HCWs) at a county hospital, all patients with culture-confirmed TB on wards A and B and all HCWs working at least one shift on these wards from January 1991 through March 1992 were studied. Tuberculin skin test conversions occurred in 30% (ward A) and 48% (ward B) of HCWs; 8 developed active TB. Workers exposed for at least one shift to workers or patients with active TB were more likely to have skin test conversion than were workers who were not exposed (ward A exposure relative risk [RR] for workers = 2.8, $P = .005$, and for patients = 2.2, $P > .5$; ward B exposure RR for workers = 2.8, $P < .001$, and for patients = 5.3, $P < .001$). Underlying conditions and performing charting activities in the nurses' work room were associated with progression to active TB among infected workers. Transmission was facilitated by delays of ≤2.5 months in treatment of workers with skin test conversion or TB symptoms.

Since 1985 in the United States, the number of hospital patients with tuberculosis (TB) has increased, in part because of the human immunodeficiency virus (HIV) epidemic [1]. With increased numbers of hospitalized TB patients, health care workers (HCWs) are at a higher risk of becoming infected with *Mycobacterium tuberculosis* due to occupational exposure. Although most HCWs do not progress from infection to active disease, HIV-infected persons, including HCWs, are at increased risk of progression to active TB [2–4].

Recent nosocomial outbreaks of TB have been caused by both patient-to-patient and patient-to-HCW transmission [4–7]. In these outbreaks, delayed identification and inadequate isolation of TB patients contributed to nosocomial transmission of TB to other patients and HCWs, and inadequate tuberculin skin test programs for HCWs delayed the identification of *M. tuberculosis* transmission to the workers [8].

Although one episode of HCW-to-HCW transmission of *M. tuberculosis* has been described, a nosocomial outbreak of TB has never been traced to HCWs with TB [9]. A recent investigation of *M. tuberculosis* transmission among HCWs at Grady Memorial Hospital, a county hospital primarily serving inner-city residents of Atlanta, implicated HCW-to-HCW transmission, including transmission to and from an HCW with HIV infection, as a major mode of transmission.

Background

Wards A and B of Grady Memorial Hospital are general medical wards distant from each other and staffed by separate personnel. From December 1991 through March 1992, routine annual HCW tuberculin skin test surveillance identified 4 HCWs from ward B with new skin test conversions. In addition, a ward A HCW was diagnosed with active TB in January 1992. In response to these events, employee health clinic personnel conducted additional skin tests in March and April 1992 for all susceptible hospital employees working on wards A and B. An initial investigation on the wards identified 4 additional HCWs from ward A and 3 from ward B who had been symptomatic and diagnosed with active TB since 18 July 1991. An epidemiologic investigation was initiated to determine the source(s) of infection among HCWs.

Methods

Definitions. The study period was January 1991 to March 1992. The HCW study population comprised all registered nurses, licensed practical nurses, nurse assistants, and clerks who worked at least one shift on ward A or B (with or without patient contact) during the study period. The study subjects were designated con-

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Reprints or correspondence: Dr. William R. Jarvis, Investigation and Prevention Branch, Hospital Infections Program, MS-E69, National Center for Infectious Diseases, Centers for Disease Control and Prevention, Atlanta, GA 30333.

* Current affiliations: Epidemiology Program Office (S.Z.), Division of STD Laboratory Research, National Center for Infectious Diseases (C.B.-S.), Centers for Disease Control and Prevention; University of Maracaibo School of Medicine, Maracaibo, Venezuela (M.P.).

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verter, negative, or case-HCWs, and a susceptible period was defined for each.

Workers were designated as case-HCWs if they developed active TB (i.e., either a positive *M. tuberculosis* culture or a tuberculin skin test conversion with clinical signs and symptoms consistent with TB) during the study period. If no acid-fast bacilli (AFB) sputum smears were available, case-HCWs were considered potentially infectious from the date of onset of symptoms until 2 weeks after cessation of symptoms or until they were removed from their duties or work area; otherwise, on-duty case-HCWs were considered infectious until 2 weeks after the last AFB-positive sputum smear.

Workers were designated converter HCWs if they had a documented skin test conversion (i.e., a negative tuberculin skin test followed by a positive one [$\geq$10 mm increase in induration], as determined by a nurse at the employee health clinic [see Results]) during the study period. Converter HCWs and those who had evidence of new *M. tuberculosis* infection with anergy were included in analyses for risk of infection.

Workers were designated negative HCWs if they had two consecutive documented tuberculin skin tests with negative results and no evidence of anergy during the study period. Workers not employed by the hospital (e.g., attending and resident physicians, outside agency personnel, and volunteers) were excluded as converter or negative HCWs because they were not included in the hospital's tuberculin skin test program.

For study purposes, all HCWs were considered susceptible to new *M. tuberculosis* infection from 10 weeks before the first negative tuberculin skin test results until 2 weeks before the onset of symptoms (case-HCWs, if no skin test conversion) or until having a positive tuberculin skin test result (converter HCWs) or the second negative tuberculin skin test result (negative HCWs) [10]. An anergic, HIV-positive case-HCW with severe immunosuppression (CD4 lymphocyte count <25 cells/mm^3) was considered susceptible from 6 months to 2 weeks before onset of symptoms [3–7]. Her tuberculin skin test was negative during her symptomatic period. Anergy was confirmed by companion testing with delayed hypersensitivity antigen skin testing administered by the standard Mantoux method [11].

A case-patient was defined as any patient with culture-confirmed TB hospitalized on either ward A or B during the study period. Case-patients with pulmonary TB were considered infectious during any hospitalized period when sputum smears were positive for AFB. HIV-infected case-patients were considered susceptible to *M. tuberculosis* infection during any period of hospitalization in either ward from 6 months to 2 weeks before being diagnosed with TB [3–7].

Data sources. To find converter, negative, and case-HCWs and case-patients, we examined staff assignment sheets and employee health clinic, employee tuberculin skin test, and microbiology records during the study period.

Epidemiologic studies. To determine whether transmission rates in wards A and B exceeded the institutional baseline, tuberculin skin test conversion rates in these wards were compared with the rate among susceptible HCWs (who never worked on wards A and B) who were assigned to general medical wards and tested at least twice during the study period and whose tuberculin skin test results were confirmed at the time of the investigation. All 76 HCWs who met these criteria were included in this comparison study.

To identify risk factors for occupational TB infection, we compared the number of shifts converter, negative, and case-HCWs worked with infectious case-HCWs or while infectious case-patients were hospitalized on wards A or B. Because of the possibility of HCW-to-HCW transmission during shift changes (when nurses report patient status to each other), we compared consecutive shifts on which negative, converter, and case-HCWs worked with infectious case-HCWs.

To examine the risk of converter HCWs developing active TB, we compared case-HCWs with converter HCWs who did not develop active TB. Data were collected from employee health clinic and hospital medical records, case-HCW interviews, and a questionnaire administered to 34 converter and 6 case-HCWs still employed at the hospital. Data included demographics, medical history, self-reported HIV serostatus, work habits, and tuberculin skin test history.

Procedure/environmental review. We reviewed the HCW tuberculin skin test program, the protocols for diagnostic evaluation and preventive therapy for HCWs with tuberculin skin test conversions, and the protocols for diagnosis, treatment, and work restriction of HCWs with active TB. We also reviewed isolation practices for known or suspected patients with active TB and the design of the air-handling systems and window exhaust fans in patient rooms during the investigation.

Microbiology. Drug-susceptibility testing for all *M. tuberculosis* isolates from case-HCWs, case-patients, and other hospitalized patients was done by the Georgia State Public Health Laboratory ($n = 23$) or a private laboratory ($n = 1$). Isolates were sent to the Centers for Disease Control and Prevention (CDC) for molecular typing using a new technique, mixed-linker polymerase chain reaction (ML-PCR) [12]. ML-PCR uses one primer specific for the *M. tuberculosis*–specific IS6110 insertion element and a linker primer complementary to the uracil-containing strand of the linker followed by a nested PCR with a second IS6110-specific primer. Restriction analysis of the PCR product was used to determine microheterogeneities of a single locus. The amplified fragments were visualized in the gel by ethidium-bromide staining and were verified to be specific for IS6110 by hybridization with the diagnostic oligonucleotide [12]. Identification and differentiation of strains was done by determining the number and position of bands in the 8% polyacrylamide gels [12]. Matching patterns were those with an identical number and position of bands.

Statistical methods. Data were entered and analyzed using Epi-Info Software [13]. Categorical variables were compared using the χ^2 test or the Mantel-Haenszel summary χ^2, and relative risks (RR) or odds ratios (OR) and 95% confidence intervals (95% CIs) were calculated. Continuous variables were compared using the Kruskal-Wallis test for two groups [13].

Results

Ward A

Descriptive epidemiology. During the study period, 23 infectious case-patients were hospitalized for 189 days on ward A. Five case-HCWs (case-HCWs 1–5), 16 converter HCWs,

Table 1. Clinical characteristics, microbiology results, and treatment of health care workers (HCWs) with tuberculosis, wards A and B, Grady Memorial Hospital, 18 July 1991 to 31 January 1992.

Case-HCW, sex	Date of last TST		Clinical characteristics			Sputum microbiology, date, result		Antituberculous therapy, date initiated
	Negative	Positive	Date of onset	Symptoms	Date, result of radiography	AFB smear	*M. tuberculosis* culture	
Ward A								
1, M	06/10/91	09/30/91	07/18/91	Cough, chest pain	10/02/91, infiltrate	ND	ND	INH/Rif/PZA, 10/02/91
2, F	03/12/90	09/03/91	08/17/91	Cough, fever	08/18/91, infiltrate	ND	ND	INH/Rif/PZA, 08/91
3, F	03/04/91	10/09/91	10/09/91	Cough, fever, chest pain	10/09/91, neg 12/03/91, infiltrate	10/09/91, ND* 12/03/91, ND* 04/92, pos	10/09/91, ND* 12/03/91, ND* 04/92, *M. tuberculosis*	INH/Rif/PZA, 12/19/91
4, F	06/05/91	01/27/92	01/92	Chest pain	01/30/92, pleural effusion	ND	ND	INH/Rif/PZA, 01/30/92
5, F	12/05/90	11/91	11/91	Productive cough	12/16/91, cavity and apical infiltrate	02/03/92, pos 02/12/92, pos 02/17/92, pos	02/03/92, *M. tuberculosis*	INH/Rif/PZA, 01/21/92; Emb, 03/04/92
Ward B								
6, F	ND†	ND†	10/01/91	Cough, fever	12/91, infiltrate	12/91, pos	01/92, *M. tuberculosis*	INH/Rif/PZA/Emb, 01/92
7, F	07/91	12/26/91	12/16/91	Cough, chills, fever, chest pain	12/16/91, infiltrate	12/26/91, pos	12/26/91, *M. tuberculosis*	INH/Rif/PZA, 12/26/91
8, F	09/91	03/25/91	03/92	Cough, chest pain	03/27/92, pleural effusion	03/92, neg	03/27/92, *M. tuberculosis*	INH/Rif/Emb/Eth, 03/27/92

NOTE. TST, tuberculin skin test; ND, not done; AFB, acid-fast bacilli; INH, isoniazid; Rif, rifampin; PZA, pyrazinamide; Emb, ethambutol, Eth, ethionamide; neg, negative; pos, positive.

* Date followed by ND means clinical signs and symptoms or TST conversion (or both) indicated that AFB smear and culture should have been done but were not.

† Patient did not have TST result in employee health clinic but was reported by private physician to have been anergic when tested prior to employment.

and 49 negative HCWs were identified. Case-HCWs 1–5 worked a total of 134 days on ward A while potentially infectious. The tuberculin skin test conversion rate on ward A was greater than that of susceptible HCWs assigned to general medical wards who never worked on wards A and B, who were tested at least twice during the study period, and whose tuberculin skin test results were confirmed at the time of the investigation (21/70 [30.0%] vs. 10/76 [13.2%]; RR = 2.3, 95% CI = 1.2–4.5; $P = .02$).

The 5 case-HCWs had tuberculin skin test conversions before active TB was diagnosed by radiologic evaluation (table 1). Case-HCWs 1–5 developed signs and symptoms of TB in July, August, October, and November 1991 and January 1992, respectively. Case-HCWs 3 and 5 had AFB smear- and culture-positive sputum. The others were treated for TB on the basis of suggestive clinical and radiologic presentation. All 5 showed symptomatic and radiographic improvement after three- or four-drug antituberculous therapy.

Risk of occupational transmission. Possible sources of infection for converter and case-HCWs on ward A included the 5 infectious case-HCWs from July 1991 to January 1992 and the 23 case-patients who were intermittently hospitalized on ward A while potentially infectious from February 1991 to March 1992. Converter and case-HCWs worked more total shifts (median, 80) during the study period on ward A than did negative HCWs (median, 4 shifts; $P = .004$). The number of shifts varied by whether the worker was assigned exclusively to that ward versus being a floater or substitute with a primary assignment elsewhere. The prevalence of tuberculin skin test conversions among HCWs who worked at least one shift or at least one consecutive shift with an infectious case-HCW was higher than among HCWs who did not (table 2). Among HCWs who worked at least one shift with an infectious case-HCW, those who worked a greater number of shifts with an infectious case-HCW had a higher risk of infection (median number of shared shifts, 18 vs. 2; $P < .01$). The prevalence of tuberculin

Table 2. Relative risk (RR) of tuberculin skin test (TST) conversion in health care workers (HCWs) exposed and not exposed to *M. tuberculosis* on ward A or B, Grady Memorial Hospital, January 1991–1992.

Exposure	TST conversions (no./no. total)		RR (95% CI)	*P*
	Among exposed	Among unexposed		
Ward A				
Worked ≥1 shift with infectious case-HCW	14/29	7/41	2.8 (1.3–6.1)	.005
Worked ≥1 consecutive shift with infectious case-HCW	16/37	5/33	2.9 (1.2–6.9)	.01
Worked ≥1 shift with infectious case-patient	19/57	2/13	2.2 (0.6–8.2)	NS
Ward B				
Worked ≥1 shift with infectious case-HCW	20/27	9/34	2.8 (1.5–5.1)	<.001
Worked ≥1 consecutive shift with infectious case-HCW	24/32	5/29	4.4 (1.9–9.9)	<.001
Worked ≥1 shift with infectious case-patient	25/33	4/28	5.3 (2.1–13.4)	<.001
Wards A and B				
Mantel-Haenszel weighted RR of ≥1 shift with infectious case-HCW	—	—	3.0 (1.9–4.5)	<.001

NOTE. CI, confidence interval; NS, not significant.
* Controlled for ≥1 shift with infectious case-patient.

skin test conversions on ward A was not significantly higher among HCWs who worked at least one shift when infectious case-patients were on the ward than among HCWs without such exposure (table 2).

Ward B

Descriptive epidemiology. During the study period, 2 case-patients were infectious for 13 days on ward B. Three case-HCWs (nos. 6–8), 26 converter HCWs, and 32 negative HCWs were identified. Case-HCWs 7 and 8 had tuberculin skin test conversions during the study period; case-HCW 6, who had HIV infection, was tuberculin skin test–negative when tested in December 1991; however, her CD4 T lymphocyte count was <25 cells/mm^3, suggesting that she was anergic. The prevalence of tuberculin skin test conversions among ward B HCWs was greater than among other general medical wards (29/61 [47.5%] vs. 10/76 [13.2%]; RR = 3.6, 95% CI = 1.9–6.8; $P < .001$).

Case-HCWs 6–8 developed signs and symptoms of TB in October and December 1991 and March 1992, respectively (table 1). Case-HCW 6 had AFB smear- and culture-positive sputum specimens, and case-HCW 7 had an AFB smear- and culture-positive broncheoalveolar lavage specimen. Pleural fluid and sputum from case-HCW 8 were AFB smear- and culture-negative. All 3 ward B case-HCWs had clinical and radiographic improvement after initiation of three- or four-drug antituberculous therapy. Case-HCWs 6 and 7 worked a total of 33 days on ward B while infectious. Case-HCW 7 did not have any patient contact while on ward B. Case-HCW 8 was not infectious while on ward B during the study period.

Risk of occupational transmission. Converter and case-HCWs on ward B worked more total shifts during the study period than did negative HCWs (median, 124 vs. 5 shifts; $P < .001$). As in ward A, the prevalence of tuberculin skin test conversions among HCWs who worked at least one shift or at least one consecutive shift with an infectious case-HCW was higher than among HCWs who did not (table 2). Although only 2 infectious case-patients were on ward B during the study period, the prevalence of tuberculin skin test conversions among HCWs who worked at least one shift while 1 of these case-patients was on the ward was greater than that of other HCWs (table 1).

The possible sources of *M. tuberculosis* infection were the 2 case-patients and 2 of the 3 case-HCWs present on ward B during the study period. Specifically, transmission of *M. tuberculosis* probably occurred from case-patient 1, who was on ward B while infectious from September 17–20, to case-HCW 6 and case–patients 3, 4, and 5 (figure 1). Case-HCW 6 developed symptoms during October 1991; case-patients 3, 4, and 5 became symptomatic and were diagnosed with TB in December 1991. Case-HCW 7, who had no patient contact on ward B but had occupational contact with HCW 6, developed symptoms and was diagnosed with TB in December 1991, suggesting HCW-to-HCW transmission from case-HCW 6.

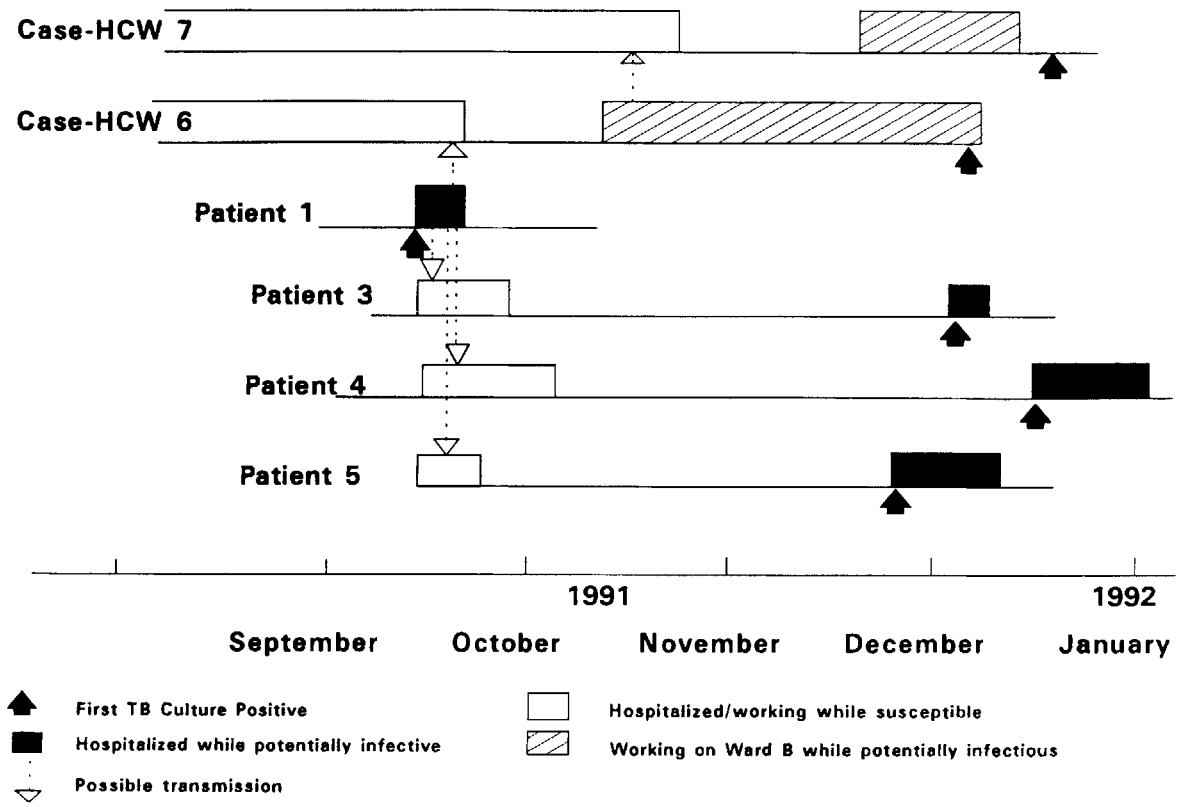

Figure 1. Possible chain of transmission of tuberculosis (TB) in ward B, Grady Memorial Hospital, August 1991 to January 1992. Health care worker (HWC) 8 is not shown, though probably part of this chain, because molecular studies could not be done to confirm her connection with chain of transmission.

Case-HCW 8 became symptomatic in March 1992 and was previously exposed to case-HCW 6 for at least 6 weeks when case-HCW 6 was infectious and to case-patients between September 1991 and January 1992.

Wards A and B

When we controlled for exposure to infectious case-patients, the risk of tuberculin skin test conversion on wards A and B continued to be significantly higher among HCWs exposed to infectious case-HCWs (weighted RR = 3.0, 95% CI = 1.9–4.5; $P < .001$). No HCW on ward A or B had tuberculin skin test conversions without exposure during at least one shift to infectious case-HCWs or case-patients.

Risk of active TB after infection with M. tuberculosis. Eight (16%) of 51 HCWs with evidence of new *M. tuberculosis* infections on wards A and B developed active TB; nonc of the case-HCWs died. Of 40 questionnaires that were distributed to HCWs, 36 (90%) were returned; 6 were from workers with active TB and 30 were from converters. Additional data were collected from medical records on the 2 nonresponding HCWs with active TB, for a total of 38 responses. Converter and case-HCWs did not differ in age, sex, shift worked, care of case-patients, or job description. Case-HCWs were more likely than converters to perform charting activities in the nurses' work room (4/8 case-HCWs vs. 5/30 converters [questionnaire respondents]; OR = 5.0; P = .05) or to have an underlying illness (OR = 10.8; P = .01). Among 5 of 8 case-HCWs who progressed to active TB, illnesses included AIDS (1), insulin-dependent diabetes mellitus (3), and pregnancy (1). Among 4 of 30 converters who did not progress to active TB, underlying illnesses included insulin-dependent (3) and noninsulin-dependent (1) diabetes.

Microbiology results. *M. tuberculosis* isolates were available from case-HCWs 3, 5, 6, and 7, from case-patients 1–6, 15, 21–22, and 25–27, and from numerous TB patients who were either susceptible while hospitalized on ward A or B or who were not epidemiologically linked to either the ward A or ward B outbreak. *M. tuberculosis* isolates from case-HCWs 5, 6, and 7; 12 case-patients; and 13 other patients were susceptible to all antituberculous drugs tested. The *M. tuberculosis* isolate from case-HCW 3 was obtained when the worker developed recurrent symptoms several months after initiation of antimycobacterial treatment; this isolate was resistant to isoniazid.

At the time of the investigation, 8 (32%) of 25 patient isolates were nonviable. In addition, genomic DNA extracted from 2

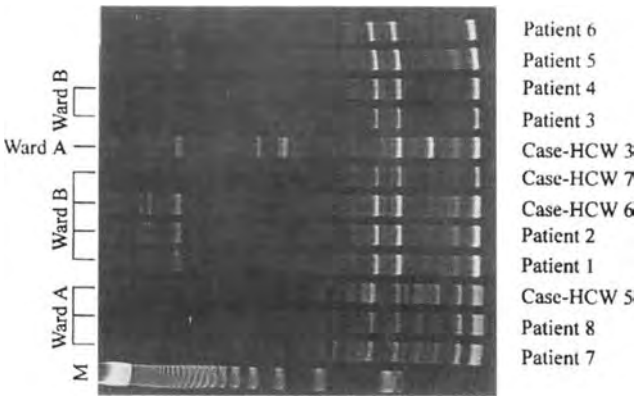

Figure 2. Mixed-linker polymerase chain reaction gel showing *M. tuberculosis* isolates from case-patient and case–health care workers on wards A and B, Grady Memorial Hospital.

case-HCW isolates repeatedly showed incomplete restriction and could therefore not be typed by the standard restriction fragment length polymorphism (RFLP) technique [12, 14, 15]. However, all of the isolates were typeable by ML-PCR, which confirmed putative chains of transmission from case-patient 1 to case-patient 2 on ward A (a distinct pattern from that of the isolates of case-HCWs 3 and 5), from case-patient 1 to case-HCW 6 and case-patients 3, 4, and 5 on ward B, and from case-HCW 6 to 7 on ward B (figure 2). Since no isolate was recovered from HCW 8, transmission from worker 6 to 8 could not be confirmed. The isolate from case-HCW 5 (ward A) was identical to those of 2 TB patients, neither of whom was hospitalized on ward A. The isolate from case-HCW 3 (ward A) was different from these 3 isolates. The isolate from case-patient 6 was identical to those of ward B case-patients and case-HCWs, though this patient had no known in-patient exposures to ward B case-patients or case-HCWs. All other *M. tuberculosis* isolates of patients without epidemiologic links to the outbreaks had distinct patterns.

Procedure and environmental review. At the time of the outbreaks, all tuberculin skin test-negative hospital employees were required to be tested annually for TB by the intracutaneous administration of 0.1 mL of purified protein derivative injected just beneath the surface of the skin on the volar surface of the forearm [16]. Employee health nurses determined test results by measuring the resulting induration. Baseline examinations were considered negative if the diameter of the induration was <10 mm and positive if it was ≥ 10 mm. An increase in induration of ≥ 10 mm in diameter was interpreted as a skin test conversion. Review of tuberculin skin test records for employees on all general medical wards and the infectious disease clinic revealed that 352 (96%) of 366 HCWs were up to date for tuberculin skin testing as of 30 April 1992; however, workers who were not hospital employees were not included in the hospital tuberculin skin test program.

Hospital policy required that employees with tuberculin skin test conversions be immediately evaluated by chest radiography and offered preventive therapy with antituberculous medications. However, case-HCWs 3 and 5 (ward A) had 1.5- to 2.5-month delays in initiation of TB medications after tuberculin skin test conversion, during which time both were treated for presumptive bacterial pneumonia by employee health clinic personnel. In addition, case-HCWs 1 (ward A) and 6 (ward B) were symptomatic (cough, fever, and pleuritic chest pain) for 2–2.5 months before seeking medical evaluation and work restriction.

Isolation practices consisted of confining known or suspected TB patients to single-patient rooms. Rooms meeting CDC guidelines for TB isolation were not available on either ward A or B during most of the study period [16]. Of six isolation rooms evaluated in May 1992, four were under negative pressure and one was neutral with respect to the hallway.

Control measures. After the outbreaks were recognized, the hospital instituted multiple control measures based on CDC guidelines: It expanded the isolation policy for TB (March 1992), required more frequent tuberculin skin tests for HCWs, included HCWs in the tuberculin skin test program (July 1992), strictly enforced policies to promptly evaluate and restrict work of HCWs with symptoms suggestive of TB, and installed exhaust fans to create negative-pressure rooms [16]. The implementation of these measures was associated with a marked decrease in occupational exposure to TB and in tuberculin skin test conversions [17]. The conversion rate in the last 6 months of 1994 was 0.35%. Moreover, results of a preliminary investigation of patients who were hospitalized on wards A and B during the times that HCWs were potentially infectious did not identify any patients likely to have been infected by these HCWs.

Discussion

Theoretically, hospital transmission of *M. tuberculosis* can occur from patient to HCW, among HCWs, and from HCW to patient. Studies of previous nosocomial TB outbreaks have shown occupational risk of infection with *M. tuberculosis* after exposure to infectious TB patients [4–8]. This investigation identified patients as sources of occupational exposure and it identified, for the first time to our knowledge, HCWs with active TB as sources of outbreak transmission. HIV-infected HCWs are at particular risk of accelerated progression from new infection to active disease, and as shown in our investigation, HCWs who develop active TB provide an often unsuspected, potential source of infection to fellow workers.

The extraordinarily high prevalence of tuberculin skin test conversion (13.2%) on general medical wards suggests that infection control practices to reduce transmission from patients with known, suspected, or unsuspected TB to HCWs were probably ineffective during the outbreak period. Although it was impossible to rule out community transmission outside the hospital, a prevalence of new infections in the community high enough to account for the tuberculin skin test conversions

would imply extensive transmission in the widely varied communities in which this diverse group of HCWs lived and socialized. No evidence of such a high level of community transmission has been observed. Previous TB outbreaks have documented very high occupational risk of infection with *M. tuberculosis* after exposure to infectious TB patients [4–8]. As the incidence of TB in this country rises, HCWs are at increasing risk of exposure to both hospitalized TB patients and HCWs with infectious TB. Immunosuppressed HCWs, including those with HIV infection, are at particular risk of accelerated progression from new infection to active disease. It is important to note that the comparison with other hospital employees only included HCWs in general medicine wards where many infectious TB patients were admitted during the study period; employees in wards of much lower occupational risk, such as pediatrics, obstetrics and gynecology, surgery, and others were excluded from this analysis.

The additional elevated risk of transmission from HCW to HCW on wards A and B was supported by epidemiology and laboratory evidence. On ward A, HCWs were at greater risk of infection after exposure to infectious case-HCWs than after exposure to infectious case-patients. Because so few isolates were available from case-HCWs on ward A, we were unable to prove or disprove the epidemiologically suspected chain of transmission from HCW to HCW. On ward B, both patient-to-HCW and HCW-to-HCW transmission were epidemiologically implicated and confirmed by ML-PCR analysis. Neither mode of transmission alone explains all HCW infections, and both probably occurred.

ML-PCR is a rapid, highly sensitive, and specific method for typing isolates of the *M. tuberculosis* complex; it is based on the RFLP technique and has proven to be a reliable tool for strain typing in previous nosocomial TB outbreaks [4–7, 12]. The main advantage of ML-PCR over the standard RFLP method is its independence from mycobacterial growth. The rapid in vitro amplification of RFLP fragments allows analysis of primary isolates within 2 days and renders typing applicable to nonviable organisms. The high sensitivity of this method eliminates the need for subculture of the isolate and produces a complete DNA pattern from ≤ 1 colony of the original culture [12]. This technique was particularly useful in our investigation because nonviable isolates and isolates that could not be restricted by standard RFLP were seen. ML-PCR should prove particularly useful when nonviable *M. tuberculosis* isolates are available; this will further clarify the epidemiology of TB in health care facilities and the community.

All case-HCWs (by definition, those who developed active TB) developed active TB <1 year after infection, a rate three times that reported in the general population [10, 18]. The major risk factors for HCWs developing active TB were underlying insulin-dependent diabetes mellitus or HIV-infection (both known risk factors for the development of active TB) and performing charting activities in the nurses' work room [2]. Development of active TB may be related to the infectious dose of *M. tuberculosis* [18]; time spent in the small nurses' work room may have resulted in exposure to a larger infectious dose and, thus, contributed to the development of active TB.

Another unusual feature of this outbreak is that it occurred in the context of a tuberculin skin test surveillance system that provided annual testing for *M. tuberculosis* infection in HCWs. Ninety-six percent of the employees were current in this hospital-required program; thus, it was far more successful than those at many other US hospitals. Initially, the surveillance program identified increasing numbers of tuberculin skin test conversions on both wards A and B [4–7, 19], leading to the administration of tuberculin skin tests to all HCWs on the two wards and subsequent identification of the outbreak of active TB. However, the failure to include in the tuberculin skin test program nonhospital-employed HCWs with potential exposures to infectious TB may have resulted in delayed recognition of some new infections. Nonhospital-employed case-HCW 6 was anergic, and a tuberculin skin test would not have been helpful; however, at the time of the outbreak, nonhospital-employed HCWs were also excluded from other employee benefits, such as access to the employee health clinic. Had case-HCW 6 had access to on-site health care, diagnosis and treatment may have occurred earlier, possibly reducing TB transmission to coworkers on ward B. The role of HCW 6 in this outbreak underscores the tremendous challenge that anergic HCWs pose when occupational TB control programs rely primarily on tuberculin skin test and place less emphasis on diagnosis and treatment.

However, access to care does not ensure that symptomatic HCWs will seek medical care or that a correct diagnosis will be made. Failure to provide preventive treatment to HCWs with tuberculin skin test conversions and delays in treatment of workers with symptoms compatible with TB on both wards A and B probably contributed to the high prevalence of transmission on both floors. HCWs with symptoms compatible with TB should be promptly evaluated for and treated, particularly if numerous TB patients are admitted to the facility. Moreover, these data point out the importance of educating HCWs about TB, increasing awareness of symptoms suggestive of active disease, and evaluating symptomatic HCWs promptly. This is particularly important for HCWs who have or are at high risk for HIV infection.

Our results emphasize the importance of active surveillance for tuberculin skin test conversion in all workers at health care facilities. Such a program facilitates early identification of infected HCWs, initiation of antituberculous preventive therapy, early identification of HCWs who may be at risk of developing active TB, estimation of the risk of nosocomial TB transmission to HCWs, and evaluation of the effectiveness of screening and infection-control practices for suspected TB patients [17]. Of utmost importance is a high index of suspicion for TB when an HCW presents with symptoms compatible with TB, particularly after a tuberculin skin test conversion. The value of a comprehensive tuberculin skin test program for all HCWs has been confirmed by evidence that implementation

of such a program is associated with marked reduction of occupational risk for TB [20, 21].

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Tuberculosis Outbreak among Healthcare Workers in a Community Hospital

D. E. GRIFFITH, J. L. HARDEMAN, Y. ZHANG, R. J. WALLACE, and G. H. MAZUREK

Departments of Medicine and Microbiology, and The Center for Pulmonary Infectious Diseases, The University of Texas Health Center at Tyler, Tyler, Texas; Southern California Pulmonary-Critical Care Medical Group Inc., Brea, California

Twenty-nine healthcare workers (HCW) were exposed to an active case of unrecognized drug-susceptible pulmonary tuberculosis in a community hospital for as long as 2 h in the emergency room and 10 h in a medical intensive care unit. Twelve of the 29 exposed HCW could not be evaluated for tuberculosis infection because 10 of them had a previously positive tuberculin skin test and two were lost to follow-up. Of the remaining 17 tuberculin skin test negative HCW, 13 (76%) either converted their skin test to positive (10 HCW) or developed active disease (three HCW) after exposure to the index case. The *Mycobacterium tuberculosis* isolates from the three HCW had identical DNA restriction fragment length polymorphism (RFLP) patterns when studied by pulsed field gel electrophoresis. This case of drug-susceptible tuberculosis was associated with unusually high rates of tuberculosis infection and disease in HCW. Prevention of similar occurrences in HCW may be difficult because of the short exposure time required for transmission of tuberculosis and the absence of consensus on optimal respiratory protective measures. Griffith DE, Hardeman JL, Zhang Y, Wallace RJ, Mazurek GH. Tuberculosis outbreak among healthcare workers in a community hospital. AM J RESPIR CRIT CARE MED 1995;152:808–11.

Tuberculosis remains an occupational hazard for healthcare workers (HCW). Prior to the advent of effective antituberculosis medications, tuberculosis infection and disease were common among HCW in sanitaria (1). Interestingly, outside of the sanitaria the importance of work-related transmission of tuberculosis to HCW was not widely recognized by the medical community until the 1950s (2). The problem was sufficient, however, to deter employment in sanitaria, warrant action by workers compensation boards, and impact insurability of HCW (1, 2). Even after the introduction of effective antituberculosis medications and a continuous decline in the incidence of tuberculosis disease, nosocomial transmission of tuberculosis to HCW has continued to occur (3–6). The problem has recently been magnified by both the increasing incidence of tuberculosis in general and multidrug-resistant (MDR) tuberculosis in particular. Currently, the greatest risk of nosocomial transmission is to immunocompromised patients, especially those who are infected with the human immunodeficiency virus (HIV) (7–11). It is also clear, however, that HCW are at risk regardless of their immune status.

Multiple patient-related factors facilitate or predispose to nosocomial spread of tuberculosis, including close contact with infectious patients, bronchoscopy, endotracheal intubation, endotracheal suctioning during mechanical ventilation, open abscess irrigation, autopsy, and procedures that stimulate coughing (12). The most consistently important factor favoring nosocomial transmission, however, is close contact with patients with unrecognized tuberculosis disease (3–11). This aspect of the problem is especially important in areas such as outpatient clinics and emergency rooms (ER) where patients may receive care before a diagnosis of tuberculosis can be made.

We identified a nosocomial outbreak of drug-susceptible tuberculosis among HCW after exposure to a critically ill patient who was treated in a community hospital ER and a medical intensive care unit (MICU). This index case was responsible for an unusually high rate of transmission of tubercular infection and disease in nonimmunocompromised HCW. The incident illustrates some of the problems in limiting work-related spread of tuberculosis.

The index case was a 22-yr-old Mexican woman who had been in the United States for 2 wk and who was admitted to La Mirada Medical Center (LMMC) in La Mirada, California on February 22, 1992. The patient was unable to give a history; however, her family stated that she had had "cold" symptoms for 2 mo, specifically cough, sputum production, fever, anorexia, and weight loss. The patient had no history of other medical illnesses or known risk factors for HIV-related illness, was receiving no medications, had no previous surgeries, and did not smoke cigarettes or drink alcohol. On the day of admission the patient had a cardiorespiratory arrest at home. She was transported by ambulance to the La Mirada Medical Center emergency room where she was intubated by the ER physician. After resuscitation the patient was tachycardic and hypotensive, requiring vasoactive agents to maintain an adequate blood pressure. On examination she appeared cachectic, was unresponsive to verbal or physical stimuli, and on chest examination had diffuse crackles and wheezes. Her chest radiograph showed dense bilateral alveolar in-

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Correspondence and requests for reprints should be addressed to David E. Griffith, M.D., Associate Professor of Medicine, University of Texas Health Center at Tyler, Tyler TX 75710.

filtrates compatible with the adult respiratory distress syndrome (ARDS). After stabilization in the ER (approximately 2 h) she was transferred to the MICU and ventilated with a mechanical ventilator. Respiratory secretions for laboratory analysis were obtained by endotracheal suctioning. She remained hypotensive despite the administration of pressors, and she survived an additional 10 h in the MICU. She subsequently had a cardiorespiratory arrest and could not be resuscitated. No autopsy was performed.

During her evaluation and treatment in the ER and MICU all of the HCW who had direct contact with this patient wore standard surgical masks. Neither the ER or the MICU was equipped with negative pressure rooms, frequent or rapid air exchanges, filters for recirculated air, or ultraviolet lights.

Tracheal suction specimens from the patient were 4+ acid-fast bacilli (AFB) smear-positive and yielded *M. tuberculosis* susceptible to all drugs. An HIV titer was negative. Subsequent evaluation of the patient's eight family members in the United States found none with positive tuberculin skin tests. Both the level of exposure to the index case and the immune status of these family members are unknown. The patient's more extensive family in Mexico was not available for evaluation.

Tuberculin skin testing for HCW exposed to the source case was performed using the Mantoux technique with intradermal purified protein derivative (PPD) and interpreted according to American Thoracic Society (ATS) guidelines (13). The diagnosis of active cases of tuberculosis were also made according to ATS guidelines (13).

The isolates of *M. tuberculosis* from the three HCW with active tuberculosis were studied for their DNA fingerprint pattern by pulsed field gel electrophoresis. The *M. tuberculosis* isolate from the index case had been discarded. The three isolates, which were recovered on Middlebrook 7H10 and/or Lowenstein-Jensen agar, had been passaged no more than twice before being frozen at −70° C in trypticase-soy broth with 15% glycerol until needed for study. Genomic DNA was prepared as previously described (14). DNA restriction fragment length polymorphism (RFLP) analysis utilizing the restriction endonuclease *Dra* I and pulse field gel electrophoresis was also performed as previously described (14).

Twenty-nine HCW were exposed to this patient during the 12 h she was cared for in the community hospital ER and MICU (Table 1). Systematic HIV testing of contacts was not done; however, none of the HCW were known to be HIV positive or to have risk factors for HIV infection identified during contact evaluation. Twelve of 29 HCW were considered nonevaluable for tuberculosis infection. Ten of them had documented positive tuberculin skin tests prior to or within 1 wk of the exposure. Four of these had previously received BCG vaccination. Two of the 29 exposed HCW were initially PPD-negative, but they were unavailable for repeat skin testing. Ten of the 29 exposed HCW were PPD-negative immediately after exposure to the patient but converted to PPD positive within 3 mo after the exposure. An additional three HCW not only converted their PPD to positive but developed apical cavitary infiltrates on chest radiograph and symptomatic pulmonary tuberculosis confirmed by sputum culture within 6 mo after exposure to the index case. None of these three HCW received isoniazid chemoprophylaxis. The three HCW with tuberculosis disease were tested for HIV and were negative. Four of 29 workers did not convert their PPD to positive. Overall, 13 of 17 (76%) of the exposed, evaluable HCW who were skin-test-negative developed the infection or disease.

Genomic DNA from the *M. tuberculosis* isolates obtained from the three active cases of tuberculosis showed identical RFLP patterns after digestion with the endonuclease *Dra* I (Figure 1), confirming a common source of the tuberculosis infection and disease.

* * *

Nosocomial transmission of tuberculosis is usually a consequence of hospitalized patients with unrecognized pulmonary or laryngeal tuberculosis who are not receiving effective antituberculosis therapy and have not been placed in respiratory isolation. This case highlights several difficult aspects of preventing nosocomial spread of tuberculosis in an ER and a MICU, settings where initiation of treatment for previously undiagnosed tuberculosis has no protective value and, for the ER specifically, where effective respiratory isolation is difficult. First, this patient was critically ill at presentation and therefore demanded close and intensive attention from multiple HCW. Second, the patient presented with diffuse pulmonary infiltrates compatible with ARDS and atypical for pulmonary tuberculosis. In fact, the only clue that this

TABLE 1

EXPOSED HEALTHCARE WORKERS

Exposed HCW	Job	Tuberculin Skin Test	Comments
1	ER physician	Positive	Previous BCG
2	ICU nurse	Positive	Previous BCG
3	Lab technician	Positive	Previous BCG
4	X-ray technician	Positive	Previous BCG
5	ER nurse	Positive	Previously positive
6	ICU nurse	Positive	Previously positive
7	Floor nurse	Positive	Previously positive
8	Respiratory therapist	Positive	Previously positive
9	Floor nurse	Positive	Previously positive
10	Environmental services	Positive	PPD conversion 1 wk after exposure
11	ICU nurse	Negative	Lost to follow-up
12	Floor nurse	Negative	Lost to follow-up
13	ICU physician	Converted	Active TB
14	ER nurse	Converted	Active TB
15	Respiratory therapist	Converted	Active TB
16	ICU nurse	Converted	
17	ER nurse	Converted	
18	Respiratory therapist	Converted	
19	Respiratory therapist	Converted	
20	ER nurse	Converted	
21	Environmental services	Converted	
22	Lab technician	Converted	
23	ER clerk	Converted	
24	Nursing supervisor	Converted	
25	Floor nurse	Converted	
26	Environmental services	Negative	No PPD conversion
27	Environmental services	Negative	No PPD conversion
28	Central supply	Negative	No PPD conversion
29	Security	Negative	No PPD conversion

Definition of abbreviations: HCW = health care worker; ER = emergency room; ICU = intensive care unit.

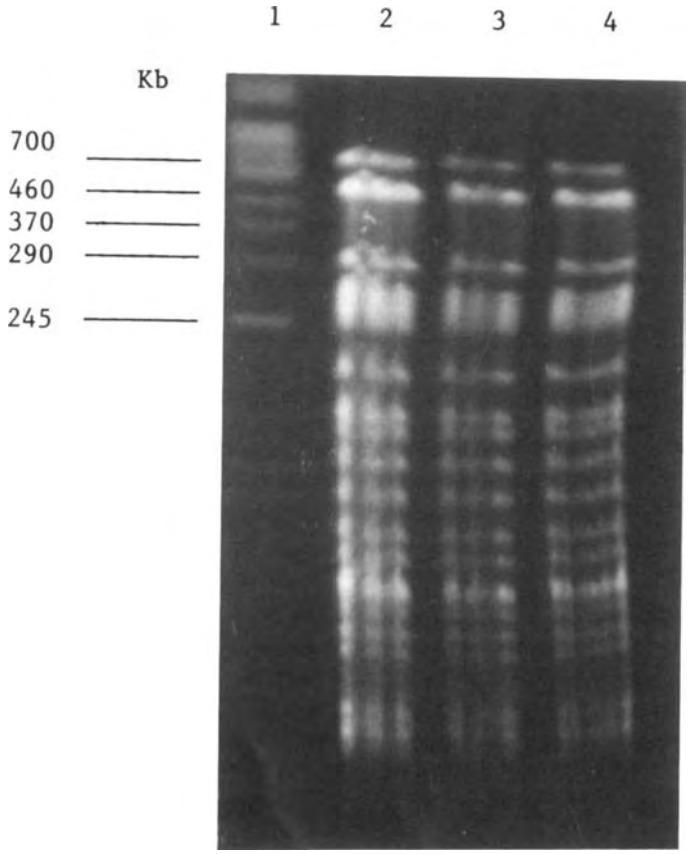

Figure 1. Genomic DNA restriction fragment patterns of three *M. tuberculosis* isolates from the described outbreak after digestion with Dra I and pulsed field gel electrophoresis. Lane 1: yeast chromosomal DNA; lane 2: HCW 13; lane 3: HCW 14; lane 4: HCW 15.

patient might have had tuberculosis was that she was from a geographic area of high tuberculosis endemnicity. Third, the patient had endotracheal intubation and endotracheal suctioning, which are associated with formation of infectious droplet nuclei. This case, therefore, represents perhaps the most difficult constellation of problems surrounding tuberculosis disease recognition and attendant care: a radiographically atypical form of tuberculosis, a critically ill patient, multiple respiratory procedures, and a patient care area difficult to provide with environmental isolation.

A more difficult factor to quantitate was the virulence of the tuberculosis strain from the index case. The high percentage of PPD conversions in evaluable HCW and the short time span between exposure and disease for three HCW suggests a highly virulent strain. It is curious that the patient's relatives in the United States were PPD-negative. Their exposure to the index case was relatively short (2 wk), and it is likely that they were not all close contacts. The critical difference may have been the performance of respiratory procedures at the hospital with the creation of a high density of infectious particles in areas with no environmental respiratory protection.

In a previous similar report, a critically ill patient with active tuberculosis treated in an ER resulted in PPD conversions in 15 of 44 (34%) previously PPD-negative HCW with possible exposure to the patient (15). Active tuberculosis developed in five of 44 (11%) of these HCW. Phagetyping of *M. tuberculosis* isolates from some of these active cases suggested a common source of infection. Of particular interest in this tuberculosis outbreak, the index case entered the ER as a *known* case of tuberculosis disease, and most of the personnel who cared for him wore surgical masks. Recirculation of air without filtration within the ER was implicated as an important factor in this outbreak.

In this study an unusually high percentage (76%) of exposed, susceptible HCW developed tuberculosis infection or disease. The four susceptible HCW who remained PPD-negative after the exposure had jobs that brought them into little or no direct contact with the patient. Thus, the risk of infection for the susceptible HCW with direct patient contact in this case was essentially 100%. It is possible that some of the known PPD-positive HCW (including BCG recipients) could have developed exogenous reinfection from the index case, although none is known to have developed tuberculosis disease. It appears that a previous tuberculin-positive state, including previous BCG administration, provided some protection against tuberculosis as a consequence of exogenous reinfection.

Although it cannot be proved that the three HCW who developed active tuberculosis in the current report were infected by the index case, these workers were immunocompetent, asymptomatic, and PPD-negative at the time of exposure to the index case, converted their PPD at the same time as other HCW exposed to the index case, became symptomatic with tuberculosis disease at about the same time, and were infected with the same strain of *M. tuberculosis*. Previous studies have argued that matching DNA fingerprint patterns from MDR tuberculosis isolates in HIV-positive populations are highly suggestive of nosocomial tuberculosis transmission (7, 9–11). Although it is possible that all three of these with tuberculosis contracted their tuberculosis isolate from a source other than the patient described above, the timing of onset of active tuberculosis and the association of the active cases with a cluster of new positive tuberculin skin tests makes it highly likely they were infected by the index case.

Recommendations for limiting nosocomial spread of tuberculosis have emphasized measures for isolating communicable hospitalized patients and limiting recirculation of air contaminated with infectious droplet nuclei (16, 17). These strategies may be difficult to implement, particularly at the initial point of contact between the patient and the healthcare system. The Centers for Disease Control and Prevention (CDC) have recently issued draft recommendations for management of patients with tuberculosis in ambulatory care settings and ERs (17). Recommendations pertinent to this discussion include vigorous triage with prompt evaluation and early detection of patients with signs and symptoms of tuberculosis, a surgical mask for the patient, and separate isolated waiting areas and examination rooms. Additional recommendations include enhanced general ventilation, ultraviolet lighting, and recirculation of air through high efficiency particulate air (HEPA) filters. Compliance with these measures is clearly of benefit for inpatients and for respiratory isolation of outpatients once they are identified as tuberculosis suspects.

Personal respiratory protection is also advised for persons entering rooms where patients with known or suspected infectious tuberculosis are being isolated (17). The effectiveness of surgical masks for protecting against transmission of tuberculosis has never been demonstrated (16), and in this outbreak surgical masks appear to have offered no protection. The CDC recommends masking devices that are individually sized and fit-tested and that filter particles one micron in size such as HEPA filter particulate respirators (PR). The CDC also concedes that "The precise level of effectiveness of respiratory protection in protecting HCW from transmission of *M. tuberculosis* in health care settings cannot be determined with currently available data" (17). Two recent studies have also questioned the cost-effectiveness of HEPA filter PR in hospitals with relatively few tuberculosis admissions

(18, 19). Some recent data suggest that fit-tested HEPA filter PR do offer greater respiratory protection than do dust-mist-fume and dust-mist PR or molded surgical masks (20). The HEPA filter PR was also the PR that was the most difficult to fit properly, a critical factor for effective respiratory protection, and the least acceptable by HCW because of perceived increased work of breathing and decreased ability to communicate (18). The optimal use of HEPA filter PR is unclear; however, it is possible that an effective PR would contribute to prevention of nosocomial transmission of tuberculosis for HCW involved with respiratory-related procedures in a patient with unrecognized tuberculosis.

This case suggests that patients with risk factors for tuberculosis and an abnormal chest radiograph, regardless of clinical presentation, should be targeted for the most intensive infection control measures. Paradoxically, those facilities with few encounters with tuberculosis, where aggressive respiratory protective measures are not cost-effective, may be the most vulnerable to a sporadic outbreak from a patient similar to the index cause in this report.

There are significant costs for effective respiratory infection control that will increase as the degree of HCW protection increases. These costs are not only monetary but include the creation of physical and emotional barriers between the HCW and the patient. The optimal application of currently available respiratory infection control remains to be determined.

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TB RESPIRATORS

Bryan D. Hardin, Ph.D.
Acting Deputy Director
National Institute for Occupational Safety and Health
Atlanta, GA

In 1994, the Centers for Disease Control and Prevention published "Guidelines for Preventing the Transmission of *Mycobacterium tuberculosis* in Health-Care Facilities" (MMWR Vol 43 No. RR-13). Those Guidelines contained detailed recommendations on many aspects of TB transmission in health care. Included was guidance on when respiratory protection should be used and what performance characteristics should guide selection of respiratory protective devices. One of those characteristics is that respirators used for protection against TB need to filter at least 95% of particulates that are 1 μm or smaller in size. Until recently, only one kind of respirator filter was available that was certified to meet that performance characteristic: the high efficiency particulate air (HEPA) filter.

OSHA regulates the use of respirators in the workplace, and one of their requirements is that respirators used must be NIOSH-certified. Authority to issue regulations on the performance of respiratory protective devices rests with NIOSH under provisions of the Mine Safety and Health Act as amended. Until July of 1995, the respirator certification program was jointly administered by NIOSH and the Mine Safety and Health Administration (MSHA) under a regulation known as "30 CFR Part 11." It was under that regulation that performance standards assured 95% efficiency at 1 μm and below only for HEPA filters. In July 1995, a new respirator standard, 42 CFR Part 84, went into effect. "Part 84" transferred the program to NIOSH and established new performance standards for particulate filter certification. All particulate filters certified under Part 84 offer 95% or better filtration efficiency against 0.3-μm particulates, so all of the new filters meet or exceed the CDC performance criterion for filter efficiency against TB.

In health care disposable or "filtering facepiece" respirators are most used. The disposable HEPA respirators were priced at $6 to $8 each, while new N95 disposables are being sold for as little as 60 cents each. This represents substantial savings not just for health care, but for all other workplaces where similar substitutions can be made. To help respirator users make the transition from Part 11 to Part 84 respirators, NIOSH published a "User's Guide to the Selection and Use of Particulate Respirators Certified Under 42 CFR 84" (NIOSH 96-101, January 1996). To provide information specific to the needs of health care NIOSH also published "Protect Yourself Against Tuberculosis -- A Respiratory Protection Guide for Health Care Workers" (NIOSH 96-102, December 1995). All of these issues will be discussed with the course participants.

Classes of Filters Certified Under 42 CFR 84

	N-series	R-series	P-series
99.97% Efficiency	N100	R100	P100[1]
99% Efficiency	N99	R99	P99
95% Efficiency	N95	R95	P95
Test Agent	NaCl	DOP oil	DOP oil
Test Maximum Loading	200 mg	200 mg	Stabilized efficiency
Contaminant Type	Solid & water-based particulates (i.e., non-oil aerosols)	Any	Any
Service Time[2]	Non-specific[3]	One work shift[4]	Non-specific

[1]The P100 filter must be color-coded magenta. The Part 84 Subpart KK HEPA filter on a PAPR will also be magenta, but the label will be different from the P100 filter, and the two filters cannot be interchanged.

[2]Limited by considerations of hygiene, damage, and breathing resistance.

[3]High (200 mg) filter loading in the certification test is intended to address the potential for filter efficiency degradation by solid or water-based (i.e., non-oil) aerosols in the workplace. Accordingly, there is no recommended service time limit in most workplace settings. However, in dirty workplaces (high aerosol concentrations), service time should only be extended beyond 8 hours of use (continuous or intermittent) by performing an evaluation in specific workplace settings that demostrates (a) that extended use will not degrade the filter efficiency below the certified efficiency level, or (b) that the total mass loading of the filter is less than 200 mg (100 mg per filter for dual-filter respirators).

[4]No specific service time limit when oil aerosols are not present. In the presence of oil aerosols, service time may be extended beyond 8 hours of use (continuous or intermittent) by demostrating (a) that extended use will not degrade the filter efficiency below the certified efficiency level, or (b) that the total mass loading of the filter is less than 200 mg (100 mg per filter for dual-filter respirators).

NaCl = Sodium Chloride DOP = Dioctyl Phthalate

Particulate Respirators Certified Under 42 CFR Part 84

On July 10, 1995, a new certification standard for particulate respirators went into effect. This regulation, 42 CFR Part 84, replaced the long standing regulation 30 CFR Part 11. (Commonly referred to as Part 84 and Part 11, respectively.) The new Part 84 covers all respirator types (self-contained breathing apparatus, air-line respirators, gas and vapor respirators, powered respirators, etc.) but only the standards for nonpowered, particulate respirators have changed from the provisions of the old Part 11.

The following is a list of nonpowered, particulate respirators that have been tested and certified by NIOSH under the provisions of the new Part 84. Other respirator types certified under the provisions of Part 84 are not included in this listing. Also not included are combination particulate respirators such as particulate filters in combination with gas and vapor filters. As additional respirators are certified, they will be added to this list. Additions are made to this list in the order that they receive certification.

Note: There may be multiple entries with the same certification number when the respirator represented by that certification number is marketed by different suppliers, under private labels.

Particulate Respirators Certified Under 42 CFR Part 84

Approval Number	Supplier/ Phone	Respirator Type/ Trade Name	Exha Valv
84A-0001	Better Breathing, Inc. 1-800-638-6275	N95, Filtering facepiece APR-3-N95-1	Yes
84A-0002	Racal Health and Safety, Inc. 1-800-682-9500	N95, Filtering facepiece Delta N95	Yes
84A-0003	Racal Health and Safety, Inc. 1-800-682-9500	N95, Filtering facepiece Delta N95	No

84A-0004	Racal Health and Safety, Inc. 1-800-682-9500	N100, Filtering facepiece Delta N100	Yes
84A-0005	Tecnol, Inc. 1-800-832-6651	N95, Filtering facepiece PFR 95 and Preventer 95	No
84A-0006	3M Company 1-800-243-4630	N95, Filtering facepiece 1860	No
84A-0007	3M Company 1-800-243-4630	N95, Filtering facepiece 8210 and 7048	No
84A-0008	Racal Health and Safety, Inc. 1-800-682-9500	N95, Filtering facepiece Racal N95	No
84A-0009	Racal Health and Safety, Inc. 1-800-682-9500	R95, Filtering facepiece Delta R95	Yes
84A-0010	Tecnol, Inc. 1-800-832-6651	N95, Filtering facepiece PFR95 and Preventer95	No
84A-0011	Tecnol, Inc. 1-800-832-6651	N95, Filtering facepiece PFR95 and Preventer95	No

84A-0012	Racal Health and Safety, Inc. 1-800-682-9500	N95, Filtering facepiece Delta N95 + Odor	Yes
84A-0013	Moldex-Metric, Inc. 1-800-421-0668	N95, Filtering facepiece 2001 and 2002	No
84A-0014	Racal Health and Safety, Inc. 1-800-682-9500	N99, Filtering facepiece Delta N99	Yes
84A-0015	Survivair 1-800-821-7236	N95, Filtering facepiece 1930	No
84A-0015	BioSafety Systems 1-800-421-6556	N95, Filtering facepiece 1930	No
84A-0016	Better Breathing, Inc. 1-800-638-6275	N95, Filtering facepiece APR-7-N95-0	No
84A-0016	Uvex Safety 1-401-232-1200	N95, Filtering facepiece Pro-Tech-N95	No
84A-0022	3M Company 1-800-243-4630	P100, Elastomeric 1/2 Mask 6000 Low-maintenance with 2091 filter	Yes
84A-0029	Uvex Safety	N95, Filtering facepiece	Yes

	1-401-232-1200	Pro-Tech-N95-A	
84A-0029	Better Breathing, Inc 1-800-638-6275	N95, Filtering facepiece APR-7-N95-1	Yes
84A-0030	3M Company 1-800-243-4630	P100, Elastomeric 1/2 Mask 7000 Series Conventional with 2091 filter	Yes
84A-0031	3M Company 1-800-243-4630	P100, Elastomeric 1/2 Mask 7000 Series Bayonet Attachment with 2091 filter	Yes
84A-0038	3M Company 1-800-243-4630	P100, Elastomeric Fullface 7000 Series Conventional with 2091 filter	Yes
84A-0071	3M Company 1-800-243-4630	P100, Elastomeric Halfmask 6000 Series Low Maintenance with 7093 filter	Yes
84A-0078	3M Company 1-800-243-4630	P100, Elastomeric Halfmask 7000 Series Conventional with 7093 filter	Yes
84A-0079	3M Company 1-800-243-4630	P100, Elastomeric Halfmask 7000 Series Bayonet Attachment with 7093 filter	Yes
84A-0086	3M Company 1-800-243-4630	P100, Elastomeric Fullface 7000 Series Conventional with 7093 filter	Yes
84A-0114	Moldex-Metric, Inc. 1-800-421-0668	N95, Filtering facepiece 8000 Series Halfmask with 8910 filters	Yes

84A-0115	Moldex-Metric, Inc. 1-800-421-0668	N99/R95 Filtering facepiece 8000 Series Halfmask with 8920 filters	Yes
84A-0116	Moldex-Metric, Inc. 1-800-421-0668	N100/P99 8000 Series Halfmask with 8930 filters	Yes
84A-0117	Moldex-Metric, Inc. 1-800-421-0668	P100 8000 Series Halfmask with 8940 filters	Yes
84A-0118	Mine Safety Appliances 1-800-672-2222	P100 Comfo-Series Halfmask with P100 or P100 Sparkfoe filters	Yes
84A-0119	Mine Safety Appliances 1-800-672-2222	P100 Comfo-Series Halfmask	Yes
84A-0120	Moldex-Metric, Inc. 1-800-421-0668	N95, Filtering Facepiece 2071 and 2072 2051 and 2052 2061 and 2062	Yes
84A-0121	Mine Safety Appliances 1-800-672-2222	P100 Comfo-Series Halfmask with Comfo Low Profile filters	Yes
84A-0122	Mine Safety Appliances 1-800-672-2222	P100 Advantage 100 Halfmask with Comfo Low Profile filters or Advantage Low Profile filters	Yes
84A-0123	3M Company 1-800-243-4630	P100 7000 Series Conventional Halfmask with 7090 filters	Yes
84A-0129	3M Company 1-800-243-4630	P100 7800 Full Facepiece with 7090 filters	Yes
84A-0160	Louis M. Gerson Co.	N95	No

	1-508-947-4000	1730,1731,2734,2735 and 2737 Filtering Facepiece	
84A-0161	Louis M. Gerson Co. 1-508-947-4000	N95 1740,1741,2744,2745 and 2747 Filtering Facepiece	Yes
84A-0170	Louis M. Gerson Co. 1-508-947-4000	P100 9000 Series halfmask with G70 filters	Yes
84A-0171	Mine Safety Appliances 1-800-672-2222	P100 Advantage 1000 Full Facepiece with Type P100 filters	Yes
84A-0172	Mine Safety Appliances 1-800-672-2222	P100 Advantage 1000 Full Facepiece with Type P100 low profile filters	Yes
84A-0181	Mine Safety Appliances 1-800-672-2222	P100 Ultra-twin Full Facepiece with Type P100 filters	Yes
84A-0182	Mine Safety Appliances 1-800-672-2222	P100 Ultra-twin Full Facepiece with Comfo P100 low profile filters	Yes
84A-0197	Air-Ace Oy Finland +358-41-281911	N95 9100 Halfmask with 300 filter	Yes
84A-0204	Louis M. Gerson Co. 1-508-947-4000	N99 1750,1751 Filtering Facepiece	No

Go back to the NIOSH home page or to the CDC home page.

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Selection of Needlestick Prevention Devices

Linda A. Chiarello, RN, MS,CIC
Director, Infection Control Program
New York State Department of Health
Albany, New York

The association of occupational bloodborne disease transmission with needlestick injuries has created a demand for devices with sharps-prevention safety features. A plethora of products have emerged in response to this demand which require careful evaluation to assure effectiveness in patient care as well as worker safety. In addition, multiple devices associated with injuries and choices between safety options require that institutions establish priorities for intervention. Primary users must be involved in the selection process.

This presentation will describe five essential steps in the selection of needlestick prevention devices. These include: 1) creation of a multidisciplinary team, 2) prioritizing prevention activities based on analysis of institution-specific injury data, 3) development of design and performance criteria for evaluating devices according to safety and patient care needs, 4) planning and implementing a clinical evaluation of devices under consideration, and, 5) analyzing performance data and cost impact for final product selection.

EVALUATING THE HANDS-FREE TECHNIQUE DURING SURGERY

Bernadette Stringer
Ph.D. Candidate
Faculty of Medicine
Department of Occupational Health
McGill University
Montréal, Québec

Recommendations for risk reduction strategies primarily come from organizations like the Association of Operating Room Nurses (AORN), Academy of Orthopedic Surgeons (AAOS), Royal College of Surgeons of England, U.S. Centers for Disease Control, although the U.S. Occupational Health and Safety Administration (OSHA) has enacted a standard, Part 1910.1030 of Title 29 of the Code of Federal Regulations, effective March 6, 1992, titled " Occupational Exposure to Blood borne Pathogens" (OSHA 1992). These organizations advocate changes in equipment, technique and practices, such as: use of a hands-free technique for passing sharps; verbal warnings when sharps must be passed directly; double and triple gloving; complete barrier protection; redesign of instruments; tying suture knots without the needle in hand; identifying exposure prone procedures, avoiding haste while carrying out procedures and many others.

To effectively evaluate injury reduction strategies of this type, one can choose a few discrete behaviours and practices, assess their use, and then compare accident levels to those before their introduction.

One risk reduction strategy in work practice, is the primary focus of this study : use of the hands-free technique.

The hands-free technique has been selected because:

1) It is an essential part of safety recommendations made for some time by professional bodies like the AORN, AAOS, CDC, Royal

College of Surgery, and has officially been part of The Providence Hospital operating room policies, where the study is being carried out, but has not been adequately evaluated;

2) Studying the hands-free-technique, will allow findings to partially validate at least one previous study, by Tokars et al.

Baker (1980) has succinctly stated criteria for judging injury control measures. "Measures designed to prevent injuries depend for their effectiveness on three things: they must work when properly used, that is, they must be efficacious; second, they must be used; and third they must be used properly". Questions about the hands-free technique that require answering are: Is it used?; Is it used properly?; Does it work when properly used?

The hands-free technique may be carried out by placing a sharp in an established neutral zone on the surgical field, placing a sharp in a basin or other means of ensuring that only one scrubbed or circulating surgical member touches this sharp at any given time.

Non-use of the hands-free technique by scrubbed and circulating personnel could result in a glove tear, a cutaneous contamination when the glove is accidentally perforated or percutaneous injury if the sharp not only perforates the glove but also penetrates the skin. Although the hands-free technique is not a work practice recommended outside the sterile surgical field, it is recommended for passing instruments from the sterile field (from the scrubbed personnel) to circulating personnel. Therefore percutaneous injuries of circulating personnel, may also be related to this work practice.

Though mucous membrane contamination, and many cutaneous contaminations are unlikely to result directly from non-use of the hands free technique, they could result indirectly, or be part of a combination of injury and contamination (splashing resulting from injury). Therefore all contaminations, whether or not directly related to use of the hands-free technique, will also be examined.

OPERATING ROOM DATA COLLECTION FORM FOR HANDS-FREE TECHNIQUE STUDY (Confidential)

SECTION A: Must be filled out for each surgery by circulating nurse

OR Theatre# _____
Date _____
day/mo./yr.
Incision time_____hr.
Surgery ended_____hr.

1. Case status
(Check one of each following)

i. in-patient [a] out-patient [b]
ii. emergency [c] non-emergency [d]

2. Service (Check one below)

general surgery	a	ENT	f
orthopedic	b	transplant	g
cvt (i.e. open ht.)	c	gynecological	h
plastics	d	eye	i
urology	e	other	j

3. Total blood loss (best estimate)
_____ml./cc.

4. Personnel present for 75% or more of the time, that the operation lasted? *(Add number after each occupational category)*

a) surgeon (attending/staff)	g) scrub nurse
b) surgeon(intern/resident	h) circulating nurse
c) medical student	i) OR tech
d) anaesthesist (attending/staff)	j) PA
e) anaesthesist (resident/fellow)	k) perfusionist
f) anaesthesia tech.	l) other

5. Was the hands-free technique used? (procedures to ensure surgeons and nurses/technicians never touched the same sharp instrument at the same time)
Yes [a] No [b]
If this was done, what method was usually used?
Sharp instruments were passed to:
a section of the sterile field.. [c]
a kidney basin..... [d]
onto a mayo stand..... [e]
f) other (please describe)_____
_____

6. What proportion of passes of sharps were done so no two persons touched a sharp instrument (hands-free technique) at the same time?
Always..... [a]
about 75% of the time..... [b]
about 50% of the time..... [c]
about 25% of the time..... [d]

7. During the surgery could you easily hear (check one) :
Quiet talking..... [a]
normal talking ..... [b]
loud talking..... [c]

SECTION B : To be filled out ONLY if an INJURY (perforation of the skin) or/and CONTAMINATION (of the skin or mucous membrane with blood or body fluid) or/and GLOVE TEAR occur during the surgery described in Section A

1. Person injured/contaminated or with torn glove:
agrees to participate..... [a]
does not agree to participate..... [b]

2. Incident type:
injury..... [a]
contamination..... [b]
glove tear..... [c]
(Turn page and answer question B8 [hand diagram] for all incident types)

3. Was this incident:
self inflicted..... [a]
inflicted by a co-worker..... [b]
c) other, explain_____
_____

4. Surgical procedure at time of injury/contamination/glove tear
_____

OR Theatre # _____
Time of event _____hr.

5. Data about the injury/contamination/glove tear is from the:
worker who sustained incident..... [a]
co-worker..... [b]
(Co-worker nearest to incident should provide information if injured/contaminated person leaves for first-aid) If information is from co-worker, fill out Section B again by asking the injured/contaminated employee questions when s/he returns)

6. Job category of person injured/contaminated or with torn glove (check one)

surgeon (attending/staff).....	a	OR tech.....	f
surgeon (intern/resident).....	b	nursing student	g
medical student.....	c	PA	h
scrub nurse.....	d	i) other, describe_____	
circulating nurse	e	_____	

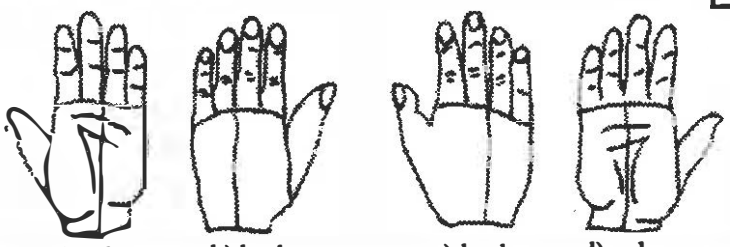
7. What protective apparel was worn by person at the time of the contamination/injury/glove tear? (check all that apply)

surgical mask.....	a	eyeglasses.....	f
surgical gown, disposable.....	b	eyeglasses & side shields.....	g
surgical gown, reusable.....	c	goggles.....	h
single pair latex/vinyl gloves.....	d	faceshield.....	i
double pair latex/vinyl gloves....	e	j) other_____	

TURN PAGE PLEASE

B 8. Describe circumstances leading to injury/ contamination/glove tear. Place an X(s) on diagram at right where (if) the employee's hand was injured/contaminated or glove torn. _____

LEFT RIGHT



a) palm b) back c) back d) palm

Section C IF THE EVENT WAS AN INJURY

OR Theatre # ___ Time of event _____hr.

1. Is the person who caused the injury:
right-handed..... a
left-handed..... b

2. Is the injured worker:
right-handed..... a
left-handed..... b

3. Was the sharp instrument/item (check one)
held by another person..... a
held by the injured person..... b
not held by anyone..... c

4. Was the sharp instrument/item considered:
contaminated..... a
uncontaminated..... b
unknown..... c

5. What device/item caused the injury (scalpel blade etc.)?_____
If you can't name it, please describe it_____

6. Was the injury:
superficial..... a
moderate (some bleeding)..... b
severe (deep/profuse bleeding)..... c

7. For what purpose was item causing injury originally used?

cutting	a	to obtain tissue	i
electrocautery	b	injection (IM, SC, other	
wiring/fixing	c	into tissue)	j
drilling/sawing	d	to contain specimen	k
suturing skin/other tissue	e	using as a tool	
suturing muscle/fascia	f	(not on patient)	l
retracting tissue/bone	g	m) other _____	
to obtain a body fluid	h	_____	

8. Did the injury occur: (check one)

before use of the item	a	recapping **unused** needle	j
during use of item	b	after use, while cleaning up	k
while manually retracting surgical tissue	c	item left on or near disposal container	l
passing instruments, hand-to-hand	d	while putting into disposal container	m
passing instruments, hands-free technique	e	after disposal, protruding from container	n
disassembling device or equipment	f	item pierced side of disposal container	o
in preparation for reuse of reusable equipment	g	after disposal item pierced trash bag	p
withdrawing a needle from rubber/other resistant material	h	q) other, describe_____	
recapping **used** needle	i	_____	

OR Theatre # _____
Time of event _____hr.

Section D IF THE EVENT WAS A CONTAMINATION

1. Contact was made on:
intact skin..... a
non-intact skin..... b
eyes/nose/mouth..... c
d) other_____

2. How much fluid was in contact?
small (< 5 cc)..... a
moderate (< 50 cc)..... b
large (> 50 cc) c

3. How long was fluid in contact?
<5 minutes..... a
5-14 minutes..... b
15 minutes - 1 hour..... c
> one hour..... d

4. Which type of body fluids were involved? (Place B in box if bloody.)

blood or blood product	a	sputum	g
vomit/gastric contents	b	saliva	h
CSF	c	peritoneal fluid	i
pleural fluid	d	amniotic fluid	j
urine	e	k) other, describe_____	
pus	f	_____	

5. Did the blood or body fluid:

touch unprotected skin	a	soak through protective garment	c
touch skin through gap in garment	b	touch skin through tear in glove	d
		soak through undergarments	e

6. Was exposure due to:(check one)

handling a sharp item	a	touching contaminated sheets, drapes, gowns	f
a broken specimen container	b	direct patient contact	g
a leaking specimen container	c	a blood/body fluid spurt	h
other container spill/leak	d	an IV tubing/bag/pump leak	i
touching contaminated equipment	e	j) other_____	

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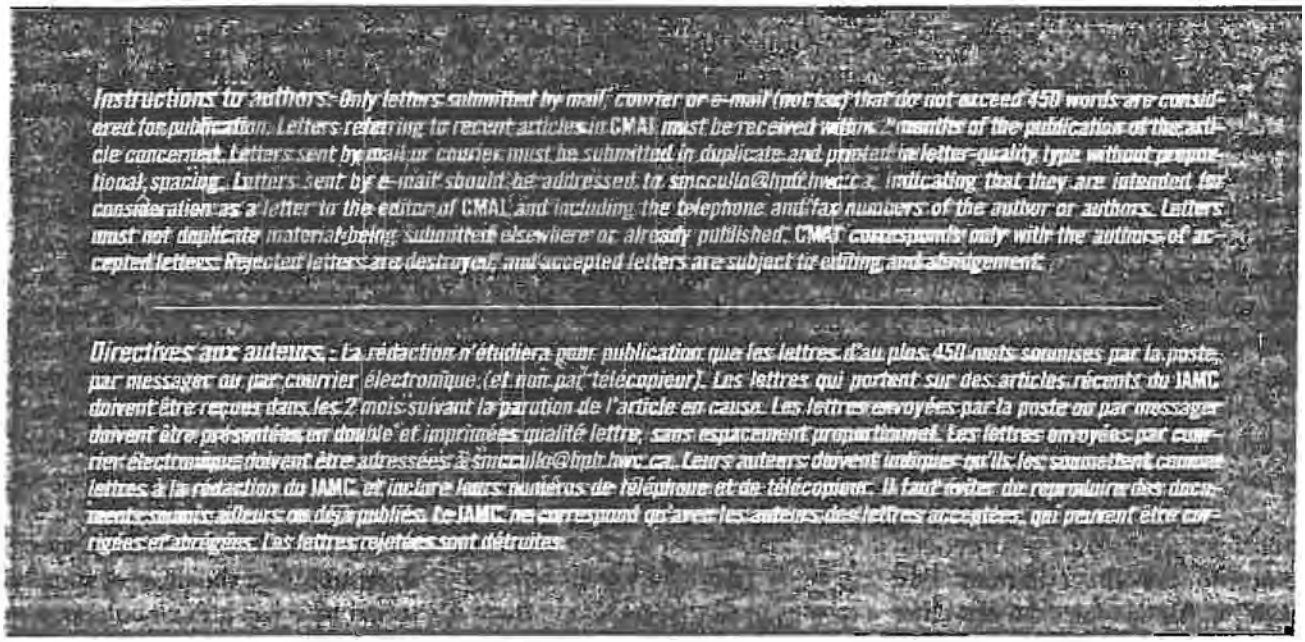

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Hospital needed for research on hands-free technique

The article "Reported use of strategies by surgeons to prevent transmission of bloodborne diseases" (*Can Med Assoc J* 1995; 152: 1089–1095), by Dr. James G. Wright, Nancy L. Young and Derek Stephens, and newspaper reports of HIV seroconversion due to a scalpel injury in an Italian surgeon (the first such case documented) illustrate the need for research on ways to prevent transmission of bloodborne diseases during surgery.

In the survey by Wright and colleagues, 92% of respondents reported a willingness to change the way they performed surgery to prevent transmission of bloodborne diseases, and 55% believed that there was too little research into ways of reducing the risk. Yet only 3.2% of respondents used the "no-touch" technique (also called the "hands-free" technique) and only 3.8% passed sharps in a basin.

As a third-year doctoral student in the Department of Occupational Health, Faculty of Medicine, McGill University, Montreal, I have developed a protocol to study the hands-free technique. This technique is defined as the indirect transfer of instruments between the surgeon or surgeons and other scrubbed personnel, during which neither person touches the same sharp item at the same time. This may involve placing sharps in a designated neutral zone — a section of the surgical field or a container — where they can be retrieved.

The hands-free technique has been recommended by the Royal College of Surgery, the Academy of Orthopaedic Surgeons, the Association of Operating Room Nurses and the US Centers for Disease Control and Prevention. Only one previous study assessed the technique, along with several other factors, and the findings were inconclusive.[1]

Hence, although it is recommended, the hands-free technique has not yet been adequately subjected to the questions used to judge injury-control measures: Is the technique used? Is it used properly? Does it reduce injury when properly used?[2]

Although use of the hands-free technique is related to only a portion of high-risk behaviour during surgery, the only way to evaluate injury reduction is to choose a few discrete practices, assess their use and compare accident levels before and after the introduction of the practices.

However, I have encountered difficulty in implementing my study because I cannot find a hospital in which at least 20% of surgical procedures are conducted with the use of the hands-free technique. The study would take 4 to 6 months in a moderately busy hospital and would involve gathering information from approximately 3000 procedures.

If any reader knows of a hospital that may meet the criteria for this study, please contact me through the Department of Occupational Health, Faculty of Medicine, McGill University, fax 514 398-7435.

Bernadette Stringer
McGill University
Montreal, Que.

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← For prescribing information see page 225

Clinical Issues

Passing surgical instruments, sharps without injury

Question: I work in a regional trauma center. My coworkers and I are concerned about being injured by a contaminated sharp during a surgical procedure and exposed to the human immunodeficiency virus (HIV) that causes acquired immune deficiency syndrome (AIDS). When we discussed our concerns at our staff meeting, our supervisor just told us to be more careful. I've heard about a new way to pass instruments during surgical procedures that is supposed to be safer. What is it, and how does it work?

Answer: What you have heard about is the "hands-free" technique of instrument transfer from the scrub person to the surgeon. This technique also may be called "no-pass" or "no-touch." This technique ensures that the surgeon, the assistant, and the scrub person never touch the same sharp instrument at the same time.[1] Instruments passed with the hands-free technique include anything sharp enough to puncture a glove (eg, scalpels, loaded needle holders, rakes, gelpie retractors, sharp-pointed electrocautery tips, skin hooks).

Using the hands-free technique, the scrub nurse places a magnetic pad or drape on the sterile field between himself or herself and the surgeon. The pad is designated as the neutral zone on which the scrub person places sharp instruments. The scrub person must alert the surgeon that a sharp instrument has been placed in the neutral zone by saying "knife," or "suture ligature," as he or she places it there. The surgeon then picks up the instrument and returns the instrument to the magnetic pad after use.[2] One surgical supply company manufactures a magnetic drape with a built-in rectangular transfer area that can be designated as a neutral zone.

Another way to designate a neutral zone is to use an emesis basin.[3] The scrub person places an instrument into the emesis basin and passes the basin to the surgeon. The surgeon lifts the instrument out of the basin which is left on the field until the surgeon returns the instrument to it. The scrub person then picks up the basin and places it on the Mayo stand. Any type of emesis basin is acceptable. If the surgeon complains that the scalpel blades are dulled because the cutting edge touched the metal basin, a plastic emesis basin may be used. A plastic emesis basin with magnets in the bottom that readily attaches to magnetic drapes is available.

Question: While I was at the 1991 Congress, I learned about the hands-free technique of transferring instruments. I thought it was a good idea, but I have been told that the Occupational Safety and Health

Vicki Fox, RN, MSN, CNOR, is an RN first assistant with Specialty Nursing Services, Inc, Tyler, Tex. She earned her bachelor of science degree in nursing at Texas Woman's University, Denton, and her master of science degree in nursing at the University of Texas at Tyler.

Using the hands-free technique is one way to put Centers for Disease Control recommendations into action.

Administration requires its use just like it requires eye protection. As the OR director responsible for keeping up with those requirements, I was surprised. I was not aware of such a requirement, and we do not use this technique in our operating rooms. What do regulating agencies have to say about this technique? Does AORN say we should use it?

Answer: This technique is not required by any regulating body. The Centers for Disease Control (CDC), Atlanta, urges taking precautions to prevent transmission of HIV and hepatitis B virus (HBV) through injuries from needles, scalpels, and other sharp instruments or devices used during surgical procedures. It leaves how this is accomplished up to the institution.[4] Using this technique is one way to put CDC recommendations into action. The *AORN Standards and Recommended Practices for Perioperative Nursing* endorses the CDC guidelines and encourages the safe handling of sharps, but it does not endorse specific methods to transfer instruments.[5]

Question: I am the director of surgical services for a hospital with four operating rooms. A new orthopedic surgeon joined our staff and has asked us to start using the hands-free technique on all of her cases. She says that everyone uses it where she was educated. I am unfamiliar with this technique; is it widely used, and are we behind the times?

Answer: The hands-free technique currently is not in widespread use. A limited number of hospitals have implemented policies and procedures to mandate it. It is used sporadically in various locations as a matter of the surgeon's preference.

Question: As the perioperative clinical educator, I would like to implement the hands-free technique into practice in our operating room. I have discussed this with my supervisor, and she supports the idea but has left it up to me to implement. The OR staff members and the surgeons may resist any policy I write that requires using it. Compliance with a policy that no one wants is unlikely and will be impossible to enforce. How do you suggest I implement this safer method of instrument transfer?

Answer: Implementing the hands-free technique requires a great deal of commitment and thoughtful persistence from both the nursing and medical staff members. Resistance to implementing the hands-free technique has occurred when the decision to implement it was made independently by either the medical or nursing staff members.

Start the change process by educating OR personnel about the modes of transmission of HIV and HBV. Keep or retrieve documentation on the number of times personnel have been exposed via needle stick or other injury to HIV or HBV during surgical procedures. Take this documentation to the staff members at a meeting or in-service program. Ask for their input on how to prevent such exposure. During the ensuing discussion, introduce and demonstrate the hands-free technique. If staff members bring up the technique themselves, that is even better. Solicit and pay attention to the feedback from the staff members. You will be able to determine what their educational needs are, which of the two hands-free techniques is best to implement in your setting, and where the greatest resistance to implementing the technique will be.

Take the HIV/HBV exposure documentation to the medical staff members as well, using a

similar process. Request time at the hospital OR committee meeting and the medical staff members section meetings. Express your concern about the number of HIV and HBV exposures, and solicit the physicians' feedback on ways to prevent exposure. Chances are that at least one of them has heard of the hands-free technique. Let the OR personnel do a demonstration with instruments and magnetic drapes. It is a good way to involve the staff members and the physicians in the change process.

At best, everyone will accept the concept and initiate policy and procedure changes in your OR. More likely, one or two surgeons will accept the idea and ask that the technique be used during their cases. If this happens, it is not a failure; it is a beginning. If the technique is implemented successfully for some, its acceptance is likely to spread.

Anyone in contact with blood or body fluids should assume those fluids are HIV positive and use universal precautions. Acceptance of the hands-free technique, however, may depend on how likely nursing and medical staff members view their risk of exposure. For example, in areas where the incidence of HIV-positive patients is high, the practice usually is accepted more quickly.

VICKI FOX, RN, MSN, CNOR

Notes

1. C D Bessinger. "Preventing the transmission of human immunodeficiency virus during operations," *Surgery, Gynecology & Obstetrics* 167 (October 1988) 287-289.
2. *Ibid*; M O'Neale, "Sterile processing; instrument safety; aseptic technique," (Clinical Issues) *AORN Journal* 53 (January 1991) 146-149.
3. *Ibid.*
4. Centers for Disease Control, "Recommendations for prevention of HIV transmission in healthcare settings," *Morbidity and Mortality Weekly Report* 36 (Aug 21, 1987) 6S; Centers for Disease Control, "Recommendations for preventing transmission of human immunodeficiency virus and hepatitis B virus to patients during exposure-prone invasive procedures," *Morbidity and Mortality Weekly Report* 40 (July 12, 1991) 5.
5. "Recommended practices for operating room sanitation," in *AORN Standards and Recommended Practices for Perioperative Nurses* (Denver: Association of Operating Room Nurses, Inc, 1991) III: 9-2; "Recommended practices for sponge, sharp, and instrument counts," in *AORN Standards and Recommended Practices for Perioperative Nurses* (Denver: Association of Operating Room Nurses, Inc, 1991) III: 16-2.

Congress Badge Identification

At Congress, AORN members will be denoted by a red border across the tops of their name badges, nonmember badges will have a blue border, exhibitors' badges will have a green border, and Headquarters staff member badges will have an aqua border.

Delegates will be designated by the letters DEL on the upper right-hand corner of their badges.

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Registrants also are asked not to put stickers on their name badges. Decorative stickers, such as those denoting chapter or region, or advertising stickers are not allowed. AORN requests your compliance with this regulation.

Latex Allergies

LATEX ALLERGIES

Wava Truscott, PhD, MBA, BS
Vice President, Scientific Affairs
SAFESkin® Corporation
San Diego, California

The concept of latex allergies includes dermal, respiratory or invasive routes of induction. Dermal route access glove-associated reactions include: 1) irritation, 2) allergic contact dermatitis (Type IV) and 3) immediate type hypersensitivity (Type I). The etiological agents which cause these reactions - chemicals (1&2), endotoxins (1), and natural rubber latex proteins (3) - are readily adsorbed to the surface of glove powder and aerosolized into the environment. A single powdered glove contains 150-750mg of powder. With the 36,000 breaths inhaled daily (approximately 12,000 during an 8 hour shift), a tremendous number of these coated rubber particles enter the respiratory tract. All three dermal route reactions have respiratory tract equivalents including asthma. Surgical procedures open the invasive route for transfer of the glove related agents from both glove surface contact with physiological fluids and tissues, and by deposition of the glove powder directly into the surgical site. Powder may remain at the site for over two years, prolonging patient exposure to the "agents of reaction" as they continue to slowly elute from the particle.

To appropriately address glove-associated occupational reactions for the healthcare worker, educational programs must address all causative agents including post-surgical complications potentially associated with the use of gloves.

LATEX REACTIONS

Wava Truscott, Ph.D.

An Outline

I. Introduction

History of Latex Reactions

1933: Irritant and Allergic Contact Dermatitis (Type IV)

1979: Hives

1987: IgE-Mediated reaction to protein in rubber latex

1989: Reports of anaphylaxis
(450 reactions 15 deaths due to latex enema balloons on silicone catheter)

1991: FDA Medical Alert

CDC Medical Alert

3 Types of Reactions

- IRRITATIONS
- TYPE IV DELAYED
- TYPE I IMMEDIATE

II. Irritation

Irritant Contact Dermatitis
(Non-Allergic)

Generic Latex Compound*

Accelerators	Preservatives
Antioxidants	Processing Aids
Antiozonants	Softeners
Colorants	Stabilizers
Emulsifiers	Vulcanizing Agents
Fillers	Water
Rubber Latex	

**Each of the components above include several ingredients.*

Irritant Contact Dermatitis

Causes and Enhancers

Gloves	Environment	Chemicals
Excess chemicals	Wind	Alcohols
Excess preservatives	Cold	Soaps and detergents
Insufficient leach		Urea-formaldehyde
Isufficicnet post-processing		Disinfectants
Occlusion		Degreasing agents
Abrasion		
Hyperhydration		
Desiccation (powder)		

Irritation (Non-Allergenic)

Also known as : *Irritant Contact Dermatitis*

- Acute:
  - Red, scalded appearance
- Chronic:
  - Dry, thickened skin, crusty, hard bumps, sores, fissures, definite line of demarcation – stops at glove edge

Irritation - Action

- Identify and remove causative agent

  If glove:
  - Select different lot number
  - Consider specially processed gloves
  - Consider powder-free gloves
  - Change manufacturer
  - Avoid occlusion, desiccation
- Allow hands to heal
  - Anti-inflammatories may be helpful
  - Caution around infectious agents
- Initiate a consistent hand care regimen

III. Allergic Reaction Definition

Hypersensitivity	Effector Cells	Antibody	Examples
Type I Immediate Hypersensitivity or Anaphylaxis	Basophils Mast Cells	IgE	Hay Fever Insect Allergy Drug Allergy
Type II Cytotoxic		IgG or IgM	Good Pasture's Disease Grave's Disease Myasthenia Gravis
Type III Immune Complex Disorders		IgG or IgM	Systemic Sensitivity Lupus Rheumatoid Arthritis
Type IV Delayed Hypersensitivity or Allergic Contact Dermatitis	T-Cells Macrophages		Contact Sensitivity to Poison Ivy

IV. Dermal Reactions

Type IV Hypersensitivity
Allergic Contact Dermatitis
Delayed Type Hypersensitivity
Chemical Allergy

Gloves	Environment	Chemicals
Accelerators	Poison Oak	Soap and Detergents
Thiurams	Genetic Predisposition	Urea-Formaldehyde
MBT's		Disinfectants
Carbamates		Nickel
Antioxidants		Methylmethacrylate
Preservatives		Dispensing Medication
Other Chemicals		Fragrances

- Appearance:
  - Acute:
    - *Red, small blisters, itch-pain, delayed onset (6 to 8 hours)*
  - Chronic:
    - *Redness, crusting, thickening of skin, papules, sores, scaling: No definite line of demarcation*

Type IV Hypersensitivity/Action

- Identify and remove causative agent
  - *If glove:*
    - Change to type of glove without offending chemical
    - Change to a specially formulated and processed glove low in contact sensitizers
    - Change of manufacture

- Allow hands to heal
    - See a dermatologist if necessary
    - Anti-inflammatories may be helpful
    - Caution around infectious agents
    - Initiate a consistent hand care regime

Synthetic Gloves:

Contact Sensitizers and Irritants

Accelerators/Curing Agents
- Aldehyde-amine reaction products
- Benzothiazoles
- Dithiocarbamates
- Dithiophosphates
- Guanidines
- Thiourea
- Thiurams
- Thiocabamyl sulfonamides
- Alkylphenol disulfides
- Paraphenylenediamine derivatives

Antioxidants & Antiozonates
- Amines
- Phenols
- Sulfides
- Phosphites

Donning agents:
- Powders

Plasticizers:
- Paratoluene sulfonamide
- Phthalates
- Naphthylamines

Processing Agents:
- Surfactants

Retarders:
- N-nitrosodiphenylamine
- Phthalic anhydride
- Sulfonamide derivatives

Stabilizers:
- Dibutyl tin dilaurate
- Dibutyl tin maleate
- Epoxy resins

Contact Sensitizers by Occupation or Category

Numerical Code for Uses of Allergens

1 – Cosmeticians, hairdressers, manicurists
2 – Dental materials
3 – Food additives, flavors, bakery materials
4 – Fragrances, perfumes, balsams
5 – Medications, local anesthetics, antibiotics
6 – Metals and metal compounds
7 – Oil, coolants, machining oils
8 – Organic dyes, textile colors and finishes
9 – Paints, varnishes, lacquers
10 – Pesticides
11 – Photoallergens
12 – Photographic chemicals
13 – Plants, woods
14 – Plastic, adhesives
15 – Preservatives, antimicrobials
16 – Rubber chemicals
17 – Shoe chemicals
18 – Soldering chemicals
19 – Sunscreens
20 – Various sources
21 – Vehicles, emulsifiers

Patch Testing

Mixture	Percentage (Weight/Weight)
Mercaptomix, 1%	
N-Cyclohexyl-2-benzothiazolesulfonamide	0.33
2,2'-Benzothiazyl disulfide	0.33
4-Morpholinyl-2-benzothiazyl disulfide	0.33
White petrolatum	99.00
Thiuram Mix, 1% pet	
Tetramethylthiuram disulfide	0.25
Tetramethylthiuram monosulfide	0.25
Tetraethylthiuram disulfide	0.25
Dipentamethylenethiuram disulfide	0.25
White petrolatum	99.00
Carbamix, 3%	
1,3-Diphenylguanidine	1.00
Zinc diethyldithiocarbamate	1.00
Zinc dibutyldithiocarbamate	1.00
White petrolatum	97.00

The "Hypoallergenic" Claim

CURRENT

Wording:	Hypoallergenic
Criteria:	Low in chemical contact sensitizers
Determinations:	Successfully pass a 200-person modified Draize test

The "Hypoallergenic" Claim

FUTURE

Wording:	???
Criteria:	Low in chemical contact sensitizers
Determination:	Utilizing chemical analysis, gloves must be determined to be below an established maximum level for the specific chemical contact sensitizer (i.e. thiurams, thiazoles, carbamates)
	and/or

V. Dermal Reactions*

Type I Hypersensitivity
Immediate Type Hypersensitivity
Protein Allergy
(Urticaria, Asthma, Anaphylaxis)

*May have non-dermal systemic symptoms

Composition of Latex from the Rubber Tree

• Water	58.5%
• Rubber Particles	36.0%
• Carbohydrates	1.6%
• Protein	1.4%
• Neutral Lipids	1.0%
• Glycolipids & Phospholipids	0.6%
• Inorganics	0.5%
• Others	0.4%*

*Natural rubber latex contains more than 240 individual chemical compounds.

Type I Hypersensitivity

Immediate Type Hypersensitivity;
Protein allergy; Urticaria; Asthma; Anaphylaxis

- Dermal: hives
- Systemic: runny nose, itching, burning eyes, local swelling, facial swelling, tightness in the throat, difficulty breathing, headaches, nausea, abdominal cramping, dizziness, rapid heart rate, blood pressure drop, anaphylaxis

(Type I)
Immediate Hypersensitivity/Action
Protein Allergy

- Hives
  - Identify and remove agent
  - Rinse
  - Notify supervisor/occupational health nurse
  - See an allergist
  - Select non-latex. Consult allergist if evaluating a low allergen glove.

- Systemic Reaction Onset
  - Remove agent
  - Seek emergency treatment
  - Utilize Epi pen if prescribed
  - Avoid latex contact unless otherwise directed by physician
  - Inform supervisor/occupational health nurse, FDA product alert line

Some Latex Products Implicated In Type I Latex Reactions

- Adhesive Tape
- Anesthesia Equipment
  - Mouthpiece
  - Breather Bag
- Cardiovascular Catheter Balloon
- Children's Balloons
- Condoms
- Dermal Rubber Dam
- Diaphragm
- Elastic Bandage
- Enema Catheter Latex Cuff
- Gloves
- IV Injection Sets
- "Koosh" Ball
- Pacifiers
- Piston Syringe (Unit Dose?)
- Racquetball Handle
- Rectal Manometer
- Squash Ball
- Tourniquet

Immediate Type Hypersensitivity Population Incidence

- 0.8% general population
- Medical personnel prone to frequent gloving:
  - *3 - 5% general hospital employees*
  - *7 - 10% operating room personnel*
- Greater than 40% of the Spina bifida population.

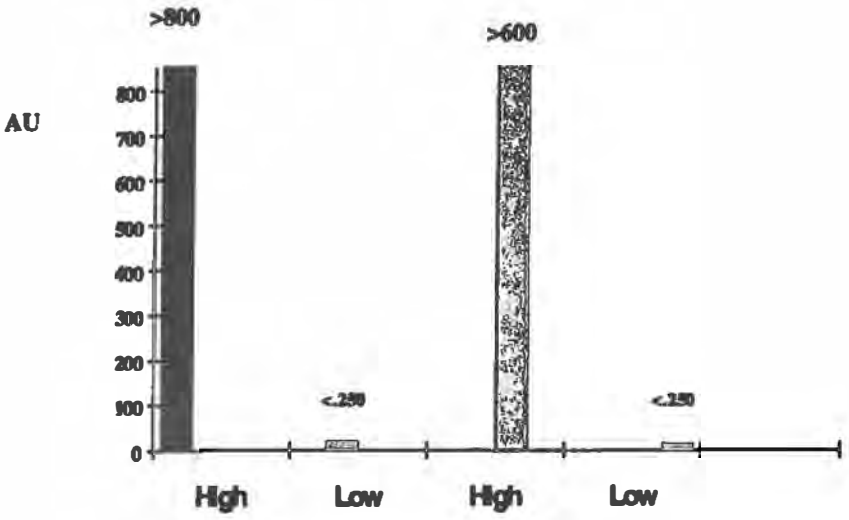
Cross-Reactive Allergens

- Avocados
- Bananas
- Cherries
- Chestnuts
- Ficus
- Kiwis
- Latex
- Peaches
- Potatoes
- Ragweed
- Tomatoes

Synthetic Gloves

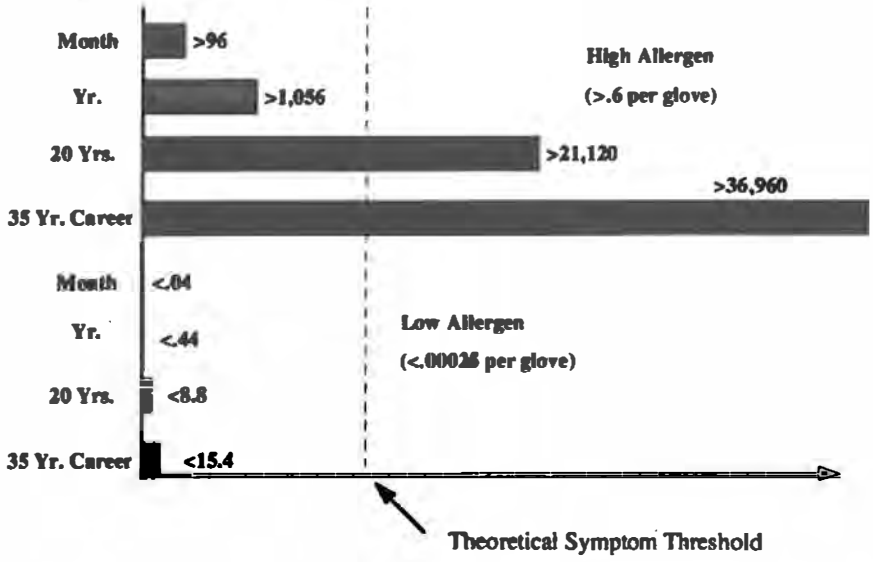
Material	Common or Trade Names	Composition
Butyl rubber	Butyl	Isobutene/isoprene
Chloroprene	Neoprene®	Polychloroprene
EVOH		Ethylene-vinylalchohol
Fluor rubber	Viton®	Vinylidene fluoride/hexafluoropropene
Nitrile rubber	Nitrile	Acrylic nitrile/butadiene
Polyethylene	PVA	Polyethylene
Polyvinylalchohol	Vinyl	Vinylalchohol
Polyvinylchloride	Elastyren®	Vinylchloride
Styrene-butadiene	Tactylon™	Styrene-butadiene
Styrene-ethylene-butadiene		Styrene-ethylene-butadiene

ALLERGEN LEVEL RANGE PER GLOVE (Thousands)
(INHIBITION IMMUNOASSAY)

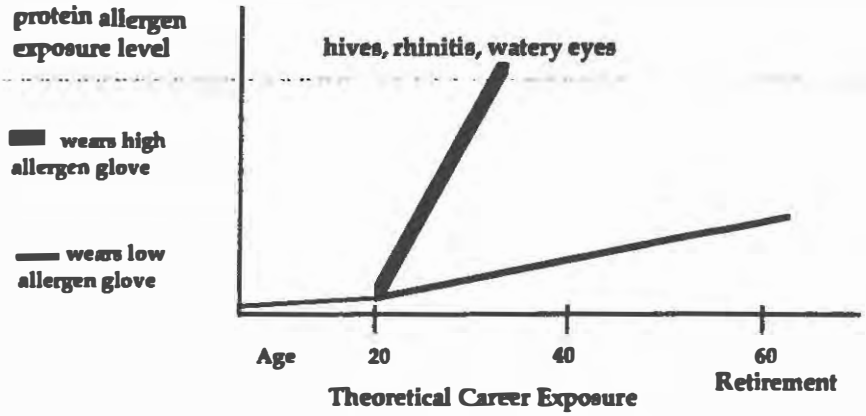


Surgical Gloves - Allergen Exposure (Millions)

8 Changes/Day



THRESHOLD FOR CLINICAL SYMPTOMS

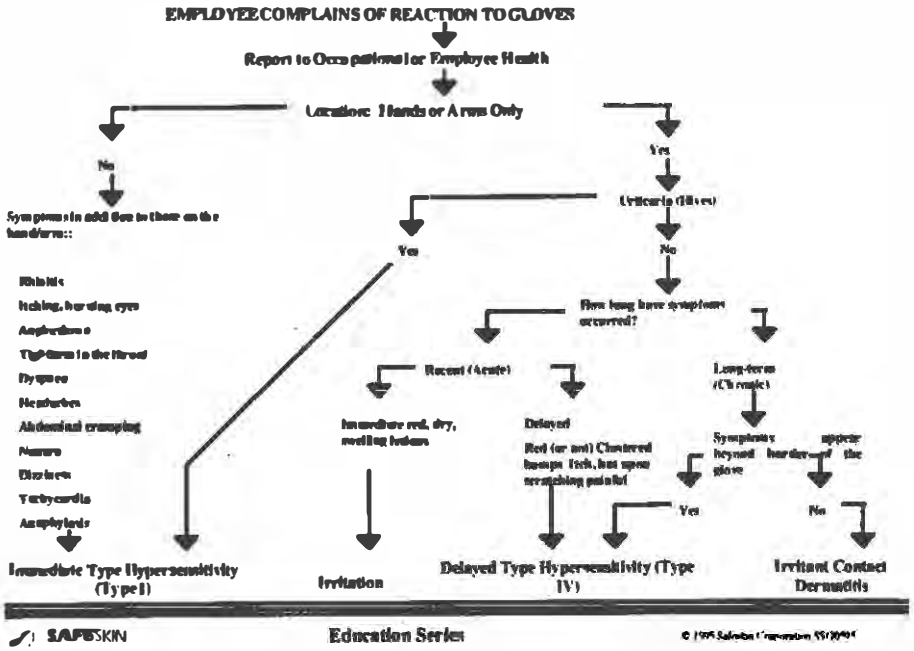


VI. Dermal Reaction Summary

Reactions Associated With Latex

Type	Cause	Symptoms
Irritation (non-allergic)	*Chemical Physical*	Acute: Red, burn, itch. Chronic: Dry, fissures, sores, hard bumps, stops at glove border.
Chemical Allergy (Type IV - Delayed)	*Chemical*	Acute: Red, itch, small blisters. Chronic: Dry, sores, thickened skin, hard bumps, scaling, continue beyond glove border.
Protein Allergy (Type I - Immediate)	*Rubber Protein*	Hives: (urticaria), swelling, runny nose, respiratory distress, faint, anaphylaxis.

GUIDE TO DIFFERENTIATION OF GLOVE REACTIONS TRIAGE FORMAT



VII. Respiratory Route

Donning Powders

USP Absorbable Dusting Powder

- **Crosslinked Cornstarch containing less than 2% magnesium oxide (FDA premarket approval required)**

Suspensions usually include:

- **Silicone**
- **Biocides**
- **NaOH**
- **KOH**
- **Calcium Carbonate**
- **Surfactants**
- **Water**

Modified Cornstarch:

Functional Characteristics

- **Particle**
- **Absorbent, adsorbent and vehicle**
- **Immunological activator**
- **Microbial substrate**

VIII. Invasive Route

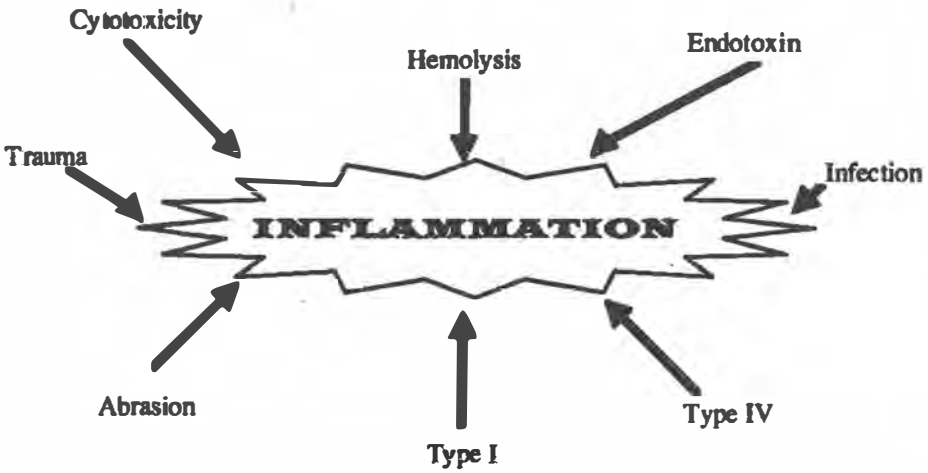
CARDINAL Symptoms of Inflammation

- Erythema
- Heat
- Swelling
- Pain

Outcomes

- Delayed healing
- Increased scarring
- Decreased function
- Increased risk of infection
- Lengthened hospital stays
- Increased Costs

CAUSES OF INFLAMMATION



Endotoxin: Biological Activities

- Pyrogenicity (fever)
- WBC influx
- Macrophage activation
- Release of vasoactive amines
- Impaired profusion of essential organs resulting in pathology: lung, liver, kidney, heart
- Inflammation
- Activated complement cascade
- Disseminated intravascular coagulation (DIC)
- Vascular necrosis

IX. Infection Control

Impact of Nosocomial Infection

	Percent of Total	Extended Hospital Stay (days)	Mortality
Urinary Tract (non-fecal)	40%	1-3	Rare
Wound Infection	18%	5-7	10%
burn patient			40%
Pneumonia	17%	10-17	20%
Bacteremia	25%	7-10	25%
Neonates (ICU)	2-25%		
(early onset)	---	---	20-50%
(late onset)	---	---	10-20%
(premature)	---	---	higher

Nosocomial Diseases

Yearly U.S. Impact:

> 5% of the patients hospitalized

> 2 million hospital acquired infections

> 30,000 deaths

> $5 billion in excess stay

Employment of infection control services reduces incidence rate about 20%.

Effect of Glove Powder on Rat Threshold for Infection (*Staphylococcus aureus*)

	Wound Content	Number Inoculated	Number Infected
Group 1	----	10	----
Group 2	2 mg powder	10	----
Group 3	1,000 bacteria	10	1
Group 4	2 mg powder + 1,000 bacteria	10	9
Group 5	2 mg pure corn starch + 1,000 bacteria		

Powder: Microbial Substrate

- Microorganisms that can be sustained by powder:
  Bacteria Yeast Fungi

Wound Complications:

- Pathogenic microorganisms
- Opportunistic microorganisms
- Threshold for infection reduced
- Bacterial metabolites and exotoxins
- Bacterial endotoxin

X. How Will These Facts Affect Each of These Areas?

Powder: Critical Issues by Specialty Area

- Anesthesiology
- Blood Banking
- Burn Units
- Central Processing
- Laboratories
- Dialysis
- Emergency Room
- Eye, Ear, Nose & Throat
- Gastrointestinal
- Immune Compromised
- *In Vitro* Fertilization
- Infectious Diseases
- Intensive Care
- Intravenous Solutions
- Neonatology
- Phlebotomy
- Post-Surgery
- Pulmonary/Respiratory
- Surgery

Latex Allergy
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MULTIPLE GLOVE POWDER GRANULOMAS MASQUERADING AS PERITONEAL CARCINOMATOSIS

Karl-Erik Giercksky, M.D., Hanne Qvist, M.D., Tone C. Giercksky, M.S., Trond Warloe, M.D., *and* Jahn M. Nesland, M.D., *Oslo, Norway*

BACKGROUND: **The occurrence of glove powder granulomas in peritoneal nodules presumed to represent carcinomatosis has not gained widespread attention and remains a challenging clinical problem even for the experienced surgeon.**

STUDY DESIGN: **During the past four years, we have registered ten cases of multiple glove powder granulomas, believed by the surgeon to represent tumor dissemination, but diagnosed by the pathologist as glove powder granules with the typical Maltese cross pattern when viewed under polarized light.**

RESULTS: **Patients were referred with the presumptive diagnosis of intra-abdominal malignant disease and all had undergone at least one previous laparotomy during the past few years at a hospital that used powdered gloves. The unsuspected perioperative finding of multiple peritoneal nodules was presumed to represent carcinomatosis and resulted in the surgeon erroneously canceling the operation in one case. In six other cases, the results of perioperative frozen sections caused the surgeon to change strategy and perform the planned procedure. Three patients had starch powder peritonitis postoperatively and one of them had a fatal pulmonary embolus. In two patients, the starch powder reaction was associated with the occurrence of true carcinomatosis and one patient later had recurrence of hepatic metastases. After a mean follow-up period of 17 months, six patients are alive with no signs of disseminated malignancy.**

CONCLUSIONS: **Based on this information, we recommend routine pathologic documentation of all peritoneal nodules appearing to be tumor dissemination. If the results influence the surgical procedure, frozen sections should always be performed. To minimize the risk of powder-induced complications, the use of particle-free gloves is strongly recommended.** ***J. Am. Coll. Surg.*****, 1994, 179: 299-304.**

THE EXTENT and successful outcome of intra-abdominal tumor surgery is definitely reduced when peritoneal carcinomatosis is demonstrated. In general practice, the occasional unsuspected findings of multiple discrete nodules of disseminated malignant tissue are sooner or later experienced by every abdominal surgeon. Such findings change the operative strategy from a radical procedure with curative objective to a palliative procedure designed to relieve the most pressing symptoms and otherwise do as little harm as possible.

With increasing interest in aggressive hepatic resection for colorectal hepatic metastasis and wide resection for local recurrences or planned second-look procedures, the incidence of peritoneal metastases seems to be increasing. While preoperative computed tomography or magnetic resonance imaging, or both, may assist in defining a tumor, they do not readily identify small tumor deposits. Even if the malignant character of the findings is obvious, a biopsy is usually performed to confirm the diagnosis. Usually, a confirmation of malignant tissue with characteristics in accordance with the primary tumor is given by the pathologist. Occasionally, the pathologist describes a small nodule with reactive or unspecific inflammatory reaction and suggests that the specimen taken at biopsy is not representative of material from the widespread tumor. The reluctance to do a repeat laparotomy on a patient for whom no surgical and usually no medical cure exists, just to get "the record straight," is obvious and understandable. However, for the terminally ill patient, operative treatment for local recurrence is usually not considered, even if the diagnosis of peritoneal carcinomatosis is not suspected. Conversely, with an incidental finding of "peritoneal carcinomatosis" during laparotomy for a benign condition, the end result would be more unpredictable and sometimes referred to as spontaneous cure of carcinoma. Moreover, if the patient undertook one of the many dubious "alternative" forms of treatment, the result might be promoted as a proof for the success of such treatment. The obvious way to prevent such situ-

From the Departments of Surgical Oncology and Pathology, The Norwegian Radium Hospital and Institute of Cancer Research, Oslo.
Reprint requests: Dr. Karl-Erik Giercksky, Department of Surgical Oncology, The Norwegian Radium Hospital and Institute of Cancer Research, Montebello, 0310 Oslo, Norway

TABLE 1.—CLINICAL SIGNS AND SYMPTOMS OF PERITONEAL GLOVE POWDER GRANULOMAS IN TEN PATIENTS

Patient No.	Age, y/sex	Clinical presentation	Previous laparotomies, time ago	Characteristics at laparotomy	Operative procedure	Histology of nodules	Follow-up, mo	Outcome
1	68/M	Pelvic recurrence	Carcinoma of the rectum, 3 y	Nodules on hepatic surface	Biopsies and cancellation of operation	Granulomas	20	No recurrence
2	63/M	Hepatic metastasis	Carcinoma of the colon, 18 mo	Multiple pelvic nodules	Frozen sections and hepatic resection	Granulomas	30	No recurrence
3	67/F	Hepatic metastasis	Carcinoma of the colon, 9 mo	Multiple pelvic nodules	Frozen sections and hepatic resection	Granulomas	29	No recurrence
4	35/M	Hepatic metastases	Appendicitis, 1 y; carcinoma of the colon, 2 mo	Multiple peritoneal nodules	Frozen sections and hepatic resection	Granulomas	26	Deceased from hepatic metastases
5	46/F	Pelvic recurrence?	Appendicitis, 1 y; carcinoma of the colon, 8 mo	Adhesions, pelvic and hepatic nodules	Frozen sections and removal of hepatic tumor	Pelvic granulomas, hepatic metastasis	24	Deceased from carcinomatosis
6	60/M	Planned reoperation	Carcinoma of the colon, 3 mo; peritonitis, 2.5 mo	Adhesions, multiple nodules	Frozen sections and anastomosis operation	Granulomas	1	No recurrence
7	47/F	Fistula of the bladder	Carcinoma of the bladder, 5 mo; fistula operation, 3 wk	Nodules on the bladder	Frozen sections and repair of fistula	Granulomas	19	No recurrence
8	52/F	Carcinomatosis?	Appendicitis, 34 y; cholecystectomy, 30 y; hysterectomy, 18 y; adhesions, 3 mo; peritonitis, 2.5 mo	Fluid, adhesions, multiple nodules	Biopsies	Granulomas and tumor cells	11	Deceased from carcinomatosis
9	75/M	Mild ileus	Carcinoma of the rectum, 2 y; recurrence, 4 mo; peritonitis, 2 mo	Fluid, adhesions, multiple nodules	Frozen sections	Granulomas	9	No recurrence
10	51/F	Postoperative peritonitis	Carcinoma of the rectum, 2 y; pelvic tumor, 3 wk	Fluid, adhesions, multiple nodules	Biopsies	Granulomas	1	Deceased from pulmonary emboli

y, Years; mo, months, and wk, weeks.

ations is, of course, to secure material for immediate examination by frozen section and to wait for confirmation of the diagnosis before closing the abdomen. It is essential for elective operative treatment of carcinoma to have the immediate availability of a pathologist and such operations should not be performed without one. Unfortunately, not all hospitals have access to around the clock pathologic services, even in an otherwise well-equipped hospital. In a few cases, however, the diagnosis of carcinoma will be changed to granuloma only when the material taken at biopsy is later studied under optimal conditions.

A large number of foreign materials introduced into the abdominal cavity can give rise to reactive nodules (1–3). Glove powder introduced during previous operation can sometimes give rise to nodules with a macroscopic appearance that is clinically extremely difficult to differentiate from carcinomatosis. We report ten clinical instances of multiple glove powder granulomas that the surgeon believed represented peritoneal carcinomatosis, a condition that either changed or could have changed the intraoperative strategy.

PATIENTS AND METHODS

During the past four years, ten patients with multiple peritoneal glove powder granulomas were treated at the Norwegian Radium Hospital, Oslo (Table 1). Starch-containing glove powder was identified by viewing the sections under polarized light for the demonstration of a typical Maltese cross pattern within the granulomas (Figs. 1 and 2). Five of the patients were women and five were men. Their mean age was 56 years

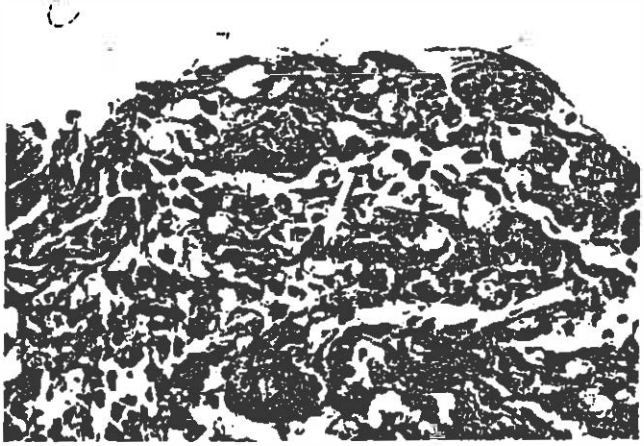

FIG. 1

FIG. 2

FIG. 1. Parts of granulomatous tissue with abundant starch-containing glove powder granules. The white arrow points to one of the granules. Hematoxylin and eosin, original manification ×560.

FIG. 2. The same sections under polarized light. Numerous Maltese crosses are seen. The black arrow points to a characteristic cross. Polarized light, original magnification ×280.

(range of 35 to 75 years). All patients were referred with the presumptive diagnosis of carcinoma of the abdomen and had previously undergone one to five laparotomies of which at least one was at a hospital where powdered gloves were used. Patient diagnoses included carcinoma of the colon and rectum (eight patients), carcinoma of the bladder (one patient), and suspected carcinomatosis of unknown origin, which later was demonstrated to be carcinoma of the stomach (one patient). Patients were referred with suspected local recurrence (four patients), hepatic metastases (three), or for reoperation (three). The clinical signs and symptoms are given in Table I.

Seven patients (Patient Nos. 1 to 7) were asymptomatic, with no sign of peritoneal reaction and the granulomas were discovered as an unsuspected finding during the planned operation. In Patient No. 1, the appearance of small hepatic "metastases" on the surface of both the right and left lobes of the liver resulted in cancellation of the planned removal of the pelvic tumor and intraoperative radiation without the mandatory confirmation of a frozen section. Results from the routine biopsies of the hepatic "metastases" received seven days later confirmed the typical pattern of starch powder granulomas without any signs of tumor tissue. The patient declined any further operative treatment when told that the bladder and prostate gland would be removed. Radiotherapy (46 Gy) was supplemented with a booster dose (20 Gy). In the other six asymptomatic patients, a preliminary diagnosis of carcinomatosis (Patient Nos. 2 to 6) or recurrent infiltrating carcinoma (Patient No. 7) was reached, but perioperative frozen sections were taken to confirm the diagnosis. When no malignant tissue was demonstrated, but instead the typical pattern of starch powder granulomas was seen, the planned operation was performed. In one of these patients (Patient No. 5), however, the intraoperative strategy was changed from an operation for pelvic recurrence to a hepatic resection because only pure starch granulomas were found in the pelvic tumor, whereas two discrete nodules detected on the hepatic surface were found to contain tumor tissue as well.

In three patients (Patient Nos. 8 to 10), symptoms of peritonitis occurred one to two weeks postoperatively after the removal of a pelvic tumor (Patient Nos. 9 and 10) or a laparotomy for adhesions (Patient No. 8). Because of persistent symptoms with severe pain, generalized discomfort, and slightly elevated temperature and infectious parameters, a second laparotomy was performed two to eight weeks postoperatively. At this time, the abdominal cavity was filled with yellow-gray fluid and there were abundant adhesions. In two of the patients (Patient Nos. 8 and 10), numerous small 1 to 3 mm tumors were found virtually covering the peritoneal surface associated with the adhesions, whereas in the third patient (Patient No. 9), such nodules were first recognized at a subsequent laparotomy two months later as a result of persistent subileus symptoms of a mild ileus. A rapid occurrence of carcinomatosis was suspected in all these patients, but histologic examination of the removed specimens demonstrated granulomas and, when

viewed under polarized light, the tissue showed the Maltese cross pattern typical of starch-containing glove powder, with no evidence of tumor cells (Figs. 1 and 2). The patient with no previous diagnosis of carcinoma (Patient No. 8) was, however, referred to our hospital for a second opinion, and when the specimens taken at biopsy were reexamined, a few cells suspected of being carcinoma were found in close proximity to the granulomas. A third laparotomy was performed, and this time, disseminated carcinoma of the stomach could easily be demonstrated and proved at biopsy. However, multiple small typical starch powder granulomas were also in evidence throughout the abdominal cavity.

The diagnosis of starch powder granulomas was made in all patients by viewing the tissue specimens under polarized light. This is the only practical way of differentiating starch powder from other foreign bodies.

RESULTS

The postoperative recovery period was generally uneventful in the patients with incidental discovery of peritoneal granulomas during an elective procedure. However, in the patients with acute starch powder peritonitis, the symptoms subsided slowly despite supportive treatment, including steroids. One patient had a fatal pulmonary embolus (Patient No. 10).

In all patients, the final pathologic examination confirmed the diagnosis of starch powder-induced granulomatous reaction. In one patient, tumor cells were found in close approximation with the granulomas (Patient No. 8) and the patient lived for another 11 months before dying as a result of tumor dissemination. Another (Patient No. 5) had discrete nodules at separate locations: one with (hepatic surface) and another without (pelvic area) tumor. Although the hepatic nodules with tumor were removed, the patient later had true carcinomatosis. In the other patients, no evidence of peritoneal tumor dissemination has appeared during the 17 month observation period (range of one to 30 months). One patient died as a result of recurrent hepatic metastases (Patient No. 4). The remaining six patients are all alive, with no evidence of disease. Even the patient who had an operation canceled (Patient No. 1) has not experienced recurrence of the pelvic tumor after radiotherapy.

DISCUSSION

There is increasing evidence that a substantial amount of foreign material is deposited in the wound after intra-abdominal operation (3–6). Particulate matter, including cellulose fragments, lint, paper fragments, and glove starch powder are bodies that are often present in granulomas at reoperation. Because of their peritoneal location and appearance, they may be misinterpreted as carcinomatosis or local tumor recurrence.

Of the various foreign bodies introduced at the time of operative treatment, glove powder particulate seems to precipitate an inflammatory response regardless of whether or not an immune response was provoked (7). When it was first introduced by Lee and Lehman, experimental evidence was presented demonstrating cornstarch powder to be nonreactive in the peritoneal cavity. Subsequently, cornstarch powder became the glove lubricant of choice for surgical gloves (8).

A biologically absorbable powder, the starch powder is treated with epichlorohydrin (1-chloro-2,3 epoxypropane), a cross-linking agent forming one to three diether glycerin groups to form a glove lubricating agent. It is believed that this agent, together with chemicals used in glove fabrication, may cause cytotoxicity (9). Even if starch used in glove powder has been classified as an inert substance, there is no longer any doubt that treated starch glove powder is able to induce a granulomatous reaction in traumatized surgical tissue (10, 11).

Reactions to the combination of starch-containing glove powder and surgical trauma seem to vary considerably from the syndrome of multiple starch granulomatous peritonitis to a few discrete asymptomatic nodules (12). In animal experiments, the reactive pattern is dependent on the amount of deposited starch powder and tissue trauma (13). In humans, a number of patients and health care workers have demonstrated a delayed hypersensitivity reaction to starch powder and an allergic component may be of importance (14, 15).

The mechanisms resulting in granuloma formation are not clear, although local stimulation of macrophages by tumor necrosis factor could be an important factor. Suppression of local fibrinolytic activity with delayed resolution of fibrin bands has also been explored as a cause of intra-abdominal adhesion formation and subsequent occurrence of granulomas (16). Regardless of the cause, the problem can be disturbing to the surgeon.

More than 20 years ago, Cox reported "pseudomalignant seedlings" consisting of starch granulomas (17). We have found no other report of this problem. During the last four years, we have regularly searched for granulomas connected to adhesions from previous operation, which has resulted in an increased awareness among our pathologists of the starch granuloma problem. All intra-abdominal tissue specimens are also examined better for the typical appearance of starch granulomas In ten patients, this represented an unexpected result that changed the treatment strategy. These patients were all referred to us from hospitals in which surgical gloves containing starch powder were still in use.

The patient who seemed to have disseminated carcinoma of the stomach represented a complex problem. There was every reason to believe that, during the first operation for ileus, carcinoma of the stomach was overlooked. In retrospective review, we found that the patient underwent a gastroscopy almost three years previously, during the first period of epigastric pain. Specimens taken at biopsy from the gastric mucous showed typically malignant cells, but for some unknown reason, no therapy was suggested. After a laparotomy for ileus, the patient rapidly showed the clinical signs and symptoms of starch granulomatous peritonitis in addition to the carcinomatosis. The starch granulomas dominated, but carcinoma cells were also found. During the period of starch granulomatous peritonitis, the carcinoma of the stomach actually showed the full signs and symptoms of carcinomatosis within weeks. We can only speculate about the reasons for this extremely rapid development. An abdominal operation results in a change in host defense status and affects a number of immunologic parameters, and direct growth stimulation of carcinoma cells from the stimulated resident macrophages cannot be excluded. We have seen both stimulation and inhibition of intra-abdominal ascites tumors from starch powder in mice, depending on when starch was introduced into the abdomen (unpublished observations). These observations are, however, not easily extrapolated to a clinical situation because of the unusual tumor type, species differences, and a growth pattern different from almost all intra-abdominal human tumor types. In the other patient presenting with both granulomas (in the pelvic area) and tumor nodules (hepatic surface), development into full carcinomatosis seems more retarded. Thus, these two instances illustrate different clinical aspects of how starch powder granulomas and multiple carcinomatous nodules can occur together.

The true benefit of aggressive operative treatment for a localized intra-abdominal recurrence has not been entirely clarified, but there are reasons to believe that the quality of life of the patient will be better and some may even be cured after radical removal. One obvious problem is to decide if the tumor is a true local recurrence or just a manifestation of a disseminated disease. Using even the most advanced methods available in clinical medicine preoperatively will not prevent the surgeon from occasionally experiencing the problem of an unsuspected macroscopic finding of carcinomatosis. In three of the patients, a successful hepatic resection was performed because the frozen section was done by a pathologist who was aware of the starch powder problem. We do, of course, not know if the hepatic metastases were the only manifestations of malignant tissue, but, thus far, no signs of extrahepatic recurrences have been observed in these patients. Pathologic documentation of dissemination should always be done, and if results will influence the operative procedure, frozen sections should immediately be performed to confirm the diagnosis. Even surgeons with considerable experience in oncology cannot always differentiate between carcinomatous nodules and starch powder granulomas.

Difficulties with the intraoperative staging of tumors add another problem to the lengthy list of documented side effects of surgical glove powder contamination (12). As a result of our experiences, we have discouraged the use of powdered surgical gloves for all operative procedures performed at our hospital. Furthermore, we recently demonstrated the introduction of starch through endoscopic instrumentation channels during diagnostic procedures when powdered gloves were used by surgical team members handling the equipment. We now use only powder-free gloves for endoscopic or minimal access operations.

Particle-free, powder-free gloves have not been universally accepted by surgeons despite the fact that patients continue to experience a wide range of postoperative powder-related complications. Glove washing, advocated as a solution to the problem, will not remove enough powder to prevent cell damage in traumatized tissue. Therefore, it would seem desirable to use particle-free gloves to maximize patient outcome and minimize the

risk of powder-induced complications for all invasive procedures.

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Occupational asthma due to latex surgical gloves

Carmen Marcos, MD; Milagros Lázaro, MD; Juan Fraj, MD; Santiago Quirce, MD; Belén de la Hoz, MD; Montserrat Fernández-Rivas, MD; and Eloy Losada, PhD

Since 1979 several reports of contact urticaria due to natural latex have been well documented. Recent case reports suggest that rhinitis and asthma may also be due to rubber exposure. We describe an operating room nurse who was exposed at work to natural rubber (latex) due to the use of latex surgical gloves. After 25 years, she developed contact urticaria, rhinoconjunctivitis and acute asthma following the handling of rubber gloves for surgical purposes. She was symptom-free when on vacation. Skin prick testing demonstrated an immediate skin reaction to latex. Rub testing with surgical gloves was positive. Specific IgE antibodies to latex were found by indirect ELISA. Specific bronchial challenge with latex extract elicited an isolated immediate asthmatic reaction that was inhibited with cromolyn sodium pretreatment. Patch testing to common rubber additives was negative. These results suggest that latex present in surgical rubber gloves and probably acting as inhalant allergen may produce occupational asthma in exposed subjects, probably by means of an IgE-mediated mechanism.

INTRODUCTION

Natural rubber (latex) has been one of the most important vegetable materials with industrial application in the last two centuries. Rubber is well known as a cause of contact dermatitis, but the sensitizing agents are mostly additives employed in the rubber manufacturing process. Until 1979, when Nutter[1] reported the first case of contact urticaria due to latex, it was thought that sensitivity to latex itself did not exist. Since then, several cases of contact urticaria have been reported[2-6] and in recent years cases of anaphylaxis, rhinitis,[7-12] and asthma[13,14] due to latex have appeared. Nevertheless, latex had not been included as a potential etiologic agent of occupational asthma until now.[14]

We describe a case of work-related rhinoconjunctivitis, asthma, and contact urticaria in an operating room nurse.

CASE REPORT

A 44-year-old woman who had been working as an operating room nurse for 25 years, began to experience perennial nasal and ocular itching, sneezing, and rhinorrea that worsened at work. Total IgE was 175 KU/L and eosinophils (35%) were found in the nasal smear. Skin prick testing and RAST to common inhalants were negative.

Three years later these symptoms continued with an urticarial eruption in the rubber glove contact areas together with wheezing and shortness of breath following the use of sterile rubber gloves for surgical purposes. The respiratory symptoms began within ten to 15 minutes of the onset of work and were of variable severity, worse when she had a respiratory infection. She was symptom-free on the days she was not occupied with this activity.

She had no personal or family history of atopy but she had contact dermatitis to nickel.

MATERIAL AND METHODS

Latex Extracts Used for in Vivo *and* in Vitro *Tests*

A sample of latex low amonio TZ 60% (LATZ) from Malaysian *Hevea brasiliensis* was provided by Guzman (Madrid, Spain). This latex was diluted 1:5 (vol/vol) in phosphate buffered saline (PBS), pH 7.3, at laboratory temperature. After stirring for 30 minutes it was centrifuged at 1000 *g* for ten minutes. Finally it was passed through filter paper.

Latex surgical glove extract: The exterior side of the latex surgical glove (Commercial Person SA. Spain) was washed with 10 mL PBS. The liquid obtained was centrifuged at 1000 *g* for ten minutes, and then dialyzed against PBS for 24 hours. Finally it was sterilized by filtration through a Millipore filter of 0.22 μ, (Millipore Corp., Bedford, MA). This was considered 1:1 vol/vol extract, and 10-fold dilutions were made for inhalation tests.

The protein concentrations of the two latex extracts were determined by Bio-Rad protein assay, according to the manufacturer's instructions (Bio-Rad, München, Germany). The protein concentrations were 420 mg/dL in natural latex, and 6 mg/dL in latex surgical glove extract.

STUDY PERFORMED

Skin Tests

Prick testing to latex was performed with: natural latex extract 1:5 (vol/vol) and with latex surgical glove extract.

Skin prick testing was also performed with a battery of commercially available common inhalants (Bencard, UK). Histamine phosphate, 10 mg/mL, and 0.9% normal saline were used as positive and negative skin test controls. Responses were interpreted after 15 minutes by

From the Servicio de Alergia, Hospital Ramón y Cajal, Madrid, Spain.

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measuring the two perpendicular diameters of the wheal. A positive reaction was defined as a wheal >3 mm in the presence of a negative reaction to the saline control.

The same tests were performed on five atopic and five normal nonexposed individuals who served as controls.

Patch tests were performed with 26 common reagents of the Spanish Contact Dermatitis Research Group, including the rubber additives thiuram mix, mercapto mix, and PPD mix. They were read at 15 minutes, 48, and 96 hours.

Rub Testing

The patient's forearm was moistened with water and then rubbed with a surgical glove for 30 seconds and examined 15 and 60 minutes later. Three atopic subjects were also tested as controls.

Immunologic Tests

Specific IgE against latex by indirect ELISA. This method detects the presence of specific IgE antibodies using natural latex-antigen-coated microtiter plates DYNATECH M-24-AR[15]: 0.1 mL of natural latex diluted 1:2000 in PBS (0.00021 mg protein) was added to coat each microtiter plate well. After coating, the sera (optimally diluted) were incubated in the wells. Thereafter, monospecific antihuman IgE labelled with peroxidase, TAGO, (Inc, Burlingame, CA) were added and finally the presence of specific antibodies was revealed by means of a chromogenic substrate (orthophenylenediamine, OPD, Sigma, USA).

Rast to latex. Specific IgE antibodies against latex was measured by commercially available discs with latex (latex, K 82, Pharmacia Diagnostics AB, Uppsala, Sweden). RAST was performed according to the manufacturer's instructions using the commercially available ^{125}I-labelled anti-IgE (Phadebas anti-IgE) and expressing the results in PRU/mL as derived from the Phadebas RAST reference system.

Specific IgG4 antibodies to latex. Serum IgG4 antibodies to latex were determined by indirect ELISA using the same method that we used for detecting specific IgE to latex, with this difference that we employed antihuman IgG4 (TAGO, Inc, Burlingame, CA) instead of antihuman IgE.

Total serum IgE. This was measured by IgE EIA technique according to the manufacturer's instructions (Pharmacia, Uppsala, Sweden).

Ambulatory monitoring of peak flow (PEFR). Serial determinations of peak expiratory flow rates (PEFRs) with a Mini-Wright peak flow meter (Clement Clarke International Ltd., London) were performed by the patient at 2-hour intervals during waking hours at work and at home for a week. The maximum and minimum values were kept for analysis of daily variability. Records with an increased diurnal variation of more than 15% to 20% appear reasonable for establishing significance of daily variability of peak flow measurement.[16–18]

Bronchial provocation tests (BPT). Nonspecific BPT with methacholine inhalation was performed according to Cockcroft,[19] with some modifications. The aerosolized particles were generated by a continuous pressurized nebulizer model De Vilbiss 646, with a fitted output of 0.28 mL/min.

Specific BPT was done with latex surgical glove extract. The patient was first skin tested with tenfold dilutions of latex surgical extract to determine a safe starting dose for the provocation. At daily intervals, the patient inhaled the aerosolized allergen in progressively increasing concentrations for two minutes at tidal volume. The initial concentration was a 1:100 vol/vol extract. A control challenge with PBS was carried out before antigen challenge. Base pulmonary function measures of FEV_1 and FVC were performed and repeated at 5, 10, 15, 20, 30, 60, and 120 minutes after each challenge. A positive immediate response was defined as 20% fall in FEV_1. Hourly peak flow measurements were performed for 24 hours after each challenge in order to detect possible late phase responses. A 35% fall in PEF from the baseline was considered a positive response. If no response was observed, the next concentration was given the following day. The inhibitory effect of cromolyn sodium (DSCG) on the inhalation reaction was also studied. Cromolyn sodium (DSCG) 40 mg. was given by inhalation using a spinhaler 30 minutes before the provocation test.

Two asthmatic patients with similar nonspecific reactivity were also challenged after obtaining their informed consent.

RESULTS

Immediate positive responses were obtained in the prick tests with the latex extracts: erythema and 11 by 9-mm wheal with pseudopods with natural latex 1:5 (vol/vol), 7 by 5-mm wheal with latex surgical glove extract. Skin prick test results are shown in Table 1. Skin tests with common inhalants were all negative. Rub testing was positive with the surgical glove, producing wheals, angioedema, and flare in the contact area within 15 minutes. There were no responses in the control subjects.

The patient had negative patch tests to 26 standard reagents including the rubber additives at both immediate and delayed readings. Total IgE was 229 KU/L. Specific antilatex IgE antibodies were found in the patient's serum by indirect ELISA technique; readings at 492 nanometers revealed a value of 0.639 OD (optical density). A positive result was considered as a value of 0.319 OD (mean of the control sera +2 standard deviations) (Table 2). Nevertheless, it was not possible to detect specific IgE antibodies against latex by commercially available discs coated with latex (Latex K82, Pharmacia Diagnostics AB. Uppsala, Sweden).

able 1. Results of Skin Tests (size of wheals in mm)

	Extract 1*	Extract 2†	Histamine, 10 mg/mL	Saline 0.9%
Patient	11 x 9 ps‡	7 x 5	7 x 6	0
Control subjects				
Atopic 1	0	0	5 x 4	0
Atopic 2	0	0	5 x 3	0
Atopic 3	0	0	6 x 5	0
Atopic 4	0	0	5 x 3	0
Atopic 5	0	0	7 x 5	0
Nonatopic 1	0	0	6 x 5	0
Nonatopic 2	0	0	6 x 4	0
Nonatopic 3	0	0	5 x 4	0
Nonatopic 4	0	0	6 x 5	0
Nonatopic 5	0	0	5 x 3	0

latural latex 1:5 vol/vol.
atex surgical glove extract 1:1 vol/vol.
Pseudopods.

ble 2. Results of Specific IgE by Indirect LISA

Serum	Specific IgE Measurements (OD-492)*
Patient's serum	0.639
Control sera	
Serum 1	0.274
Serum 2	0.312
Serum 3	0.286
Serum 4	0.295
Mean of control sera	0.291

D: optical density. Plates were read at 7 nm.

We did not find IgG4 antibodies ainst latex by indirect ELISA.

Plots of daily maximum and minum peak expiratory flow rates EFR) as well as daily variability peak flow measurements are illtrated in Figure 1. Changes in FR ≥15% were recorded on days was exposed to latex surgical ves at work.

Bronchial challenge with methaoline revealed bronchial hyperictivity, with a PC 20 value of 4 mg/mL. After challenge with ex surgical glove extract 1:10 l/vol), the patient had an immeite response. FEV_1 decreased 44% 15 minutes and returned to base- two hours later (Fig 2). No late iction was observed. Pretreatt with inhaled cromolyn so- DSCG) inhibited the immeite response (Fig 2).

Bronchial challenges with latex surgical glove extract in the control subjects were negative.

DISCUSSION

Natural latex, obtained from the tropical tree *Hevea brasiliensis*, mainly contains a polymer of cis-1-4-polyisoprene, and 4.5% of proteins. This milky sap is submitted to a manufacturing process in which chemical additives that are potent sensitizers (thiurams, carbamates, phenylenediamine derivates) are added to natural latex. Further, rubber surgical gloves contain a powder (flock) inside, which some authors[20] suggest might produce an immunologic reaction.

The results of the investigation carried out in our patient strongly suggest that she was sensitized to latex by an IgE-mediated immunologic reaction. This conclusion is supported by the presence of an immediate response to skin prick tests, and the finding of specific IgE antibodies to latex by indirect ELISA. The negative results obtained in the control subjects support the specificity of these findings.

In the immunologic studies performed on the patient we were unable to find specific IgE against latex by commercially available discs with latex. Turjanmaa et al[24] found positive RAST results in nine of the 15 patients with latex contact urticaria diagnosed by prick and use tests.

The negative results of the patch tests with the rubber chemical additives seem to make their clinical involvement unlikely; moreover, these substances have only been reported to cause delayed cutaneous responses and have never been reported to cause immediate hypersensitivity.

Our patient developed airway obstruction at work, as was documented by the ambulatory monitoring of peak flow (PEFR). The bronchoconstrictive response after specific bronchial challenge with latex surgical glove extract indicated that latex might be causative of the asthmatic symptoms. The negative results obtained in the control subjects support the specificity of these findings.

The exact nature of latex allergen is not completely known. Recently there has been great effort to characterize and isolate this allergen(s). Most authors support the protein nature of latex allergen.[21-23] On the other hand, vapors of terpenes have been incriminated in rubber-induced asthma by Seaton et al[13] in a study lacking immunologic confirmation.

It is well known that latex may provoke symptoms by means of direct contact (contact urticaria). The fact that our patient developed respiratory symptoms before any cutaneous manifestations suggests that latex might also be an inhalant allergen. Latex allergen(s) was probably released spontaneously into the atmosphere on handling the gloves, evoking an immunologic response at the mucosal surfaces; however, cutaneous antigen absorption cannot be ruled out.

Despite long use of latex in industrial applications, occupational asthma by latex has only recently been reported by Tarlo et al[14] who studied the prevalence of occupational asthma to latex in a plant surveyed, finding 11% prevalence of immediate skin reactivity to latex,

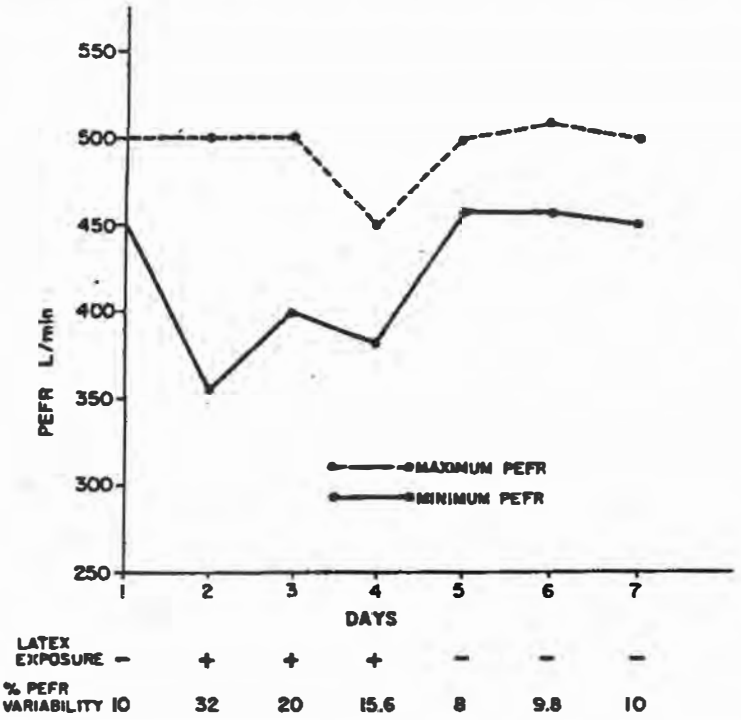

Figure 1. Plot of daily maximum, minimum and variability of peak expiratory flow rate in the patient.

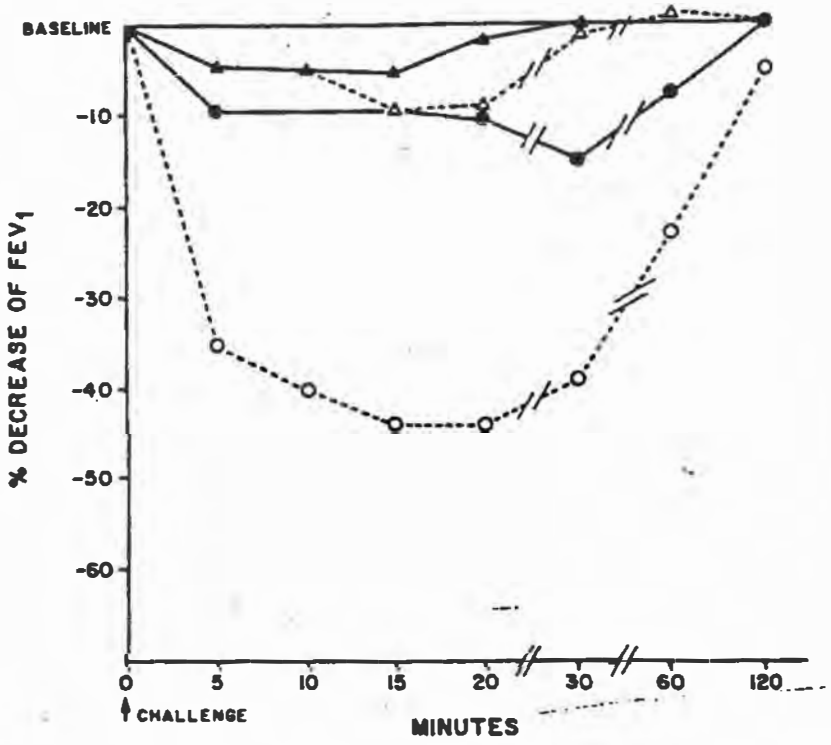

Figure 2. Results of specific inhalation challenges: ▲——▲ control challenge with PBS; ●——● BPT with glove extract (1:100 vol/vol); O- - -O BPT with glove extract (1:10 vol/vol); and Δ- - - -Δ BPT with glove extract (1:10 vol/vol) after cromolyn sodium (DSCG), 40 mg, inhalation.

and 6% of workers who had pulmonary function testing had evidence of occupational asthma due to latex. We agree with them that latex should be included among the increasing number of agents that can induce occupational asthma as in our patient.

Further studies are needed to identify the latex allergen(s) and to develop manufacturing processes for latex-allergen-free rubber products.

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Request for reprints should be addressed to:
Dra. Carmen Marcos Bravo
Servicio de Alergia. Hospital Ramón y Cajal.
Carretera de Colmenar Km 9.1
Madrid 28034
Spain

POOR ADHERENCE TO UNIVERSAL PRECAUTIONS IN AN EMERGENCY ROOM

In order to evaluate compliance with Universal Precautions observers rated 129 personnel involved in 1274 interventions on 151 consecutive critically ill and injured patients in an inner city emergency department (Johns Hopkins Hospital) in July, 1988. The observers recorded compliance with wearing of gowns, masks, eye protection, and gloves for any invasive procedure with a risk of spraying of blood or profuse bleeding and for contact with patients bleeding profusely. Participation in minor procedures such as phlebotomy or handling blood specimens required wearing gloves.

Personnel adhered to recommended barrier precautions only 44% of the time. Adherence was only 19.5% during interventions in patients with profuse bleeding compared with 44.7% in patients who were not bleeding. Adherence was only 16.7% during major procedures such as thoracotomy, intubation, cutdown, and placement of central line or thoracostomy tube. Adherence was 56.4% during more minor procedures. Adherence rates varied among different types of health care provider: residents 58%, emergency staff physicians 38%, emergency nursing staff 44%, paramedics 8%, radiology technicians 14%, housekeeping staff 91%.

In response to a follow-up questionnaire 47% of providers indicated there was not always enough time to observe precautions, 33% believed precautions interfered with skillful performance of procedures. 23% considered the materials uncomfortable, and only 2.7% believed Universal Precautions did not work.

Observation that as many as 4% of emergency patients have had unrecognized infection with human immunodeficiency virus indicates strict observation of Universal Precautions is essential to minimize risk of transmission to emergency personnel.

—RMS

Kelen GD. DiGiovanna TA, Celentano DD. et al. Adherence to Universal (barrier) Precautions during interventions on critically ill injured emergency department patients. JAIDS 1990:3:987–994.

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Glove-Associated Reactions: Addressing an Increasing Concern

Wava Truscott
Lorraine Roley

Increasingly, the dermatology professional will be called upon to assist in establishing protocols for recognizing, differentiating, and managing glove-related reactions. Addressing preventative measures upfront will decrease possible morale problems, long-term treatment and compensation expenses, as well as potential career-limiting situations.

Objectives

This independent study offering is designed for nurses and other health care professionals who may encounter glove-associated reactions. A multiple choice examination follows this article and is designed to test the objectives listed below. After studying the information presented in this article, the reader will be able to:

1. Describe the three glove-related reactions, their distinguishing characteristics, and causative agents.
2. Discuss guidelines to preserve barrier integrity through proper glove selection, storage, donning, and use.
3. Identify hazards associated with the use of powdered gloves.

The emergence and increased concern over acquired immunodeficiency syndrome (AIDS), hepatitis, and other bloodborne pathogens has heightened the awareness of the need for caution whenever there is potential contact with patient body fluids. New policies and procedures requiring the use of gloves have affected individuals who work in hospitals, clinics, private practice, laboratories, convalescent homes, as well as medical, fire, and police emergency personnel. For a number of individuals, however, this has resulted in increased incidence of glove-associated adverse reactions (Slater, 1992; Truscott, 1994a). Clinical expression, etiology, and pathology vary greatly as do indirect consequences. It is essential that reaction management programs be established to facilitate rapid recovery and prevent potentially serious consequences. Occupational and employee health departments as well as risk managers are advised to seek the assistance of staff dermatologists and allergists in developing these programs. As dermatological nurses, your expertise will be called upon in such a capacity with increasing frequency.

Wava Truscott, PhD, MBA, BS, *is Vice President, Scientific Affairs, Safeskin Corporation, San Diego, CA.*

Lorraine Roley, MA, *is Manager, Technical and Clinical Information, Safeskin Corporation, San Diego, CA.*

Recognizing the type of reactions with subsequent isolation of causative agents may facilitate the selection of appropriate alternative gloves as well as the implementation of correct management controls. Taking the program to the preventative mode will facilitate the selection of gloves manufactured to minimize the risk of developing allergies or irritation. The purpose of this article is to discuss glove-related reactions, together with possible direct and indirect consequences related to glove-associated reactions.

Reactions

Though often referred to by several descriptors, there are basically only three types of reactions associated with gloves (see Table 1) (Truscott, 1994a). It is critical that staff understand the differences between these conditions and can readily aid in their management. Each reaction will be discussed separately.

Table 1. Types of Glove-Associated Reactions

Mechanism	Terms Used
Irritation	Irritant contact dermatitis
Type IV Hypersensitivity	Delayed type hypersensitivity Allergic contact dermatitis Chemical allergy
Type I Hypersensitivity	Immediate type hypersensitivity Protein allergy Urticaria Occupational asthma Anaphylaxis

Irritation

Irritation is caused either by a direct injury to the epidermal cells or by the removal or destruction of their protective intracellular lipids. This results in increased cell vulnerability and local inflammation.

Clinical symptoms. Irritation manifests within minutes to hours after gloves are donned. The first symptoms are generally erythema and edema associated with pruritus or burning. If exposure to the irritant persists, the irritation will advance to an irritant contact dermatitis. Symptoms of this chronic condition, referred to as irritant contact dermatitis, include dry thickened skin, cracks, fissures, lesions, and papules. It is important to note that symptoms do not appear on the skin beyond the area of glove contact. Because everyone is susceptible to irritant reactions, it is more likely that in situations where a large percentage of the individuals are suddenly experiencing a dermatitis that the mechanism is irritant rather than allergic.

Causes and recommendations. Irritation is most often caused by chemicals that are non-glove related. Common irritating substances include soaps, detergents, and disinfectants, especially when they are left on the skin after insufficient rinsing. Gloves may enhance the effects of these irritants as they provide a warm, moist, occlusive environment encouraging dermal penetration of potential irritants. Jewelry unnecessarily increases the potential for irritation by inhibiting proper rinsing.

Synthetic and latex gloves can also cause irritation due to chemicals in the compound formulation, poor leaching, excessive use of biocides, or insufficient post processing (Moore, 1992; Truscott, 1994b). Glove powders are often implicated in irritant reactions. They absorb protective intracellular lipids and follow with powder particle abrasion of the unprotected cells. When powder is present, glove chemicals are also transported via powder aerosolization into the environment, potentially irritating delicate ocular and pulmonary membranes (Truscott, 1994c). It should be noted that the spread of formaldehyde, glutaraldehyde, and other sensitizing chemicals used in disinfection are also easily aerosolized after they contaminate powder particles in powdered gloves.

Staff should remove jewelry and rinse hands thoroughly to ensure the removal of soaps and disinfectants (Larsen, 1989). Gloves should be removed frequently to prevent hyperhydration of the epidermis and to limit the adverse effects of excessive occlusion. Relief of irritated hands is sometimes found by donning gloves larger than those normally chosen, thereby increasing air circulation and reducing friction. Low in chemical additives, hypoallergenic gloves reduce the potential for irritation and are recommended for individuals prone to irritant reactions. Encourage long-term hand care regimen for personnel to maintain healthy skin. Such a program should incorporate washing with a mild soap, thorough rinsing, and using a lotion (see lotions and medications), especially in off-duty hours. As the body's firstline of defense, it is imperative that epidermal integrity be preserved.

Type IV, Delayed Type Hypersensitivity

Type IV, delayed type hypersensitivity or allergic contact dermatitis is a cell-mediated allergic response to specific chemicals referred to as contact sensitizers. The primary cells involved in this type of allergy are T-cells and macrophages. Cytokines released by these leukocytes also initiate an inflammatory response, often making it difficult to distinguish aller-

gic contact dermatitis from irritant contact dermatitis.

Clinical symptoms. There are no external symptoms during the sensitization period. Finally, after repeated exposure to the offending chemical, a sufficient number of T-cells are sensitized, recruiting enough macrophages and causing enough inflammation that symptoms begin to appear on subsequent contact. The acute response often appears as clustered vesicles that are pruritic and elicit pain when scratched. After repeated contact, the condition may become chronic with accompanying hyperplasia, desiccation, crusting, papule formation, scaling, and peeling with open lesions. A chronic dermal delayed type hypersensitivity is referred to as allergic contact dermatitis. Symptoms can extend up the arm beyond the boundary of glove contact.

Causes and recommendations. Both latex and synthetic gloves use chemicals which may cause Type IV reactions. The most frequent offenders are accelerators, required during production to catalyze the binding of elastomeric particles. In decreasing order of their implication as contact sensitizers, they are thiurams, mercaptobenzothiazols (MBTs), and carbamates.

Accelerators are reported to be responsible for greater than 80% of glove-related allergic contact dermatitis cases (Heese, 1991). This is actually very fortunate in that it allows individuals allergic to one accelerator to avoid gloves or manufacturers using that particular accelerator. For instance, if individuals are allergic to MBT, they should be able to wear gloves using carbamates without incident.

Gloves from different manufacturers vary with regards to the amount of chemicals used during manufacturing and the amount of residual chemicals remaining on the finished glove. Levels of offending contact sensitizers may be so low that no reaction is elicited (hypoallergenic). Because the remaining 15% to 25% of glove-related contact dermatitis is caused by a variety of antioxidants, biocides, colorants, and other chemical additives, using hypoallergenic gloves is often a very wise preventative investment for employees prone to this type of allergic condition. By avoiding employee treatment costs, sick leave, retraining, and possible job loss, the upfront expense of high quality is actually a cost savings.

Endotoxin, lipopolysaccharides from gram-negative microorganisms, have also been linked to cases of glove-associated hand dermatitis (Shmunes & Darby, 1984). Because endotoxin is not destroyed during sterilization, this sensitizer may be present in sterile and nonsterile gloves. Powdered gloves are more likely to possess high levels of endotoxin. The cornstarch powder used to coat the gloves readily supports the growth of microorganisms during glove manufacturing, increasing the risk of endotoxin contamination of the gloves. Once the gloves are in the work environment, endotoxin-laden powder may also be inhaled by personnel, potentially affecting pulmonary membranes and functioning as an immunological adjuvant for other antigenic substances.

As with irritation, allergic contact dermatitis can put staff at increased risk of infection due to the broken epidermal surface. Extra caution must be practiced around infectious agents and patients due to the reduced protection provided.

Type I, Immediate Hypersensitivity

Glove-associated irritation and Type IV, delayed type hypersensitivity have been reported since the 1930s. Type I, immediate type hypersensitivity, however, was associated once with latex use in 1927 (Nater, 1975) and then not again until 1979, followed by sporadic cases through 1988 (Gonzalez, 1992; Slater, 1992).

In 1990, the latex balloon on silicone catheters used for rectal barium enema examinations was reported to have caused 450 anaphylactic reactions, resulting in 15 deaths (Ownby, Tomlanovich, Sammons, & McCullough, 1991).

Type I, immediate type hypersensitivity to latex, is an IgE-mediated response that has the potential to elicit severe reactions in susceptible individuals (Seaton & Cherrie, 1988). Routes of exposure include inhalation, invasive procedures, and dermal and mucosal contact absorption. Repeated challenge with the allergen amplifies the production of allergen-specific IgE antibodies in susceptible individuals. These antibodies attach to high affinity receptors on mast and basophil cells which circulate throughout the body, and concentrate in mucosal tissues. The development of a Type I sensitization is asymptomatic until a threshold level of sensitized mast cells is reached.

Clinical symptoms. After the threshold level of sensitized mast cells is reached, subsequent exposure will elicit a Type I response. The ensuing combination of the latex protein allergen with the IgE causes cell degranulation. The secretory products of basophils and mast cells are histamine, heparin, serotonin, and arachidonic acid, which are converted into prostaglandins and leukotrienes by other cells. Together, these products are responsible for the symptoms of Type I allergic reactions (Sell, 1987).

Symptoms may occur locally or systemically. They include urticaria, rhinitis, pruritus, conjunctivitis, dyspnea, pharyngeal edema, asthma, abdominal cramping, angioedema, headaches, nausea, dizziness, hypotension, tachycardia, and anaphylaxis. Anaphylactic shock may be fatal. *Personnel must be trained to recognize and respond appropriately to potential shock conditions.* Patients, including health

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Table 2. Groups At-Risk for Type I

Population	Percent IgE Positive
Spina Bifida	40%
Health Care Providers	
General hospital	3%-7%
Surgical personnel	7%-12%
General Public	<1%

care professionals who become patients, may insist that they only have the urticarial form of reaction and thus expect no complications during their hospital stay. However, when the latex proteins are in direct contact with mucosal tissues through inhalation or invasive procedures involving the peritoneal lining, mucosa, or serosal surfaces, clinical symptoms may suddenly shift to systemic.

Causes and recommendations. Type I allergens specific to gloves are proteins originating in the latex raw material from the rubber tree, *Hevea braziliensis*. When these proteins are separated using two-dimensional gel electrophoretic methods, 240 peptides are isolated. It has been difficult to determine which proteins to use in developing diagnostic assays, because different proteins are allergenic for different latex-sensitized individuals. It is probable that the numerous routes of exposure will be the key in understanding the protein-specific allergen complexity.

An additional contributing factor may be the large variety of cross-reactive allergens. Latex sensitive individuals often have (or develop) a history of allergic reactions to bananas, avocados, chestnuts, kiwis, tomatoes, cherries, and potatoes (Fink, 1995). These reactions may include tingling or swelling of the lips, rhinitis, hives, or any of the symptoms described previously for Type I hypersensitivity. Because each may increase the exposure to a different set of latex-similar proteins, an individual's consumption of these cross-reactive allergens may also influence to which proteins a susceptible individual becomes sensitized.

Populations at risk for immediate type hypersensitivity to natural rubber latex are listed in Table 2 (Fay, 1991; Gonzalez, 1992; Glove allergies, 1991).

Patients with chronic illnesses requiring bladder catheterization, rectal disimpaction, or other repetitive latex or rubber contact procedures are also at higher risk. This is especially so if their condition required invasive procedures during infancy, although the exact reason for the early age vulnerability is unclear. Spina bifida patients are in this category. Over 40% have latex protein specific IgE antibodies. Approximately 75% of latex-sensitized individuals have a history of atopy, thus adding atopy to the list of risk factors. Due to the extremely high reaction rate among spina bifida patients, all should be considered latex sensitive as a precaution.

Health care providers can delay or avoid the threshold level of Type I symptom expression by using gloves low in protein allergens. Although quality gloves with durable barrier protection and low protein levels may cost more at the onset, their value is more than justified by avoiding the costs of treatment, sick leave, and workmen's compensation as well as departmental transfers, replacement, retraining, and the potential for career limitation of employees who have become sensitized.

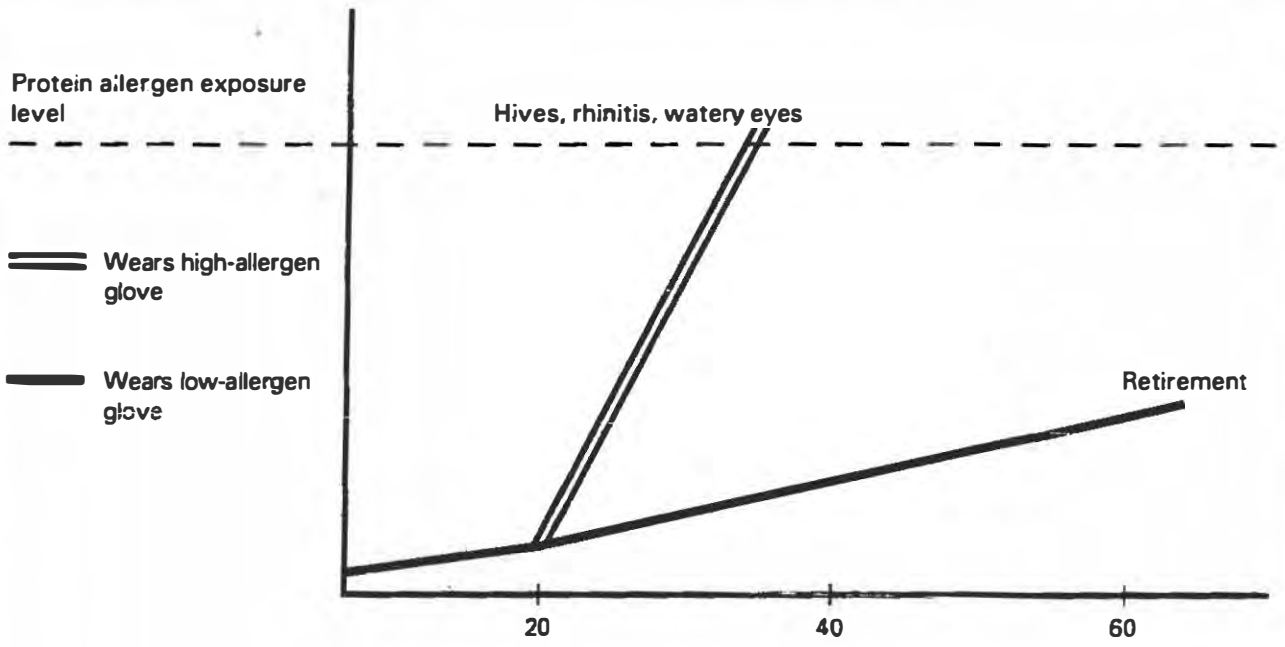
Individuals already sensitized should wear a Medic Alert tag and use *extreme caution* with all latex and rubber products. Only synthetic gloves should be worn.

Powder

Sensitized individuals (Type I) must avoid working near staff members who wear powdered gloves (Beezhold, Kostyal, & Wiseman, 1994; Truscott, 1994c). Similarly, health care providers should only wear powder-free gloves whenever they are in the vicinity of latex-sensitized patients. Latex proteins adhere to glove powder particles and are subsequently dispersed as aeroallergens, readily inhaled by everyone in the vicinity and deposited on whatever the glove contacts. Recently, several hospitals have performed air-sampling studies verifying the impact of glove powder in the immediate hospital environment as well as through ventilation system contamination (Saltus, 1993; Tarlo, Sussman, Contala, & Swanson, 1994). Because allergic sensitization is dose and rate dependent, minimizing environmental exposure through the use of powder-free gloves will reduce the risk of sensitizing staff members. If this is not possible, lightly powdered gloves with low protein levels should be selected. Another reason to minimize the use of powdered gloves is that powder also carries glove-associated chemicals and endotoxins. This transforms the powder particles into an excellent immunological precursor and adjuvant, amplifying the bronchial immunological response to protein allergens and increasing the risk of latex sensitization (Tarlo et al., 1994; Truscott, 1994c). To assess the impact of the work environment on an individual, measurements of respiratory capacity should be determined against exposure duration using a peak flow meter.

Specific protocols must be established to facilitate the immediate care of latex-sensitive patients. All

Figure 1.
Threshold for Clinical Symptoms



Theoretical Career Exposure

Hypothetically: Twins aspire to go into the medical field as nurses. Each begins her career at a different hospital. Hospital A uses high–protein, powdered gloves, and Hospital B has switched to low–protein, powder–free, gloves. The twin on staff at Hospital A became Type I latex sensitive at age 35, limiting her career. The twin at Hospital B retired at a normal age without ever reaching the threshold of symptom expression.

such patients must be identified, with obvious notation on their chart and person. Wear latex-free gloves for any patient contact. A specific location for latex-free alternative medical devices should be created, readily available, and stocked.

Hypoallergenic

The term hypoallergenic means less likely to cause an allergic response. The package label claim of hypoallergenicity was developed by the FDA to differentiate gloves low in chemical contact sensitizers, addressing the needs of those individuals suffering from allergic and irritant contact dermatitis. To qualify for this designation, gloves must be evaluated using a 200-person modified Draize test (repeated application of glove patches over a 6-week period).

Because Type I, immediate type hypersensitivity to natural rubber latex has only recently been identified, the current requirements to obtain the hypoallergenic claim do not include testing appropriate for this form of allergic condition. Manufacturing methods used to reduce chemical contact sensitizers may or may not reduce protein allergens (Moore, 1992; Truscott, 1994b). Although small amounts of chemical contact sensitizers are often tolerated by those with allergic contact dermatitis, low levels of protein allergen on a glove may elicit a response from Type I sensitized individuals.

Individuals already diagnosed with Type I hypersensitivity must wear synthetic gloves. Nonlatex gloves must also be worn when treating patients with Type I hypersensitivity. Whenever purchasing gloves, ask the manufacturer for the level of latex proteins. Lower protein levels reduce the rate of sensitization. The onset of symptoms in genetically susceptible individuals may be prevented if latex protein allergen exposure never reaches the threshold level required for clinical expression (see Figure 1).

The Food and Drug Administration (FDA) recognizes the modified Lowry, ASTM 5712-95, as the offi-

cial method of latex protein measurement. Using this method, it has been determined that protein levels differ as much as several thousand micrograms per gram (µg/g) depending on manufacturer and glove type. No official definition of "low" or "safe" protein level exists. It is almost impossible to determine what level of protein challenge will push individuals over the threshold into symptom expression. This is due to the multitude of latex protein sources as well as the variation in individual susceptibilities. However, well-processed powder-free gloves should have protein levels at or below 50 µg/g (FDA stated lowest sensitivity level of the assay), and 150 µg/g or lower for powdered gloves (some have levels over 2,500 µg/g!). It should be noted, however, that due to the adsorption of protein to the surface of powder particles, subsequent aerosolization, inhalation, and impactation on respiratory mucosal tissue, the availability of the protein is much greater. Thus, protein levels on powdered gloves represent a greater risk to personnel and patient.

The FDA, manufacturers, and the American Standards and Test Materials (ASTM) organization have been working to determine alternate evaluation criteria and terminology to identify and distinguish between gloves low in chemical contact sensitizers and those low in latex proteins. For now, the hypoallergenic claim is still granted under the FDA 510(k) process for those gloves that qualify under the original requirements. Individuals responsible for purchasing gloves should require that they have low levels of protein and chemicals, and that they provide employees with appropriate preventative protection.

Barrier Protection Issues

At first glance, one might believe that a section covering barrier protection in an article written to the dermatological nurse regarding latex-related reactions is inappropriate. However, the epidermal layer of the skin is usually disrupted in dermatological reactions, breaking down the employee's firstline of defense. In addition, several well-intended treatments compromise the protective capacity of glove materials. Therefore, it is essential that preserving barrier protection be discussed prior to establishing programs for glove-related reactions.

Compromised skin barrier. Irritant and allergic contact dermatitis compromise our natural barrier protection, providing easy access routes for viral, bacterial, and fungal invasion through cracks and lesions. When possible, hands should be healed prior to returning to work. Because this is often not possible, laboratory, emergency, and hospital care personnel must exercise added caution around potentially infectious agents.

Lotions and medications. In search of moisturizers and healing ointments, individuals often use mineral oil, lanolin, cocoa butter, jojoba oil, or petroleum-based lotions or salves. These agents act as plasticizers, disrupting the chemical bonds that maintain material strength of latex and many synthetic glove materials (O'Neale, 1990; Voeller, Coulson, Bernstein, & Maxamura, 1989). Although a hand-care regimen incorporating these ingredients is encouraged away from work, only latex-compatible, non-oil based lotions can be used when wearing gloves.

If uncertain as to the suitability of a particular lotion, the following evaluation may be performed. Cut equal strips from the palm or dorsal surface of the glove, approximately 1/4 inch by 2 inches. Stretch and secure the strips at approximately 3x their length. Coat one heavily with the lotion in question. Leave the other uncoated as a control. After 30 minutes, release the strips and place them side by side. Compared to the control glove, if the lotion-treated sample has enlarged either in length or width, the mechanical stability has been degraded and the lotion is unacceptable.

Jewelry. Jewelry, such as rings, bracelets, and watches should be removed prior to donning gloves to reduce the risk of puncture. The absence of jewelry also permits less obstructed washing and rinsing, thereby decreasing the risk of developing related irritant and allergic contact dermatitis.

Composition. Latex gloves have set and maintained the standard for barrier durability. Choose alternate glove materials carefully. Vinyl, for instance, does not have the strength, elongation potential, or flexibility of latex. ASTM performance requirement standards are far less stringent for vinyl than they are for latex. Vinyl breaks rather than gives. This is apparent at the microscopic and macroscopic levels, particularly between fingers and at the fingertips during strenuous, friction creating, and torquing manipulations. If other nonlatex glove materials are being considered, it is strongly recommended that evaluations include durability assessments. After the completion of routine gloved procedures, fill the used gloves with water and observe for leaks. Such studies should only be conducted using appropriate contamination controls.

Storage. Proper storage and handling of gloves are critical in maintaining barrier integrity. Prolonged heat, excessive moisture, and intense light are detrimental to glove materials. Ozone, created by electrical equipment such as fans, generators, X-ray machines, and fluorescent lights alter the molecular structure of the glove, resulting in broken bonds and weakening the glove (Clark, Sherwin, & Baker, 1989). Effects are amplified in creases, often resembling perforation lines which easily tear. Gloves should be stored away from sunlight, direct artificial light, and electrical

Figure 2.
Reaction Profile

REACTION	Immediate Type Hypersensitivity	Irritation	Delayed Type Hypersensitivity
ALSO KNOWN AS:	Type I hypersensitivity Urticaria IgE-mediated allergy Protein allergy	Irritant contact dermatitis	Type IV hypersensitivity Allergic contact dermatitis Cell-mediated allergy Chemical allergy
IMMEDIATE INTERVENTION	Emergency treatment for anaphylaxis may be required.	NA	NA
CAUSE	Protein allergens from natural rubber latex source (*Hevea braziliensis*) either on glove surface and/or powder bound, suspended in the air or settled onto objects.	Residual chemical Excessive pH shift Microbially contaminated powder Excessive occlusion Too tight Hyperhydration/maceration Drying effects of excessive powder Abrasive affects of powder Non-glove related irritants (e.g., insufficient hand rinsing)	Chemical contact sensitizers potentially added during manufacture: Thiruams Mercaptobenzothiazole Carbam ates Butylhydroxyanisol (BHA) 3,5-di-tertiary butyl 4-hydroxytoluene (BHT) 4,4-thiobis (6-tertiary butyl) meta cresol (Lowinox 44S36) Amine antioxidant derivatives (IPPD), CPPD, DPPD, or any other chemical of PPD mix Insufficient rinsing of scrubs, disinfectants and other potential chemical contact sensitizers.
ACTION	See an allergist. Wear an alert bracelet/necklace. Carry an Epi-Pen®. Alert fellow employees.	Wash and rinse hands thoroughly. See a dermatologist if severe. Anti-inflammatory medication may be helpful.	Anti-inflammatory medication may be helpful — see a dermatologist if severe.
GLOVE-RELATED ACTION	Procure synthetic glove for the employee. Make certain working environment is free from powdered gloves.	Use different lot or batch number. Remove gloves at least hourly to air hands. Wear a larger glove size. Wear powder-free.	Switch to hypoallergenic glove formulated and/or processed to be low in chemical contact sensitizers.

quipment. They should be stored in areas with good entilation where the relative humidity does not xceed 40% and the temperature is no greater than 0°F.

love Protocols

Glove protocols are assembled to educate and ssist infection control nurses, occupational health ersonnel, and health care individuals. They cover sues regarding appropriate selection, storage, and se as well as assisting in identifying and managing love-related reactions.

A list of realistic alternatives to latex-containing devices is a necessary part of any protocol and can be used to create a latex-free environment that addresses the needs of the latex-sensitive (Type I) patient. Alternatives for health care workers who are latex sensitive should also be addressed. Guides to assist in developing and using glove-associated reaction protocols are presented in Figures 2 and 3. Once established, institution-specific protocols should be reviewed by dermatologists and allergists familiar with latex-associated reactions.

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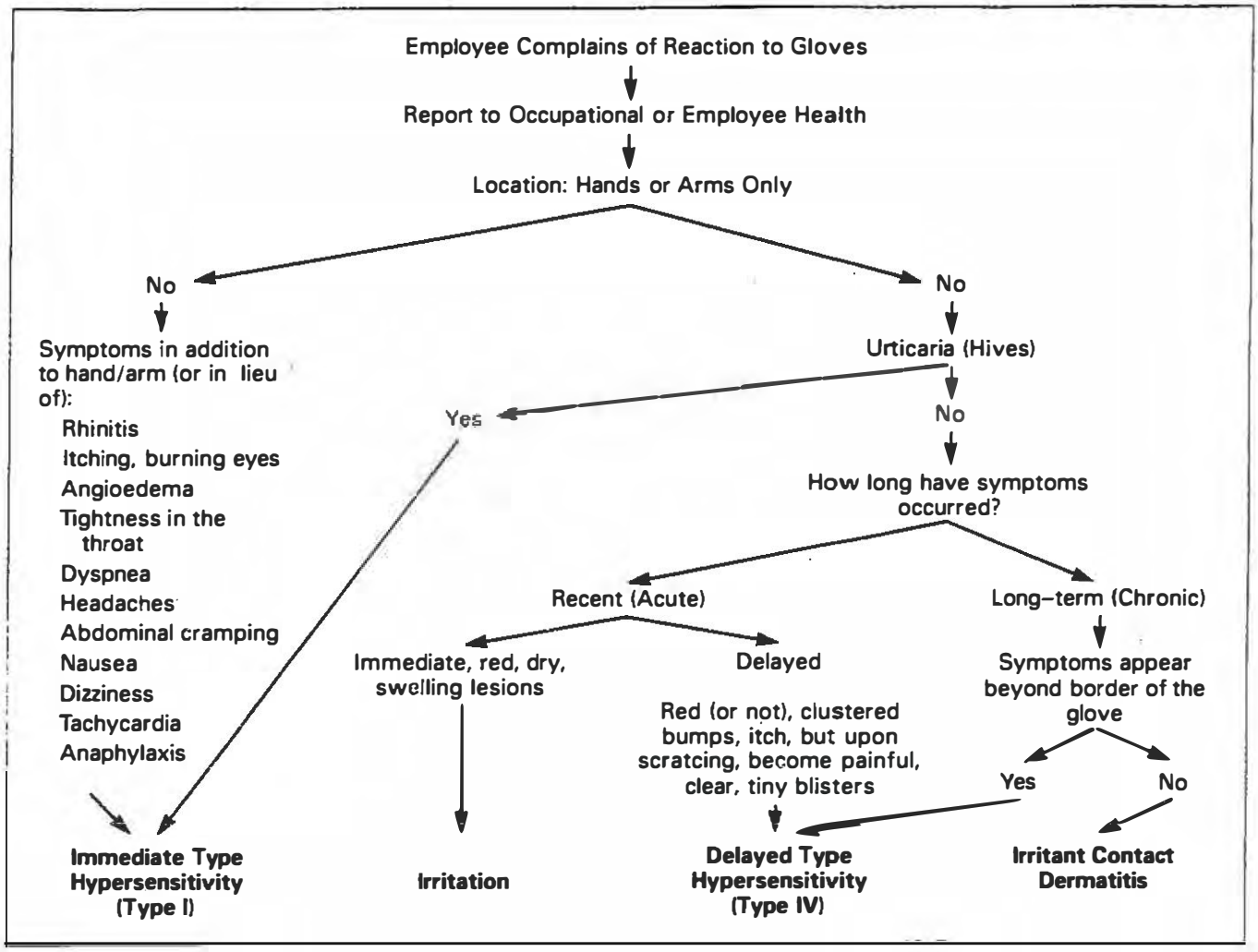
Figure 3.
Guide to Differentiation of Glove Reactions Triage Format



Summary

Actions taken to increase employee protection against bloodborne pathogens have inadvertently also lead to increased glove-related dermatological reactions. These reactions may be divided into three categories: (a) irritation, (b) Type IV hypersensitivity, and (c) Type I hypersensitivity. Hospitals are establishing programs to help identify and deal with these issues for both patients and employees.

As actions are taken to address the three glove-related reactions, care must be exercised to avoid compromising barrier protection through the use of inappropriate glove materials or incompatible lotions.

Allergic sensitization is dose and rate dependent. To reduce the risk of developing a Type IV hypersensitivity to the chemicals in latex or synthetic materials, gloves low in chemical contact sensitizers should be selected. To minimize the risk of developing a Type I hypersensitivity, gloves low in latex protein allergens should be worn. If an individual has been diagnosed with, or shows symptoms of, Type I hypersensitivity, only synthetic gloves should be worn. Personnel working in the vicinity of a Type I sensitized employee or patient must wear powder-free gloves to avoid contaminating the environment with latex protein laden powder particles. Because it is now thought that the protein-laden powder contaminated environment is a major factor in sensitizing the hospital staff members and causing occupation asthma, powder-free conversion is highly recommended. □

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Posttest Questions

Choose *one* correct answer for each question.

1. Which of the following is *not* a glove-associated reaction?
   a. Irritation
   b. Type I hypersensitivity
   c. Type IV hypersensitivity
   d. Type II hypersensitivity

2. Irritation may be caused by any of the following *except*:
   a. Detergents
   b. Excessive chemicals in the glove.
   c. Powder
   d. Proteins in the glove.

3. Irritant dermatitis reactions are characterized by all of the following symptoms *except*:
   a. Erythema
   b. Hives
   c. Pruritus
   d. Lesions

4. Contact sensitizers are chemicals that elicit what type of condition in susceptible individuals?
   a. Type I
   b. Type II
   c. Type IV
   d. Irritation

5. Glove-associated delayed type hypersensitivity (Type IV) is caused by:
   a. Proteins
   b. Powder
   c. Chemical contact sensitizers.
   d. Gloves that are too tight.

6. A Type IV reaction is:
   a. A nonallergic condition.
   b. Must be proceeded by a Type I condition.
   c. IgE mediated.
   d. T-cell mediated.

7. One symptom that distinguishes allergic from irritant contact dermatitis is that the allergic form may be present:
   a. With papules.
   b. With dry, cracked skin.
   c. With pruritus.
   d. Beyond the area of glove contact.

8. Chemical additives used in the manufacture of gloves that are most frequently associated with Type IV hypersensitivity are:
   a. Antioxidants
   b. Accelerators
   c. Biocides
   d. Colorants

9. Endotoxins are *not:*
   a. Pyrogenic lipopolysaccharides.
   b. Associated with hand dermatitis.
   c. Destroyed during sterilization.
   d. Capable of affecting pulmonary membranes.

10. To prevent the development of a Type IV, delayed type hypersensitivity reaction to latex or synthetic gloves, individuals should:
    a. Wear vinyl gloves.
    b. Put petroleum jelly under gloves.
    c. Wear gloves low in chemical contact sensitizers.
    d. Wear gloves low in proteins.

11. 450 anaphylactic reactions resulting in 15 deaths were reported to have been caused by:
    a. Latex gloves
    b. Inhalation of powder
    c. Bladder catheterization
    d. Rectal catheterization

12. Type I hypersensitivity is _____ mediated.
    a. IgE
    b. T-cell
    c. Macrophage
    d. Hypothalamus

13. Anaphylactic shock is *not* a:
    a. Potential symptom of Type I hypersensitivity.
    b. Systemic reaction requiring immediate emergency treatment.
    c. Characterized by hypotension.
    d. Potential symptom of Type IV hypersensitivity.

14. Individuals allergic to the proteins in natural rubber latex are often also allergic to any of the following *except:*
    a. Bananas
    b. Avocados
    c. Kiwis
    d. Wheat

15. The percentage of surgical personnel estimated to be sensitive to latex is approximately:
    a. 7% to 12%
    b. 3% to 5%
    c. 10% to 41%
    d. 1% to 2%

16. Which of the following conditions is not recognized as a risk factor for latex sensitivity (Type I)?
    a. Atopy
    b. Spina bifida
    c. Health care provider
    d. Gender

17. Which of the following is *not* recognized as a preventative measure for reducing the risk of Type I hypersensitivity to latex?
    a. Only wear gloves low in protein levels.
    b. Wear only powder-free gloves.
    c. Work in a powder-free environment.
    d. Choose gloves low in chemical additives.

18. Accelerators are reported to be responsible for greater than what percent of the glove-related cases of allergic contact dermatitis?
    a. 35%
    b. 60%
    c. 80%
    d. 15%

19. The term "hypoallergenic" refers to gloves low in:
    a. Vinyl
    b. Endotoxin
    c. Chemical additives
    d. Powder.

20. Although lotions with a/an _____ base are excellent on off-hours, they should not be worn under latex gloves as they can disrupt the chemical bonds between rubber molecules and breach barrier integrity.
    a. Organic
    b. Hydrophilic
    c. Water
    d. Oil

21. The following storage conditions are detrimental to maintaining glove barrier integrity *except:*
    a. Heat greater than 90° F.
    b. Absence of light.
    c. Moisture greater than 40%.
    d. Operation of ozone-generating equipment.

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Answer Form:
Glove-Associated Reactions: Addressing an Increasing Concern

Check the box next to the correct answer.

1. ☐A ☐B ☐C ☐D	2. ☐A ☐B ☐C ☐D	3. ☐A ☐B ☐C ☐D	4. ☐A ☐B ☐C ☐D	5. ☐A ☐B ☐C ☐D	6. ☐A ☐B ☐C ☐D	7. ☐A ☐B ☐C ☐D	8. ☐A ☐B ☐C ☐D	9. ☐A ☐B ☐C ☐D	10. ☐A ☐B ☐C ☐D	11. ☐A ☐B ☐C ☐D	12. ☐A ☐B ☐C ☐D	13. ☐A ☐B ☐C ☐D	14. ☐A ☐B ☐C ☐D

15. ☐A ☐B ☐C ☐D	16. ☐A ☐B ☐C ☐D	17. ☐A ☐B ☐C ☐D	18. ☐A ☐B ☐C ☐D	19. ☐A ☐B ☐C ☐D	20. ☐A ☐B ☐C ☐D	21. ☐A ☐B ☐C ☐D

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Evaluation	**Strongly disagree**				**Strongly agree**
1. The offering met the stated objectives.					
a. Describe the three glove-related reactions, their distinguishing characteristics, and causative agents.	1	2	3	4	5
b. Discuss guidelines to preserve barrier integrity through proper glove selection, storage, donning, and use	1	2	3	4	5
c. Identify hazards associated with the use. of powdered gloves.	1	2	3	4	5
2. The content was current and relevant.	1	2	3	4	5
3. The content was presented clearly.	1	2	3	4	5
4. The content was convered adequately.	1	2	3	4	5
5. I am more confident of my abilities since completing this material.	1	2	3	4	5
6. The material was ☐ new, ☐ review for me (check one)	1	2	3	4	5

Comments _____

_____

7. Time required to complete reading assignment:
Less than 1 hour ☐ 1-2 hours ☐ 2-3 hours ☐ More than 3 hours ☐

Posttest Instructions

1. To receive continuing education credit for individual study after reading the article, darken the appropriate box corresponding to the best answer on the answer form (a photocopy of the answer form is acceptable). Each question has only one correct answer. A passing score for this test is 16 correct answers (76%).
2. Peel and Press your mailing label and/or complete the information requested on the answer form in the space provided.
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Violence

VIOLENCE IN THE HEALTH CARE FACILITIES

Jane A. Lipscomb, R.N., Ph.D.
Senior Scientist
Office of the Director
National Institute for Occupational Safety and Health
Washington, DC

April, 1996

I. Background on problem

A. Historically psychiatric facilities have been considered high risk; problem solving/control strategies were focused on how therapist could predict "dangerousness"

B. Currently no health care setting is immune from violence

C. Spectrum of assaults in the workplace is broad

1. client to worker (by far the majority of incidents)

2. worker to client

3. employee to employee

4. employer to employee

5. employee to employer (or surrogate)

6. random acts of violence played out in the workplace

D. Background factors leading to violence in workplace

1. violence in society is on the increase

2. availability and use of firearms

3. use of hospitals by police for criminal holds

4. influence of alcohol and drugs

5. layoffs and organizational restructuring

II. Extent of the problem in health care

A. BLS data for 1993 showed health care and social service workers having the highest rate of assault injuries; almost 2/3 of nonfatal assaults occurred in nursing homes, hospitals and establishments providing residential care and other social services.

1. rate of nonfatal assault in "nursing and personal care facilities" was 38/10,000 compared with 3/10,000 in private industry

B. Between 1980-90, NIOSH's NTOF database reported 106 occupational violence-related deaths occurred among health care workers.

1. highest rate occurred among pharmacist (1.21 per 100,000 workers) followed by physician (0.36 per 100,000) and RNs (0.12 per 100,000)

C. Estimated prevalence of assaults in one psychiatric hospital in 1989 was 16-25 injuries per 100 staff per year compared with 8.2 injuries of all types in all industries and 14.2 in construction workers.

D. Dept of Labor and Industries study of assaults on staff in WA State psychiatric hospital (12/93)

E. Weapon-carrying in ED

1. 4-8% of ED pts and up to 24% of major trauma pts seen in ED carry weapons

III. Known risk factors for violence in the workplace

A. Risk factors for homicide (in general)

1. exchange of money with the public

2. working alone/in small numbers*

3. working late or early morning hours*

4. working in high crime areas*

5. guarding valuables

6. working in community setting*

B. Environmental factors for assault in health care settings

1. poor security

2. inadequate training

3. staffing levels and patterns

4. recent hires

5. time of day

6. containment activities

7. gender of provider (equivocal)

8. long waits in ED (anecdotal)

III. Worksite Prevention Program Elements in "Guidelines for Preventing Workplace Violence for Health Care and Social Service Workers" (OSHA, March 1996)

A. Management commitment and employee involvement

1. endorsement and visible involvement of top management

2. motivation and resources to deal effectively with the problem

3. employee participation and feedback

4. written program and communication plan

B. Worksite analysis

1. systematic analysis to find existing or potential hazards

2. "threat assessment team" to assess the vulnerability to violence

3. review of injury and illness records and worker compensation claims to identify patterns of assault that could be prevented

4. periodic inspection of workplace to evaluate worker tasks, identify hazards and evaluate the effectiveness of existing security measures

5. analyze incidents of assaults and details of the situation and its outcome

C. Hazard prevention and control

1. engineering control and workplace adaptation

2. administrative and work practice controls

3. post-incident response

D. Safety and health training

1. every employee (including supervisors and managers) should understand the concept of "Universal Precautions for Violence"

E. Recordkeeping and evaluation of the program

1. OSHA 200 logs, medical reports, incident reports

2. information on patients with history of violence, drug abuse, criminal activity

3. minutes of safety meetings, training

IV. Specific control measures/strategies

A. Engineering controls

1. security guards, metal detectors, access control, bullet proof glass/partitions

2. silent alarms, personal alarms (individually activated that pinpoint source location on locator board), two-way radios, escort services

3. lighting and other environmental factors

4. change office design to include escape route for workers

B. Administrative controls

1. work practices - staffing patterns (acuity-based formula)

2. banning working alone after dark

3. minimize cash/drugs on hand

4. victim/perpetrator profile (mentally ill, gang members, drug use, individuals with history of violence)

5. clear policies and procedures

C Education/training of employees (and others)

1. conflict resolution/nonviolent response

2. security

3. rights and liabilities

4. performance based evaluation of training

5. strategy for training which provides coverage for employees involved in training

6. education regarding safety on the job at the undergraduate and graduate level

C. "Universal precautions" against violence

D. Post-assault intervention

1. voluntary, systems approach

a. debrief victims

b. assess victims's sense of control, social supports, and ability to make sense of the incident

c. short-term support group

E. Problems of underreporting

F. Special risks in home care

IV. Regulatory/legal activities

A. State activities

1. "Guidelines for Security and Safety of Health Care and Community Service Workers" (CAL/OSHA, 1993)

2. CA - AB 508 - (10/93)

a. focus on emergency depts; requires training, security and safety assessment and plan, reporting of assault to local enforcement agency, security personnel

3. "Study of Assaults on Staff in WA State Psychiatric Hospitals" (WA State Dept. of Labor and Industries, December 1993)

B. Federal

1. OSHA - No standard but 3/96 guidelines

2. Charter Barclay Hosp. cited under 5(a)(1) for failing to protect workers from pts' violent behavior (9/93)

a. others (not hospitals)

V. Conclusion

A. Violence in the workplace on the increase in general

B. Workplace violence is not random and unpredictable and treating as such is a barrier to prevention

C. Environmental risk factors for violence in the workplace have been identified and need to be implemented

D. Research is needed to evaluation interventions once in place

E. OH professions need to collaborate with law enforcement, social scientists, labor

F. Management commitment to controlling the problem, as well as employee involvement is essential

Violence Toward Health Care Workers

AN EMERGING OCCUPATIONAL HAZARD

by Jane A. Lipscomb, PhD, RN, and Colleen C. Love, MA, RN

The occupational risk of injury and illness associated with employment in the health care industry may be greater than readers think. Well known hazards such as exposure to bloodborne pathogens, chemotherapeutic agents, and radiation have been the subject of many occupational health studies over the past decade.

By contrast, violence toward health care workers has only recently been addressed as an occupational health hazard. On April 26, 1989, Dr. Donald Millar, Director of the National Institute for Occupational Safety and Health (NIOSH), told the House Education and Labor Subcommittee on Health and Safety, "Another issue of concern to (NIOSH) is the violent assault of nurses inside and outside of facilities where they must work at night. In addition, there are a number of injuries that are caused by attacks by patients at hospitals."

Soloff (1987) specifically addressed this issue by stating, "Violence is endemic in the mental health treatment setting and constitutes a real if unacknowledged occupational hazard." Violence in health care settings is not only prevalent, but is increasing. Efforts must be directed at describing the risk of violence in high risk settings and identifying risk factors so that measures can be instituted to prevent future assaults.

The purpose of this article is to review the literature on assaults toward health care work-

ABOUT THE AUTHORS:

Dr. Lipscomb is Assistant Professor and Director of Occupational Health Nursing, Department of Mental Health, Community, and Administrative Nursing, University of California, San Francisco, CA. Ms. Love is Coordinator of Nursing Research, Atascadero State Hospital, Atascadero, CA.

ers. Specifically, the article discusses background on the problem; definitions of assault and other methodologic issues; prevalence of assaults; high risk settings and trends in violence; weapon carrying in hospitals; environmental risk factors; monetary and emotional costs of violence; and strategies for prevention.

BACKGROUND

The problem of violence in mental health care facilities has an extensive history, with the first documented case of a patient fatally assaulting a psychiatrist in 1849 (Bernstein, 1981). Psychiatric settings have been the subject of the most research to date.

The majority of studies have examined the risk of violence to psychiatrists and other therapists, focusing on the victim's role, the assaultive patient's characteristics, and contextual factors surrounding the assault. As nurse scientists have begun to generate research on the problem of patient violence, nurses have become a focus of research, and studies have begun to examine the emotional, cognitive, and social effects which persist long after the assault and the return to patient care (Lanza, 1983; Poster, 1989; Ryan, 1989).

In a recent report, 74% of surveyed psychiatric nurses agreed that staff members working with mentally ill patients can expect to be physically assaulted sometime during their career (Poster, 1989). Seventy-three percent of nurses (n = 154) completing the survey reported that they had been assaulted by a patient at least once during their career. Reviews of assaults to staff by patients in other mental health facilities found that the proportion of staff assaulted ranged from 42% (Madden, 1976) to 80% (Lanza, 1983). These findings suggest that the risk of work related injury in this occupational group is of crisis proportion.

Epidemiologic inquiries into the prevalence of assaults and associated risk factors are increasing in number and scope. However, several serious methodologic problems remain. As with most occupational illnesses and injuries, underreporting is a serious problem, and reporting is complicated by the perception that assaults on health care workers are part of the job (Lanza, 1983; Madden, 1976; Poster, 1989). Some have even suggested that these attacks are in some way precipitated by the staff themselves (Aiken, 1984).

DEFINITION OF ASSAULT AND OTHER METHODOLOGIC ISSUES

As with any epidemiologic study, a clear and measurable definition of the outcome of interest is critical. Assaultive incidents are difficult to quantify, and one standardized definition of inpatient violence that will allow for comparisons across patient populations and across settings does not currently exist.

A variety of definitions are presented in the patient violence literature. The broader the definition, the more incidents will be captured. Some studies define assault to include subjective elements such as the feeling of being threatened (Jones, 1985; Lanza, 1988; Whitman, 1976). Others include assaults directed only toward staff (Aiken, 1984) or only assaults that result in injury of staff (Carmel, 1989). Other definitions may capture violent events that damage property (Levy, 1976; Skodol, 1978). Definitions that include verbal assault (Greenfield, 1989; Morrison, 1989; Whitman, 1976) and self harm cover a wide range of violent incidents (Morrison, 1989; Skodol, 1978).

The lack of a standardized, well operationalized definition of assault has both clinical and research implications. In practice, if systematic bias results in only certain incidents being reported, the scope of the problem is underestimated and prediction and preventive interventions are hampered. On the other hand, by narrowing the phenomenon for the purpose of research, one is able to look with more depth and control at a particular aspect of violence. Since at this time the literature does not include a standard definition of assault, it is imperative to note the definition used when comparing rates across studies.

Any definition of assault that relies solely on incident report data (and there are many) captures a biased sample of all assaults (Brizer, 1989; Lanza, 1991; Silver, 1987). These reports usually include only the most serious assaults and those that result in physical injury requiring medical attention. Events such as verbal threat or sexual assault, which may lead to illness or injury of a different nature, are completely missed with this type of study. This omission in reporting is important, because a number of studies show that an individual's perception of an event is a critical factor in the intensity and duration of response to that event (Cohen, 1983; Folkman, 1984; Lazarus, 1981).

Lion (1981) compared the number of formal incident reports of assaults on staff with the assaults on staff noted in the daily ward reports at a state psychiatric hospital, and concluded that five times as many assaults occurred as were formally reported. This underreporting of assaults reflects institutional policies, management problems, ward politics, and staff tolerance (Haller, 1988; Lanza, 1991).

In addition to lack of a standardized definition

of assault and the underreporting of events, most studies published to date present findings based on the frequency of assaults among various patient or health care worker populations (e.g., 20 assaults per year) rather than the rate of assaults (e.g., 20 assaults per 100 staff per year). Conclusions based on frequency of events rather than rates may be misleading.

Haller (1988), in a critical review of the literature, made a similar point about incomplete analysis and reporting of assault data. The researchers concluded that most studies that examine the profile of violent patients do not assess or report the primary diagnoses of the non-assaultive patients in each sample. Therefore, discovering that the majority of patients involved in assaultive behavior are schizophrenic is of limited value without similar data on the non-assaultive patients.

A similar example is the study that reports the distribution of job titles of victims of assaults. The fact that the majority of assaults in inpatient settings are directed toward nursing staff is uninformative without denominator data on the job titles of the total number of employees (or the number of patient contact hours) in the institution.

PREVALENCE OF ASSAULTS

A number of studies of mental health care institutions and at least one emergency department have been conducted to estimate the prevalence of assaultive patients and/or assaults on health care workers. Larkin (1988), in a prospective study of a large British psychiatric hospital, found that 37% of 600 patients engaged in assaultive behavior—defined as any behavior that could physically damage the individuals themselves, another individual, or property. They reported that very serious incidents (defined as life threatening, e.g., strangulation) occurred at a rate of five per month. Rossi (1985) reported that the incidence of violent or "fear-inducing" behavior among the mentally ill was associated with 45% of patient admissions (n = 1687) to a general hospital's psychiatric unit from 1979 to 1982.

Lanza (1983) reported on the assault experience of 40 nursing staff (60% response rate) in a Veterans Administration (VA) neuropsychiatric hospital. The respondents, who had an average of 6 years of psychiatric nursing experience, reported being assaulted an average of seven times in their career. Although the term "assault" was not defined in this article, prior assaults included being grabbed, hit, choked, knocked out, or thrown to the floor. Madden (1976) surveyed 115 psychiatrists in Maryland and found that 48% of them had been assaulted, for a total of 68 times.

Efforts must be directed at describing the risk of violence in high risk settings and identifying risk factors so that measures can be instituted to prevent future assaults.

Bernstein (1981) found a similar prevalence of 42%. In his survey of 453 licensed psychotherapists (46% response rate), 14% reported having been assaulted (hit, bitten, kicked, or choked) on at least one occasion; 36% had been threatened; and 61% had been physically afraid of at least one client.

Lion (1981) studied all formal incidence reports completed by personnel at a Maryland state hospital during 1972, and identified 203 cases of assaults among 800 nursing staff (approximately 25 injuries per 100 nursing staff). A review of daily ward reports over a 3 month period revealed 237 reports which, extrapolated to the entire year, resulted in 1108 assaults, or nearly five times as many assaults as formally reported.

The Occupational Safety and Health Administration (OSHA) defines an occupational injury as one which results in death or in "lost workdays, loss of consciousness, restriction of work or motion, termination of employment, transfer to another job, or medical treatment (other than first aid)." This definition was used by Carmel (1989) to conduct a 1 year study of injuries in a 973 bed maximum security forensic hospital in California. The researchers found that nursing staff sustained 16 injuries per 100 staff.

By comparison, work related injuries reported to OSHA during 1989 occurred at a rate of 8.3 per 100 full time workers in all industries combined, with the highest rate of 14.2 per 100 full time workers in the construction industry (Bureau of Labor Statistics, 1991). Carmel's data suggest that at this maximum security hospital, the rate of injuries from assaults alone put this group of workers at a higher risk than that of the most hazardous industry in the country, the construction industry.

Lavoie (1988) surveyed the medical directors (75% response rate) of 127 large university based hospital emergency departments, and reported that 43% had at least one physical attack on a medical staff member per month and 7% described acts of emergency department violence that resulted in death.

These data suggest that the prevalence of violence in mental health care institutions is

high, approximately 16 to 25 injuries per 100 staff per year, and that as many as 37% to 45% of all patients in these settings may engage in violent behavior. Surveys of psychiatric nurses, psychiatrists, and other therapists estimate that approximately 50% to 100% of these health professionals have experienced at least one assault during the course of their career. In addition, emergency department personnel at large university based hospitals face a significant risk of fatal injury from assaults by patients or their families.

HIGH RISK SETTINGS AND TRENDS IN VIOLENCE

A number of settings place health care workers at high risk of assault, including mental health care facilities, emergency departments, pediatric units, medical-surgical units, and long term care facilities. One study of a university hospital found that assaults were distributed throughout the hospital, with 41% occurring in the psychiatric unit, 18% in the emergency room, 13% on medical units, 8% in surgical units, and 7% in the pediatric unit (Conn, 1983). The recent siege at a Utah hospital, which resulted in the death of one emergency room nurse and a 17-hour hostage situation in the hospital maternity ward (*New York Times,* September 22, 1991), demonstrates the potential magnitude of the risk of violence.

Although community mental health outpatient settings have not been the subject of systematic study of the problems of violence, at least one fatal attack on a psychologist in Southern California in 1989 has raised the level of concern among health care workers in these settings. Bernstein (1981), in his survey of psychiatrists and therapists, found that 33% of incidents took place in an inpatient setting, 26% in an outpatient setting, and 21% in private practice.

In addition to various settings being identified as the site of assaultive patient behavior, violence in health care settings is on the rise. Hodgkinson (1984) found that incident reports of assaults on staff in a large psychiatric institution within London had doubled between 1979-1980 and 1982-1983.

Some have speculated about the cause for the increased violence in hospitals. Increased violence in the general population as a means of solving problems, increased use of mind altering drugs and alcohol abuse, and the increased availability of weapons may all contribute to the problem of violence in the health care setting.

In psychiatric settings, the increase in violence has been attributed to: 1) deinstitutionalization of the chronically mentally ill; 2) the right of involuntary patients to refuse psychotropic medications; 3) the changed involuntary commitment criteria from "in need of treatment" to "dangerousness"; and 4) shorter hospital stays and frequent readmissions of violent patients. The blurred boundary between mental illness and criminality is also thought to have contributed to the problem of violence in hospitals. At times, law enforcement personnel will divert a violent individual who is acting "crazy" to a locked psychiatric setting rather than to jail (Jones, 1985).

WEAPON CARRYING IN HOSPITALS

Weapon carrying patients are a concern in emergency departments throughout the country. The literature suggests that weapon carrying in both psychiatric and general emergency services is not uncommon and that the ability of staff to predict which patients are carrying weapons is poor (McCulloch, 1986).

Anderson (1989) found that 8.4% of 287 inpatients admitted to a New Jersey hospital during the first 6 months in 1987 carried weapons. McCulloch (1986) found that 8% of 175 patients searched in a psychiatric emergency department carried weapons, while McNeil (1987) found 4% of all patients seen in a psychiatric emergency room carried weapons. Wasserberger (1989) reported that at one Los Angeles level 1 trauma center, 4,796 weapons were confiscated from 21,456 patients over a 9 year period, and at least 25% of the major trauma patients were carrying lethal weapons.

Lavoie (1988), in a survey of 127 emergency department directors, found that 43% of departments confiscated at least one weapon per month; one hospital confiscated 300 weapons per month using a metal detector; 18% reported at least one threat with a weapon each month; and two hostage incidents were reported to have occurred at knife point.

Goetz (1991) conducted a retrospective study of 500 patients (1.3% of patients seen) who were searched for weapons by security officers in a university emergency department during a 20 month period. Eleven percent of psychiatric patients were searched with 17.3% found to be carrying weapons, while 0.4% of all medical patients were searched with 15.7% found to be carrying weapons.

These six studies support the ideas that weapon carrying is not uncommon in emergency departments and that all health care workers and emergency department personnel in particular may be at risk of serious injury from weapon related assaults.

ENVIRONMENTAL RISK FACTORS

A number of environmental risk factors have been associated with patient assaults, including:

inadequate training, staffing patterns, time of day, and containment activities. A limited number of studies have evaluated each of these variables.

Inadequate training, policies, and procedures have been identified as contributing to assaults. Three studies have shown that training in the management of assaultive behavior can reduce injury from assault (Carmel, 1990; Infantino, 1985; Lehmann, 1983). Reports that inexperienced health care workers are at increased risk of assault suggest that additional training of novice health care workers may prevent assaults. Bernstein (1981) found that less experienced therapists were threatened or assaulted more frequently than seasoned clinicians by a ratio of 4:1. Hodgkinson (1984) reported that student nurses were at greater risk of assault than nursing assistants.

Carmel (1989) found that the majority of injuries (9.9/100 staff) were sustained while containing patient violence; the remainder (6.1/100 staff) were the result of battery type assaults. Lion (1981) also found that the largest percentage of patient assaults on staff occurred during seclusion or restraining activities. This finding suggests the need for additional research into factors such as training (and staffing) rather than into personal patient characteristics.

Staffing patterns have been associated with increased assaults. Jones (1985) found that short staffing appeared to lend itself to an increased likelihood of violent behavior. Fineberg (1988) found a relationship between violence in a psychiatric ward and the use of agency nursing staff ($r=0.56$) after a 12 month period during which permanent nursing staff was halved.

Fottrell (1980) found that nursing staff consistently bear the brunt of inpatient assaults. This may be due to nursing staff spending the greatest amount of time interacting with patients and setting and enforcing limits, which may lead to a greater number of potentially assaultive encounters (Haller, 1988). Jones (1985) found that nursing assistants, followed by nurses and physicians, were the most common targets of assault in a large VA medical center. These findings should lead to future studies of environmental factors for assault associated with these job titles and activities.

Several studies have reported that assaults occur most frequently during times of high activity and interaction on patient wards. Ionno (1983) found that physical assaults were most common on visiting days, and suggested that the increased activity level associated with these days may lead to increased assaultiveness.

Jones (1985) concluded that increased activity

Several studies have reported that assaults occur most frequently during times of high activity and interaction on patient wards.

was the single most significant environmental factor in assaults in a VA medical center. She found that the majority of violent incidents occurred during the day (59% during the day shift), with the largest number of incidents in a 2 hour period occurring between 8:30 and 10:30 a.m. Carmel (1989) reported that injuries were more likely to occur during three peak periods (meal hours) than other times of day. These data need to be confirmed in other studies and incorporated into security policies and training programs.

Although the focus of this review is environmental factors that increase the risk of violence to health care workers, it would be incomplete without addressing the issue of the profile of the violent patient. Predicting "dangerousness" has been the goal of psychiatry for some time, yet recent studies suggest that psychiatrists and other therapists currently cannot accurately predict violent behavior (Bernstein, 1981; Monohan, 1984; Werner, 1983).

The focus of inquiry in defining a violent patient profile includes: demographics, diagnosis, and a history of violent behavior. The literature on the first two of these three characteristics is equivocal at best. Therefore, discussion is limited to the third feature as a way to predict violent behavior.

Bernstein (1981) found that 76% of those who had threatened or attacked a therapist had a history of violence. Kurlowicz (1990) found that a history of violent behavior within the past several hours was a strong predictor of assaults in the emergency department. Drummond (1989) reported success in reducing assaults against staff by 91% by flagging charts of patients with a history of assaultive or disruptive behavior.

A number of studies have documented that a small percentage of patients are responsible for the majority of assaults (Aiken, 1984; Colenda, 1991; Convey, 1986; Dooley, 1986; Fottrell, 1980; Jones, 1985; Larkin, 1988; Lion, 1981; Murry, 1991). This supports the hypothesis that patients with a history of violent behavior place health care workers at greatest risk of future assaults.

Werner (1983) studied the question of predicting dangerousness by asking 15 psychiatrists and 15 psychologists to review data in a psychiatric rating scale. The data included whether a physical attack on another person had led to each

patient's present admission to the hospital. Based on these data they were asked to predict which of 40 male inpatients at a VA hospital were likely to commit physical assaults within 1 week of admission. While these health professionals agreed among themselves about which patients would be violent and the critical predictor variables, their predictions were rarely accurate when compared with subsequent patient behavior.

Although efforts at predicting "dangerousness" have been less than successful (Bernstein, 1981; Werner, 1983), efforts continue because a number of studies have demonstrated that a small percentage of all mental health patients pose a significant proportion of all violent attacks. Fottrell (1980) found that 3% of patients were involved in 70% of the incidents. Larkin (1988) found that 4% of patients were involved in 60% of the incidents. Jones (1985) reported that 34 patients were responsible for 60% of a total of 200 recorded incidents.

The literature suggests that a small core of patients, typically 7% to 10% of the total psychiatric population, display assaultive behavior dangerous enough either to be worthy of mention in nursing reports, or to cause an injury and therefore require the completion of an injury report (Haller, 1988). They suggest the need to compile a clear picture of a potentially assaultive psychiatric inpatient, with a focus on the psychological and clinical profile (as opposed to strictly demographic).

Haller also suggested the need for study into the question of why certain staff in particular are assaulted and whether the determinants of assaults differ when staff (as compared with other patients) are victimized. Study is also needed into factors that predict health care workers' varying responses and recovery from an assault event. In the meantime, the environment must be made safe for all health care workers through currently available engineering and administrative controls.

MONETARY AND EMOTIONAL COSTS OF VIOLENCE

Very few studies have attempted to assess health care institutions' financial burden in the event of an assault and even fewer have attempted to measure the true emotional and professional cost borne by the victim.

Adler (1983) documented 422 workdays lost over a 2 year period due to violence toward staff in a 312 bed privately endowed psychiatric facility. This, the author noted, was a significant increase over prior years. Carmel (1989) reported that of 121 staff sustaining 134 injuries, 43% involved lost time from work, with 16 (13%) of those injured missing more than 21 days from work. Hunter (unpublished data) estimated the costs of assault from this study and found that 134 injuries from patient violence cost $766,290 and resulted in 4,291 days lost and 1,445 days of restricted duty.

Hunter found that injuries from battery were 2.2 times as costly as injuries due to containment. Love (unpublished grant proposal, 1991) noted that in 1990, 103 staff in a large state hospital sustained injuries directly related to patient assaults, totaling more than $77,073 plus the expense of over 1,395 industrial leave days at an estimated cost of $133,920.

Lanza (1989) reported that of 99 staff assaults, 38% required some days lost from work, with 12% requiring more than 1 month for full recovery. In a study of the cost of assaults, Lanza (1989) reported that during a 4 month period, 78 assaults were recorded. Extrapolating to a yearly cost, a conservative estimate of the total cost of reported assaults was approximately $38,000 per year.

This estimate included the cost of staff time, police time, and victim cost such as lost time, medical cost, employee assistance program (EAP) time, and overall training cost. This estimate did not include any cost of modified duty, staff turnover related to the assault, medical/psychological costs not related in time to the event, and overall staff productivity related to the demonstrated risk of assault. The varying costs per assault extrapolated from these data suggest that improvement in measuring the total cost of assaults is needed.

A service not considered in any of the above studies is the cost of staff support services for the unit or department experiencing the event. When an outbreak of violence occurs, staff often feel responsible for the episode. When one is victimized, victims tend to blame themselves, or others (including coworkers and supervisors) cast blame on the victim. Often there is also a heightened awareness of the potential for future violence following an assault. For both of these reasons, support services for staff following an assault are essential.

These support services must take into consideration the potential cognitive, emotional, and physical sequelae which may be present long after the victim has returned to work (Poster, 1989). No research to date has examined the effects of assault on victims' ability to perform their job tasks or make professional judgments. Studies also are needed to explain the differences in post-assault outcome, including return to work and length of employment following an assault.

STRATEGIES FOR PREVENTION

Adequate security is essential to the prevention

of staff assaults in high risk settings such as mental health and emergency care centers. Data on the prevalence of security in emergency departments come from Lavoie's (1988) survey of emergency department directors.

Seventy-nine (62%) respondents stated that their security personnel were present in the emergency department on a 24 hour a day basis. Of the 23 respondents who reported a frequency of weapons display as a threat once each month or more, eight (35%) did not use 24 hour security. Of the 16 (29%) respondents noting violent emergency department deaths in the last 5 years, five (31%) did not use 24 hour emergency department security personnel at the time of the survey.

The use of uniformed security personnel in emergency departments allegedly has been found unacceptable by many hospital administrators because it may send the community a message about potential risk of violence in this setting. Hospital administrators should be urged to provide adequate security and be informed that public relations may not suffer from the use of uniformed security if the hospital effectively communicates the benefit from these security personnel to the community. In addition, security staff should meet regularly with health care workers to discuss strategies for successfully preventing violence in the setting.

Data on the availability of alarm systems in mental health facilities have not been published in the scientific literature. One anecdotal report of conditions at a California state hospital in which alarm systems were unavailable or not functioning at the time of a near fatal attack on a hospital physician suggests that there is significant room for improvement in this obvious strategy for preventing or minimizing the consequences of assaults. By contrast, a large forensic facility in California has a hospital-wide alarm system which can be activated by pointing alarm pens, carried by every staff member, at the ceiling (Love, C.C., personal communication, 1991).

Of the various administrative strategies currently in place to prevent assaults, staff training is by far the most common strategy in mental health settings. Over the past 10 years, management of assaultive behavior training has become common in most psychiatric facilities. One institution reported requiring 14 hours of prevention and management of assaultive behavior coursework at the time of employment and a 2 hour review class annually (Poster, 1989).

In contrast, Lavoie (1988) found that only 51 directors surveyed (40%) stated that their emergency department nurses receive formal training in recognition and management of violent patients. If their survey of emergency department

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medical directors is representative of training in non-surveyed emergency departments, training is far from adequate in this setting.

Related to the need for training programs is the need for intervention trials evaluating the effectiveness of this training in reducing violent attacks. Carmel (1990) found an inverse relationship between staff participation in training in the management of assaultive behavior (separate from the effect of training alone) and subsequent rates of staff injury. Others have published training program content (Lehmann, 1983; Perrin, 1989; Tardiff, 1988). A discussion of this content is beyond the scope of this article.

The need for written policies and procedures for using restraints and controlling violent patients should be obvious, especially in light of the requirement of the Joint Commission on the Accreditation of Healthcare Organizations (JCAHO, 1988). Yet 12% of university based emergency department directors reported an absence of such written policies (Lavoie, 1988).

Drummond (1989) reported on a systems approach to reducing violence in a VA hospital in Oregon. An incident report analysis was used to identify patients at high risk for repeated violence. Charts of patients with a pattern of seriously disruptive behavior, and who a consensus of committee members believed was at high risk of violence, were flagged within the computerized scheduling system. When a patient who had been flagged was checked in by a clerk, a note on the computer monitor advised health care providers to search for weapons and have hospital police standing by for assistance.

Over a 6 month period, 48 patient charts were flagged and the rate of violent incidents 1 year prior to the flagging and 1 year post-flagging was compared. The number of incidents declined by 91.6%, and visits to the medical center for any reason by these patients decreased by 42.4%. Because this study took place in a large urban VA hospital where patients with a history of violence are likely to be identified, it may not be generalizable to other settings. In addition, the difficulties inherent in defining high risk patients remain.

Wasserberger (1989) made specific recommen-

dations for emergency department employees, including training to recognize danger, rehearsing responses, and safely restraining patients. Wasserberger also recommended treating agitated patients immediately, debriefing after major incidents, counseling victims of the assault, using metal detectors, and improving security.

One innovative strategy is currently underway in a state forensic hospital in California. Borrowing from approaches to safety in industrial settings, investigators at the hospital will identify habitually violent offenders and compile data sheets on these types of patients (similar to Material Safety Data Sheets). These data sheets then will be developed into a "prevention at a glance" guidelines. The program will use these data to develop codes of safe practice for workers who care for violent individuals (Love, C.C, unpublished grant proposal, 1991).

Additional strategies have been suggested by health care workers who have been victims of assault. A number of investigations have focused on the victims' perceptions of the preventability of the assault. Jones (1985) asked victims of 200 assaults whether they thought the violent incident they were reporting could have been prevented, and 24% responded affirmatively.

Strategies for preventing the assault suggested by these health care workers included: installing a panic button or buzzer system at the nursing home, preventing admission of inappropriate patients, increasing the number of staff, increasing male staff, and more definitive action by staff in setting limits or giving medications. Lanza (1984), in her follow up study of 99 nurses' reactions to physical assault, found that 57% felt there was no chance or only a slight chance of preventing the assault. These data suggest that victims of violence often feel at a loss to prevent these assaults.

Preventive strategies to enhance health care workers' perceptions and actual control of these situations include active participation on hospital health and safety committees and post-assault support sessions. High risk personnel in particular should be encouraged to serve as members of the hospital health and safety committee. Hospital employee assistance programs (EAP) should include mental health benefits, and EAP professionals should be expert in the management of victims of assault.

A final strategy in the prevention of future assaults is the use of workers' compensation for physical injury and occupational stress, and legal action against the assaultive patient and the institution. Few cases of legal action are reported in the literature relative to the number of assault incidents. However, Poster's (1989) study of 184 psychiatric nurses reported that 58% agreed that staff members have the right to take legal action against assaultive patients. Only 37% disagreed with the statement "If I were physically assaulted, I would take legal action."

It is important to note that the success of any particular strategy will depend on the comprehensiveness of the overall risk management program in the institution and the related institutional support for this effort.

CONCLUSION

The study of violence toward health care workers as an occupational hazard is in its infancy. Efforts are needed to further define the risk of violence toward these workers and to identify and test preventive measures to reduce future assaults. Mental health care workers have been the subject of the most study to date, but emergency department personnel and health care workers in general medical settings also are at risk.

Violent incidents are severely underreported. The emphasis of studies is on those resulting in formal incident reports of injury and assaultive patient profiles rather than environmental factors associated with the assault. Weapon carrying is highly prevalent in emergency departments and increases the risk of serious injury from assaults for all health care workers.

The adequacy of existing hospital security, employee training, and policies and procedures for preventing violence has rarely been examined. When examined, it suggests that it is sorely inadequate, particularly in emergency settings. Identified risk factors for assaults include staffing patterns, time of day, and containment activities. Further study is needed into all of these areas and the emotional impact of assaults on staff in health care settings.

Evidence that mental health care workers have a higher injury rate from assaults alone than workers in the construction industry from all causes is alarming. The occupational health community needs to respond to this crisis situation by putting resources into the study and prevention of violence in this setting. In addition, health care institutions need to be educated that they have much to gain from efforts to identify and reduce the current epidemic of violence in these settings.

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Violence Toward Health Care Workers
An Emerging Occupational Hazard.

Lipscomb, J.A., & Love, C.C.

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1. Violence toward health care workers has only recently been addressed as an occupational health hazard and research in this area is in its infancy.

2. Violent incidents are severely underreported and when studied are usually limited to formal incident reports.

3. Identified envrionmental risk factors for assaults include staffing patterns, time of day, and containment activities.

4. Health care institutions need to be educated that they have much to gain from efforts to identify and reduce the current epidemic of violence in these settings.

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This report was prepared by Lillian Bensley, Ph.D., Nancy Nelson, Ph.D., M.P.H., Joel Kaufman, M.D., M.P.H., Barbara Silverstein, Ph.D., M.P.H., and John Kalat, B.S. Additional information is available from Lillian Bensley, Washington State Department of Labor and Industries, P.O. Box 44330, Olympia, Washington 98504-4330.

EXECUTIVE SUMMARY

Overview

The purpose of this study was to identify ways to improve worker safety in the State of Washington by reducing assaults on state employees at Eastern and Western State Hospitals. The study was initiated by the state legislature and conducted by the Department of Labor and Industries, acting in consultation with interested parties. We assessed the magnitude of assaults, reviewed the research literature on risk factors in other hospitals, evaluated hospital activities aimed at reducing assaults, and developed recommendations. Data collection efforts included conducting a survey of hospital employees, interviewing groups of patients, and analyzing existing data from workers' compensation claims, employee injury reports, and training and staffing records.

Incidence of Assaults

In order to assess the incidence and severity of assaults, we compared the results of a survey of hospital employees to existing data from workers' compensation claims and hospital employee injury reports. Each of these data sources has limitations. Workers' compensation data revealed that patient violence was responsible for 16.6 and 12.0 accepted claims per 100 employees per year at Western and Eastern State Hospitals, respectively. This comprised half of total claims. We estimated that for nursing staff, assaults were responsible for 23.2 and 18.5 claims per 100 employees per year. Hospital employee injury reports revealed rates of 41.0 and 35.3 reported assaults per 100 employees per year at Western and Eastern State Hospitals, respectively. We estimated that for nursing staff, there were 70.9 and 63.4 reported assaults per 100 nursing staff members per year. Among survey respondents, results revealed rates of 386 and 437 physical assaults resulting in at least minor injury per 100 ward staff members per year at Western and Eastern State Hospitals, respectively.

Recommendations

Increased training of hospital employees in the management of potentially assaultive patients.

We recommend:

- the creation of a pool of employees dedicated to the replacement of staff undergoing training;
- the routine notification of supervisors as to their employees' training status, where this is not already done;

- compliance with training requirements be made part of the evaluation process for both employees and supervisors;
- all ward employees receive training in restraint and containment procedures, where this is not already done;
- increased training for employees and supervisors in responses following assaults (e.g., available benefits); and
- performance based evaluation of training, to maximize its effectiveness in realistic situations.

Staffing levels that take into consideration the level of care required by patients

Option 1 The first option is to change the staff-to-patient ratio formula for allocating and funding hospital staff positions to an acuity-based formula that takes into consideration the level of care required by patients. This option should include an evaluation component.

Option 2 The second option is that additional research be conducted to

- test the ability of acuity-based staffing to reduce assaults on a small number of wards;
- identify the routes by which this predicted effect occurs; and
- determine the costs and effectiveness of using acuity-based staffing requirements to determine legislatively authorized staffing levels.

Installation of security alarm systems by which an employee can call for help in the event of assault

Option 1 The preferred option is immediate retrofit of all wards to include a reliable and effective alarm system. Employees should have the opportunity to provide input into the selection, testing, and purchase of the system, and adequate training should be provided. State-of-the-art alarm systems include individually activated transmitters, carried by employees, that provide an audible alarm and also pinpoint the source location visually on a locator board. An evaluation component should be included.

Option 2 The second option is to install reliable and effective alarm systems in wards as they undergo renovation, and in other wards as resources become available. Option 2 is otherwise identical to Option 1.

Additional Recommendations

Additional recommendations are in the areas of:

- Structured psychological support for assaulted employees,

- Workers' compensation and assault pay claims,

- Reporting,
- Communications,
- Improved pre-injury planning and enhanced return to work efforts for injured employees,
- Ongoing hospital committees to address assaults,
- Wellness programs, and
- Public policy.

Implementation of Recommendations

To effectively implement changes in order to achieve success in reducing assaults requires employee involvement in planning and implementing decisions and top management commitment to provide the necessary organizational resources. We recommend that these specific recommendations be implemented in the context of an agency-employee partnership based on the elements of management commitment, employee involvement, and procedures for ongoing evaluation and improvement.

Guidelines for Preventing Workplace Violence for Health Care and Social Service Workers

U.S. Department of Labor
Robert B. Reich, Secretary

Occupational Safety and Health Administration
Joseph A. Dear, Assistant Secretary

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Contents

Notice

These guidelines are **not** a new standard or regulation. They are advisory in nature, informational in content, and are intended for use by employers seeking to provide a safe and healthful workplace through effective workplace violence prevention programs adapted to the needs and resources of each place of employment. The guidelines are not intended to address issues related to patient care. The guidelines are performance-oriented and the implementation of the recommendations will be different based upon an establishment's hazard analysis.

Violence inflicted upon employees may come from many sources—i.e., patients, third parties such as robbers or muggers—and may include co-worker violence. These guidelines address only the violence inflicted by patients or clients against staff. It is suggested, however, that workplace violence policies indicate a zero-tolerance for violence of any kind.

The Occupational Safety and Health Act of 1970 (OSH Act)[1] mandates that, in addition to compliance with hazard-specific standards, all employers have a general duty to provide their employees with a workplace free from recognized hazards likely to cause death or serious physical harm. OSHA will rely on Section 5(a) of the OSH Act, the "General Duty Clause,"[2] for enforcement authority. Employers can be cited for violating the General Duty Clause if there is a recognized hazard of workplace violence in their establishments and they do nothing to prevent or abate it. Failure to implement these guidelines is not in itself a violation of the General Duty Clause of the OSH Act. OSHA will not cite employers who have effectively implemented these guidelines.

Further, when Congress passed the OSH Act, it did so based on a finding that job-related illnesses and injuries were imposing both a hindrance and a substantial burden upon interstate commerce, "in terms of lost production, wage loss, medical expenses, and disability compensation payments."[3]

At the same time, Congress was mindful of the fact that workers' compensation systems provided state-specific remedies for job-related injuries and illnesses. Issues on what constitutes a compensable claim and what the rate of compensation should be were left up to the states, their legislatures, and their courts to determine. Congress acknowledged this point in Section 4(b)(4) of the OSH Act, when it stated categorically: "Nothing in this chapter shall be construed to supersede or in any manner affect any workmen's compensation law . . . ."[4] Therefore, these non-mandatory guidelines should not be viewed as enlarging or diminishing the scope of work-related injuries and are intended for use in any state and without regard to whether the injuries or fatalities, if any, are later deemed to be compensable.

[1] Public Law 91-596, December 29, 1970; and as amended by P.L. 101-552, Section 3101, November 5, 1990.

[2] "Each employer shall furnish to each of his employees employment and a place of employment which are free from recognized hazards that are causing or are likely to cause death or serious physical harm to his employees."

[3] 29 U.S.C. 651(a).

[4] 29 U.S.C. 653(b)(4).

Acknowledgments

Many persons, including health care, social services, and employee assistance experts; researchers, educators; unions, and other stakeholders; OSHA professionals; and the National Institute for Occupational Safety and Health (NIOSH) contributed to these guidelines.

Also, several states have developed relevant standards or recommendations, such as the California OSHA (CAL/OSHA), *CAL/OSHA Guidelines for Workplace Security,* and *Guidelines for Security and Safety of Health Care and Community Service Workers*; the Joint Commission on Accreditation of Health Care Organizations, *1995 Accreditation Manuals for Hospitals*; Metropolitan Chicago Healthcare Council, *Guidelines for Dealing with Violence in Health Care*; New Jersey Public Employees Occupational Safety and Health (PEOSH), *Guidelines on Measures and Safeguards in Dealing with Violent or Aggressive Behavior in Public Sector Health Care Facilities*; and the State of Washington Department of Labor and Industries, *Violence in Washington Workplaces,* and *Study of Assaults on Staff in Washington State Psychiatric Hospitals.* Information is available from these and other agencies to assist employers.

Introduction

For many years, health care and social service workers have faced a significant risk of job-related violence. Assaults represent a serious safety and health hazard for these industries, and violence against their employees continues to increase.

OSHA's new violence prevention guidelines provide the agency's recommendations for reducing workplace violence developed following a careful review of workplace violence studies, public and private violence prevention programs, and consultations with and input from stakeholders.

OSHA encourages employers to establish violence prevention programs and to track their progress in reducing work-related assaults. Although not every incident can be prevented, many can, and the severity of injuries sustained by employees reduced. Adopting practical measures such as those outlined here can significantly reduce this serious threat to worker safety.

OSHA's Commitment

The publication and distribution of these guidelines is OSHA's first step in assisting health care and social service employers and providers in preventing workplace violence. OSHA plans to conduct a coordinated effort consisting of research, information, training, cooperative programs, and appropriate enforcement to accomplish this goal.

The guidelines are not a new standard or regulation. They are advisory in nature, informational in content, and intended for use by employers in providing a safe and healthful workplace through effective violence prevention programs, adapted to the needs and resources of each place of employment.

Extent of Problem

Today, more assaults occur in the health care and social services industries than in any other. For example, Bureau of Labor Statistics (BLS) data for 1993 showed health care and social service workers having the highest incidence of assault injuries (BLS, 1993). Almost two-thirds of the nonfatal assaults occurred in nursing homes, hospitals, and establishments providing residential care and other social services (Toscano and Weber, 1995).

Assaults against workers in the health professions are not new. According to one study (Goodman et al., 1994), between 1980 and 1990, 106 occupational violence-related deaths occurred among the following health care workers: 27 pharmacists, 26 physicians, 18 registered nurses, 17 nurses' aides, and 18 health care workers in other occupational categories. Using the National Traumatic Occupational Fatality database, the study reported that between 1983 and 1989, there were 69 registered nurses killed at work. Homicide was the leading cause of traumatic occupational death among employees in nursing homes and personal care facilities.

A 1989 report (Carmel and Hunter) found that the nursing staff at a psychiatric hospital sustained 16 assaults per 100 employees per year. This rate, which includes any assault-related injuries, compares with 8.3 injuries of **all** types per 100 full-time workers in all industries and 14.2 per 100 full-time workers in the construction industry (BLS, 1991). Of 121 psychiatric hospital workers sustaining 134 injuries, 43 percent involved lost time from work with 13 percent of those injured missing more than 21 days from work.

Of greater concern is the likely underreporting of violence and a persistent perception within the health care industry that assaults are part of the job. Underreporting may reflect a lack of institutional reporting policies, employee beliefs that reporting will not benefit them, or employee fears that employers may deem assaults the result of employee negligence or poor job performance.

Risk Factors

Health care and social service workers face an increased risk of work-related assaults stemming from several factors, including:

- The prevalence of handguns and other weapons—as high as 25 percent[5]—among patients, their families, or friends. The increasing use of hospitals by police and the criminal justice systems for criminal holds and the care of acutely disturbed, violent individuals.
- The increasing number of acute and chronically mentally ill patients now being released from hospitals without followup care, who now have the right to refuse medicine and who can no longer be hospitalized involuntarily unless they pose an immediate threat to themselves or others.
- The availability of drugs or money at hospitals, clinics, and pharmacies, making them likely robbery targets.
- Situational and circumstantial factors such as unrestricted movement of the public in clinics and hospitals; the increasing presence of gang members, drug or alcohol abusers, trauma patients, or distraught family members; long waits in emergency or clinic areas, leading to client frustration over an inability to obtain needed services promptly.

[5] According to a 1989 report (Wasserberger), 25 percent of major trauma patients treated in the emergency room carried weapons. Attacks in emergency rooms in gang-related shootings as well as planned escapes from police custody have been documented in hospitals. A 1991 report (Goetz et al.) also found that 17.3 percent of psychiatric patients searched were carrying weapons.

- Low staffing levels during times of specific increased activity such as meal times, visiting times, and when staff are transporting patients.
- Isolated work with clients during examinations or treatment.
- Solo work, often in remote locations, particularly in high-crime settings, with no back-up or means of obtaining assistance such as communication devices or alarm systems.
- Lack of training of staff in recognizing and managing escalating hostile and assaultive behavior.
- Poorly lighted parking areas.

Overview of Guidelines

In January 1989, OSHA published voluntary, generic safety and health program management guidelines for all employers to use as a foundation for their safety and health programs, which can include a workplace violence prevention program.[6] OSHA's violence prevention guidelines build on the 1989 generic guidelines by identifying common risk factors and describing some feasible solutions. Although not exhaustive, the new workplace violence guidelines include policy recommendations and practical corrective methods to help prevent and mitigate the effects of workplace violence.

The goal is to eliminate or reduce worker exposure to conditions that lead to death or injury from violence by implementing effective security devices and administrative work practices, among other control measures.

The guidelines cover a broad spectrum of workers who provide health care and social services in psychiatric facilities, hospital emergency departments, community mental health clinics, drug abuse treatment clinics, pharmacies, community care facilities, and long-term care facilities. They include physicians, registered nurses, pharmacists, nurse practitioners, physicians' assistants, nurses' aides, therapists, technicians, public health nurses, home health care workers, social/welfare workers, and emergency medical care personnel. Further, the guidelines may be useful in reducing risks for ancillary personnel such as maintenance, dietary, clerical, and security staff employed in the health care and social services industries.

[6] OSHA's *Safety and Health Program Management Guidelines* (*Fed Reg* 54(16):3904- 3916, January 26, 1989), provide for comprehensive safety and health programs containing these major elements. Employers with such programs can include workplace violence prevention efforts in that context.

Violence Prevention Program Elements

There are four main components to any effective safety and health program that also apply to preventing workplace violence, (1) management commitment and employee involvement, (2) worksite analysis, (3) hazard prevention and control, and (4) safety and health training.

Management Commitment and Employee Involvement

Management commitment and employee involvement are complementary and essential elements of an effective safety and health program. To ensure an effective program, management and front-line employees must work together, perhaps through a team or committee approach. If employers opt for this strategy, they must be careful to comply with the applicable provisions of the National Labor Relations Act.[7]

Management commitment, including the endorsement and visible involvement of top management, provides the motivation and resources to deal effectively with workplace violence, and should include the following:

- Demonstrated organizational concern for employee emotional and physical safety and health.
- Equal commitment to worker safety and health and patient/client safety.
- Assigned responsibility for the various aspects of the workplace violence prevention program to ensure that all managers, supervisors, and employees understand their obligations.
- Appropriate allocation of authority and resources to all responsible parties.
- A system of accountability for involved managers, supervisors, and employees.
- A comprehensive program of medical and psychological counseling and debriefing for employees experiencing or witnessing assaults and other violent incidents.
- Commitment to support and implement appropriate recommendations from safety and health committees.

Employee involvement and feedback enable workers to develop and express their own commitment to safety and health and provide useful information to design, implement, and evaluate the program.

[7] Title 29 U.S.C., Section 158(a)(2).

Employee involvement should include the following:

- Understanding and complying with the workplace violence prevention program and other safety and security measures.
- Participation in an employee complaint or suggestion procedure covering safety and security concerns.
- Prompt and accurate reporting of violent incidents.
- Participation on safety and health committees or teams that receive reports of violent incidents or security problems, make facility inspections, and respond with recommendations for corrective strategies.
- Taking part in a continuing education program that covers techniques to recognize escalating agitation, assaultive behavior, or criminal intent, and discusses appropriate responses.

Written Program

A written program for job safety and security, incorporated into the organization's overall safety and health program, offers an effective approach for larger organizations. In smaller establishments, the program need not be written or heavily documented to be satisfactory. What is needed are clear goals and objectives to prevent workplace violence suitable for the size and complexity of the workplace operation and adaptable to specific situations in each establishment.

The prevention program and startup date must be communicated to all employees. At a minimum, workplace violence prevention programs should do the following:

- Create and disseminate a clear policy of zero-tolerance for workplace violence, verbal and nonverbal threats, and related actions. Managers, supervisors, co-workers, clients, patients, and visitors must be advised of this policy.
- Ensure that no reprisals are taken against an employee who reports or experiences workplace violence .[8]
- Encourage employees to promptly report incidents and to suggest ways to reduce or eliminate risks. Require records of incidents to assess risk and to measure progress.
- Outline a comprehensive plan for maintaining security in the workplace, which includes establishing a liaison with law enforcement representatives and others who can help identify ways to prevent and mitigate workplace violence.
- Assign responsibility and authority for the program to individuals or teams with appropriate training and skills. The written plan should ensure that there are adequate resources available for this effort and that the team or responsible individuals develop expertise on workplace violence prevention in health care and social services.
- Affirm management commitment to a worker-supportive environment that places as much importance on employee safety and health as on serving the patient or client.
- Set up a company briefing as part of the initial effort to address such issues as preserving safety, supporting affected employees, and facilitating recovery.

Worksite Analysis

Worksite analysis involves a step-by-step, commonsense look at the workplace to find existing or potential hazards for workplace violence. This entails reviewing specific procedures or operations that contribute to hazards and specific locales where hazards may develop.

A "Threat Assessment Team," "Patient Assault Team," similar task force, or coordinator may assess the vulnerability to workplace violence and determine the appropriate preventive actions to be taken. Implementing the workplace violence prevention program then may be assigned to this group. The team should include representatives from senior management, operations, employee assistance, security, occupational safety and health, legal, and human resources staff.

The team or coordinator can review injury and illness records and workers' compensation claims to identify patterns of assaults that could be prevented by workplace adaptation, procedural changes, or employee training. As the team or coordinator identifies appropriate controls, these should be instituted.

The recommended program for worksite analysis includes, but is not limited to, analyzing and tracking records, monitoring trends and analyzing incidents, screening surveys, and analyzing workplace security.

[8] Section 11 (c)(1) of the OSH Act, which also applies to protected activity involving the hazard of workplace violence as it does for other health and safety matters: "No person shall discharge or in any manner discriminate against any employee because such employee has filed any complaint or instituted or caused to be instituted any proceeding under or related to this Act or has testified or is about to testify in any such proceeding or because of the exercise by such employee on behalf of himself or others of any right afforded by this Act."

Records Analysis and Tracking

This activity should include reviewing medical, safety, workers' compensation and insurance records—including the OSHA 200 log, if required—to pinpoint instances of workplace violence. Scan unit logs and employee and police reports of incidents or near-incidents of assaultive behavior to identify and analyze trends in assaults relative to particular departments, units, job titles, unit activities, work stations, and/or time of day. Tabulate these data to target the frequency and severity of incidents to establish a baseline for measuring improvement.

Monitoring Trends and Analyzing Incidents

Contacting similar local businesses, trade associations, and community and civic groups is one way to learn about their experiences with workplace violence and to help identify trends. Use several years of data, if possible, to trace trends of injuries and incidents of actual or potential workplace violence.

Screening Surveys

One important screening tool is to give employees a questionnaire or survey to get their ideas on the potential for violent incidents and to identify or confirm the need for improved security measures. Detailed baseline screening surveys can help pinpoint tasks that put employees at risk. Periodic surveys—conducted at least annually or whenever operations change or incidents of workplace violence occur—help identify new or previously unnoticed risk factors and deficiencies or failures in work practices, procedures, or controls. Also, the surveys help assess the effects of changes in the work processes (see Appendix A for a sample survey used in the State of Washington). The periodic review process should also include feedback and followup.

Independent reviewers, such as safety and health professionals, law enforcement or security specialists, insurance safety auditors, and other qualified persons may offer advice to strengthen programs. These experts also can provide fresh perspectives to improve a violence prevention program.

Workplace Security Analysis

The team or coordinator should periodically inspect the workplace and evaluate employee tasks to identify hazards, conditions, operations, and situations that could lead to violence.

To find areas requiring further evaluation, the team or coordinator should do the following:

- Analyze incidents, including the characteristics of assailants and victims, an account of what happened before and during the incident, and the relevant details of the situation and its outcome. When possible, obtain police reports and recommendations.
- Identify jobs or locations with the greatest risk of violence as well as processes and procedures that put employees at risk of assault, including how often and when.
- Note high-risk factors such as types of clients or patients (e.g., psychiatric conditions or patients disoriented by drugs, alcohol, or stress); physical risk factors of the building; isolated locations/job activities; lighting problems; lack of phones and other communication devices, areas of easy, unsecured access; and areas with previous security problems. (See sample checklist for assessing hazards in Appendix B.)
- Evaluate the effectiveness of existing security measures, including engineering control measures. Determine if risk factors have been reduced or eliminated, and take appropriate action.

Hazard Prevention and Control

After hazards of violence are identified through the systematic worksite analysis, the next step is to design measures through engineering or administrative and work practices to prevent or control these hazards. If violence does occur, post-incidence response can be an important tool in preventing future incidents.

Engineering Controls and Workplace Adaptation

Engineering controls, for example, remove the hazard from the workplace or create a barrier between the worker and the hazard. There are several measures that can effectively prevent or control workplace hazards, such as those actions presented in the following paragraphs. The selection of any measure, of course, should be based upon the hazards identified in the workplace security analysis of each facility.

- Assess any plans for new construction or physical changes to the facility or workplace to eliminate or reduce security hazards.
- Install and regularly maintain alarm systems and other security devices, panic buttons, hand-held alarms or noise devices, cellular phones, and private channel radios where risk is apparent or may be anticipated, and arrange for a reliable response system when an alarm is triggered.
- Provide metal detectors—installed or hand-held, where appropriate—to identify guns, knives, or other weapons, according to the recommendations of security consultants.

- Use a closed-circuit video recording for high-risk areas on a 24-hour basis. Public safety is a greater concern than privacy in these situations.
- Place curved mirrors at hallway intersections or concealed areas.
- Enclose nurses' stations, and install deep service counters or bullet-resistant, shatter-proof glass in reception areas, triage, admitting, or client service rooms.
- Provide employee "safe rooms" for use during emergencies.
- Establish "time-out" or seclusion areas with high ceilings without grids for patients acting out and establish separate rooms for criminal patients.
- Provide client or patient waiting rooms designed to maximize comfort and minimize stress.
- Ensure that counseling or patient care rooms have two exits.
- Limit access to staff counseling rooms and treatment rooms controlled by using locked doors.
- Arrange furniture to prevent entrapment of staff. In interview rooms or crisis treatment areas, furniture should be minimal, lightweight, without sharp corners or edges, and/or affixed to the floor. Limit the number of pictures, vases, ashtrays, or other items that can be used as weapons.
- Provide lockable and secure bathrooms for staff members separate from patient-client, and visitor facilities.
- Lock all unused doors to limit access, in accordance with local fire codes.
- Install bright, effective lighting indoors and outdoors.
- Replace burned-out lights, broken windows, and locks.
- Keep automobiles, if used in the field, well-maintained. Always lock automobiles.

Administrative and Work Practice Controls

Administrative and work practice controls affect the way jobs or tasks are performed. The following examples illustrate how changes in work practices and administrative procedures can help prevent violent incidents.

- State clearly to patients, clients, and employees that violence is not permitted or tolerated.
- Establish liaison with local police and state prosecutors. Report all incidents of violence. Provide police with physical layouts of facilities to expedite investigations.
- Require employees to report all assaults or threats to a supervisor or manager (e.g., can be confidential interview). Keep log books and reports of such incidents to help in determining any necessary actions to prevent further occurrences.
- Advise and assist employees, if needed, of company procedures for requesting police assistance or filing charges when assaulted.
- Provide management support during emergencies. Respond promptly to all complaints.
- Set up a trained response team to respond to emergencies.
- Use properly trained security officers, when necessary, to deal with aggressive behavior. Follow written security procedures.
- Ensure adequate and properly trained staff for restraining patients or clients.
- Provide sensitive and timely information to persons waiting in line or in waiting rooms. Adopt measures to decrease waiting time.
- Ensure adequate and qualified staff coverage at all times. Times of greatest risk occur during patient transfers, emergency responses, meal times, and at night. Locales with the greatest risk include admission units and crisis or acute care units. Other risks include admission of patients with a history of violent behavior or gang activity.
- Institute a sign-in procedure with passes for visitors, especially in a newborn nursery or pediatric department. Enforce visitor hours and procedures.
- Establish a list of "restricted visitors" for patients with a history of violence. Copies should be available at security checkpoints, nurses' stations, and visitor sign-in areas. Review and revise visitor check systems, when necessary. Limit information given to outsiders on hospitalized victims of violence.
- Supervise the movement of psychiatric clients and patients throughout the facility.
- Control access to facilities other than waiting rooms, particularly drug storage or pharmacy areas.
- Prohibit employees from working alone in emergency areas or walk-in clinics, particularly at night or when assistance is unavailable. Employees should never enter seclusion rooms alone.
- Establish policies and procedures for secured areas, and emergency evacuations, and for monitoring high-risk patients at night (e.g., open versus locked seclusion).
- Ascertain the behavioral history of new and transferred patients to learn about any past violent or assaultive behaviors. Establish a system—such as chart tags, log books, or verbal census reports—to

identify patients and clients with assaultive behavior problems, keeping in mind patient confidentiality and worker safety issues. Update as needed.

- Treat and/or interview aggressive or agitated clients in relatively open areas that still maintain privacy and confidentiality (e.g., rooms with removable partitions).
- Use case management conferences with co-workers and supervisors to discuss ways to effectively treat potentially violent patients.
- Prepare contingency plans to treat clients who are "acting out" or making verbal or physical attacks or threats. Consider using certified employee assistance professionals (CEAPs) or in-house social service or occupational health service staff to help diffuse patient or client anger.
- Transfer assaultive clients to "acute care units," "criminal units," or other more restrictive settings.
- Make sure that nurses and/or physicians are not alone when performing intimate physical examinations of patients.
- Discourage employees from wearing jewelry to help prevent possible strangulation in confrontational situations. Community workers should carry only required identification and money.
- Periodically survey the facility to remove tools or possessions left by visitors or maintenance staff which could be used inappropriately by patients.
- Provide staff with identification badges, preferably without last names, to readily verify employment.
- Discourage employees from carrying keys, pens, or other items that could be used as weapons.
- Provide staff members with security escorts to parking areas in evening or late hours. Parking areas should be highly visible, well-lighted, and safely accessible to the building.
- Use the "buddy system," especially when personal safety may be threatened. Encourage home health care providers, social service workers, and others to avoid threatening situations. Staff should exercise extra care in elevators, stairwells and unfamiliar residences; immediately leave premises if there is a hazardous situation; or request police escort if needed.
- Develop policies and procedures covering home health care providers, such as contracts on how visits will be conducted, the presence of others in the home during the visits, and the refusal to provide services in a clearly hazardous situation.
- Establish a daily work plan for field staff to keep a designated contact person informed about workers' whereabouts throughout the workday. If an employee does not report in, the contact person should followup.
- Conduct a comprehensive post-incident evaluation, including psychological as well as medical treatment, for employees who have been subjected to abusive behavior.

Post-Incident Response

Post-incident response and evaluation are essential to an effective violence prevention program. All workplace violence programs should provide comprehensive treatment for victimized employees and employees who may be traumatized by witnessing a workplace violence incident. Injured staff should receive prompt treatment and psychological evaluation whenever an assault takes place, regardless of severity. (See sample hospital policy in Appendix C). Transportation of the injured to medical care should be provided if care is not available on-site.

Victims of workplace violence suffer a variety of consequences in addition to their actual physical injuries. These include short and long-term psychological trauma, fear of returning to work, changes in relationships with co-workers and family, feelings of incompetence, guilt, powerlessness, and fear of criticism by supervisors or managers. Consequently, a strong followup program for these employees will not only help them to deal with these problems but also to help prepare them to confront or prevent future incidents of violence (Flannery, 1991, 1993; 1995).

There are several types of assistance that can be incorporated into the post-incident response. For example, trauma-crisis counseling, critical incident stress debriefing, or employee assistance programs may be provided to assist victims. Certified employee assistance professionals, psychologists, psychiatrists, clinical nurse specialists, or social workers could provide this counseling, or the employer can refer staff victims to an outside specialist. In addition, an employee counseling service, peer counseling, or support groups may be established.

In any case, counselors must be well trained and have a good understanding of the issues and consequences of assaults and other aggressive, violent behavior. Appropriate and promptly rendered post-incident debriefings and counseling reduce acute psychological trauma and general stress levels among victims and witnesses. In addition, such counseling educates staff about workplace violence and positively influences workplace and organizational cultural norms to reduce trauma associated with future incidents.

Training and Education

Training and education ensure that all staff are aware of potential security hazards and how to protect themselves and their co-workers through established policies and procedures.

All Employees

Every employee should understand the concept of "Universal Precautions for Violence," i.e., that violence should be expected but can be avoided or mitigated through preparation. Staff should be instructed to limit physical interventions in workplace altercations whenever possible, unless there are adequate numbers of staff or emergency response teams and security personnel available. Frequent training also can improve the likelihood of avoiding assault (Carmel and Hunter, 1990).

Employees who may face safety and security hazards should receive formal instruction on the specific hazards associated with the unit or job and facility. This includes information on the types of injuries or problems identified in the facility and the methods to control the specific hazards.

The training program should involve all employees, including supervisors and managers. New and reassigned employees should receive an initial orientation prior to being assigned their job duties. Visiting staff, such as physicians, should receive the same training as permanent staff. Qualified trainers should instruct at the comprehension level appropriate for the staff. Effective training programs should involve role playing, simulations, and drills.

Topics may include Management of Assaultive Behavior; Professional Assault Response Training; police assault avoidance programs, or personal safety training such as awareness, avoidance, and how to prevent assaults. A combination of training may be used depending on the severity of the risk.

Required training should be provided to employees annually. In large institutions, refresher programs may be needed more frequently (monthly or quarterly) to effectively reach and inform all employees.

The training should cover topics such as the following:

- The workplace violence prevention policy.
- Risk factors that cause or contribute to assaults.
- Early recognition of escalating behavior or recognition of warning signs or situations that may lead to assaults.
- Ways of preventing or diffusing volatile situations or aggressive behavior, managing anger, and appropriately using medications as chemical restraints.
- Information on multicultural diversity to develop sensitivity to racial and ethnic issues and differences.
- A standard response action plan for violent situations, including availability of assistance, response to alarm systems, and communication procedures.
- How to deal with hostile persons other than patients and clients, such as relatives and visitors.
- Progressive behavior control methods and safe methods of restraint application or escape.
- The location and operation of safety devices such as alarm systems, along with the required maintenance schedules and procedures.
- Ways to protect oneself and coworkers, including use of the "buddy system."
- Policies and procedures for reporting and recordkeeping.
- Policies and procedures for obtaining medical care, counseling, workers' compensation, or legal assistance after a violent episode or injury.

Supervisors, Managers, and Security Personnel

Supervisors and managers should ensure that employees are not placed in assignments that compromise safety and should encourage employees to report incidents. Employees and supervisors should be trained to behave compassionately towards coworkers when an incident occurs.

They should learn how to reduce security hazards and ensure that employees receive appropriate training. Following training, supervisors and managers should be able to recognize a potentially hazardous situation and to make any necessary changes in the physical plant, patient care treatment program, and staffing policy and procedures to reduce or eliminate the hazards.

Security personnel need specific training from the hospital or clinic, including the psychological components of handling aggressive and abusive clients, types of disorders, and ways to handle aggression and defuse hostile situations.

The training program should also include an evaluation. The content, methods, and frequency of training should be reviewed and evaluated annually by the team or coordinator responsible for implementation. Program evaluation may involve supervisor and/or employee interviews, testing and observing, and/or reviewing reports of behavior of individuals in threatening situations.

Recordkeeping and Evaluation of the Program

Recordkeeping and evaluation of the violence prevention program are necessary to determine overall effectiveness and identify any deficiencies or changes that should be made.

Recordkeeping

Recordkeeping is essential to the success of a workplace violence prevention program. Good records help employers determine the severity of the problem, evaluate methods of hazard control, and identify training needs. Records can be especially useful to large organizations and for members of a business group or trade association who "pool" data. Records of injuries, illnesses, accidents, assaults, hazards, corrective actions, patient histories, and training, among others, can help identify problems and solutions for an effective program.

The following records are important:

- OSHA Log of Injury and Illness (OSHA 200). OSHA regulations require entry on the Injury and Illness Log of any injury that requires more than first aid, is a lost-time injury, requires modified duty, or causes loss of consciousness.[9] (This applies only to establishments required to keep OSHA logs.) Injuries caused by assaults, which are otherwise recordable, also must be entered on the log. A fatality or catastrophe that results in the hospitalization of 3 or more employees must be **reported to OSHA within 8 hours.** This includes those resulting from workplace violence and applies to **all** establishments.
- Medical reports of work injury and supervisors' reports for each recorded assault should be kept. These records should describe the type of assault, i.e., unprovoked sudden attack or patient-to-patient altercation; who was assaulted; and all other circumstances of the incident. The records should include a description of the environment or location, potential or actual cost, lost time, and the nature of injuries sustained.
- Incidents of abuse, verbal attacks or aggressive behavior—which may be threatening to the worker but do not result in injury, such as pushing or shouting and acts of aggression towards other clients—should be recorded, perhaps as part of an assaultive incident report. These reports should be evaluated routinely by the affected department. (See sample incident forms in Appendix D).
- Information on patients with a history of past violence, drug abuse, or criminal activity should be recorded on the patient's chart. All staff who care for a potentially aggressive, abusive, or violent client should be aware of their background and history. Admission of violent clients should be logged to help determine potential risks.
- Minutes of safety meetings, records of hazard analyses, and corrective actions recommended and taken should be documented.
- Records of all training programs, attendees, and qualifications of trainers should be maintained.

Evaluation

As part of their overall program, employers should evaluate their safety and security measures. Top management should review the program regularly, and with each incident, to evaluate program success. Responsible parties (managers, supervisors, and employees) should collectively reevaluate policies and procedures on a regular basis. Deficiencies should be identified and corrective action taken.

An evaluation program should involve the following:

- Establishing a uniform violence reporting system and regular review of reports.
- Reviewing reports and minutes from staff meetings on safety and security issues.
- Analyzing trends and rates in illness/injury or fatalities caused by violence relative to initial or "baseline" rates.
- Measuring improvement based on lowering the frequency and severity of workplace violence.
- Keeping up-to-date records of administrative and work practice changes to prevent workplace violence to evaluate their effectiveness.
- Surveying employees before and after making job or worksite changes or installing security measures or new systems to determine their effectiveness.
- Keeping abreast of new strategies available to deal with violence in the health care and social service fields as these develop.
- Surveying employees who experience hostile situations about the medical treatment they received initially and, again, several weeks afterward, and then several months later.

[9] The Occupational Safety and Health Act and recordkeeping regulations in *Title 29 Code of Federal Regulations (CFR), Part 1904* provide specific recording requirements that comprise the framework of the occupational safety and health recording system (BLS, 1986a). BLS has issued guidelines that provide official Agency interpretations concerning the recordkeeping and reporting of occupational injuries and illnesses (BLS, 1986b).

- Complying with OSHA and state requirements for recording and reporting deaths, injuries, and illnesses.
- Requesting periodic law enforcement or outside consultant review of the worksite for recommendations on improving employee safety.

Management should share workplace violence prevention program evaluation reports with all employees. Any changes in the program should be discussed at regular meetings of the safety committee, union representatives, or other employee groups.

Sources of Assistance

Employers who would like assistance in implementing an appropriate workplace violence prevention program can turn to the OSHA Consultation service provided in their state. Primarily targeted at smaller companies, the consultation service is provided at no charge to the employer and is independent of OSHA's enforcement activity. (See Appendix E.)

OSHA's efforts to assist employers combat workplace violence are complemented by those of NIOSH (1-800-35-NIOSH) and public safety officials, trade associations, unions, insurers, human resource, and employee assistance professionals as well as other interested groups. Employers and employees may contact these groups for additional advice and information.

Conclusion

OSHA recognizes the importance of effective safety and health program management in providing safe and healthful workplaces. In fact, OSHA's consultation services help employers establish and maintain safe and healthful workplaces, and the agency's Voluntary Protection Programs were specifically established to recognize worksites with exemplary safety and health programs. (See Appendix E.) Effective safety and health programs are known to improve both morale and productivity and reduce workers' compensation costs.

OSHA's violence prevention guidelines are an essential component to workplace safety and health programs. OSHA believes that the performance-oriented approach of the guidelines provides employers with flexibility in their efforts to maintain safe and healthful working conditions.

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SOCIAL AND LEGAL ISSUES

Jeff Minzel, JD
Attorney-at-Law
Davis, Wright, Tremaine
Seattle, Washington

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INVOLVING WORKERS IN THE PROCESS

Jamie Cohen
Assistant Director
Health and Safety Department
Service Employees International Union (SEIU)
Washington, D.C.

MOVING AHEAD IN DIFFICULT TIMES

June Fisher, MD
Clinical Associate Professor of Medicine
University of California at San Francisco
San Francisco, California

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