

USE OF INFECTION CONTROL GUIDELINES BY WORKERS IN HEALTHCARE FACILITIES TO PREVENT OCCUPATIONAL TRANSMISSION OF HBV AND HIV

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ABSTRACT

OBJECTIVE: Develop national estimates of compliance with infection control guidelines by workers in healthcare facilities to prevent occupational transmission of hepatitis B virus (HBV) and human immunodeficiency virus.

DESIGN: A national survey of 3,094 workers in hospitals.

SETTINGS: United States ambulatory care hospitals with emergency rooms.

RESULTS: While the sampled hospitals had policies that incorporated the Centers for Disease Control and Prevention's (CDC) infection control guidelines, only 55% of patient care staff, 56% of physicians, and 30% of housekeeping staff reported receiving at least one of the shots recommended in the HBV vaccination series. About one half of patient care staff reported that they recapped used needles at least sometimes after giving injections

and after drawing blood. Only 43% of patient care staff "always" wore gloves to draw blood. While most patient care staff "always" changed gloves between patients, only 61% reported that they "always" washed their hands after taking off their gloves. One half of patient care staff reported a percutaneous exposure to a patient's blood, and one quarter reported a percutaneous exposure in the past year. The most common cause of these exposures was recapping used needles.

CONCLUSIONS: Efforts to reduce exposures to bloodborne pathogens will involve compliance with the Occupational Safety and Health Administration bloodborne pathogens standard and the CDC's infection control guidelines, continued education and training, and emphasis on engineering controls where applicable (*Infect Control Hosp Epidemiol* 1994;15:243-252).

INTRODUCTION

Almost from the beginning of the acquired immu-

nodeficiency syndrome (AIDS) epidemic, the Centers for Disease Control and Prevention (CDC) provided

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guidelines to workers in healthcare facilities to prevent occupational transmission of bloodborne pathogen infection. Guidelines published in 1982 covered bloodborne pathogens such as the hepatitis B virus (HBV) and the human immunodeficiency virus (HIV).¹ In 1987, a joint Advisory notice was issued by the Department of Labor and the Department of Health and Human Services.²

As knowledge about the prevalence and transmission of HIV increased, the guidelines have been expanded and updated.^{3,4} A significant step was the recommendation that, due to the uncertainty involved in identifying HIV and HBV-infected patients, *all* patients and blood samples should be treated as potentially infected and guidelines universally applied. Often referred to as "universal precautions," these guidelines recommend workplace practices to prevent transmission of bloodborne pathogens through 1) vaccination for HBV, 2) care in the use and disposal of needles, without recapping, and sharp instruments (including a recommendation to dispose of used needles into sharps disposal containers), 3) wearing gloves and protective equipment such as masks, gowns, and protective eyewear in situations where healthcare workers might come in contact with blood or bloody body fluids, and 4) changing gloves between patients and washing hands when gloves are changed. The Occupational Health and Safety Administration (OSHA) bloodborne pathogen standard, promulgated in 1992, was based on these guidelines. A proposed standard had been published in 1989 and a compliance assistance guideline for the February 27, 1990 OSHA Instruction CPL2-2.44B "Enforcement procedures for occupational exposures to hepatitis B virus and human immunodeficiency virus" was issued in 1991. The CDC guidelines and the OSHA compliance directive were in place at the time the survey was conducted and the final OSI-IA bloodborne standard went into effect soon afterward.⁵

Strategies for prevention of occupational transmission of bloodborne pathogens have become increasingly important since 1987, when the first documented cases were reported of healthcare workers acquiring HIV infection by contact with a patient's blood.⁶ Case histories were published in the scientific literature on 19 healthcare workers in whom seroconversion was documented, following occupational exposure to HIV. Prospective studies have documented an HIV transmission rate of approximately 0.3% after percutaneous exposure to HIV-infected blood.⁷⁻¹¹ The risk for HIV transmission after mucocutaneous exposure is much lower, although transmission does occur.¹²⁻¹³ The risk of acquiring hepatitis B infection following puncture with a needle contaminated by a hepatitis B carrier ranges from 6% to 30%.¹⁴ Hepatitis B virus is the major

infectious occupational health hazard in the healthcare industry. In 1992, the CDC estimated that 6,800 healthcare workers whose jobs entail exposure to blood become infected with hepatitis each year, and that 250 of them are hospitalized as a result of acute complications. Of the infected workers, approximately 100 will die (from cirrhosis, liver cancer, or fulminant hepatitis).

Prior to this survey, there were no nationally representative data on the extent to which healthcare workers complied with infection control guidelines to prevent occupational transmission of HIV and HBV. However, a number of studies in individual hospital settings indicated that compliance was not as high as desired.¹⁵⁻²⁰ Accordingly, in the summer and fall of 1991, a national survey of workers in healthcare facilities was conducted to determine 1) to what extent the CDC bloodborne pathogen infection control guidelines were being used and 2) what factors influenced their use. Results reported herein will be valuable in evaluating and developing strategies to protect workers occupationally exposed to bloodborne pathogens.

METHODS

In 1991, a multistage, stratified random national survey was conducted of 3,094 healthcare workers in hospitals, emergency rooms, and in-patient services who were involved in direct patient care. Survey data were collected from 2,440 patient care staff (hospital staff engaged in direct patient care activities where there was a potential of exposure to blood or bloody body fluids, including RNs, LPNs, aides, phlebotomists, and medical technologists/technicians), 457 physicians, and 197 housekeeping staff.²¹ In-person interviews with infection control practitioners also were conducted to identify hospital policies related to implementation of CDC guidelines.

Primary sampling units (PSUs) were standard metropolitan statistical areas identified in the sample frame developed for the National Health Interview Survey.²² These PSUs were sorted into two strata: population areas with high AIDS prevalence (i.e., 1989 AIDS prevalence ≥ 20 per 100,000 population) and areas with low AIDS prevalence (1989 AIDS prevalence < 20 per 100,000 population).²³ Three PSUs in high AIDS areas and seven PSUs in low AIDS areas were sampled. PSUs were selected with probability proportionate to size.

Next, between two and five hospitals were sampled with probability proportionate to size from within each PSU. Hospitals selected for the sample were limited to short-stay general care hospitals with emergency departments and 200 or more employees. The final sample consisted of 34 hospitals (12 hospitals from the high AIDS stratum and 22 hospitals from the

low AIDS stratum). This represented 64% of eligible hospitals selected for the survey. Hospitals that refused to participate or were subsequently found to be ineligible were replaced by the hospital from the same PSU that most closely matched the primary hospital in size and, if possible, in type of ownership. Analyses indicated that there were no significant differences in terms of size or ownership characteristics between participating and nonparticipating hospitals or between nonparticipating hospitals and replacement hospitals.

The survey took place in the summer and fall of 1991. At the time of the survey, 10 of the 34 sampled hospitals had adopted universal precautions, which covered blood and specific body fluids, while 21 of the sampled hospitals had adopted "body substance precautions," which additionally covered urine and feces. The remaining three sampled hospitals had a combined policy which, as analysis of policy descriptions indicated, was quite similar to universal precautions. All sampled hospitals offered free vaccination for hepatitis B to their employees.

Finally, a simple random sample of workers was selected from each hospital. This sample included only staff involved in direct patient contact or exposure, including physicians, nurses, aides, orderlies, laboratory technologists/technicians, etc., and housekeeping and laundry personnel. Administrative, clerical, records, social service, pharmacy, and other staff with low exposure potential were excluded. Workers were surveyed using a self-administered instrument that was mailed back in a sealed envelop to a data collection firm. Two weeks after the initial distribution, a follow-up survey was distributed, and 2 weeks later, a second follow-up mailing (using a shortened version of the survey instrument) was sent.

In questions about the nature of percutaneous exposures, respondents were allowed multiple categories. Percentages are then based on the number of respondents who gave a particular response divided by the number of all respondents who provided at least one answer in the series of potential responses. Among physicians, the rate of percutaneous exposures in the past year was assessed by asking, "How many times during the past 12 months have you accidentally stuck yourself or been stuck by a needle or other sharp instrument that was in contact with a patient's blood so that you broke your skin?" Percutaneous exposures among housekeeping staff were operationally defined by an affirmative response to the question, "Have you ever been stuck by accident on the job with a used needle or other sharp instrument so that you broke your skin or drew blood?"

Survey Topics

This survey focused on the three components of

the CDC guidelines most immediately affected by control practices that have to be implemented by individual workers, specifically 1) vaccination for HBV, 2) care in use and disposal of needles and sharps (e.g., not recapping disposable syringes/needles, and disposal of syringes/needles and other sharps in sharps containers), and 3) barrier precautions (e.g., use of gloves, washing hands between patient contacts, and use of protective gowns, face masks, and eyewear.) In addition, data were collected on the frequency and nature of percutaneous exposures, knowledge and attitudes regarding HIV/AIDS and HBV, and training in infection control practices.

Accuracy of Self-Report Information

Impact of Nonresponse. To determine the potential effects of nonresponse on study findings, two special sets of analyses were conducted. One analysis compared early respondents to later respondents in the national survey. This analysis was based on the rationale that individuals who responded only in a second follow-up (designated as later respondents) might be more similar to nonrespondents than those who participated at the initial request (designated as early respondents). No major differences between earlier and later respondents were identified.

The other analysis evaluated pilot survey data from an Eastern teaching hospital where, after two requests to participate in a survey, nonrespondents were offered an incentive to complete the survey.²⁴ Individuals who responded only after being offered an incentive were similar in their compliance practices to individuals who responded to the survey initially.

RESULTS

Of an initial sample of 4,417 workers, responses were received from 3,094 (70%), including 2,439 (73%) of 3,326 patient care staff, 456 (57%) of 806 physicians, and 198 (70%) of 285 housekeepers.

Vaccination for Hepatitis B

Despite the fact that all sampled hospitals offered free HBV vaccination to their staff (>80% of staff surveyed indicated awareness of these policies), only a little more than one half of patient care staff (55%) and physicians (57%) received at least one shot for hepatitis B (Table 1). A little less than one half of patient care staff (42%) and physicians (45%) completed the series of three shots, and therefore might be considered to be immunized for hepatitis B. Only 30% of housekeeping staff received at least one shot, and only 13% of housekeeping staff received all three hepatitis B shots.

Compared to those who were not vaccinated, patient care staff who received at least one of the shots

TABLE 1

NATIONAL ESTIMATES OF HEPATITIS B VACCINATION AND IMMUNIZATION AMONG HEALTHCARE FACILITY WORKERS (1991)

Hepatitis B Vaccination	N	%	CI ₉₅
Patient care staff	2,406		
Vaccinated for hepatitis B		55	(50, 60)
Received all three hepatitis B shots		42	(38, 46)
Physicians	454		
Vaccinated for hepatitis B		57	(48, 65)
Received all three hepatitis B shots		45	(36, 54)
Housekeeping staff	192		
Vaccinated for hepatitis B		30	(20, 40)
Received all three hepatitis B shots		14	(9, 19)

Note: This table shows the sample size (N), national estimate (%), and 95% confidence interval (CI₉₅) incorporating survey design effects around each national estimate.

for hepatitis B were significantly more likely to agree that hepatitis B was a risk for hospital staff (97% versus 89%), a concern for staff in their hospital (94% versus 87%), and a concern for themselves (80% versus 71%). Patient care staff who had not been vaccinated were significantly more likely to believe that the hepatitis B vaccine could make people sick (30% versus 20%).

Care in Use and Disposal of Needles and Sharp Instruments

Sharps Disposal. The greatest success of infection control guidelines appears to be in use of sharps disposal containers (as shown in Table 2 for patient care staff and Table 3 for physicians). Most patient care staff (96%) reported that they "always" used sharps disposal containers. But, 38% of patient care staff indicated that sharps containers had been full "sometimes" or "often" in the last month. Six percent of percutaneous exposures occurred when a worker was stuck by a needle or sharp object that was sticking out of a disposal container.

Recapping. Recapping, however, continued to be a problem. More than one-half (55%) of patient care staff recapped (at least sometimes) after giving injections, and nearly one-half (45%) recapped (at least sometimes) after drawing blood. When used needles were recapped, this was most frequently done using both hands (64% of these instances), i.e., the needle was held in one hand and the other hand was used to guide the needle into the cap. Recapping used needles was more common among physicians (as shown in Table 3). Only 25% of physicians "never" recapped a syringe after giving an injection, and only 35% of physicians "never" recapped needles after drawing blood. One quarter (25%) of the percutaneous expo-

sure of patient care staff occurred during recapping.

Although recapping remains a problem, the earlier practice of bending or breaking a used needle has been largely eliminated from the workplace. Only 8% of patient care staff indicated that they clipped off or broke off a needle after they had given an injection.

Barrier Precautions

Glove Use. Glove use varied by procedure. As shown in Table 2, 43% of patient care staff "always" used gloves to draw blood, but only 32% of patient care staff "always" used gloves to start or disconnect an IV line. Only 60% of housekeeping staff "always" wore gloves to clean up a patient's room.

Changing Gloves. There was a high degree of compliance with this recommendation; 88% of patient care staff "always" changed their gloves between patients (as shown in Table 4). However, only about two thirds (65%) of housekeeping staff "always" changed their gloves before going to another patient's room.

Handwashing. Handwashing was less well practiced (as shown in Table 4); only 62% of patient care staff and 54% of physicians reported that they "always" washed their hands after taking off gloves that were clean. By comparison, 82% of housekeeping staff reported that they "always" washed their hands after taking off their gloves.

Use of Masks, Gowns, and Protective Eyewear. Patient care staff often did not use gowns, masks, or protective eyewear in situations where blood or other bloody body fluids could splash or spray. Less than one quarter (24%) of patient care staff "always" used gowns, less than one fifth (19%) "always" used masks, and only one tenth (10%) "always" used protective eyewear, even though 10% of patient care staff reported being splashed with blood or bloody body fluids in the face or eyes at least once in the past month.

Percutaneous Exposures

Percutaneous Exposures of Patient Care Staff

Despite hospital adoption of recommended guidelines, percutaneous exposures continued to pose risks for workers. The incidence of percutaneous exposures was assessed by asking patient care staff, "Have you ever accidentally stuck yourself or been stuck on the job by a needle or other sharp that was in contact with a patient's blood so that you broke your skin?" More than one half (52%) of patient care staff reported at least one percutaneous exposure. Almost one quarter (24%) had experienced such an exposure within the past year (as shown in Table 5).

Patient care staff were asked to describe the details of the most recent incident resulting in a percutaneous exposure. More than three quarters

TABLE 2

NATIONAL ESTIMATES OF GLOVE USE, RECAPPING, AND USE OF SHARPS DISPOSAL CONTAINERS BY PATIENT CARE STAFF (1991)

Precaution	N	Never (0%)		Seldom/Very Seldom (10% to 20%)		Some of the time/Often* (30% to 70%)		Most of the Time/Almost Always (80% to 90%)		Always (100%)	
		%	CI ₉₅	%	CI ₉₅	%	CI ₉₅	%	CI ₉₅	%	CI ₉₅
Glove use											
Wear gloves to draw blood	1,680	7	(4, 10)	11	(9, 14)	18	(15, 21)	21	(17, 24)	43	(39, 47)
Wear gloves for IV	1,681	9	(7, 12)	14	(12, 17)	24	(21, 28)	20	(17, 23)	32	(27, 37)
Recapping											
Recap after injection	1,739	45	(41, 49)	23	(20, 26)	18	(15, 21)	8	(6, 11)	5	(4, 7)
Recap after drawing blood	1,680	55	(50, 61)	17	(12, 22)	10	(6, 14)	9	(5, 12)	9	(6, 12)
Recap after IV	1,681	64	(61, 67)	14	(12, 17)	11	(8, 13)	7	(5, 8)	5	(4, 6)
Disposal											
Use disposal box	1,739	0	(0, 1)	0	(0, 1)	1	(1, 2)	2	(1, 3)	96	(94, 97)

*Includes less than half the time, about half the time, and more than half the time.

TABLE 3

NATIONAL ESTIMATES OF GLOVE USE, RECAPPING, AND USE OF SHARPS DISPOSAL CONTAINERS BY PHYSICIANS (1991)

Precaution	N	Never (0%)		Seldom/Very Seldom (10% to 20%)		Some of the time/Often* (30% to 70%)		Most of the Time/Almost Always (80% to 90%)		Always (100%)	
		%	CI ₉₅	%	CI ₉₅	%	CI ₉₅	%	CI ₉₅	%	CI ₉₅
Glove use											
Wear gloves to draw blood	281	23	(13, 32)	7	(2, 12)	17	(9, 24)	16	(9, 23)	38	(26, 50)
Wear gloves for IV	268	8	(2, 13)	10	(4, 15)	23	(15, 31)	17	(10, 24)	42	(32, 52)
Recapping											
Recap after injection	282	25	(20, 31)	17	(11, 25)	20	(13, 27)	16	(9, 23)	21	(14, 29)
Recap after drawing blood	281	35	(29, 41)	18	(13, 23)	14	(10, 19)	13	(8, 17)	21	(13, 28)
Recap after IV	268	41	(33, 50)	19	(11, 27)	17	(9, 25)	13	(6, 20)	10	(4, 16)
Disposal											
Use disposal box	455	4	(2, 6)	4	(1, 7)	11	(7, 16)	8	(3, 10)	75	(69, 80)

*Includes less than half the time, about half the time, and more than half the time.

(77%) of these exposures were caused by a needle. About one third (32%) of the time, patient care staff reported wearing gloves when the incident happened. About two thirds (68%) of the incidents were reported to hospital infection control staff or other designated personnel.

Percutaneous exposures most frequently occurred when patient care staff stuck themselves when recapping a used needle (25%). A number of percutaneous exposures were disposal related; 8% of

percutaneous exposures occurred when a worker was stuck by another person, and 6% resulted from a needle in trash or bed linen. About 7% of percutaneous exposures occurred while performing a procedure. Patient care staff (56%) reported that they "sometimes" or "often" needed to set aside a needle prior to final disposal to complete a procedure. Finally, 6% of percutaneous exposures resulted from a needle sticking out of a disposal container. In response to another question, 38% of patient care staff indicated that sharps

TABLE 4
NATIONAL ESTIMATES OF CHANGING GLOVES AND HANDWASHING BY HEALTHCARE WORKERS (199 1)

		Never (0%)		Seldom/Very Seldom (10% to 20%)		Some of the time/Often* (30% to 70%)		Most of the Time/ Almost Always (80% to 90%)		Always (100%)	
Precaution	N	%	CI ₉₅	%	CI ₉₅	%	CI ₉₅	%	CI ₉₅	%	CI ₉₅
Changing gloves (change gloves before going to another patient or to another patient's room)											
Patient care staff	2,257	2	(1, 3)	1	(0, 1)	2	(1, 3)	7	(5, 8)	88	(86, 90)
Physicians	406	4	(2, 6)	1	(0, 2)	2	(1, 3)	3	(1, 4)	91	(88, 94)
Housekeeping staff	186	5	(1, 10)	5	(0, 10)	19	(9, 30)	6	(0, 12)	65	(51, 78)
Handwashing (wash hands after taking off gloves when gloves were clean)											
Patient care staff	2,359	2	(1, 2)	2	(1, 3)	9	(7, 10)	26	(24, 29)	61	(57, 65)
Physicians	418	4	(2, 6)	5	(3, 7)	14	(10, 17)	24	(20, 28)	54	(45, 62)
Housekeeping staff	195	2	(0, 4)	1	(0, 2)	4	(1, 6)	12	(7, 17)	82	(77, 87)
Handwashing (wash hands after examining or treating a patient without gloves)											
Patient care staff	2,244	2	(1, 3)	1	(1, 2)	6	(5, 8)	24	(21, 26)	67	(64, 70)
Physicians	406	3	(1, 4)	4	(2, 6)	16	(12, 20)	31	(26, 36)	47	(41, 53)

*Includes less than half the time, about half the time, and more than half the time.

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disposal containers "sometimes" or "often" were full.

Percutaneous Exposures of Physicians. One third (34%) of physicians reported experiencing a percutaneous exposure in the past 12 months, and 17% reported two or more such exposures in the past 12 months (Table 6). Only one fifth (20%) of physicians who were injured reported the incident. Almost three quarters of the incidents involved a needle or syringe (73%), and in almost three quarters (74%) of these incidents, the physicians were wearing gloves. Percutaneous exposures most frequently occurred during operation on (23%) or suturing of (21%) a patient. About one fifth (20%) of incidents happened during recapping of a used needle.

Percutaneous Exposures of Housekeeping Staff. As shown in Table 7, 39% of housekeeping staff had experienced a percutaneous exposure, though in many of those incidents, workers could not be certain whether the object had come in contact with a patient's blood. Almost one fifth (18%) of housekeeping staff reported experiencing such an incident during the past 12 months. These incidents most often were caused by a used needle or syringe (43%), though other sharp objects (16%) and broken glass (13%) also were mentioned as causes. Most (81%) of these incidents were reported. The percutaneous exposures of housekeeping staff most frequently resulted from their being stuck by a needle in trash (41%). Around one fifth (23%) of incidents involved cleaning up sharps and glass. About 5% of incidents occurred because a needle stuck out of a disposal container.

Dermal Exposure to Blood. The survey also con-

tained questions about the frequency of dermal exposure to blood and bloody body fluids. Most patient care staff (64%) and physicians (59%) reported that they had gotten blood or bloody body fluid on their bare hands at least once in the past month. About 6% of housekeeping staff reported that they had gotten blood on their bare hands during the past week. A substantial number of patient care staff (44%) and physicians (40%) reported that they had gotten blood on their clothes at least once in the past month. One tenth (10%) of patient care staff and almost one fifth (19%) of physicians had gotten blood or bloody fluids in their face, mouth, or eyes at least once during the past month. Among patient care staff, getting blood or bloody fluids on the face, or in the mouth or eyes most commonly occurred during a surgical procedure (21%), or while suctioning a patient (19%).

Training and Compliance

Most workers received on-the-job training in infection control precautions; 89% of patient care staff reported attending at least one training session in infection control precautions and more than one half (51%) reported attending three or more sessions. Almost one half of patient care staff (46%) reported attending training sessions within the past six months. In addition to training, 71% of patient care staff (and 79% of housekeeping staff) recalled seeing posters in the hospital reminding them to follow infection control precautions. Somewhat less than one half (45%) of patient care staff reported that compliance with infection control precautions was included in their performance review.

TABLE 5**NATIONAL ESTIMATES OF PERCUTANEOUS EXPOSURES OF PATIENT CARE STAFF (1991)**

Situation	N	%	CI ₉₅
Number of percutaneous exposures	2,410		
Ever		52 (49, 55)	
Once or more in last year		24 (23, 25)	
Two or more times in last year		7 (5, 8)	
Type of instrument (needle or syringe)	956	77 (74, 80)	
Wearing gloves when happened	1,115	32 (29, 35)	
Reported incident	1,115	68 (65, 71)	
Location of incident	1,113		
Hospital ward/patient's room		3 8 (36, 40)	
Intensive care unit		14 (12, 16)	
Operating room/delivery room		10 (9, 12)	
Emergency room/trauma care		7 (5, 9)	
Laboratory		5 (4, 6)	
Other		16 (13, 18)	
How the last incident happened	1,113		
Recapping needle		25 (21, 29)	
Giving an injection		14 (11, 17)	
Drawing blood		14 (12, 15)	
Carrying to disposal container		9 (7, 11)	
Disconnecting IV or peripheral line		8 (6, 10)	
Stuck by another person		8 (6, 9)	
Needle had been set down while completing a procedure		7 (6, 8)	
Inserting IV or peripheral line		6 (5, 8)	
Needle sticking out from disposal container		6 (4, 8)	
Needle in trash or bed linen		6 (4, 7)	
Backed into IV pole needle		2 (1, 4)	
Suturing a patient		0.8 (0.3, 1)	
Other		24 (21, 26)	

N = Number responding to question.

Note: Among patient care staff, percutaneous exposures were operationally defined as an affirmative response to the question, "Have you ever accidentally stuck yourself or been stuck on the job by a needle or other sharp instrument that was in contact with a patient's blood so that you broke your skin?"

Training and Vaccination for Hepatitis B. Logistic regression analysis, controlling for specific duties—notably the frequency with which patient care staff drew blood—indicated a significant association between training and the prevalence of vaccination for hepatitis B (odds ratio for vaccination of patient care staff, 1.37; Wald F statistic = 5.6, $P < 0.04$).

Training and Handwashing. There also was a significant association between training and the likelihood that patient care staff "always" washed their hands after they took off their gloves. Having controlled for frequency of drawing blood (patient care staff who more frequently drew blood were less apt to wash their hands), handwashing was related to two

TABLE 6**NATIONAL ESTIMATES OF PERCUTANEOUS EXPOSURES OF PHYSICIANS (1991)**

Situation	N	%	CI ₉₅
Number of percutaneous exposures	453		
Once or more in the last year		34 (29, 38)	
Two or more times in last year		17 (13, 20)	
Type of instrument (needle or syringe)	157	73 (64, 83)	
Wearing gloves when happened	157	74 (66, 82)	
Reported incident	157	20 (14, 27)	
Location of Incident	157		
Operating room/delivery room		47 (38, 57)	
Hospital ward/patient's room		8 (2, 15)	
Emergency room/trauma care		8 (4, 11)	
Laboratory		8 (4, 11)	
Intensive care unit		4 (0, 9)	
Other		23 (17, 29)	
How the last incident happened	157		
Operating on a patient		23 (17, 29)	
Suturing a patient		21 (13, 29)	
Recapping needle		20 (15, 26)	
Drawing blood		12 (6, 17)	
Stuck by another person		11 (3, 18)	
Giving an injection		10 (3, 16)	
Carrying needle/sharp object to disposal container		9 (7, 11)	
Needle had been set down while completing a procedure		6 (2, 10)	
Inserting IV or peripheral line		5 (1, 9)	
Needle in trash or bed linen		2 (0, 5)	
Other		18 (8, 27)	

N = Number responding to question.

Note: Among physicians, percutaneous exposures were operationally defined by responses to the question, "How many times during the past 12 months have you accidentally stuck yourself or been stuck on the job by a needle or other sharp instrument that was in contact with a patient's blood so that you broke your skin?"

other factors: 1) training in infection control precautions—patient care staff who had participated in one or more training sessions were more likely than staff who had not been trained to report that they "always" washed their hands after taking off their gloves (odds ratio, 1.21; Wald F statistic = 3.9; P two-tailed < 0.08), and 2) inclusion of compliance with precautions in performance reviews—patient care staff who reported that compliance with precautions was included in performance reviews were more likely to report that they "always" washed their hands after they took off their gloves (odds ratio, 1.41; Wald F statistic = 6.3; $P < 0.04$).

Willingness to Treat AIDS Patients. Controlling for employee background variables (ie, frequency of drawing blood and years working in healthcare), there was a significant association between receipt of

TABLE 7
NATIONAL ESTIMATES OF DERMAL AND PERCUTANEOUS
EXPOSURES OF HOUSEKEEPING STAFF (199 1)

Situation	N	%	CI ₉₅
Blood on clothes	188		
Never in past week		93	(87, 98)
Once or more in past week		8	(2, 13)
Blood or bloodstained things on bare hands	198		
Never in past week		95	(90, 99)
Once or more in past week		6	(1, 10)
Number of percutaneous exposures*			
Ever	196	39	(30, 49)
One or more in last year	196	18	(14, 23)
Two or more times in last year	198	4	(3, 5)
Type of instrument	77		
Needle or syringe		43	(32, 53)
Sharp object		16	(10, 21)
Glass		13	(6, 20)
Don't know		17	(9, 24)
Reported incident	77	81	(71, 90)
Location of incident	77		
Hospital ward/patient's room		26	(15, 37)
Emergency room/ICU/OR		18	(9, 27)
Waste disposal area		13	(4, 22)
How the last incident happened	77		
Stuck by needle in trash		41	(30, 51)
Cleaning up sharps and glass		23	(13, 32)
Needle stuck out of the disposal box		5	(0, 12)
Stuck by someone else		3	(0, 8)
Other		22	(16, 28)

N = Number responding to question.

* Stuck by accident on the job with a used needle or other sharp instrument so that you broke your skin or drew blood?

training in infection control precautions and willingness to treat AIDS patients (odds ratio, 1.95; Wald F statistic = 16.5; $P < 0.01$). Staff who frequently drew blood were more willing to treat AIDS patients (odds ratio, 1.18; Wald F statistic = 4.3; $P < 0.07$). Staff who had worked longer in the health field were significantly less willing to treat AIDS patients (odds ratio, 0.97; Wald F statistic = 7.3; $P < 0.02$). Patient care staff who reported training in infection control procedures were significantly less likely to agree that they would refuse to treat an AIDS patient if they had the choice (24% versus 38%).

DISCUSSION

Study Caveats

In interpreting these findings, it is important to keep in mind several caveats.

Sample Size Constraints. Even though the survey

covered a large number of respondents (3,094), these respondents were clustered within a relatively small number of primary sampling units ($n = 10$) and hospitals ($n = 34$), so the precision of national estimates of patient care staff is typically in the range of $\pm 4\%$ to 5% , and precision of estimates of physicians, housekeeping staff, and subgroups of patient care staff is typically in the range of $\pm 5\%$ to 8% .

Response Rate. The response rate among patient care staff (70%) for this survey is respectable, given the constraints that concerns about confidentiality placed on the survey-takers' ability to follow up nonrespondents. At the same time, the accuracy of national estimates rests on the assumption that hospitals and individuals who responded to the survey were similar to those who did not. Participating hospitals were similar in size and ownership to nonparticipating hospitals, and the replacement hospitals were selected from the same communities and were similar in size and characteristics to hospitals that did not participate.

There is some evidence to suggest that workers who completed the survey were similar to those who did not. In this survey, patient care staff who responded only to a second mail follow-up were similar in their work practices to staff who responded earlier. Similarly, a pilot study in a teaching hospital that offered a special incentive to nonrespondents to complete the survey found no significant differences in the background or workplace practices of initial respondents compared to healthcare workers who responded only after being offered an incentive to participate.²⁴

Self-Reported Information. A final caveat is that the survey was based on self-reported information, and it is possible that workers may tend to report a higher level of compliance than is actually the case. Hence, it may be prudent to interpret the estimates in this national survey as "best case" estimates of compliance.

Despite these caveats, however, this survey provides the first national estimates of levels of compliance of healthcare workers with CDC infection control guidelines, and as discussed below, it provides information that may be used to improve workplace safety.

Validity. The validity of self-reported information was investigated in two studies of emergency department personnel in one urban and two suburban hospitals in the Midwest. One study compared self-reported information by 67 emergency department staff, the questions used in the national survey with observations of 1,018 patient-healthcare worker interactions.²⁵⁻²⁶ A subsequent study in two suburban hospitals compared self-reported information from 103 healthcare workers and observations of 1,822 patient-healthcare worker interactions.²⁷⁻²⁸ The stud-

APPENDIX

The following includes information and sample questions from the survey instruments. There were 4 different survey instruments. Copies of the complete instruments can be obtained from the author by written request.

IV Lines

B10. Over the last week that you worked (or last 5 days of work), how frequently, on average, did you start an IV or peripheral line? [31]

[0] Never [please go to Question B13 on the next page.]

[1] 1 to 2 times a month

[2] 3 to 4 times a week

[3] 1 to 2 times a day

[4] 3 to 4 times a day

[5] 5 to 7 times a day

[6] Once an hour

[7] 2 to 3 times an hour (once every half hour)

[8] 4 or more times an hour (once every 15 minutes)

B11. During the last week, how often did you wear gloves when you were starting an IV or peripheral line on a patient?

Very			Some of	Less	About	Half	More	Most of the	Almost	Always	
Never	Seldom	Seldom	the time	than	the time	Half	than	time	Always		
0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%	[32-33]

B12. Last week, how often did you recap (resheath) the needle after you started an IV or peripheral line?

Very			Some of	Less	About	Half	More	Most of the	Almost	Always	
Never	Seldom	Seldom	the time	than	the time	Half	than	time	Always		
0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%	[32-33]

ies found a reasonable degree of consistency between aggregate levels of self-reported and observed levels of compliance with universal precaution guidelines in the areas most related to percutaneous exposures.

Self-reported data on glove use and recapping rates after giving injections, after phlebotomy, and after starting an intravenous line (IV) were within 10 percentage points of observed rates of these practices. Self-reported data varied, ranging from 8% to 40% higher than observed rates for use of gowns, masks, and protective goggles. However, self-reported rates of compliance with handwashing recommendations were three times higher than observed rates. Handwashing was one of the practices that a validation study in an emergency room indicated self-reported rates of compliance had considerably higher than observed rates. Hence, it is likely the self-reported compliance in this survey represents a "best case" estimate of handwashing.

Strategies for Increasing Compliance

These findings suggest that efforts to encourage the compliance of workers in healthcare facilities with guidelines and regulations are likely to entail a comprehensive strategy that includes policy training, initial and continued, and equipment availability and

design. Implementation and enforcement of the OSHA standard are important since an implication of this study is that hospital policies are not, in themselves, sufficient to result in healthcare worker compliance. These policies must be actively communicated and employee compliance ensured.

The analyses in the survey data study identified an association between compliance and a number of administrative practices such as reminder posters and inclusion of compliance with infection control precautions in staff performance reviews. Individual infection control practitioners also described other actions that appeared to encourage acceptance of vaccine for hepatitis B, such as having healthcare workers sign a release form if they declined to accept the hepatitis B vaccine (newly required in the OSHA bloodborne pathogen standard), providing the hepatitis B vaccine in conjunction with the annual tuberculosis check-up, and offering vaccination from a "rolling-cart" that visited healthcare workers in their work units. These associations may be reflective of employer emphasis on infection control and safety, which translated into worker adoption of safety practices and a willingness to treat AIDS patients.

Finally, efforts to decrease percutaneous injuries must focus on equipment and its placement, use, and

availability. It will be important to examine ways to redesign equipment and work practices to reduce these injuries. It will also be important to address issues of equipment availability, strategic location of sharps disposal containers, and efforts to ensure that sharps disposal containers are emptied regularly.

Compliance with current regulations and development and implementation of new strategies will continue to be important in the prevention of occupational transmission of bloodborne pathogens.

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