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AN EVALUATION OF BIOAEROSOL PARTICULATE IN ELEMENTARY SCHOOL CLASSROOMS. K.H. Bartlett, S.M. Kennedy, M. Brauer, B. Dill, C. vanNetten, University of British Columbia, Vancouver, B.C., Canada

Public concern about biologic contamination of indoor air and the perception of the impact of indoor air on personal health have been increasing. To examine the spectrum of potential exposures to bioaerosols and possible determinants of exposure, a 2-year study of elementary school classrooms was begun in 1996. All 39 schools from one British Columbian school district were enrolled to ensure different building ages and construction materials, but the same maintenance protocols. Schools were randomly assigned to a winter, spring, or fall sampling period. Three rooms were studied at each school. Data collected included number of occupants and patterns of occupancy, CO_2 levels, temperature and percent relative humidity (%RH), total particulate, and air exchange rates using tracer gas (SF_6) and CO_2 decay. Indoor and outdoor bioaerosols were collected using an Andersen N-6 impactor onto media formulated for the culture of fungi or bacteria. Bacteria and fungi were identified using standard microbiological techniques using differential stains and/or phase contrast microscopy.

Indoor levels of bacteria were, on average, an order of magnitude higher than outside levels (geometric mean 214 vs. 19 CFU/m^3, $p<0.001$) and were all gram-positive organisms. Indoor fungal counts ranged from 32 to 2495 CFU/m^3. There was a trend for winter indoor fungal levels to be lower (geometric mean 189 CFU/m^3) than either spring (g.m. 296 CFU/m^3) or fall (g.m. 393 CFU/m^3) ($p<0.02$) in parallel with lower interior %RH ($p<0.002$). In the fall sampling there were significantly higher counts of xerophilic fungi (g.m. 122 CFU/m^3) ($p<0.002$). Some of the potentially allergenic fungal genera isolated indoors included *Aspergillus fumigatus, A. niger, Aureobasidium, Botrytis, Cladosporium, Eurotium, Penicillium, Paecilomyces, Rhizopus,* and *Trichoderma*. Control of exposures to indoor fungi was related to the air handling system of the school.

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REMOVAL OF 60 TONS OF MANURE FROM A BUILDING: PROTECTING WORKERS AT RISK. S.W. Lenhart, M. Schafer, NIOSH, Cincinnati, OH

An accumulation of pigeon manure was removed from the twelfth floor of a prison's administration building before removal of an empty 150,000-gallon water tank and the building's demolition. Sixty tons of manure were removed using a long, flexible hose connected to a trailer-mounted, industrial vacuum system. Removal workers wore full-facepiece, powered air-purifying respirators and disposable coveralls, gloves, and shoe coverings.

Twelve manure samples were collected outside the water tank, 8 were collected inside the tank, and 5 soil samples were collected near the building's foundation. Using standard fungal culturing methods, each sample was analyzed for three potentially infectious microorganisms: *Blastomyces dermatitidis, Cryptococcus neoformans,* and *Histoplasma capsulatum*. A handheld aerosol monitor was used to measure air concentrations of dust aerosolized during manure removal. Air sampling was also conducted near the vacuum equipment and waste hopper and in a parking lot to estimate background dust concentrations.

C. neoformans was recovered from 4 of 12 manure samples collected outside the water tank and from 7 of 8 samples collected inside the tank. No sample was found to contain *H. capsulatum* or *B. dermatitidis*. During most removal activities, airborne dust concentrations ranged from 0.8 to 1.5 mg/m^3. Airborne dust increased to 3.0 mg/m^3 during dry shoveling, and to greater than 20 mg/m^3 during a brief period of dry sweeping. Airborne dust concentrations near the waste hopper and in the parking lot were 0.03 mg/m^3.

C. neoformans causes cryptococcosis and is often found in bird manure accumulations. Formerly a rare infectious disease, the incidence of cryptococcosis has increased because of its frequent occurrence among HIV-infected persons. Recovery of *C. neoformans* from manure samples and dusty working conditions suggested that the exposure precautions taken by removal workers were necessary.

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SUSTAINING A LATEX CONTROL PROGRAM IN A LARGE BIOMEDICAL FACILITY. J.F. McCarthy, B. Weeks, N. Moss, Environmental Health & Engineering, Inc., Newton, MA

This presentation examines the challenges in maintaining an effective latex control program in a large biomedical facility. The identification of appropriate nonlatex substitutes and low-allergen containing gloves is a key initiative in establishing a successful latex control program. Often, the substitutes or low allergen alternatives represent a significant increase in expenditures. Conflicting priorities (cost containment and providing a low-risk environment) can encroach upon EH&S program goals.

As the health care industry forms new networks and affiliate markets it is critical for the industrial hygienist to be an integral part of the procurement and product review process. Experience with supply problems of approved products dictates the necessity for maintaining good communication with vendors/manufacturers while specifying product needs. External pressures to continue to identify new alternatives, introduction of new materials/kits, and cost control initiatives dictate the need to maintain an aggressive program. Therefore, latex control programs must involve the continued testing of all new products prior to being introduced into the facility and periodic testing of products already in use.

Establishing latex-free crash carts for medical procedures and latex-safe kit tote for patients' personal use are instrumental in preventing further sensitizations to latex and protecting currently sensitized individuals.

The industrial hygienist has several metrics for evaluating the program effectiveness. Air monitoring, wipe samples for residual allergen proteins, and reduction of number of cases are a few parameters that can be utilized. Latex control program involves the continued initiative and education of staff, vendors, and purchasing departments.

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NITRIC OXIDE AND NITROGEN DIOXIDE EXPOSURE MODELING FOR HEALTH CARE WORKERS INVOLVED IN NITRIC OXIDE TREATMENT. J. Tomey, T.A. Hall, M.L. Phillips, C. Brown, K. Sekar, A. Cersian, M. McCoy, University of Oklahoma College of Public Health, Oklahoma City, OK

Recent biomedical research has demonstrated that nitric oxide (NO) is an important biological mediator of pulmonary vasodilation. NO is currently undergoing clinical trials for use in the treatment of persistent pulmonary hypertension in infants.

NO is familiar to industrial hygienists as a combustion by-product and common industrial pollutant. NO exposures above the threshold limit value of 25 ppm can result in increased methemoglobin formation and potential neurotoxicity. Additionally, at elevated concentrations NO reacts rapidly with air to form nitrogen dioxide (NO_2), a potent respiratory irritant with a TLV-TWA of 3 ppm and a TLV-STEL of 5 ppm.

A personal exposure-modeling program was undertaken to determine potential NO and NO_2 exposures of employees in a neonatal ward during administration of NO to infants. An I-NOvent delivery system (Ohmeda Inc.) was used to dilute 400 ppm NO gas from a cylinder to 20 ppm in oxygen for delivery to the ventilator for simulated patient administration. A typical NO administration team includes a respiratory therapist and a nurse practitioner. Toxi Ultra datalogging dosimeters (Biosystems Inc.) were used to determine personal breathing zone concentrations of NO and NO_2 during the setup, simulated use, and disassembly of the NO delivery system. NO and NO_2 emissions from vent ports on the I-NOvent and the associated ventilator were also monitored. Modeling was conducted using standard and oscillatory ventilators. Multiple experimental runs were conducted for each ventilator configuration. Personal dosimetry results indicate that peak personal exposures to NO were below 2.0 ppm. NO_2 concentrations were below quantifiable levels (~1 ppm). These modeling results indicate that potential exposure to NO and NO_2 during setup, use, and breakdown of the I-NOvent system is below applicable TLVs, but the potential for exposure could be further reduced by scavenging residual gas from the system.

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EVALUATION OF OCCUPATIONAL EXPOSURES AT MEDICAL WASTE TREATMENT FACILITIES. P.A. Jensen, NIOSH, Cincinnati, OH; K. Leese, E. Uhorchak, L. Hodson, M. Owen, Research Triangle Institute, Research Triangle Park, NC; E. Cole, DynCorp, Durham, NC

This year more than 800,000 tons of medical waste will be processed in the United States prior to its ultimate disposal. Waste processing will be carried out at various off-site commercial treatment facilities, or on-site at health care facilities, laboratories, or industrial operations where the waste is generated. As the waste is transported, unloaded, treated, and disposed of, workers can be exposed to a variety of potentially hazardous medical waste components and treatment residues, to include biological and nonbiological aerosols, toxic chemicals, radioactive materials, and infectious agents

including blood splatter. They may also be at risk regarding a number of safety-related concerns including injuries, noise, nonionizing radiation exposure, and ergonomics.

The second phase of this study evaluated the effectiveness of engineering controls in protecting the worker from bioaerosols, chemical vapors, and blood splatter/splash in medical waste treatment facilities. Three treatment technologies were evaluated: steam autoclave, microwave, and mechanical-chemical. The studies consisted of personal monitoring for VOCs identified in the first study, air quality monitoring (temperature, relative humidity, CO, CO_2), monitoring for general respirable aerosols, personal monitoring for blood splatter, and emission point monitoring for microbial aerosols. The data show that the highest risk is due to blood splatter during the dumping of medical waste into larger containers. Splatter was observed on various surfaces, including the workers' PPE and clothing. Ergonomic hazards included lifting, twisting, pulling, pushing, and movement of boxes and reusable containers was the norm. With the exception of posted noisy areas, a loose microwave generator, and a few mechanical problems, all other testing/evaluation results were within normal limits or not detected. Recommendations to minimize or eliminate these hazards were made to the three facilities.

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EMERGENCY MANAGEMENT OF PATIENTS CONTAMINATED WITH HAZARDOUS MATERIALS. K.A. Packard, N. Moss, J. McCarthy, M. Jay, Environmental Health & Engineering, Inc., Newton, MA

Providing medical care to patients who arrive at hospital emergency rooms contaminated with hazardous materials poses a risk of secondary exposure to hospital personnel. Adequate preparation for such events includes an emergency management plan; an environmentally isolated decontamination facility; decontamination procedures; personal protective equipment; and training for medical, safety, occupational health, engineering, housekeeping, and security personnel.

Incidents causing one or more individuals to sustain injuries complicated by the presence of chemical or biological contamination may originate from industrial site or transportation accidents, exposure to chemicals at home, or acts of terrorism.

The hazardous materials emergency management plan presented will address decontamination facility design including ventilation engineering controls, wastewater collection, patient privacy, and personal protective equipment. Procedures will also be presented for ascertaining chemical identity and properties, receiving and decontaminating patients, exposure monitoring, internal and external communications, security, site cleanup, and proactive medical follow-up for employees involved in the decontamination event.

Successful implementation of a well-designed emergency management plan will result in the protection of hospital visitors, patients, and employees from injury caused by exposure to chemically or biologically contaminated patients and the prevention of contamination to the hospital facility and equipment.

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STRESSFUL TASKS THAT CAUSE BACK INJURIES IN NURSING AIDES. N. El-Ayouby, NIOSH, Morgantown, WV; W. Myers, West Virginia University, Morgantown, WV

This study determined the most stressful tasks, as perceived by the nursing aides in three nursing home facilities, that result in back injuries. It was suggested by the National Institute For Occupational Safety and Health (NIOSH) that consideration should be given to back injury problems of that industry.

The population under study consisted of 30 participants from three nursing homes. The study utilized two-phase questionnaires. The first phase questionnaire was used to obtain information from the nursing aides on the stressful tasks experienced during residents' care. Participants were asked to identify the five major tasks that, in their opinion, are considered most seriously stressful to the back. The second phase of the questionnaire was developed from the combined statements received in the first phase of the questionnaire. A total of 25 ratable statements were collected and sent to the same participants to rate them according to their severity. A rating of 1 is not stressful and rating of 4 is severely stressful. Response total was 90% (N=27). Twelve statements were rated severely stressful to the back. All 12 of them fall under 1 of 3 categories: tasks involving sudden movements (mean rating of 3.7), tasks involving lifting (mean rating of 3.5), and tasks involving posture (mean rating of 3.05). ANOVA ($p=0.05$) analysis was used to determine the differences in mean perceptions among the three nursing homes. A total agreement among the nursing homes on the severely stressful tasks was noticed. However, there were some disagreements determined among them on the slightly stressful tasks. Data indicate that tasks involving sudden movements, e.g., falling with a patient, not being aware of patient's ability to perform, the patient's resistance, and slipping, could result in fall. When the body trunk muscles overrespond to this fall, the lower back is overloaded and injury occurs. This finding differs from that in the literature regarding back injuries in hospital settings where lifting is the major cause of back injuries. This difference could be attributed to the nature of the patients in the nursing home facilities. In conclusion, there is a need for an assessment of biomechanical exposure in the nursing home industry. Additionally, there is a need to mandate training for handling techniques that use ergonomic principles.

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ANALYSIS OF 7 YEARS OF BODY SUBSTANCE EXPOSURES AT A UNIVERSITY HOSPITAL. E.A. Aton, V.J. Fraser, Washington University School of Medicine, Saint Louis, MO

This work analyzes 7 years of data on body substance exposures (BSEs) at a large university hospital, assessing trends for risk and interpreting indications for risk reduction strategies. Institutions must analyze BSE data to design effective strategies for prevention of BSEs. Data reported here profile 2970 BSEs reported at a large urban tertiary care university hospital. The quarterly cumulative rate for BSE (per 200,000 labor hours) has declined from 9.42 at the beginning of year three to 6.06 in year seven.

At this institution 2461 BSEs (82.9%) were from a puncture, laceration, or bite. Five-hundred and nine (17.1%) of the BSEs involved a splash of a body substance. The proportion of BSEs associated with splash of body substance has risen steadily during the study period, from 10.6% in year one to 23.1% in year seven. This is attributed to increased recognition by employees of potential hazard by such an exposure. Nursing personnel experienced 1364 (46.1%) of the BSEs, while physicians had 404 (13.7%), and other staff had 1188 (40.2%) of the BSEs. It has previously been identified that BSEs are underreported. Appropriate medical assessment and care can be provided only for BSEs that are reported. The proportion of BSEs reported by physicians has also risen in the study period, from 7.3% in year one to 19.0% in year seven. This increase is attributed to substantial initiatives undertaken during the study period to educate this population on the risks and risk prevention strategies associated with their work. Data from years six and seven were classified by accident analysis pattern categories. In 373 (47.2%) of the 789 BSEs in this time frame one or more unsafe condition(s) was a factor in the exposure. In 685 (86.8%) of the BSEs one or more unsafe action(s) was a factor in the exposure. These data indicate that for a bloodborne pathogen exposure control plan to be successful in reducing risks to health care workers it must incorporate behavioral approaches in addition to standard methodologies for engineering and administrative controls.

Education and other strategies can be effective in increasing employee reporting of BSEs. Effective strategies for risk reduction from BSE will include behavioral strategies with standard methodologies.

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IMPLEMENTATION OF A TUBERCULOSIS AIR-PURIFYING RESPIRATORY PROTECTION PROGRAM AT A LARGE UNIVERSITY HOSPITAL. E.A. Aton, Washington University School of Medicine, Saint Louis, MO

This work identifies elements of a tuberculosis (TB) respiratory protection plan (RPP) as prepared at a large university hospital, acknowledges challenges encountered in this venue when compared with a standard industrial model, and reports data for respirator fit-testing and TB skin-testing (TST) programs in the employee population. CDC recommendations identify the need for health care workers (HCWs) to wear air-purifying respirators when in the presence of patients who have or may have infectious pulmonary TB, or during laboratory of clinical procedures in which droplet nuclei of *Mycobacterium tuberculosis* may be aerosolized. OSHA standards require that employers who provide air-purifying respirators to employees must do so within an established RPP, as specified at 29 CFR 1910.34.

Barnes-Jewish Hospital, a large tertiary care center in an urban area, is a member of the BJC Healthcare System. An Infection Control Consortium (ICC) has been established for the system, to prepare strategic plans for prevention of nosocomial infection, for implementation by member institutions. The ICC has prepared a TB control plan, including specifications for usage of NIOSH N-95 air-purifying respirators for individuals who enter areas of potential TB hazard. The ICC endeavors to sup-

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