inated with copper-8-quinolinolate. Air sampling during demolition recovered an average of 340cfu/5.6 m^3 A. fumigatus. After remediation the area was cleaned and verified with surface contact sampling plates. Post-remediation air sampling did not recover A. fumigatus from 52 m^3. Aspergillosis surveillance on the patient ward between the initial water infiltration and closure revealed no clinical aspergillosis. Conclusion: Water damage should be followed by efforts to detect in-hospital fungal growth, and if found, careful remediation and recertification should be conducted before reoccupation.

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

Fifty percent of the respondents to a survey of medical waste treatment facility workers reported having received cuts and scratches. Twenty-two percent reported direct contact with waste blood. DOL/DHHS estimated that the risk of acquiring HBV infection following puncture with a contaminated needle ranges from 6 to 30 percent; while under similar circumstances, the risk of HIV infection was estimated to be less than 1 percent. This study evaluated the effectiveness of engineering controls in protecting the worker from aerosols (biological and nonbiological), chemicals, and safety hazards in medical waste treatment facilities. Three treatment technologies were evaluated: steam autoclave, microwave, and pyrolysis. The initial studies consisted of an industrial hygiene survey, comprehensive safety assessment, identification of potential emission points from the treatment system process, identification of target VOCs, area sampling for airborne metals and aldehydes, noise and nonionizing radiation measurements, identification and assessment of existing engineering controls, preliminary respirable aerosol assessment, and assessment of blood and microbial contamination on surfaces. A second study of the steam autoclave facility consisted of personal monitoring for VOCs identified in the first study, air quality monitoring (temperature, relative humidity, CO, CO-sub2), 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. 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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USER-BASED DESIGN OF CONTROL TECHNOLOGY TO PREVENT OCCUPATIONAL EXPOSURE TO BLOOD. J.M. Fisher, R. Gross, B. Schalet, The Trauma Foundation, San Francisco General Hospital, San Francisco, CA; C. Kasting, CDC, Atlanta, GA

Historically, the role of the industrial hygienist in heath care has been extremely limited. Safety issues related to devices and technology have focused primarily on patient safety. Rarely has the impact on health care workers' safety been addressed.

The Training for Development of Innovative Control Technology Project is a collaborative effort of product designers (PD) and industrial hygienists (IH) working with line health care workers (HCW) to promote the development and use of control technology to prevent occupational exposure to blood. It is funded by a cooperative agreement with the NIOSH/HIV office of CDC.

To familiarize the PDs and IHs with the hospital and prehospital emergency environments, they were mentored on site by a broad group of health care workers. Initially, "need finding" included sharp injury analysis, HCW focus groups, structured observations, control technology identification, and failure analysis of products. As a result of these efforts, the first written criteria for various control technologies and protective equipment were developed. The importance of user involvement in efforts to promote the use of control technologies was highligted. To expand the role of the user in the actual development and design of safety products a course was given to nurses in the principles of product design and industrial hygiene. This activity yielded two major outcomes: a multidimensional performance standard for control technologies in this area was drafted, and a systematic method of laboratory testing that replicates actual usage of devices was developed. These activities have demonstrated the fruitfulness of collaboration between product designers and industrial hygienists. The importance of involving end users in the development of control technology has also been defined. The development and usability of a performance standard and the applicability of a systematic testing method for product development and product selection will be presented.

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USE OF LOCAL EXHAUST VENTILATION TO CONTROL AEROSOL EXPOSURES RESULTING FROM THE USE OF A RECIPROCATING SAW DURING AN AUTOPSY. K.F. Martinez, R.L. Tubbs, NIOSH, Cincinnati, OH; P. Ow, County of Los Angeles, Commerce, CA

In December of 1995, investigators from the National Institute of Occupational Safety and Health responded to a health hazard evaluation request from the county coroner's office of a large metropolitan area. Specifically, the request asked for assistance in evaluating the use of reciprocating saws during forensic autopsies and the resulting operator exposure to generated bone, blood, and tissue fragments. Two reciprocating saw models were evaluated during the conduct of six examinations; an electric Stryker® saw and a pneumatic saw equipped with local exhaust ventilation (LEV). The generation of aerosols was monitored in real-time with light scattering instruments including the Met One Model 227 Handheld Laser Particle Counter for area measurements and the Handheld Aerosol Monitor (HAM) for personal breathing zone (PBZ) measurements. Integrated PBZ samples for tissue and bone fragments were also collected using 37-millimeter polyvinyl chloride filters analyzed by optical microscopy. Additionally, spectral noise samples were collected with a Larson-Davis Laboratory Model 2800 Real-Time Analyzer and a Larson-Davis Laboratory Model 2559 1/2" random incidence microphone.

For the area measurements, peaks were observed during the use of the electric Stryker saw for particles greater than 1 µm. These peaks corresponded to the use of the reciprocating saw on the cranial region of the decedent and were at least an order of magnitude above the baseline. Peaks were not observed at any of the measured particle size cut points with the pneumatic saw equipped with LEV. Integrated PBZ samples agreed with the real-time measurements indicating an 88% reduction in the concentration of bone and tissue fragments (0.037 to 0.004 fragments/cubic centimeter) for the operating forensic technician. These results indicate that saws equipped with LEV exhibit lower generated aerosol concentrations outside of the capture zone of the hood. Additionally, peaks observed with the HAM collected on the forensic technician indicate that aerosols generated by the use of unventilated saws are capable of reaching the worker breathing zone. The noise data showed little difference between the two types of saws. Although noise levels for either saw can approach 95 dB(A), the short amount of time, 5 minutes or less, which the pathologist or technician are subjected to the noise lowers the time-weighted average ((TWA) value below any applicable evaluation criteria.

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LONGITUDINAL INDUSTRIAL HYGIENE STUDY OF N_2O CONTROLS AT A PEDIATRIC DENTAL FACILITY. J. McGlothlin, K.G. Crouch, O. Johnston, NIOSH, Cincinnati, OH

Researchers from the National Institute for Occupational Safety and Health (NIOSH) conducted four in-depth field evaluations to evaluate nitrous oxide (N_2O) exposure in children's pediatric dental facility over an 18-year period from December 1978 to February 1996. The purpose of this longitudinal industrial hygiene study was to evaluate the effectiveness of N_2O controls to reduce waste anesthetic gases in pediatric dental operatories. The NIOSH recomended exposure limit for N_2O is 25 ppm during administration. The first three field evaluations were conducted at the same facility, the fourth was conducted at a new facility in which the N_2O ventilation design was based on NIOSH recommendations that are noted below. The first evaluation was conducted in December 1978 and showed N_2O levels for dentists ranging from

110-3500 ppm, for dental assistants from 750-1300 ppm, and for the dental operatory, N_2O concentrations ranged from 75-3000 ppm. NIOSH researchers recommended using a N_2O scavenging exhaust system that had just been marketed to reduce exposures. The second evaluation was conducted in April 1988 and showed N_2O levels for the dentists ranging from 133-1000 ppm, for dental assistants from 4-432 ppm, and for dental room concentrations from 8-144 ppm. NIOSH recommended improved work practices, better room ventilation, increasing the scavenging mask air exhaust rate to 45 liters per minute, and installing a scavenging system flow meter to monitor scavenging meter flow rates. The third evaluation was conducted in November 1992 in which dentist N_2O levels ranged from 8-410 ppm, and dental assistants from 1-50 ppm. Improved scavenging mask fit, reduced mask leakage, improved room ventilation, and better work practices were recommended to reduce N_2O exposures. The fourth field evaluation was conducted in February 1996. Dental N_2O concentrations ranged from 3-172 ppm, dental assistants from 2-27 ppm, and room concentrations from 1-18 ppm. Improved work practices and calibrated scavenging gas flow meters were also recommended to control N_2O. These control methods over time have had a major impact on reduction of N_2O. This study has shown that N2O concentrations may be controlled to approximately 25 ppm or less by the following: (1) maintaining a leak-free N_2O delivery system, (2) adjusting the scavenging system exhaust ventilation to approximately 45 liters per minute, (3) installing a flow meter to assure proper exhaust rate, (4) redesigning the scavenging mask for better patient fit, (5) using an auxiliary exhaust ventilation placed near the patient's mouth to capture excess N_2O, and (6) installing a general ventilation system that does not recirculate N_2O in the dental facility.

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CONTROL STRATEGIES FOR AEROSOLIZED MEDICATIONS. N.E. Moss, B. Weeks, J. McCarthy, Environmental Health and Engineering, Inc., Newton, MA

Teaching hospitals are continuously developing new treatment protocols to improve patient care. Medicated aerosols used to treat pulmonary hypersensitivity and pneumonia or for infection prophylaxis have been found to increase airway hypersensitivity in respiratory therapists. Since the application and use of aerosolized medications is continuing to rise, exposure control strategies must be developed to address this increased use. In many cases, as new materials are used, the potential health risks to health care workers may not yet be known. Methodologies used for controlling the more traditional aerosolized medications such as ribavirin and pentamidine may not be effective or practical for addressing the new treatment protocols. The use of respiratory protection, in-room filtration systems and increased ventilation exchange rates for controlling exposures to Tobramycin, Amphotericin, Gentamycin and DNAse will be examined. General control strategies have been developed based on the modeling of room ventilation studies and estimated dosage generated by various aerosolizing equipment (e.g., nebulizers and SPRAG units). Control mechanisms and opeational guidelines were developed and implemented through a multidisciplinary task group.

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OSHA'S PROPOSED RULEMAKING FOR OCCUPATIONAL EXPOSURE TO TUBERCULOSIS (TB). A.L. Edens, K. Landkrohn, OSHA, Washington, DC

On August 25, 1993, OSHA was petitioned by the Labor Coalition to Fight TB in the Workplace for a permanent standard for occupational exposure to TB. Citing recent resurgence in TB and the emergence of multidrug-resistant strains of TB, the Coalition stressed the need for a substance-specific standard for the hazards associated with occupational exposure to TB.

On January 26, 1994, in response to the petition, OSHA initiated rulemaking for a permanent standard and began development of a proposed standard for occupational exposure to TB. As a part of this process, OSHA had its preliminary risk assessment peer reviewed and convened stakeholder meetings to solicit comments and concerns from potentially affected parties on the concepts and approaches being considered for inclusion in OSHA's proposed rule.

Industrial hygienists use a basic methodology of recognition, evaluation, and control when addressing hazards in the workplace. This same approach can be applied to the control of occupational exposure to TB. For example, elements considered for the proposed standard include a determination of occupationally exposed employees, early identification and isolation of individuals with suspected or confirmed infectious TB, implementation of engineering controls in certain work settings, and use of personal respiratory protection.

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THE ECONOMICS OF IMPLEMENTING A TUBERCULOSIS CONTROL PLAN IN TWO HOSPITALS. W. Charney, San Francisco General Hospital, San Francisco, CA

Tuberculosis has reemerged as a public health threat. California reported 5382 cases of TB in 1992, a 54% increase in reported cases since 1985. Two inner city hospitals of similar size with approximately 4000 employees each treated 200 active cases of TB. San Francisco General Hospital treated 270 cases of active TB in 1995 with some cases diagnosed with multiple drug resistant strains.

There is a shortage of data covering the economics of implementing a TB control plan based on the Center for Disease Guidelines. Therefore, a study was undertaken in two San Francisco hospitals to determine the cost of implementing a TB control plan. The cost of engineering controls, respiratory protection, administrative controls, and clinical controls were evaluated. Construction of negative pressure isolation rooms, sputum induction facilities, bronchoscopy rooms, fit testing employees with adequate respirators and training were evaluated for cost. Each hospital spent over $120,000 for compliance to federal and state regulation for TB.

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COMPLIANCE WITH OSHA'S RESPIRATORY PROTECTION STANDARD IN THE HEALTH CARE FACILITIES. U. Krishnan, C. Janicak, Illinois State University, Normal, IL

Transmission of Mycobacterium tuberculosis (TB) is a recognized risk in health care facilities. With drug resistant tuberculosis being on the rise, there is an urgent need to provide better protection to health care providers. In addition to TB, hospital employees also face an increased risk for exposure to other contaminants like ethylene oxide and formaldehyde, both of which are suspected human carcinogens. OSHA inspection records with respiratory protection standard (29 CFR 1910.134) violations in health care facilities (SIC = 80) were examined in order to determine whether there is need for intervention strategies to improve compliance with the standard. Between July 1, 1990, and June 30, 1995, 401 health care facilities were cited for violation of the respiratory protection standard, which collectively accounted for 938 violations. Findings indicate that hospitals were more frequently inspected than other health care facilities, and of these hospitals, federal facilities were inspected at a rate over 10 times higher than privately owned institutions. Employee complaints prompted over 60 percent of all inspections. Potential exposure to tuberculosis was the most frequently identified respiratory hazard, accounting for over one-fourth of all inspections. Ethylene oxide and formaldehyde were the next most frequently identified hazards. Among the areas of respiratory protection violations, failure to provide proper respirator accounted for over one-third of all citations, followed by failure to have written procedures and failure to provide employee training. Cost has always been one of the barriers in meeting health and safety regulations. It is believed that with the introduction of the new NIOSH approved respirators that are now available for about one-sixth the cost of the HEPA respirators that were in use before July 1995, more facilities should find it affordable to comply with the regulations. Findings from this study will provide a baseline against which to compare future respiratory protection compliance levels.

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A SIMULATION MODEL FOR OCCUPATIONAL TUBERCULOSIS TRANSMISSION. M. Nicas, E. Seto, University of California, Berkeley, CA

We describe a simulation model of TB infection and disease development among hospital employees. A hypothetical cohort of 1000 susceptible workers was divided into low-, medium- and high-risk groups. Employees worked 220 days per year. The number of pulmonary TB patients admitted daily was treated as a Poisson random variable. If admitted, a TB patient imparted a daily risk of infection that was identical for all employees within a risk group but that varied between risk groups. All TB patients remained 10 days and were treated as equally

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PRAGMATIC PRINCIPLES FOR AVOIDING MANAGEMENT PITFALLS. M.L. Sanders, Naval Engineering Field Activity, Poulsbo, WA

Making the transition from an industrial hygienist managing programs to a manager programming industrial hygienists can be traumatic and career damaging. Keen technical and verbal skills are common entrance requirements to the people-management arena, but industrial hygienists who desire to make that professional move must be aware of three particularly dangerous pitfalls which neither of those skills will protect against.

One pitfall results from failure to distinguish between leadership and management, another from failing to distinguish between organizational process and function, and the third for failing to recognize the customer. Industrial hygienists must have the insight to recognize and evaluate those pitfalls, avoiding or backfilling in order to walk safely over them.

Specific and succinct descriptions of principles for both the prevention and the resolution of these problem areas have been developed; use of these principles is the catalyst for efficacious management. Whether the professional industrial hygienist is in the private or the public sector, assuming the responsibility for a controlled management response using these principles in the face of business adversity can turn impending failure into resounding success and ensure career growth.

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SCIENTIFIC CONTRIBUTIONS TO THE REVISION OF THE OSHA'S 1,3-BUTADIENE HEALTH STANDARDS. C.T. Chen, OSHA, Washington, DC

The current OSHA's 1,3-butadiene (BD) health standard is an 8-hour time-weighted average (TWA) exposure of 1,000 ppm for workers exposure to BD which is adopted from 1968 American Conference of Governmental Industrial Hygienist's (ACGIH's) threshold limit values (TLVs®) in 1971 to prevent irritation and narcosis effects. Due to the demonstration that BD causes multiple cancers in two animal studies in 1983, OSHA was petitioned by unions in 1984 and referred by EPA in 1985 for regulatory action. In 1990, OSHA published a proposed BD standard with an 8-hour TWA exposure of 2 ppm, a short-term exposure limit (STEL) of 10 ppm, and the ancillary provisions. There are many scientific studies contained in OSHA BD docket which enhanced the completion of a BD standard. Animal bioassays, human epidemiologic studies, experimental investigations on the metabolites and their mechanism in vitro and in vivo systems provides convincing evidence that BD is a probable human carcinogen. Three out of five quantitative risk assessments used NTP study with exposures of 6.25–625 ppm BD to calculate their best estimates of risk. Due to the availability of three breakthrough studies on BD, OSHA was able to allow the use of cartridges and canisters for respiratory protection that would enhance workers' protection, address industry's concerns, and reduce compliance cost. A series of plant visits conducted by the National Institute of Occupational Safety and Health (NIOSH) produced worker exposure profiles and information on technological feasibility which greatly helped in economic analysis. An epidemiologic study sponsored by the International Institute of Synthetic Rubber Producers (IISRP) completed in late 1995 clearly demonstrated an excess risk of cancer among workers exposed to BD which is complementary to the animal studies. This promoted IISRP to engage with unions to reach agreement on a standard with an 8-hour TWA exposure of 1 ppm, a STEL of 5 ppm, and other aspects of standard. This demonstrates that studies from various disciplines of science will greatly enhance the development of a workplace health standard. The opinion expressed here is sole of author.

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CIH PLUS IHIT UTILIZATION BY INDUSTRY OR INDUSTRY GROUP, AND PRELIMINARY PROJECTIONS OF FUTURE NEED FOR SUCH INDUSTRIAL HYGIENE PROFESSIONALS. L.W. Whitehead, CIH University of Texas-Houston Houston, TX, M. West Baylor College of Medicine, Houston, TX

Estimates of future need for public health professionals are very useful for planning educational programs and incentives for graduate education, and for staffing projections. No such estimates are known to exist for