

HLDs are used in healthcare to chemically disinfect reusable, semi-critical medical and dental devices to control and prevent healthcare associated infections among patient populations. Healthcare workers who use HLDs are at risk of being exposed to these chemicals, some of which are recognized as respiratory and skin irritants and sensitizers.

Methods: NIOSH conducted a web-based survey of healthcare workers in 2011. The study population included members of professional practice organizations who indicated that they handled HLDs in the past seven calendar days. Participating organizations invited either all or a random sample of members via email which included a hyperlink to the survey. Descriptive analyses of the survey results were conducted including simple frequencies and prevalences.

Results: A total of 4,657 respondents completed the survey. HLDs used most often were glutaraldehyde (59%), peracetic acid (16%), and ortho-phthalaldehyde (15%). Among the survey respondents 19% reported their employer lacked or that they were unaware of standard procedures for handling of HLDs while 17% reported having never received training on the safe handling of HLDs. Failure to wear recommended PPE was reported for water-resistant gown (44%) and protective gloves (9%). The most commonly reported reason for not wearing PPE was 'minimal exposure'. Twelve percent of respondents reported skin contact with HLDs within the previous seven days. Respondents reporting skin exposure were four times more likely not to wear gloves. A spill or leak of HLDs in the previous seven days was reported by 5% of respondents.

Conclusions: Findings indicated precautionary practices were not always used, underscoring the importance of improved training and education on HLD hazards among employers and workers.

SR-402-06

Use of Precautionary Practices Reported by Nurses and Pharmacy Personnel Who Compound Antineoplastic Drugs

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Objective: Precautionary guidelines detailing standards of practice and equipment to minimize exposure to antineoplastic drugs during handling activities have been available for nearly three decades. The purpose of this study was to describe work conditions and practices including availability and use of exposure controls and barriers to using personal protective equipment by healthcare workers who prepare chemotherapy drugs. This survey is the first to examine use of engineering and administrative controls among pharmacy professionals.

Methods: Several professional practice organizations representing pharmacists, pharmacy technicians, and oncology nurses collaborated with NIOSH to develop and implement the survey. Organizations invited members via email with a link to the anonymous web-based survey.

Results: 241 nurses and 183 pharmacy professionals who compounded antineoplastic drugs in the past week completed the survey. Lack of universal adherence to recommended guidelines, reported by nurses and pharmacy professionals respectively, include: failure to always use engineering controls including closed-system drug transfer devices (75%, 53%), biological safety cabinets (11%, 23%) and needleless systems (59%, 75%); failure to always wear non-absorbent gown with closed front and tight cuffs (38%, 20%) or chemotherapy

gloves (8%, 10%); I.V. lines sometimes/always primed with antineoplastic agent (19%, 30%) instead of non-drug solution; taking home potentially contaminated clothing (24%, 9%); and lack of hazard awareness training (9%, 13%). Sixty-one percent of nurses and 45% of pharmacy professionals reported that their employer did not provide a medical surveillance program. The most common reason for not wearing chemotherapy gloves by both groups was "skin exposure was minimal." Top reasons for not wearing protective gowns were: "not part of our protocol" (nurses) and "an engineering control was being used" (pharmacy professionals). However, 11% of nurses and 4% of pharmacy professionals reported skin contact with antineoplastic drugs during the past week.

Conclusions: Despite the long-standing availability of safe handling guidance recommended practices are not always followed placing workers, co-workers, and even family members at risk. Employers and healthcare workers share responsibility for ensuring safe compounding of antineoplastic drugs. Study findings can be used to raise awareness of hazards and exposure controls among both groups.

SR-402-07

Exposure Evaluation and Control of Acetone in a Plastination Laboratory

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Objective: Occupational exposure monitoring to acetone was conducted in a university laboratory that specializes in the process of plastination, a unique method of specimen preservation. Exposure to acetone occurs during the dehydration and transferring of specimens to and from large, open-top vats of acetone. This study evaluated four different ventilation systems to determine the most effective method for removing acetone vapors, decreasing LEL and reducing occupational exposures below acceptable occupational exposure limits. General ventilation, increase in negative pressure in general ventilation, and two local exhaust ventilation systems were evaluated.

Methods: Exposure sampling was conducted during 2012–2013 using a handheld volatile organic compound (VOC) detector with a photoionization detector (PID) that ranges from 0 to 10,000 ppm (MiniRAE 2000, RAE Systems). The instrument was calibrated with isobutylene. The acetone correction factor was applied to accurately measure acetone vapor exposure. Exposure concentrations were logged during the entire specimen transfer process, typically 10 to 60 minutes. ProRAE-Suite was used to calculate the STEL and TWA of exposure to acetone. Comparisons of all four ventilation designs were used to determine which system provided the most effective means of control.

Results: Ventilation Design 1 used general exhaust as the primary method of removing acetone vapors and resulted in a STEL of 1420 ppm. In comparison, Ventilation Design 4 was a slotted hood and make-up air system with dedicated fans. The resulting changes to the ventilation design proved successful as the STEL was reduced to 714 ppm. This is below the ACGIH STEL for acetone (750 ppm), and is nearly half of the original STEL with Ventilation Design 1. The highest calculated 8-hr TWA was 48 ppm, well below the OSHA PEL of 1000 ppm and ACGIH TLV of 500 ppm.

Conclusions: The final ventilation design was determined to be the most effective at reducing acetone exposure and eliminating potentially explosive atmospheres. The results indicated a

slotted hood with dedicated exhaust and supply fan was the most effective at reducing exposure and removing acetone vapors from the workplace.

SR-402-08

Identification of Chemicals and By-products Generated from Semiconductor Photo-lithography Process

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Objective: A photosensitive material called PR(photoresist) is used in Semiconductor photo-lithography process. Since the components of PR are the core technology of the PR material, the components are kept as trade secret by PR manufacturing companies. Thus, it is necessary to verify safety of photo-lithography process in health's point of view. In this study, the uncertainty of the hazard of photo-lithography process will be resolved by confirming the by-products. More specifically, the study is focused on figuring out if any by-products may possibly cause hematopoietic and lymphatic cancers or not.

Methods: A qualitative analysis on the PR components and by-products produced in photo-lithography process were evaluated. Analysis of the by-products was performed under equivalent condition as the real photo-lithography process, by detection of out-gassing in each step of photo-lithography process (PR coating, soft bake, exposure, post exposure bake). 5975C GC/MSD tool interconnected to Agilent 7890A GC system and Teledyne Tekmar HT3 Headspace tool were used. PR is categorized in 3 different groups, including I-line, KrF and ArF PR. And 4 I-line PR, 5 KrF PR and 5 ArF PR samples were selected for this study which are used most commonly in two semiconductor workplaces.

Results: As a result of this study on PR components and by-products of photo-lithography process, 39 chemicals in I-line PR, 25 chemicals in KrF PR and 23 chemicals in ArF PR were detected through analysis. Further study was executed on whether the detected chemicals include any hematopoietic and lymphatic cancers causing chemicals categorized by IARC or not. In conclusion, there were no chemicals that cause hematopoietic and lymphatic cancers (benzene, formaldehyde, ethylene oxide, etc) among the chemicals identified in this study.

Conclusions: 39 chemicals were found in I-line PR, 25 chemicals in KrF PR and 23 chemicals in ArF PR. However, it was verified that there are no direct relationship between semiconductor photo-lithography process and hematopoietic and lymphatic cancers. In results, the uncertainty of the hazard of photo-lithography process is resolved. Future studies will be continued on other toxicity (CMR, etc), and if such hazardous chemicals are found, exposure assessment will be held to confirm whether the workers are exposed to them. Although exposure assessment was not performed, this study on the identification of possible hazard chemicals is still meaningful by itself.

CS-402-09

Case Study of Several Indoor Air Quality (IAQ) Assessments Which Identify Non-traditional Causes/ Agents Associated with the Described Complaints/ Symptoms/Concerns of Office Occupants

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Situation/Problem: This poster session is a discussion of several case studies of Indoor Air Quality assessments that were determined through the on-site investigation to involve

agents which are not traditionally associated with poor air quality. It was determined that a more detailed and creative assessment strategy is warranted to identify causes of unusual odors, rashes/insect bites and incidents of headaches.

Resolution: The purpose of these Industrial Hygiene Indoor Air Quality Assessments/Investigations was: -To obtain information on the employee complaints/concerns as they related to the office environment through employee interviews and by conducting an on-site evaluation. -To review the building's Heating, Ventilation and Air Conditioning System, obtain readings of general Indoor Air Quality parameters and to investigate possible contributing factors associated with the symptoms/concerns. -To identify possible causes either from internal (within the building) or external (outside the building) contaminant source(s) for the symptoms/complaints/concerns related to the respective office environment. and -To identify corrective action(s) to remove the suspected "cause" for the symptoms/complaints/concerns.

Results: Industrial Hygiene investigations of concerns/complaints/symptoms that were initially believed to be related to poor Indoor Air Quality, turned out to be caused by agents such as insects (yellow sac spiders), rodents (lizards aka "skinks") and a lack of adequate lighting. Some of conclusions were developed immediately, and some conclusions may involve the use of outside experts (pest control and a local zoo) to help specify the causative agent.

Lessons Learned: Employee concerns/complaints/symptoms may be presented to an industrial hygienist as an "Indoor Air Quality" issue. Once an investigation takes place, the actual issue/cause for the complaint might be related to physical (noise or lighting) or biological (in these cases, insect or rodent) in nature. Utilization of good industrial hygiene hazard assessment methods can yield a positive outcome in these non-conventional Indoor Air Quality assessments by thinking outside of the box and considering causative agents that may not be typically associated with poor indoor air quality.

SR-402-10

Determinations of the Indoor Air Quality in Hairdressing Salons in Taipei

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Objective: Various cosmetic hair products are constantly used in hairdressing salons. Aside from skin absorption, different hazards may be released during hair treatments. Previous studies have indicated that increased risks of cancers, respiratory symptoms, reproductive disorders, and skin symptoms were found among hairdressers. However, the exposure assessments are few. To assess the hairdressing environment in Taipei, the walk-through survey and air sampling of formaldehyde, volatile organic compounds (VOCs), and phthalates were performed in this study.

Methods: Charcoal, XAD-2, and OVS-Tenax tubes were used for the air sampling, and the flow rates were 50 mL min⁻¹, 100 mL min⁻¹, and 1000 mL min⁻¹, respectively. Both 5-hour average environmental sampling and customer's personal sampling during hair treatments were performed. After absorbents were desorbed, the samples were analyzed with gas chromatography/mass spectrometry. A direct-reading device was used to observe changes of formaldehyde concentrations during opening hours. Meanwhile, environmental characteristics and products ingredients were also recorded in this study.



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