

contaminated. The index case, a three-year-old girl, visited her local physician several times between December 1999 and June 2000 for flu-like symptoms, screaming, anorexia, and inability to talk. In late June 2000, the North Texas Poison Center (NTPC) was contacted. The girl was seen and tested for mercury, revealing blood mercury and urine mercury levels of 295 mcg/L and 1097 mcg/24 hours respectively. Her four siblings, mother, and grandmother also had markedly elevated urine mercury. Laboratory results were expressed as mcg/24 hours. Most guidelines are based on mcg/L, making interpretation of the data difficult especially in the five children ranging from 3-16 years old. The family was relocated and all received chelation therapy with DMSA. The NTPC immediately reported the case to the state health department (TDH). In late July, the trailer was decontaminated by a "decontamination service" and the house declared "acceptable." The family moved back in. In late September, TDH conducted an environmental investigation utilizing an industrial hygienist. The mercury level in the trailer was 9 mcg/cu-m at that time (TLV-TWA 25 mcg/cu-m). The industrial hygienist advised the family to clean the walls with soap and water, put a coating over the floor, and ventilate the home for another month. Most family members received a second round of chelation therapy in August. The index case is now symptom-free. Mercury levels in all family members have dropped considerably. This case illustrates the need for primary care professionals, occupational health specialists, toxicologists, and industrial hygienists to work together and have an action plan to address environmental health problems.

190

PERMEABILITY OF SINGLE-FAMILY DWELLINGS: IMPLICATIONS FOR INDOOR AIR QUALITY. M. Phillips, N. Esmen, D. Johnson, T. Hall, R. Lynch, A. Gibson, University of Oklahoma Health Sciences Center, Oklahoma City, OK.

As part of the Oklahoma Urban Air Toxics Study, fan pressurization measurements were performed to determine the permeability of detached single-family dwellings of research subjects. The date of construction of homes in this study was more or less evenly distributed by decade from the 1930's through the 1990's. The ASHRAE119 "normalized leakage" (NL) was estimated by dividing the air exchange rate at 50 Pa by 20 or 16 for 1-story and 2-story dwellings, respectively. Applying the Lawrence Berkeley Laboratory criteria for appropriate infiltration levels based on the ASHRAE119 leakage class of the home, approximately half of the houses were acceptable, approximately one-sixth were too leaky and approximately one-third were so airtight that additional ventilation would be recommended. The relationship between NL and descriptive variables for each house was analyzed by a generalized linear model. Three factors tended to cluster together: newer homes were typically built on slabs and had fewer windows than older homes. With appropriate control for confounding, the factors that showed some contribution to the model in their order of importance were: type of foundation, number of openings, year of construction, framing, and veneer. Nearly all homes that were found to be "too tight" were built after 1980. Year of remodeling, number of floors, presence of attached garage, attic access, and HVAC system type did not show a contribution. These results suggest that many newer residences may be too airtight to allow adequate natural ventilation to dilute air contaminants generated from the

use of consumer products inside the home. Interestingly, many of the research subjects expressed a perception, contradicted by blower door measurements, that their homes were very leaky. Under these circumstances, concern over energy efficiency and reducing drafts could lead homeowners to tighten their dwellings without recognizing the necessity for allowing infiltration of some fresh air.

191

THE RELATIONSHIP BETWEEN ADVERSE BIRTH OUTCOMES AND MATERNAL EXPOSURE TO AIR POLLUTANTS DURING PREGNANCY. L. Lee, National Taiwan University, Taipei, Taiwan Republic of China.

This is a study to investigate the relationship of maternal exposure to outdoor air pollution and adverse birth outcome. We analyzed the singleton births ($n=36887$) registered by Taiwan national birth register between November, 1994 to December, 1997 at 50 areas in the 700m radius of air pollution monitoring stations. The maternal exposure of SO₂, PM₁₀, NO, NO₂, and NO_x were evaluated by arithmetic means of air pollution monitoring data. Odds ratios of low birth weight (<2500g), preterm delivery (<37 weeks of gestation), neonatal mortality, and postneonatal mortality been calculated after controlling for maternal age, education, marriage status, infant gender, birth year, birth area, and birth order.

Dermal Issues II Papers 192-197

192

SURFACE CONTAMINATION AND SKIN EXPOSURE TO ALIPHATIC ISOCYANATES IN AUTO BODY SHOPS: A QUANTITATIVE ASSESSMENT. Y. Liu, M. Stowe, F. Walsh, J. Sparer, M. Cullen, C. Holm, C. Redlich, Yale University School of Medicine, New Haven, CT; F. Youngs, D. Bello, S. Woskie, University of Massachusetts Lowell, Lowell, MA; M. Boeniger, NIOSH, Cincinnati, OH.

Little has been done to quantify surface contamination and skin exposure to aliphatic isocyanates in auto body shops and to evaluate the effectiveness of personal protective equipment (PPE). The purpose of this study was to quantitatively evaluate such contamination and exposure in 20 shops that participated in a large epidemiological study on isocyanate asthma. Surfaces from mixing and painting tools and PPE (gloves and respirators) were wiped with a 16 cm² polypropylene glycol moistened pad. The size of areas wiped was recorded. The pad was immediately placed in a vial containing 1-(9-anthracenyl-methyl)piperazine in methylene chloride for derivatization. The unprotected skin of hands, face and neck was similarly evaluated for both painting and non-painting tasks. PPE protected skin areas were also assessed. Samples were extracted in the lab and analyzed on high-pressure liquid chromatography. Hexamethylene diisocyanate (HDI) monomer (ng/inch²) and oligomer (μg/inch²) in monomer equivalent amount were quantified and used for assessment. Results showed that surface levels of HDI (monomer and oligomers; gm±gsd) were significantly higher ($p<0.001$) when HDI-containing hardeners were used (4.28 ± 4.22 and 0.16 ± 5.99) than when no hardeners were used (0.93 ± 1.64 and 0.01 ± 1.66). Surfaces with higher contamination were hardener containers (108.06 and 2.90), mixing benches (25.89 and 0.80), rulers (6.33 and 0.50), and

gloves (4.67 and 0.11). Average skin exposure was 0.30 ± 2.85 (monomer) and 0.006 ± 3.13 (oligomer). Levels were significantly higher ($p<0.05$) for painting tasks (0.51 ± 3.98 and 0.01 ± 3.97) than non-painting tasks (0.20 ± 1.45 and 0.003 ± 1.81). Skin exposure under PPE was measured as 0.51 ± 2.27 and 0.013 ± 2.30 with hardener use, indicating HDI breakthrough. These results suggest surface contamination and skin exposure to isocyanates are common in auto body shops and are affected mainly by painting activities. Skin exposure may significantly contribute to the total isocyanate exposure. In addition, current PPE is inadequate in protecting workers from dermal exposures.

193

CRITICAL ASSESSMENT OF METHODS FOR ESTIMATING WORKER EXPOSURE TO CHLORPYRIFOS. L. Geer, N. Cardello, T. Buckley, Johns Hopkins School of Hygiene and Public Health, Baltimore, MD; M. Dellarco, T. Leighton, R. Zendzian, U.S. EPA, Washington, DC.

The United States Environmental Protection Agency (EPA) requires that pesticide registrants perform occupational exposure assessment studies on pesticide handlers to ensure the health of the workers is not jeopardized. We used these data to evaluate the effectiveness of exposure measurement methods. This evaluation is especially warranted for dermal exposures where methods are poorly developed. Five pesticide registrant studies were used to assess methods for measuring worker exposure to chlorpyrifos. Dermal exposure was estimated using whole body dosimetry (WBD) while inhalation exposure was estimated using air sampling. The total absorbed dose was estimated from the primary chlorpyrifos urinary metabolite, 3,5,6-trichloro-2-pyridinol (3,5,6-TCP). The relative contribution of dermal exposure to total exposure ranged from 7.6% to 87% among workers ($n=80$). Absorbed dose calculated from the concentration of 3,5,6-TCP in urine ranged from 0 to 31.19 μg/kgBW chlorpyrifos with a mean of $3.83(\pm 6.00)$ μg and a median of 2.24 μg. Mixer/loaders exhibited the highest mean absorbed dose of 12.09 μg/kgBW compared to workers in other job categories. Dermal exposure estimates derived from WBD techniques were compared with actual absorbed dose based on biological monitoring. The correlation between passive dosimetry and biological monitoring methods was highly variable across the five studies ($r^2=0.12$ to 0.8). Much of this variability may be due to differences in effectiveness of dermal exposure methods. We will explore these differences and identify optimal methods for dermal assessment, using biological monitoring as a standard. For several of the studies, absorbed dose was also estimated using a simple one-compartment kinetic model. The resulting values correlated well with urinary metabolite values, suggesting that further analysis of kinetic models could prove useful in estimating worker exposure to chlorpyrifos.

194

ASSESSING THE CLEANING EFFICACY OF INDUSTRIAL HAND CLEANSERS. R. Shick, Kimberly-Clark Skin Wellness Institute, Roswell, GA; G. Grove, KGL Skin Study Center, Broomall, PA.

Industrial workers in many industries come into contact with a variety of soils that are very difficult to remove from their skin. These soils include such materials as motor oil and grease, oil and rubber

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ABSTRACTS