

Abstract Book

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Conclusions: These results suggest that the unique work history (e.g., farming and other manual labor) of rural residents may lead to higher occupational exposures to VGDF. We will be using the assigned occupational exposures in an upcoming study to investigate whether they are associated with decrements in the spirometry of adults living in a rural county, in order to inform strategies for prevention.

CS-403-05

Options for the Placement of Breathing Zone Air Samples Inside a Welder's Helmet

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Situation/Problem: Breathing zone air sample placement during welding job tasks presents a challenge inside welding helmets. The OSHA Directorate of Compliance Programs states that the correct placement for air samples is near the breathing zone of the employee. Furthermore, the OSHA Technical Manual for Personal Sampling states, "when sampling for welding fumes, the filter cassette must be placed inside the welding helmet to obtain an accurate measurement of the employee's exposure". The American Welding Society also recommends placing the sample inside the helmet. The issue is where to place the sample inside the helmet so it doesn't interfere with the welder's work and comfort.

Resolution: This study presents two options for the placement of air samples inside a welder's helmet that are acceptable to working welders. One option is to clip the sample on a bandana that is tied around the neck. The second option is to clip the sample on a welder's skull cap so it hangs down and along the cheek between the nose and mouth. Employee feedback on the two options indicated they were user-friendly and did not disturb the welder or hinder their job tasks.

Results: Five different welders in 3 separate workplaces were sampled. Side-by-side monitoring was conducted using the bandana and skull cap locations during Gas Metal Arc (GMAW) or MIG welding. NIOSH Method 7303 was followed for air sampling and laboratory analysis. Manganese data was selected for statistical analysis as it is the component of welding fume that is of most concern when welding carbon steel. Statistics computed for the bandana sample data and the skull cap sample data validated this study's proposed sample locations.

Lessons learned: Secure the bandana sample to the welder's shirt so it stays securely inside the helmet. Coach the welder to keep the bandana sample tucked inside the welding helmet. Consider the possibility of skin irritation from sweat, dirt and welding fume accumulation on the bandana. One out of five sampled welders mentioned this concern.

CS-403-06

A Quantitative Model to Predict Allergic Contact Dermatitis from Wearable Technology Products

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Situation/Problem: Wearable products with electronic components are being introduced to consumers without formal biocompatibility testing or health risk assessment. Some products that assess physiological functions involve prolonged skin contact with plastic and metal components

under occluded conditions. Recent media reports have described occurrences of skin reactions such as allergic contact dermatitis (ACD) from wearable technology products. These products therefore present a new product stewardship challenge.

Resolution: A quantitative risk assessment model was developed that incorporates estimates of both dermal exposure and ACD elicitation risk. Product prototypes were tested in artificial sweat solution for varying time periods to reflect product-specific dermal exposure use scenarios. Leachates were analyzed for sensitizing metals and organic chemicals to derive potential applied dermal dose or load (in $\mu\text{g}/\text{cm}^2/\text{unit time}$) per sensitizing chemical. To estimate ACD risk per chemical, a nickel ACD-elicitation risk model was developed using published human patch test nickel data. The reported fraction of sensitized user populations exhibited ACD reactions at specified dermal nickel loads. This nickel distribution was then generalized to predict ACD risk for chemical sensitizers with limited patch test data. Prediction was based on the observation that estimated distribution of population sensitivity to nickel is similar to distributions of patch test dose response data for other sensitizing chemicals.

Results: Results indicate that the sensitizing metals (nickel, chromium, and cobalt), and sensitizing organics (primarily acrylate and epoxy compounds) are leached from a variety of tested wearable product prototypes. Dermal loads were estimated to range from <1 to $>50 \mu\text{g}/\text{cm}^2/\text{week}$ with chemical loads potentially posing a wide range of risks of ACD reaction in sensitized users, with $<0.01\%$ to $>10\%$ of the sensitized users expected to react.

Lessons learned: This methodology can help manufacturers in identifying components of wearable technology products that pose a high risk of leaching and consequent ACD reactions, in order to make their products biocompatible prior to introduction into consumer markets.

SR-403-07

A Bayesian Approach for Summarizing Real-Time Exposure Data with Left Censoring

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Objective: Direct-reading instruments are valuable tools for measuring exposure. They provide real-time data and valuable information on short-term exposure variability. However, statistical analysis is complicated by autocorrelation among successive measurements, nonstationary time-series, and presence of left-censoring due to limit-of-detection (LOD). A Bayesian framework is proposed for analyzing exposure time-series that accounts for nonstationary autocorrelation and LOD issues.

Methods: A spline based approach was used to model nonstationary autocorrelation with relatively few assumptions about autocorrelation structure. Left censoring was addressed by integrating over the left tail of the distribution. The model was fit using Markov-Chain Monte Carlo within a Bayesian paradigm. The method can flexibly account for hierarchical relationships, random effects and fixed effects of covariates. The method was implemented using the rjags package in R and is illustrated by applying it to real-time exposure data.

Estimates for covariates from the Bayesian model were compared to those from the frequentist models including linear regression and mixed effects models with different autocorrelation structures. Simulations studies were conducted to evaluate method performance.

Results: Simulation studies with LODs ranging from 0-50% showed lowest root mean squared errors for task means and the least biased standard deviations from the Bayesian model compared to the frequentist models across all levels of LOD. In the application, task means from the Bayesian model were similar to means from the frequentist models, while the standard deviations were different. Parameter estimates for covariates, e.g., source enclosure, were significant in some frequentist models, but in the Bayesian model their credible intervals contained zero; such discrepancies were observed in multiple datasets. Variance components from the Bayesian model reflected substantial autocorrelation, consistent with the frequentist models. Plots of means from the Bayesian model showed good fit to the observed data.

Conclusions: The proposed Bayesian model out performs the frequentist models in estimating task means, standard deviations and parameter estimates for covariates, thus providing an approach for modeling nonstationary autocorrelation in a hierarchical modeling framework.

CS-403-08

Noise Exposure Assessment in a Dog Grooming Operation

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Situation/Problem: Noise exposures to bathers/groomers in a national pet store chain may exceed the OSHA Action Level. Noise exposures had not been monitored previously. The store needed to determine if bathers/groomers were required to participate in a Hearing Conservation Program per the OSHA Noise Standard. If noise levels did exceed the Action Level of 85 dBA TWA, what methods of noise control are available in order to achieve compliance with the OSHA noise standard.

Resolution: Employees were selected and fitted with Casella CEL 350 noise dosimeters. The noise dosimeters were calibrated before and after the monitoring period. Observations of employee work procedures were made identifying peak noise exposures. Direct sound level measurements were made of specific noise sources. Noise sources were identified as blowers (some with faulty bearings), positioning of the air blower nozzle in relation to the dog, and barking dogs in the kennel area. Administrative controls were also identified to help reduce employee noise exposure.

Results: Four different stores were visited and a total of 15 employees were evaluated. Two of the fifteen had noise exposures at 85 dBA TWA, other employees were below the Action Level. Recommendations to further reduce noise exposures included the following: Engineering Controls: Replace defective blowers that generated a loud squeal over 90 dBA with newer and/or quieter blowers. Move blowers adjacent to the drying tables located at head height to underneath the tables. Enclose the blower unit to help further reduce noise transmission Provide plastic strips or other barrier material between the kennel area and the bunker to reduce noise from barking dogs. Administrative Controls: Some workers performed more bathing tasks, while other workers performed more grooming tasks (cutting/trimming fur) which is a quiet

task. Schedule work so that employees' work tasks are more equally balanced between bathing and grooming. Train workers to maintain the blower nozzle away from the dog's body. Placing the air nozzle close to the body generates air turbulence and excessive noise.

Lessons learned: Relatively simple solutions including administrative controls, placement of blowers and barriers to prevent sound transmission are effective in reducing employee noise exposures.

CS-403-09

Evaluation of Noise Exposures During High Pressure Washing, Piglet Vaccinating and Room Relocation at a Hog Farrowing Facility

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Situation/Problem: Hog breeding farms require labor intensive operations including thoroughly cleaning animal housing and farrowing rooms, vaccinating each individual piglet and moving piglets from room to room. High pressure power washers are used to clean all farrowing room surfaces including ceilings, walls, floor grates and basins, etc. Additionally, piglets are vaccinated and moved in groups from room to room. Personal Dosimetry revealed selective operations expose workers to high noise levels. Two of three individuals experienced noise above the OSHA PEL of 90 dBA for an eight hour TWA. HC TWA noise exposures during: room pressure washing were up to 99.5 dBA, piglet relocation were up to 86 dBA and piglet vaccination were up to 81 dBA. Excessive occupational noise exposures have been linked to noise induced hearing loss.

Resolution: Management investigated lower noise power washer guns, modified work schedules, limiting duration of power washing by any individual and continued to include exposed workers in hearing conservation program

Results: Attempts to identify suitable replacement power washer units proved unsuccessful. The employer's main focus was to ensure their hearing conservation program was adequate and to strive to schedule a rotational work schedule limiting any employee's daily operation of a power washer to an hour or less per day to reduce PEL TWA exposures to below 90 dBA.

Lessons learned: No suitable quieter pressure wash guns were identified. Worker rotation was a means of lowering an individual's noise exposure on days that pressure washing is performed. Worker rotation does not reliably reduce worker exposures to below 85 dBA for a full shift TWA. In order to reduce worker noise exposures to below the PEL of 90 dBA on days when power washing is performed, workers are limited to one (1) hour or less of pressure washing. In general, limiting the power washing duration to one hour per person per day is estimated to result in noise exposures ranging from 84 dBA to 88 dBA TWA. A two hour power washing operating limit is estimated to result in a TWA exposure range of 87 dBA to 91 dBA.