

electrode surface,  $Pb^{+2}$  is reduced, accumulated, and the electric potential of the electrode scanned. The response is linear over a broad concentration range (1–200 ppb).

Since the current ACGIH biological exposure index (BEI<sup>®</sup>) for lead is based on blood concentration (500 ng Pb/mL blood), saliva Pb must be correlated with blood/plasma concentrations. To evaluate the relationship between saliva and blood Pb, F-344 rats were treated with single oral doses in the range of 50–500 mg Pb/kg body weight, and 24 hours later were administered pilocarpine — a muscarinic agonist — to induce salivation. Blood and ~1–2 ml of saliva were collected and saliva, whole blood, red blood cells (RBC), and plasma were quantitated for Pb by ICP/MS.

A comparison of saliva and blood Pb levels revealed a biphasic curve wherein the slope increased as RBC binding saturated and more Pb was available for salivary excretion. These data indicate that 1 ng Pb/mL saliva corresponds with 500 ng Pb/mL blood in the rat. ICP/MS analyses of the Pb samples (saliva and blood) were compared with results using the MFE system and correlated well ( $r^2 = 0.87$ ).

Ultimately, blood, saliva, and tissue dosimetry will be evaluated using a physiologically based pharmacokinetic model for lead that incorporates the salivary gland. Once fully developed, this MFE device will be an important tool for real-time analyses of nonvolatile contaminants.

This study was supported by U.S. DOE Contract DE-AC06-76RLO 1830).

## 172

**ENHANCED SIGNAL INTENSITIES ON T1-WEIGHTED MRI AS A BIOMARKER OF EXPOSURE TO MANGANESE.** Y. Kim, Ulsan University Hospital, Ulsan, Republic of Korea; K. Kim, J. Yang, Industrial Safety and Health Research Institute, Incheon, Republic of Korea; Y. Shin, Inje University, Kimhae, Republic of Korea; K. Kwon, Handong University Hospital, Pohang, Republic of Korea; J. Kim, Dong-A University Hospital, Pusan, Republic of Korea

**Background:** Bilateral enhanced signal intensities, confined to the globus pallidus and midbrain, can be observed on T1-weighted magnetic resonance imaging (MRI) due to the paramagnetic quality of manganese (Mn). The enhanced signal in T1-weighted images was observed in experimental Mn poisoning of the nonhuman primate or in a patient with Mn intoxication. However, these enhanced signals in MRI in humans exposed to Mn without manganese were rarely reported.

We performed an epidemiological study on Mn-exposed workers with its focus on enhanced signal intensities in MRI to evaluate its usefulness as a exposure biomarker.

**Procedures and Discussion:** We studied 121 male workers, including Mn-exposed, nonexposed manual, and nonexposed clerical workers in factories. Environmental and biological monitoring on Mn, neurological examination, and MRI was carried out. The proportion of workers with enhanced signal intensities among the exposed, the nonexposed manual workers, and the nonexposed clerical workers was 46.1%, 18.8%, and 0%, respectively. Especially, 73.5% of the welders showed increased signal intensities in the exposed groups.

In no subject were clinical signs of manganese observed. Enhanced signal intensities correlated with blood Mn concentration. These changes in MRI resolved within six months following the withdrawal

from the source of Mn.

Blood Mn is an inadequate biomarker of Mn exposure on an individual basis although elevated blood Mn level may be more useful in monitoring exposures for a group of workers. Hence, enhanced signal intensities on the T1-weighted image reflect recent exposure to Mn on an individual basis.

**Conclusion:** Enhanced signal intensities in MRI may be a useful biomarker of Mn exposure on an individual basis.

## 173

**EVALUATION OF CREATININE ADJUSTMENT FOR URINARY FLUORIDE MONITORING IN AN EPIDEMIOLOGIC STUDY.** S. Carter, N. Seixas, K. Thomas, M. Morgan, J. Kaufman, University of Washington, Seattle, WA

The use of spot urine samples for biological monitoring of occupational exposures can be affected by urine volume for compounds whose excretion is not by diffusion. For these compounds, results have historically been adjusted for creatinine concentration. Since solute and creatinine excretion can be affected when urine is very concentrated or very dilute, more recent strategies suggest that urine results be screened for "normal" creatinine excretion, but not adjusted.

Several criteria for acceptable creatinine levels are available: 300–3000 mg/L (WHO), 500–2500 mg/L (German BATs), and 500–3000 mg/L (ACGIH).

As part of an epidemiology study in an aluminum smelter, 294 post-shift urine samples were collected over a three-year period representative of five job categories. A subset of these samples (34) included full-shift air monitoring for particulate and gaseous fluoride for jobs that did not use respiratory protection.

Five methods of expressing urine fluorides through various combinations of creatinine adjustment and screening levels were compared. First, the correlation between the urine fluoride measures and the air monitoring results were determined. Unadjusted urine results provided the largest correlation coefficient at 0.53 and 0.57 for unscreened and screened results. Second, each urine result was used in a linear regression analysis to calculate dose metrics for use in exposure assignment by job and ambient temperature.

Creatinine adjustment without screening generates a different ordering in the exposure ranking profile of the five jobs in comparison with the other urine fluoride measures. Our data suggest that expressing spot urine fluorides unadjusted, but screened, for creatinine excretion provides the best correlation with ambient fluoride exposures and, therefore, the most appropriate ranking of job categories.

## 174

**A FIELD EVALUATION OF A NEW END-EXHALED BREATH METHOD TO EVALUATE SOLVENT EXPOSURE IN DRY-CLEANING SHOPS.** L. Ewers, M. Petersen, A. Ruder, G. Burroughs, G. Ernest, N. Sweet, NIOSH, Cincinnati, OH

A field study was conducted using a newly developed, near-real-time method with a simple collection device and a portable gas chromatograph (NIOSH Method 3704) for estimating solvent exposure in the following-day, preshift breath of dry-cleaning shop workers.

The purpose of this study was to document strategies for reducing exposures to perchloroethylene

(PCE), a solvent used by more than 70% of dry cleaners and a potential occupational carcinogen. In this component of the study, PCE concentrations in workers' breath were compared with time-weighted averages (TWAs) calculated from personal breathing zone (PBZ) air samples.

Three dry-cleaning shops and five workers participated. Workers were repeatedly monitored for solvent exposures one day a week using PBZ sampling; the corresponding breath samples were collected the following morning and conformed to ACGIH recommendations. Overall, PBZ-PCE concentrations ranged from 0.54 ppm to 94 ppm (mean of 26 ppm,  $n = 55$ ); following-day breath PCE concentrations ranged from 0.18 ppm to 11 ppm (mean of 4.1 ppm,  $n = 57$ ).

A model was fit using the following-day breath PCE as the dependent variable and PBZ-PCE as the independent variable. Other independent variables were included in the full model and were iteratively eliminated if insignificant with a p-value greater than 0.05. The resulting least-squares equation explained 61% of the variability in the following-day breath PCE concentration and contained PBZ-PCE concentrations, job title, and their interaction.

This percentage of explained variability is similar to that obtained from data available in the published literature. However, the increase in breath PCE concentration per unit increase in PBZ-PCE concentration was lower than others have obtained using different sampling methods.

## 175

**VARIABILITY AND POSITIVE PREDICTIVE VALUE OF THE BERYLLIUM BLOOD LYMPHOCYTE PROLIFERATION TEST FOR CHRONIC BERYLLIUM DISEASE.** D. Deubner, Brush Wellman Inc., Elmore, OH; M. Goodman, J. Ianuzzi, Exponent, Inc., Landover, MD; P. Chapman, M. Kelsh, Exponent, Inc., Menlo Park, CA

Lymphocyte proliferation assays are widely used as biomarkers for sensitization to metals including beryllium. Results are typically categorized as abnormal (positive), normal (negative), or borderline. This study evaluated the variability and positive predictive value of nearly 5000 blood lymphocyte proliferation test (BLPT) results collected since 1992 from three laboratories during periodic surveys at two beryllium plants in Tucson, Arizona, and Elmore, Ohio.

Single split blood samples were sent to two independent laboratories. If both laboratories reported a negative BLPT, the person was considered not sensitized. Discrepancies between the two laboratories or uninterpretable results warranted repeat testing. Two positive BLPTs, either from the two independent laboratories or from repeat testing at the same laboratory, were sufficient to consider a person beryllium sensitized.

Analysis included examination of inter- and intralaboratory variability by calculating a kappa statistic and assessment of positive predictive value of BLPT with respect to forecasting chronic beryllium disease (CBD). The level of agreement between the first and the second test for all three laboratories (i.e., intralaboratory variability) was fair to moderate, with kappa ranging between 0.3 and 0.5. The interlaboratory agreement depended on the survey site and ranged from poor ( $kappa = 0.1$ ) in Elmore to good ( $kappa = 0.8$ ) in Tucson. An abnormal BLPT test was approximately 50% predictive of CBD as detected on subsequent bronchoscopy.

# AIHCE 2000

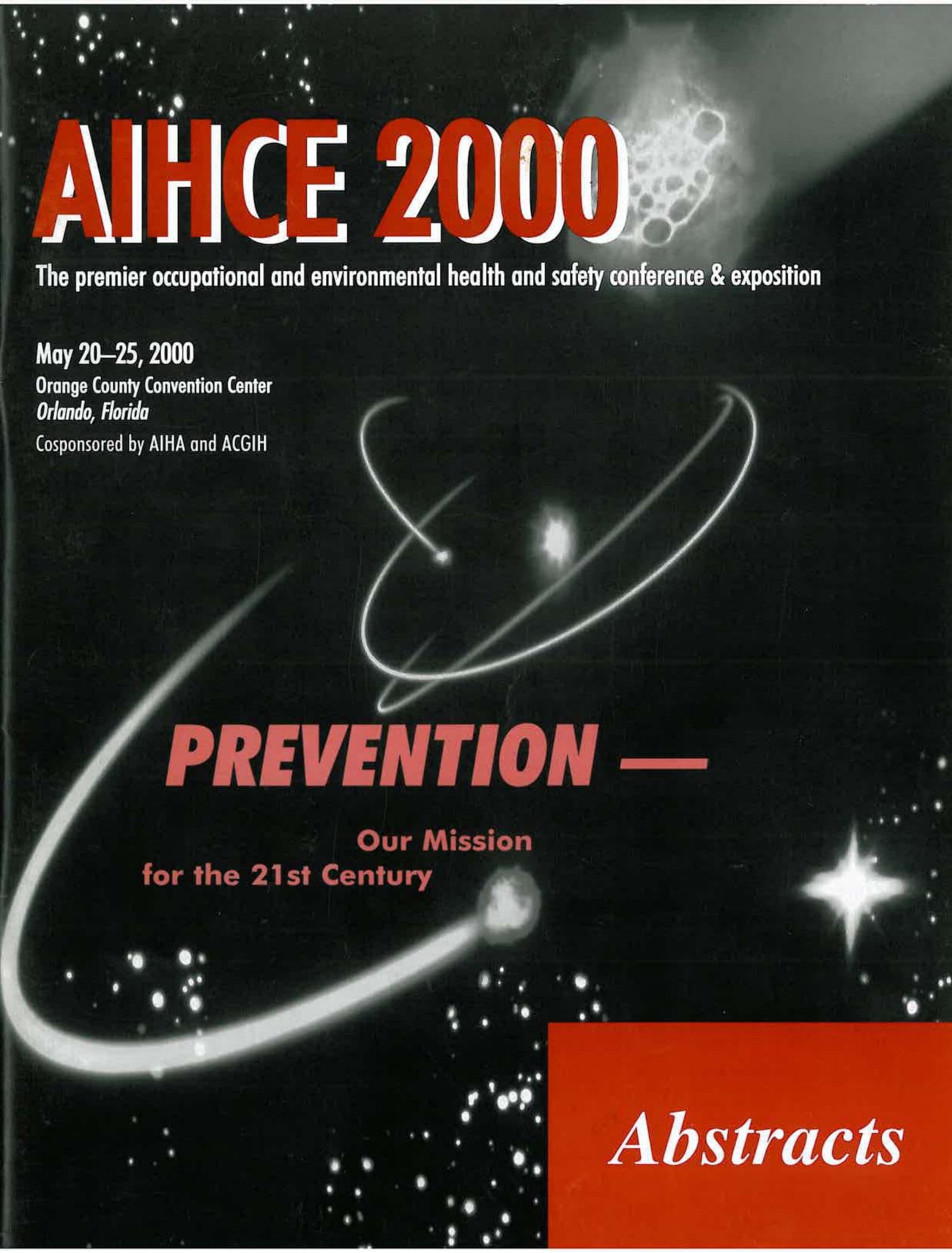


The premier occupational and environmental health and safety conference & exposition

May 20–25, 2000

Orange County Convention Center  
Orlando, Florida

Cosponsored by AIHA and ACGIH



**PREVENTION —**

**Our Mission  
for the 21st Century**

*Abstracts*