the application and the potential exposures associated with it.

To apply the two-box model to this scenario, the assumptions associated with this model needed to be validated, requiring acquisition of additional information. The industrial hygienist, product steward, and technical development experts collaborated to facilitate the exchange of appropriate information. The acquired parameters were incorporated into the model and an estimation of potential exposure under the defined conditions was determined. The results led to recommendations for quantitative validation, process engineering controls, and potential regulatory requirements, which were communicated to the risk managers for their consideration.

Understanding the assumptions, collecting adequate information, communicating the results, and providing interpretive support are critical components of modeling potential exposure to facilitate quantitative human health risk assessment and risk management.

52

OBSERVATIONAL EXPOSURE ASSESSMENT: A MODELING STUDY OF THE AMOUNT OF DATA REQUIRED TO ESTIMATE UNDERLYING DISTRIBUTION. M.A. Cohen, Washington State Department of Labor & Industries, Olympia, WA

Workplace exposure assessments can be conducted using many methods ranging from gathering historic job assignments to detailed instrumentation. To better understand the exposures, observations of the workers performing their jobs may be required. Many factors affecting the exposure cannot be measured without direct observations, and often in assessing musculoskeletal hazards, observational analysis is the primary assessment method. Given the importance of observational assessments, little has been reported regarding how to determine appropriate protocols for the frequency and duration of making the observations.

This paper uses a modeling approach to estimate how much information regarding the exposure would be lost, given predetermined exposure and observation profiles. Two exposure profile types were investigated, stepped and stepped with randomness. Two observation profiles were also investigated, random and periodic. To understand the sensitivity of the analyses better, each exposure and observation profile was varied over a range of values. To rate the estimates' prediction of the time course of the theoretical exposure, nonparametric correlation coefficients were calculated. To rate the estimates' prediction of the average exposure, simple univariate statistics were calculated.

The simulated data support the intuitive thought that to assess a more complex exposure pattern properly, more frequent observations will be required. In estimating the mean exposure, not as many observations are required. When observations are made on a periodic basis, it is possible to make fewer measurements to obtain higher correlation coefficients and mean exposures that are closer to the theoretical value than with randomly made observations. These methods can be used to help guide the design of observational exposure assessment activities in numerous fields of occupational and environmental health.

53

POTENTIAL EXPOSURE-BASED WORKER CLASSIFICATION SYSTEM. W.G. Tankersley, D.M. West, D.L. Crager, Oak Ridge Associated Universities, Oak Ridge, TN

Workers are commonly classified for occupational studies and other purposes using traditional classification systems typically based on job titles and departments. Often, job titles are uninformative (helper, operator, supervisor), ambiguous (assistant labor, equipment operator), or misleading (lab supervisor = laborer supervisor) resulting in misclassification of employees with similar or identical job titles who have remarkably different exposure potentials. Health studies or plant assessments based on such classifications may result in faulty conclusions or inappropriately implemented policies. The reported research was aimed at developing a practical system for classifying workers or jobs based on potential for exposure to a designated set of materials or conditions. The Potential Exposure Profile System (PEPS) stores qualitative information (yes/no) on up to 36 potential occupational exposures, encoded in an 11-digit decimal PEPS code that is linked to individuals or to traditional job title/department combinations. A Microsoft Access 95 application provides a variety of functions for management of the PEPS database. PEPS codes are computer assigned from input provided by the user for each of the 36 designated potential exposures. Persons with appropriate authorization may add records to the PEPS database or modify previously assigned codes. Records may be selected for viewing or printing using a menu-driven query tool within the PEPS application. Use of the PEPS system to classify workers according to potential exposure should diminish the degree of misclassification and increase the reliability of conclusions based on population exposure data.

54

CONTROLLING EXPOSURE PROFILESCCRITIQUE OF CURRENT PRACTICE. P. Hewett, NIOSH, Morgantown, WV

The purpose of this presentation is to compare and critique the range of exposure monitoring program models used by IHs to manage risk in the workplace.

Several general methodologies, or exposure monitoring programs, were considered: individual-based, maximum risk employee-based, and group-based (subdivided into those based on exposure zones, homogeneous exposure groups, similar exposure groups, and monomorphic exposure groups).

The methodology used by the IH to assess and control each employee's exposure profile first reflects the statistical interpretation the IH imparts to the relevant occupational exposure limit (OEL). Available resources influence baseline survey sample sizes and the sample size and frequency of follow-up audits. Sample size affects the sophistication of the data analysis techniques. Lack of group homogeneity can be offset by using upper confidence limit-based statistical techniques. Large sample size and highly sophisticated data analysis techniques can be offset by invalid statistical interpretations of legal or authoritative OELs. In principle, the most efficient approach is one based on the MRE concept. Proper selection of MREs can be improved by experience and use of modern direct reading survey instruments. Group-based strategies are preferred since they characterize the exposure profiles of a larger percentage of workers.

In summary, IHs have a range of methodologies for controlling exposure profiles. Each has advantages, disadvantages, underlying assumptions, and differing levels of efficiency. Recognition of the strengths and limitations of each methodology permits the selection and application of the most efficient and reliable exposure monitoring program for each work environment.

55

AN EFFICIENT SAMPLING DESIGN METHOD TO DETERMINE TASK-BASED EXPOSURE DISTRIBUTION. N.A. Esmen, M.L Phillips, N. Rainey, University of Oklahoma, Oklahoma City, OK

In many exposure assessment cases, it is important to estimate the exposure characteristics of the tasks that contribute to the measured exposure. For example, one may wish to determine the most important exposure, prioritize control, etc. Often, the direct approach of sampling each task individually is too time-consuming, too intrusive, or too costly.

Starting from the fact that a worker's exposure over a sampling period is a linear combination of exposure experienced during the performance of each task, estimates of characteristic exposure for each task can be extracted from 8-hour personal samples, provided that the number of samples is not less than the total number of tasks performed. Ideally, an accurate estimate of the fraction of time each worker spent at each task would lead to a direct solution easily by matrix inversion. However, approximate task durations are not necessary. Using readily available optimization techniques, task exposure estimates can be generated based simply on noting which tasks were performed during 2-hour, 4-hour, or 8-hour segments. Accuracy of estimates decreases as the segment length increases. If there are more samples than the tasks analyzed, the task-based concentration variances can be estimated using boot-strap methods.

The technique is demonstrated using synthetically generated samples. The illustrations were designed to be typical in both the number of tasks performed by each worker and the between-worker and within-worker variability with respect to tasks and exposures. The results show that the method is both convenient and efficient, in that a large amount of information can be estimated from relatively few samples. The method is also accurate within the limitations imposed by the censoring of minimal-duration tasks. In the worst case, where an 8-hour segment is used, the rank order and order of magnitude of task exposures is preserved.

56

RETROSPECTIVE EXPOSURE ASSESSMENT WITH DETERMINISTIC MODELS AND SUBJECTIVE EXPERT JUDGMENTS IN A BAYESIAN FRAMEWORK. G. Ramachandran, J.H. Vincent, University of Minnesota, Minneapolis, MN

To establish dose-response relationships for diseases caused by long-term exposures to pollutants, it is vital to determine exposures of individuals or cohorts as functions of time.

Abstracts

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