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Research Recommendations of the NORA Exposure Assessment Methods Team

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The National Occupational Research Agenda (NORA) is a framework to guide occupational safety and health research into the next decade. This framework is being built by National Institute for Occupational Safety and Health (NIOSH) and its partners in industry, academia, and labor. Over 500 individuals and organizations from outside of NIOSH partnered to develop the NORA concept. The process embodies 20 partnership teams addressing 21 priority research areas. Each partnership team includes members from NIOSH, other government agencies, academia, labor, and industry.

The team that is the focus of this presentation is the exposure assessment methods (EAM) team. The goals of the EAM team include:

- Providing the vision for future research and resources for new research efforts in exposure assessment,
- Directing and focusing occupational safety and health research on exposure assessment,
- Facilitating collaboration and coordination, and
- Establishing and developing broad-based and lasting partnerships.

Exposure assessment is the primary activity that generates data for the occupational exposure databases (OEDB) discussed in these proceedings (International Symposium on Occupational Exposure Databases and Their Application for the Next Millennium, The Forum Hotel, London, England, November 1–3, 1999). Team activities related to OEDBs are mentioned in the Team Products section.

DEFINITIONS

To accomplish these goals, the EAM team first grappled with the concept of "exposure assessment." Many disciplines with-in the occupational health community consider themselves to conduct exposure assessments, including industrial hygienists, engineers, psychologists, etc. So we attempted to define exposure assessment, writing what we hoped would be *inclusive* definitions wherein each discipline could read the same words and see themselves. The team offers these definitions as an attempt at harmonizing the approach to the field.

First, *occupational exposure assessment* is the application of a body of knowledge to determine the relevant characteristics of one or more factors in an environment which pose health and safety risks to workers. The process of occupational exposure assessment includes identifying and characterizing workplace exposures, evaluating their significance, and developing estimates of exposure for individual or groups of workers which may be used in risk assessment or exposure-response studies.

Related definitions include the following:

- *Hazard Identification*: Establishing the existence of a hazard through field observations and/or laboratory analysis of the exposures and/or adverse health effects.
- *Exposure Characterization*: Describing the qualities of a given environment. These may include: magnitude, frequency, and duration of the exposure; the chemical and physical properties of an agent; the organizational or behavioral properties of an environment; and the potential for interaction with the human body or influence over human behavior.
- *Exposure Evaluation*: Determining the significance of an exposure relative to known or perceived risks.
- *Exposure Estimation*: Developing an approximate exposure value for an individual or a statistical distribution of exposure values for groups of workers in similar exposure conditions.

This last term, exposure estimation, has been used traditionally in retrospective epidemiological studies, job exposure matrices development, and risk assessments. It includes the more concrete processes that many practitioners think of when they think of exposure assessment. But occupational exposure assessment includes all of the above aspects.

Team Products

The NORA teams, as mentioned above, are small partnerships. Team products, such as symposia, workshops, and papers, are another method of partnership in NORA. The EAM team co-sponsored an Applied Workshop on Occupational and Environmental Exposure Assessment with the American Conference of Governmental Industrial Hygienists (ACGIH®) in 1998. We also had team members on the planning committees of two recent conferences. One was the National Institute of Environmental Health Science/National Toxicology Program Workshop, The Role of Human Exposure Assessment in the Prevention of Environmental Disease, held September 22–24, 1999, in Rockville, Maryland. The other was the one that produced these Proceedings: The International Symposium on Occupational Exposure Databases and Their Application for the Next Millennium, held October 31–November 3, 1999, in London.

The major EAM team focus has been to develop a paper that presents a research agenda in the area of exposure assessment. It began with the team brainstorming research needs and opportunities in exposure assessment. In addition to the discipline expertise on the team—chemistry, biology, industrial hygiene, toxicology, occupational health nursing, epidemiology, and physics—we invited representatives from other disciplines such as physical agents and occupational medicine to provide input to the team and review our outputs. The list that resulted from the several brainstorming sessions was well over 100 items long. The paper took form as the long list of research needs and opportunities were grouped into four major categories: study design, methods, toxicology, and education.

The study design section recognizes that the success of any exposure assessment is fundamentally a function of the study design and its inherent sampling strategy. Whether the study is to characterize multiple facets of current occupational exposure, evaluate compliance, assess an engineering control, or construct estimates of historical exposure, a well-designed study is scientifically defensible, produces valid data, leads to a better understanding of disease, and results in improved public health.

The study design section has recommendations regarding data quality, data collection, data management, and data analysis. Topics that are particularly relevant for the International Symposium on Occupational Exposure Databases (OEDB) are under Data Management. One of these refers to national occupational exposure surveys (NOES) done in the past by NIOSH, and says that the Team "is aware that there is an initiative within NIOSH to update the NOES and encourages continued efforts in that regard." Among other things, the team therefore recommends, "research to develop innovative mechanisms for continually updating the NOES data set."

The other topic under Data Management related to the Symposium on OEDB is the establishment of a National OEDB (NOEDB) in the United States. The Team recommends, "creation of a National Occupational Exposure Database." The details of designing such a program . . . should . . . be undertaken by a NIOSH-OSHA-stakeholders team." In fact, the team has previously recommended in a memorandum to NIOSH leaders that NIOSH take the lead in establishing an NOEDB. The designers of such an NOEDB will certainly be aware of the need to look at international links because of the impact of the International Symposium on OEDB.

The EAM team is not the only NORA team with an interest in OEDBs. The surveillance research methods team, the emerging technologies team, and others, have a stake in the OEDB activity.

The monitoring method development section recognizes that measurement tools, both methods and instruments, are fundamental to exposure assessment. It addresses environmental, biological, psychosocial, and ergonomic methods. Of particular importance is the development of guidelines for the development and evaluation of measurement methods. Measurement method guideline documents are needed for direct-reading instruments, diffusive samplers, dermal exposure methods, and biological monitoring methods. Such guidance documents specify the experimentation required for determining the performance indicators for a technique such as method accuracy, the experimentation needed to verify performance under extremes of conditions, the calculations needed, and the criteria to be met.

The toxicology section addresses the need for understanding the underlying toxicological relationships, such as those between workplace exposure, internal dose, target-organ dose, pre-clinical effects, and clinical effects. Knowledge of these relationships is fundamental to exposure assessment. The paper puts forward several research needs in this area, including: more research to ascertain the mechanism of action of chemical, physical, and biological agents, and; the development of a toxicity assessment protocol including guidelines for a systematic approach to estimating exposure limit.

The paper also contains a section on education and communication. This may seem somewhat misplaced in a document on exposure assessment methods prepared as part of a national *research* agenda. However, the exposure assessment methods team feels that good research comes from well-prepared researchers, so we do make some recommendations with regard to education, both formal classroom training and the use of fellowships directed at exposure assessment.

The EAM team paper will be published as a NIOSH document in 2000. The research agenda, however, should never be considered static. We hope you will have an opportunity to consider the paper's content and comment back to the team.

PARTNERSHIPS

NORA engenders another kind of partnering as a result of the research opportunities that are identified. During the last two years, NIOSH has partnered with other federal agencies to co-fund grants in certain NORA priority research areas. In 1999, exposure assessment methods was one of the research

priorities highlighted in the request for grant applications, and those applications are currently undergoing review.

NIOSH is also considering criteria and options for cooperating with non-federal partners. The exposure assessment team, along with other NORA teams, has participated in discussions with the Chemical Manufacturer's Association (CMA). Areas of potential cooperation and common interest include:

- Macro-level identification of where, and to whom, exposures are occuring
- Dermal exposure and bioavailability.

The recommendations made in the EAM team paper include several that coincide with these common interests: the development of new job exposure matrices, creation of an on-going National Occupational Exposure Survey, development of a National Occupational Exposure Database, and updating the NIOSH Occupational Exposure Sampling Strategy Manual. All of these will help in identification of where exposures are occurring and identify who is being exposed. On the dermal issue, NORA has a very active allergic and irritant dermatitis team. The exposure assessment methods team has also made recommendations for increased research in dermal exposure assessment.

CONCLUSION

Now is the time to see that the priorities identified in the NORA exposure assessment team's research agenda actually get done. Symposia, such as this International Symposium on Occupational Exposure Databases, will advance several of the priorities on the agenda. The agenda is a *national* research agenda, not just a menu from which NIOSH selects its projects. NORA is intended to encourage all the partners to pool resources and maximize the return on research investment for all concerned. The agenda is not static or fixed, but a work in progress. As research products are developed and move off the agenda, new research needs and priorities emerge.

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