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Solvent Exposure in the Railroad Industry

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Letter To The Editor

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To the Editor: In 1995, physicians from four member clinics of the Association of Occupational and Environmental Clinics (AOEC), in Cincinnati, Ohio, Morgantown, West Virginia, Lansing, Michigan, and Atlanta, Georgia, discovered that they had all been evaluating large numbers of railroad employees. Most of the patients were employed by CSX Railroad, although many had worked for predecessor companies such as the C&O, CC&O, L&N, and Seaboard Coast Lines. The earliest of the patients had been seen in approximately 1986, but the majority had been seen since 1992. The total number of patients seen was estimated by the reporting clinics to be approximately 400. The patients described varying but intense, long-term exposures to a variety of organic solvents, including carbon tetrachloride, trichloroethane, and trichlorethylene, through both inhalation and skin absorption. In most cases, the presenting complaints related to central nervous system function, involving both cognition and affect, although some of the West Virginia patients had been referred for evaluation of abnormal liver-function tests. In some cases, there were complaints related to other organ systems, such as musculoskeletal and respiratory symptoms. Many of the patients were pursuing litigation against the railroad under the Federal Employers' Liability Act.

Recognizing the similarities in their clinical experiences, noting that the patients they were seeing might represent a widespread occupational health problem, and believing that a coordinated approach would be useful, these physicians conceived of a workshop to discuss solvent exposure in railroad employees. The workshop, held with financial support from the National Institute for Occupational Safety and Health (NIOSH), was held in November 1996 and is reported in this letter.

The goals of the workshop were to assess the magnitude of the problem; to identify questions that need to be answered; to propose actions that could fill data gaps, improve the scientific understanding of solvent toxicity, support public health practice in the railroad industry, and protect the health of employees who

work with solvents; and to identify what individuals or institutions might best carry out the recommended actions. We sought broad representation from affected institutions and disciplines, rather than consensus. The expected outcome of the meeting was the identification of issues needing further clarification.

An important early consideration was ongoing litigation. Numerous railroad workers had filed legal claims against the railroads, citing long-term health damage from solvent exposure. Clinicians from all four involved AOEC clinics had testified on behalf of patients they had diagnosed with solvent-related health effects. Other experts in the field, including occupational medicine physicians, neurologists, neuropsychologists, toxicologists, and industrial hygienists, had also participated in this litigation as expert witnesses for either the plaintiffs or the defense. Railroad health and safety personnel, for their part, were constrained in what they could say and do by the industry's active involvement in litigation. Participants in litigation may, at times, avoid sharing information openly, advocate strongly for their positions, minimize uncertainties in data, avoid speculation and hypothesizing, and focus more on assessing available data than on generating new data—all approaches more suitable for advocacy than for scientific dialogue. A challenge for this workshop was therefore to achieve open, respectful, and rigorous scientific dialogue rather than constrained, defensive, and/or polarized debate. This challenge was underscored when, prior to the workshop, representatives of CSX Railroad declined invitations to attend and speak, based on the advice of counsel (although representatives of other railroad companies did participate).

Several steps were taken to promote productive dialogue. Attendance at the workshop was by invitation only, and no attorneys involved in litigation were invited. (One attorney, a NIOSH official, did attend.) Balance was carefully sought by inviting representatives of diverse points of view. A professional facilitator led the workshop. Finally, workshop organizers emphasized at the outset the importance of congenial, scientific dialogue.

The first day of the workshop consisted of a series of presentations on clinical observations to date, and on relevant scientific issues of solvent neurotoxicity, neuropsychological testing, neuroimaging, and epidemiology. Each presentation was followed by group discussion, in which areas of agreement and disagreement were identified. Several points were discussed at length:

- *The existence of chronic neurologic toxicity after solvent exposure.* Most participants considered the association between long-term, excessive solvent exposure and chronic neurotoxicity to be well-established, based on multiple scientific studies and consensus statements from prior meetings. Several participants challenged this view, pointing to methodological shortcomings and inconsistent findings in many available studies and citing published expressions of doubt. However, all participants agreed that further well-conducted scientific study, drawing on animal toxicology, clinical research, epidemiology, and other methods, would be useful in clarifying this issue
- *The extent of solvent exposure in the railroad industry.* According to participating clinicians who had evaluated large numbers of railroad employees, many patients described heavy solvent exposures, both through work process descriptions and through recounting frequent acute symptomatic responses. There were accounts of spraying entire drums of solvents onto locomotives to remove grease, working in small enclosed or semi-enclosed areas with high solvent concentrations, manually immersing parts into vapor and liquid degreasers, and washing tools, hands and clothing with solvents, all with little or no protective equipment. There were also accounts of frequent episodes of dizziness, headache, and other symptoms of intoxication, of the need for regular fresh air breaks, and of episodes of loss of consciousness while working. One workshop participant stated that "this is probably the largest cohort of workers in the U.S. with a history of such heavy solvent exposure."

However, other participants, including railroad physicians familiar with the industry, expressed doubt regarding the magnitude of exposure. They stated that the industry is quite diligent in controlling hazardous workplace exposures. They pointed out that other railroad companies have few if any claims related to solvent exposure, and questioned the apparent inconsistency among the different railroad companies. One participant recalled personal experience handling solvents and stated that railroad worker accounts of "practically swimming in solvents" did not sound plausible. Finally, several participants emphasized that ongoing litigation could bias the workers' accounts of their exposures and symptoms, and underscored the absence of objective exposure data. However, most participants agreed on the need for further information on past work practices, the types of solvents used, and changes over time. Most also agreed that an overview of the industry, comparing practices at different railroad companies, would be helpful in putting the current problem in context. All participants agreed that past industrial hygiene data, if available and of adequate quality, would be extremely helpful. In the absence of such data, there was agreement on the need for structured industrial hygiene approaches to historical exposure reconstruction.

- • *The need to confirm the safety of current practices.* Many participants expressed the view that current workplace hygiene in the railroad industry appears to be much improved in comparison to workers' descriptions of past practice. Most agreed, however, that given the possibility of excessive exposures in the past, it would be appropriate to confirm the safety of current exposures and practices through industrial hygiene evaluation of modern railroad facilities.
- • *The opportunity for scientific study related to past exposures.* There was broad agreement that, if past long-term excessive solvent exposure could be confirmed, this situation would present an important opportunity for scientific study of the health effects of solvents. A range of scientific questions deserves study. Does excessive solvent exposure cause chronic neurotoxicity? If so, which solvents are most hazardous? What levels of exposure are safe? Can specific lesions in the nervous system be identified? Are particular neuropsychological tests, neuroimaging studies, or electrophysiologic studies useful in diagnosis? A particularly detailed review of functional neuroimaging was presented by Dr Kirk Frey. Functional neuroimaging (functional magnetic resonance imaging, cerebral blood flow positron emission tomography [PET]/single photon emission computed tomography [SPECT], cerebral glucose metabolism PET imaging, and neurochemical marker imaging with PET or SPECT) are not established techniques for the diagnosis of toxic encephalopathy, but they offer powerful, sensitive approaches to research on brain function and disease. Research recommendations for functional neuroimaging studies included specific hypothesis testing rather than "fishing expeditions," careful matching of patient and control groups, and the use of both positive and negative controls.

Other research questions were discussed as well. What are the clinical features of the syndrome? Can symptoms and/or objective deficits develop anew, or worsen, after the cessation of exposure? Are some individuals more susceptible than others, and if so, are there markers of susceptibility? What approaches to treatment and rehabilitation are most beneficial? Two participants, in later comments, suggested an additional research agenda: What role do factors such as group influence, secondary gain, and litigation play in the presentation of symptoms?

Workshop participants discussed in detail the feasibility of epidemiologic study of the railroad workers. On the positive side, this is a large workforce with a tendency toward long-term, stable employment; active and retired members can be identified and located; and job histories can be reconstructed. Compared with other solvent-exposed occupational groups, such as painters, the railroad workers were exposed to relatively few

solvents and in relatively stable patterns. On the other hand, serious limitations were noted. Most importantly, several participants expressed concern that widespread belief in solvent toxicity among employees, and the high profile of litigation, might lead to unavoidable information bias and seriously hinder the study of this population. One participant maintained that these obstacles preclude valid retrospective study of the railroad work-force. The absence of adequate objective exposure information, and the difficulty of defining the syndrome in operational terms, were also recognized. However, while acknowledging these limitations, nearly all workshop participants supported the notion of further study to clarify and learn from the clinical experience to date.

The second day of the conference was dedicated to small group sessions. Before the small group sessions, all participants were asked to specify their interests (as opposed to their positions) with regard to the railroad workers. A wide range of interests emerged, with most eliciting general concurrence. Several speakers cited very broad interests, such as the application of good science to these questions, limiting the potentially distorting impact of litigation on the science, and maximizing worker safety and health. More specific interests raised included better approaches to diagnosis and clinical care of patients, improved scientific understanding of the health effects of solvent exposure, and assurance that current practices in the industry are safe. Many participants were interested in the methodological requisites of high-quality research, such as a clear case definition, accurate reconstruction of past exposures, appropriate use of neuroimaging studies, and standardized neurobehavioral test batteries. Thus a number of shared interests was evident.

Before beginning the small group sessions, each group was asked to address three questions: What are the research questions that should be answered? What are the actions that should be taken? Who should undertake these actions? After the small group sessions, participants reconvened to pool their answers and formulate recommendations.

By the end of the workshop, there was general agreement on questions that need to be answered, as shown in Table 1. In addition, workshop participants recommended several actions, as shown in Table 2.

TABLE 1

1. Coordinated clinical approaches by the clinics that are seeing these patients.
2. An industrial hygiene survey of current conditions in the railroad industry. (Working initially on CSM, NIOSH is well positioned to carry out such a survey, with collaboration of company officials. Such a survey might be limited to assessing existing sampling methods and reviewing the resulting data. Alternatively, further sampling might be appropriate.)
3. A committee with representation from labor, management, NIOSH, and academia should be formed to stimulate and oversee research in the industry. Precedents for such an effort exist in the automobile and rubber industries. NIOSH is well-positioned to lead this effort.
4. Research efforts with funding from government and industry, distributed through a systematic process using widely distributed requests for proposals and peer review of research applications, and including at least some of the following:
 - Establishment of railroad worker registries to provide the infrastructure for further study.
 - Development of a case definition suitable for studying the workforce.
 - Published case series, with ample clinical descriptions, of the subjects already included.
 - Development of a data base of neurobehavioral and other data already gathered to help generate hypotheses for further study.
 - Exploratory studies, to characterize the availability of data such as exposure data, medical records, employment records, and school records. Results of such studies would define the parameters of a feasible research program.
 - Detailed exposure reconstruction of past solvent exposures using a range of methods.
 - Identification of objective tests useful in assessing solvent neurotoxicity.
 - Analytical epidemiologic studies designed to test specific hypotheses regarding solvent toxicity, using objective measures whenever possible. These should include etiologic studies, studies of early diagnosis methods, and, of special importance, studies of treatment and rehabilitation methods.
5. Consider alternatives to litigation. Workshop participants noted the difficulty of carrying out good science in the setting of litigation, and the expense of alternative systems of claims adjudication and dispute resolution. They made no specific recommendations, but commended the concept of nonadversarial judgments.

TABLE 2

Note: A list of workshop participants and their institutional affiliations may be found on the AOEC Web site at <http://occ-env-med.mc.duke.edu/oem/aoec.htm>

Workshop Participants: Heinz Ahlers, JD, NIOSH, Cincinnati, OH; James Albers, MD, PhD, Department of Neurology, University of Michigan, Ann Arbor, MI; Edward Baker, MD, MPH, Public Health Practice Program Office, CDC, Atlanta, GA; Ted Barrett, PhD, Psychology Service, VA Medical Center, Cincinnati, OH; Stanley Berent, PhD, Neuropsychology Division, University of Michigan, Ann Arbor, MI; Margit Bleecker, MD, PhD, Center for Occupational and Environmental Neurology, Baltimore, MD; Karen Bolla, PhD, Department of Neurology, Johns Hopkins School of Medicine, Baltimore, MD; Bob Budinsky, PhD, Terra, Inc., Tallahassee, FL; John M. Dement, PhD, Division of Occupational and Environmental Medicine, Duke University Medical Center, Durham, NC; Robert B. Dick, PhD, NIOSH, Cincinnati, OH; Alan Ducatman, MD, MS, Institute of Occupational and Environmental Health, West Virginia University, Morgantown, WV; Michael Ellenbecker, PhD, Department of Work Environment, University of Massachusetts at Lowell, Lowell, MA; Robert G. Feldman, MD, Department of Neurology, Boston University School of Medicine, Boston, MA; Lawrence Fine, MD, DrPH, NIOSH, Cincinnati, OH; Kirk Frey, MD, PhD, Division of Nuclear Medicine, University of Michigan, Ann Arbor, MI; Howard Frumkin, MD, DrPH, Department of Environmental and Occupational Health, Rollins School of Public Health of Emory University, Atlanta, GA; Stephen L. Goldman, MD, CSX Transportation, Jacksonville, FL.

The following people did not attend the conference but offered comments on draft report: Joanne Green, PhD, Department of Neurology, Emory University School of Medicine, Atlanta, GA; Marc Haut, PhD, Department of Behavioral Medicine and Psychiatry, West Virginia University, Morgantown, WV; Kenneth Hudnell, PhD, Neurotoxicology Division, National Health and Environmental Effects Research Laboratory, EPA, Research Triangle Park, NC; Robert James, PhD, Terra, Inc., Tallahassee, FL; R. Michael Kelly, MD, MPH, Work and Health Institute, St. Lawrence Hospital, Lansing, MI; Katherine H. Kirkland, MPH, Association of Occupational and Environmental Clinics, Washington, DC; Douglas Linz, MD, MS, Center for Occupational Health, University of Cincinnati, Cincinnati, OH; Paula Lina, MD, MPH, Norfolk Southern Corporation, Norfolk, VA; Lynda Lombardo, MD, Institute of Occupational and Environmental Health, West Virginia University, Morgantown, WV; Timothy McCormick, DO, MPH, Union Pacific Railroad, Omaha, NE; Lisa Morrow, PhD, Western Psychiatric Institute and Clinic, Pittsburgh, PA; David Otto, PhD, Human Studies Division, National Health and Environmental Effects Research Laboratory, EPA, Research Triangle Park, NC; Brian Schwartz, MD, MS, Division of Occupational and Environmental Health, Johns Hopkins University, Baltimore, MD; Allene Scott, MD, MPH, Department of Occupational and Environmental Health, Graduate School of Public Health, University of Pittsburgh, Pittsburgh, PA; Gary Solomon, PhD, Psychiatric Consultants, PC, Nashville, TN.

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Section Description

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