Ann. occup. Hyg., Vol. 49, No. 3, pp. 197–199, 2005
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Published by Oxford University Press
doi:10.1093/annhyg/mei008

Commentary

Occupational Exposure Visualization Comes of Age

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Received 10 January 2005; in final form 16 February 2005; published online 29 March 2005

It has been 20 years since video exposure monitoring (VEM) was embraced as an instrument to provide better documentation of at-risk workers both in Europe and in the United States. Although the first VEM efforts started independently, the passion for this new technology and what it can do to improve the occupational environment has been advanced by a small but growing team of researchers on both sides of the Atlantic. As technology advances over the next ten years, VEM is set to become one of the major instruments in the arsenal of occupational exposure assessment and control.

The technical aspects and uses of VEM are reviewed in this issue by some of the key players in these developments (Rosén *et al*., 2005). In the 1980s a small group of researchers from the engineering control technology branch of the National Institute for Occupational Safety and Health (NIOSH) were working on developing controls to reduce worker exposure to airborne chemicals during batch processing at a manufacturing plant in the Midwest. The research team consisted of a chemical engineer and two occupational hygienists, one specializing in the use of real-time instruments and the other in ergonomics. The diverse talents and skill sets of this team formed a synergy that took advantage of emerging technologies in the portable computer, video and real-time sensor markets (McGlothlin *et al*., 1987; 1996). The result of the application of this new technology, VEM in the United States was very promising. For the first time, researchers could discern exposure sources and the interaction between work practices and engineering controls such as local exhaust ventilation. Pinpointing exposure sources led to cost effective controls and the development of an effective feedback mechanism for showing workers and management where they had exposures and where they could be controlled. Overlaying videography with the real-time particulate sensors proved very effective.

At the same time, unknown to the NIOSH researchers, a like-minded group of researchers at the National Board of Occupational Safety and Health in Sweden (now called the National Institute for Working Life) were considering ways to engage exposed workers in environmental control processes (Rosen and Lundstrom, 1987). The goal of this group was to develop methods for workers to see with their own eyes the potential hazards (in real-time) to which they were being exposed.

Computer and video technology were getting less expensive and more portable, and real-time instruments (in the United States the instrument was the handheld aerosol monitor or HAM) were being used for particulate monitoring. By visualizing the work being done and combining it with real-time monitoring, occupational hygienists had a formula for success. They could provide a convenient means of feedback for workers and management and they had a new weapon to 'see' exposure sources and targeting controls.

As the benefits of this new occupational exposure assessment method became obvious, other NIOSH researchers applied this method to their projects, resulting in a popular NIOSH government publication titled 'Analyzing workplace exposure using direct reading instruments and video exposure monitoring techniques', (CDC/NIOSH, 1992). Researchers for the National Institute for Working Life in Sweden identified two methodologies to evaluate worker exposure to air contaminants, one of which was commercialized (Walsh, 2002). From 1980 through the 1990s NIOSH researchers explored different ways to use this technology. They concluded that while the technology was unique, it would primarily be used to

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augment traditional integrated sampling methods. Meanwhile, in Europe, there was extensive technical development and the group of researchers expanded from the Swedish group to include research groups from Finland, Austria and UK. Many successful studies were conducted using this method which were subsequently published (Andersson and Rosén, 1995; Walsh *et al*., 2000; Rosén and Andersson, 2002). These European researchers were able to showcase their research effort at the International Occupational Hygiene Association meeting in Bergen, Norway in 2002 (Walsh, 2002).

Since 1999 Purdue's Exposure Assessment Research Laboratory (PEARL), at Purdue University has concentrated on advancing this method of exposure assessment. Applications have varied from particulate monitoring in clay making in the Art Department at Purdue, to noise and jet engine emissions at airports, to solvent and particulate exposure in numerous pharmaceutical industries, to detection of radiological trace elements as a teaching tool for Purdue lab technicians (McGlothlin, 2002; McGlothlin and Xu, 2003; Xu and McGlothlin, 2003; Wang and McGlothlin, 2004). PEARL has advanced the technology from a clunky array of instruments that needed to be wired, to a small, streamlined system with wireless data and video transmission and internet capabilities. Commercial interest in VEMs from PEARL's research has been high and commercial ventures are underway.

There are challenges in advancing VEM both in Europe and in the United States. These challenges have resulted more from competition than the technology itself. For several years companies that made real-time sampling instruments focused on data loggers to capture information and later uploaded the information to computers for analyses. However, over the past few years companies have integrated radio transmitters with their real-time sensors so that the data can be transmitted directly to a computer. While this is applauded in the occupational hygiene community, a disturbing trend has occurred where the communications protocol developed is proprietary. This means that the occupational hygienist cannot build a flexible VEM system—they have to use the manufacturer's system. If there are limitations to the sensor then it becomes a problem and, I fear, a means of slowing down the progress of protecting workers using VEM. In the United States this is nothing new as turf battles on the propriety of technology have been brewing for years, particularly in the electronics industry. Unfortunately, this trend is occurring with environmental sensor manufacturers as they see potential increased revenues from adding software and telecommunications to their sensors.

As time passes, I believe there will be market forces that encourage sensor manufacturers to develop 'plug and play' technology for their sensors because of the increased costs to maintain operations that are not at the core of their business. Also, customers may not purchase their sensors because they are specific and not cost-justified. In the United States, 9/11 has brought a sober change to the way the Americans regard terrorism. However, it has resulted in a boom for manufacturers who make biological, radiological and chemical sensors. The Department of Defense (DoD) has been one of the biggest customers. Perhaps it will be for the DoD to dictate uniform standards to these manufacturers so as to have maximum flexibility in protecting the United States and its allies.

This is an exciting time for occupational hygienists as VEM reconnects the health professional with the workforce to focus on exposure sources and cost effective controls. The technical changes are important—the hygienist can see and act on sources of contamination—but the human changes in the job that the technology permits can also overturn traditional approaches. Rosén (2002) emphasized this three years ago in his Annals editorial looking ahead to the Bergen conference. The new review (Rosén *et al*., 2005) also highlights the possibilities for collaboration and training, and the greater likelihood of workers accepting and using control measures if their success has been visually demonstrated.

Traditional sampling methods will not be easily replaced as most compliance standards are based on these methods. However, in order for occupational hygiene to advance as a profession it cannot be business as usual. Occupational hygienists have the means of doing a better job using VEM as an instrument in their arsenal to protect workers and workers deserve the best we can give them.

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