

Benefits of New Sensor Technologies to Measure (Occupational) Exposures

Key message

Occupational exposure to hazardous substances is a significant cause of work-related illnesses and deaths. According to the International Labour Organization (ILO), over 2.3 million people die each year from work-related accidents or diseases. Inhalation hazards are responsible for nearly half of these. Novel air quality sensors can play a crucial role in preventing these cases by providing real-time data on hazardous substances such as particulate matter, volatile organic compounds (VOCs), and gases like carbon monoxide and nitrogen dioxide. However, more effort is needed for successful implementation of these devices and subsequently better protection of workers worldwide.

Traditional methods vs. sensor technology

Occupational hygienists play a crucial role in ensuring the health and safety of workers by identifying and managing workplace health hazards. Typically, they are involved in the identification, assessment and evaluation of risks and when needed the implementation of control measures. Traditionally, risk management decisions have often been based on limited data points as measurements are often time consuming and costly to obtain. Consequently this can lead to inaccurate assessments and inadequate protective measures. In addition, most methods used for the assessment provide average concentrations over the total measurement period, missing important information on times when exposure may be high. Knowledge about peaks in exposures or insights on specific activities that increase exposure would allow more efficient control of exposures. The advent of new sensor technologies offers the potential to gather more cost-effective, comprehensive and continuous data, improving risk assessments and management. Air sensors, especially when used together with contextual information about work activities and surroundings, for example with body-worn cameras, provide valuable information to better target control measures. These technologies enable more precise monitoring, trend analysis, and more rapid and targeted management of risks, offering a unique way to prevent workers from getting ill or injured.

State of the art technology

In the last couple decades low-cost air quality sensors have been developed to monitor environmental air pollution and have been instrumental in the citizen science movement. But, the application of these devices in the occupational setting has not progress as far. Sensor solutions became more mature with recent advancements that improved the accuracy, sensitivity, and response time of these sensors. Recent research highlights the practical applications of these new sensor technologies in various industries complementing existing methods. Studies demonstrate their effectiveness in monitoring air quality, detecting hazardous substances, and providing actionable data for risk management.

Nevertheless, at this time, the use of sensors for comparing with limit values as is often done for regulatory compliance, is most challenging. Particularly, relatively low-cost sensors do not currently not provide the same level of accuracy or reliability in performance as standard methods. However,

these same types of sensors have now become a complementary ‘indicative’ or secondary method for filling in information on air pollution patterns in a cost-effective way for environmental regulators. Low-cost air quality devices are now more widespread both for personal use but also are increasingly used by government authorities and researchers to provide air quality information in areas underserved by traditional air monitoring. Air quality sensors could play the same role in workplaces by increasing the information that can be used to better understand temporal and spatial as well as between-worker variation in exposures to help manage risks more effectively. To do this it is important to understand the necessary quality assurance and quality control needed to enable sensors to play this role. We therefore call for authorities involved in occupational hygiene work (e.g. occupational health and safety regulators, standardisation entities) to engage in developing a set of performance and data quality objectives for secondary or ‘indicative’ instruments such as sensors that are analogous to those used by environmental regulators for use in occupational applications. This would include guidance on how sensors can complement standard methods, enabling health and safety professionals to be able to reliably use these instruments to enhance their monitoring and control strategies.

Guidelines and example application for use of sensors can be found here: <https://www.we-expose.eu/guidance-on-low-cost-sensors-for-managing-occupational-exposures>

How could sensors enhance workplace risk management?

1. **Sensors can be used as a tool to stimulate ‘worker science’.** Sensors can empower workers to better understand their exposures and take informed action to protect themselves and their colleagues. Workers have a responsibility just as the employer does to ensure a safe working environment.
2. **Identifying sources or activities that influence exposure.** The continuous measurements provide valuable information in time and place. When identifying peaks in the exposure profile, sources or activities can be identified that increase the exposure.
3. **Evaluating the effectiveness of risk management measures.** By comparing exposure before and after the implementation of a control measure, insights can be obtained on the effectiveness of the control. Many control measures require finetuning and selecting the correct settings for a successful implementation. Sensors can help to find the most effective approach.
4. **Enhancing training.** Sensors particularly in combination with body-worn cameras or other means of gathering contextual information, are a valuable source for training purposes. Training material can be developed to illustrate the effect on exposure of e.g. different working procedures to motivate the importance of following a specific procedure. As with any personal data collection, it is important to ensure privacy and legal considerations are met.

Call to action: When taking the burden of occupational diseases seriously, sensors are a valuable additional tool to current more traditional measurement methods. Acting now by integrating these methods more in current processes helps preventing occupational diseases.

Recommendations

To support this action we recommend the following:

- **Promote** the use of sensors to raise awareness about the opportunities.
- **Implement** sensors in guidelines, standards and regulation on measuring exposures at the workplace.
- **Generate** a set of guidelines or standards and data quality objectives for indicative or secondary methods of monitoring workplace exposures to provide confidence to health and safety professionals about sensor methods
- **Support** research on getting sensors even more mature for regulatory applications.

More information: EPHOR studies the working-life exposome and aims to reduce the burden of Non-Communicable Diseases (NCDs) on EU healthcare systems, improve the productivity of the EU workforce, and increase the competitiveness of EU industry. More information is available via: <https://www.ephor-project.eu/>