

The Early Career Occupational Hygienist Award

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Use the space below to describe your career so far in no more than 150 words.

I am an Occupational Hygienist at Cura Terrae (formerly Envirocare), where I have worked since 2023. I identify workplace health risks, conduct exposure monitoring, and recommend solutions to protect worker health. My work includes air quality assessments, noise and vibration surveys, and often using real-time monitoring technology. Previously, as an Occupational Hygiene Advisor in Indonesia (2020–2022), I addressed severe air pollution from regional haze incidents, enhancing my expertise in environmental health hazards and risk communication. I hold a strong academic background in occupational health and safety, with research on health protection programs during haze periods (Master's) and indoor air quality (Bachelor's). Actively progressing through British Occupational Hygiene Society (BOHS) modules, I am committed to advancing in the field. My experience reflects a dedication to safeguarding worker health through evidence-based practices, innovative monitoring, and continuous professional development.

Use the space below to write your piece on the following question - *“What are the pros and cons of real-time monitoring and what direction do you see it taking in the future?”*
This must be between 1500 and 3000 words.

OCCUPATIONAL HYGIENE: REAL-TIME CHALLENGES AND HOPES

“It is like living in Gotham City!” That is what I used to think every time the thick yellowish haze swallowed Pekanbaru, a city on Sumatra Island in Indonesia, where I worked as an Occupational Hygiene Advisor from 2020 to 2022 during the pandemic. The air was not just hazy, it was toxic! People breathed smoke from forest fires burning massively for the palm plantation industry, worsened by peat fires and hotspots due to drier, hotter temperatures from climate change. This had plagued the region for nearly 25 years, though I only lived there for almost eight. At its worst, it seemed people were used to it. We monitored particulate matter (PM₁₀ and PM_{2.5}) with direct reading instruments, evaluated the results, and recommended safety measures; dust masks were strongly advised, especially outdoors. Sadly, most people ignored the advice.

That experience hit me hard. It was not just a job, it was personal. It sparked a drive in me to protect people from these imminent yet overlooked dangers. I started research using the data we had collected to assess our health protection programme’s effectiveness during haze periods. However, maintaining the dust monitoring program was tough. It required trained operatives, and in the heavy haze, that meant risking their safety. Plus, with so many areas to cover, we needed more equipment and staff, which drove up costs. The gear also needed calibration from an authorised service abroad, adding expense. So, we turned to cheaper real-time sensor monitors. They worked brilliantly, with data accessible online, a real treasure! That is why I am so fascinated by real-time monitoring technology in occupational hygiene.

The world is evolving fast, technology is advancing, industries are shifting, and worker safety must keep pace, especially as new hazards emerge. Industry 4.0 is transforming workplaces with tools like automation and smart sensors (Leso et al., 2018). Real-time monitoring, offering instant updates on hazards like dust or noise, feels like a game-changer. But it is not all sunshine and rainbows. In this essay, I will share what I have learned about its benefits, challenges, and future, drawing from my time in Sumatra and my early career work as an occupational hygienist in the UK.

Why Real-Time Monitoring Feels Like a Breakthrough

Occupational hygiene monitoring traditionally takes time. We collect samples, send them to a lab, and wait for results before evaluating, especially for air monitoring. It works, but in today’s fast-paced world, it can feel too slow, particularly when immediate action is needed. In my first year as an occupational hygienist in the UK, I faced cases where clients needed quick reports, like a glassblowing lab that had to shut down until results arrived, or an investigation into xylene migration between labs due to draining activities. Unfortunately, lab results take time. Meanwhile, workplace noise, vibration, and hand-arm vibration assessments are relatively more efficient since the equipment provides direct readings. Some noise dosimeters even offer real-time Bluetooth monitoring, giving us data instantly. They show exactly when noise spikes, how long it lasts, and who is at risk. Though not a formal report, real-time monitors help identify issues faster and plan safety measures. It was exciting to help clients make their workplaces safer and healthier. Real-time monitoring feels essential in occupational hygiene. It was eye-opening to learn that NIOSH has been championing direct reading and real-time monitoring since 2014 with their “Right Sensors Used Right” initiative (NIOSH, 2014). It is thrilling that a formal body is collaborating with academics, industries, and health and safety professionals to advance occupational hygiene through real-time technology.

A Personal Spark: From Haze to Purpose

This is not just about technology; it is about people. In 2019, one of the worst haze periods occurred on Sumatra island, creeping across Southeast Asia countries. This drove me to study how PM_{2.5} particle exposure affected workers both indoors and out. The risks were real, and direct reading monitors became our lifeline. We set thresholds, and when levels stayed high for days, we activated the emergency management team. Though the dust monitors had their challenges. We initially used a real-time aerosol mass monitor; it was effective but expensive and difficult to maintain. It also required multiple operatives for continuous monitoring, as we needed to cover a large area. However, we did not want to risk the dust monitor operative's safety. So, we needed a safer alternative. We switched to other real-time air quality sensors to cover multiple remote areas, as they were simpler and more affordable, though perhaps not as reliable as the aerosol mass monitor. It was a trade-off, but it showed me the importance of real-time monitoring in emergencies, even with flaws.

What's Great About Real-Time Monitoring

Here is why I am excited about real-time monitoring:

- **Indicative insight:** While using a dust monitor at a wastewater treatment site, I expected the main dust source in the shed area to be from the chute dispensing process to the shovel. However, the real-time dust monitor revealed a different primary dust source, challenging our initial assumptions. Dust levels in the area peaked during the operation of a mobile dust sweeper! In other cases, however, the real-time monitor would confirm our initial assumptions.
- **Early Detection:** I learned it in a factory where steel was ground; they used vibration sensors on power tools. Workers logged in, and the system tracked their daily exposure, alarming when limits were near, flagging operatives to stop using tools and prevent overexposure.
- **Safety Empowerment:** Wearables, like smartwatches that buzz when noise is too loud, alert users to protect themselves. This aligns with the Operator 4.0 concept (Romero et al., 2020), which envisions workers enhanced by smart technologies such as wearables, augmented reality, and real-time monitoring to improve safety, efficiency, and well-being. It is educational and empowering, I love that!
- **Easy Access:** Some real-time monitors are now available to the public; like PM_{2.5} monitors for carpenters' workshops, including the air quality sensor. It puts safety tools in more hands and raises occupational hygiene awareness.
- **Continues data recording:** Real-time aerosol mass monitors and air quality sensors operate non-stop, providing immediate insights into air quality shifts and enabling quick responses to hazards. Over time, this data helps spot patterns and supports long-term decision-making. In Sumatra, real-time sensors allowed us to act swiftly to protect workers, even though we had to process the data manually. Wallace et al. (2011) found direct reading tools like the DustTrak could overestimate dust levels by two to three times compared to lab tests. Still, it was progress worth having!
- **Real-time Comparative Analysis:** With multiple sensors deployed across remote locations, real-time data enables direct exposure level comparison between areas. This helps quickly identify and prioritise at-risk locations or groups, tracking exposure variations, and assessing trends across different areas, leading to more informed decision-making and targeted interventions.

These wins make me think real-time monitoring, especially with AI, could be a game-changer, turning data into action in no time.

Where It Gets Tough

But it is not all rainbows. There are real challenges:

- **Accuracy Concern:** Current sensors might detect total VOCs but cannot specify whether it is xylene or another substance. While helpful for quick checks, occupational hygienists still need lab analysis for specific substances. Also, though real-time monitors can alert workers to peak exposures, we typically need long-term personal monitoring for time-weighted averages (TWA) to prove compliance with occupational exposure limits (HSE, 2023).
- **Data Flood and Skills:** Real-time monitoring generates masses of data. I have seen raw data from aerosol mass monitors, as well as data from computer ergonomic programs, overwhelm teams, leaving them unsure of what to focus on. NIOSH (2014) highlighted this, stressing that occupational hygienists must choose the right sensors and have tools to manage and analyse the data effectively.
- **Privacy Worries:** Workers often dislike being monitored, but let's be honest, no one enjoys it! Studies show that many feel uneasy about wearables (Salamone et al., 2021; Mueller et al., 2024). Similar concerns arose when I was in Sumatra, where ergonomic monitors were fitted to computers. Although these sensors were not worn directly, users still worried they were being tracked for productivity in using the computers rather than just for health.
- **Cost:** While some sensors are affordable, developing and using bespoke 'right sensors' can be expensive, requiring collaboration between technology creators, end-users, and occupational hygienists. Smaller companies might struggle, limited to basic real-time monitors.
- **Legal Limitations:** Direct reading data often cannot stand up in court. In the UK, only HSE-approved methods like MDHS 14/4 for dust are legally accepted, as they are rigorously tested for precision (HSE, 2023). Real-time tools are great for quick risk assessments but not yet reliable for legal standards. I learned that direct reading monitors are brilliant for spotting concerns on-site, but for proving compliance, we still need lab data. We have to get it right!

What's Next: A Hopeful Future

I see a bright future for real-time monitoring:

- **All Hands on Deck:** It will take an interdisciplinary approach, with occupational hygienists working with sensor experts, engineers, data analysts, and behavioural scientists to understand workers, particularly for wearable technologies to integrate real-time monitoring with effective risk communication (NIOSH, 2014).
- **Hybrid Solutions:** For legal challenges, hybrid systems could use real-time monitors to flag issues and lab methods like MDHS for court-ready proof. With collaboration, real-time sensors might one day be precise enough for legal use.
- **AI Stepping In:** I imagine Artificial Intelligence (AI) analysing data, spotting risks, suggesting actions, and even modelling how interventions, such as varying LEV setups, general ventilation, or welding tool extractors, could control welding fume levels in a workshop. Fisher et al. (2023) suggest AI-driven wearables could reduce health hazards by tracking risks in real time. Johnston et al. (2004) showed that EASE (Estimation and Assessment of

Substance Exposure), an AI tool, can estimate personal TWA exposures, paving the way for advancements in occupational hygiene, though its accuracy was limited. This undoubtedly exciting, but can we fully trust it?

- Keeping It Human: Technology is not perfect. I have seen aerosol mass monitors mistake mist for haze. Research backs this up, Javed and Guo (2021) found DustTrak monitors doubled PM_{2.5} readings in humid conditions, misjudging reality. In occupational hygiene, context matters, and that is where the human touch steps in. In my view, human judgement remains irreplaceable.

I dream of a future where real-time monitors are smart, wearable, and available to track hazards like noise, vibrations, and hazardous substances, with AI making sense of it all. But we need rules on accuracy, privacy, and use to ensure it complements lab methods and hygienist expertise.

Why Real-Time Monitoring Matters to Me

Experiencing the haze in Sumatra, researching it, and knowing potential carcinogenic materials were in the air was deeply concerning, especially when colleagues overlooked the risks. It felt like complacency to me, though the danger was obvious, backed by dust measurements. On a broader scale, I was frustrated by the lack of immediate action from authorities, perhaps due to poor risk communication or the distance making it seem less urgent since they could not see it. I wonder if wearable real-time dust monitors with alerts and recommendations could have educated and protected my colleagues. Maybe visible online dust level maps, showing real-time risks to health, could have raised awareness off-site. But I also realised people are involved, and we cannot always expect others to react as we hope. This taught me the value of teamwork, including behavioural scientists, to understand workers and all perspectives better. We needed better tools. Real-time monitors were a start, and with wearable tech, AI, and improved communication, we could protect workers and empower them to protect themselves. That is why I care; every reading is someone's breath, someone's life.

Still, I wonder: could wearables stress workers more than help? Will we rely too much on technology and lose sight of the bigger picture? I don't have all the answers, but I believe the future lies in collaboration, refining technology, and thoughtful AI integration to support both hygienists and workers.

Moving Forward: Balancing Innovation and Humanity

I believe real-time monitoring is the future of occupational hygiene. It flags risks quickly, empowers workers, and could transform workplace health and safety. But it has challenges, accuracy, privacy, data overload. The future looks bright with AI and collaboration, but we must always put people first.

Occupational hygiene is a blend of science and art. For me, it is also about combining sensor technology with a deep understanding of workplaces and the people. If we can do that, we are not just keeping pace, we are creating a safer, healthier world. That is worth pursuing!

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