A STEPWISE APPROACH IN OCCUPATIONAL EXPOSURE ASSESSMENT

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1. Introduction

An average Malaysian employee spends between eight to twelve hours at work for most days of the week, accumulating between 50,000 and 80,000 working hours throughout their lifetime. During this period, workers inevitably encounter various occupational exposures, including physical, chemical, biological, ergonomic and psychosocial agents. Although not all exposures are harmful, some have the potential to cause adverse health effects, thus warranting careful classification as occupational hazards. The distinction between exposure and hazard remains fundamental in occupational health practice. As Malaysia transitions into a strengthened regulatory environment following the enforcement of the Occupational Safety and Health (Amendment) Act 2022 on 1 June 2024, the importance of robust exposure assessment has increased substantially. The amended OSHA markedly expands its coverage to include *all* workplaces, such as public services, statutory authorities and private institutions, reinforcing the need for systematic identification and evaluation of workplace risks.

Risk, in occupational health terms, is understood as the probability of harm resulting from exposure to hazardous agents. However, establishing a clear cause-effect relationship between workplace exposure and disease remains difficult due to complex factors such as

varying job histories, concurrent non-work exposures, and long latency periods associated with occupational illnesses. As work arrangements diversify (including hybrid and remote models) exposure assessment must increasingly account for non-traditional environments and emerging psychosocial and ergonomic risks.

2. Malaysia's Strengthened Regulatory Framework

Malaysia's revised OSHA framework represents a major evolution in the country's occupational safety and health landscape. With its expanded scope, OSHA 2022 now applies comprehensively across all industries and workplace types, including those previously excluded such as private healthcare, educational institutions, co-working hubs and fitness centres. The clarification that remote work also falls under OSHA's purview underscores the government's recognition of changing work patterns.

Under the amended Act, employers must conduct documented risk assessments and are legally obligated to implement preventive measures based on the assessment outcomes. This requirement ensures that risk assessment is not merely a procedural exercise but a substantive one that must lead to action.

Workplaces employing five or more workers are now mandated to appoint an Occupational Safety and Health Coordinator, while all employers must establish appropriate emergency procedures and assume responsibility for the safety and health of contractors and subcontractors operating under their control.

Employee protections have also been strengthened, including the statutory right to refuse unsafe work when imminent danger exists and the employer has failed to address it.

Furthermore, the legal consequences of non-compliance have been heightened, with revised penalties reaching up to RM500,000 and the possibility of imprisonment for severe breaches, reflecting the government's commitment to building a safer and more accountable work culture.

The regulatory framework also underwent consolidation through the repeal of the Factories and Machinery Act 1967, with all machinery-related oversight now integrated under OSHA via the Plant Requiring Certificate of Fitness Regulations 2024 and the Licensed Person Order 2024. This integration modernises and streamlines regulatory oversight.

3. Hazard Identification

Hazard identification is the first essential step in any occupational exposure assessment. It involves the systematic examination of workplace environments, materials, tools and practices to identify elements that may pose health risks. With OSHA now applicable to a

wider spectrum of workplaces, hazard identification must encompass risks present in both traditional industrial settings and contemporary workspaces such as offices and remote workstations. Ergonomic challenges including poor posture, suboptimal workstation setups and prolonged static positions are increasingly recognised as important hazards, as are psychosocial factors such as work-related stress, isolation and emotional strain. Individual worker characteristics, such as age, pre-existing health conditions, pregnancy status and overall susceptibility, must also be considered, as these factors influence the extent to which exposure may lead to harm.

4. Exposure Assessment Methods

4.1 Monitoring Data

Direct measurement remains one of the most objective and reliable methods in exposure assessment, employing calibrated instruments to quantify hazards such as airborne chemicals, noise levels, temperature extremes and particulate concentrations. In Malaysia, Chemical Health Risk Assessment (CHRA) continues to be legally required under the USECHH Regulations 2000, and must be conducted by assessors registered with the Department of Occupational Safety and Health (DOSH) using the CHRA Manual (3rd Edition, 2018).

Biological monitoring, including the evaluation of biomarkers like urinary phenol for benzene exposure or blood cadmium levels, provides additional insight into internal dose. Despite its accuracy, direct monitoring can be resource-intensive and logistically demanding, especially for small and medium enterprises that may lack the technical expertise or budget.

4.2 Self-Reporting Approaches

Self-reporting techniques such as structured interviews and validated questionnaires play an important role in assessing exposures that are difficult to capture through measurement, particularly those related to psychosocial and ergonomic risk factors. Tools like the DASS-42 allow practitioners to evaluate emotional states including stress, anxiety and depression. The amended OSHA elevates the importance of psychosocial and ergonomic monitoring, granting the Minister of Human Resources the authority to issue specific requirements in these areas.

While useful, self-reported data may be prone to biases related to memory, perception or lack of hazard awareness.

4.3 Expert Assessment Method (EAM)

The Expert Assessment Method is particularly valuable in situations where exposures must be estimated retrospectively or where direct measurements are impractical. By analysing detailed occupational histories and task-specific information, experts assign qualitative or semi-quantitative exposure levels based on known hazard profiles. EAM demonstrates high sensitivity and specificity and has been successfully applied in Malaysian studies assessing exposure to carcinogens, thus contributing significantly to the advancement of occupational epidemiology in the country.

4.4 Direct Observation

Direct observation involves examining workplace activities in real time or through recorded video to identify exposure patterns, ergonomic risks and unsafe behaviours. Tools such as the Rapid Entire Body Assessment (REBA) structure this process by evaluating body postures, movements and applied forces. As musculoskeletal disorders gain recognition as a major occupational health concern and enhanced by OSHA's widened emphasis on ergonomic requirements, direct observation becomes an increasingly important method for recognising and mitigating such hazards.

4.5 Predictive Modelling

Predictive modelling uses mathematical algorithms and simulated scenarios to estimate exposures when measurements are unavailable. These models often integrate monitoring data, environmental conditions and geographic information systems (GIS) to estimate potential exposure levels among workers and surrounding communities. The growing influence of the exposome paradigm, which considers the cumulative impact of lifelong environmental exposures, expands the relevance of predictive modelling in modern occupational health.

5. Risk Characterization

Risk characterization synthesises hazard information and exposure data to determine the overall likelihood and severity of harm. This step guides prioritisation of control measures, enabling organisations to focus on the most significant risks. With the amended OSHA mandating both the performance and implementation of risk assessments, employers must ensure that their conclusions translate into timely and effective interventions. The characterization process therefore becomes not only an analytical procedure but a regulatory requirement linked to organisational accountability.

6. Implementation of Control Measures

Once risks have been characterised, appropriate control measures must be implemented according to the established hierarchy of controls. Eliminating hazards entirely remains the most effective approach, followed by substituting them with safer alternatives. Engineering controls such as improved ventilation systems, noise attenuation devices or machinery enclosures act at the source of exposure and are preferred when elimination is not feasible. Administrative controls, including job rotation, training, safe-work procedures and health surveillance, help regulate exposure by modifying the way work is carried out. Personal protective equipment (PPE), although essential, should always be considered the final line of defence.

Under the amended OSHA, employers must also establish comprehensive emergency response procedures and coordinate safety measures among contractors and subcontractors working on-site. These provisions strengthen overall workplace readiness and foster safer operational practices across diverse industries.

7. Conclusion

Occupational exposure assessment remains a cornerstone of workplace health protection. With the implementation of Malaysia's updated OSHA framework, exposure assessment is now both a scientific practice and a legal requirement applicable to all workplaces. A methodical approach, from hazard identification through exposure assessment, risk characterization and implementation of controls ensures transparency, regulatory compliance and the highest standard of worker protection. As the nature of work continues to evolve and new forms of exposure emerge, Malaysia's strengthened occupational safety and health legislation provides a robust foundation for safeguarding employee well-being across sectors.

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