J-OSH
Journal of Occupational Safety and Health
https://journal.stikespemkabjombang.ac.id
Volume 01 Number 01
March 2026
e-issn: xxxx-xxxx

OCCUPATIONAL HEALTH AND ENVIRONMENTAL RISK MANAGEMENT: INTEGRATING OCCUPATIONAL HEALTH, INDUSTRIAL HYGIENE, ENVIRONMENTAL SAFETY, AND EMERGENCY RESPONSE

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Submitted:
1 March 2026
Accepted:
15 March 2026

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ABSTRACT

Occupational health and environmental risk management provides an integrated approach to preventing work-related injury and disease, controlling hazardous exposures, protecting the surrounding environment, and maintaining organizational resilience during emergencies. This manuscript synthesizes the conceptual and professional content of the source document into an academic framework encompassing occupational health, industrial hygiene, environmental and safety management, and emergency response. A narrative thematic method was used to organize the source material and its cited references into five analytical domains: the risk management cycle, functional differentiation among professional teams, environmental and social impacts, professional competencies, and emergency preparedness. The synthesis indicates that effective risk management requires systematic hazard identification, risk assessment, control according to the hierarchy of controls, and continuous monitoring. Occupational health services primarily manage worker health outcomes, fitness for work, health surveillance, and case management, whereas industrial hygiene focuses on recognizing, evaluating, and controlling workplace exposures. Environmental and safety professionals extend this system to pollution prevention, legal compliance, incident investigation, and management-system integration. Emergency Response Teams provide the operational capacity to contain fires, chemical releases, serious injuries, and other acute events before they escalate. The findings further show that these functions should not operate in isolation; their integration supports stronger governance, more reliable exposure control, improved worker well-being, and better environmental and social performance. Professional development should therefore combine clinical, technical, managerial, communication, and emergency-response competencies. An integrated governance model is recommended in which occupational health, industrial hygiene, environmental safety, and emergency response share risk information, surveillance findings, control priorities, and performance indicators.

Keywords: Occupational Health; Environmental Risk Management; Industrial Hygiene; Occupational Safety; Emergency Response; Workplace Health; ESG

https://doi.org/10.33023/jikep.v11i3.3349

Introduction

Workplaces generate a broad spectrum of hazards that may affect workers, organizational assets, the surrounding environment, and nearby communities. Physical agents, chemical substances, biological hazards, ergonomic demands, psychosocial pressures, unsafe work processes, and environmental releases may produce both immediate and long-term consequences. These consequences include occupational injuries, work-related diseases, reduced work capacity, environmental contamination, operational disruption, legal liability, and loss of stakeholder confidence. Occupational Health and Environmental Risk Management (OHERM) addresses these interconnected concerns through a systematic process of hazard recognition, risk evaluation, control, monitoring, and continual improvement.

The underlying purpose of occupational health is not limited to treating illness after it occurs. It includes the promotion and maintenance of workers' physical, mental, and social well-being; the prevention of health impairment caused by working conditions; and the adaptation of work to workers' capacities. This preventive orientation is consistent with the World Health Organization's emphasis on healthy work environments and with broader contemporary approaches that connect worker safety, health, and well-being (World Health Organization [WHO], n.d.; Chari, 2018). Environmental risk management expands this perspective by considering how workplace operations may affect air, water, soil, ecosystems, and communities beyond the facility boundary.

In practice, OHERM is implemented through several complementary professional functions. Occupational health teams monitor workers' health, conduct fitness-for-work assessments, support health promotion, manage work-related cases, and coordinate rehabilitation. Industrial hygiene teams identify and measure hazardous exposures, interpret findings against applicable standards, and recommend controls. Environmental and safety professionals manage regulatory compliance, pollution prevention, incident investigation, emergency planning, and occupational health and safety management systems. Emergency Response Teams (ERTs) provide rapid and coordinated action during fires, chemical releases, explosions, serious injuries, natural hazards, and other critical events. Although these functions are frequently organized in separate departments, their work is interdependent.

The integration of these functions is increasingly important because modern organizations face complex and dynamic risk profiles. Digital systems, new materials, changing production technologies, climate-related events, workforce diversity, and expanding sustainability expectations have altered the context of occupational safety and health. Future-oriented occupational safety and health systems must therefore be adaptive, data informed, and capable of anticipating emerging

risks rather than relying solely on reactive compliance (Felknor et al., 2023). In addition, occupational health and safety management systems can contribute to sustainable organizational performance by reducing injury, preventing environmental loss, and strengthening social responsibility (Kineber et al., 2023).

This manuscript aims to reorganize and synthesize the source material into a structured academic discussion of OHERM. Specifically, it examines: (1) the core risk management cycle; (2) the respective and overlapping roles of occupational health, industrial hygiene, environmental safety, and emergency response; (3) the environmental and social implications of occupational health and safety practices; (4) professional competency and career development; and (5) an integrated governance approach for organizational implementation.

Methods

This manuscript used a narrative, literature-based synthesis. The primary source was the uploaded chapter on Occupational Health and Environmental Risk Management, including its descriptions of professional scope, competency pathways, emergency-response functions, conceptual frameworks, and reference list. No primary data were collected, and the manuscript should therefore be interpreted as a conceptual and professional synthesis rather than an empirical effectiveness study or a systematic review.

The source content was reorganized through thematic analysis. First, statements were grouped according to the risk management sequence of hazard identification, risk assessment, risk control, monitoring, and evaluation. Second, role descriptions were categorized into occupational health, industrial hygiene, environmental and safety management, and emergency response. Third, professional qualifications and competencies were synthesized into broad domains of clinical competence, exposure science, regulatory knowledge, management-system capability, communication, leadership, and emergency preparedness. Fourth, the environmental and social implications of occupational health and safety were examined in relation to sustainability and environmental, social, and governance (ESG) principles.

The cited sources in the original document were used to support the conceptual synthesis, including guidance from WHO, the International Occupational Safety and Health competency framework, workplace emergency guidance from the Occupational Safety and Health Administration, occupational health and safety management literature, and research on safety climate and environmental risk management. Because the original document did not report a database search strategy, screening process, or formal quality appraisal, no claims of systematic evidence coverage are made.

Results and Discussions

The Occupational Health and Environmental Risk Management Cycle

The synthesis identified a four-stage cycle as the operational foundation of OHERM: hazard identification, risk assessment, risk control, and monitoring and evaluation. Hazard identification requires recognition of physical, chemical, biological, ergonomic, psychosocial, process-safety, and environmental hazards. The purpose is not only to list hazards but also to understand their sources, pathways, exposed populations, and potential consequences.

Risk assessment combines the likelihood of an unwanted event with the severity of its consequences. In occupational health, this may involve estimating exposure intensity, duration, frequency, and worker susceptibility. In environmental management, assessment may also consider the movement of contaminants beyond the workplace and their effects on surrounding communities or ecosystems. A structured assessment enables organizations to prioritize resources and distinguish routine risks from those requiring urgent intervention.

Risk control should follow the hierarchy of controls. Elimination and substitution are preferred because they remove or reduce hazards at their source. Engineering controls, such as enclosure, local exhaust ventilation, isolation, and process redesign, reduce exposure without depending primarily on individual behavior. Administrative controls include procedures, scheduling, training, work-rest arrangements, and access restrictions. Personal protective equipment is necessary when residual risk remains, but it should not replace feasible source or engineering controls. This hierarchy reinforces the preventive principle that the most reliable controls are those embedded in the design of work.

Monitoring and evaluation determine whether controls remain effective. Workplace measurements, worker health surveillance, audit findings, incident reports, near-miss data, and environmental indicators should be reviewed together. Changes in processes, materials, workforce characteristics, or regulatory expectations may invalidate previous assumptions. Therefore, OHERM is a continuous management cycle rather than a one-time assessment. This approach is consistent with integrated occupational health, safety, and environmental management systems, which emphasize planning, implementation, performance evaluation, and continual improvement (Honkasalo, 2000).

Functional Integration of Occupational Health, Industrial Hygiene, Environmental Safety, and Emergency Response

The source material consistently distinguishes the major professional functions by their primary object of control. Occupational health focuses on the worker and the health consequences

of work. Industrial hygiene focuses on the hazard source, exposure pathway, and workplace environment. Environmental and safety management addresses broader organizational controls, environmental impacts, regulatory compliance, and incident prevention. Emergency response focuses on rapid containment and life safety when preventive controls fail or an external emergency occurs.

Table 1 summarizes these functions.

Function	Primary Focus	Core Activities	Typical Outputs	Key Interfaces
Occupational Health	Worker health and functional capacity	Health surveillance, medical assessment, fitness for work, health promotion, case management, rehabilitation	Health profiles, fitness decisions, referral and follow-up plans	Human resources, clinical services, industrial hygiene, management
Industrial Hygiene	Hazard sources and workplace exposure	Hazard recognition, exposure monitoring, risk characterization, control recommendations	Exposure data, health risk assessments, control plans	Occupational health, engineering, operations, safety
Environmental and Safety Management	Organizational safety systems and environmental impact	Risk assessment, waste and emission control, compliance, audits, incident investigation, management systems	Policies, procedures, legal reports, corrective actions	Operations, regulators, communities, occupational health
Emergency Response Team	Immediate control of acute emergencies	Alarm activation, evacuation, firefighting, rescue, first aid, spill response, decontamination, incident command	Emergency actions, casualty stabilization, post-incident review	Security, fire services, health services, external responders

Table 1. Functional differentiation and integration within OHERM.

The distinction between occupational health and industrial hygiene is especially important. For example, when workers are exposed to excessive noise, the industrial hygiene function measures sound levels, characterizes exposure, evaluates controls, and recommends engineering or administrative measures. The occupational health function evaluates hearing outcomes, conducts audiometric surveillance where appropriate, provides counseling, and manages affected workers. Neither function is sufficient alone: exposure data without health surveillance may miss early biological effects, while clinical surveillance without source control may repeatedly identify damage without preventing further exposure.

Organizational size influences how these responsibilities are allocated. Smaller organizations may combine multiple functions within one multidisciplinary team. Larger or high-risk organizations commonly separate occupational health, industrial hygiene, environmental management, safety, and emergency response to provide greater technical specialization.

Separation, however, should not create information silos. Shared risk registers, joint case reviews, integrated inspections, and coordinated management reporting are needed to ensure that observations from one discipline trigger action in the others.

Occupational Health and Worker-Centered Risk Management

Occupational health services translate workplace risk information into actions that protect individual and collective worker health. Their responsibilities include pre-placement and periodic health assessments, health surveillance, fitness-for-work evaluation, health promotion, counseling, management of work-related injuries and diseases, rehabilitation, and return-to-work coordination. Occupational health nursing contributes a distinctive combination of clinical assessment, prevention, worker education, case management, and organizational consultation.

A worker-centered approach requires more than medical examinations. Surveillance programs should be linked to known hazards, exposure groups, and control strategies. Health findings should inform workplace interventions while protecting confidentiality and respecting professional ethics. For example, a pattern of respiratory symptoms among workers should prompt investigation of dusts, fumes, ventilation performance, and work practices rather than being treated only as a series of individual clinical cases.

Professional risk in occupational and environmental health nursing also requires clear scope of practice, competent documentation, referral pathways, and evidence-based decision making (American Association of Occupational Health Nurses [AAOHN], 2000). Occupational health practitioners therefore need both clinical competence and the ability to interpret workplace processes, exposure information, legal duties, and organizational risk.

Industrial Hygiene as the Exposure-Control Function

Industrial hygiene provides the technical basis for recognizing, evaluating, and controlling workplace exposures. Its scope includes chemical agents such as gases, vapors, dusts, and solvents; physical agents such as noise, heat, radiation, and lighting; biological hazards; ergonomic stressors; and selected psychosocial conditions. The industrial hygienist develops sampling strategies, selects appropriate instruments or analytical methods, interprets results, and recommends control measures.

Effective industrial hygiene is not limited to measurement. Monitoring should answer a management question: whether exposure is adequately controlled, which workers are at greatest risk, and what intervention is required. A technically accurate measurement has limited value if it is not translated into engineering, administrative, or personal protective actions. Likewise, control recommendations should be verified through follow-up measurements and worker feedback.

The source material also emphasizes progression from junior to advanced industrial hygiene practice. Early-career professionals generally require competence in routine hazard recognition, monitoring, and reporting. More advanced roles require health risk assessment, statistical and epidemiological interpretation, program design, strategic sampling, management-system integration, and leadership. International and national certifications may support this development, but certification should complement rather than replace supervised field experience.

Environmental and Safety Management, Sustainability, and ESG

Environmental and safety management expands the risk perspective from the worker to the organization, the environment, and the community. Core responsibilities include environmental aspect and impact assessment, control of hazardous materials, waste management, air and water pollution prevention, safe operating procedures, incident investigation, audit, regulatory reporting, and management of standards such as ISO 14001 and ISO 45001. In high-risk industries, these activities are integrated with process safety, contractor management, and crisis preparedness.

The environmental and social effects of occupational health and safety practices are closely linked. Safe chemical storage reduces both worker exposure and soil or water contamination. Effective waste management protects employees, waste handlers, communities, and ecosystems. Control of emissions and leaks prevents occupational exposure while reducing off-site impacts. Consequently, occupational health, safety, and environmental programs form a technical foundation for the environmental and social pillars of ESG.

The social impact is particularly evident in the prevention of injury and occupational disease, the promotion of decent working conditions, worker participation, and protection of surrounding communities from catastrophic events. A strong safety climate encourages workers to report hazards, follow procedures, participate in improvement, and trust management responses. Safety climate research in the Indonesian construction industry has highlighted the importance of organizational commitment, communication, and practical implementation in improving health and safety performance (Lestari et al., 2020). Broader reviews also indicate that safety climate remains a central mechanism through which policies are translated into day-to-day behavior (Luo, 2020).

For occupational health nurses and industrial hygiene professionals, ESG creates an opportunity to connect clinical and exposure-control programs with sustainability objectives. Examples include reducing unnecessary hazardous materials, improving environmentally responsible medical-waste management, considering sustainable personal protective equipment where safety is not compromised, and using worker health indicators as part of social performance

reporting. These activities should be governed carefully so that sustainability goals do not weaken essential health protections.

Emergency Response as a Critical Control Layer

Prevention remains the primary objective of OHERM, but organizations must also prepare for low-frequency, high-consequence events. The Emergency Response Team is the internal operational capability responsible for rapid initial action during fires, explosions, hazardous-material releases, medical emergencies, structural failures, and natural hazards. Its role is to protect life, stabilize the incident, prevent escalation, protect the environment, and coordinate with external responders when the event exceeds internal capacity.

An effective emergency program includes hazard-specific response procedures, alarm and communication systems, evacuation routes, assembly areas, incident command arrangements, first aid and casualty management, fire suppression, spill control, decontamination, rescue capability, equipment inspection, and regular drills. Workplace emergency guidance emphasizes that emergency action plans should define responsibilities, reporting procedures, evacuation arrangements, and accountability for personnel (Occupational Safety and Health Administration [OSHA], n.d.-a, n.d.-b).

ERT competence requires both technical and non-technical skills. Technical capability may include firefighting, first aid, hazardous-material response, rescue, breathing-apparatus use, and emergency communications. Non-technical capability includes leadership under pressure, situational awareness, team coordination, disciplined decision making, and clear communication. Drills should therefore evaluate command, communication, and coordination, not merely equipment use.

Post-incident review is essential. Emergency events and exercises generate information about control failures, response delays, training needs, and weaknesses in organizational interfaces. Findings should be incorporated into the risk register, operating procedures, exposure controls, medical preparedness, and business continuity plans. In this way, emergency response becomes part of the continual-improvement cycle rather than a stand-alone function.

Professional Competency and Career Development

The source document describes multiple professional pathways, including occupational health nurse, occupational health officer or manager, industrial hygienist, environmental and safety professional, and ERT member or leader. Although entry requirements vary by organization and risk profile, the synthesis identified six common competency domains: technical knowledge, regulatory and ethical practice, risk assessment, communication, management, and continuous learning.

Occupational health practitioners require clinical assessment, health surveillance, case management, health promotion, fitness-for-work judgment, documentation, and referral competence. Industrial hygienists require exposure science, sampling, instrumentation, data interpretation, control design, and technical reporting. Environmental and safety professionals require legal compliance, management systems, incident investigation, audit, environmental monitoring, and cross-functional program development. ERT professionals require emergency planning, rescue and response skills, command-system knowledge, physical readiness, and decision making under pressure.

At managerial level, technical competence must be combined with strategic planning, project management, budgeting, performance measurement, stakeholder communication, negotiation, and leadership. Competency frameworks such as that of the Institution of Occupational Safety and Health emphasize balanced development across technical, core, and behavioral competence (Institution of Occupational Safety and Health [IOSH], n.d.). Organizational frameworks similarly position leadership, consultation, risk management, assurance, and continual improvement as mutually reinforcing elements of occupational health and safety governance (Massey University, 2025).

For nurses seeking broader careers in industrial hygiene or environmental safety, a staged pathway is appropriate: foundational training in occupational health and safety, supervised exposure-monitoring experience, competence in health risk assessment, participation in multidisciplinary programs, and progressive certification where relevant. Conversely, engineering or safety professionals working in integrated OHERM systems should develop sufficient health literacy to understand surveillance findings, vulnerable-worker considerations, and the clinical consequences of exposure.

Proposed Integrated Governance Model

The findings support an integrated governance model in which occupational health, industrial hygiene, environmental safety, and emergency response operate through a shared risk-management architecture. The model begins with a common hazard and aspect register. Each hazard is linked to exposed workers, environmental receptors, legal requirements, existing controls, health-surveillance needs, emergency scenarios, responsible persons, and performance indicators. At operational level, joint inspections and multidisciplinary risk assessments should be used for high-priority hazards. Occupational health data may identify emerging health patterns; industrial hygiene data can determine whether exposure control is adequate; environmental monitoring can identify off-site implications; and emergency drills can test whether residual risks are manageable.

Integrated review prevents fragmented decisions, such as introducing a control that protects workers but transfers pollution to the external environment.

At management level, governance should include clear accountability, worker participation, competent leadership, reliable reporting, and regular review. Key indicators may include exposure exceedances, occupational illness trends, corrective-action closure, waste and emission performance, emergency-drill findings, training competence, near-miss reporting, and worker perceptions of safety climate. Indicators should be interpreted collectively because a low injury rate alone does not prove that exposures and environmental risks are adequately controlled.

The integration of health, exposure, environmental, safety, and emergency data ultimately strengthens organizational learning. It enables prevention to be targeted at the source, supports earlier detection of adverse effects, improves preparedness for residual risk, and provides more credible evidence for management and stakeholders. This integrated model is consistent with the broader movement toward worker well-being, resilient safety systems, and sustainable organizational performance.

Conclusion

Occupational Health and Environmental Risk Management is a multidisciplinary system for protecting workers, controlling workplace exposure, preventing environmental harm, and maintaining preparedness for emergencies. Its effectiveness depends on a continuous cycle of hazard identification, risk assessment, control according to the hierarchy of controls, and monitoring and evaluation.

Occupational health, industrial hygiene, environmental and safety management, and emergency response have distinct but interdependent responsibilities. Occupational health manages worker health outcomes and functional capacity; industrial hygiene manages hazardous exposures; environmental and safety professionals manage organizational, regulatory, and environmental controls; and ERTs provide rapid intervention when acute events occur. These functions achieve greater value when they share information, jointly prioritize risk, and evaluate controls through an integrated governance system.

The synthesis further demonstrates that OHERM contributes not only to injury and disease prevention but also to environmental protection, social responsibility, worker well-being, operational continuity, and ESG performance. Professional development should therefore combine discipline-specific expertise with leadership, communication, ethical practice, data interpretation, and emergency preparedness. Organizations should establish multidisciplinary coordination mechanisms, maintain competent personnel, and continuously adapt their systems

to emerging technologies, changing work conditions, and evolving environmental and social expectations.

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