

Policy Analysis

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Industrial Disasters—Preparedness and Response Perspectives: Integrating ISO 45001, MIMMS, and Local MCI Response Plans

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Abstract

In sudden-onset industrial disaster, responding effectively to a mass casualty incident (MCI) requires more than clinical readiness; it demands the integration of multiple regulatory frameworks and standards. In the context of an industrial disaster, the International Organization for Standardization 45001 will provide parameters for the creation of the response plan. In addition, the utilization of the Major Incident Medical Management and Support operational framework will expand the complex industrial interagency response. These should be components of the local MCI response plan, which has proven successful worldwide to enhance the capacity and capabilities in responding to complex emergencies.

From a policy analysis perspective, the complexity and far-reaching consequences of industrial sudden onset disasters underscore the importance of implementing coordination mechanisms that bring together management systems and operational benchmarks. To build essential competencies among first responders, first receivers, and industrial workers, modular simulation exercises focusing on specific risk management and MCI response components are essential.

Introduction

The frequency of industrial disasters, a category of man-made (technological) disasters, has increased significantly in recent decades. Prominent examples include the Triangle Shirtwaist factory fire (1911),¹ Bhopal (methyl isocyanate, 1984),² Buncefield, Hertfordshire, England (oil refinery, 2005),³ Deepwater Horizon (oil rig, 2010),⁴ West Fertilizer (ammonium nitrate, 2013),⁵ Beirut Port (ammonium nitrate, 2020),⁶ and Listvyazhnaya, Russia (mine collapse, 2021).⁷ According to the Emergency Events Database (EM-DAT), industrial disasters occurring between January 1, 1995, and December 31, 2021, accounted for 29,708 deaths and 57,605 injuries.^{8,9} The complexity of such disasters and their wide-reaching effects on workers, responders, and communities require an all-hazards approach to both industrial risk management and disaster preparedness.

Since the 1990s, emergency management has shifted from a reactive civil protection model to a proactive risk management paradigm based on system-thinking methodologies. Within this framework, employers are required—under Clause 8.2 of the International Organization for Standardization (ISO) 45001, Occupational Health and Safety Management System (OHSMS), to “establish, implement and maintain the processes needed to prepare for and respond to potential emergency situations.”¹⁰ This requirement extends to planning, training, testing, and exercising responses. Contractors, visitors, first response agencies, government regulatory authorities, and, where appropriate, local communities must be included in preparedness and response planning. In the United States (US), the Occupational Safety and Health Administration (OSHA), under the jurisdiction of the US Department of Labor, enforces robust guidelines for industrial emergency preparedness.¹¹

While existing data lacks a consistent taxonomy and severity scoring system for workplace incidents, prehospital systems have proactively introduced standards to better prepare first responders and industrial site personnel. Against this backdrop, several recent reviews have highlighted common challenges in managing mass casualty incidents (MCIs). These studies stress that industrial disasters often result from a combination of technical failures, human errors, and insufficient safety procedures.^{9,12–16} These reviews also emphasize the need for specific training tailored to emergency medical services (EMS) personnel, first responders, and industrial workers. Such training should aim to improving initial triage, enhance ongoing field treatment until patient transfer, and strengthen the leadership competencies of medical incident commanders. Moreover, these authors advocate further research to better ensure EMS professionals

are adequately prepared for the complexity and dynamic nature of real-world industrial MCIs scenarios.

Discussion

Preventive measures, such as regular maintenance of technical systems and systematic worker training, are crucial for reducing the likelihood of industrial disasters. This multifaceted approach requires reassessing current safety practices in industries, improving management of risks from industrial disasters along with preparing for and responding to potential disasters.¹⁰ Several reviews have analyzed common challenges in prehospital management of MCIs. Despite their value, one recent review¹² referenced only the third edition of Major Incident Medical Management and Support (MIMMS 2011),¹⁷ overlooking significant updates introduced in the fourth edition (2023).¹⁸ Indeed, the fourth edition introduces a new terminology, updated command tiers, the National Health Service (NHS) Major Incident Triage, a revised Hazardous Material/CBRE chapter, an expanded Natural Disaster section, a new chapter on marauding Terrorist Attacks, and additional tabletop exercises. In the United States, emergency medical service (EMS) agencies and hospital systems may be less familiar with the MIMMS framework, licensed by the Advanced Life Support Group in the United Kingdom (UK). MIMMS is an all-hazard structured response model applicable to incidents of any origin. It has been widely implemented in both civilian and military operations in over 15 countries—including European and Asian nations, Australia, and North Atlantic Treaty Organization (NATO) affiliated military units. To date, over 22,150 global participants have completed the training, which is mandatory for all medical staff deployed to NATO field operations. Its effectiveness has been demonstrated in major incidents, such as the 7/7 London Bombings (2005), the London Bridge Attack (2017), and the Manchester Arena Bombing (2017), to name but a few.¹⁸

Nevertheless, many systematic reviews focus mainly on triage systems but overlook other critical aspects of MCI response—particularly field care prior to hospital transfer.^{19,20} A comprehensive response framework should integrate crucial operational paradigms such as those defined in MIMMS¹⁸ including the:

- CSCATT: The Seven principles—*Command & Control; Safety; Communication; Assessment; Triage; Treatment; Transport*.
- METHANE: The standardized information transmission protocol—*M—Major Incident Declared; E—Exact Location; T—Type of Incident; H—Hazards; A—Access; N—Number of Casualties; E—Emergency Services*.
- IIMARCH: The structured briefing template—*I—Information; I—Intent; M—Method; A—Administration; R—Risk Assessment; C—Communications; H—Humanitarian Issues*.

Collectively, these frameworks promote structured coordination and efficient response, enhancing overall effectiveness in responding to MCIs and thus would enhance the response to industrial MCIs.

The World Health Organization (WHO) identifies EMS systems as fundamental components of healthcare operations.²¹ It emphasizes that preparedness for MCIs must extend across all phases of MCI management, including prevention, preparedness, response, and recovery.²² Regular exercises are critical to this preparedness, supported by well-established training curricula such as those from

the Joint Services Interoperability Programme and the London Emergency Services Liaison Panel (LES).^{23,24} Interoperability between first response agencies and the local occupational health regulatory agency is crucial and can be achieved through a balanced combination of discussion-based and operational exercises tailored specifically to responders, decision-makers, and industrial liaisons to the MCI response.^{25,26}

Exercise planning should also include key performance indicators and data analysis of exercise participants and agencies. This evaluation process should be rooted in foundational principles that standardize training and education to guide the creation of interoperable MCI response plans. These exercises should minimize psychological harm²⁷ to participants in controlled environments while offering formal debriefing to add to data to identify areas for improvement.²⁸ Most importantly, a systematic exercise cycle should include clear stages: (1) program management; (2) exercise design and development; (3) execution; (4) comprehensive evaluation; and (5) continuous improvement planning. Regular organization of these exercises is a critical component of the whole process. For example, in the UK, standardized exercise schedules recommend testing “communication systems” at least every six months, conducting “tabletop exercises” yearly, and performing both “live play exercises” and “command post exercises” at least every three years.²⁹ This systematic approach ensures a consistently high level of operational readiness, supported by regular risk assessment.

In addition, Hugelius³⁰ has noted that a considerable gap remains between training and real events. Training should therefore draw on real-life experiences and evidence rather than relying solely on abstract exercises or simulations.³¹ Given that full-scale exercises are difficult to run regularly, Weinstein has proposed that modular simulation exercises should be performed to achieve comparable competencies.³² These simulations should be designed with rigorous instructional principles and realism to replicate the cognitive intensity and physical demands of actual MCIs.³³

Lastly, the “common themes and challenges” identified by Hugelius and Becker lack a clear taxonomy.¹² A more structured framework offered by MIMMS principles of command, safety, communication, assessment, triage, treatment, transport (CSCATTT), which are integrated into NATO’s Standardization Agreement (STANAG) 2879 on medical policy in mass casualty management.³⁴ Another comprehensive paradigm, developed by the National Disaster Life Support Foundation (NDLSF),³⁵ is summarized in the PRE-DISASTER mnemonic:

- “PRE”: Planning and practice, Resilience, Education and training.
- “DISASTER”: Detection, Incident management, Safety and Security, Assess hazards, Support, Triage and Treatment, Evacuation, and Recovery.

Conclusion

While current literature offers valuable insights into the challenges of prehospital MCI response, there is a need to benchmark against updated standards and established practices. Simulation exercises for MCI should also be aligned more closely with international guidelines. This alignment will ensure that EMS personnel, first responders, and industrial workers gain the essential knowledge and skills required to manage MCIs effectively and achieve more favorable outcomes.

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