



Public Health Risks in Economic Port Mass Gatherings: Lessons from the Shahid Rajaei Port Explosion

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Abstract

Introduction: The 2025 Shahid Rajaei Port explosion in Iran serves as a critical case study in public health failures within high-risk industrial zones. This incident, which killed dozens and injured over 1,500, exposed systemic vulnerabilities in hazardous material management, emergency response, and health infrastructure at economically vital ports.

Case Presentation: Key deficiencies included delayed hazard identification due to absent real-time cargo tracking, chaotic crisis coordination among agencies, and collapsed medical systems lacking chemical exposure protocols. The disaster further revealed profound gaps in victim identification, mental health support, and responder safety, exacerbating long-term trauma and eroding public trust. Comparative analysis with global port disasters (Tianjin, Beirut) underscores recurring patterns of neglected safety protocols and institutional complacency.

Conclusions: This study proposes actionable reforms: (1) Reclassifying ports as mass gathering zones requiring Hajj-level health preparedness; (2) implementing smart tracking systems for populations and hazardous materials; and (3) establishing unified command structures with embedded mental health teams. The findings emphasize that ports' economic significance demands proportional investment in safety as a non-negotiable priority, not a discretionary cost.

Keywords: Port Safety, Chemical Explosions, Public Health Crises, Hazardous Materials, Victim Identification, Emergency Response

1. Introduction

Ports — economically vital yet structurally vulnerable — have emerged as under recognized hotspots for public health threats during mass gatherings (1). These high-throughput hubs routinely host thousands of workers, transport operators, customs officers, and transient visitors in dynamic, high-density environments. Yet, unlike mass gatherings that are ritualistic, ceremonial, or sporting in nature (such as the Hajj or Olympic Games), economic ports often lack formal frameworks

for real-time health risk monitoring, victim identification, and interagency coordination. The explosion at Shahid Rajaei Port, Iran's busiest maritime hub, exposed the severe limitations of current health infrastructure in such contexts (2). The incident escalated rapidly from an industrial fire into a mass casualty crisis, revealing profound systemic gaps: The absence of victim identification systems, fragmented population data, and uncoordinated health reporting among stakeholders. These failures resulted not only in preventable deaths and injuries but also in secondary public health crises — psychological trauma among

families, conflicting casualty counts, and delays in body retrieval and forensic processing (3).

This case highlights the urgency of reconceptualizing economic ports as potential high-risk mass gathering zones, where public health planning must be integral – not peripheral – to safety protocols. Drawing lessons from structured events like the Hajj and disaster responses in ports like Tianjin (China) (4) and Beirut (Lebanon) (5), the study explores how such models can be localized for Iranian economic zones. Objectives of this case report:

(1) To identify and categorize public health risks specific to mass gatherings in economic ports.

(2) To analyze the case of Shahid Rajaei Port as a critical incident reflecting systemic vulnerabilities.

(3) To propose evidence-based, context-specific strategies – including victim identification systems, crowd analytics, and unified health communication protocols – for improving health crisis response in Iranian ports.

Given the scale of daily port operations and their national economic significance, addressing these public health vulnerabilities is both a scientific necessity and a policy imperative. This case report thus aims to offer a practical, scalable model for advancing health preparedness across Iran's port infrastructure.

2. Case Presentation

On the afternoon of April 26, 2025, a chemical explosion in multiple containers at Shahid Rajaei Port in Bandar Abbas killed dozens of workers, employees, and civilians' onsite. Several individuals remain missing, and over 1,500 people working near the blast zone sustained injuries. On-site field assessments and firsthand accounts from affected individuals and truck operators uncovered several key issues, outlined below.

2.1. The Port Houses 130,000 Containers, and Preliminary Estimates Place Damages at \$3-5 Billion

This figure accounts for (1) destroyed containers and cargo near the epicenter and (2) severe damage to parked vehicles and infrastructure. The financial toll has strained government resources. Meanwhile, safety experts, judicial authorities, and parliament members have condemned the tragedy, noting that adherence to safety protocols by cargo owners and stricter government oversight of imported goods could have averted the disaster – sparing families irreversible grief.

2.2. Deficiencies Observed in Public Health Management Following the Explosion at Shahid Rajaei Port

The catastrophic chemical explosion at Shahid Rajaei Port exposed significant shortcomings in public health management and emergency response, exacerbating both human and logistical losses. Key failures included delays in hazard identification, inconsistent reporting, overcrowding, inadequate crisis coordination, and poor sanitary conditions – all of which compounded the tragedy.

2.2.1. Delayed Identification and Response

Authorities were slow to recognize the scale of the hazard, particularly the presence of toxic chemicals in the burning containers (6). This delay critically postponed evacuations and medical interventions, leaving victims exposed to smoke inhalation and chemical burns for prolonged periods. Initial responders lacked real-time access to cargo manifests, hindering targeted containment efforts.

2.2.2. Statistical Discrepancies and Transparency Gaps

Official casualty figures fluctuated wildly across government agencies, with initial reports undercounting fatalities and injuries (7). For instance, local hospitals recorded over 1,500 injured, while early port statements cited only "hundreds." Such contradictions eroded public trust and complicated resource allocation for rescue teams.

2.2.3. Chaotic Crowding and Poor Evacuation

The blast site became dangerously overcrowded due to ineffective perimeter control. Bystanders, desperate relatives, and uncoordinated volunteers obstructed first responders (8). Nearby roads jammed with emergency vehicles and panicked civilians, delaying ambulances. No pre-established evacuation routes were enforced, violating basic disaster protocols.

2.2.4. Systemic Crisis Management Failures

The response lacked a unified command structure. Multiple agencies (port security, municipal firefighters, and military units) operated with conflicting priorities, leading to duplicated efforts or critical gaps – such as untreated chemical exposure cases (9). Communication breakdowns left hospitals unprepared for the influx of patients, many arriving without triage documentation.

2.2.5. Collapse of Sanitary and Medical Infrastructure

Overwhelmed clinics near the port faced shortages of burn treatments, antidotes for chemical exposure, and even basic sterilizers (10). Injured survivors reported

being turned away due to lack of capacity, while makeshift treatment areas struggled with unsanitary conditions. The absence of decontamination zones raised risks of secondary health crises among rescue workers.

2.2.6. Root Causes and Accountability

Post-incident analyses highlighted neglect of routine safety audits at the port, including failure to enforce chemical storage regulations (11). Government supervisors admitted to "lapses" in verifying imported cargo hazards, while parliamentary investigators accused private contractors of bypassing safety protocols to cut costs.

2.3. Clinical and Public Health Relevance

The explosion revealed systemic failures in preventive surveillance, including the absence of real-time hazardous material tracking and poor enforcement of safety regulations (12). The lack of mental health support for survivors and first responders compounded long-term trauma, while inconsistent casualty reporting undermined trust in health authorities. This tragedy underscores the urgent need to integrate industrial zones into public health emergency frameworks, ensuring preparedness for chemical disasters through strengthened monitoring, rapid response systems, and cross-sectoral coordination. The lessons extend beyond Iran, offering a stark warning for ports worldwide operating without robust health safeguards.

2.4. Health Findings Analysis

The explosion incident at Shahid Rajaei Port was not only a technical crisis but also a manifestation of structural and chronic gaps in public health within the country's economic infrastructure. A thorough investigation of this incident reveals multiple systemic weaknesses in occupational safety, population management, victim identification, and inter-organizational coordination.

2.4.1. Neglect of Hazardous Materials Safety and Weakness in Implementing HSE Requirements

The core of this disaster stemmed from the incomplete implementation of occupational safety (HSE) requirements and the absence of effective monitoring mechanisms in the storage and handling of hazardous materials at the country's port and customs infrastructure. Reports indicate that: (1) Cargo

information was recorded incompletely or unclearly; (2) no serious risk assessments were conducted in high-risk areas; (3) emergency drills or training programs at the port or customs were either nonexistent or held symbolically.

This tragedy is a direct result of the prevailing approach that views safety as an unnecessary cost rather than a structural necessity. It seems that no institution or manager feels real responsibility until a disaster occurs.

2.4.2. Delay in Identifying Victims

One of the most concerning human consequences of the Shahid Rajaei Port explosion was the significant delay in identifying the bodies of victims (13). In some cases, the process of identification and returning the bodies to the families took over a week. This delay not only caused profound psychological distress for the families but also disrupted funeral coordination, issuance of death certificates, and other legal and social procedures. However, it should be noted that in explosive incidents, the process of identifying bodies is further complicated by technical and specialized challenges, including:

(1) High heat and burning intensity, which destroys facial features, fingerprints, and clothing.

(2) Disintegration of bodies due to the explosion's shockwave, making identification extremely complex and requiring body parts to be matched with biological records.

(3) The destruction of identification documents, such as national ID cards or birth certificates, which are typically kept in personal belongings.

(4) The absence of an active biometric database to quickly retrieve and match genetic information, fingerprints, or facial images.

(5) The lack of Disaster Victim Identification (DVI) teams and standard forensic medical equipment at the disaster site or nearby.

Additionally, the delay in forming a forensic coordination team and the absence of a national protocol for managing bodies in crisis conditions led to slow and confused initial actions for preserving, photographing, numbering, and sampling the bodies. As a result, many families were left in a state of ambiguous loss — where they did not know whether their loved ones had died or were missing — which can lead to long-term psychological disturbances. These shortcomings highlight that without the establishment of rapid and reliable identity verification infrastructure, casualty management in high-mortality incidents will

be ineffective, ultimately becoming a secondary crisis in itself.

2.4.3. Lack of Real-Time Population Tracking System in Port Environments

At the time of the explosion at Shahid Rajaei Port, there was no digital system to track the entry and exit of staff, contractors, visitors, and other individuals present in the port's operational area (14). This information gap was a major reason for the inefficiency in quickly identifying the missing and compiling initial casualty statistics, leaving the number of people present at the time of the incident, particularly in high-risk areas such as warehouses and loading docks, uncertain. As a result, initial reports of the number of casualties and missing persons were contradictory, incomplete, and unreliable, and search and rescue operations were carried out manually based on fragmented and verbal information.

This situation reflects an inability to grasp the importance of establishing real-time tracking systems in high-traffic and high-risk economic environments like ports. These environments require accurate human management systems, as any information gap can lead to the loss of human lives during a crisis. While many advanced ports such as Singapore, Hamburg, and Dubai use smart entry and exit systems (15) — including electronic ID cards, QR codes, RFID, and facial recognition technologies — to precisely track movements, Iranian ports still lack such infrastructure. These deficiencies not only create challenges during crises but also hinder daily occupational safety management.

Establishing intelligent entry and exit tracking systems at ports has vital benefits:

- (1) The ability to quickly generate a list of people present at the disaster site and streamline search and rescue efforts.
- (2) Immediate identification of potentially missing individuals by comparing entry and exit data.
- (3) Accurate and timely allocation of medical, rescue, and support resources.
- (4) Improved accuracy of official statistics and reduced conflicting information dissemination.
- (5) Prevention of unauthorized access to high-risk areas through digital identity verification.

The lack of such systems at Shahid Rajaei Port not only caused confusion and delayed emergency response but also served as a clear sign of the weak organizational safety culture and lack of investment in digital human infrastructure. If a system for accurately tracking

individuals had been available, many initial ambiguities, from the precise number of casualties to determining the whereabouts of people at the time of the incident, could have been addressed within the first few hours.

2.4.4. Statistical Chaos and Institutional Discoordination

The explosion at Shahid Rajaei Port was accompanied by confusion in reporting casualty and missing person figures (16). In the early days, various organizations independently published conflicting and exaggerated numbers, leading to a significant decrease in the casualty count in later reports. For instance, the number of fatalities dropped from over 70 to 57, which fueled rumors and reduced public trust in official sources. This chaos, particularly on social media, was due to the absence of a coordinated crisis communication body. Each organization entered the field independently, which created confusion and public distrust. Families were bewildered, and sometimes their loved ones were listed as casualties, only for these reports to later be refuted or corrected. This situation led to severe media criticism and a crisis of credibility for the disaster management authorities.

To prevent such issues in the future, it is recommended that a coordinated health information center be established at economic ports under the Ministry of Health and in collaboration with the Crisis Management Organization. This center should have a unified digital infrastructure to provide transparent and traceable information regarding casualties, the injured, the missing, and the identification process by connecting to hospitals, morgues, and rescue teams.

2.4.5. Psychological and Social Consequences for Survivors

The delay in identifying bodies, lack of effective communication between families and relief organizations, and the absence of initial psychiatric support had profound impacts on the survivors of the incident (17). These conditions led to increased anxiety, depression, and the experience of ambiguous loss, which became a new crisis at the psychological and social levels. Ambiguous loss refers to a state in which a person does not know whether their loved one is alive or dead, and this uncertainty can result in long-lasting psychological harm. The damages experienced by the survivors included:

- (1) Uncertainty about the fate of loved ones for several days – the lack of transparency in body identification and timely communication left families in confusion for a long time. This ambiguity, especially

during the early stages of the incident, triggered severe anxiety and feelings of helplessness among families.

(2) Unanswered calls and visits by families to medical and judicial centers – many families attempted to follow up on the status of their loved ones but were met with unanswered calls and a lack of information from relief and medical centers, leading to further crisis. This lack of responsiveness exacerbated the sense of uncertainty and inability to control the situation.

(3) Absence of specialized mental health teams in the initial days of the incident – one of the major weaknesses in crisis management was the lack of specialized mental health teams in the initial days after the incident. Survivors, despite experiencing severe psychological pressure, urgently needed psychiatric care, but this gap contributed to increased depression and anxiety.

(4) Lack of a clear program for monitoring survivors' mental health – beyond the initial issues, there was no organized program for monitoring the mental health of survivors in the weeks and months following the incident. This led to the failure to address long-term psychological damage, and individuals continued to face lasting emotional consequences.

2.4.6. Environmental Health Threats to First Responders

The environmental health threats to first responders during the Shahid Rajaei Port explosion were one of the critical aspects that required special attention in disaster management (18). The environment at the site was heavily polluted with dense smoke, suspended particles, toxic gases from burning chemicals, and remnants of incendiary materials. This pollution, combined with high temperatures, posed severe health threats, particularly near the explosion's epicenter. However, serious issues existed in managing the health of responders, with some of the key concerns as follows:

(1) Insufficient protective equipment against pollution and heat – despite the presence of personal protective equipment (PPE), these measures were insufficient to cope with the scale of pollution and the intensity of heat at the disaster site. Under such conditions, many responders were exposed to toxic chemicals and extreme heat, which could have caused severe physical and psychological harm.

(2) Lack of occupational health monitoring – no occupational health assessments were conducted to evaluate responders' exposure to toxic materials and environmental pollutants. As a result, responders continued their work without awareness of the risks

they faced, despite the potential short-term and long-term health impacts.

(3) No official reports on the health of responders – beyond physical concerns, no reports were collected on the psychological or physical health of the responders during or after the incident. This neglect of mental and physical health not only led to exhaustion and burnout but also created a risk of long-term health and psychological issues.

These issues were a result of the disregard for occupational health aspects in designing disaster management structures and training responders. In preparing disaster response programs, especially for large and complex events, attention must be given not only to equipment but also to creating appropriate environmental conditions and implementing continuous occupational health monitoring. This will help reduce potential risks and prevent serious harm to responders. Additionally, the need for clear guidelines to assess and report the health of responders at different stages of the crisis is essential so that preventive and therapeutic actions can be taken promptly when necessary.

3. Discussion

The catastrophic explosion at Shahid Rajaei Port in 2025 serves as a sobering case study when examined alongside similar industrial disasters globally, revealing a disturbing pattern of systemic failures and missed opportunities for prevention. When compared to incidents like the Tianjin Port explosion and the Beirut ammonium nitrate blast (19), the Rajaei tragedy stands out not for its uniqueness but for how starkly it magnified well-documented vulnerabilities in industrial safety and emergency response systems.

The mishandling of hazardous materials at Rajaei Port mirrored the root causes of the Tianjin disaster, where improperly stored chemicals triggered a massive explosion. However, Rajaei's case demonstrated even greater institutional negligence. While Tianjin at least maintained partial records of dangerous goods (though they were ignored) (20), Rajaei operated without any functional real-time cargo tracking system. This critical deficiency delayed emergency responders' ability to identify the burning chemicals, exacerbating the crisis. Similarly, the complete absence of meaningful safety drills at Rajaei surpassed even Beirut's notorious lack of preparedness, where officials had at least conducted some nominal risk assessments prior to their catastrophe.

The emergency response to the Rajaei explosion revealed alarming deficiencies when measured against

global counterparts. Like Beirut, Rajaei suffered from a fragmented command structure, but with added layers of dysfunction (21). The victim identification process stretched for over a week — far longer than Beirut's three-day struggle — primarily due to Iran's lack of biometric databases and properly trained Disaster Victim Identification teams (22, 23). While Tianjin benefited from China's centralized forensic resources, Rajaei's authorities were left scrambling with outdated, paper-based systems. The resulting confusion in casualty reporting, with official death tolls fluctuating wildly, eroded public trust more severely than even the censored communications following Tianjin's explosion.

Public health systems at Rajaei collapsed under the strain of the disaster in ways that surpassed comparable incidents. Medical facilities near the port were completely overwhelmed, lacking even basic sterilization equipment—a more severe breakdown than what occurred in Tianjin, where hospitals remained at least partially functional. The psychological toll on survivors and families was compounded by the complete absence of initial mental health support teams, unlike Beirut where non-governmental organizations mobilized psychosocial support within days of the explosion (24). This neglect of mental health services represented a profound failure to learn from established post-disaster care protocols implemented in other nations.

At its core, the Rajaei disaster exposed a dangerous institutional complacency that goes beyond the bureaucratic inertia seen in Tianjin or the corruption that plagued Beirut's port authorities. Iranian port operators and regulators demonstrated a cultural dismissal of safety measures as unnecessary expenses rather than fundamental requirements. Private contractors operated with near-total impunity, bypassing safety protocols more brazenly than their counterparts in other global ports. The absence of digital population tracking systems — standard equipment in modern ports like Dubai or Singapore — left authorities completely in the dark about who might be missing in the aftermath.

What makes the Rajaei case particularly tragic is how clearly it demonstrates the consequences of ignoring established global safety practices. Modern ports worldwide have implemented sophisticated hazard monitoring systems, unified command structures for emergencies, and comprehensive worker tracking mechanisms. The technology and protocols to prevent such disasters exist and have been proven effective in comparable high-risk environments. That these

solutions were not in place at Rajaei speaks to a fundamental failure of institutional priorities and accountability.

The parallels between Rajaei and other global port disasters form a disturbing pattern of warning signs ignored and lessons unlearned. Each of these tragedies — Tianjin, Beirut, and now Rajaei — followed a similar trajectory of neglected warnings, inadequate safety measures, and chaotic emergency responses. What sets Rajaei apart is the degree to which basic preventive measures were overlooked, transforming what might have been a containable incident into a full-blown catastrophe. This case underscores the urgent need for the global maritime industry to treat port safety not as a variable cost but as a non-negotiable foundation of operations. Until this fundamental shift occurs, communities surrounding these economic hubs will remain vulnerable to entirely preventable tragedies.

3.1. Conclusions

The Shahid Rajaei Port explosion stands as a harrowing testament to the human and economic costs of systemic negligence in industrial safety governance. This tragedy, while unique in its specific failures, echoes a global pattern of preventable port disasters — from Tianjin to Beirut — that collectively demand urgent policy reform. For decision-makers, the incident offers not merely a case study in failure, but a roadmap for institutional transformation.

At the heart of this disaster lay a fundamental misalignment of priorities economic efficiency was consistently privileged over human security. The absence of real-time hazardous material tracking, biometric identification systems, and unified crisis protocols were not technical oversights, but symptoms of a deeper institutional apathy toward safety as a non-negotiable pillar of port operations. This mindset must be radically restructured through binding international safety standards for economic ports, enforced through transparent auditing mechanisms and severe penalties for non-compliance.

The public health dimensions of the catastrophe reveal equally critical lessons. Ports must be reclassified as high-risk mass gathering zones, requiring the same level of medical preparedness as stadiums or pilgrimage sites. This necessitates dedicated funding for chemical exposure treatment stockpiles, mobile decontamination units, and embedded mental health teams—resources that proved catastrophically absent during Rajaei's crisis. The psychological toll on survivors and responders underscores that trauma care is not a

post-disaster luxury, but a core component of emergency response that must be pre-positioned.

For Iranian policymakers specifically, the path forward requires dismantling bureaucratic silos that crippled coordination. A singular Port Safety Authority, armed with real-time data integration across customs, health, and emergency services, could have prevented the fatal delays in chemical identification and victim tracing. The private sector's role in safety violations demands equally stringent oversight, with cargo operators held legally liable for protocol breaches through a public-private accountability framework.

Globally, this incident sounds a final warning. Ports cannot remain the weak link in industrial safety chains. The International Maritime Organization must champion a new era of port governance where digital twinning, AI-driven risk analytics, and automated containment systems become baseline requirements – not aspirational goals. As climate change intensifies the volatility of stored chemicals, and as global trade volumes grow, the lessons of Rajaei must catalyze action before the next preventable catastrophe strikes. The technology exists. The protocols are known. What remains is the political will to value human life above logistical expediency.

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