
Research article

A Comparative Assessment of CBRN Management in Türkiye Within The Frameworks of the IHR, NATO, Sendai Framework, IAEA, And ADR

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Abstract

Purpose: This article aims to analyze Türkiye's Chemical, Biological, Radiological, and Nuclear (CBRN) risk management capacity within the framework of national legislation and evaluate its alignment with key international frameworks, including the International Health Regulations (IHR), NATO standards, the Sendai Framework, the International Atomic Energy Agency (IAEA), and the ADR.

Design: The study adopts a qualitative document analysis method. Relevant national legislation and regulatory documents are comparatively examined in terms of technical capacity, institutional structure, coordination, and integration. Data are analyzed using a deductive coding approach based on thematic categories derived from international frameworks.

Findings: Indicate that Türkiye possesses a well-developed infrastructure in the CBRN (Chemical, Biological, Radiological, and Nuclear) sector, particularly in terms of technical capacity and sector-specific expertise. Biological risk monitoring and early warning systems demonstrate strong alignment with the IHR, while nuclear and radiological safety mechanisms comply with IAEA standards. Chemical risk management and the transport of hazardous materials largely align with the Sendai and ADR frameworks. However, despite this strong technical capacity, sufficient integration within a comprehensive governance model has not been achieved. Key weaknesses include limited interagency coordination, unclear command and control mechanisms, and fragmented structure among CBRN components.

Originality/Value: This study contributes to the literature by conceptualizing CBRN governance through the relationship between technical capacity and institutional integration. It emphasizes the need for a comprehensive governance model to strengthen institutional coordination, clarify command-and-control structures, and improve legislative and governance preparedness for CBRN incidents.

Keywords: CBRN, disaster risk governance, public health surveillance, risk management, international frameworks, institutional coordination.

Introduction

The recent increase in Chemical, Biological, Radiological, and Nuclear (CBRN) risks has necessitated greater attention from national and international systems concerned with public and community safety, health, and disaster management (Javan Biparva et al., 2026; Ranse et al., 2025). CBRN threats attract attention not only because of their significant impacts on public health and the environment but also due to their multi-sectoral nature (Narimani et al., 2025; Harefa et al., 2026). These threats involve complex management processes that require coordinated intervention by interdisciplinary institutions (Farhat et al., 2024; Vengidasamy et al., 2024; Ahmad and Qzih, 2025). Current research in the field of CBRN underscores the need for multidimensional approaches to risk assessment (Malizia et al., 2025). At the

international level, various frameworks addressing the different dimensions of CBRN incidents have been developed (Amin et al., 2024). Studies in the literature emphasize the importance of decision-making mechanisms for preparedness against CBRN incidents through multidisciplinary and coordinated approaches (Coleman et al., 2019). While the International Health Regulations (IHR) focus on areas such as surveillance, early warning systems, and public health, NATO places greater emphasis on security, preparedness, and command-and-control parameters (Chattu et al., 2024; Maisaia et al., 2024). The Sendai Framework for Disaster Risk Reduction prioritizes risk reduction, preparedness, and hazard concepts in its CBRN approach (Busayo et al., 2020; Wright et al., 2020). In contrast, while the International Atomic

Energy Agency (IAEA) focuses on various technical standards in the radiological and nuclear fields, the European Agreement concerning the International Carriage of Dangerous Goods by Road (ADR) regulates the safe transport of hazardous materials (Jaloliddin, 2026; Rabiej and Kociemba, 2025). In this context, Türkiye has developed a comprehensive legal framework and institutional structure covering the various components of CBRN risks (Ogur and Canturk, 2022). A review of the existing literature indicates that CBRN risk management is primarily addressed in terms of specific risk types, sectors, or operational capabilities. These studies make significant contributions, particularly by focusing on health systems, disaster response, or security aspects. However, it is evident that there is a limited number of studies that examine CBRN management at the national legislative level and in comparison with international frameworks, in a manner that encompasses multiple risk components. In this context, there is a clear gap in the literature regarding the comprehensive governance structure and regulatory-based institutional alignment of CBRN management, and this study aims to address that gap. This study aims to analyze Türkiye's capacity to manage CBRN incidents within the framework of relevant national legislation and to examine the compatibility of this framework with key international frameworks such as the IHR, NATO, Sendai, IAEA, and ADR. Adopting a comparative and analytical approach, the study aims to identify the system's strengths and areas requiring improvement. The study's central argument is that, despite Türkiye possessing a high level of technical and sectoral capacity in the CBRN field, this capacity is not organized within an integrated governance model or a clearly defined command and control system. In this context, the study contributes to the literature by presenting a comprehensive analytical framework that addresses the fields of health, security, disaster management, nuclear safety, and transportation in an integrated manner. This study addresses the following research question. How effectively does Türkiye's CBRN governance align with international frameworks in terms of capacity and integration?

Methodology

Research Design and Data Sources

This study employs a qualitative document analysis method. Document analysis is a research approach based on the systematic examination of official documents (Bowen, 2009). The data sources of the study consist of legislation currently in force in Türkiye concerning the CBRN field, as well as the national plans of relevant institutions (Table 2). The legislation examined was selected based on criteria such as covering at least one component of CBRN risks, being legally binding at the national level, and defining institutional responsibilities. Documents falling outside this scope and lacking direct relevance to CBRN were excluded. During the analysis process, the purpose and scope sections of the legislative texts, the types of risks they address, the responsible institutions, and the fundamental functions of the regulations were taken into consideration. Furthermore, the evaluation was not limited to a descriptive level; the role of the regulations within CBRN management and their compatibility with one another were also examined. In this study, the International Health Regulations (IHR), NATO's CBRN approach, the Sendai Framework for Disaster Risk Reduction, International Atomic Energy Agency (IAEA) standards, and the ADR agreement were used not only as references but also as an analytical framework (World Health Organization, 2025; North Atlantic Treaty Organization, 2022; United Nations, 2015; International Atomic Energy Agency, 2014; United Nations Economic Commission for Europe, 2022). The level of compliance of the legislation was assessed in accordance with criteria derived from these frameworks.

Data Analysis and Coding Process

Data analysis was conducted using a deductive coding approach based on themes derived from international frameworks (Braun and Clarke, 2006). Accordingly, organizational structure, technical capacity, command and control, coordination, risk management, and system integration were identified as the primary categories of analysis. Using the coding matrix developed prior to the analysis, each legal document was evaluated according to six

categories (organizational structure, technical capacity, command and control, coordination, risk management, and system integration). These categories were addressed based on indicators derived from and defined by international frameworks. The selected legislative texts were systematically reviewed in Excel and coded according to these categories. The categories identified during the coding process were applied consistently, and the integrity of the analysis was maintained. This approach enabled the study to move beyond a purely descriptive examination and provide a comparative and analytical assessment (Elo and Kyngäs, 2008). Since the coding process was conducted by a single researcher, one of the study's limitations is that

inter-coder reliability could not be assessed. Additionally, the study is based solely on legislative texts and does not encompass institutional practices at the implementation level. To present the analysis findings in a comparative manner, the evaluation in Table 1 was conducted by considering the scope of the examined legislation, the responsible institutions, and the functional roles of the regulations. Compliance levels were determined by considering the extent to which framework requirements were reflected in the legislation, together with the presence of institutional responsibilities, enforcement mechanisms, coordination arrangements, and system integration.

Table 1. Comparative alignment of Türkiye's CBRN governance with international frameworks based on qualitative content analysis

Governance Dimensions	IHR	NA TO	SEND AI	IAE A	AD R
Public Health and Surveillance	✓	X	✓	X	X
Security and Defence	X	✓	X	X	X
Disaster Risk Reduction and Preparedness	✓	X	✓	X	X
Radiological and Nuclear Safety	X	✓	X	✓	✓
Chemical Risk Management	X	✓	✓	X	✓
Biological Risk Management	✓	✓	✓	X	✓
Transport and Logistics Safety	X	X	✓	✓	✓
Command and Control Structures	X	✓	X	X	X

In Table 1, the “✓” symbol indicates the presence of alignment with the relevant international framework, whereas the “X” symbol denotes limited or absent alignment. The assessments are based on findings derived from the content analysis of the legislative texts. The evaluation is based on the scope, institutional responsibility, and functional alignment of the legislation. Table 1 provides a binary overview of whether governance dimensions are addressed by the selected international frameworks, whereas detailed compliance classifications are presented separately in Table 3.

Findings

Table 2. Analytical Classification of Legislation Related to CBRN Management in Türkiye

Legislation	CBRN Sector	Responsible Agency	Core Function	Framework	General Assessment of the Relevant Official Document
Regulations on CBRN Threats and Hazards	General CBRN	AFAD	Coordination and task allocation in CBRN	NATO + Sendai	It forms the foundation of the CBRN sector in Türkiye. Institutional coordination exists; however, the command-and-control system remains unclear (Presidency of the Republic of Türkiye, 2020).
Law No. 5902 on the Disaster and Emergency Management	Disaster Management	AFAD	Disaster management and coordination	Sendai	A strong institutional capacity has been established through the centralization of disaster management in Türkiye. However, CBRN threats are not directly addressed

Authority (AFAD)					(Grand National Assembly of Türkiye, 2009).
Türkiye Disaster Response Plan	Operational	AFAD	Response organization and task allocation	Sendai	It provides operational capacity by structuring response organizations at the local level and covers CBRN incidents (AFAD, 2022).
Law No. 1593 on Public Health	Biological	Ministry of Health	Prevention and control of infectious diseases	IHR	It provides a well-established and robust system for public health and epidemic management in Türkiye; however, it has not been updated to encompass the multidimensional nature of modern CBRN threats (Grand National Assembly of Türkiye, 2018).
Law No. 5977 on Biosafety	Biological	Ministry of Agriculture and Forestry	Control of GMO and biotechnological risks	IHR	It provides a technical framework for regulating related risks; however, its narrow scope excludes the security dimension of biological threats (Grand National Assembly of Türkiye, 2010).
Regulation on the Principles of Surveillance and Control of Infectious Diseases	Biological	Ministry of Health	Surveillance, early warning, and data management	IHR	It establishes a data-driven, multi-layered early warning system; however, limited interdisciplinary integration with other CBRN components weakens comprehensive risk management (Ministry of Health of Türkiye, 2007).
Radiation Safety Regulation	Radiological	Nuclear Regulatory Authority	Radiation safety and dose control	IAEA	It complies with international standards regarding radiological risks; however, the lack of clear legal definitions for CBRN coordination mechanisms creates structural gaps in implementation (Turkish Atomic Energy Authority, 2000).
Law No. 7381 on Nuclear Regulation	Nuclear	Nuclear Regulatory Authority	Regulation and oversight of nuclear activities	NATO + IAEA	An advanced regulatory and oversight system has been established in the nuclear sector (Official Gazette of the Republic of Türkiye, 2022).
Regulation on the Registration, Evaluation, Authorization, and Restriction of Chemicals	Chemical	Ministry of Environment, Urbanization, and Climate Change	Recording and control of chemical risks	Sendai	It provides an advanced system for the prevention of chemical risks (Ministry of Environment and Urbanization of Türkiye, 2017).
Regulation on the Transport of Dangerous Goods by Road	Chemical	Ministry of Transport	Transportation safety and risk control	Sendai + ADR	It ensures transportation safety in accordance with international standards; however, it establishes only a limited connection with CBRN incident management (Ministry of Transport and Infrastructure of Türkiye, 2013).
Regulation on the Prevention of Major Industrial Accidents and the Mitigation of Their Effects	Chemical	Ministry of Environment, Urbanization, and Climate Change	Industrial risk analysis and prevention	Sendai	Strong preventive measures exist against industrial accidents; however, the facility-based approach limits national integration (Ministry of Environment and Urbanization of Türkiye and Ministry of Labour and Social Security of Türkiye, 2019).

Law No. 7126 on Civil Defense	Disaster Management	Ministry of the Interior	Civil protection and crisis preparedness	NATO	It provides social protection and preparedness capacity; however, preparedness for CBRN threats remains limited (Grand National Assembly of Türkiye, 2018).
Law No. 5442 on Provincial Administration	Operational	Governor's Offices	Provincial-level coordination and crisis management	Sendai	It ensures rapid and centralized coordination at the local level (Grand National Assembly of Türkiye, 2020).
Regulation on the Implementation of Hospital Disaster and Emergency Plans(HAP)	Health	Ministry of Health	Hospital preparedness and response capacity	IHR + Sendai	It is an important document for preparedness and resilience within the health system (Ministry of Health of Türkiye, 2020).

The findings presented in Table 2 indicate that legislation concerning CBRN management in Türkiye is well developed on a sectoral basis but lacks a comprehensive framework. While a more pronounced institutional structure exists in the areas of biological and chemical risks, the limited integration between these areas is noteworthy. These findings further suggest that while biological and chemical domains demonstrate relatively stronger institutionalization, the lack of integration between sectors limits overall system coherence and reduces the effectiveness of CBRN governance.

Table 3. Analysis of the Alignment of Türkiye's CBRN Capabilities with International Frameworks

Analysis Criterion	Current Situation in Türkiye	Details of the Analysis Criteria in the Relevant Framework	Level of Compliance
IHR – Surveillance and Early Warning	The infectious disease surveillance system includes data collection, information sharing, and early warning mechanisms	According to the IHR (2005), countries are required to establish surveillance systems to enable the early detection of public health threats. They must possess the capacity for a rapid and effective response to such risks. Laboratory infrastructure and the necessary health measures at points of entry must be ensured. International communication channels and national focal points must also be established.	High level of alignment
IHR – Emergency Health Response	Response capacity has been planned and institutionalized within the frameworks of HAP and TAMP. However, multisectoral integration specific to CBRN incidents has been addressed only to a limited extent.	According to the IHR (2005), the rapid detection and assessment of public health threats are critical. Countries must have the capacity to respond effectively to endemic, pandemic, and other risk situations. International coordination and information sharing must be ensured throughout the response process.	Moderate level of alignment
IHR – Inter-System Integration	Institutional cooperation efforts and mechanisms in the CBRN domain	According to the IHR (2005), the coordination of different systems is essential for the effective management of public health emergencies. Mechanisms must be established to facilitate	Low level of alignment

	remain limited within existing legal and regulatory frameworks. Regulations include mechanisms for military support and cooperation; however, as these mechanisms have not been sufficiently institutionalized, they remain incident-specific.	intersectoral coordination and regulate the flow of information among relevant agencies, thereby enhancing the effectiveness of early warning, assessment, and response processes. According to NATO, the primary responsibility for CBRN incidents lies with national civil authorities, while military capabilities support this process when necessary. This cooperation is conducted in a bidirectional manner during planning, training, exercises, and response processes. While civilian infrastructure supports military operations, military forces are also expected to provide logistical, technical, and operational support to civil authorities during crises. According to NATO, technical and operational capabilities encompass both national and international military capacities. Within this framework, intelligence, qualified personnel, equipment, planning, and regular exercises are key elements. NATO emphasizes that these capabilities should be interoperable, sustainable, and rapidly deployable. Early warning and command-and-control systems play a critical role in enabling rapid and coordinated responses to incidents.	
NATO – Civil-Military Coordination			Moderate level of alignment
NATO – CBRN Technical and Operational Capabilities	Current technical equipment, training, response capacity, and related field capabilities are in place.		High level of alignment
NATO – Command -and - Control System	A strong multisectoral structure exists under AFAD coordination; however, the command-and-control system remains limited.	According to NATO, the command-and-control system plays a central role in enabling rapid and coordinated responses. It involves the effective deployment of CBRN expertise and personnel and their integration into decision-making processes at all levels. According to the Sendai Framework, hazards, exposure, and vulnerability must be reduced, while community preparedness capacity and resilience should be strengthened. This is achieved through priority areas such as understanding hazards and risks, strengthening disaster risk management, prioritizing risk reduction, and enhancing preparedness processes. The Sendai Framework emphasizes that countries must develop preparedness plans at the local level, build capacity, and enhance public awareness. In this context, effective resource utilization, cross-sectoral collaboration, and the activation of crisis management mechanisms are essential. It also highlights the	Low level of alignment
Sendai – Risk Reduction	Regular inspections of chemical and industrial risks are conducted.		High level of alignment
Sendai – Preparedness and Response	The AFAD, TAMP, and HAP systems are actively implemented and demonstrate an advanced level of functionality.		High level of alignment

Sendai – Comprehensive Risk Management	CBRN risks are integrated into the general disaster management system but are not addressed as a distinct system.	importance of planning post-disaster recovery processes in a manner that reduces future risks. According to the Sendai Framework, comprehensive risk management requires that disaster risk be approached not as a single-dimensional issue, but as a multidimensional and cross-sectoral one, involving the participation of the entire society. The public sector, private sector, and all segments of society must be included in this process. The framework calls for the establishment of strong local coordination mechanisms, enhanced inter-agency cooperation, and the integration of risk management into all policies.	Moderate level of alignment
IAEA Radiation and Nuclear Safety	Standards for radiation safety, dose control, and nuclear facility safety have been established, and activities related to radiation and nuclear safety are systematically organized.	According to the IAEA, countries must assume regulatory and supervisory roles and establish a robust legal and institutional framework at the national level. The system should adopt a comprehensive structure covering areas such as radiation safety, nuclear safety, waste management, and transport safety. Prior risk assessment, continuous monitoring, and preparedness for potential accidents are essential. In this context, emergency response plans, early warning systems, and international cooperation mechanisms play a crucial role.	High level of alignment
IAEA – Nuclear Emergency and Preparedness	Relevant emergency plans and organizational structures are in place; however, the integration of nuclear emergency management with other CBRN components remains limited.	According to the IAEA, a pre-planned and continuously improved system for emergency response and preparedness must be established. In this context, countries are required to develop national-level preparedness plans for potential emergencies, clearly define responsibilities, and ensure inter-agency cooperation. In the event of an emergency, the objective should be to protect the public and the environment through a rapid, coordinated, and effective response.	Moderate level of alignment
ADR – Safety of Transport of Dangerous Goods	National legislation governing the transport of dangerous goods is implemented in accordance with the ADR.	According to the ADR, a comprehensive system must be established to prevent risks arising during the transport of dangerous goods, ensuring proper packaging, tank usage, and control. The ADR provides coordination and oversight by assigning specific responsibilities to all parties involved in the transportation and shipping process.	High level of alignment

The study evaluated requirements derived from international frameworks, including the clarity of institutional responsibilities, the existence of enforcement mechanisms, system integration,

functional alignment with international frameworks, and the scope of the legislation. The inclusion of the vast majority of these requirements in the legislation, together with

clearly defined institutional responsibilities and enforcement mechanisms, was classified as high-level compliance(>75%).

The presence of specific shortcomings related to implementation, coordination, or institutional integration was classified as moderate compliance (40–75%), whereas situations in which institutional responsibilities and implementation or coordination mechanisms were highly limited or inadequate were classified as low compliance (<40%).

Figure 1 illustrates the institutional components of CBRN management in Türkiye and the inter-agency relationships. At the center of this structure is the Disaster and Emergency Management Presidency (AFAD), while various ministries and agencies contribute to the system within their respective areas of responsibility. It is evident that areas such as public health, nuclear safety, chemical risk management, and hazardous materials transportation are organized under distinct institutional frameworks.

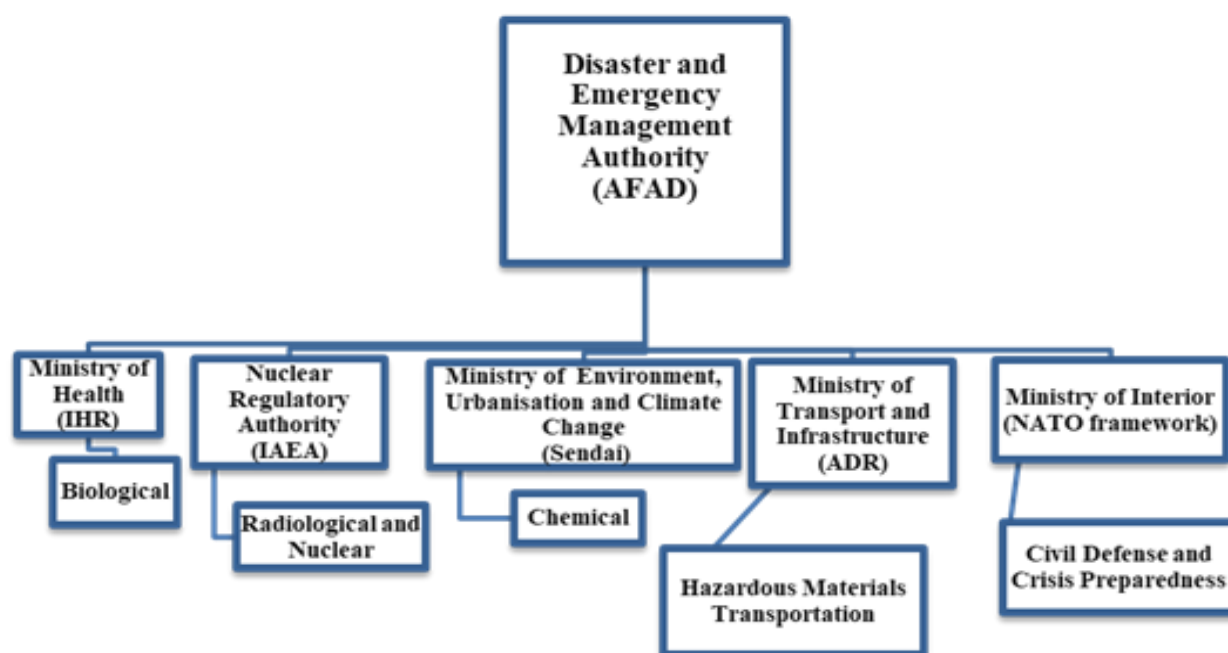


Figure 1. Institutional structure of CBRN governance in Türkiye

Discussion

The findings of this study indicate that CBRN management in Türkiye possesses a high level of technical and institutional capacity in certain areas; however, this capacity is not integrated into a comprehensive management model (Table 2). A general review of the legislation reveals that regulations addressing different types of risks are well developed within their respective domains, but cooperation among these regulations remains limited. The findings align with studies highlighting that limited inter-agency coordination in CBRN management negatively affects system effectiveness. This situation indicates that existing resources have not yet been integrated into a cohesive framework. First, from the perspective of biological risk management, Türkiye demonstrates

a strong infrastructure in terms of surveillance and early warning systems (Presidency of the Republic of Türkiye, 2018). This finding is consistent with studies emphasizing the strength of such systems while also noting that their integration with other risk areas remains limited. This public health-based framework effectively supports data generation, monitoring, and intervention processes and demonstrates a high level of compliance with the International Health Regulations (IHR). However, the institutional linkage between these resources and other CBRN components remains limited (Table 3). This suggests that, as biological risks are often associated with chemical, radiological, or security dimensions, coordination challenges may arise in field-level management during exposure incidents. It should be noted that, despite the

presence of a robust technical infrastructure, a lack of integration remains a significant factor limiting system performance.

Indeed, the literature emphasizes that managing coexisting risks is complicated by organizational structures and insufficient coordination (Boin et al., 2020). Similarly, other studies indicate that multisectoral collaboration in CBRN management has not yet achieved a fully integrated structure (Harefa et al., 2026). Some research further suggests that, due to the inherent complexity of CBRN threats, management approaches may be insufficient, and coordination issues may reduce the effectiveness of interventions (Narimani et al., 2025). In the radiological and nuclear sectors, Türkiye stands out as having one of the most developed areas of technical capacity according to the relevant legislation. It is evident that legislation concerning nuclear and radiation safety is largely aligned with international standards and provides a robust framework, particularly in terms of oversight, risk control, and safety. However, this sector has developed within a relatively separate structure, maintaining only limited connections with other CBRN components. From the perspective of system integrity, weak interaction with other risk areas may lead to certain disconnects. This observation is consistent with studies highlighting implementation and integration challenges in the nuclear and radiological sectors despite strong regulatory frameworks (Putra et al., 2025). In terms of chemical risk management, legislative efforts—such as the regulation of chemical substances, the transport of hazardous materials, and the prevention of industrial accidents—establish a strong framework focused on risk reduction. This finding aligns with the literature indicating that chemical risk management is largely centered on preventive and technical regulations, while crisis management and response dimensions remain more limited; overall, it is assessed to be largely aligned with the Sendai Framework for Disaster Risk Reduction (United Nations, 2015). However, the strong emphasis on preventive and technical aspects results in a limited connection with crisis management and response processes. In this context, a potential disconnect between risk reduction and crisis management may complicate the functioning of CBRN management. This is consistent with studies indicating that, despite the existence of

preparedness plans, implementation, training, and response capacity may remain limited, and that deficiencies in crisis management and inter-agency cooperation negatively affect system effectiveness (Baikmohammadi et al., 2024; Alahmari and Khan, 2023). From the perspective of disaster management, Türkiye has a robust institutional infrastructure in terms of legislation (Grand National Assembly of Türkiye, 2009; AFAD, 2022). AFAD legislation and the Türkiye Disaster Response Plan establish a multidisciplinary coordination structure and support operational capacity by clearly defining task distribution. However, although this structure reflects overall strength in disaster management, it does not sufficiently address the need for a continuous and centralized command-and-control mechanism specifically for CBRN incidents. Despite the emphasis on coordination in the relevant legislation, a permanent and hierarchical command-and-control structure has not been fully institutionalized. This situation may pose a risk of fragmented decision-making processes, particularly in multi-actor and high-uncertainty CBRN incidents. In this regard, the study is consistent with previous research indicating that CBRN incident management presents practical challenges due to its multi-stakeholder nature and the need for strong coordination, and that seamless inter-agency coordination is essential for an effective response (Ersoy Yalçın, 2025). At the core of the study, it becomes evident that CBRN management in Türkiye has developed within the framework of a “high technical capacity–low integration” paradigm. This finding is supported by recent studies that emphasize the need for coordination and preparedness strategies in response to current biological threats or bioterrorism scenarios (Ludovici et al., 2025). Previous studies similarly indicate that technical capabilities alone are insufficient and that institutional integration and inter-agency coordination are critical components of effective CBRN governance (Sarjito, 2025; Rietveld, 2025). When compared with international frameworks, Türkiye demonstrates a high level of compliance with relevant standards in many areas; however, this compliance is not uniformly distributed. Public health efforts aligned with the IHR are strong; risk reduction and preparedness mechanisms are developed in accordance with the Sendai

Framework; the nuclear safety sector demonstrates technical adequacy within the framework of IAEA standards; and the transport of hazardous materials under the ADR is fully aligned with international norms. However, an integrated command-and-control-based management model has not been fully institutionalized in Türkiye. Overall, CBRN management in Türkiye exhibits a strong yet fragmented structure. In this context, there is a need for institutional restructuring that goes beyond technical capacity to strengthen the system. Enhancing inter-agency integration, clarifying command-and-control mechanisms, and unifying different risk areas under a common governance framework are critical for achieving greater alignment with international standards. In this context, the study demonstrates that CBRN governance should be evaluated not only in terms of technical capacity but also in relation to how this capacity is coordinated and integrated within the system. Furthermore, this study contributes to the literature by addressing CBRN governance within a comprehensive legislative framework and by presenting an analytical model that explains governance through the structural relationship between capacity and integration. Although Türkiye demonstrates substantial legislative alignment and sector-specific institutional capacities, the existence of legal frameworks and formally assigned responsibilities should not be interpreted as direct evidence of operational effectiveness during real CBRN incidents. Operational performance depends on additional factors, including inter-agency exercises, workforce competencies, communication systems, resource mobilization capacities, and field-level interoperability. Therefore, the findings of this study should be interpreted as an assessment of legislative and governance preparedness rather than actual response performance. The establishment of a dedicated CBRN coordination center in Türkiye which would ensure coordination through a multidisciplinary approach managed from a single hub, the adoption of a CBRN specific incident command system, the conduct of multisectoral exercises using various communication platforms, and the development of a national CBRN policy that defines all responsibilities could strengthen CBRN management.

Research limitations and implications

This study has certain limitations. The analysis is limited to legislative documents and therefore may not fully capture implementation practices or institutional functioning in real-world settings. In addition, the coding process was carried out by a single researcher, which restricts the assessment of coding reliability. The study is also confined to selected international frameworks, and the inclusion of additional frameworks could offer a broader perspective. In addition to all of this, this study did not address field observations, exercise reports, or existing operational performance metrics. Therefore, it is not possible to assess response capabilities in the event of an actual CBRN incident. Future studies should employ mixed-method designs combining document analysis with expert interviews, Delphi studies, simulation exercises, and empirical preparedness assessments. This study benefited from AI-based tools during the translation and language editing processes.

Conclusion

This study demonstrates that CBRN management in Türkiye is based on strong technical and institutional capacity and exhibits a high level of compliance across most of the areas examined; however, it is not sufficiently organized within an integrated management structure. While substantial alignment with international standards has been achieved in the areas of public health, nuclear safety, chemical risk management, and disaster response, this alignment is not uniformly reflected across the entire system. The absence of a fully institutionalized model based on an integrated command-and-control structure and effective civil–military coordination may pose a risk from a management perspective. This finding highlights that the relationship between capacity and integration is a critical factor in CBRN management. Accordingly, strengthening CBRN governance requires not only enhancing technical capacity but also improving inter-agency coordination, clarifying command-and-control mechanisms, and integrating different risk areas under a unified governance framework. Future CBRN management models must go beyond sector-specific capabilities and adopt integrated, command-and-control-focused management

structures that combine technical expertise with organizational interoperability and resilience.

About the authors

Ali Sert is a lecturer at Burdur Mehmet Akif Ersoy University and holds a PhD in CBRN (Chemical, Biological, Radiological and Nuclear) defence. His research focuses on disaster risk governance, public health preparedness, and institutional coordination in multi-risk environments. In addition, his work includes the development of new risk models in the CBRN field, as well as CBRN disaster analysis and risk mapping methodologies. His research particularly examines the legislative and organizational dimensions of CBRN management and its alignment with international frameworks.

Ethics and Consent to Participate

Ethical approval was not required because this study was based exclusively on publicly available legislative texts, policy documents, and institutional regulations

Consent for Publication

Not applicable

Competing interests

The author declares that he has no competing interests.

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Authors' contributions

AS conceived and designed the study, conducted the document analysis, developed the coding framework, interpreted the findings, drafted and revised the manuscript, and approved the final version.

Data Accessibility Statement

All data analysed in this study are based on publicly available legislation, regulations, institutional documents, and international frameworks. The sources used in the analysis are listed in the references and tables. No additional dataset was generated.

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References

1. Javan Biparva, A., Nasiri, A., Karamali, M., & Nasiri, T. (2026). Strategic dimensions of risk management in dealing with CBRNE events in military hospitals: A qualitative analysis with a policy approach from the perspective of experts. *Risk Management and Healthcare Policy*, 19, 1–12. <https://doi.org/https://doi.org/10.2147/RMHP.S571765>
2. Ranse, J., Mackie, B., Crilly, J., Heslop, D., Wilson, B., Mitchell, M., et al. (2025). Strengthening emergency department response to chemical, biological, radiological, and nuclear disasters: A scoping review. *Australasian Emergency Care*, 28(1), 37–47. <https://doi.org/https://doi.org/10.1016/j.auec.2024.09.003>
3. Narimani, S., Seyedin, H., Moslehi, S., & Tavan, A. (2025). Comprehensive psychosocial support in CBRNE incidents: A systematic review of strategies for citizens and frontline personnel. *BMC Emergency Medicine*, 25(1), Article 259. <https://doi.org/10.1186/s12873-025-01409-3>.
4. Harefa, F., Harahap, Y., Dewi, D. A. R., Nurrobi, R. T., & Harsono, C. F. (2026). Risk-based modeling approach for strengthening hospital preparedness against CBRNE threats to enhance public health. *Journal of Hunan University Natural Sciences*, 53(1). <https://doi.org/https://doi.org/10.55463/issn.1674-2974.53.1.11>
5. Farhat, H., Alinier, G., Chaabna, K., El Aifa, K., Abougalala, W., Laughton, J., et al. (2024). Preparedness and emergency response strategies for chemical, biological, radiological and nuclear emergencies in disaster management: A qualitative systematic review. *Journal of Contingencies and Crisis Management*, 32(3), e12592. <https://doi.org/https://doi.org/10.1111/1468-5973.12592>
6. Vengidasamy, P., Tamrin, S. B., Hj, M. A., & Rahman, A. (2024). CBRN hazard management in Malaysian healthcare: A review of the literature and implications for practice. *International Journal of Management and*

- Human Science*, 8(1), 11–26.
<https://doi.org/https://doi.org/10.31674/mjmr.2024.v08i01.002>
7. Ahmad, M., & Qzih, E. (2025). Critical deficits in CBRNE preparedness: A nationwide assessment of Jordanian healthcare providers' knowledge, skills, and training gaps. *SAGE Open Medicine*, 13.
<https://doi.org/https://doi.org/10.1177/20503121251385060>
8. Amin, F., Verma, K., & Acharya, P. (2024). Multi-hazard risk and integrated approach to resilience. In *Disaster risk and management under climate change* (pp. 581–592). Springer.
9. Chattu, V. K., Mol, R., Singh, B., Reddy, K. S., & Hatefi, A. (2024). Pandemic treaty as an instrument to strengthen global health security: Global health diplomacy at its crux. *Health Promotion Perspectives*, 14(1),
<https://doi.org/10.34172/hpp.42744>
10. Maisaia V, Guchua A, Mozgin W. Threat of CBRN weapons use by terrorist groups and UN-NATO international security policy. *Front Health Inform*. 2024;13(6).
11. Busayo, E. T., Kalumba, A. M., Afuye, G. A., Ekundayo, O. Y., & Orimoloye, I. R. (2020). Assessment of the Sendai framework for disaster risk reduction studies since 2015. *International Journal of Disaster Risk Reduction*, 50, Article 101906.
<https://doi.org/https://doi.org/10.1016/j.ijdrr.2020.101906>
12. Wright, N., Fagan, L., Lapitan, J. M., Kayano, R., Abrahams, J., Huda, Q., & Murray, V. (2020). Health emergency and disaster risk management: Five years into implementation of the Sendai framework. *International Journal of Disaster Risk Science*, 11(2), 206–217.
<https://doi.org/https://doi.org/10.1007/s13753-020-00274-x>
13. Jaloliddin R. International cooperation in nuclear energy through the prism of IAEA standards. *Cent Asian J Soc Sci Hist*. 2026;7(1):166–172.
<https://doi.org/10.51699/cajssh.v7i1.1269>
14. Rabiej, K., & Kociemba, D. (2025). Business process management as a tool for implementing ADR agreement requirements in the road transport of dangerous goods. *Zarządzanie Innowacyjne w Gospodarce i Biznesie*, 41(2), 135–153.
<https://doi.org/https://doi.org/10.25312/ziwgib.834>
15. Ogur, E., & Canturk, N. (2022). An evaluation of law enforcement capabilities in the context of CBRN risk perceptions: A research within Türkiye and the United States. *Bulletin of Legal Medicine*, 27(1), 78–86.
<https://doi.org/10.17986/blm.20221750>
16. Bowen, G. A. (2009). Document analysis as a qualitative research method. *Qualitative Research Journal*, 9(2), 27–40.
<https://doi.org/https://doi.org/10.3316/QRJ090207>
17. World Health Organization. (2025). *International health regulations (2005): Third edition, incorporating amendments adopted in 2014, 2022 and 2024*. World Health Organization.
18. North Atlantic Treaty Organization. NATO's chemical, biological, radiological and nuclear (CBRN) defence policy. 2022.
19. United Nations. (2015). *Sendai framework for disaster risk reduction 2015–2030*. United Nations Office for Disaster Risk Reduction.
<https://www.undrr.org/publication/sendai-framework-disaster-risk-reduction-2015-2030>
20. International Atomic Energy Agency. (2014). *Radiation protection and safety of radiation sources: International basic safety standards* (General Safety Requirements No. GSR Part 3). International Atomic Energy Agency.
<https://www.iaea.org/publications/8930/radiation-protection-and-safety-of-radiation-sources-international-basic-safety-standards>
21. United Nations Economic Commission for Europe. (2022). *Agreement concerning the international carriage of dangerous goods by road (ADR): Applicable as from 1 January 2023*. United Nations.
<https://unece.org/transport/dangerous-goods/adr-2023-files>
22. Elo, S., & Kyngäs, H. (2008). The qualitative content analysis process. *Journal of Advanced Nursing*, 62(1), 107–115.
<https://doi.org/https://doi.org/10.1111/j.1365-2648.2007.04569.x>
23. Presidency of the Republic of Türkiye. Regulation on duties regarding chemical, biological, radiological, and nuclear threats and

- hazards. Off Gaz. 2020;31261. Available from: <https://mevzuat.gov.tr/mevzuat?MevzuatNo=3033&MevzuatTur=21&MevzuatTertip=5>
24. Grand National Assembly of Türkiye. Law on the organization and duties of the Disaster and Emergency Management Authority (Law No. 5902). 2009. Available from: <https://www.mevzuat.gov.tr/MevzuatMetin/1.5.5902.pdf>
 25. Disaster and Emergency Management Authority (AFAD). Türkiye disaster response plan (TAMP). 2022. Available from: https://www.afad.gov.tr/kurumlar/afad.gov.tr/e_Kutuphane/Planlar/TAMP.pdf
 26. Grand National Assembly of Türkiye. Public health law (Law No. 1593). Last amended in 2018.
 27. Grand National Assembly of Türkiye. Law on biosafety (Law No. 5977). 2010.
 28. Ministry of Health of Türkiye. Regulation on the Principles of Surveillance and Control of Infectious Diseases. Official Gazette No. 26537. 2007.
 29. Turkish Atomic Energy Authority. Radiation Safety Regulation. Official Gazette No. 23999. 2000.
 30. Official Gazette of the Republic of Türkiye. Law on nuclear regulation (Law No. 7381). 2022.
 31. Ministry of Environment and Urbanization of Türkiye. Regulation on chemicals (KKDIK). 2017.
 32. Ministry of Transport and Infrastructure of Türkiye. Regulation on transport of dangerous goods by road. 2013.
 33. Ministry of Environment and Urbanization of Türkiye; Ministry of Labour and Social Security of Türkiye. Regulation on prevention of major industrial accidents. 2019.
 34. Grand National Assembly of Türkiye. Civil defense law (Law No. 7126). Last amended in 2018.
 35. Grand National Assembly of Türkiye. Provincial administration law (Law No. 5442). Last amended in 2020.
 36. Ministry of Health of Türkiye. Regulation on hospital disaster and emergency plans (HAP). 2020.
 37. Boin, A., Ekengren, M., & Rhinard, M. (2020). Hiding in plain sight: Conceptualizing the creeping crisis. *Risk, Hazards & Crisis in Public Policy*, 11(2), 116–138. <https://doi.org/https://doi.org/10.1002/rhc3.12193>
 38. Putra, Z. P., Pratama, H. A., Sumarbagiono, R., Nurliati, G., Romli, M., Bakhri, S., Setiawan, B., Pamungkas, N. S., & Yusuf, M. (2025). Advancing sustainable development through the safe management of disused sealed radioactive sources: Research and trends (2000–2024). *Nuclear Engineering and Technology*, 57(12), 103828. <https://doi.org/https://doi.org/10.1016/j.net.2025.103828>
 39. Baikmohammadi, S., Amirheidari, B., Dehesh, T., Moghadam, M. N., Yazdi-Feyzabadi, V., Hassani, E., & Habibzadeh, H. (2024). A qualitative study on barriers and strategies to hospital preparedness against chemical, biological, radiological, and nuclear incidents. *Journal of Education and Health Promotion*, 13(1), Article 3. https://doi.org/https://doi.org/10.4103/jehp.jehp_1827_22
 40. Alahmari, A. A., & Khan, A. A. (2023). Chemical, biological, radiological, and nuclear preparedness of public hospitals in Riyadh. *Disaster Medicine and Public Health Preparedness*, 17, e401. <https://doi.org/https://doi.org/10.1017/dmp.2023.66>
 41. Ersoy Yalçın U. Türkiye's approach to CBRN incident management: a comprehensive analysis. *J Forensic Sci Crime Res*. 2025;7(2):179–195. <https://izlik.org/JA84SY86YC>
 42. Sarjito, A. (2025). Harmonising Indonesia's CBRN policy with the IHR and WHO–UNODA frameworks. *Global Biosecurity*, 7(1). <https://doi.org/https://doi.org/10.31646/gbio.331>
 43. Rietveld, R. M. (2025). Towards a future battlefield forensics framework: A NATO action research case study. *Scandinavian Journal of Military Studies*, 8(1), 451–465. <https://doi.org/https://doi.org/10.31374/sjms.333>
 44. Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*, 3(2), 77–101.

- <https://doi.org/https://doi.org/10.1191/1478088706qp063oa>
45. Malizia A, McGovern J, Sarigiannis D, et al. Integrating the exposome framework in CBRNe risk assessment: a holistic approach to chemical, biological, radiological, nuclear, and explosive threats. *Eur Phys J Plus*. 2025;140:1103.
doi:<https://doi.org/10.1140/epjp/s13360-025-07030-4>.
46. Coleman CN, Bader JL, Koerner JF, Hrdina C, Cliffer KD, Hick JL, et al. Chemical, Biological, Radiological, Nuclear, and Explosive (CBRNE) Science and the CBRNE Medical Operations Science Support Expert (CMOSSE). *Disaster Med Public Health Prep*. 2019;13(5-6):995-1010.
doi:<https://doi.org/10.1017/dmp.2018.163>.
47. Ludovici GM, Tassi PA, Iannotti A, Russo C, Quaranta R, Giuga G, Rao S, Malizia A. Nipah Virus Outbreaks: A CBRNE Framework for Global Biocontainment. *Global Biosecurity*. 2025;7(1).
doi:<https://doi.org/10.31646/gbio.327>.

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