Supply and logistics impediments in natural disasters: an example from the 2023 Syria–Türkiye earthquakes

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Abstract

Purpose – This study aims to evaluate the functionality of the emergency medical supply chain (EMSC) in northwest Syria (NWS) during the response to the February 6th, 2023 Türkiye–Syria earthquake, focusing on key challenges, strengths and areas for improvement in the system.

Design/methodology/approach – A mixed-methods approach was used, incorporating data from 15 health facilities through surveys and key informant interviews with supply chain personnel.

Findings – This study uncovered significant vulnerabilities in the EMSC, particularly in procurement, forecasting, coordination, information systems and staffing. Emergency shipments were frequently delayed, with many facilities receiving incomplete supplies or lacking clarity on delivery timelines. Stockpiles played a critical role in the early response, but poor forecasting led to severe shortages where 92% of facilities lacked analgesics and 69% antibiotics. Cross-border disruptions further exposed the risk of overreliance on external suppliers. Communication was fragmented, with health responders relying on informal platforms like WhatsApp, underscoring the absence of robust, centralized communication tools during emergencies.

Originality/value – To the best of the authors' knowledge, this study is the first to assess EMSC performance in NWS following the 2023 earthquake. It provides actionable insights into systemic weaknesses, emphasizing the urgent need for strategic reforms. Recommendations include establishing a national electronic logistics management information system, strengthening coordination protocols, enhancing prepositioning strategies and investing in structured training for supply chain personnel. With Syria transitioning toward unified governance, the findings highlight a pivotal opportunity to build a more resilient and responsive supply chain infrastructure, better equipped to manage future emergencies in conflict-affected and resource-constrained settings.

Keywords Supply chain, Syria, Supply chain management in disaster relief, Humanitarian logistics, Earthquake

Paper type Research paper

The current issue and full text archive of this journal is available on Emerald Insight at: **https://www.emerald.com/insight/2042-6747.htm**

Journal of Humanitarian Logistics and Supply Chain Management
Emerald Publishing Limited [ISSN 2042-6747]
[DOI 10.1108/JHLSCM-05-2025-0072]

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Received 12 May 2025
Revised 7 January 2026
24 February 2026
Accepted 19 March 2026

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1. Introduction

On February 6, 2023, a series of earthquakes, including a significant 7.8 magnitude tremor, struck southern Türkiye and northern Syria, resulting in widespread devastation. In northern Syria, the earthquakes caused the loss of over 4,500 lives (World Vision, 2024). At that time, northwest Syria (NWS) encompassed an area of approximately 7,703 km^2, covering parts of the Idlib and Aleppo governorates. The area was bounded by the Turkish border to the north and the front line with the former Assad regime to the south and east. It sheltered about 5.2 million people, including 2 million living in tented settlements (OCHA, 2024). This region had already faced multiple compounding crises including active conflict, insecurity, economic instability, a cholera outbreak, the COVID-19 pandemic and limited access to essential services. As a result, the population and services experienced unparalleled strain as the earthquake compounded a preexisting, severely underfunded humanitarian crisis (IOM, 2025). The earthquake placed additional pressure on the region's already fragile health systems. It revealed gaps in the preparedness and coordination of emergency response, as well as limitations in local decision-making processes and the ability to respond rapidly to emerging needs (Johns Hopkins Bloomberg School of Public Health, 2023). In addition, it exposed the significant political and governance challenges faced by both local and international aid mechanisms. Central to effective response in such crises is the operational capability of the emergency medical supply chain (EMSC), which refers to the system and processes for procuring, storing, transporting and distributing medications and medical supplies required for emergency and critical care during crises. The efficient operation of the EMSC is vital to ensure the timely delivery of life-saving treatments and resources in disaster-affected areas, particularly where disruption can have severe consequences for patient outcomes (Xu and Wang, 2024).

In the aftermath of the 2023 Türkiye–Syria earthquake, the performance of the EMSC became a critical determinant of survival, especially in this resource limited setting (Mahroos *et al.*, 2024). However, emergency supply chains can face unique challenges, including infrastructure damage, transportation disruptions, insufficient storage facilities and fragmented coordination among stakeholders. These challenges are even more severe in fragile settings like NWS, where limited pre-crisis planning, fragmented governance structures and overwhelming humanitarian needs have long exceeded the capacity of existing response systems (Hatahet, 2023). The response in NWS involved multiple international and local stakeholders and was coordinated primarily through the humanitarian clusters approach (OCHA, 2024). The Syria Health Cluster based in Gaziantep, Türkiye, Idlib Health Directorates (IHD), the White Helmets (WH), along with multiple local and international nongovernmental organizations (NGOs), and the local authorities engaged in these efforts. Given the absence of alternative routes, the humanitarian response was heavily dependent on cross-border operations, primarily through Bab Al Hawa border crossing between Türkiye and Syria; this crossing had been subject to six-month renewals by the UN Security Council and was the only formal avenue for aid to reach NWS before the earthquakes (UN News, 2023). The reliance on a single access point left the response particularly vulnerable, as demonstrated when the cross-border lifeline through Bab Al Hawa was effectively brought to a standstill during the first 48 h following the earthquake (*Reuters*, 2023).

While numerous studies have examined the humanitarian response to the 2023 Türkiye-Syria earthquakes, including aid coordination and immediate relief efforts (IASC, 2024; Santarisi *et al.*, 2024; Mercy Corps, 2023), logistical challenges, particularly regarding the EMSC in NWS, remain underexplored. Although some research has analyzed post-disaster logistics, these have largely focused on Türkiye. For instance, a recent study critically examined the application of post-disaster logistics frameworks in Türkiye, highlighting issues such as coordination inefficiencies, gaps between theoretical models and operational realities, delays in resource allocation and the impact of damaged infrastructure on aid delivery (Demir, 2023). In contrast, little is known about how medical supply chains functioned in NWS, particularly within the cross-border humanitarian response, leaving an important gap in the current understanding of the earthquake's impact on health service delivery.

This study examines the performance of the EMSC in NWS after the earthquakes, focusing on the main strengths, gaps and challenges encountered. Drawing on the experience of the Syrian American Medical Society (SAMS) and their partner Direct Relief (DR), the study also explores the role of local actors, governance and resource allocation in shaping humanitarian logistics. This research aims to inform future emergency preparedness and supply chain planning. Although political shifts, most notably the fall of the Syrian regime in December 2024, have since reshaped the landscape, these findings remain relevant for other contexts facing overlapping crises.

2. Methodology

2.1 Study design

A mixed-methods approach has been used in this study to assess the EMSC in NWS. The study was planned in January 2024, with data collection taking place in September and October 2024, and data analysis being completed in November 2024. It has included a quantitative component using a facilities survey based on an adapted version of the Logistics Indicator Assessment Tool (USAID, 2008) developed by the United States Agency for International Development (USAID) and a qualitative component comprising key informant interviews guided by the Logistics System Assessment Tool (LSAT) (USAID, 2009) that was also developed by USAID. Both tools have been modified by the research team and piloted to focus on local capacity, the role of local actors and the complexities of cross-border logistics, while ensuring accessibility with language options and flexible data collection methods. These adaptations have enabled the study to provide relevant insights on the EMSC's effectiveness and challenges in NWS.

2.2 Health facilities survey

The survey has been conducted in 15 health facilities distributed across various locations within the earthquake-

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affected areas of NWS, including Idlib and Aleppo governorates from October 28 to November 13, 2024. These facilities, operated by different organizations, have been purposively selected to represent a wide geographical spread across districts that were mainly impacted by the earthquake, including Harem, Jisr al-Shughur, Afrin and Atareb. The selection is a result of cross-referencing facility lists from the IHD, WH and the World Health Organization (WHO), with a focus on facilities that handled approximately 80% of the earthquake response. The survey tools have been reviewed by supply chain staff from SAMS to ensure the accuracy of translation and confirm their relevance to the local context. Following the review, the tools were uploaded to KoboToolbox and contextualized and adapted to the Syrian Arabic dialect during the training session to ensure clarity and accurate data collection. An example of the survey questions included:

> "Are there standard operating procedures (SOPs) for Warehousing & Storage available at this site/facility (in electronic or paper copy)?" and "What tools are in use for tracking and managing inventory?"

A pilot phase has then been implemented in two SAMS-operated facilities in early October 2024 (Bab Al-Hawa Hospital and Al-Atareb Hospital) to test the revised survey instrument. This phase has proven essential for identifying any remaining issues with the survey questions and has allowed for further adjustments to the tool. Data collection has been carried out by the monitoring and evaluation field team of SAMS, who have conducted on-site visits and administered the survey in Arabic using KoboToolbox. Before each visit, coordination with facility focal points has ensured the availability and consent of relevant staff. The collected data have subsequently been analyzed using IBM SPSS Statistics (Version 29) to identify key patterns and insights.

2.3 Key informant interviews

2.3.1 Recruitment and sampling

Participants have been recruited through purposeful and snowball sampling methods, commonly used in qualitative research to identify information-rich informants, particularly when relevant individuals are difficult to access (Naderifar *et al.*, 2017). The recruitment process began with the identification of key informants through SAMS Turkey office coordinators, who have facilitated communication with individuals from NGOs directly involved in supporting the 15 health facilities that were included in this study. To expand the participant pool, initial informants have been asked to recommend other individuals with relevant experience and knowledge who could contribute to the study, ensuring a broad range of perspectives from those involved in the logistics and operational aspects of the earthquake response.

2.3.2 Inclusion and exclusion criteria

Inclusion criteria included participants employed in supply chain management or health management positions at one of the organizations funding the selected health facilities. These individuals have been expected to have direct experience with the EMSC during the earthquake response. Exclusion criteria included individuals without relevant experience in supply chain management or health management roles, as well as those who have not worked with organizations actively involved in funding or operating health facilities in NWS.

2.3.3 Data collection

Data collection has been conducted from October to November 2024 through semi-structured interviews guided by a modified version of the LSAT [*Logistics System Assessment Tool (LSAT)*, 2009] to ensure that questions have captured participants' experiences, perceptions and insights related to the EMSC. Interviews lasted between 60 and 90 min, were conducted online via Microsoft Teams, and were recorded for transcription. Interviews have been conducted in Arabic or English, depending on participant preference. Two bilingual researchers, fluent in both Arabic and English, conducted and facilitated the interviews.

2.3.4 Recording and analysis

All interviews have been recorded with the informed consent of participants and transcribed and translated using Turboscribe, an AI-based transcription software. To ensure confidentiality and compliance with ethical protocols, access to the AI software has been limited to the researchers conducting the interviews, and transcripts cross-checked by a bilingual researcher to ensure the accuracy of the translated content. Audio recordings and final transcripts have been stored securely on encrypted, password-protected devices accessible only to the research team. After transcription and review, the AI-generated files have been deleted to prevent any further access or storage beyond the research team. Thematic analysis was used to analyze the interview data and identify key themes, elements and challenges. Iterative data analysis has been used where the first step was listening to the interview recordings, reviewing transcripts and making notes of initial impressions. Following this, the transcriptions have been systematically coded by two researchers using Dedoose 9.2.22, a qualitative data analysis software. The coding process was iterative, with codes having been refined and redefined as the analysis progressed. Codes have then been grouped into categories that reflected the broader themes identified in the data. Throughout the analysis process, the research team has maintained a reflective stance, considering the potential biases and assumptions that could influence the interpretation of the data.

2.4 Ethical considerations

Ethical exception for this study has been obtained through Johns Hopkins University IRB No: 30611 and the research team followed ethical practices including obtaining informed consent from all participants and ensuring all data were securely stored on password-protected computers to which only named researchers had access. No sensitive questions have been asked of participants, but they were advised they could stop the interview at any time.

3. Results

3.1 Quantitative survey findings

This section will present the quantitative findings from the survey on health facilities including facility background information, disaster response experiences, stock and inventory management practices, forecasting and procurement planning and human resource capacities across 15 secondary healthcare facilities in northwest Syria.

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Table 1 provides a summary of the key quantitative findings across the surveyed facilities. Detailed results are presented in the subsections that follow.

3.1.1 Facility background information

The survey was conducted across 15 health facilities, all of which were secondary healthcare hospitals located in NWS. Of these, 14 facilities (93.3%) were situated in Idlib governorate, and one facility (6.7%) was in Aleppo governorate. The facilities were operated and funded by eight different organizations, including international nongovernmental organizations and local NGOs.

All 15 facilities (100%) reported having functional roads that were accessible in all weather conditions, ensuring consistent physical access. The median road distance from each facility to the nearest medical supply warehouse was 38 km, ranging from 4 to 80 km. Regarding supply chain management, 11 facilities (73.3%) reported having specific standard operational procedures (SOPs) for managing emergency medicines, which were distinct from protocols used for routine medicines. Four facilities (26.7%) reported having no specific SOPs for emergency medicines. The geographic distribution of the surveyed facilities in relation to the earthquake impact zone is shown in Figure 1.

Table 1 Summary of key quantitative findings from the health facility survey ($n = 15$), Northwest Syria, February 2023 earthquake response

Quantitative finding category	Key data
Response timeliness and delivery	73.3% of facilities reported slow responses/ delayed emergency shipments 60% of facilities faced uncertain delivery timelines 53.3% of facilities received partial deliveries/ incomplete supplies Nine out of 15 facilities did not receive any emergency shipments within the first 24 h Only one facility received its first shipment from its main partner organization within the first day
Emergency medicine shortages	92.3% of facilities lacked analgesics 76.9% lacked bandages and dressings 69.2% lacked intravenous (IV) fluids with electrolytes
Inventory management systems	100% of facilities used manual stock cards for inventory tracking 93.3% of facilities used Excel spreadsheets for inventory tracking Only 46.7% (7 facilities) had a dedicated information system for supply chain inventory management
Forecasting and planning	Forecasting was inconsistent; 13 facilities conducted it post-earthquake, but most relied on short-term, consumption-based methods (less than Three months) Only 8 facilities used forecasting data to inform procurement decisions Only 5 out of 15 facilities had formal procurement plans
Human resources (HR)	Six facilities reported lacking adequate supply chain staff at the time of the earthquake Five out of 15 surveyed facilities were understaffed during the earthquake response Only five facilities had specific HR plans addressing emergency medical supply chains

3.1.2 Disaster response

3.1.2.1 Timing and sources of first emergency shipments. The timing and source of the first shipment of medical supplies following the earthquake varied considerably across the surveyed facilities. The earliest delivery occurred three hours after the earthquake, provided by Médecins Sans Frontières (MSF) to an orthopedic specialty hospital in Aqrabat, Idlib governorate. The longest delay was 30 days for a shipment delivered by the WHO.

Of the 15 facilities, only one received its first shipment from its main partner organization within the first day. The other five facilities that received shipments within the first day obtained them from other NGOs operating in the area, such as MSF and Qatar Red Crescent, rather than their primary partners. The remaining nine facilities did not receive shipments within the first day. These initial shipments were shared among facilities through direct coordination at the field level, with supplies exchanged between facilities and NGOs operating in NWS.

By the end of the first week, the number of facilities that had received their first shipment increased from six to 13. Among these, two shipments had been preplanned before the earthquake and did not primarily contain medications for the response. Throughout the first month, four additional shipments were delivered: two by WHO, one by another NGO and one by the IHD. Figure 2 illustrates the sources of first shipments across the facilities.

The delays and inconsistencies in deliveries were reflected in the challenges reported by the facilities, including delayed responses (11 facilities, 73.3%), uncertain delivery timelines (9 facilities, 60%) and partial deliveries (8 facilities, 53.3%).

In addition to these challenges, facilities reported that most of the supplies received during the earthquake response were in-kind donations from other organizations, rather than being procured through the mechanisms that typically supported supply chains before the earthquake. This created additional difficulties as in-kind donations often are not aligned with the specific needs of each facility. Furthermore, the heavy reliance on external donations, as seen in this instance, disrupted the consistency of supply flows.

3.1.2.2 Emergency medicine shortages and mitigation strategies. During the earthquake response, the most commonly reported shortages of emergency medicines, as reported by 13 facilities, were analgesics (92.3%), bandages and dressings (76.9%) and intravenous (IV) fluids with electrolytes (69.2%) (Figure 3). Notably, 13 out of 15 facilities reported that their first shipment was based on predefined emergency medicine lists, such as the Interagency Emergency Health Kit (IEHK), while only two facilities received shipments tailored to their specific needs.

To address these shortages, facilities implemented a variety of mitigation strategies, including contacting supporting NGOs, relying on donations from local charities and community volunteers, requesting supplies from other facilities and coordinating with the health directorate and WHO to secure emergency stock.

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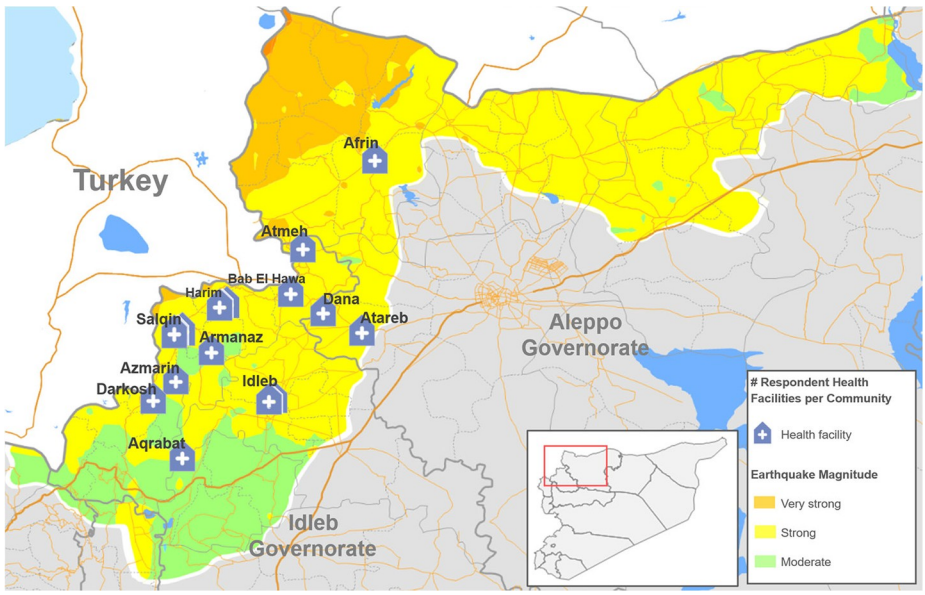
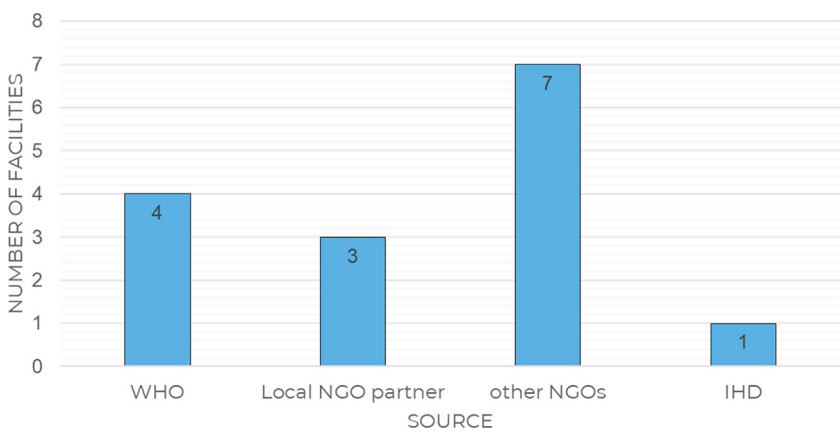
Figure 1 The earthquake impact map highlights dots representing the hospitals included in this study, with dot size corresponding to population density in each town



Note(s): While other facilities may have been closer to the impact zone, many were damaged or suspended, limiting their functionality. As a result, most patient referrals were directed to Idlib in the south, which experienced relatively less impact.

Figure 2 The source from which the first shipment arrived and the number of facilities that received a shipment from that source, not taking into account the delay in receiving the first shipment



3.1.3 Stock and inventory management

Among the surveyed facilities, stock and inventory management practices varied and several gaps were noted. Under normal circumstances, seven out of the 15 (46.7%) facilities reported that delivery times for emergency medicines differed from those for routine medicines. Emergency medicine deliveries typically took one to two weeks, while routine medicine deliveries ranged from two weeks to three months.

Only 7 out of 15 (46.7%) facilities had a dedicated information system for supply chain inventory management. Inventory tracking was primarily done using manual stock cards (100%) and Excel spreadsheets (93.3%), with no mention of more advanced electronic logistics management information systems (eLMIS). While all facilities reported tracking quantities and expiry dates, only eight facilities (53.3%) conducted inventory sampling to assess the condition and quality of incoming shipments.

As for emergency medicines reordering, most facilities relied on simple consumption calculations using Excel sheets from previous months, with only two facilities (13.3%) using more advanced methods, such as the Economic Order Quantity metric.

Stock-taking was conducted in all the facilities surveyed (100%), but frequencies varied widely, indicating inconsistent

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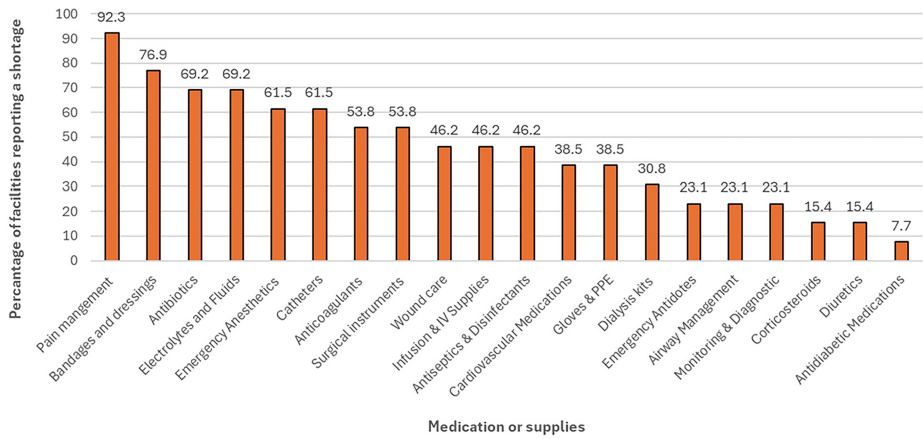
Figure 3 Percentage of facilities reporting shortages in emergency medications and supplies among the surveyed facilities during the earthquake response



practices. One facility (6.7%) performed stock-taking on a weekly basis, 11 facilities (73.3%) conducted this on a monthly basis, one facility (6.7%) quarterly, one (6.7%) annually and one (6.7%) reported different frequencies for emergency medicines (bi-weekly) and regular medicines (monthly).

3.1.4 Forecasting and procurement planning

Forecasting medical supply needs, which involves estimating future demand based on consumption patterns, service delivery and other relevant indicators, was inconsistently applied among the surveyed facilities. Before the earthquake, 10 out of the 15 facilities conducted forecasting, a number that increased to 13 out of 15 after the earthquake. However, most forecasting was short-term, with 7 out of 10 facilities forecasting for periods less than three months. The most commonly used forecasting methodologies relied on consumption rates and service numbers, while only two facilities incorporated demographic data, indicating limited use of broader demand predictors. Furthermore, although ten facilities engaged in forecasting before the earthquake, only eight used forecasting data to inform procurement decisions.

Procurement planning, the process of translating forecasted needs into actionable purchasing and stock replenishment plans, was even less consistently applied. Only 5 out of 15 facilities had formal procurement plans, typically designed to meet four months of forecasted demand. Due to the gaps in forecasting, facilities relied on more immediate and reactive indicators to plan purchases, such as available stock levels and financial cycles.

3.1.5 Human resources

Five out of 15 surveyed facilities were understaffed during the earthquake response. Only five facilities had specific human resources (HR) plans addressing both regular and EMSCs, defined as the preidentification and allocation of staff trained to manage supply chain operations during emergencies.

The most commonly used capacity-building methods were on-the-job training, coaching, and online training, though their adequacy for emergency response was not assessed. Six facilities reported lacking adequate supply chain staff at the time of the earthquake.

3.2 Qualitative survey findings

This section will outline the qualitative findings from the key informant interviews, highlighting the five emerging themes: crisis communication, coordination, information management, funding and disaster preparedness while managing the EMSC during the 2023 earthquake in northwest Syria.

3.2.1 Results of interviews

A total of eight interviews were conducted with participants representing organizations responsible for managing the fifteen selected facilities. Participants held key roles in supply chain and health program management, including positions such as supply chain coordinators, managers and health program leaders. Table 2 presents an overview of the participants and their respective roles.

3.2.2 Key emerging themes

Analysis of the interview transcripts identified five main themes: crisis communication, coordination, information management, funding and donor relations and existing disaster preparedness.

Table 3 summarizes the key qualitative themes and associated insights. In the following subsections, each theme is described in more detail and supported by illustrative participant quotes.

3.2.2.1 Crisis communication. This theme refers to the plans and practices for managing and sharing information during a crisis or unexpected event, in this study, the 2023 earthquake. Across the interviews, participants reported facing major

Table 2 Summary of interview participant characteristics

Participants ID	Position
P01	Supply chain coordinator
P02	Health program manager
P03	NWS procurement coordinator – operations
P04	Supply chain coordinator
P05	Supply chain senior officer
P06	Health programs manager
P07	Supply chain manager
P08	Supply chain officer

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Table 3 Summary of key qualitative themes from key informant interviews on emergency medical supply chain performance during the February 2023 earthquake response in Northwest Syria ($n = 8$)

Qualitative finding category	Key insights and themes
Crisis communication	Participants reported major communication barriers and complete blackouts, especially between teams in Syria and Türkiye Responders relied on informal tools like WhatsApp, which proved flexible and effective for rapid decision-making but lacked features for structured message tracking or integration with logistics systems
Coordination	Heavy reliance on intra-coordination (between local actors/NGOs) Significant gaps in external coordination (with international organizations) led to unclear roles, duplication of efforts, and overstocking of certain items Coordination with Türkiye was hindered by border closures and shifts in Turkish policy prioritizing domestic needs, restricting exports of medical supplies into NWS
Information management systems	Challenges in obtaining timely and accurate data from health facilities hindered the ability to effectively address medical needs Functioning systems often had data on central warehouse stock but lacked real-time data at the facility level (warehouses or pharmacies)
Funding and donor relations	The earthquake response saw faster and more flexible funding than typical protracted Syrian crisis responses, including expedited disbursements and relaxation of procurement regulations Organizational flexibility (e.g. rapid implementation of emergency waivers) was key to enabling faster life-saving activities Despite announced appeals, the amount of allocated funding that reached affected areas in the initial weeks was significantly less
Existing disaster preparedness	Many facilities were unprepared for the scale of the earthquake, despite previous experience with crises like COVID-19 or cholera outbreaks Facilities had to rely heavily on existing stockpiles of emergency supplies, demonstrating the crucial role of prepositioned stock

communication barriers during the earthquake, which impacted the functionality of the EMSC. Participant P01 emphasized this by stating:

> The major thing was communication, lack of coordination because you don't actually have a connection with anyone, even at the field level. You can't get anyone at any time.

Some participants described complete communication blackouts, which made coordination between staff challenging, especially between teams in Syria and Türkiye, as both were affected by the earthquake. During this period, reliance on informal communication channels, such as instant messaging tools like WhatsApp, helped speed up decision-making and maintained the EMSC's functionality. As Participant P08 noted:

> Honestly, the WhatsApp group was the most effective and responsive. I considered the WhatsApp group the most flexible way to interact and communicate, of course.

Communication challenges also included the inability to reach staff and assess who was able to respond, due to the damage and destruction caused by the earthquake.

3.2.2.2 Coordination. This theme refers to the ability to organize different elements of the EMSC to enable it to function smoothly. The majority of participants emphasized the importance of coordination, but a distinction emerged between intra-coordination and external coordination. Intra-coordination is defined in this study as coordination between local actors and NGOs operating at the facility level, while external coordination refers to coordination between NGO management teams and international organizations such as WHO and other international NGOs.

Most participants reported heavy reliance on intra-coordination during the earthquake response. Significant gaps were observed in external coordination, particularly regarding the definition of roles and responsibilities for assessing EMSC needs during crises.

Participants also reported that lack of coordination led to duplication of efforts and overstocking of certain items. As P01 noted:

> You will get all the supplies available on the market for your facility, which you don't need that urgent, while some other facility might need it at this time and right away and can't get it because you have the resources to purchase, like you have a team in place at that time because the other team was like just not ready. So, the one who gets first will get the supplies.

In addition, coordination with Türkiye was identified by all participants as a critical issue, as border closures and shifts in Türkiye's policies, such as prioritizing domestic needs and restricting the export of medical supplies, directly affected the availability, procurement and transportation of emergency medical supplies into NWS. P02 recalls:

> Supplies were put on hold for export at the time because Türkiye had an urgent need for medicine and medical supplies. While it was understandable given the devastation in Türkiye, we too were severely impacted by the earthquake.

3.2.2.3 Information management systems. This theme highlights the difficulties encountered in collecting and managing data on emergency medical supplies. Several participants reported significant challenges in obtaining timely and accurate data from health facilities, which hindered their ability to effectively address those facilities' medical needs. Participant P03 noted,

> We faced problems with collecting the data. I remember some of our health facilities were unreachable. Even when we managed to reach some of them, they were unable to provide accurate data.

As a result, without reliable data on emergency medical needs, supplies were often sent based on reactive requests or outdated forecasting information. Although participants from organizations with functioning information management systems reported fewer issues, these systems still presented shortcomings, such as having data on stock available at central warehouses but lacking real-time data at facility-level warehouses or pharmacies.

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Participant P04 explained:

> When we check our system for medicines like X, Y, or Z, we sometimes find no stock in our central warehouse. However, when we check the overall data, including stocks within the facilities, we discover some items are available there. In such cases, we contact the facility to confirm if they need those items,

indicating some reliance on indirect methods to address gaps in inventory data.

3.2.2.4 Funding and relationship with donors. Funding and access to funds were heavily discussed by all participants, as the functionality of the EMSC depends on timely and adequate financing. Compared to the typically longer response delays from donors in the protracted Syrian crisis, the earthquake response was described as faster and more flexible. This flexibility manifested in specific actions, such as expedited funding disbursements, the relaxation of procurement regulations and the temporary repurposing of existing program funds to support earthquake-related activities. Participants noted that the dynamics of a hybrid disaster, combining a sudden natural disaster with an ongoing conflict, led to a shift in donor behavior, with more timely and acceptable responses.

Participant P08 reflected on this, stating:

> You feel that during the earthquake or even a year after it, the fund that came as a result of the earthquake was very flexible.

Several participants highlighted that organizational flexibility in internal policies and procedures also contributed to their ability to respond, including the rapid implementation of emergency waivers and simplification of some bureaucratic processes. According to participants, this combination of donor flexibility and streamlined internal processes was key to enabling faster responses and supporting life-saving activities, a feature noted as unique to the earthquake response but absent in previous crises.

However, not all donors showed this level of flexibility. As Participant P01 noted:

> Yes, there were some exceptions. We had donors who were very flexible. They would even sign the waiver form. But those were few.

3.2.2.5 Existing disaster preparedness. While some participants acknowledged the difficulty of preparing for a disaster of such magnitude, others reflected on their previous experiences with crises such as attacks on healthcare, COVID-19 and cholera outbreaks. However, despite these prior experiences, many facilities were unprepared for the scale of the earthquake. Participant P06 mentioned that previous training provided some flexibility in response, stating:

> Our team gained good experience with external audits and observations. This allowed the programs and project management teams to have more freedom and agility in decision-making while still protecting the organization.

Nevertheless, these experiences did not fully equip facilities for an emergency of this scale. The lack of preparation became particularly evident when all facilities were affected simultaneously, leaving little to no capacity to refer cases to other healthcare centers, as had been possible during prior attacks on healthcare. This lack of contingency planning significantly hindered the response, as participants also highlighted the absence of clear communication channels, which compounded the difficulties in coordinating an effective emergency response.

In addition, many facilities had to rely heavily on existing stockpiles of emergency supplies, but these stocks were limited and not all organizations had the resources or infrastructure to sustain a prolonged response. As P08 noted, "During that stage, we benefited from the stock available in the warehouses of medicines and consumables," though this was not universal, and many facilities struggled with inadequate preparedness for an emergency of this scale.

4. Discussion

This study evaluated the functionality of the EMSC in NWS in the aftermath of the 2023 Türkiye-Syria earthquake, highlighting key challenges, strengths and areas for improvement. While certain adaptive mechanisms facilitated response efforts, systemic vulnerabilities severely weakened supply chain effectiveness. The findings were categorized into key themes for a comprehensive analysis of the EMSC response. These themes are broadly consistent with existing literature on emergency and supply chain responses during crises. Specifically, previous studies have highlighted that effective communication, coordination and information management are critical components of emergency logistics and that their disruption frequently leads to operational inefficiencies and delayed responses (Kovács and Falagara Sigala, 2021; Abbas and Miller, 2025). Finally, the role of disaster preparedness during large-scale emergencies has been well documented (Hussain *et al.*, 2022; Paton *et al.*, 2000).

The following subsections elaborate on each of these themes during conducted interviews. They explore the impact of crisis communication and coordination challenges on the functionality of the EMSC, identified gaps in information management limited situational awareness, highlighted the impact of donor response flexibility and finally showcased how existing levels of disaster preparedness shaped organizational resilience during the 2023 earthquake.

4.1 Standard operating procedures shortfalls

Organizational structures and policies significantly influence disaster response outcomes, shaping the efficiency of EMSCs (Vaillancourt, 2016). Despite 100% of surveyed facilities reporting the presence of SOPs for supply chain management, their implementation during the earthquake response was inconsistent, particularly in ensuring predictability and alignment with facility needs. Nearly half (46.7%) of the facilities reported variations in delivery times between emergency and routine medicines, with emergency deliveries taking up to two weeks.

Furthermore, 73.3% of facilities experienced delayed responses, 60% faced uncertain delivery timelines and 53.3% received partial shipments, posing significant challenges for resource allocation and impeding effective response efforts. These findings suggest that existing SOPs may require revision to enhance their applicability in emergency settings. Regular reviews and updates of SOPs, incorporating lessons learned from past disasters and emerging best practices in humanitarian logistics (Kovács and Spens, 2009), are essential. Moreover, as Kato *et al.* (2022) highlighted in their comparative study of Japan and Taiwan, strict adherence to predefined procedures can hinder responsiveness during emergencies, emphasizing

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the need for SOPs that balance structured instructions with operational flexibility. SOPs should therefore be tailored to address context-specific challenges, including supply chain disruptions, transportation breakdowns and communication failures frequently encountered in crisis settings (Van Wassenhove, 2006).

4.2 Communication challenges

Our findings suggest that communication was a major challenge during the earthquake response, disrupting information flow and hindering supply chain functionality. Participants reported widespread communication blackouts, making it difficult to reach key personnel and relay urgent updates – especially for operations coordinating between Syria and Türkiye, as both regions were heavily affected. In several cases, the inability to relay supply needs in real time resulted in delays in dispatching critical shipments. These findings align with broader disaster response literature, which emphasizes the importance of structured, redundant communication networks to minimize disruptions and ensure continuity during crises (Kovács and Tatham, 2009). As (Yang *et al.*, 2024) noted, resilient supply chains depend heavily on effective information sharing. Delays and coordination breakdowns become inevitable when real-time data exchange is absent. The experiences reported by participants in our study similarly reflect these challenges, as the absence of an emergency communication system forced responders to rely on instant messaging tools such as WhatsApp.

While WhatsApp proved adaptive in enabling information sharing between supply chain actors during infrastructure breakdowns, it lacked key features required for managing large-scale emergency logistics. Specifically, it does not support structured message tracking, priority alerting, or integration with logistics information systems. However, it proved valuable in maintaining situational awareness. WhatsApp's dependence on local telecommunication networks, which remained operational near the impacted areas, provided initial disaster resilience. Nevertheless, without an alternative emergency communication system, the response was vulnerable to network failures. Establishing a dedicated emergency communication network is essential to avoid such vulnerabilities. The literature suggests addressing communication infrastructure through multiple strategies, including investing in redundant, crisis-proof communication networks, integrating satellite-based messaging systems (Fajardo, 2019), ensuring preestablished communication protocols and identifying emergency contact protocols to ensure effective information dissemination and coordination during emergencies (Savoia *et al.*, 2013).

4.3 Coordination challenges

Our study identified significant external coordination challenges during the earthquake response. Fragmented governance structures led to unclear roles and responsibilities in assessing EMSC needs, resulting in misaligned resource distribution – for example, overstocking certain items while critical shortages persisted elsewhere. This issue is common in humanitarian logistics, where pre-determined supply allocations often fail to meet real-time demands (Van der Laan *et al.*, 2009).

Despite external coordination challenges, local actors demonstrated adaptability by leveraging informal networks to secure emergency supplies more efficiently than formal international channels. This decentralized approach aligns with findings from other disaster responses, where local collaboration enhances supply chain agility in resource-constrained environments (Wagner and Thakur-Weigold, 2018). These findings highlight the necessity for improved coordination strategies, emphasizing clear role definitions, integrated information-sharing systems and enhanced collaboration among humanitarian actors to optimize resource distribution and response effectiveness (Okeagu *et al.*, 2021).

The role of donors in mitigating supply chain delays during the earthquake response was variable. While some international donors expedited funding approvals and relaxed procurement regulations, others adhered to standard bureaucratic protocols, slowing down response efforts. Donor flexibility, such as expedited funding and loosened procurement rules, mirrors the two-stage model proposed by Yang *et al.*, which prioritizes urgent supply allocation (Stage I) and optimizes transport routes (Stage II) for greater efficiency (Yang *et al.*, 2024). Shortly after the earthquake, the United Nations Office for the Coordination of Humanitarian Affairs (OCHA) launched a flash appeal of $398m for the response in Syria, which was fully funded. An additional $25m was released by the Central Emergency Response Fund (OCHA, 2023b). However, the amount of allocated funding that reached the affected areas in the initial weeks was significantly less than these announced figures, limiting the effectiveness of the emergency response (Norwegian Refugee Council, 2023). These findings highlight the need for standardized emergency funding protocols to ensure consistent and timely responses in future disasters.

4.4 Importance of prepositioning

Research on disaster preparedness emphasizes the importance of prepositioning essential medical supplies to enable immediate response capacity, particularly in fragile settings with restricted access (Apte, 2010; USAID Global Health Supply Chain Program, 2018). In NWS, the disruption of cross-border shipments forced facilities to rely entirely on preexisting stock. Our study found that a lack of prepositioned emergency supplies and scenario-based training contributed to delays in response efforts. In addition, our quantitative analysis revealed that during the first week following the earthquake, all emergency shipments received were sourced from prepositioned stock within warehouses in NWS, including supplies from the WHO, as cross-border operations were suspended during this critical period. Both quantitative and qualitative findings highlight severe delays in emergency shipments: 9 out of the 15 facilities did not receive any emergency shipments within the first 24 h, and 2 facilities were still waiting for their first shipment by the end of the first week.

The vulnerability of cross-border aid mechanisms has been a longstanding concern due to their reliance on United Nations Security Council authorizations and approval from the former Government of Syria (GoS) (Jesse Marks *et al.*, 2023; Security Council Report, 2023). Following the earthquake, it took over a week for the GoS to authorize the use of additional border crossings for UN aid deliveries, significantly delaying the humanitarian response (UN News, 2023). This delay exposed

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the critical importance of prepositioning supplies within Syria to ensure timely aid delivery when external access is compromised.

As also noted by Coskun *et al.* (2024), centralized cooperation in inventory planning is recommended when average demand is high and when the trans-shipment between facilities is reliable and cost-effective. Their analyses also measure how inefficient decentralized decision-making can be when using the concept of the *price of anarchy*. These results highlight the need for coordinated prepositioning strategies to improve efficiency and responsiveness during disaster responses.

As highlighted in Xu and Wang's study, a key strategy for healthcare coalitions to mitigate risk and maintain supply continuity during crises, such as earthquakes, is the prepositioning of stock (Xu and Wang, 2024). Other research showed that localized stockpiling, combined with scenario-based training, significantly strengthens supply chain resilience and improves response efficiency (Apte, 2010; Balcik and Beamon, 2008). To enhance its emergency preparedness, Syria's health system should prioritize the strategic prepositioning of medical supplies across the country.

4.5 Procurement challenges

The procurement of medical supplies in NWS heavily depended on external sources from Türkiye. Donor regulations, designed to avoid violating sanctions on Syria, restricted procurement to a limited number of well-vetted, prequalified suppliers, reducing supply chain flexibility.

Following the earthquake, a series of humanitarian carve outs, or waivers, to international sanctions were introduced to facilitate relief efforts. The US Treasury Department was the first to issue General License 23 (OFAC, 2023), followed by similar measures from the UK (OFSI, 2023), the EU and Switzerland (Council of the EU, 2023). Although these waivers were implemented more swiftly than previous emergency sanction waivers, they still failed to facilitate aid delivery within the critical first 72 h, the period when the most lives could have been saved (Moret, 2023).

The suspension of cross-border operations for the first seven days further disrupted the supply chain at a critical moment (Cinar *et al.*, 2023). In addition, Türkiye faced significant challenges balancing domestic needs, which led to restrictions on the exportation of medical supplies for external aid efforts. To circumvent these restrictions, organizations such as Direct Relief procured medications from outside Türkiye and delivered in-kind donations to responders in Syria, such as SAMS, via airlifts to Turkish airports (Direct Relief, 2023). While this method proved effective, it was more expensive than standard procurement processes.

These challenges reflect similar observations from previous earthquake relief operations. For example, Maghsoudi and Moshtari (2021) found that during the 2017 Kermanshah earthquake, relief organizations faced procurement delays, regulatory constraints and logistical bottlenecks that hindered the timely distribution of medical supplies to affected areas. Such recurring issues show the urgent need for stable and predictable cross-border aid mechanisms to ensure continuous and equitable distribution of medical supplies in conflict-affected regions like NWS (OCHA, 2023c).

4.6 Forecasting issues

A contributing factor to medical supply shortages was the reliance on short-term, consumption-based forecasting methods. Thirteen facilities engaged in forecasting post-earthquake, but many used models based on consumption data spanning fewer than three months. The results indicated that forecasting was not effective in informing procurement planning, contributing to mismatches between predicted and actual demand for emergency medical supplies during demand surges. The study by Bastani *et al.* on the 2018 Kermanshah earthquake highlighted similar forecasting limitations, emphasizing the need for dynamic forecasting systems capable of adjusting to shifting demand in real time (Bastani *et al.*, 2023). The earthquake's scale and unpredictability also revealed the limitations of conventional forecasting models, highlighting the need for more accurate approaches to forecasting and procurement in emergency settings (Kunz *et al.*, 2017; Rostami-Tabar *et al.*, 2022).

4.7 Lack of critical medicines

The study uncovered significant shortages in critical medical supplies, with 92% of facilities lacking analgesics, 77% lacking bandages and 69% lacking antibiotics. These shortages directly impacted patient outcomes. Although Syria reported fewer injuries than Türkiye following the earthquake (9.9 per 10,000 compared to 24.6 per 10,000 in Türkiye) (Santarisi *et al.*, 2024). the mortality rate was higher in Syria's most severely affected regions, reaching 9.3 per 1,000, compared to 7.7 per 1,000 in Türkiye (Santarisi *et al.*, 2024). This suggests that supply shortages may have contributed to adverse health outcomes in Syria. Palteki *et al.* (2025) similarly highlighted that inadequate access to critical medical supplies during earthquakes can significantly compromise patient safety, revealing the direct link between resource availability and clinical outcomes in disaster settings.

Another notable shift was the increased dependence on in-kind donations, which became a primary method for addressing medical supply shortages. In the aftermath of the earthquake, facilities turned to in-kind donations over traditional procurement, as they offered a more immediate and accessible solution. This trend is consistent with the literature, which shows that during emergencies, limited access to regular procurement channels often forces a reliance on emergency stockpiles and in-kind donations. Xu and Wang further emphasize this in their study, highlighting the effectiveness of a diversified supply strategy that combines prepositioned stock, contracted reserves and emergency procurement (Xu and Wang, 2024). This trend is consistent with existing research, which shows that emergencies often disrupt regular procurement channels, making standardized in-kind kits (such as the IEHK kits) a more reliable supply source (Kovács and Falagara Sigala, 2021).

4.8 Importance of information management

Research highlights that eLMIS plays a crucial role in enhancing supply monitoring, coordination and overall disaster preparedness (Kovács and Falagara Sigala, 2021; Kovács and Spens, 2009). Our study revealed significant deficiencies in information management systems, with many facilities resorting to alternative solutions due to the lack of a robust

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eLMIS. During the 2023 earthquake response, 53.3% of facilities operated without such systems, exposing a major gap in the management of EMSCs.

A key finding related to inventory management showed that all surveyed facilities depended on manual stock cards (100%) and Excel spreadsheets (93.3%), with only 46.7% using dedicated inventory management systems. Interview participants who used eLMIS reported improved response times due to faster access to critical data. However, the heavy reliance on manual systems exacerbates inefficiencies, particularly in disaster settings where logistical challenges were compounded by outdated or fragmented IT infrastructure (Apte, 2010). These findings highlights the need for a comprehensive strategy for technology use during disasters, such as standardized data protocols that can enable information sharing among systems and stakeholders (Sakurai and Murayama, 2019). Implementing such strategies could improve coordination, data accessibility and decision-making during emergency responses.

4.9 Challenges in human resources

The study revealed that six out of 15 surveyed facilities were understaffed during the earthquake, with only five having formal HR plans covering emergency supply chain operations. Facilities without dedicated logistics staff reported greater difficulties in tracking inventory and forecasting needs, which directly hindered response efficiency.

Frontline staff often lacked a comprehensive understanding of the entire supply chain process, as their job descriptions indicated minimal involvement in forecasting and procurement planning. These findings highlight the limitations of standard supply chain procedures in addressing the complex needs of disaster-affected areas. Training opportunities were limited and informal, with most facilities relying on on-the-job coaching rather than structured emergency response training. Abdi *et al.* (2021) similarly found that during the 2017 Kermanshah earthquake, nurses faced major challenges due to inadequate staffing, insufficient training and unclear roles, which led to compromised patient care and operational efficiency. Research highlights the critical role of a skilled workforce in disaster response (Heaslip, 2013). This aligns with Wright *et al.*'s findings that crisis preparedness requires health supply chain leadership at the decision-making level, and that supply chain capacity cannot function effectively without digital infrastructure and professional integration (Wright *et al.*, 2024). To strengthen preparedness, formal training in emergency logistics, procurement and inventory management is essential. Integrating logistics training into health workforce programs can enhance coordination and decision-making capabilities. For instance, the Joint Supply Initiative (JSI) developed a 12-week blended learning course to enhance the skills of humanitarian logistics staff, enabling them to apply capacity development into their daily operations (USAID, 2022).

5. Conclusion

5.1 Limitations

This study had several limitations that should be taken into account. First, it relied on self-reported data from facility staff, which may have introduced response biases. Participants might have overemphasized successes, downplayed challenges or struggled to recall specific details from 2023. Additionally, during the interview period, ongoing hostilities and escalating security concerns in NWS may have limited participants' ability to fully engage at the time of the interviews, as their attention was likely directed toward emerging operational priorities. These conditions may have also limited the depth of reflection on past events.

5.2 Recommendations

To strengthen future disaster responses, several key improvements are recommended based on the gaps identified in EMSC preparedness and response during the 2023 earthquake.

First, implementing a centralized national eLMIS is essential to enable real-time supply tracking. This system should integrate inventory data from both local and international responders to reduce supply mismatches and minimize delays. In addition, procurement strategies must become more flexible and data-driven, incorporating emergency surge needs while reducing reliance on rigid supplier regulations. To further enhance preparedness, forecasting methods should shift from short-term, consumption-based models to dynamic, scenario-based approaches capable of anticipating demand fluctuations and supporting the prepositioning of adequate supplies before crises occur.

Furthermore, strengthening internal and external coordination among local and international actors is critical to ensuring timely and efficient resource allocation. Clearly defining roles and responsibilities will help minimize duplication, streamline resource distribution and improve communication among stakeholders. Given the recurring communication failures observed during the earthquake response, it is also vital to develop redundant, crisis-proof communication systems. This should include satellite-based messaging platforms and preestablished emergency contact networks to maintain continuous information flow, particularly during infrastructure disruptions that impede conventional communication channels.

Equally important is the expansion of prepositioned supplies at strategic locations within Syria, recognizing their crucial role in enabling rapid response. However, stockpiling alone is insufficient, it must be paired with scenario-based training to ensure efficient distribution during cross-border disruptions or access constraints.

Finally, addressing human resource limitations is essential. Staff shortages and the lack of structured emergency logistics training significantly hinder response capacity. Investing in comprehensive training programs for supply chain personnel in forecasting, procurement and inventory management will strengthen operational readiness and reduce reliance on reactive, ad hoc solutions.

The recommendations below synthesize the key strategic priorities identified throughout this study. They consolidate the thematic findings discussed in earlier sections into a focused set of actionable reforms aimed at strengthening Syria's EMSC system. Each recommendation is accompanied by suggested implementation steps to guide practical application by policymakers, humanitarian actors and health authorities, as summarized in Table 4.

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Table 4 Summary of conclusions and recommendations

Recommendation	Suggested implementation steps	Priority
1. Standardize and update SOPs for emergency supply chains	• Review and revise existing SOPs to incorporate lessons learned from previous disasters • Include flexibility for rapid adaptation in emergencies and ensure SOPs address coordination, communication and procurement • Disseminate updated SOPs across facilities and conduct regular training • Evaluate adherence and update SOPs after simulation exercises and actual responses	Urgent
2. Develop crisis-proof communication systems	• Establish redundant communication networks (satellite-based systems, emergency radio, and offline-capable apps) • Identify communication focal points in each facility and maintain an emergency contact network • Conduct regular drills simulating communication blackouts • Integrate communication continuity plans into national preparedness and coordination systems	Critical
3. Strengthen coordination and role clarity	• Establish a unified coordination mechanism including MoH, the Health Cluster, NGOs and donors • Define clear roles, responsibilities, and reporting lines to avoid duplication and resource gaps • Create a shared logistics dashboard for real-time visibility of supply movements • Conduct annual multiagency coordination exercises to test and refine procedures	Urgent
4. Expand and optimize prepositioned supplies	• Identify secure and geographically distributed warehouse sites across Syria • Maintain and rotate prepositioned stocks based on Interagency Emergency Health Kit (IEHK) standards • Pair stockpiling with scenario-based training to ensure efficient deployment during crises • Regularly assess risk and update contingency stock levels accordingly	Very-urgent
5. Improve procurement flexibility and supply continuity	• Introduce emergency procurement mechanisms allowing temporary waivers of donor restrictions during crises • Develop preapproved vendor lists, both domestic and international, to reduce dependence on cross-border routes • Simplify donor procedures for rapid fund disbursement and procurement • Strengthen partnerships with international and local suppliers to diversify sourcing	Urgent
6. Enhance forecasting methodology	• Replace short-term, consumption-based forecasting with dynamic, scenario-based models incorporating demographic and epidemiological data • Integrate forecasting tools into the eLMIS to align forecasting, procurement and stockpiling • Conduct regular forecasting reviews and training sessions • Use forecasting outputs to guide procurement and prepositioning decisions	Urgent
7. Address shortages of critical medicines	• Establish minimum stock thresholds for essential and life-saving medicines at all secondary facilities • Coordinate in-kind donations to match real facility needs based on standardized emergency lists • Strengthen interfacility redistribution mechanisms to respond to sudden shortages • Ensure forecasting and procurement processes prioritize analgesics, antibiotics and IV fluids	Very-urgent
8. Establish a centralized national eLMIS	• Develop a unified electronic logistics management information system integrating all humanitarian and public health supply chain actors • Enable real-time visibility of inventory, stock levels and expiry dates • Ensure interoperability with existing data systems and provide training for logistics staff • Incorporate backup systems and offline modes to maintain operability during infrastructure disruption	Critical
9. Enhance human resource capacity	• Develop structured training programs in emergency logistics, procurement and inventory management • Integrate supply chain management modules into national health workforce plans • Long-term capacity building and staff retention initiatives	Urgent

5.3 Future directions

The 2023 earthquake response in NWS revealed significant vulnerabilities within the EMSC, exposing critical weaknesses that must be addressed as the new Syrian authorities work to rebuild health system preparedness. Shortages of essential medical supplies, delivery delays, inaccurate data and poor communication and coordination were among the key challenges faced in this fragile and fragmented setting.

However, with the fall of the Assad regime in December of 2024 and the transition to a unified national governance, Syria has a unique opportunity to implement systemic reforms. Strengthening the capacity of national medical supply chains and adopting adaptive logistics strategies will be essential to building a more resilient and responsive system, capable of withstanding future crises.

Acknowledgements

The authors extend their gratitude to WHO, UOSSM, SEMA, Relief International, SDI, SHAM, HIHFAD, Alameen who participated in the surveys and interviews. The authors would also like to acknowledge Direct Relief as well as SAMS for their contributions to the study.

Funding

This work was supported by a grant from Direct Relief and executed by the Syrian American Medical Society to highlight the efforts of the emergency medical supply chain during the earthquake.

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References

Abbas, R. and Miller, T. (2025), "Exploring communication inefficiencies in disaster response: perspectives of emergency managers and health professionals", *International Journal of Disaster Risk Reduction*, Vol. 120, p. 105393, doi: 10.1016/j.ijdrr.2025.105393.

Abdi, A., Vaisi-Raygani, A., Najafi, B., Saidi, H. and Moradi, K. (2021), "Reflecting on the challenges encountered by nurses at the great Kermanshah earthquake: a qualitative study", *BMC Nursing*, Vol. 20 No. 1, p. 90, doi: 10.1186/s12912-021-00605-3.

Apte, A. (2010), "Humanitarian logistics: a new field of research and action", *Foundations and Trends® in Technology, Information and Operations Management*, Vol. 3 No. 1, pp. 1-100, doi: 10.1561/0200000014.

Balcik, B. and Beamon, B.M. (2008), "Facility location in humanitarian relief", *International Journal of Logistics Research and Applications*, Vol. 11 No. 2, pp. 101-121, doi: 10.1080/13675560701561789.

Bastani, P., Sadeghkhani, O., Bikine, P., Mehralian, G., Samadbeik, M. and Ravangard, R. (2023), "Medication supply chain resilience during disasters: exploration of causes, strategies, and consequences applying Strauss and Corbin's approach to the grounded theory", *Journal of Pharmaceutical Policy and Practice*, Vol. 16 No. 1, p. 99, doi: 10.1186/s40545-023-00604-6.

Cinar, E.N., Abbara, A. and Yilmaz, E. (2023), "Earthquakes in Turkey and Syria–collaboration is needed to mitigate longer terms risks to health", *BMJ*, Vol. 380, p. p559, doi: 10.1136/bmj.p559.

Coskun, A., Salman, F.S. and Pashapour, A. (2024), "Relief item inventory planning under centralized and decentralized bilateral cooperation and uncertain transshipment quantities", *Socio-Economic Planning Sciences*, Vol. 95, p. 101991, doi: 10.1016/j.seps.2024.101991.

Council of the EU (2023), "Earthquake in Türkiye and Syria: EU amends restrictive measures in place regarding Syria to facilitate the speedy delivery of humanitarian aid", 23 February, available at: www.consilium.europa.eu/en/press/press-releases/2023/02/23/earthquake-in-turkiye-and-syria-eu-amends-restrictive-measures-in-place-regarding-syria-to-facilitate-the-speedy-delivery-of-humanitarian-aid/ (accessed 23 February 2026).

Demir, E. (2023), "The Turkey/Syria Earthquake 2023: theoretical framework of post-disaster logistics and its flawed application", *Journal of Economics, Trade and Marketing Management*, Vol. 5 No. 2, p. 47, doi: 10.22158/jetmm.v5n2p47.

Direct Relief (2023), "Turkey-Syria earthquake relief", 6 February, available at: www.directrelief.org/emergency/turkey-syria-earthquake/ (accessed 23 February 2026).

Fajardo, C.A.B. (2019), "Emergency communications network for disaster management", Chapters, available at: https://ideas.repec.org//h/ito/pchaps/181325.html

Hatahet, S. (2023), *Local Governance Structures and Humanitarian Responses to the Earthquake in North-West Syria*, European University Institute (EUI), San Domenico di Fiesole (FI), doi: 10.2870/125423.

Heaslip, G. (2013), "Services operations management and humanitarian logistics", *Journal of Humanitarian Logistics and Supply Chain Management*, Vol. 3 No. 1, pp. 37-51, doi: 10.1108/20426741311328501.

Hussain, A., Masood, T., Munir, H., Habib, M.S. and Farooq, M.U. (2022), "Developing resilience in disaster relief operations management through lean transformation", *Production Planning & Control*, Vol. 34 No. 15, pp. 1475-1496, doi: 10.1080/09537287.2022.2026671.

IASC (2024), "Inter-Agency humanitarian evaluation (IAHE) of the collective response to the earthquakes in Türkiye/Syria", 5 March, available at: https://interagencystandingcommittee.org/inter-agency-humaniatrian-evaluations-steering-group/inter-agency-humanitarian-evaluation-iahe-collective-response-earthquakes-turkiyesyria (accessed 23 February 2026).

International Organization for Migration (2025), "Crisis in the Syrian Arab Republic", available at: www.iom.int/crisis-syrian-arab-republic (accessed 23 February 2026).

Johns Hopkins Bloomberg School of Public Health (2023), "Turkey-Syria earthquakes reveal gaps in global disaster response", available at: https://publichealth.jhu.edu/2023/turkey-syria-earthquakes-reveal-gaps-in-global-disaster-response (accessed 23 February 2026).

Kato, T., Wang, J.-J. and Tsai, N.-Y. (2022), "Elements of standard operating procedures and flexibility issues in emergency management: a Japan–Taiwan comparison", *International Journal of Disaster Risk Reduction*, Vol. 71, p. 102813, doi: 10.1016/j.ijdrr.2022.102813.

Kovács, G. and Falagara Sigala, I. (2021), "Lessons learned from humanitarian logistics to manage supply chain disruptions", *Journal of Supply Chain Management*, Vol. 57 No. 1, pp. 41-49, doi: 10.1111/jscm.12253.

Kovács, G. and Spens, K. (2009), "Identifying challenges in humanitarian logistics", *International Journal of Physical Distribution & Logistics Management*, Vol. 39 No. 6, pp. 506-528, doi: 10.1108/09600030910985848.

Kovács, G. and Tatham, P. (2009), "Responding to disruptions in the supply network–from dormant to action", *Journal of Business Logistics*, Vol. 30 No. 2, pp. 215-229, doi: 10.1002/j.2158-1592.2009.tb00121.x.

Kunz, N., Van Wassenhove, L.N., Besiou, M., Hambye, C. and Kovács, G. (2017), "Relevance of humanitarian logistics research: best practices and way forward", *International Journal of Operations & Production Management*, Vol. 37 No. 11, pp. 1585-1599, doi: 10.1108/IJOPM-04-2016-0202.

Maghsoudi, A. and Moshtari, M. (2021), "Challenges in disaster relief operations: evidence from the 2017 Kermanshah earthquake", *Journal of Humanitarian Logistics and Supply Chain Management*, Vol. 11 No. 1, pp. 107-134, doi: 10.1108/JHLSCM-08-2019-0054.

Mahroos, R.E., Yuliwulandari, R., Febriawan, Z., Affrita, T. M., Rusdi, M.S., Widawasista, Y.B., Novendra, G., Ningrum, K., Winata, L., Djarin, N. and Amara, A. (2024), "Medication supply chains during disaster", *Global International Journal of Innovative Research*, Vol. 2 No. 11, pp. 2586-2593, doi: 10.59613/global.v2i11.349.

Marks, J., Rihawi, H. and Katoub, M. (2023), "UN crossborder aid to Syria requires more than consent", Refugees International, 13 September, available at: www.

Downloaded from http://ftp.nowpublishers.com/jhlscm/article-pdf/doi/10.1108/JHLSCM-05-2025-0072/11495141/jhlscm-05-2025-0072en.pdf by guest on 30 May 2026

refugeesinternational.org/perspectives-and-commentaries/un-crossborder-aid-to-syria-requires-more-than-consent/ (accessed 23 February 2026).

Mercy Corps (2023), "The Turkey-Syria earthquake", available at: https://ca-syr.org/report/the-turkey-syria-earthquake (accessed 23 February 2026).

Moret, E. (2023), "Effectiveness of humanitarian exceptions to sanctions: lessons from the Syria earthquake", ReliefWeb, 12 December, available at: https://reliefweb.int/report/syrian-arab-republic/effectiveness-humanitarian-exceptions-sanctions-lessons-syria-earthquake (accessed 23 February 2026).

Naderifar, M., Goli, H. and Ghaljaie, F. (2017), "Snowball sampling: a purposeful method of sampling in qualitative research", *Strides in Development of Medical Education*, Vol. 14 No. 3, doi: 10.5812/sdme.67670.

Norwegian Refugee Council (2023), "Syria earthquake one month on: families struggle, funding dangerously slow", 6 March, available at: www.nrc.no/news/2023/march/syria-earthquake-one-month-on-families-struggle-funding-dangerously-slow (accessed 23 February 2026).

OCHA (2023b), "UN emergency fund releases an additional US$25 million to boost earthquake response in Syria", available at: www.unocha.org/news/un-emergency-fund-releases-additional-us25-million-boost-earthquake-response-syria (accessed 23 February 2026).

OCHA (2023c), "Syria: humanitarian situation is 'unsustainable and insupportable,' top UN aid official tells Security Council", 21 December, available at: www.unocha.org/news/syria-humanitarian-situation-unsustainable-and-insupportable-top-un-aid-official-tells (accessed 23 February 2026).

OCHA (2024), "Syrian Arab Republic humanitarian response plan 2024", available at: https://humanitarianaction.info/plan/1175 (accessed 23 February 2026).

Office of Financial Sanctions Implementation (OFSI) (2023), "General licence INT/2023/2711256", GOV.UK, 17 February, available at: www.gov.uk/government/publications/ofsi-general-licence-int20232711256 (accessed 23 February 2026).

Office of Foreign Assets Control (OFAC) (2023), "Issuance of Syria general license 23", U.S. Department of the Treasury, 9 February, available at: https://ofac.treasury.gov/recent-actions/20230209_33 (accessed 23 February 2026).

Okeagu, C.N., Reed, D.S., Sun, L., Colontonio, M.M., Rezayev, A., Ghaffar, Y.A., Kaye, R.J., Liu, H., Cornett, E. M., Fox, C.J. and Urman, R.D. (2021), "Principles of supply chain management in the time of crisis", *Best Practice & Research Clinical Anaesthesiology*, Vol. 35 No. 3, pp. 369-376, doi: 10.1016/j.bpa.2020.11.007.

Palteki, T., Salimi, S., Younas, A., Taylan, S. and Aydın, E. (2025), "Understanding patient safety during earthquakes: a phenomenological study of disaster response", *BMJ Quality & Safety*, Vol. 35 No. 3, pp. 169-180, doi: 10.1136/bmjqs-2024-018115.

Paton, D., Smith, L. and Violanti, J. (2000), "Disaster response: risk, vulnerability and resilience", *Disaster Prevention and Management: An International Journal*, Vol. 9 No. 3, pp. 173-180, doi: 10.1108/09653560010335068.

Reuters (2023), "Earthquake knocks out Syrian aid lifeline, UN says", 7 February, available at: www.reuters.com/world/middle-east/quake-halts-un-cross-border-aid-syria-unclear-when-will-resume-spox-2023-02-07/ (accessed 23 February 2026).

Rostami-Tabar, B., Hasni, M. and Babai, M.Z. (2022), "On the inventory performance of demand forecasting methods of medical items in humanitarian operations", *IFAC-PapersOnLine*, Vol. 55 No. 10, pp. 2737-2742, doi: 10.1016/j.ifacol.2022.10.132.

Sakurai, M. and Murayama, Y. (2019), "Information technologies and disaster management: benefits and issues", *Progress in Disaster Science*, Vol. 2, p. 100012, doi: 10.1016/j.pdisas.2019.100012.

Santarisi, A., Hertelendy, A.J., Issa, F., Franc, J., Woodward, C., Mathew, D., Noel, J., Curtis, T.J., Miller, E.D., Agubosim, C. and Kenyon, V. (2024), "Analysis of disparities in the initial health care response to the February 2023 earthquakes in Turkey and Syria", *Disaster Medicine and Public Health Preparedness*, Vol. 18, p. e270, doi: 10.1017/dmp.2024.290.

Savoia, E., Lin, L. and Viswanath, K. (2013), "Communications in public health emergency preparedness: a systematic review of the literature", *Biosecurity and Bioterrorism*, Vol. 11 No. 3, pp. 170-184, doi: 10.1089/bsp.2013.0038.

Security Council Report (2023), "In hindsight: the demise of the Syria cross-border aid mechanism", available at: www.securitycouncilreport.org/monthly-forecast/2023-08/in-hindsight-the-demise-of-the-syria-cross-border-aid-mechanism.php (accessed 23 February 2026).

UN News (2023), "Earthquake disaster: UN chief welcomes Syria decision to open aid corridors", 13 February, available at: https://news.un.org/en/story/2023/02/1133437 (accessed 23 February 2026).

USAID (2008), "Logistics indicators assessment tool (LIAT)", Arlington, VA, available at: http://iaphl.org/wp-content/uploads/2016/05/Logistics-Indicators-Assessment-Tool-LIAT.pdf (accessed 23 February 2026).

USAID (2009), "Logistics system assessment tool (LSAT)", Arlington, VA, available at: https://iaphl.org/resources/publications/logistics-system-assessment-tool/ (accessed 23 February 2026).

USAID (2022), "Building capacity to improve health commodity management in humanitarian and disaster settings", JSI Research & Training Institute, Inc, available at: https://publications.jsi.com/JSIInternet/Inc/Common/_download_pub.cfm?id=24996&lid=3 (accessed 23 February 2026).

USAID Global Health Supply Chain Program (2018), "Best practices in supply chain preparedness for public health emergencies", USAID Global Health Supply Chain Program, available at: www.ghsupplychain.org/sites/default/files/2021-12/Best-Practices-in-Supply-Chain-Preparedness-for-Public-Health-Emergencies_January-2018_English.pdf (accessed 23 February 2026).

Vaillancourt, A. (2016), "Kit management in humanitarian supply chains", *International Journal of Disaster Risk Reduction*, Vol. 18, pp. 64-71, doi: 10.1016/j.ijdrr.2016.06.002.

Downloaded from http://ftp.nowpublishers.com/jhlscm/article-pdf/doi/10.1108/JHLSCM-05-2025-0072/11495141/jhlscm-05-2025-0072en.pdf by guest on 30 May 2026

Van der Laan, E.A., De Brito, M.P. and Vergunst, D.A. (2009), "Performance measurement in humanitarian supply chains", *International Journal of Risk Assessment and Management*, Vol. 13 No. 1, pp. 22-45, doi: 10.1504/IJRAM.2009.026388.

Van Wassenhove, L.N. (2006), "Humanitarian aid logistics: supply chain management in high gear", *Journal of the Operational Research Society*, Vol. 57 No. 5, pp. 475-489, doi: 10.1057/palgrave.jors.2602125.

Wagner, S.M. and Thakur-Weigold, B. (2018), "Supporting collaboration in humanitarian supply chains – insights from a design science project", *Production Planning & Control*, Vol. 29 No. 14, pp. 1130-1144, doi: 10.1080/09537287.2018.1542175.

World Vision (2024), "Beyond the rubble: the impact of the earthquake on children in Northwest Syria one year later", 6 February, available at: https://reliefweb.int/report/syrian-arab-republic/beyond-rubble-impact-earthquake-children-northwest-syria-one-year-later (accessed 23 February 2026).

Wright, A.M., Snowdon, A., Saunders, M. and Trampas, D. (2024), "The necessity of healthcare supply chain resilience for crisis preparedness", *Healthcare Management Forum*, Vol. 37 No. 2, pp. 95-100, doi: 10.1177/08404704231207386.

Xu, A. and Wang, Q. (2024), "Integrated emergency medical supply planning considering multiple supply channels in healthcare coalitions", *International Journal of Disaster Risk Reduction*, Vol. 113, p. 104823, doi: 10.1016/j.ijdrr.2024.104823.

Yang, H., Zhang, P., Zhang, P., Zhang, C. and Yan, X. (2024), "Optimization of a two-stage emergency logistics system considering public psychological risk perception under earthquake disaster", *Scientific Reports*, Vol. 14 No. 1, p. 31983, doi: 10.1038/s41598-024-83670-3.

Further reading

OCHA (2023a), "Flash appeal: Syrian Arab Republic earthquake (February–May 2023) [EN/AR]", 14 February, available at: www.unocha.org/publications/report/syrian-arab-republic/flash-appeal-syrian-arab-republic-earthquake-february-may-2023-enar (accessed 23 February 2026).

Yang, Q. (2024), "Emergency management and response strategies for resilient supply chain systems in the face of unexpected events", *Industry Science and Engineering*, Vol. 1 No. 3, pp. 1-6, doi: 10.62381/I245301.

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