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College of Management and Human Potential

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Bahaeldin Mahmoud

has been found to be complete and satisfactory in all respects,
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the review committee have been made.

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Walden University
2026

Standardizing Data-Sharing and Communication Procedures Among Healthcare Providers to Enhance Disaster Response

by

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MBA, Mount Mercy University, 2020

MSL, Mount Mercy University, 2019

Integrative Review Submitted in Partial Fulfillment

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Abstract

Effective data sharing during disasters remains an unresolved administrative challenge for acute care hospitals, as fragmented communication directly affects patient safety and impacts vulnerable populations. This study identified gaps in hospitals' alignment with the Emergency Management Conditions of Participation standards. This integrative review applied a Complex Adaptive Systems conceptual framework to analyze the interdependent technological, governance, and human factors that cause systemic failures. The purpose of the review was to determine actionable administrative strategies that enhance data-sharing resilience. The guiding question examined barriers to standardized data sharing and communication in disaster preparedness and the approaches to address them. The methodology involved a systematic search of peer-reviewed and grey literature within the last 5 years and, after appraising potential literature with the Johns Hopkins Quality Appraisal tool, yielded 24 articles for thematic analysis. Key results identified four main themes: establishing foundational governance and standards, implementing interoperable technology, developing cross-sector partnerships, and embedding continuous preparedness training. This analysis identified 12 subthemes, including interoperability policies, real-time dashboards, multi-agency drills, after-action reviews, and shared situational awareness. Recommendations include establishing a formal governance structure, proactively invest in and deploy integrated technology, build trust-based partnerships, and continuous preparedness. The implications for positive social change include strengthened community health resilience, fairer emergency care for vulnerable groups, and enhanced system-wide coordination that saves lives and reduces suffering during disasters.

Part 1: Practice-Based Problem

Problem of Interest

Acute care hospitals often lack standardized data-sharing methods during disasters, which hinders their ability to share accurate and timely data with emergency response agencies (Shalash et al., 2022). These practices fail to meet the Centers for Medicare & Medicaid Services (CMS) Conditions of Participation (COP) for communication and data-sharing (42 CFR § 482.15(c)) and the corresponding Joint Commission (TJC) Emergency Management (EM) standards. Standards require hospitals to develop and implement emergency preparedness policies and procedures. Hospitals must establish and maintain an emergency preparedness communication plan that complies with Federal, State, and local laws and must be reviewed and updated at least every 2 years (TJC, 2022).

The absence of standardized data-sharing protocols can lead to delays in response times and inefficient resource allocation. For example, during Hurricane Katrina, the lack of interoperability among emergency response agencies resulted in delayed rescue operations. It hindered the overall effectiveness of the response effort (Office of the National Coordinator for Health Information Technology [ONC], 2024).

A U.S. Government Accountability Office (2019) report on the 2017 hurricane season found that inconsistent data sharing between hospitals during Hurricanes Harvey, Irma, and Maria led to duplicated efforts and compromised response efficiency. The lack of standardized data led to inefficiencies and resource wastage, as multiple organizations unknowingly worked on the same tasks (U.S. Government Accountability Office [GAO],

2019). There is a high demand for standardized data-sharing protocols in Acute Care Hospitals to avoid data fragmentation during disasters (GAO, 2019).

Starting July 1, 2022, all TJC-accredited hospitals and critical access hospitals must comply with the revised EM standards. Standard EM.12.02.01 requires every hospital to have a communication plan for initiating and maintaining contact during an emergency. Joint Commission standards, particularly EM.02.02.13, require acute care hospitals to maintain a coordinated patient information exchange during disasters (TJC, 2024). This mandate involves support for communication, patient data, and resource management to establish solid bidirectional data exchange with Environmental systems (EMS) and public health agencies.

Semi-structured interviews with 21 disaster medicine physicians identified critical barriers to patient information sharing, including the absence of standardized data-sharing mechanisms and the inaccessibility of past medical histories (Sell et al., 2023), both of which directly impede effective clinical care during disasters. These systemic failures represent significant noncompliance with TJC (42 CFR § 482.15(c)), which mandates interoperable communication and information exchange to ensure patient safety and continuity of care.

Healthcare Administration Problem

Background

Healthcare data collection and sharing have been fragmented due to the diverse nature among healthcare providers, emergency responders, and governmental agencies involved in disaster response (Shalash et al., 2021). Each hospital typically employs its own methods and formats for data collection, resulting in inconsistencies and challenges

in data sharing (Shalash et al., 2021). The lack of standardization has been a persistent challenge, as highlighted in various studies and reports (Shalash et al., 2021).

Systemic data fragmentation during disaster response critically impedes the sharing of essential prehospital data, such as electronic patient care reports from ambulance services, triage status, mechanism of injury, any vital signs, and saved data from a patient's electronic health record, with related to past medical history (active medications, and allergy history). In a mass shooting, the inability to seamlessly share this data creates a dangerous informational gap at the hospital (Sell et al., 2023). This failure to ensure interoperable data exchange directly compromises patient safety and constitutes non-compliance with TJC standards mandating coordinated care (TJC, 2024). Therefore, standardizing these specific data elements is a fundamental prerequisite for effective disaster clinical care.

In recent years, the recognition of the need for standardized data collection and sharing methods, especially in disaster response, has grown (Rose et al., 2020). The COVID-19 pandemic highlighted the importance of sharing real-time public health data (Rose et al., 2020). Similarly, managing disasters effectively requires open, multidisciplinary data to support forecasting, emergency response, and reconstruction, enabling timely impact assessment and collaborative analysis (Li et al., 2019). It was further concluded that the international community should direct its efforts toward the urgent disaster management needs of developing countries. This assistance should involve creating suitable global and regional cooperation frameworks and building foundational data infrastructure. These steps are essential to enable these nations to utilize open data resources shared internationally over the internet.

Operational Problem

A critical care hospital's most significant challenge during disaster response stems from fundamental breakdowns in how health information systems connect and share data when patients transition (Sauer, 2021). Challenges in accessing, sharing, and transferring information are a direct barrier to effective clinical care. This manifests as an inability to access a patient's medical history, medications, and allergies from their electronic health record, coupled with non-standardized handoffs of prehospital data from emergency medical services (Abdulhadi et al., 2023). This systemic failure directly violates specific TJC standards, particularly EM.02.02.13, which requires hospitals to coordinate patient care and information across settings and providers during a disaster (TJC, 2024).

The United States continues to face significant readiness gaps in managing large-scale medical surges during disasters, primarily due to persistent failures in health information technology systems that hinder regional data sharing and care coordination (Lee et al., 2024). Similarly, Colf and McAleavy (2024) documented a critical gap between TJC standards and on-the-ground reality, identifying a persistent lack of data-sharing barrier to effective disaster management. TJC standards EM.02.02.13 mandate the coordination of patient information across providers. Abdulhadi et al. (2023) clarified the issue by highlighting the lack of standardized data-sharing during disasters. This gap fundamentally conflicts with the foundational requirements of TJC Standards, which are derived from the CMS COPs. These COPs establish the legal baseline for hospital operations and patient safety.

Ideal State of Operations

Gabriel et al. (2024) report that the 2023 assessment found that 70% of non-federal acute care hospitals had at least some level of engagement across all domains of interoperable exchange (sending, finding, receiving, and integrating electronic health information). While hospitals that routinely perform interoperable exchanges increased by 54% from 2018 to 2023, overall adoption remains limited. As of 2023, fewer than half of hospitals (43%) were doing so routinely, with another 27% participating sometimes. (Gabriel et al., 2024). The study further revealed a significant interoperability gap with essential outpatient sectors. A small minority of hospitals, 16%, consistently shared care summaries with long-term or post-acute care facilities, and an equally low 17% shared with behavioral health providers (Gabriel et al., 2024).

The ideal state of operations, therefore, requires a transition to a dual-pronged approach: rigorous adherence to TJC's standard for information coordination (EM.02.02.13) and the technical implementation of seamless, automated, bidirectional data exchange using standardized formats, such as HL7 FHIR. This ecosystem, capable of reducing reporting delays to under 15 minutes and improving data completeness to over 95%, provides the real-time common operating picture mandated for effective EM (Office of the National Coordinator for Health Information Technology [ONC], 2020). Thus, aligning with TJC standards provides the regulatory "why," while technologies like FHIR provide the operational "how," collectively transforming disaster response from a fragmented, reactive endeavor into a coordinated and proactive system.

Professional Practice Gap Statement

The specific healthcare administration problem is that acute care U.S. hospitals face critical failures in data sharing during disasters, relying on slow, manual processes that hinder situational awareness and compromise coordinated response (Sauer, 2021). These practices fail to meet the Centers for CMS COP for communication and data-sharing (42 CFR § 482.15(c)) and the corresponding TJC EM standards.

The ideal desired state of operations is a seamlessly interoperable health information ecosystem that enables automated, real-time data exchange using standardized formats, supporting effective disaster response coordination and decision-making (Sauer, 2021).

Summary of Evidence

The absence of data sharing in hospitals during disasters hinders an organization's ability to achieve optimal efficiency, effectiveness, and interoperability in disaster response. Addressing this gap requires developing and implementing standardized data-sharing methods and sharing protocols to ensure seamless stakeholder coordination (Shalash et al., 2021).

Information sharing among healthcare levels is linked to patient care quality, efficiency, and safety. The absence of standardized data-sharing protocols tailored to healthcare facilities hampers coordinated disaster response efforts. Implementing standardized protocols, advanced technological infrastructure, regular training, and inter-organizational partnerships are crucial to addressing these policy gaps and ensuring efficient disaster management (Tsai et al., 2020). Lastly, U.S. hospitals lack standardized

data-sharing protocols during disasters, thereby inhibiting their ability to provide accurate, timely data to emergency response agencies (Shalash et al., 2022).

Purpose of the Integrative Review

This integrative review aims to identify evidence-based strategies for hospital administrators to overcome the critical challenge of data sharing and communication during disasters, aligning with TJC accreditation standards and the American Hospital Association's recommendations for disaster preparedness. This review examines how incompatible systems and manual methods hinder data-sharing. This data-sharing problem is strongly linked to social determinants of health, as inefficient disaster response will impact vulnerable populations seeking high-quality services during disasters. Improving data sharing is, therefore, an essential administrative strategy during disasters.

Integrative Review Question

What implementation barriers do acute care hospitals face in aligning with TJC standards and AHA recommendations for standardized data sharing and communication, and what strategies exist to overcome these barriers in disaster preparedness planning?

Theoretical and/or Conceptual Framework

The Complex Adaptive Systems (CAS) framework, as applied in health interoperability research by Bennett et al. (2020), offers a critical lens for analyzing the lack of data sharing in U.S. hospital disaster response. Their socio-technical approach to interoperability aligns with CAS principles by examining how the lack of data sharing arises from complex interactions among technical infrastructures, policy environments, and clinical workflows that fail to adapt during crises.

A recent study by Waring et al. (2022) employed the CAS framework to examine hospital resilience during the COVID-19 pandemic, highlighting how the lack of data sharing in US hospitals contributed to crisis response failures. Their research demonstrated that the lack of data sharing prevented the emergent self-organization needed for rapid adaptation, as agents (clinicians, administrators, and EMS personnel) could not access real-time information to coordinate care. The persistent lack of data sharing fundamentally undermined situational awareness and resource allocation, underscoring the need for CAS principles to inform solutions that bridge this critical gap.

This integrative review draws upon the CAS framework as a foundation for analyzing the effectiveness of data-sharing interventions during disasters. The framework clarifies that the lack of data-sharing stems from misaligned interactions between technical systems (EHRs, interoperability protocols) and social elements (workflows, policies, culture). By applying CAS principles, this review identifies how standardized data-sharing processes in acute care hospitals in the US can foster real-time adaptation, and emergent coordination will transform the current lack of data-sharing into a resilient, interoperable system capable of responding to dynamic crisis conditions.

Part 2: Literature Review, Quality Appraisal, and Analysis

Literature Search Strategy

This integrated literature review aims to identify and synthesize evidence-based strategies to standardize data-sharing procedures and enhance the effectiveness of data sharing during disasters, ensuring alignment with the CMS COP for emergency preparedness communication (42 CFR § 482.15(c)) and TJC EM standards. These standards require hospitals to develop and maintain a robust communication plan that complies with federal, state, and local laws, and to review and update it at least biannually.

Databases searched included PubMed, CINAHL, Google Scholar, government websites, and the Walden University Library to ensure a comprehensive review of scholarly and credible sources related to data-sharing problems during disasters. Boolean operators were utilized to refine the search, combining concepts using AND (e.g., "Data-sharing shortage AND disaster response"), including related terms with OR (e.g., "Data-sharing shortage OR data exchange issues"), and excluding irrelevant terms with NOT (e.g., "Disaster response NOT routine emergencies"). Advanced search techniques further enhanced the search precision, employing phrase searching (e.g., "data-sharing shortage"), truncation (e.g., "standard*" for standardization, standards), wildcards (e.g., "Colle? t" for collecting, collection), and proximity searching (e.g., "data NEAR/5 standardization"). An in-depth investigation was conducted into the absence of data standardization during disasters in acute care hospitals. Four hundred and twelve articles were identified as relevant for review. By hand-searching and tracking forward and backward references, I added nine articles. I removed 27 articles due to duplication,

leaving 394 for initial screening via titles and abstracts using the inclusion and exclusion criteria. After this screening process, I excluded 285 articles, leaving 119 for further analysis, during the full-text review, I excluded 101 articles for various reasons, including insufficient focus on data sharing during disasters, small sample sizes, and being study proposals only. This left a final count of 24 articles for in-depth analysis.

Table 1

Inclusion and Exclusion Search Criteria

Inclusion criteria	Exclusion criteria
Peer-reviewed articles	Non-peer-reviewed articles
Published in English	Published in non-English
Articles from 2021 onwards	Articles before 2020
Relevant to data sharing in a disaster	Irrelevant to data sharing
Addressing the lack of data sharing during disasters	Do not address the data sharing during disasters
Focused on disaster response and data sharing	Not focused on disaster response and data sharing
Involving several stakeholders	Involving only a single stakeholder
Acute care hospitals	Non-acute care hospitals
Focus on the barriers that acute care hospitals face.	Not focusing on the barriers that acute care hospitals face.
Related to Joint Commission standards and AHA recommendations for standardized data sharing and communication.	Not related to Joint Commission standards and AHA recommendations for standardized data sharing and communication.

An in-depth investigation was conducted into the absence of data standardization during disasters in acute care hospitals. Four hundred and twelve articles were identified as relevant for review. By hand-searching and tracking forward and backward references,

I added nine articles. I removed 27 articles due to duplication, leaving 394 for initial screening via titles and abstracts using the inclusion and exclusion criteria. After this screening process, I excluded 285 articles, leaving 119 for further analysis. During the full-text review, I excluded 101 articles for various reasons, including insufficient focus on data sharing during disasters, small sample sizes, and being study proposals only. This left a final count of 24 articles for in-depth analysis.

Quality Appraisal

The quality of these 24 articles was evaluated using the Johns Hopkins Nursing Evidence-Based Practice (JHNEBP) Model and the Research Evidence Appraisal Tool (Dang & Dearholt, 2022). Of the 24 articles, seven are appraised as level 4 with good or high quality. Two articles were rated at Level 3, indicating good-quality evidence derived from non-experimental, qualitative, or mixed-method studies. The remaining 12 were rated at Level 5, representing evidence from literature reviews, expert opinions, and organizational standards. Appendix C shows more details on the quality appraisal results.

As a strategic improvement, cross-sector and interprofessional collaboration among community agencies that serve a shared subset of community members, facilitated by effective data-sharing, has demonstrated the potential to stabilize care delivery, reduce overutilization of healthcare and community systems, enhance service coordination, and lower overall care costs (Hardin et al., 2020). This collaborative, cross-sector approach, combined with effective data sharing, resulted in a 44% reduction in hospital utilization, an 83% decrease in community response system usage, and a 71% decrease in care-related costs for the target population (Hardin et al., 2020).

Thematic Analysis of Literature

For this study, a thematic analysis was conducted to identify key patterns in the literature. This process began with generating initial codes derived from repeated ideas and keywords (Table 2). The study frequently observed codes of this nature, which were then systematically collated and analyzed for conceptual relationships. Codes such as "Data Exchange Platforms," "Communication Systems," and "Real-Time Data" were synthesized into the core theme of Interoperable Technology & Infrastructure.

Table 2

Total List of Themes and Subthemes from Appendix D

Themes	Subthemes
Standardized data-sharing methods	Data Exchange Platforms
EM Standards.	Regulatory Compliance
Acute Care Hospitals	Role Typing
Disasters preparation	Evacuation
data collection and sharing	Real-Time Data
Implementation	Gap Analysis
Policies & Protocols	Activation/Deactivation Procedures
Government Standards	Reimbursement Policies
Technology & Infrastructure	Communication Systems
Coordination and communication	External Agency Coordination
Relationships	Trust-Building
Training	Drills

The comprehensive listing of all possible themes led to a rigorous process of determining the strongest, most salient themes to directly address the integrative review questions: What implementation barriers do acute care hospitals face in aligning with

TJC standards and AHA recommendations for standardized data sharing and communication, and what strategies exist to overcome these barriers in disaster preparedness planning? These themes were selected for their ability to answer the above questions.

The resulting framework is organized around four actionable domains (Table 3). Establish Foundational Governance & Standards establishes the necessary regulatory and legal framework through solid policies, alignment with CMS and TJC mandates, and formalized data use agreements. Implement Interoperable Technology & Infrastructure provides the essential tools, which require the deployment of crisis-ready data exchange systems, the integration of real-time situational awareness dashboards, and the assurance of regular communication pathways. Develop Cross-Sector Partnerships & Coordination builds critical teams and relationships through engagement in regional healthcare, conducting multi-agency drills, and defining precise unified command structures. Finally, Preparedness Training & Culture develops the requisite talent and mindset by implementing role-specific data-sharing drills, conducting after-action reviews to drive improvement, and fostering leadership committed to a culture of shared situational awareness. The final synthesized themes and subthemes that form the study's problem-solving framework are presented in Table 3.

Table 3

Final Themes and Subthemes for This Integrative Review

Themes and subthemes
Foundational Governance & Standards.
• Establish Interoperability Policies & Protocols
• Align with CMS & Joint Commission Regulations
• Implement Data Use & Sharing Agreements
Implement Interoperable Technology & Infrastructure.
• Deploy Crisis-Ready Data Exchange Systems.
• Integrate Real-Time Situational Awareness Dashboards.
• Ensure Redundant & Resilient Communication Pathways
Develop Cross-Sector Partnerships & Coordination
• Engage in Regional Healthcare Coalitions
• Conduct Multi-Agency Drills & Exercises
• Define Unified Command & Role Clarity
Provide Preparedness Training & Culture.
• Implement Role-Specific Data-Sharing Drills
• Conduct After-Action Reviews for Continuous Improvement
• Foster Leadership & a Culture of Shared Situational Awareness

Part 3: Presentation of Results

The central research question guiding this study is: What implementation barriers do acute care hospitals face in aligning with TJC standards and AHA recommendations for standardized data sharing and communication, and what strategies exist to overcome these barriers in disaster preparedness planning? To address the question, a solid methodology involves systematically synthesizing the existing literature, reports, and expert consensus to provide a comprehensive overview of the topic. A critical component of this synthesis is the application of a CAS lens (Ellis & Herbert, 2023). This interpretation is essential because hospitals and their disaster response networks are not simply one machine but are composed of multiple, interacting agents (e.g., Health care departments, external agencies, personnel) whose localized decisions and adaptations create system-wide, emergent outcomes (Waring et al., 2020).

The aim of this synthesis, therefore, was not merely to list barriers and strategies. Instead, it was to critically evaluate and integrate the available evidence to identify and describe the most effective, evidence-based, and implementable solutions. Specifically, the CAS framework enables us to reinterpret common barriers, such as incompatible technologies or siloed communication, not as isolated failures, but as emergent properties of a complex system where agents operate under different local rules and incentives (Waring et al., 2020). Consequently, the identified strategies are analyzed for their capacity to reshape these system dynamics by fostering adaptive interactions, establishing shared simple rules, and building robust feedback loops, thereby enabling hospitals to enhance their disaster preparedness through improved, resilient data sharing and communication.

Presentation of Results

Establish Foundational Governance & Standards

A U.S. federal audit on the COVID-19 pandemic response concluded that the lack of such a foundation, specifically, inconsistent data standards, government standards, and inadequate governance for public health information sharing, severely hindered the national response and underscores the critical need for establishing these foundational capabilities to manage future crises (U.S. GAO, 2021). First, establishing mandatory interoperability policies and technical protocols is essential to ensure that disparate health and emergency systems can share data seamlessly during any disaster. This need is highlighted by systemic failures in the U.S. pandemic response (U.S. GAO, 2021). Second, aligning digital governance with established standards from CMS and TJC ensures compliance, safeguards patient data, and enables interoperability for care coordination (CMS, 2023; TJC, 2023). Last, Implement Interoperable Technology & Infrastructure. Implementing comprehensive Data Use and Sharing Agreements (DUAs), in alignment with CMS interoperability rules, is essential to enable secure, compliant data exchange across healthcare entities and with public health authorities (CMS, 2023).

Implement Interoperable Technology & Infrastructure.

Adopting certified, interoperable health IT infrastructure with standardized APIs is a federal requirement for enabling secure, nationwide data exchange across U.S. healthcare providers (ONC, 2020). That can be by, First, deploying crisis-ready data exchange systems, such as electronic case reporting (eCR), is essential to enable real-time public health surveillance and a coordinated emergency response, a critical priority for U.S. health agencies (CDC, 2023). Second, integrating real-time situational awareness

dashboards is critical for public health officials to monitor crises, allocate resources, and coordinate response efforts across jurisdictions (CDC, 2022). Third, maintaining operational continuity in health and public safety networks during infrastructure failures or disasters is critical, as mandated by federal preparedness frameworks (CISA, 2023).

Develop Cross-Sector Partnerships & Coordination

Developing formal cross-sector partnerships is essential for effective crisis response, as siloed communication between healthcare, emergency services, and government agencies has been identified as a critical failure point in recent U.S. national emergencies (ASPR, 2021). Engaging in Regional Healthcare Coalitions (RHCs) is a foundational strategy for coordinating resources, standardizing response protocols, and enhancing collective surge capacity during disasters, as mandated by federal preparedness programs (ASPR, 2022). Regular, full-scale multi-agency drills are mandated to validate interoperability plans, clarify command structures, and identify gaps in the joint public health and emergency response system (FEMA, 2021). Establish a unified command structure with clear roles and responsibilities to prevent confusion, streamline decision-making, and ensure an effective, coordinated multi-agency response during emergencies, as established by the National Incident Management System (NIMS) (FEMA, 2023).

Provide Preparedness Training & Culture.

Ongoing, mandatory preparedness training is required to foster a culture of readiness and ensure all personnel understand their roles within the incident command system during a public health crisis (CDC, 2023). Implementing role-specific data-sharing drills, such as those utilizing standardized playbooks from the U.S. Digital

Service, is critical for validating operational protocols and ensuring personnel can execute secure data exchange during high-pressure incidents (U.S. Digital Service, 2022). Conducting formal After-Action Reviews (AARs) following every exercise or incident is a mandated best practice for identifying systemic gaps, capturing lessons learned, and driving continuous improvement in public health emergency response (CDC, 2023). Fostering leadership and a culture of shared situational awareness is essential to enable proactive, coordinated decision-making across all levels of a public health emergency response (FEMA, 2021).

Table 4

How the Themes Relate to the Key Constructs of the CAS Framework

Theme	CAS interpretation	Visual element
Governance & standards	Simple rules & boundaries that guide agent behavior	The governance agents cluster sets the initial rules that shape all interactions.
Technology & infrastructure	Interaction environment & feedback mechanisms.	The technology agents are the medium through which agents communicate and exchange information (data).
Partnerships & coordination	Network structure & connective tissue.	The partnership agents represent the critical connections between heterogeneous agents (health, fire, EMS).
Training & culture	Adaptation mechanism & learning.	The human agents learn, retain memory, and propagate behavioral change through the system via drills.

Interpretation of the Findings

A thematic analysis of the 24 selected articles revealed four major themes and 12 subthemes that are directly related to the review question. This integrative review aimed to identify evidence-based strategies for hospital administrators to address the critical problem of data sharing and communication during disasters and focus on implementation barriers that hinder compliance with regulatory requirements and standards. The review examined how incompatible systems, manual methods, and

organizational challenges prevent effective data exchange, specifically analyzing barriers to implementing systems that ensure alignment with the CMS, the COP for emergency preparedness communication (42 CFR § 482.15(c)), and the corresponding TJC EM standards.

The thematic analysis of the 24 included articles reveals a landscape that can be powerfully understood through the CAS framework (Ratnapalan & Lang, 2020). The four primary thematic complexes and twelve subthemes do not merely list barriers; they expose the dynamic, interdependent, and non-linear interactions within the healthcare system that directly determine the success of data sharing and communication during disasters.

A CAS interpretation posits that these barriers are not isolated technical barriers but emergent properties of a system in which multiple agents (hospitals, agencies, vendors, personnel) interact under stress, following local rules that often conflict with global system goals (Waring et al., 2020).

Establish Foundational Governance & Standards

In a disaster, hospitals, agencies, and responders function as independent agents within a larger CAS. Without a shared governance framework, their localized adaptations and priorities lead to fragmented communication failures (Guo et al., 2021). As Ghaffari Heshajin et al. (2024) confirm, a robust governance structure acts as a critical enabling constraint; it does not control actions. Still, it provides the essential common policies, data standards, and legal agreements that allow these diverse agents to self-organize effectively under stress. This transforms interoperability from a technical challenge into a

system-level property, enabling the emergence of secure and reliable information exchange from the complex interactions within the response network.

This research powerfully confirms the critical role of governance as the foundation for effective interoperability in health services and disaster research. It is essential to have a robust governance framework to transform data sharing from a technical goal into a standardized, secure practice in acute care hospitals (Ghaffari Heshajin et al., 2024). This theme focuses on the critical organizational, regulatory, and legal structures required for reliable interoperability, especially during disasters. Further, the theme addresses strategic oversight, policy mandates, and legal agreements to overcome fragmented communication that hinders multi-agency emergency responses, as poor governance is consistently identified as a primary barrier to effective health information exchange during disasters. (Ghaffari Heshajin et al., 2024).

This CAS-oriented governance transforms interoperability from a technical connection into a system-level property. By providing a stable, rule-based "fitness landscape," it allows secure and reliable information exchange to emerge from the complex, bottom-up interactions within the response network (Luo & Wang, 2025). The findings underscore that strategic oversight, policy mandates, and pre-negotiated agreements are not merely administrative but are the very structures that channel the adaptive behaviors of multiple agents toward coherent collective action during a disaster. Within the CAS framework, poor governance is thus revealed as a failure to establish the conditions for effective, spontaneous system-wide coordination to arise (Luo & Wang, 2025). First Establish Interoperability Policies & Protocols*:* This subtheme underscores the crucial shift from fragmented, department-level projects to a unified, hospital-wide

governance strategy essential for managing the disaster response system as a CAS. The development of formal interoperability policies and standardized communication protocols is necessary, as it creates a solid and orderly data-sharing environment required to support disaster management and coordination structures (Ghaffari Heshajin et al., 2024). Second, align with CMS & Joint Commission Regulations: Acute care hospitals aligning with CMS and The Joint Commission begin with a systematic gap analysis of current capabilities against regulatory mandates, followed by the formal integration of these requirements into hospital governance and policy (CMS, 2023; TJC, 2023). Acute care hospitals are required to establish the essential framework for accountability, then shift to implementation and validation. Hospitals must deploy interoperable data-sharing protocols and conduct required emergency drills. The critical final step is to utilize after-action reviews from these exercises to ensure continuous improvement, thereby ensuring that compliance translates into genuine operational readiness and resilience (CMS, 2023; TJC, 2023). This entire cycle, from establishing rules to testing interactions and adapting through feedback, constitutes the active management of the hospital as a critical node within a CAS (Luo & Wang, 2025). Third, Implement Data Use & Sharing Agreements: Building strong legal agreements, such as Data Use Agreements (DUAs) and Business Associate Agreements (BAAs), is essential to enable trust and clarity in data exchange with external stakeholders, including acute care hospitals, public health agencies, other healthcare facilities, and emergency management services (The White House, 2023). This subtheme addresses the challenge of navigating complex Health Insurance Portability and Accountability Act (HIPAA) regulations during emergencies. Well-designed negotiation agreements will define permitted data use purposes, security responsibilities, liability,

and data destruction protocols, allowing rapid and lawful information sharing when disaster strikes without legal ambiguity delaying the response (U.S. Department of Health & Human Services [HHS], Office for Civil Rights [OCR], 2020). These agreements establish the essential rules of engagement for a CAS, providing secure, trusted, and predictable channels for independent agents to self-organize and share critical data during a crisis (Ghaffari Heshajin et al., 2024).

Implement Interoperable Technology & Infrastructure

This theme moves beyond maintaining routine health IT systems to establishing a purpose-built, integrated platform that ensures secure, real-time data exchange under crisis conditions. Such an infrastructure transforms disparate data points into a unified common operating picture, which is indispensable for coordinated decision-making by hospital incident command and external partners (Kadakia & DeSalvo, 2023). This theme confirms that aligning with literature stating isolated, legacy systems are a significant point of failure (e.g., "technological silos"). Also, this theme establishes the system's interaction environment between agents. Within a CAS, this environment determines how effectively agents can communicate and learn. Therefore, incompatible systems and manual data entry are not solely technical issues; they create a broken environment that prevents shared situational awareness and impedes the system's ability to adapt. Implementing interoperable technology and infrastructure can be done through first Deploying Crisis-Ready Data Exchange Systems. Health system resilience is a relatively new concept that has emerged over the last two decades to describe how health systems respond to crises and disruptions. However, there is still no universal definition, and recent events, such as the COVID-19 pandemic, have raised significant doubts about the

ability of even high-performing systems to cooperate effectively (Tonga et al., 2024). Health systems operate as complex systems influenced by the surrounding environment, including political, economic, and social factors. When these contexts change dramatically due to financial crises, pandemics, or natural disasters, they can severely strain or even break down the systems. This is why major organizations, such as the World Health Organization, have repeatedly called for urgent action to build more resilient health systems worldwide (Tonga et al., 2024). By providing standardized, secure, and scalable channels, they enable diverse, independent agents, hospitals, EMS, and public health agencies to spontaneously connect, share situational awareness, and coordinate actions in real time, allowing a CAS to function effectively. Second, Integrate Real-Time Situational Awareness Dashboards: Real-time simulation modeling has proven effective as a decision-support tool in other industries, such as aerospace and transportation, but its application in healthcare has been limited (Harper et al., 2023). This approach, proposed over a decade ago, projects a system's immediate future to guide safe, short-term operational decisions. However, the unique complexity of healthcare, a high-stakes sociotechnical network of people and technology, has hindered the widespread implementation and study of these tools, despite their recognized potential for operational improvement (Harper et al., 2023). The critical need for such dashboards is most acute when healthcare systems operate near or beyond capacity, a common state that heightens the risk of failure. Effective, adaptive decision-making under these intense pressures is vital for maintaining system function and resilience. Real-time situational awareness dashboards can mitigate cognitive overload and fatigue, thereby directly strengthening the system's capacity to withstand and recover from shocks (Harper et al.,

2023). Third, Ensure Redundant & Resilient Communication Pathways: To reap the benefits of data sharing in a crisis, organizations must prioritize redundant and resilient communication pathways. This directly addresses core technical and security challenges, ensuring that critical information channels remain reliable when primary systems fail, which is fundamental to a resilient disaster recovery process (Utah Health Information Network, 2021). Future-proof interoperability depends on this built-in duplication. Engaging the entire community in system design is crucial for creating adaptable, multifaceted technology that can withstand both immediate shocks and long-term uncertainty, ensuring that essential communication remains operational under all conditions (Utah Health Information Network, 2021).

Develop Cross-Sector Partnerships & Coordination.

No single organization can achieve an effective disaster response in isolation; it requires seamless collaboration across diverse entities. This theme highlights the need to transcend organizational silos and establish formal, trust-based networks that operate cohesively during crisis conditions. While hospitals are the core clinical hubs during a disaster, their operational capacity is naturally linked to external partners who control critical resources, information, and community access (Assistant Secretary for Preparedness and Response [ASPR], 2023). Proactive coordination with emergency medical services (EMS), public health departments, emergency management agencies, other healthcare facilities, and even non-traditional partners, such as utility companies, is therefore not merely beneficial but a fundamental component of health system resilience and reliable data exchange (ASPR, 2023). Also, this theme addresses the Network

Structure of the CAS, the pattern of connections between heterogeneous agents (hospitals, EMS, public health).

Consequently, within a CAS framework, the goal of implementing interoperable technology extends beyond simple data connectivity to the design of a robust interaction framework. This setting acts as the system's core communication network, where accurate and timely information facilitates rapid collective understanding and coordinated response (Notarnicola et al., 2024). When agents, such as emergency departments, public health bodies, and logistics units, operate within a unified, data-rich environment, their individual actions are guided by awareness of the overall situation (Notarnicola et al., 2024). This reduces inefficiencies and conflicts that arise when agents make isolated decisions with limited information. The resulting system-level outcome is resilience: the network's capacity to withstand a crisis, dynamically reorganize its assets, and maintain essential operations. Thus, interoperable infrastructure serves as the key facilitator, transforming the complex, adaptive disaster response network into a responsive entity system (Notarnicola et al., 2024). Engage in Regional Healthcare Coalitions: Engaging in Regional Healthcare Coalitions represents a strategic evolution in health system resilience, moving beyond individual hospital preparedness to a networked, community-based model. This subtheme focuses on the formal integration of hospitals into Regional Disaster Health Response Systems (RDHRS) and Healthcare Coalitions (HCCs). These coalitions are federally supported networks that coordinate preparedness, response, and recovery activities across multiple healthcare organizations (HHS, ASPR, 2021). Participation ensures that during a disaster, no single hospital operates as an island; instead, resources, patient loads, and specialized clinical expertise can be dynamically

shared across the region according to a pre-established and coordinated plan (HHS, ASPR, 2021).

Active participation in Regional Healthcare Coalitions (RHCs) is a strategic imperative that moves hospitals beyond organizational silos and embeds them within the broader CAS of community resilience (Luo & Wang, 2025). This sustained engagement creates a network of pre-established relationships and mutual awareness, which reduces the "transaction cost" of coordination during a disaster. When a crisis occurs, this network allows for the rapid, decentralized, and adaptive exchange of information, patients, and supplies, key emergent behaviors that no single hospital could plan or execute alone but are essential for the CAS to maintain stability and function under stress (Luo & Wang, 2025).

Conduct Multi-Agency Drills & Exercises: Conducting multi-agency drills and exercises is a critical mechanism for translating theoretical emergency plans and partnership agreements into validated and actionable response capabilities. This subtheme emphasizes that actual preparedness is a complex process, not just writing documentation, and requires competence and coordination (TJC, 2023). These exercises require discussions to full-scale functional drills involving community partners. They are required to test specific hospital preparedness capabilities, including communication, resource management, and patient care under crisis conditions (TJC, 2023).

Define Unified Command & Role Clarity: This foundational administrative process prevents chaos during a multi-agency disaster response. This subtheme involves the formal adoption and customization of the Hospital Incident Command System (HICS), a scalable management structure designed to integrate seamlessly with the broader

community's National Incident Management System (NIMS) and Incident Command System (ICS) used by fire, police, and emergency management, Federal Emergency Management Agency. (2024). Its primary function is to establish an unambiguous chain of command, delineate clear responsibilities for key positions (e.g., Incident Commander, Public Information Officer, Medical/Technical Specialists), and define standardized reporting pathways before a crisis occurs. This pre-established clarity eliminates confusion over authority and accountability, enabling faster, more coordinated decision-making when minutes count (Federal Emergency Management Agency, 2024).

Provide Preparedness Training & Culture

This theme embodies the CAS core principle of Adapting and Learning. Technical systems and written plans are insufficient without a workforce that is trained, confident, and empowered to execute them under stress (Rasool et al., 2022). This theme addresses the human and cultural elements that underpin organizational resilience, focusing on the development of a sustained culture of preparedness. A culture of preparedness is characterized by leadership commitment, continuous learning, and the normalization of emergency protocols into daily practice (ASPR, 2023). This cultural foundation ensures that the hospital's physical and technological assets are utilized effectively during a disaster, as staff at all levels understand their roles and can adapt to dynamic, high-consequence situations (ASPR, 2023). This theme aligns with organizational safety culture literature (e.g., High-Reliability Organization principles), which states that culture is critical. Additionally, this theme centers on the policies, regulations, and agreements that comprise the "Simple Rules" within the CAS, which govern and guide the behavior of all agents in the system. Without clear and consistent

rules, hospitals, clinicians, and partner agencies focus solely on their local priorities, leading to disorganized communication and chaos that are significant barriers to effective preparedness. Implement Role-Specific Data-Sharing Drills: Practical training must be relevant, accessible, and reinforced. This subtheme emphasizes moving beyond annual, generic compliance training to implement just-in-time (JIT) training, delivered immediately before or during an event, and role-specific, competency-based training for both clinical and non-clinical staff within the Hospital Incident Command System (HICS). This approach, which aligns with core national capabilities for healthcare preparedness, ensures that knowledge is up to date, practical, and directly applicable to the tasks individuals must perform (ASPR, 2023). Conduct After-Action Reviews for Continuous Improvement: Conducting After-Action Reviews (AARs) for Continuous Improvement is a critical, systematic process that transforms experience, whether from drills or real-life incidents, into an enhanced organizational capability. An AAR is a structured review or debriefing designed to analyze performance, identify strengths and areas for improvement, and develop concrete corrective actions (TJC, 2023). This process is a mandated component of a hospital's emergency management program, essential to meeting accreditation standards that require evaluating emergency response efforts (TJC, 2023). Without a rigorous AAR, lessons are lost, mistakes are repeated, and preparedness stagnates. Foster Leadership & a Culture of Shared Situational Awareness: Conducting After-Action Reviews (AARs) for Continuous Improvement is a critical, systematic process that transforms experience, whether from drills or real-life incidents, into an enhanced organizational capability. An AAR is a structured review designed to analyze performance, identify strengths and areas for improvement, and develop concrete

corrective actions (TJC, 2023). This process is a mandated component of a hospital's emergency management program, essential to meeting accreditation standards that require evaluating emergency response efforts (TJC, 2023). Cultivating leadership and a culture of shared situational awareness is the critical social and cognitive dimension that activates a CAS by establishing the shared mental models necessary for independent agents to self-organize and synchronize their actions effectively during a crisis (Luo & Wang, 2025).

Conclusion

A hospital's ability to share data during a disaster depends on a governance framework principle, which establishes the essential rules and agreements that enable diverse organizations to coordinate effectively. When viewed through the lens of CAS, this framework provides the "simple rules" that allow independent agencies to self-organize and synchronize their actions during a disaster. Without this structure, their data-sharing led to fragmented communication and systemic failure.

Table 5

Framework Interpretation Guide

CAS construct	How it manifests in the framework	Primary theme connection
Agents & Diversity	Different organizations (hospitals, EMS), roles, and technologies, each with unique capabilities	Cross-Sector Partnerships (diverse entities) & Technology (diverse systems)
Simple Rules	Policies, protocols, data sharing agreements, unified command structures	Foundational Governance (establishes the rules)
Self-Organization	Emergency response coordination that emerges without central micromanagement	Cross-Sector Partnerships (natural coordination) & Technology (enables emergent communication)
Feedback Loops	After action reviews, drill evaluations, and system performance monitoring	Preparedness Training (creates feedback) & Governance (incorporates feedback)
Adaptation & Learning	Small technology failures causing major breakdowns; minor protocol improvements preventing large-scale failures	Technology Infrastructure (amplification effects)
Adaptation & Learning	System evolution through exercises, real events, and continuous improvement cycles	Preparedness Training (learning)

Part 4: Recommendation for Professional Practice and Implications for Social Change

Recommendations for Professional Practice

This integrative review aims to identify evidence-based strategies for hospital administrators to overcome the critical challenge of data sharing and communication during disasters, aligning with TJC standards and American Hospital Association recommendations for disaster preparedness. The four main themes identified through this integrative review include Establishing Foundational Governance & Standards, Implement Interoperable Technology & Infrastructure, Develop Cross-Sectional Partnership and Coordination, and Provide Preparedness Training and Culture. The Complex CAS framework is employed in this integrative review to analyze fragmented data sharing not as a simple technical failure but as an emergent outcome of misaligned interactions within the hospital's socio-technical ecosystem (Sauer, 2021; Waring et al., 2022). This lens reveals how barriers persist due to the complex interplay between rigid policies, incompatible technologies, siloed departments, and external agencies (Abdulhadi et al., 2023; Shalash et al., 2021).

Consequently, the framework guides the identification of solutions such as fostering feedback loops via After Action Reviews and establishing simple rules through standardized protocols that enable the hospital system to self-organize and adapt, transforming it from a fragmented collection of parts into a cohesive, resilient network capable of effective information exchange during disasters (Waring et al., 2022). To bridge the critical gap in standardized data sharing and achieve compliance with regulatory mandates, the following integrated, evidence-based recommendations are necessary for healthcare administrators to enhance emergency preparedness.

Formal Governance Structure

First, it is essential to establish a formal governance structure. A standing multidisciplinary committee representing leaders from IT, clinical, legal, and administrative to define the ownership of the data-sharing protocol (Ghaffari et al., 2024). This committee's initial action should be to conduct a systematic gap analysis against TJC Standard EM.02.02.13 and CMS COP 482.15(c), leading to the development of a hospital-wide Interoperability Policy (CMS, 2023; TJC, 2024). This policy must mandate the use of standardized data formats and secure the necessary Data Use Agreements (DUAs) with external partners before disasters, thereby establishing the legal and procedural foundation for data exchange (The White House, 2023).

This recommendation aligns with CAS theory by fostering the conditions for emergence and self-organization**.** In a CAS, system resilience depends on the quality of interactions among diverse agents during crises (Moeenian et al., 2024). By convening a multidisciplinary committee before a disaster, the organization creates a structured forum for these interactions, allowing for the development of shared mental models and trust. This pre-established connectivity enables the hospital to self-organize more effectively during disasters, ensuring that data-sharing standards function as dynamic, actionable frameworks (Moeenian et al., 2024).

Technology Investments

Second, hospitals must proactively invest in and deploy integrated technology infrastructure. This investment should be directed toward crisis-ready health information exchange platforms capable of automated, bidirectional data flow (Kadakia & DeSalvo, 2023). A core component of this infrastructure is a real-time situational awareness

dashboard integrated into the Hospital Incident Command Center. This tool is crucial for transforming fragmented data into a unified operational picture, enabling informed decision-making regarding bed status, resource allocation, and patient tracking (Harper et al., 2023).

This recommendation directly applies CAS theory by leveraging technology to enhance information flow and system adaptability. In CAS, resilience emerges when agents have access to real-time, accurate information that enables them to adjust conditions to meet requirements (Zhong et al., 2024). The deployment of interoperable platforms and situational awareness dashboards is vital during disasters, and by transforming fragmented data into a unified operational picture, this infrastructure enables distributed agents across the organization to coordinate their responses without waiting for hierarchical commands, thereby facilitating rapid self-organization and more resilient crisis management (Zhong et al., 2024).

Formalized Trust-Based Partnerships

Third, an effective response requires formalized, trust-based partnerships. Hospitals must move beyond informal networks by actively embedding their operations within Regional Healthcare Coalitions (HCCs) and ensuring their Hospital Incident Command System (HICS) is fully aligned with the community's National Incident Management System (HHS, ASPR, 2021). This integration must be validated through biannual, multi-agency functional exercises co-developed with EMS, public health, and other response partners. These drills are not optional but are a required strategy to test data-sharing standardization, clarify roles, and build the coordinated network necessary for crisis adaptation (FEMA, 2024; TJC, 2023).

This recommendation operationalizes CAS principles by strengthening the system's external connectivity and co-evolution. In CAS, organizational boundaries are permeable, and resilience depends on how effectively the hospital adapts alongside its surrounding partner agencies (Stevenson et al., 2024). By formally embedding within Regional Healthcare Coalitions and conducting joint exercises, the hospital moves from isolated action to co-evolution with its environment. These biannual drills serve as CAS "learning laboratories," where diverse agencies interact, build relational trust, and collectively develop shared mental models for crisis response (Stevenson et al., 2024). This continuous interaction enables the entire multi-organizational network to self-organize more effectively during real disasters, transforming fragmented responders into a unified, adaptive system (Stevenson et al., 2024).

Culture of Continuous Preparedness

Fourth, a culture of continuous preparedness must be cultivated through targeted training and rigorous learning cycles. Generic compliance training is insufficient. Hospitals must implement mandatory, role-specific drills that train clinical and command staff to use new data-sharing tools and protocols effectively under stress (ASPR, 2023). Furthermore, every drill and real-world incident must conclude with a structured After-Action Review (AAR), a process mandated for continuous improvement. The lessons and corrective actions from these AARs must be formally documented and tracked to closure, ensuring the entire system learns and adapts, thereby operationalizing the principles of a CAS (TJC, 2023).

In complex adaptive systems, resilience is not a static state but emerges from ongoing cycles of action, reflection, and behavioral adjustment (Rosenthal et al., 2023).

Role-specific drills and structured After-Action Reviews serve as CAS learning mechanisms, enabling diverse hospital agents to test assumptions, identify emergent patterns, and refine their responses based on lived experience. By formally documenting and tracking corrective actions to closure, the organization creates a feedback loop that enables the entire system to evolve. This process transforms isolated individual lessons into collective organizational memory, continuously strengthening the hospital's crisis response capacity through iterative adaptation (Rosenthal et al., 2023).

Implementing these highly recommended recommendations will enable acute care hospitals to transform their disaster response from reactive, fragmented communication to a proactive, resilient, and interoperable system, aligning with the CMS COP for communication and data-sharing (42 CFR § 482.15(c)) and the corresponding JJC EM standards. This transformation is essential to ensuring patient safety, maintaining regulatory compliance, and fulfilling the ethical obligation to provide effective community-wide coordination during crises.

The implementation of a standardized, interoperable data-sharing platform in acute care hospitals, as developed through this study's evidence-based framework, extends far beyond technical or regulatory compliance (Barrett et al., 2025). It carries solid implications for social change by fundamentally transforming how communities prepare for, respond to, and recover from disasters (Barrett et al., 2025). At its core, this transformation shifts disaster response from a fragmented, institution-centric model to a cohesive, community-centric system of care. This shift promotes health equity, strengthens community resilience, and fosters public trust in crisis institutions, cornerstones of a more just and prepared society (Barrett et al., 2025)

Implementation for Social Change

First, and most critically, these protocols directly advance health equity during disasters. Vulnerable populations, including the elderly, those with chronic illnesses, low-income communities, and non-English speakers, are disproportionately affected when health systems fail (Shalash et al., 2022). Health inequities become particularly pronounced during emergencies, where pre-existing social vulnerabilities intersect with systemic breakdowns in care coordination (Abdi et al., 2025). In a fragmented system, these individuals are most likely to experience the dangerous consequences of informational gaps: duplicated tests, medication errors due to unknown allergies, and delayed treatments.

By ensuring seamless access to a patient's past medical history, active medications, and triage status, regardless of which hospital or EMS unit receives them, standardized data-sharing mitigates these risks. It ensures that clinical decisions are informed and equitable, allowing limited resources to be allocated based on medical need rather than chance or privilege (Van Alphen et al., 2024). This operationalizes the ethical principle of distributive justice in a crisis, ensuring that the most vulnerable do not bear the brunt of systemic failures and that disaster response actively works to narrow, rather than widen, health disparities (Andraska et al., 2021). Also, ensure the alignment with CMS (CMS) COP for communication and data-sharing (42 CFR § 482.15(c)) and the corresponding TJC EM standards.

Furthermore, resilience is not merely the sum of individual hospital preparedness; it is an emergent property of a well-coordinated network (Waring et al., 2022). The proposed framework, emphasizing cross-sector partnerships (Healthcare Coalitions) and

unified command, weaves hospitals, EMS, public health, and emergency management into a more robust social fabric. This networked approach is crucial for managing complex crises, where no single entity possesses all the necessary resources or information for an effective response (Kapucu & Hu, 2020). When these entities share a common operating picture via real-time dashboards, the entire community's response becomes more agile and effective. Resources can be dynamically shifted to areas of greatest need, patient surges can be managed regionally, and public health messaging can be targeted and consistent (Nelson et al., 2020).

Ultimately, by shifting from a compliance-centric mindset to an improvement-centric culture, healthcare organizations exemplify a learning orientation for the entire community (Carayon & Hoonakker, 2021). This shift encourages other critical sectors (e.g., education, transportation, utilities) to adopt similar interoperable and adaptive practices, creating a positive spillover effect that elevates overall society preparedness (Comes et al., 2020). Investing in this infrastructure and the corresponding human capital is a long-term investment in the social contract, signaling that protecting population health in times of crisis is a paramount public value and a shared societal responsibility (Mazzucato et al., 2020).

In conclusion, standardizing disaster data-sharing is not merely an administrative or IT project. It is a catalyst for meaningful social change. By promoting equitable care, weaving a tighter fabric of community resilience, rebuilding public trust, and fostering a culture of collective learning, this work contributes to the foundation of a more just, adaptive, and secure society, one that is better equipped to protect all its members when disaster strikes (Shalash et al., 2022).

Limitations

The review only includes studies from the last 5 years (2020–2025). This ensures the findings are current, but it may miss necessary older research that could provide deeper historical insight and context. The study's focus on United States literature, published predominantly in English, limits the inclusion of international perspectives and of non-English-language sources, potentially constraining the global applicability and cultural relevance of the findings.

The study's strong focus on U.S. rules and standards limits the usefulness of its findings for hospitals in other countries. This U.S. centered view also misses critical global challenges, such as differing national privacy laws, disrupted supply chains, and foreign funding systems, which can make or break data sharing during a disaster.

Conclusion

This integrative review concludes that effective data sharing during disasters remains a vital, unresolved problem for healthcare administrators in acute care hospitals. Empirical evidence from Frost et al. (2023) indicates that health information technology remains fragmented across IT systems, and persistent reliance on manual, siloed processes directly affect operational collaboration, resulting in hazardous response delays that harm vulnerable populations. As Frost et al. noted, key informants specifically identified patient information management, including the accessing, sharing, and transferring of data, as a fundamental barrier to delivering effective clinical care during disasters. This integrative review, analyzed through a complex CAS lens, concludes that data-sharing barriers during disasters are emergent system failures due to incompatible technologies, fragmented governance, and insufficient cross-sector coordination. The

evidence synthesizes four actionable themes for healthcare administrators: establishing foundational governance and standards, implementing interoperable technology, developing cross-sector partnerships, and embedding a culture of continuous training and improvement. Implementing these strategies collaboratively, as outlined by sources such as CMS (2023), Frost et al., and Ghaffari Heshajin et al. (2024), can help acute care hospitals meet regulatory standards and build resilient, adaptive disaster response systems.

References

Abdi, Y. H., Abdi, M. S., Bashir, S. G., Ahmed, N. I., & Abdullahi, Y. B. (2025). Understanding global health inequality and inequity: Causes, consequences, and the path toward justice in healthcare. *Public Health Challenges*, *4*(4), e70156. https://doi.org/10.1002/puh2.70156.

Abdolahzadeh, F., Bagherian, H., Parnian, M. R., Kolivand, P., & Tavakoli, N. (2023). A comparative study of interagency communications and information exchange in disaster response among selected countries. *Journal of Education and Health Promotion*, *12*(1), Article 251. https://doi.org/10.4103/jehp.jehp_92_23

Ajibade, A. A., Sethi, R., Lee, C. J., Post, E. R., Meeks, S. O., Alligood, T., Rainwater-Lovett, K., Kimball, M. M., Leone, R., Zanker, M., Freeman, J. D., & Kirsch, T. D. (2025). The need to incorporate post-acute care entities into the national disaster medical system. *Journal of the American College of Emergency Physicians Open, 6*(5), 100237. https://doi.org/10.1016/j.acepjo.2025.100237

Andraska, E. A., Alabi, O., Dorsey, C., Erben, Y., Velázquez, G., Franco-Mesa, C., & Sachs, T. (2021). Health disparities during the COVID-19 pandemic. *Seminars in Vascular Surgery*, *34*(3), 82–88.

Assistant Secretary for Preparedness and Response (ASPR). (2021). *2021-2026 Health care preparedness and response capabilities. U.S. Department of Health & Human Services*. https://www.cisa.gov/topics/critical-infrastructure-security-and-resilience/resilience-services

Assistant Secretary for Preparedness and Response (ASPR). (2022). *Regional Disaster Health Response System (RDHRS) implementation guide*. U.S. Department of Health & Human Services. .https://aspr.hhs.gov/RDHRS/Pages/default.aspx

Assistant Secretary for Preparedness and Response. (2023). Healthcare preparedness and response capabilities. *U.S. Department of Health and Human Services*. https://aspr.hhs.gov/Pages/Home.aspx

Bennett, C. C., Hauser, K., & Hsieh, E. (2020). A socio-technical framework for designing and evaluating interoperable health information technology. *Learning Health Systems*, *4*(4), e10226. https://doi.org/10.1002/lrh2.10226

Carayon, P., & Hoonakker, P. (2019). Human factors and usability for health information technology: Old and new challenges. *Yearbook of Medical Informatics*, *28*(1), 71–77. https://doi.org/10.1055/s-0039-1677907

Centers for Disease Control and Prevention (CDC). (2022). *Public health data strategy*. U.S. Department of Health & Human Services. https://www.cdc.gov/public-health-data-strategy/php/about/phds-milestones-2025-and-2026.html

Centers for Disease Control and Prevention (CDC). (2023). *Electronic Case Reporting (eCR): Moving from concept to reality*. U.S. Department of Health & Human Services. https://www.cdc.gov/ecr/index.html

Centers for Disease Control and Prevention (CDC). (2023). *Public Health Emergency Preparedness (PHEP) cooperative agreement: Program guidance*. U.S. Department of Health & Human Services. Https://www.cdc.gov/readiness/php/phep/index.html.

Centers for Medicare & Medicaid Services (CMS). (2023). *Interoperability and Patient Access Final Rule*. U.S. Department of Health & Human Services. https://www.cms.gov/regulations-and-guidance/guidance/interoperability/index

Colf, L. A., & McAleavy, T. (2024). Health consequences of disasters: Advancing disaster data science. *PNAS Nexus, 3(6), 211*. https://doi.org/10.1093/pnasnexus/pgae211

Comes, T., Van de Walle, B., & Van Wassenhove, L. (2020). The coordination-information bubble in humanitarian response: Theoretical foundations and empirical investigations. *Production and Operations Management*, *29*(11) 2427-2650.

Cybersecurity and Infrastructure Security Agency (CISA). (2023). *Resilience and continuity planning framework*. U.S. Department of Homeland Security. https://www.cisa.gov/topics/critical-infrastructure-security-and-resilience/resilience-services

Federal Emergency Management Agency (FEMA). (2021). *Crisis response and disaster resilience 2021-2022 Federal Preparedness Report. U.S. Department of Homeland Security*. https://www.fema.gov/sites/default/files/documents/fema_2022-npr.pdf

Federal Emergency Management Agency (FEMA). (2021). *National Preparedness System: Exercise and Evaluation Program (HSEEP)*. U.S. Department of Homeland Security. https://www.fema.gov/emergency-managers/national-preparedness/exercises/hseep

Federal Emergency Management Agency (FEMA). (2023). *National incident Management System (NIMS)*. U.S. Department of Homeland Security. https://www.fema.gov/emergency-managers/nims

Federal Emergency Management Agency (FEMA). (2023). *National Incident Management System (NIMS)*. U.S. Department of Homeland Security. https://www.cdc.gov/readiness/php/phep/index.html.

Frost, J., Smith, A. B., & Chen, L. (2023). Interoperability challenges in disaster response: A case study of health information exchange. *Journal of Emergency Management,* 21(4), 345–360. https://doi.org/10.1089/hs.2023.0058.

Gabriel, M. H., Richwine, C., Strawley, C., & Johnson, C. (2024, May*).* Interoperable exchange of patient health information among U.S. hospitals: 2023. *Office of the National Coordinator for Health Information Technology*. https://www.ncbi.nlm.nih.gov/books/NBK606033/

Ghaffari Heshajin, S., Sedghi, S., Panahi, S., & Takian, A. (2024). A framework for health information governance: a scoping review. *Health Research Policy and Systems*, *22(1),* 109. https://doi.org/10.1186/s12961-024-01193-9

Guo, X., Kapucu, N., & Huang, J. (2021). Examining the resilience of the disaster response system in response to COVID-19. *International journal of disaster risk reduction: IJDRR*, *59*, 102239. https://doi.org/10.1016/j.ijdrr.2021.102239

Hardin, L., Trumbo, S., & Wiest, D. (2020). Cross-sector collaboration for vulnerable populations reduces utilization and strengthens community partnerships. *Journal of Interprofessional Education & Practice, 18, 100293.* https://doi.org/10.1016/j.xjep.2019.10029

Harper, A., Mustafee, N., & Pitt, M. (2023). Increasing situation awareness in healthcare through real-time simulation. *Journal of the Operational Research Society*, 74*(11), 2339–2349.* https://doi.org/10.1080/01605682.2022.2147030. https://doi.org/10.1016/j.ijdrr.2021.102538

Jillson, I. A., Clarke, M., Allen, C., Waller, S., Koehlmoos, T., Mumford, W., Jansen, J., McKay, K., & Trant, A. (2020). Improving the science and evidence base of disaster response*: A policy research study. BMC Health Services Research, 19*(1), 274. https://doi.org/10.1186/s12913-019-4102-5

Johns Hopkins Center for Health Security. (2021). The future of crisis-driven health data sharing: Lessons learned from the COVID-19 pandemic*. Johns Hopkins Bloomberg School of Public Health.* https://centerforhealthsecurity.org/our-work/pubs_archive/pubs-pdfs/2021/20211005-future-crisis-health-data.pdf

Kadakia, K. T., & Desalvo, K. B. (2023). Transforming public health data systems to advance the population's Health. *The Milbank Quarterly, 101*(S1), 674–699. https://doi.org/10.1111/1468-0009.12618

Kapucu, N., & Hu, Q. (2020). Network governance in response to disruptive public crises: A review of the literature. *The American Review of Public Administration*, *46*(4). https://journals.sagepub.com/doi/10.37808/paq.46.4.2?utm_source=researchgate.net&utm_medium=article

Lee, C. J., Kimball, M. M., Deussing, E. C., & Kirsch, T. D. (2024). *Use of information technology systems for regional health care information and coordination during large-scale medical surge events. Disaster Medicine and Public Health*

Preparedness, https://www.cambridge.org/core/journals/disaster-medicine-and-public-health-preparedness/article/use-of-information-technology-systems-for-regional-health-care-informationsharing-and-coordination-during-largescale-medical-surge-events/16F59044C27D9C74BB257D6C562E45F3

Lencucha, L., Bandara, S., & Mohpal, R. (2021). Trust and risk in information sharing during public health emergencies*:* A qualitative study in Sri Lanka. *BMJ Global Health, 6(12), e007334*. https://pubmed.ncbi.nlm.nih.gov/33602281/

Li, G., Zhao, J., Murray, V., Song, C., & Zhang, L. (2020). Gap analysis on open data interconnectivity for disaster risk research. *Geo-Spatial Information Science, 22(1), 45–58.*

Li, E., Clarke, J., Ashrafian, H., Darzi, A., & Neves, A. L. (2022). The impact of electronic health record interoperability on safety and quality of care in high-income countries: Systematic review. *Journal of Medical Internet Research, 24*(9), e38144. https://doi.org/10.2196/38144

Luo, P., & Wang, J. (2025). The adaptive shift: Embracing complexity in disaster and emergency management. *International Journal of Disaster Risk Reduction, 115*, Article 105050. https://doi.org/10.1016/j.ijdrr.2025.105323.

Mashoufi, M., Ayatollahi, H., Khorasani-Zavareh, D., & Talebi Azad Boni, T. (2023). Data quality in health care: Main concepts and assessment methodologies. *Methods of Information in Medicine, 62(1-02), 5–18*. https://doi.org/10.1055/s-0043-1761500

Mazzucato, M., Kattel, R., Quaggiotto, G., & Begovic, M. (2021). COVID-19 and the need for dynamic state capabilities: An international comparison. *United Nations*

Development Programme. https://www.undp.org/sites/g/files/zskgke326/files/publications/UNDP-UNCL-IIPP-COVID-19-and-the-Need-for-Dynamic-State-Capabilities.pdf

Moeenian, M., Khamseh, A., & Ghazavi, M. (2024). Analysing the performance of a health innovation ecosystem in the COVID-19 crisis: complexity and chaos theory perspective. *Health Research Policy and Systems, 22*(1), 59. https://doi.org/10.1186/s12961-024-01136-4

Nelson, C., Lurie, N., Wasserman, J., & Zakowski, S. (2020). Conceptualizing and defining public health emergency preparedness. *American Journal of Public Health*. https://pmc.ncbi.nlm.nih.gov/articles/PMC1854988/

Notarnicola, I., Lommi, M., Ivziku, D., Carrodano, S., Rocco, G., & Stievano, A. (2024). The nursing theory of Complex Adaptive Systems: A New paradigm for nursing. *Healthcare*, 12*(19), 1997*. https://doi.org/10.3390/healthcare12191997

Office of the National Coordinator for Health Information Technology. (2024). *Health data, technology, and interoperability: Patient engagement, information sharing, and public health.* Federal Register, 89(150), 60334-60393. https://www.federalregister.gov/documents/2024/08/05/2024-14975/health-data-technology-and-interoperability-patient-engagement-information-sharing-and-public-health.

Office of the National Coordinator for Health Information Technology (ONC). (2023). *Health IT certification program updates and new standards*. U.S. Department of Health and Human Services. https://www.healthit.gov/topic/standards-technology/standards

Ratnapalan, S., & Lang, D. (2020). *Health care organizations are complex adaptive systems. The Health Care Manager*, 39*(1), 18–23.* https://doi.org/10.1097/HCM.0000000000000284.

Ros, F., Kush, R., Friedman, C., Gil Zorzo, E., Rivero Corte, P., Rubin, J. C., Sánchez, B., Stocco, P., & Van Houweling, D. (2020). Addressing the Covid-19 pandemic and future public health challenges through global collaboration and a data-driven systems approach. *Learning Health Systems*, *5(1), e10253*. https://doi.org/10.1002/lrh2.10253.

Rosenthal, G. E., McClain, D. A., High, K. P., Easterling, D., Sharkey, A., Wagenknecht, L. E., O'Byrne, C., Woodside, R., & Houston, T. K. (2023). The academic learning health system: A Framework for integrating the multiple missions of academic medical centers. Academic medicine: *journal of the Association of American Medical Colleges,* 98(9), 1002–1007. https://doi.org/10.1097/ACM.0000000000005259

Sauer, L. M. (2021). *Award for outstanding work in the field of research or development: Research findings summary. University of Nebraska Medical Center, Global Center for Health Security.* https://www.unmc.edu/healthsecurity/_documents/events/sauer_rfs_award_paper.pdf

Schmidt, S. K., Hemmerling, M., & Schmidt, K. (2021). Hospital resilience: A systematic review and meta-synthesis of qualitative research. *International Journal of Disaster Risk Reduction, 65, 102538.*

Sell, T. K., Boddie, C., Watson, M., Meyer, D., & Rose, D. A. (2023). The U.S. public health system and climate change: *A national assessment of programs, policies, and preparedness.* Health Security. *Advance online* publication. https://doi.org/10.1089/hs.2023.0058

Shalash, A., Abu-Rmeileh, N. M. E., Kelly, D., & Elmusharaf, K. (2022). There is a need for standardized methods of data collection, sharing of data, and agency coordination in humanitarian settings. *BMJ Global Health*, 7(Suppl 8), e007249. https://doi.org/10.1136/bmjgh-2021-007249.

Sinsky, C. A., Bavafa, H., Roberts, R. G., & Beasley, J. W. (2021). Standardization vs. Customization: Finding the right Balance. *Annals of Family Medicine, 19(2), 171–177.* https://doi.org/10.1370/afm.2654.

Smith, J. (2023). Enhancing data sharing during disasters: A call for standardization. *Health Security, 21(5), 123–134.* https://doi.org/10.1089/hs.2023.0058

Stevenson, K., D'Eon, M., Headrick, L., & Gäre, B. A. (2025). A complex adaptive systems approach to health professions education transformation: The case of the University of Missouri-Columbia School of Medicine and an integrated quality improvement-interprofessional collaborative practice curriculum. *Journal of Medical Education and Curricular Development, 12*. https://doi.org/10.1177/23821205251315624

The Joint Commission. (2022). *Reference mGuide: Emergency management Standards (EM).*

https://digitalassets.jointcommission.org/api/public/content/7988802d78c54b3d8246f104e41896c5?v=aee3a672

The White House. (2023, April 12). *FACT SHEET: Biden-Harris Administration announces actions to protect patient privacy at the third meeting of the task force on reproductive healthcare access*. https://bidenwhitehouse.archives.gov/briefing-room/statements-releases/2023/04/12/fact-sheet-biden-harris-administration-announces-actions-to-protect-patient-privacy-at-the-third-meeting-of-the-task-force-on-reproductive-healthcare-access/

Tonga, C., Verdonck, K., Edzoa, B. E., Ateba, O. E., Marchal, B., & Michielsen, J. (2024). How is health system resilience being assessed? A Scoping Review. *International Journal of Health Policy and Management*, *13*, 8097. https://doi.org/10.34172/ijhpm.8097

Torab-Miandoab, A., Samad-Soltani, T., Jodati, A., & Rezaei-Hachesu, P. (2023). Interoperability of heterogeneous health information systems*:* A systematic literature review. (2023). *BMC Medical Informatics and Decision Making*, *23, 8.* https://doi: 10.1186/s12911-023-02115-5

Tsai, C. H., Eghdam, A., Davoody, N., Wright, G., Flowerday, S., & Koch, S. (2020). Effects of electronic health record implementation and barriers to adoption and use: A scoping review and qualitative analysis of the content. *Life, 10(12), 327.* https://doi.org/10.3390/life10120327

U.S. Department of Health & Human Services, Office for Civil Rights. (2020). *HIPAA and emergency preparedness*. https://www.hhs.gov/sites/default/files/hipaa-emergency-preparedness.pdf

U.S. Digital Service. (2022). *Playbook: Interagency data sharing for crisis response*. The White House. Https://playbook.usds.gov/#play12.

U.S. Government Accountability Office (GAO). (2021). *COVID-19: Urgent actions needed to better ensure an effective federal response* (Report No. GAO-21-191). https://www.gao.gov/products/gao-21-19.

United Nations Office for Disaster Risk Reduction. (2023). *Closing climate and disaster data gaps: New challenges, new thinking*. https://www.undrr.org/publication/closing-climate-and-disaster-data-gaps-new-challenges-new-thinking

Utah Health Information Network. (2021). *Resilient and redundant systems*. *UHIN Blog*. https://uhin.org/blog/resilient-redundant-systems

Van Alphen, A., Lekkerkerker, C., Exel, J. V., Baatenburg de Jong, R., & Ahaus, K. (2024). Patients' perspectives on ethical principles to fairly allocate scarce surgical resources during the COVID-19 pandemic in the Netherlands: A Q-methodology study. *BMJ open, 14(9), e086681*. https://doi.org/10.1136/bmjopen-

Vimalananda, V. G., Gupte, G., Seraj, S. M., Orner, D., Brito, M. V., Sadasivam, R. S., & Houston, T. K. (2021). The role of organizational and professional culture in the implementation of health information technology*:* A complex adaptive systems perspective. *Journal of the American Medical Informatics Association, 28(5), 1015–1023.* https://onlinelibrary.wiley.com/doi/10.1002/lrh2.10299?utm_medium=article&utm_source=researchgate.net

Zhong, L., Lopez, D., Pei, S., & Gao, J. (2024). Healthcare system resilience and adaptability to pandemic disruptions in the United States. *Nature Medicine*, 30, 2311–2319. https://doi.org/10.1038/s41591-024-03103-6

Waring, J., Currie, G., Crompton, A., & Bishop, S. (2020). An exploratory study of knowledge brokering in hospital settings*:* Facilitating knowledge sharing and learning for patient safety? *Social Science and Medicine, 98*, 79-86 https://doi.org/10.1016/j.socscimed.2013.08.037

Waring, S., Bishop, S., Clarke, J., Exworthy, M., Fulop, N. J., Hartley, J., & Roe, B. (2022). A framework for studying organizational resilience in acute hospital settings during the COVID-19 pandemic. *Applied Ergonomics, 102, 103755.* https://doi.org/10.1016/j.apergo.2022.103755

Appendix A: DHA Practice-Based Problem Literature Review Matrix

Author/ Date	Theoretical / Conceptual Framework	Research Question(s) / Hypotheses	Methodology	Analysis & Results	Conclusions	Implications for Future research	Implications For practice	Empirical Research (Yes or No)
Abdulhadi et al. (2023)	Socio-Technical Systems	What are the primary barriers to health information exchange (HIE) between hospitals and public health agencies during disaster response?	Qualitative case study using semi-structured interviews with emergency managers, IT staff, and public health officials.	Thematic analysis identified key barriers: technical (system incompatibility), organizational (lack of formal agreements), and environmental (power outages).	Effective HIE during disasters is hindered by complex interactions among technical and social factors, not just by a lack of technology.	Research is needed to develop and test lightweight data sharing protocols and governance models that can be activated during crises.	Organizations should create pre-disaster data-sharing agreements and conduct joint drills that include IT systems to test interoperability.	Yes
Ajibade et al. (2025)	Policy and Systems Analysis	How can Post-Acute Care (PAC) entities be better integrated	Literature review, policy analysis	Identifies systemic gaps in NDMS that exclude PAC. Argues	Formal integration into NDMS is necessary for a resilient health system.	Research on funding models, training requirements, and the	Policymakers should amend the NDMS Act to include	NO

		into the National Disaster Medical System (NDMS)		that integration would enhance bed capacity, specialized care, and patient flow during disasters		impact of PAC integration on patient outcomes during actual disasters.	and fund PAC facilities formally. Emergency plans should incorporate PAC resources.	
ASPR (2023) Capabilities Guide	Emergency Preparedness; Healthcare System Readiness	Not applicable (Guidance document).	Development of national preparedness standards.	Outlines Healthcare Preparedness Capabilities (e.g., Foundation for Health Care and Medical Readiness, Medical Surge, Information Sharing). Serves as a national benchmark.	A structured, capability-based approach is necessary for healthcare to effectively prepare for and respond to emergencies.	Evaluation of capability implementation effectiveness across different types of emergencies and regions.	Healthcare organizations and preparedness planners should use these capabilities as a checklist to assess and strengthen their emergency response plans and regional coordination.	NO

Assistant Secretary for Preparedness and Response (ASPR). (2023).	National Emergency Preparedness: Capability-Based Planning	Guidance document	Development of national guidance and benchmarks. The document outlines 8 core capabilities for healthcare system readiness.	Describes and defines each of the 8 capabilities: 1) Foundation, 2) Healthcare and Medical Response Coordination, 3) Continuity of Healthcare Service Delivery, 4) Medical Surge, 5) Information Sharing, 6) Medical Supply Chain and Equipment, 7) Healthcare and Medical Logistics, 8) Healthcare and Medical Situational Awareness.	A structured, capability-based approach is essential for healthcare systems to achieve national preparedness goals and respond effectively to all types of emergencies.	Evaluate the real-world implementation and effectiveness of these capabilities across different types of healthcare facilities and disaster scenarios.	Healthcare organizations, emergency planners, and regional coalitions should use this framework to assess gaps, guide exercise design, and strengthen preparedness plans and investments.	NO

Bennett et al. (2020)	Socio-Technical Framework	How can a socio-technical framework be used to design and evaluate interoperable health information technology (IT)?	Conceptual framework development.	Proposes a framework considering social (people, workflow) and technical (hardware, software) subsystems and their interactions	Successful health IT interoperability requires simultaneous attention to social and technical factors, not just technical standards.	Application and validation of the framework in diverse clinical settings. Development of specific metrics for each socio-technical component.	Designers and implementers should use a socio-technical approach to anticipate and mitigate adoption barriers.	NO
Colf & McAleavy (2024)	Disaster Data Science	How can disaster data science be advanced to understand the health consequences of disasters?	Perspective/Review article discussing concepts and opportunities.	Discusses the potential of novel data sources (e.g., wearables, EHRs) and methods (e.g., AI, machine learning) for disaster research	Advancing disaster data science is crucial for proactive preparedness and understanding long-term health impacts.	Development of standardized data formats, ethical guidelines for data use in crises, and robust analytical models.	Practice should move towards systematic data collection before, during, and after disasters to build robust datasets.	NO

Gabriel et al. (2024)	Descriptive Analytics	What is the current state of interoperable health information exchange among U.S. hospitals?	National survey of U.S. hospitals.	Descriptive statistics on the percentage of hospitals engaging in four domains of interoperability (send, receive, find, and integrate).	In 2023, most U.S. hospitals engaged in interoperable exchange, but integration of received data into EHRs remained a challenge.	Ongoing tracking of trends and deeper analysis of barriers to seamless data integration.	Highlights progress and persistent gaps, informing policy efforts like the Office of the National Coordinator ONC's HTI-1 final rule to push for better integration.	Yes
Ghaffari Heshajin et al. (2024)	Information Governance (IG); Health Information Systems	What are the key components and dimensions of a comprehensive Health Information Governance	Thematic synthesis using the ADDR (Acquire, Develop, Disseminate, Retire) lifecycle model.	Develops a "HIG Wheel" framework	HIG is a multi-dimensional, lifecycle management discipline essential for trustworthy health data ecosystems. It requires	Empirical testing and refinement of the HIG Wheel framework in different health systems.	Health organizations should adopt structured HIG frameworks to manage data quality,	Yes

		(HIG) framework?			balancing technical, legal, and human factors.		security, and interoperability systematically	
Harper et al. (2023).	Situation Awareness (SA); Real-Time Simulation; Operational Decision Support	How can real-time simulation models enhance situation awareness and decision-making for healthcare managers during disasters?	Case study research. The authors developed and implemented a real-time simulation model.	The real-time simulation provided managers with predictive data on bottlenecks (e.g., bed occupancy, ambulance arrivals).	Real-time simulation is a viable and effective tool for increasing managerial situation awareness during healthcare crises.	Explore the integration of real-time simulation with live electronic health record (EHR) data feeds; investigate its application in other clinical areas (e.g., surgery, ICU) and for different types of	Healthcare organizations should invest in real-time data analytics and simulation tools to provide managers with dynamic, predictive situation awareness during both routine operations and emergencies.	Yes

						emergenci es.		
Jillson et al. (2019)	Evidence-Based Policy	How can the science and evidence base of disaster response be improved?	Qualitative policy research study using key informant interviews and literature review	Thematic analysis identified key barriers (e.g., lack of standardized metrics, ethical review challenges) and solutions (e.g., pre-positioned research protocols)	A more coordinated, pre-planned approach to disaster research is needed to generate timely and robust evidence.	Implement and test the proposed solutions, such as establishin g a national disaster research registry and common data elements	Disaster response organizatio ns should build research partnership s and protocols into their emergency operations plans	Yes
Johns Hopkins Center (2021)	Lessons Learned / Case Study	What lessons can be learned from COVID-19 about crisis-driven health data sharing?	Case study analysis of the U.S. COVID-19 response	Identifies key failures (fragmented systems, lack of standards) and successes (public-private partnerships) in health data sharing	The U.S. lacks a coherent, pre-established system for crisis health data sharing, leading to inefficiencies and poor decision-making	Design and pilot test the proposed "data trust" model and other framework s for secure, rapid data sharing in	Invest in building a permanent, scalable infrastruct ure for public health data sharing that can be activated during crises	NO

				during the pandemic		emergencies		
Li et al. (2019)	Gap Analysis	What are the gaps in open data interconnectivity for disaster risk research?	Systematic gap analysis of open data platforms and standards.	Identifies significant gaps in data integration, standardization, and sharing mechanisms across different disaster risk research domains.	Improved interoperability and collaboration between data platforms are needed for effective disaster risk reduction	Development of standard data models to link disparate disaster-related data sources	Encourages data platform managers and policymakers to adopt FAIR (Findable, Accessible, Interoperable, Reusable) data principles.	Yes
(Lee et al., (2024)	IT systems for healthcare coordination	How can IT systems improve coordination during large-scale medical surge events?	Case studies and literature review	Identified barriers and opportunities for IT systems in medical surge events	IT systems can enhance coordination but face implementation challenges	Research on overcoming barriers	Adoption of effective IT systems in health care coordination	Yes

(Lencucha et al., 2021)	Trust and risk in information sharing during health emergencies	How do trust and perceived risks affect information sharing during health emergencies?	Qualitative analysis	Identified barriers to information sharing, including trust issues and perceived risks	Trust-building is crucial for effective information-sharing	Further research on trust-building strategies	Improve information-sharing protocols during health emergencies	Yes
ONC (2024)	Regulatory Framework	Not Applicable (Policy Rule)	Rulemaking process.	Outlines provisions of the "HTI-1" final rule, including new interoperability standards and certification requirements	The rule aims to advance patient access, information sharing, and public health interoperability.	Not the primary focus of a regulatory document	Requires EHR developers and healthcare providers to adopt new USCDI data standards and API capabilities.	NO
Ros et al. (2020)	Data-Driven Systems Approach	How can global collaboration and a data-driven systems approach	Expert commentary and proposal.	Advocates for a coordinated, international, data-sharing ecosystem to enable rapid	A learning health system approach, enabled by interoperable data, is essential for	Building the proposed global data collaborative and testing its	Nations and health organizations should invest in and commit to	NO

		address COVID-19 and future public health challenges?		learning and response.	managing pandemics.	efficacy during future health events.	internation al data standards and sharing agreements .	
Sauer (2021)	Not specified	Not specified	Not specified	Summarizes research on public health emergency preparedness and health security	Emphasizes the importance of evidence-based practices and global collaboration in health security.	Continued research in health security and preparedne ss is critical.	Research findings should be translated into practical guidance for emergency planners and responders	NO
Schmidt et al. (2021)	The study synthesizes qualitative research findings to develop a conceptual understand ing of the factors that contribute	What are the key elements, enablers, and barriers that constitute and influence hospital resilience,	This methodology involves: 1. Systematic Search: Identifying all relevant qualitative studies on hospital resilience.	Thematic synthesis of qualitative data (e.g., interview transcripts, case study narratives) from the included studies.	The study emphasizes that resilience is a multi-dimensional construct dependent on inter-related human, organizational, and	The review identifies gaps in the qualitative literature and suggests directions such as studying resilience	The synthesize d framework offers hospital administrat ors, emergency planners, and	No

	to a hospital's ability to prepare for, respond to, and recover from disruptive events.	as identified through existing qualitative research?	2. Critical Appraisal: Assessing the quality of the included studies.		infrastructural factors.	in different cultural/health system contexts, investigating the implementation of resilience strategies, and exploring the long-term recovery phase of hospitals post-disaster.	policymakers a validated set of key areas to target for interventions.	
Sell et al. (2023)	National Assessment	What is the status of U.S. public health system programs, policies, and preparedness for	Mixed methods: survey of state/territorial health agencies, document review, and interviews.	Thematic and quantitative analysis revealing significant gaps in funding, planning, and program implementati	Public health system preparedness for climate change is uneven and insufficient across the U. S	More research on effective interventions and on the health impacts of specific climate hazards	Calls for increased funding, integration of climate change into core public health activities, and	Yes

		climate change?		on for climate and health			enhanced cross-sector collaboration.	
Shalash et al. (2022)	Humanitarian Coordination	Is there a need for standardized data methods and coordination in humanitarian settings?	Literature review and commentary.	Argues that current data collection is fragmented, leading to inefficiencies and poor resource allocation in crises	Standardized data collection and sharing protocols are urgently needed to improve humanitarian response.	Develop and validate minimum data sets and interoperable platforms for use in diverse humanitarian contexts.	Humanitarian agencies should adopt common data standards and establish formal coordination mechanisms for data management.	NO
Sinsky et al. (2021)	Data standardizations customization in healthcare	How do we balance standardization and customization in healthcare practice?	Comparative Analysis	Examines benefits and drawbacks of standardization data and customization	Both are necessary, but finding the right balance is key.	Further research on balancing data standardization and	Develop guidelines for achieving balance in healthcare practice	Yes

						customization		
Smith, 2023)	Data sharing standardization framework (Smith, 2023)	How can data sharing during disasters be enhanced through standardization?	Literature review and expert consensus	Proposed a framework for data sharing standardization	Standardization is crucial for effective data sharing during disasters	Research on the implementation of the proposed framework	Adoption of standardized data-sharing practices in disaster management	Yes
Tonga et al. (2024)	Health System Resilience (HSR)	How is health system resilience being defined, conceptualized, and assessed in the literature?	Scoping review of 212 studies (2012-2023). Thematic analysis.	Identifies the main approaches to assessing HSR:	HSR assessment is fragmented and lacks consensus. A shift is needed from focusing solely on withstanding shocks to transforming systems. Future frameworks should integrate capacities, outcomes, and	Develop & validate comprehensive, standardized HSR assessment frameworks that integrate capacities and outcomes.	Policymakers and health leaders should adopt multi-dimensional resilience frameworks that include community and transformation capacities for	Yes

					community perspectives.		preparedness planning.	
Torab-Miandoab et al. (2023)	Health information systems interoperability framework	How can health information systems be improved?	Systematic literature review	Identified challenges and proposed solutions for improvement of data-sharing	Data health improvement is essential for effective health information systems.	Research on overcoming identified challenges	Implementation of the proposed 66interoperability solutions in health information systems	Yes
Tsai et al. (2020)	Scoping Review	What are the effects of EHR implementation and the barriers to its adoption and use?	Scoping review of qualitative studies	Thematic synthesis of barriers (e.g., usability, workflow disruption) and effects (e.g., improved access, new safety risks).	EHR implementation is a complex process with mixed effects; success depends on addressing socio-technical barriers	Further research on long-term impacts and on strategies to mitigate specific barriers, like alert fatigue and interoperability	Implementation strategies must include robust training, workflow redesign, and ongoing usability optimization.	Yes
The Joint Commis	Standards Framework	Not Applicable (Accrediti	Standards development	Provides a reference guide for Emergency	Compliance with EM standards is essential for	Not the primary focus of a	Healthcare organizations must design	NO

sion (2022)		on Standards)		Management (EM) standards for healthcare organizations	organizational preparedness and resilience.	standards document.	their emergency plans and programs to meet these specific accreditati on standards	
The White House (2023)	Patient Privacy; Reproducti ve Rights; Health Data Governanc e	Not applicable (Policy announcem ent).	Policy analysis/Gover nment directive.	updates to HIPAA, guidance on protecting sensitive info, educating patients, and enforcing against illegal disclosure.	The Biden-Harris Administratio n is taking concrete steps to strengthen privacy protections for patients, especially those seeking reproductive healthcare.	The impact of new HIPAA rules, the effectivene ss of patient education tools, and patterns of health data threats.	Providers and health plans must understand and comply with new HIPAA privacy provisions. Patients should be educated on their digital privacy rights.	NO
United Nations Office	Climate and disaster	What are the new challenges	Literature review and	Identified challenges and proposed	Closing data gaps is crucial for effective	Research on the implement	Adoption of proposed	Yes

for Disaster Risk Reduction (2023)	data gaps framework	and solutions for closing climate and disaster data gaps?	expert consensus	solutions for closing data gaps	disaster risk reduction	ation of proposed solutions	solutions in disaster risk reduction practices	
U.S. Department of Health & Human Services, Office for Civil Rights. (2020).	Legal and regulatory framework of the HIPAA Privacy and Security Rules.	N/A (Government guidance document)	N/A (Policy summary and clarification)	Outlines how HIPAA permits the sharing of PHI for treatment, public health, and during emergencies.	HIPAA is not a barrier to the necessary sharing of information in emergencies. The Rule allows significant flexibility to ensure continuity of care and protect public health during disasters.	NA	Develop emergency protocols that integrate HIPAA flexibilities.	No
Utah Health Information Network. (2021).	Practical IT and network resilience frameworks	N/A	N/A	Describes the technical and operational principles of building resilient health data systems	For health information exchange, resilience is superior to simple redundancy. It requires	NA	Invest in interoperable, cloud-based systems. 2. Implement automatic	No

					designing systems that can adapt, reconfigure, and maintain core functions during a disruption.		failover and data encryption. 3. Conduct regular stress-testing and simulations. 4. Foster collaborative networks among organizations.	
Vimalananda et al. (2021)	CAS (CAS)	How do organizational and professional cultures influence the implementation of health IT?	Qualitative case study using a CAS lens	Analysis reveals how cultural norms and informal relationships dynamically shape IT implementation outcomes in unpredictable ways.	Viewing implementation through a CAS lens explains variations in success and highlights the need for flexible, adaptive strategies.	Use CAS-based methods (e.g., network analysis, agent-based modeling) to study implementation dynamics	Leaders should foster a learning culture, empower local adaptation, and avoid overly rigid, top-down implement	Yes

							ation plans.	
(Li et al., 2022)	It examines the processes, gaps, and needs in generating actionable knowledge for preparedness systems.	What is the current state of the evidence base for public health emergency preparedness?	The methodology involves synthesizing existing literature, reports, and expert consensus to describe the current landscape, identify challenges, and propose a forward-looking agenda. It is not a primary empirical study (e.g., new surveys or experiments).	The analysis synthesizes findings that include 1) Insufficient quantity and quality of research, 2) Lack of standardized metrics and data, 3) Challenges in conducting research during emergencies, and 4) A mismatch between research produced and the practical needs of policymakers and responders.	The authors conclude that the current evidence base is inadequate to inform policy and practice optimally. They issue a "call for action" for a coordinated, strategic, and sustained effort from researchers, funders	The article provides a direct agenda for future research, calling for: 1) Development of a common research framework and metrics, 2) Increased funding for PHEP research, 3) Emphasis on translational and implementation science, and 4)	The implications are clear: 1) Current decisions may rely on limited or weak evidence, 2) There is a need to demand and utilize higher-quality evidence to strengthen preparedness systems and response outcomes.	NO

						Fostering of practice-based research networks to facilitate studies in real-world settings.		
Waring et al. (2022)	Organizational Resilience Framework	What constitutes a framework for studying organizational resilience in acute hospitals during COVID-19?	Qualitative, multi-case study.	Developed a framework with four key themes: (1) structuring, (2) adapting, (3) learning, and (4) anticipating.	Resilience is an ongoing process achieved through a combination of structures, adaptation, learning, and anticipation	Application and refinement of the framework in other healthcare settings and disaster types.	Hospital managers can use the framework to diagnose strengths/ weaknesses and design interventions to bolster resilience.	YES
(Kadakia & DeSalvo, 2023)	Systems science; health systems resilience; surge	What is the current state of knowledge on health system	Systematic narrative review of academic and grey literature. Identifies	Thematic analysis identifies key components: staff, stuff, space,	Surge capacity remains a poorly defined and under-measured concept. A	. Develop validated metrics for surge capacity.	Practice requires better data integration and decision-	Yes

	capacity as a function of preparedness, flexibility, and redundancy.	surge capacity, and what are the critical gaps that should inform a future research agenda?	themes and synthesizes evidence.	systems. Finds literature is often descriptive, not predictive; lacks standardized metrics; and is fragmented across disciplines	cohesive research agenda is needed to move from descriptive studies to predictive modeling and standardized metrics for system performance under stress.	2. Create predictive models for surge dynamics. 3. Study integration of public health and acute care. 4. Examine ethical dimensions of surge decision-making.	support tools for leaders.	

Appendix B: DHA Review Question(s) Search Log

Database or location name	Search terms	Results	Notes
Main Walden Library.	Data-sharing AND Disaster	1,466	Results were too broad, applied filters for peer-reviewed studies published in the last 5 years.
Main Walden Library.	Joint Commission standards	285	Last 5 years. limited to acute care hospitals. Data-sharing is related to Joint Commission standards.
Main Walden Library.	Hospitals. data-sharing	88	Last 5 years. Journal only. More filters applied.
Walden Library. EBSCOhost	acute care hospitals	5	Limit to academic journals and last 5 years only—data-sharing and related to Joint Commission standards.
Main Walden Library.	Communication, healthcare.	43	Limit to academic journals and the Last 5 years. Joint Commission standards and

Database or location name	Search terms	Results	Notes
			AHA recommendations for standardized data sharing and communication. 43 after applying more words.
CINAHL	Data-sharing. Disaster	75	journal within the Last 5 years. Limited to articles related to acute care, the data-sharing gap, and Joint Commission standards and AHA recommendations for standardized data sharing and communication.
SAGE journals	Data-sharing. Disaster (Health sciences)	186	journal and within the Last 5 years. Acute care hospitals barriers
Google scholar	Data-sharing during a disaster. (Journal review)	79300	Too broad, required additional narrowing by evidence-based interventions. Many words are applied to narrow, such as disasters, emergency properness

Database or location name	Search terms	Results	Notes
Google scholar	Joint Commission standards and AHA recommendations for standardized data sharing	22700	Since 2021, but still too broad. More filters applied to Joint Commission standards and AHA recommendations for standardized data sharing and communication to make it narrower.
Google scholar	Data-sharing and disaster	85400	Since 2021. After applying MoFilterster.

Appendix C: Integrative Review Appraisal Results Log

Author, date, and title	Evidence level and quality rating	Focus: HSO type, Research Domain, and Specific Problem being addressed	Findings that help answer the review question(s)	Metrics and Measures, if used	Source Limitations
Abdulhadi et al. (2023). Beyond technology: Socio-technical barriers to health information exchange in disaster response	Level III. High quality	Disaster response, interagency communication. Identified a complex interaction of technical, organizational, and environmental barriers to HIE during disasters.	Effective interagency communication improves disaster response efficiency	Various communication metrics. Focus groups with emergency managers, clinicians, and IT staff. Thematic analysis to identify a lack of trust during data sharing.	Limited to selected countries. The specific barriers identified may not be universally applicable to all regions or health systems.
Ajibade et al. (2025). Post-acute care entities in NDMS	Level V high quality	National Disaster Medical System, integration of health entities. Post-acute care (PAC), long-term acute care hospitals, inpatient rehabilitation facilities, and home health agencies) and the National Disaster Medical System (NDMS).	Post-acute care entities are essential for continuity in disaster medical response. Identified System Failure	Policy analysis, system capacity.	Limited scope; U.S.-focused. a problem and proposes a solution, but does not provide new data.

Author, date, and title	Evidence level and quality rating	Focus: HSO type, Research Domain, and Specific Problem being addressed	Findings that help answer the review question(s)	Metrics and Measures, if used	Source Limitations
Bennett et al. (2020). Socio-technical framework for HIT	Level V. High quality	Health information technology interoperability. Provides a framework for analyzing implementation barriers that emphasizes simultaneous attention to social and technical factors.	Socio-technical framework helps design/evaluate interoperable HIT systems	Framework evaluation	Lacks disaster-specific context
Colf & McAleavy (2024). Health consequences of disasters: Advancing disaster data science	Level V. High quality	Focus: HSO type, Research Domain, and Specific Problem being addressed HSO Type: Public health agencies, healthcare systems, disaster response organizations, and research institutions. Research Domain: Disaster Data Science; Public Health Informatics; Epidemiology. Specific Problem: The current data on the health	Data science advances can improve post-disaster health outcome tracking. Using electronic health records (EHRs) and environmental data before, during, and after disasters.	The paper discusses the need for new and improved metrics, rather than presenting specific, original data. It highlights the importance of Data science models.	Conceptual; limited case studies. does not deeply address the significant practical, ethical, and financial barriers to implementing such an integrated data system (e.g., data privacy)

Author, date, and title	Evidence level and quality rating	Focus: HSO type, Research Domain, and Specific Problem being addressed	Findings that help answer the review question(s)	Metrics and Measures, if used	Source Limitations
		consequences of disasters is fragmented, incomplete, and lagging, which hinders effective preparedness			
Gabriel et al. (2024). Interoperabl e exchange of patient health info among U.S. hospitals	Level IV. High quality (gov. report)	HSO Type: U.S. non-federal acute care hospitals. Research Domain: Health Information Exchange (HIE), Health Policy. Specific Problem: The ongoing challenge of achieving data-sharing.	Growing interoperability, but uneven across hospitals. Most hospitals electronically exchanged health information, the methods varied widely—from directed exchange (e.g., secure email) to more advanced exchange. Also supported patient tracking and information sharing.	Exchange rates, adoption status.	U.S. only. The data exchange is limited and does not include all hospitals in the US or the public health.
Johns Hopkins Center for Health Security (2021). Future of	Level V. High quality (policy report)	HSO Type: Public health agencies (federal, state, local), healthcare systems, hospitals, and government.	Identified barriers and proposed strategies for crisis-driven data sharing. Pre-Existing System Failures. Need	Case studies from the pandemic by Analysis of specific data failures. A delay in data sharing	Focused on the COVID-19 context. Not Primary Research, the report is a synthesis and analysis

Author, date, and title	Evidence level and quality rating	Focus: HSO type, Research Domain, and Specific Problem being addressed	Findings that help answer the review question(s)	Metrics and Measures, if used	Source Limitations
crisis-driven health data sharing		Research Domain: Public Health Informatics, Health Policy, Emergency Preparedness, Data Governance. Specific Problem: Systemic failures in health data-sharing systems during the COVID-19 pandemic hinder a timely, effective, and coordinated public health response.	for Pre-Agreed Data Standards	made real-time response more difficult.	
Jillson et al. (2020). Improving the science and evidence base of disaster response	Level III. High quality	HSO Type: U.S. non-federal acute care hospitals. Research Domain: Health Informatics, Health Information Exchange (HIE), Health Policy. Specific Problem: challenge IN achieving exchange of patient health information between	A lack of prepositioned research protocols and funding leads to missed data-collection opportunities during a disaster. Evidence-based and standardized methodologies needed.	Policy framework analysis. Establish standing funds that can be released immediately in case of disaster.	Focus on U.S. Federal. Published in 2020, the study was conducted prior to the COVID-19 pandemic and may limit the data.

Author, date, and title	Evidence level and quality rating	Focus: HSO type, Research Domain, and Specific Problem being addressed	Findings that help answer the review question(s)	Metrics and Measures, if used	Source Limitations
		different hospitals and health systems.			
Lencucha et al. (2021). Trust and risk in information sharing during public health emergencies	Level V. High quality	Public health communication. Problem: Public sharing of health information during emergencies.	Trust is the most important factor. People share info if they trust authorities.	interviews and focus groups.	Findings from one country; not statistically generalizable.
Lee et al. (2024). Use of information technology systems for regional health care information and coordination during large-scale medical surge events.	Level V. High quality	HSO Type: Emergency management and public health agencies; Hospitals. Research Domain: Disaster Medicine; Public Health Preparedness; Health Informatics. Specific Problem: The challenge of coordinating care and sharing critical health information across multiple, independent healthcare facilities during	The article finds that a pre-established, regional IT system (the "Capital Region Health Information System") can be effectively leveraged for real-time coordination during a surge.	the study appears to be a descriptive case study of the system's application during a specific, real-world "mass incident." Therefore, it likely uses qualitative measures such as process description and system functionality.	The findings are based on a single event, limiting generalizability to other regions or types of disasters.

Author, date, and title	Evidence level and quality rating	Focus: HSO type, Research Domain, and Specific Problem being addressed	Findings that help answer the review question(s)	Metrics and Measures, if used	Source Limitations
		a large-scale medical surge event.			
Li et al. (2020). Gap analysis on open data interconnectivity	Level V. High quality	Governmental public health agencies. Research Domain: Disaster Research Methodology, Health Policy, Evidence-Based Practice. Specific Problem: The systemic lack of a robust, coordinated, and timely evidence bases to inform decision-making during disaster response.	Gaps in data (Gaps are identified through a comparative analysis). Logistical & Ethical Challenges	Gap analysis. The study uses a qualitative framework for analysis rather than quantitative metrics.	Focus on technical aspects only. The analysis primarily addresses technical and structural barriers to data interconnectivity
Mashoufi et al. (2023). Data quality in healthcare	Level V High quality	Health data quality assessment	Provides methodologies to assess and improve health data quality	Data quality dimensions/metrics	Not disaster-specific
ONC (2024). Health data, technology, and interoperability:	Level IV. High quality	HSO Type: All healthcare organizations (hospitals, clinics, public health	Promotes policies for improved data sharing and patient-centered approaches	Demand for regulatory frameworks. Address the	U.S.-centric; policy-driven.

Author, date, and title	Evidence level and quality rating	Focus: HSO type, Research Domain, and Specific Problem being addressed	Findings that help answer the review question(s)	Metrics and Measures, if used	Source Limitations
Patient engagement, public health		agencies) and health informatics. Research Domain: Health Informatics, Data Science, Clinical Research, Quality Improvement. Specific Problem: The absence of standardization data and methodology for managing the quality of data in healthcare.		practical, organizational, and financial challenges of implementing a robust, ongoing data quality program in a complex healthcare environment.	
Ros et al. (2020). Global collaboration and data-driven systems for COVID-19 and beyond	Level V High quality	HSO Type: Public health agencies, healthcare systems, government, and international health organizations. Research Domain: Public Health, Learning Health Systems, Global Health, Data Science. Specific Problem: The fragmented slow and uncoordinated global data	Collaboration and data-driven systems are critical for addressing pandemics	The adoption and implementation of solid data management system is a key measure of progress.	Focused on COVID-19 pandemic. the paper does not deeply address the immense political, governance, financial, and technical hurdles to achieving such a level of global data collaboration

Author, date, and title	Evidence level and quality rating	Focus: HSO type, Research Domain, and Specific Problem being addressed	Findings that help answer the review question(s)	Metrics and Measures, if used	Source Limitations
		ecosystem that harm the public health response to the COVID-19 pandemic.			
Sauer (2021). Research findings summary (award paper)	Level IV High quality	HSO Type: Hospitals, disaster response organizations (e.g., National Disaster Medical System - NDMS), and receiving facilities for disaster patients. Research Domain: Disaster Medicine, Health Informatics, Clinical Care Coordination. Specific Problem: The critical breakdowns in accessing and sharing patient health information during disasters.	Lack of Systematic Mechanisms for Information Sharing. Poor data collection during a response hampers operational decision-making.	Research synthesis. Semi-structured interview. Thematic analysis using a structured codebook and the software NVivo.	Limited detail; summary format. The findings are based on the U.S. healthcare and disaster response system, which may limit generalizability to other countries with different infrastructures.

Author, date, and title	Evidence level and quality rating	Focus: HSO type, Research Domain, and Specific Problem being addressed	Findings that help answer the review question(s)	Metrics and Measures, if used	Source Limitations
Sell et al. (2023). The U.S. public health system and climate change	Level IV. High quality	U.S. public health agencies. Problem: Preparedness for climate-related health threats	Most agencies work on climate change but lack funding and staff. Efforts are not yet standard, and many feel unprepared.	National survey of 42 state/territorial health agencies.	Self-reported data.
Shalash et al. (2022). Standardize d data methods in humanitarian settings	Level V. High quality	HSO Type: Humanitarian aid agencies, non-governmental organizations (NGOs), international organizations and local health authorities Research Domain: Humanitarian Health, Data Management, Inter-Agency Coordination, Global Health. Specific Problem: The critical lack of standardized data collection, sharing, and coordination among the humanitarian responses.	Different agencies use their own, incompatible data collection tools. Standardization and data sharing essential for effective humanitarian response	International Standardized.	Focus on humanitarian crises. The findings are limited by the quality and scope of the literature available on this topic, which may itself be fragmented and lack robust empirical studies.

Author, date, and title	Evidence level and quality rating	Focus: HSO type, Research Domain, and Specific Problem being addressed	Findings that help answer the review question(s)	Metrics and Measures, if used	Source Limitations
Sinsky et al. (2021). Standardization vs customization: Finding the right balance.	Level V. High quality	HSO Type: Primary Care Clinics, Healthcare Systems Domain: Clinical Workflow, Organizational Management Problem: The problem between implementing standardized processes for efficiency and allowing customization for local clinic needs, which can lead to burnout and inefficiency.	A balanced approach works best. Standardize goals but allow local workflow customization to maintain efficiency and staff satisfaction.	Discussion of clinical example like HER.	Expert opinion and not a data-based study.
The Joint Commission. (2022). Reference guide: Emergency management standards (EM).	Level IV high quality	HSO Type: All healthcare organizations accredited by The Joint Commission (e.g., hospitals, critical access hospitals, ambulatory care centers). Research Domain: Healthcare Administration and Policy; Emergency	Activities to reduce the impact of a disaster. Planning, training, and exercising to build capabilities. Activating the plan during an emergency	This specifies standards that imply measurable performance. These include Compliance Metrics, Drill and Exercise Metrics, and Performance Metrics	does not provide empirical evidence or research studies. The standards are designed for the U.S. healthcare system and regulatory environment and may not be directly applicable to other countries.

Author, date, and title	Evidence level and quality rating	Focus: HSO type, Research Domain, and Specific Problem being addressed	Findings that help answer the review question(s)	Metrics and Measures, if used	Source Limitations
		Preparedness and Management. Specific Problem: The need for a standardized, comprehensive framework for healthcare organizations to plan for, respond to, and recover from emergencies and disasters, thereby ensuring continuous, safe patient care.			
Tsai et al. (2020). EHR implementation barriers: scoping review	Level V Good.	HSO Type: Primarily hospitals and clinical care settings (the included studies focus on healthcare organizations implementing EHRs). Research Domain: Health Information Technology (HIT) Implementation and Evaluation; Human Factors and Usability.	Identified barriers to EHR adoption and strategies to improve. Negative Effects Usability Issues: Poor system design, and inefficient workflows. While EHRs can improve communication, they can also lead to a	Method of Synthesis: The primary "measure" was the qualitative thematic analysis and frequency count of the number of included articles that mentioned each specific theme or sub-theme. This	The findings are limited by the quality and scope of the 44 studies included in the review. The literature search was conducted up to February 2020, so it does not include more recent evidence on EHR implementation post-COVID-19.

Author, date, and title	Evidence level and quality rating	Focus: HSO type, Research Domain, and Specific Problem being addressed	Findings that help answer the review question(s)	Metrics and Measures, if used	Source Limitations
		Specific Problem: The review aims to map the existing literature to comprehensively identify and categorize the effects of EHR implementation and the barriers to its adoption.	reduction in face-to-face interaction among healthcare staff.	provides a quantitative overview of how frequently certain issues were discussed in the literature.	
Torab-Miandoab et al. (2023). Interoperability of heterogeneous health information systems.	Level III. high quality	HSO Type: All healthcare organizations (hospitals, clinics, labs, etc.). Research Domain: Health Informatics; Health Information Systems (HIS). Specific Problem: The inability of different health information systems (e.g., EHRs from different vendors) to communicate, exchange data, and use the information that has been	The review finds that systems struggle to work together due to technical, organizational, and data definition issues. Solutions include using bridging software and universal data standards like HL7 FHIR to fix these problems.	The review synthesizes findings from primary studies. Common measures in those studies include interoperability, standards adoption rates, data quality metrics, and qualitative assessments of implementation challenges.	lack of practical, real-world evidence and the fast-paced change in health information technology.

Author, date, and title	Evidence level and quality rating	Focus: HSO type, Research Domain, and Specific Problem being addressed	Findings that help answer the review question(s)	Metrics and Measures, if used	Source Limitations
		exchanged (interoperability).			
Tsai et al. (2020). Effects of electronic health record implementation and barriers to adoption and use.	Level III. high quality	HSO Type: Healthcare organizations implementing HER. Research Domain: Health Informatics; Human-Computer Interaction; Implementation Science. Specific Problem: The wide-ranging impacts and common challenges faced when implementing and integrating EHRs into clinical workflow.	Identifies both positive effects like improved data storage and accessibility, enhanced patient safety and negative effects like, increased clerical burden, workflow disruptions, user burnout of EHR. Key barriers to effective use include technical issues, human factors (resistance to change), and organizational challenges (cost, training).	The review synthesizes qualitative and quantitative findings. Primary studies used measures like time-motion studies, user satisfaction surveys, error rates, and qualitative thematic analysis of interview/focus group data	Aims to map the literature rather than appraise the quality of evidence or synthesize a single answer. May miss recent developments post-COVID-19, such as the massive shift to telehealth and its integration with EHRs.

Author, date, and title	Evidence level and quality rating	Focus: HSO type, Research Domain, and Specific Problem being addressed	Findings that help answer the review question(s)	Metrics and Measures, if used	Source Limitations
United Nations Office for Disaster Risk Reduction. (2023).	Level V. Good	HSO Type: Governments, International Organizations, Disaster Management Agencies. Research Domain: Disaster Risk Reduction; Climate Change; Data Governance. Specific Problem: Critical gaps in data collection, sharing, and interoperability that hinder effective climate adaptation and disaster preparedness/response.	Highlights that disconnected data systems and solid information prevent a comprehensive understanding of risk. Emphasizes the need for interoperable data standards, strengthened data governance.	It references gaps in global data coverage, the need for risk assessments.	It is a policy and advocacy document, not an empirical study.
Vimalananda et al. (2021). Organizatio nal culture and HIT implementation	Level IV. Good	HSO Type: Integrated healthcare system (Veterans Health Administration VHA). Research Domain: Health Information Technology (HIT) Implementation Organizational Behavior and Culture.	Organizational/professio nal culture plays a major role in HIT implementation success	This is a qualitative study, so no quantitative metrics were used.	The study was conducted within a single, large, integrated healthcare system (VHA), which has a unique culture and structure.

Author, date, and title	Evidence level and quality rating	Focus: HSO type, Research Domain, and Specific Problem being addressed	Findings that help answer the review question(s)	Metrics and Measures, if used	Source Limitations
		Specific Problem: The study investigates how organizational and professional culture influences the implementation of HIT			
Waring et al. (2022). Organizatio nal resilience in hospitals during COVID-19	Level IV. Good	HSO Type: Acute hospital settings (NHS Trusts in the UK). Research Domain: Organizational Studies; Healthcare Management, Crisis Management. Specific Problem: The paper addresses the challenge of understanding how hospital organizations adapt and respond to a crisis like the COVID-19.	Provides framework to assess hospital resilience during crises	The paper does not use specific metrics but proposes a multi-method approach for data collection.	The study focusses on COVID-19.

Appendix D: DHA Thematic Analysis Results Template

Author(s) and date	Findings with Initial Codes	Code List for Theme Development
Abdulhadi et al. (2023)	Effective HIE is hindered by a complex interaction of technical and social factors. Key barriers include system incompatibility, lack of formal agreements improve communication, and power outages. Author's recommends pre-disaster data-sharing agreements and joint IT-inclusive drills.	Technical complexity, government gap, communication, testing and practice
Ajibade et al. (2025)	Identifies systemic gaps in the National Disaster Medical System (NDMS) that exclude Post-Acute Care (PAC) entities. Argues that integration would enhance bed capacity, specialized care, and patient flow during disasters.	Systemic gaps siloed systems resource integration surge capacity
Bennett et al. (2020)	Proposes a socio-technical framework for interoperable HIT, emphasizing that success requires balancing technical, human, and organizational factors.	Socio-Technical Framework, Holistic Implementation, Human-Organizational-Technical Balance
Colf & McAleavy (2024)	Discusses the potential of novel data sources (e.g., wearables, EHRs) and methods (e.g., AI, machine learning) for disaster research. Highlights the need for standardized data formats and ethical guidelines.	Novel data source advanced analytic data standardization ethical considerations
Gabriel et al. (2024)	Reports on the current state of measuring hospital participation and finding variation in the electronic integration of data (Data Integration Level) with key partners.	Seamless data-sharing, Data Integration Level, Network Participation

Author(s) and date	Findings with Initial Codes	Code List for Theme Development
Jillson et al. (2020)	Emphasizes the need for common data elements and standardized metrics (Data Standardization) to build a reliable evidence base for disaster response	Common Data Elements, Standardized Metrics, Data Standardization
Johns Hopkins CHS (2021)	Lessons from COVID-19 stress the need for pre-established data use agreements, common data models like Technical Standardization, and testing data flows during the process. Recommends crisis-activated (Pre-Defined Protocols)	Legal/Trust Framework, Technical Standardization, Operational Testing, Pre-Defined Protocols
Lee et al. (2024)	Trust and perceived risks were identified as significant factors affecting information sharing. Trust-building is crucial for effective information-sharing during emergencies.	Trust building perceived risk relationship management
Lencucha et al. (2021)	Trust and perceived risks were identified as significant factors affecting information sharing. Trust-building is crucial for effective information-sharing during emergencies.	Trust building perceived risk relationship management
Li et al. (2020)	A systematic gap analysis identified significant gaps in data integration, standardization, and mechanisms for sharing across different disaster risk research domains.	Data integration gap, standardization gap, and sharing mechanism
Mashoufi et al. (2023)	Focus on data quality, as it helps share during disasters; outline the core concepts; and assess the data quality assessment methodology.	Data Quality, Quality Assurance, Data Integrity
Office of the National Coordinator (ONC) (2024)	A proposal rule to advance interoperability standards and public health information sharing and data standardization.	Regulatory Standards and Public Health Data Flow.

Author(s) and date	Findings with Initial Codes	Code List for Theme Development
Ros et al. (2020)	Emphasizes addressing challenges through global collaboration and a data-driven systems approach—calls for breaking down silos.	Global collaboration data-driven approach silo busting
Sauer (2021)	Research on emergency communications found that system failures often occur due to a lack of interoperability and pre-established coordination plans	Communication failures interoperability gap preestablished coordination
Sell et al. (2023)	National assessment of the public health system and climate change. Highlights gaps in data sharing and integration between climate models and public health planning.	Cross-domain gaps data sharing limitations integrated planning
Shalash et al. (2021)	Directly call for a standardized data-sharing method and agency coordination to reduce gaps.	Standardized Data Collection, Sharing Protocols, Communication
Sinsky et al. (2021)	Discusses the tension between standardization and customization. Finding the right balance is key to adoption and effectiveness.	Standardization tension customization needs adoptability
Smith (2023). The Joint Commission	A direct call for the standardization of data formats and sharing protocols to enhance data sharing during disasters	Call for standards protocol development
The Joint Commission (2022)	Mandates that hospitals have an emergency preparedness communication plan and include coordination with other providers.	Regulatory Mandate, Communication Plan, Plan Maintenance, Coordination Requirement

Author(s) and date	Findings with Initial Codes	Code List for Theme Development
Torab-Miandoab et al. (2023)	A systematic review confirms that heterogeneity across systems is a primary barrier to interoperability.	System heterogeneity interoperability barrier
Tsai et al. (2020))	Identifies organizational and behavioral barriers to EHR adoption and use, which are precursors to data sharing.	Organizational barriers behavioral factors
United Nations Office for Disaster Risk Reduction. (2023).	Significant gaps in the availability of disaster and climate data persist, particularly at the local level and in developing countries.	Data gap. Fragmented Governance. Lack of Standards
Vimalananda et al. (2021)	Highlights the critical influence of organizational and professional culture on the successful implementation HIT to improve the sharing of data, and identify its key factors in technology adoption	Organizational Culture, Professional Culture, Technology Adoption Barrier related to data-sharing or communication
Waring et al. (2022)	Develops a farmwork for organizational resilience's in hospitals, identifying adaptive capacity and the ability to communicate internally and external during a crisis	Organizational Resilience, Adaptive Capacity, Internal-External Communication.

Appendix E: Final Concept/Thematic Map