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ARTICLE

Mapping Knowledge Structure and Evolution in U.S. Emergency Management Research

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Abstract
This study mapped the knowledge structure and examined the knowledge linkage in U.S. emergency management research from 2011 to 2024. Drawing on a conceptual framework that categorizes knowledge into scenarios, missions, and influencing factors, we constructed a dataset of publications authored by scholars affiliated with academic emergency management programs, retrieved from the Web of Science. Using bibliographic coupling and clustering analysis, we identified 22 research themes across five core research areas. Our findings indicate that although the field is thematically diverse, linkages between themes and areas remain limited. Nevertheless, knowledge integration has increased after 2016, with a few integrative hubs emerging. Further analysis of shared references suggested that integration occurred through shared theoretical or methodological foundations, asymmetric knowledge borrowing, and growing conceptual convergence. This study provided a comprehensive and empirical assessment of the interdisciplinary evolution of emergency management research and offered insights for scholars and academic program administrators seeking to strengthen knowledge integration and field development.

Keywords Bibliographic coupling analysis · Emergency management development · Knowledge linkage · Knowledge structure · United States

1 Introduction

Taking on "the quintessential government role" (Waugh 2015), emergency management helps individuals, families, and communities mitigate against, prepare for, respond to, and recover from hazards (McLoughlin 1985; Petak 1985; Comfort et al. 2012). In response to increasingly complex hazards and disasters, governments around the world have invested in building and strengthening emergency management systems. Universities have also launched academic emergency management programs to advance research and train practitioners (Feldmann Jensen et al. 2019; Albris et al. 2020). Shaped by the practical challenges of real-world emergencies, emergency management scholarship is problem-driven and draws from a wide range of disciplines, including engineering, Earth sciences, sociology, public administration and policy, public health, and urban planning.

Despite this shared commitment to improving emergency outcomes, interdisciplinary research in emergency management continues to face persistent barriers, particularly a lack of consensus around disciplinary boundaries and definitions (National Research Council 2006; Peek and Guikema 2021; Wolbers et al. 2021). At the same time, funding agencies such as the U.S. National Academies of Sciences and the National Science Foundation have placed growing emphasis on interdisciplinary approaches (National Research Council 2006; Peek and Guikema 2021). As external incentives for integration grow and internal barriers to collaboration persist, a comprehensive examination of the knowledge structure and linkages within emergency management research is essential for advancing the field.

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While several review studies have advanced our understanding of the interdisciplinary nature of emergency management, key limitations remain in how comprehensively they examined the field's knowledge structure and assessed the strength of knowledge linkages. In terms of scope, most reviews focused on specific topics, offering valuable insights but limited perspective on the field as a whole. A smaller subset adopted broader frameworks based on emergency scenarios or missions (Kuipers and Welsh 2017; Oh and Lee 2020; Peek and Guikema 2021; Wolbers et al. 2021). Given the field's inherent complexity, interdisciplinarity is widely recognized as vital to emergency management scholarship and practice (Dynes and Drabek 1994; National Research Council 2006; McEntire 2007; Comfort et al. 2012). However, only a few studies have acknowledged the presence of weak knowledge linkages (Peek and Guikema 2021; Wolbers et al. 2021), and systematic empirical evidence on this issue remains scarce. Methodologically, many reviews relied on keyword- or journal-based search strategies. Yet, disciplinary variation makes it difficult to reach consensus on keyword selection, often resulting in fragmented or limited coverage (National Research Council 2006; Oh and Lee 2020; Peek and Guikema 2021; Wolbers et al. 2021).

To fill the research gaps, this study aimed to map knowledge structure and assess knowledge linkages over time, and track the field's interdisciplinary development. The United States has built a relatively advanced emergency management system and has actively promoted interdisciplinary progress (Comfort et al. 2012; Peek and Guikema 2021). Therefore, this study examined the U.S. emergency management field to identify the research topics, themes, and areas and to analyze the knowledge linkages among the research themes and areas within the field. Specifically, this study examined the following questions: What research topics, themes, and areas have been studied in the U.S. emergency management field from 2011 to 2024? Did the research themes and research areas have close linkages integrating emergency management knowledge? What themes and which areas exhibited closer knowledge linkage over time?

This study made four key contributions to the literature on emergency management knowledge mapping. First, it proposed a three-dimensional conceptual framework—scenarios, missions, and influencing factors—to define the boundaries of the field and support a systematic assessment of its interdisciplinary scope. Second, it applied a methodological approach that integrates conceptual modeling with bibliographic coupling, enabling a more rigorous analysis of knowledge linkages than traditional keyword-based reviews. Third, it empirically mapped the structure of emergency management research and quantified linkages among themes and areas, offering a more comprehensive depiction of interdisciplinary integration. Specifically, it identified weakly connected themes and areas and tracked how their relationships have evolved over time. Finally, this study provided actionable insights for scholars and professionals in the field of emergency management seeking to enhance knowledge integration and strengthen academic emergency management programs.

2 Literature Review

Section 2 reviews previous knowledge mapping studies on emergency management, highlighting key limitations in existing research. By examining interdisciplinarity, topical focus, and methodological challenges in prior review studies, we identified critical issues that motivate our study and underscored the need for a more systematic understanding of the field.

2.1 Interdisciplinarity in Emergency Management Research

Interdisciplinarity is widely recognized as a defining characteristic of emergency management both in theory and practice; however, few studies have systematically measured or mapped the extent of knowledge integration across disciplines. Scholars have long emphasized that emergency management is inherently interdisciplinary (Dynes and Drabek 1994; National Research Council 2006); Comfort et al. 2012, a perspective grounded in the complex practical demands of real-world emergencies that require diverse expertise (Wolbers et al. 2021).

The interdisciplinary nature of emergency management manifests in two dimensions: the structure of the knowledge system and the strength of linkages among its components. At the structural level, prior studies showed that hazard and disaster studies drew from a broad spectrum of fields—including natural sciences, engineering, and sociology, but also from public administration, public health, urban planning, and communication—thereby bridging research and practice (Peek and Guikema 2021). In addition, the research focus has gradually widened from preparedness toward mitigation, response, and recovery, reflecting increasing crisis complexity and evolving management objectives (Wolbers et al. 2021). These findings offered insights into the composition of emergency management knowledge, though within constrained analytical scopes.

At the linkage level, empirical evidence remains sparse. Conducting interdisciplinary research still faces persistent barriers that hinder integration (National Research Council 2006; Peek and Guikema 2021). Although some studies indicated weak linkages (Peek and Guikema 2021; Wolbers et al. 2021), there lacks comparable metrics to assess the extent of knowledge integration. Thus, further research is

needed to examine empirically the interdisciplinary nature of emergency management knowledge system.

2.2 Topic-Specific Focus in Emergency Management Review Studies

Since Comfort, Waugh, and Cigler's (2012) foundational reflection on the evolution of emergency management research and practice, a growing number of studies have reviewed developments in the field over the past decade. Most of these reviews have adopted a topic-specific lens, focusing on specific aspects of emergency management. A smaller group of studies has taken a broader analytical perspective, examining the field either by emergency scenarios or core mission areas (for example, Oh and Lee (2020)).

A majority of existing literature centered on specific topics, such as disaster resilience (Demiroz and Haase 2019; Pickering et al. 2021; Saja et al. 2021), the impact of disaster risks on sustainable development (Wen et al. 2023), risk perception (Siegrist and Arvai 2020; Siegrist 2021), risk communication (Balog-Way et al. 2020), human-animal interactions in disaster contexts (Wu et al. 2023), the use of open data and emerging technologies in disaster management (Gao et al. 2022; Berg et al. 2023), emergency evacuation (Liu et al. 2020), and disaster risk (Hao et al. 2023). These studies have offered valuable insights into specific issues and topics.

In contrast, a limited number of studies offered a more comprehensive view of the field. Some organized emergency management research around types of emergency scenarios such as crisis and disaster research (Kuipers and Welsh 2017; Wolbers et al. 2021). Rather than reviewing emergency scenarios, Oh and Lee (2020) traced the evolution of topic clusters across four decades of international emergency management research. Peek and Guikema (2021) emphasized the importance of understanding hazards and disaster research through factors such as social systems, the natural environment, technological systems, and the built environment. They further discussed interdisciplinarity in hazards and disaster research, addressing recent advancements in theories, methods, and approaches.

While these studies highlighted the interdisciplinary nature of the field, a more systematic framework for understanding its interdisciplinary development remains underexplored. This study sought to fill that gap by first identifying the conceptual foundation of emergency management and then analyzing the evolving knowledge structure and linkages over time.

2.3 Challenges in Literature Selection and Analysis

The scope-related limitations discussed above are closely tied to how previous studies selected and collected their literature data. The methodologies commonly used in prior reviews present additional challenges for understanding the interdisciplinarity of emergency management research. Most existing reviews gathered literature either by searching a predefined set of keywords (Liu et al. 2020; Gao et al. 2022), by including articles from selected journals (Kuipers and Welsh 2017; Hao et al. 2023), or through a combination of both approaches (Nohrstedt et al. 2018; Demiroz and Haase 2019; Hu et al. 2022).

However, defining the scope of a review through keywords is particularly difficult in a broad and multidisciplinary field like emergency management (Oh and Lee 2020; Wolbers et al. 2021). Disciplinary differences shape varying interpretations of what constitutes emergency management research (National Research Council 2006; Peek and Guikema 2021; Wolbers et al. 2021). As a result, scholars from different backgrounds often struggle to reach a consensus on appropriate keyword selection. Likewise, journal-based approaches may exclude relevant articles published in disciplinary or professional journals that fall outside the core emergency management domain.

Regarding clustering methods, most prior reviews relied on keyword co-occurrence networks to capture the knowledge structure of emergency management research (Liu et al. 2020; Hao et al. 2023). While this approach can reveal thematic clusters within a specific scope, it is limited in its ability to detect interdisciplinary linkages. Keywords are often prone to issues such as synonymy, ambiguity, and contextual variation, which can introduce noise and bias into the analysis and obscure meaningful interdisciplinary relationships. Moreover, the interpretations of keywords may vary depending on the authors' contextual understanding. To address these limitations, this study employed bibliographic coupling, offering a more robust means of capturing interdisciplinary relationships within the emergency management field.

2.4 Research Contribution and Motivation

This study distinguished itself from previous knowledge mapping efforts in several key aspects. It introduces a three-dimensional conceptual framework to define the boundaries of the field, disaggregating emergency management into scenarios, missions, and factors. This framework provides a structured perspective for identifying both the core content and interdisciplinary scope of the field. Building on this foundation, the three-tiered aggregation logic—encompassing topics, themes, and areas—enables a more nuanced understanding of how knowledge clusters emerge and evolve.

In terms of methodology, the integrated conceptual modeling and bibliographic coupling analysis of this study departs from the commonly used keyword co-occurrence or

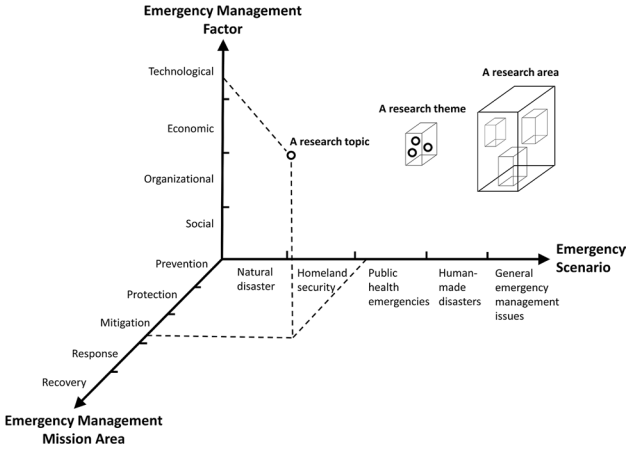

Fig. 1 The conceptual basis of the knowledge structure of the emergency management field

qualitative synthesis methods, allowing for a more systematic and quantitative assessment of knowledge connectivity. By empirically examining the knowledge structure and linkages among research themes and areas, this study offered a more robust and comprehensive depiction of interdisciplinary integration.

3 Conceptual Basis of the Knowledge Structure

This study adapted the theoretical concepts proposed by FEMA (2015) and Oh and Lee (2020) as the conceptual basis to define the knowledge structure of the emergency management field. As shown in Fig. 1, we developed a framework to organize the broad emergency management research based on three dimensions: emergency scenarios, emergency management mission areas, and emergency management factors. The first dimension is emergency scenarios. This study adopts a taxonomy of emergency scenarios used in previous research (Hu et al. 2022). It classifies emergency scenarios into five major emergency categories: natural hazards (for example, floods, hurricanes, wildfires), human-induced disasters (for example, transport accidents, oil spill), public health emergencies (for example, pandemics, food poisoning), homeland security (for example, terrorism, civic unrest), and general emergency management issues that are not concerned with any specific category of emergencies.

The second dimension is emergency management mission areas. Modern emergency management involves various activities, such as risk identification and assessment, crisis and emergency risk communication, monitoring and early warning, search and rescue, coordination, evacuation and sheltering, and disaster relief and recovery (Haddow et al. 2021). These activities can be broadly categorized into five emergency management mission areas: prevention, protection, mitigation, response, and recovery (FEMA 2015).

The third dimension is emergency management factors, which include social, economic, organizational, and technological aspects or determinants that impact how humans interact and cope with hazards and disasters (Oh and Lee 2020). Many social, economic, organizational, and technological factors are sources of vulnerability to disasters. Also, diverse social, political, organizational, and economic factors affect human perceptions and behaviors and the implementation of emergency management activities (Oh and Lee 2020).

Based on the three dimensions, this study defines a research topic as a line of inquiry that looks into an emergency management mission area and its associated emergency management factors for an emergency scenario. A research theme is defined as a collection of research topics that either focus on the same emergency management mission area or the same emergency scenario. A research area is a collection of themes examining the same major emergency categories.

4 Data and Methods

Section 4 outlines the data and methods used in this study. We describe our data collection process, present a taxonomy of disciplines, and detail the analytical approaches employed to examine the knowledge structure and linkages within emergency management research.

4.1 Data Collection

As shown in Fig. 2, we employed a "program-faculty-publication" approach to obtain an inclusive and comprehensive dataset on emergency management literature and scholars in emergency management programs in the United States. This approach is particularly effective for studying multidisciplinary and interdisciplinary knowledge structures, as it captures scholars from diverse disciplinary backgrounds who contribute to the field (Zuo et al. 2019). We started with a list of selected emergency management programs provided by the Federal Emergency Management Agency (FEMA) Higher Education Program.[1] We then retrieved the information of the faculty affiliated with these emergency management programs, including their names, titles, graduating programs, research areas, and more importantly, their publication records from 2011 to 2024. We searched the Web of Science database to obtain publication records from 2011 to 2024 for each faculty member using author names and

[1] https://training.fema.gov/hiedu/collegelist

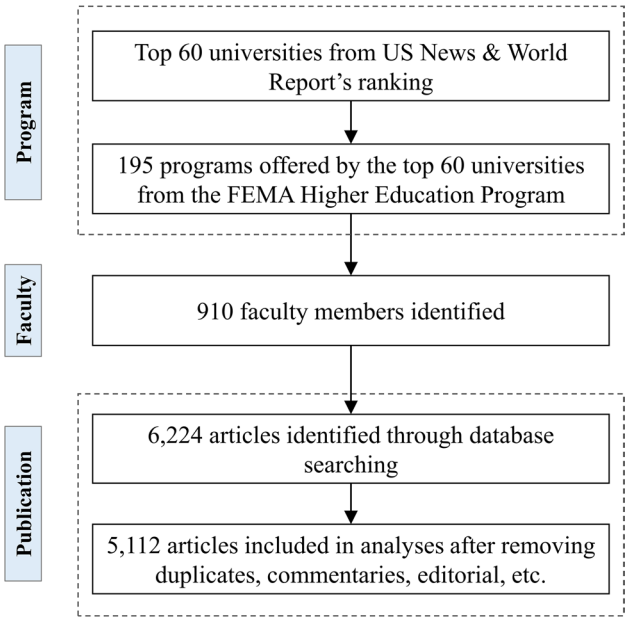

Fig. 2 A flowchart of the "program-faculty-publication" data collection process

affiliations. A total of 5,112 research articles were obtained. Full details of data collection and screening procedures are provided in Appendix A.[2]

4.2 A Taxonomy of Disciplines

We coded the disciplinary backgrounds of authors and journals using the taxonomy developed by the National Research Council (Ostriker et al. 2011). Detailed coding categories are provided in Appendix B.[2] Among diverse disciplines, we highlighted public administration in the broad social sciences because emergency management has long been anchored in public administration (Comfort et al. 2012). Furthermore, public administration scholars constitute the largest group of faculty in our dataset (see Sect. 5.1). Therefore, we examined their contributions to the emergency management research.

4.3 Examining the Knowledge Structure and Linkages

This study relied on bibliographic coupling analysis to investigate the knowledge structure and links in the emergency management field (see Fig. 3). Bibliographic coupling is a method of grouping documents based on the common

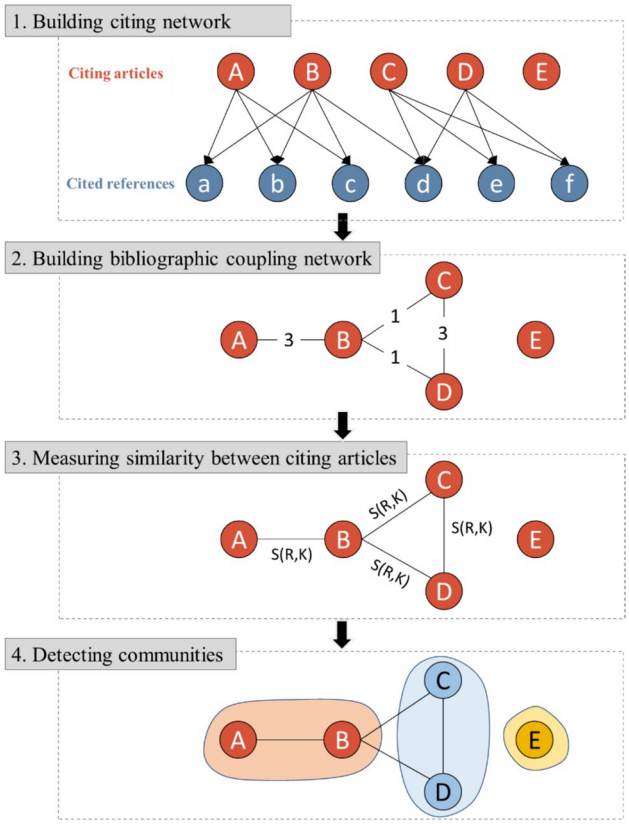

Fig. 3 An illustration of bibliographic coupling clustering

references that these documents share (see Appendix C[2] for details on this method).

Our analysis included five steps (Fig. 4), with the first three steps identifying research topics, themes, and areas, and the last two steps assessing the knowledge links. First, 5,112 articles were clustered into research topics using successive bibliographic coupling analyses. Second, research topics that either focus on the same emergency management mission areas or the same emergency scenarios were combined into research themes. Third, themes addressing similar emergency categories were aggregated into five research areas. The fourth and fifth steps quantified knowledge links across themes and areas based on shared references and keywords. Python 3.8.12 and the igraph 0.9.6 package were used to perform the bibliographic coupling analysis and visualizations. Detailed procedures are provided in Appendix D.[2]

5 Findings and Discussion

This section presents and discusses the main findings. We provide an overview of emergency management research in the United States, analyze the field's knowledge structure, examine linkages between themes and research areas, and

[2] All appendices in this article are available at Figshare (http://doi.org/10.6084/m9.figshare.30723893).

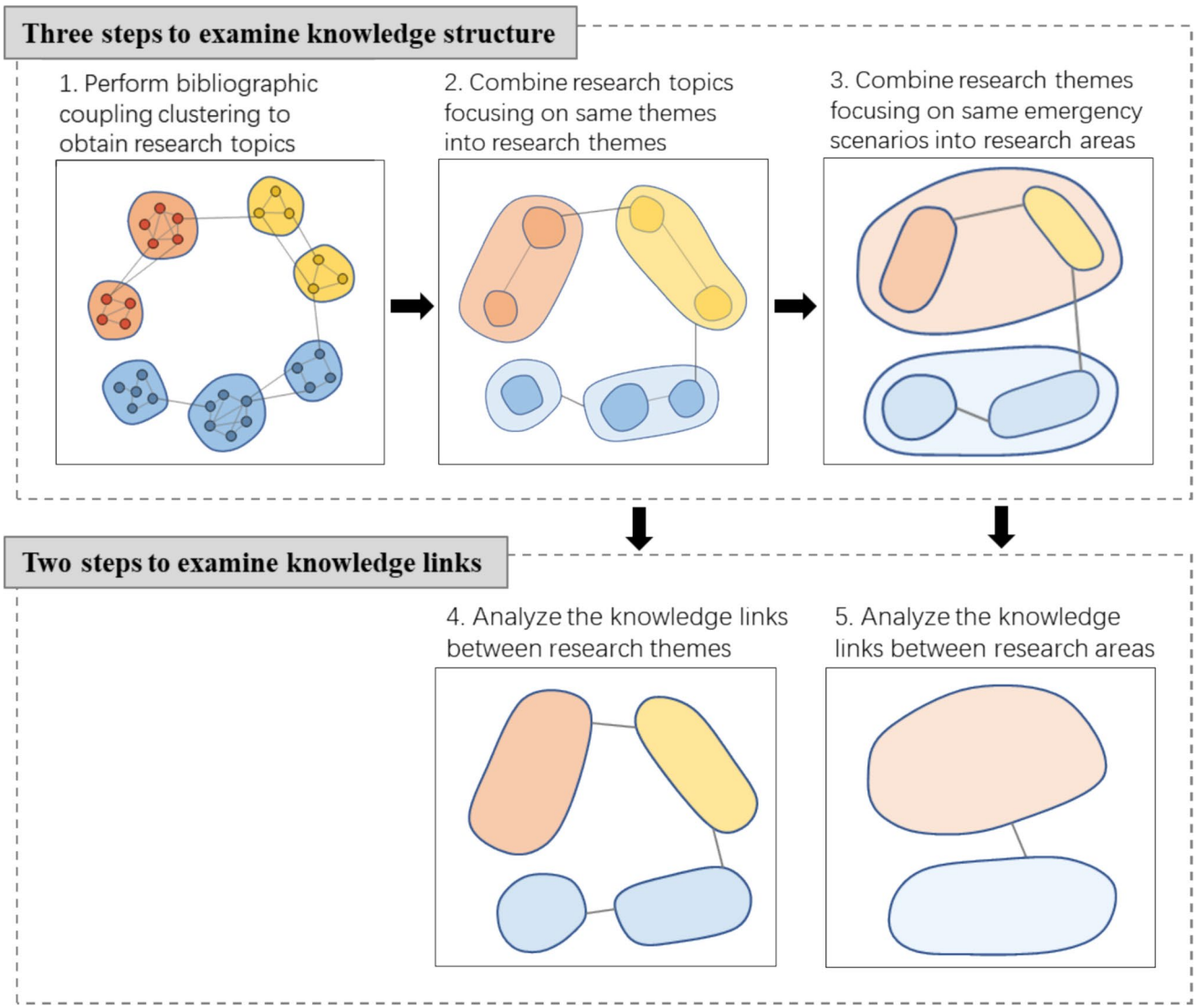

Fig. 4 The five-step analysis process

investigate the role that U.S. public administration scholars have played in emergency management research.

5.1 Overview of Emergency Management Research in the United States

The emergency management field has received increasing attention in recent years. As shown in Fig. 5, the total number of emergency management articles in the studied U.S. emergency management academic programs averaged around 110 from 2011 to 2015. The number rose gradually in 2016, reaching 278 in 2018, then decreased slightly in 2019 and increased to 298 in 2020. Over the next four years, the number was largely stable at around 300 articles per year during the first two years, but then dropped to about 250 articles annually in the subsequent two years. This growth pattern is generally consistent with the trend of disaster relief funding in recent years in response to the escalating frequency and intensity of disasters, as shown in Fig. 5. The growing demand for emergency management research might drive the rapid increase in emergency management research. There was a significant increase in the amount of fund allocated in 2013, 2018, and 2020, respectively. These increases in fund are probably responses to Hurricane Sandy in late 2012, Hurricane Harvey and California wildfires during 2017–2018, and COVID-19 in late 2019. The United States has experienced more than 10 meteorological disasters yearly since 2015 (Congressional Research Service 2022). In 2020, the country was hit by 22 severe weather-related disasters, including record-breaking wildfires in the western United States, rain and flooding in the Tittabawassee River, and heat waves in the Phoenix area (Thompson 2020).

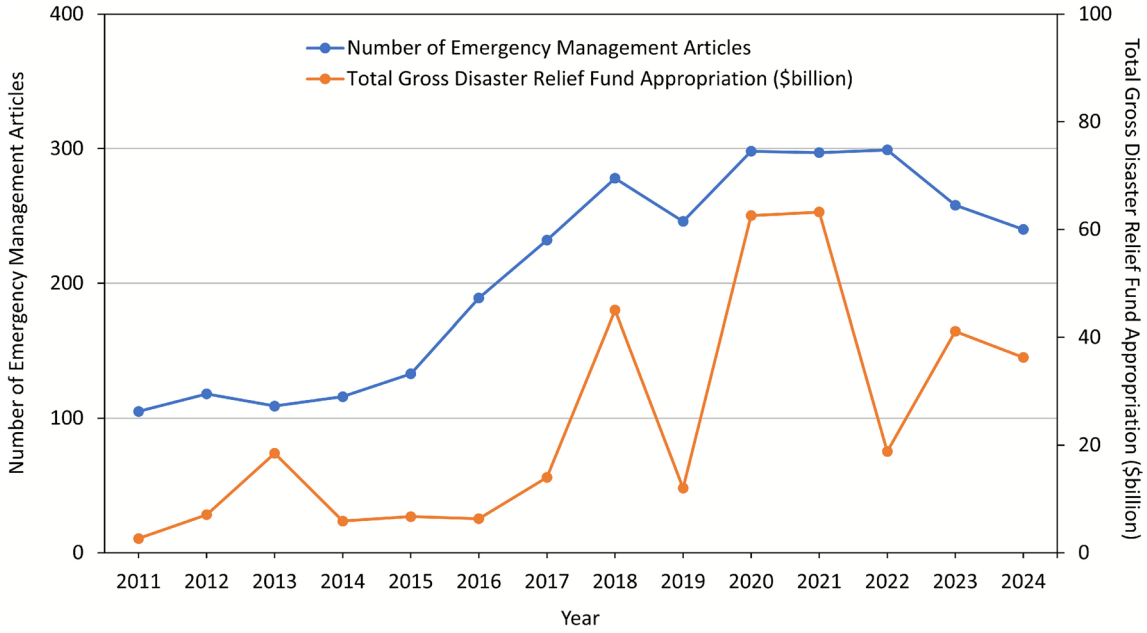

Fig. 5 Number of emergency management articles and the federal Disaster Relief Fund appropriation in the United States. *Data source* Congressional Research Service (2022) and FEMA (2024).

Emergency management research in the United States has appeared in 722 different journals. The top 10 journals with the highest number of publications include *Risk Analysis*, *Earthquake Spectra*, *Natural Hazards*, *International Journal of Environmental Research and Public Health*, *PLOS One*, *International Journal of Disaster Risk Reduction*, *Natural Hazards Review*, *Journal of Geophysical Research-Solid Earth*, *Journal of Geotechnical and Geoenvironmental Engineering*, and *Food and Nutrition Bulletin*. These journals demonstrate the multidisciplinary nature of the emergency management field.

The scholars affiliated with these emergency management programs have diverse disciplinary backgrounds. Table 1 presents summary statistics on the disciplines of the scholars affiliated with emergency management programs in the United States. The largest group of scholars, accounting for 22.1% of the faculty in emergency management programs, are from the public administration discipline. About 18.4% of the scholars are from other social sciences such as political science, sociology, and law. In addition, 17.4%, 10.6%, and 8.5% of scholars are from public health, engineering, and Earth science, respectively. It is worth noting that 19.9% of the faculty in these emergency management programs are professional emergency management personnel who come from a variety of professions related to emergency management, such as firefighters, safety and security officers, public servants, engineers, and consultants with emergency management experience. This finding indicates that emergency management programs in the United States highly value the first-hand experience of emergency managers and first responders.

Table 1 Disciplinary background of scholars affiliated with the U.S. emergency management programs

Category	Discipline	Number of scholars	Percentage (%)
Social science	Public administration	201	22.1
	Other social sciences	167	18.4
Life and health sciences	Public health	158	17.4
	Other life and health sciences	20	2.2
Natural science	Earth science	77	8.5
	Other natural sciences	4	0.4
Engineering science	Engineering science	97	10.6
Other disciplines	Other disciplines	5	0.5
Professional personnel	Professional personnel	181	19.9

5.2 Knowledge Structure of the Emergency Management Field in the United States

This study identified 283 research topics across 22 research themes in the five research areas in the emergency management field in the United States (the names of the 22 research themes correspond to the labels of the nodes shown in Fig. 6). For ease of notation, we prefix the name of each research theme with the name of its corresponding research area. For example, the research theme of resilience in the research area of natural hazards is named "Natural Hazards-Resilience."

Table 2 provides an overview of five research themes selected from each of the five research areas during 2011–2015, 2016–2020, and 2021–2024, respectively. Specifically, two researchers independently ranked the research themes within each research area based on their salience. After comparing the rankings, researchers held discussions for the themes where the rankings differed and ultimately reached a consensus on the five research themes. The five selected research themes are "Homeland Security-Terrorism," "Public Health Emergencies-Pandemic Mitigation," "Natural Hazards-Resilience," "Human-induced Disasters-Environmental Pollution," and "General Emergency Management Issues-Risk Communication." For each selected research theme, we present three research topics with the highest number of publications, three disciplines with the largest number of scholars, and three disciplines with the largest number of journals.

Terrorism has been a primary focus of the research area of homeland security since the 9/11 terrorist attacks. This research theme not only examines the behaviors of terrorists and terrorist organizations but also assesses emerging risks from chemical, biological, radiological, and nuclear (CBRN) terrorism, and scenario modeling of terrorist attacks. This research theme has attracted scholars from engineering, public administration, and other social sciences. Accordingly, research on this theme has appeared in journals in public administration, other social sciences, and engineering.

For example, policy scholar Koblentz (2017) noted an emerging threat—the reemergence of smallpox—given that the globalization of orthopoxvirus synthesis technologies would enable more laboratories and scientists to create infectious variola virus. He argued that a biological incident, either because of a laboratory accident or an intentional release, would result in a global disaster. Therefore, stakeholders, including international organizations, national governments, industry, and the biology community, should devise new approaches to prevent the reemergence of smallpox. In another article, Garcia and von Winterfeldt developed a decision tree analysis method to evaluate the deterrence effects and the effectiveness of different countermeasures against terrorist attacks in a dynamic and hostile environment (Garcia and von Winterfeldt 2016).

In public health emergencies, research on pandemic mitigation is extensive and has increased significantly during 2011–2024. This research theme focuses on assessing transmission risks associated with emerging viruses, understanding vaccine hesitancy, public awareness and perceptions of infectious diseases, and the challenges of emerging viruses to the healthcare system. As expected, public health scholars have been the majority in this research theme and most publications have appeared in public health journals. For example, public health scholars conducted surveys on staff and parents at childcare agencies to assess support for a childcare agency staff mandatory vaccination policy

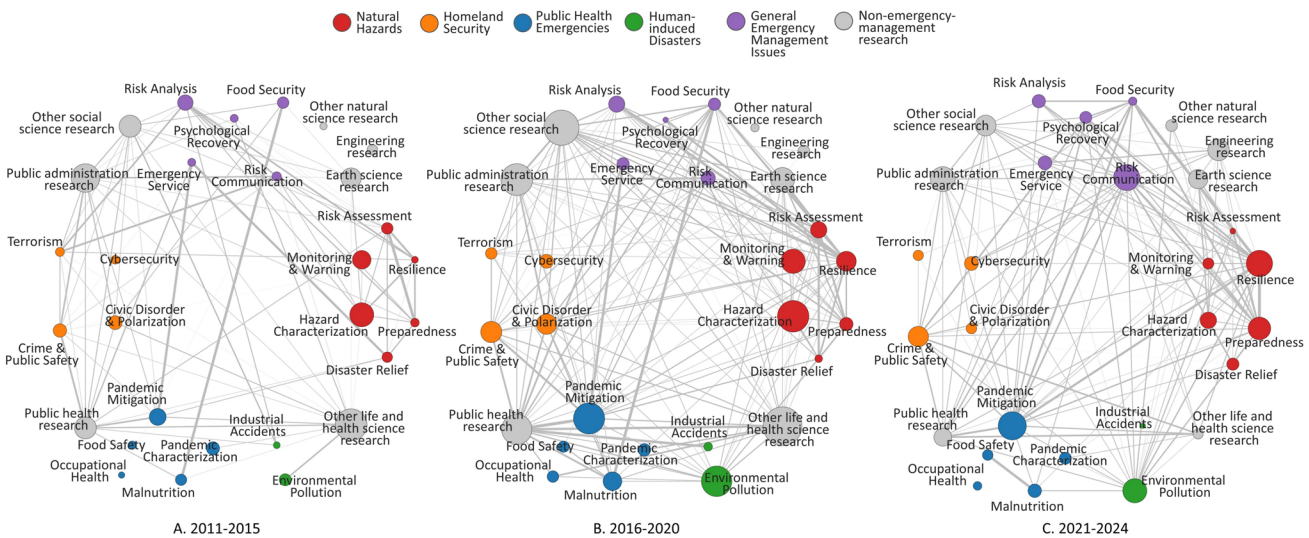

Fig. 6 Knowledge links between emergency management research themes

Table 2 Selected emergency management research themes in the emergency management field in the United States

Period	Research themes	Research topics	Authors' disciplines	Journals' disciplines
2011–2015	Homeland Security-Terrorism	Strategies against biological threats; Risk and decision analysis in counterterrorism context; Economic impact of terrorism	Engineering (e.g., Detlof Winterfeldt); Public administration (e.g., Gregory Koblentz); Social sciences other than public administration (e.g., Richard John)	Social sciences other than public administration (e.g., *Studies in Conflict & Terrorism*); Engineering (e.g., *International Journal of Critical Infrastructure Protection*); Multidisciplinary sciences (e.g., *PNAS*)
	Public Health Emergencies-Pandemic Mitigation	H1N1 vaccine compliance; HIV stigma and discrimination; Transmission risk of HPV	Public health (e.g., Terri Rebmann); Social sciences other than public administration (e.g., Stephen Walls); Natural sciences other than Earth science (e.g., James Taylor)	Public health (e.g., *Vaccine*); Life and health sciences other than public health (e.g., *Stress and Health*); Social sciences other than public administration (e.g., *Ethics & Behavior*)
	Natural Hazards-Resilience	Assessment of community resilience; Impact of disaster losses on post-disaster recovery; Conceptualization of resilience	Earth science (e.g., Susan Cutter); Engineering (e.g., Bernard Amadei); Social sciences other than public administration (e.g., Kathleen Tierney)	Earth science (e.g., *Environment*); Social sciences other than public administration (e.g., *American Behavioral Scientist*); Multidisciplinary sciences (e.g., *Scientific Reports*)
	Human-induced Disasters-Environmental Pollution	Relationship between air pollution and human diseases; Monitoring and modeling of exposure to toxic substances in fire; Exposure to heavy metals and its impact on human behavior	Public health (e.g., Pamela Xaverius); Earth science (e.g., Kabindra Shakya); Natural sciences other than Earth science (e.g., Christa Hasenkopf)	Earth science (e.g., *Journal of Geophysical Research-Atmospheres*); Life and health sciences other than public health (e.g., *Journal of Asthma*); Public health (e.g., *American Journal of Public Health*)
	General Emergency Management Issues-Risk Communication	Dissemination patterns of risk information; Public emotions, behavior, and decision making in crisis; Knowledge and preparedness of the general public for crisis	Public administration (e.g., Yushim Kim); Social sciences other than public administration (e.g., Michelle Meyer); Engineering (e.g., Royce Francis)	Social sciences other than public administration (e.g., *Risk Analysis*); Engineering (e.g., *Reliability Engineering & System Safety*); Earth science (e.g., *Earthquake Spectra*)

Table 2 (continued)

Period	Research themes	Research topics	Authors' disciplines	Journals' disciplines
2016–2020	Homeland Security-Terrorism	Extremism and behaviors of terrorist organizations; Risk and decision analysis in the context of counterterrorism; Emerging technologies and CBRN terrorism	Social sciences other than public administration (e.g., Gary LaFree); Public health (e.g., Terri Rebmann); Engineering (e.g., Bernard Amadei)	Social sciences other than public administration (e.g., *Terrorism and Political Violence*); Engineering (e.g., *Journal of Chemical Information and Modeling*); Public administration (*Journal of Homeland Security and Emergency Management*)
	Public Health Emergencies-Pandemic Mitigation	HIV medication adherence and prevention; Transmission risk of Zika virus; Coordination of public health systems in pandemics	Public health (e.g., Stephanie Dopson); Engineering (e.g., David Broniatowski); Life and health sciences other than public health (e.g., Erin Sorrell)	Public health (e.g., *American Journal of Public Health*); Life and health sciences other than public health (e.g., *Journal of Adolescent Health*); Social sciences other than public administration (e.g., *Journal of Social Issues*)
	Natural Hazards-Resilience	Development of post-disaster recovery indicators; Resilience assessment of infrastructure system in natural hazards; Development and implementation of resilience planning	Social sciences other than public administration (e.g., Galen Newman); Engineering (e.g., Liesel Ritchie); Public health (e.g., Robyn Gershon)	Earth science (e.g., *Natural Hazards*); Social sciences other than public administration (e.g., *Political Geography*); Engineering (e.g., *Journal of Building Engineering*)
	Human-induced Disasters-Environmental Pollution	Health risks of air pollution and its socio-economic impacts; Monitoring of groundwater contamination; Impact of oil spills on people and ecosystems	Public health (e.g., Steven Howard); Social sciences other than public administration (e.g., Yan Song); Engineering (e.g., Cesar Moreira)	Earth science (e.g., *Atmospheric Environment*); Natural sciences other than Earth science (e.g., *Journal of Physical Chemistry A*); Social sciences other than public administration (e.g., *Research on Aging*)
	General Emergency Management Issues-Risk Communication	The impact of media reporting on public risk perception of disasters; Dissemination patterns of risk information; Preparedness and public risk perception of emergencies	Social sciences other than public administration (e.g., Joseph Hamm); Public administration (e.g., Louise Comfort); Engineering (e.g., Thomas A. Mazzuchi)	Social sciences other than public administration (e.g., *Risk Analysis*); Engineering (e.g., *Journal of Management in Engineering*); Earth science (e.g., *Natural Hazards Review*)

Table 2 (continued)

Period	Research themes	Research topics	Authors' disciplines	Journals' disciplines
2021–2024	Homeland Security-Terrorism	Cyberterrorism and Cybercrime; Ideological dissemination of online extremism; Extremism and behaviors of terrorist organizations	Public administration (e.g., Gregory Koblentz); Public health (e.g., Hong Xian) Social sciences other than public administration (e.g., Chermak Steven)	Social sciences other than public administration (e.g., *Policing-An International Journal of Police Strategies & Management*); Public administration (e.g., *Policy Studies Journal*); Public health (e.g., *Healthcare*)
	Public Health Emergencies-Pandemic Mitigation	Coordination of public health systems in pandemics; Enhancing community resilience and public health response; Comprehensive management of HIV	Public health (e.g., Jennifer Osetek); Public administration (e.g., Naim Kapucu); Social sciences other than public administration (e.g., Galen Newman)	Public health (e.g., *Lancet Planetary Health*); Public administration (e.g., *Public Performance & Management Review*); Social sciences other than public administration (e.g., *Disasters*)
	Natural Hazards-Resilience	Social capital and resilience in disaster management; Social vulnerability in hazard mitigation and post-disaster recovery; Big data for urban disaster management and recovery	Social sciences other than public administration (e.g., Phil Berke); Engineering (e.g., Tina Dura); Earth science (e.g., Tim Frazier)	Earth science (e.g., *Natural Hazards*); Social sciences other than public administration (e.g., *Journal of Risk Research*); Public Health (e.g., *Journal of Homeland Security and Emergency Management*)
	Human-induced Disasters-Environmental Pollution	Relationship between air pollution and human diseases; Environmental justice and environmental pollution exposure disparities; Monitoring of groundwater contamination	Public health (e.g., Steven Howard); Public administration (e.g., Bing Ran); Social sciences other than public administration (e.g., Yan Song)	Social sciences other than public administration (e.g., *Cities*); Natural sciences other than Earth science (e.g., *Urban Forestry & Urban Greening*); Earth science (e.g., *Professional Geographer*)
	General Emergency Management Issues-Risk Communication	Hesitancy in COVID-19 vaccination and misinformation on social media; Behavioral biases and vaccination uptake during the COVID-19 pandemic; Risk perception and evacuation decision making in disaster contexts	Social sciences other than public administration (e.g., Charles R. Figley); Public health (e.g., Mark Dworkin); Public administration (e.g., Juliette Kayyem)	Social sciences other than public administration (e.g., *International Journal of Disaster Risk Science*); Public health (e.g., *Vaccines*); Public administration (e.g., *Policy Studies*)

(Rebmann et al. 2016). They found that about 80% of the respondents supported a mandatory staff vaccination policy, and the determinants of support include belief that vaccines are safe and effective and support for the policy only if there were no costs. Similar to the research theme of "Homeland Security-Terrorism," engineering scholars have also contributed to this research theme. For instance, computer scientists developed a machine learning-based method to mine vaccine-related social media data for monitoring the trend of influenza vaccination uptake in real time (Huang et al. 2019).

Resilience in natural hazards research has attracted much attention from 2011 to 2024. This research theme includes studies on conceptualizing resilience, assessing disaster resilience and recovery capabilities, and developing and implementing resilience planning. Studies on this theme have mainly appeared in Earth science and social science journals. Most of the scholars who contributed to this research theme are also from these disciplines. For example, Cutter and her colleagues significantly contributed to the measurement, monitoring, and assessment of disaster resilience (Cutter 2016; Cutter et al. 2008).

The theme of environmental pollution focuses on monitoring environmental pollution and assessing its effects on human health and behaviors, which have been long-lasting research themes in Earth science and public health. Scholars from public health and other life and health sciences explored the relationship between environmental pollutants and human diseases. Scholars from Earth science were more concerned with the dynamics of pollution and its monitoring. Social science scholars focused on the socioeconomic causes and impacts of environmental pollution. For example, an analysis of the air polluter location in the United States found that major air polluters were significantly more likely to be located near a state's downwind border because states had incentives to pass environmental regulations and policy tools encouraging firms to export their pollution to neighboring states (Monogan III et al. 2017). Studies on this theme are primarily published in Earth science and public health journals. For example, Ecologist Gibson and her colleagues published a study in *Biological Conservation* that evaluated the impact of the Deepwater Horizon oil spill on imperiled species (Gibson et al. 2017).

The research theme of risk communication covers several research topics, including information diffusion patterns in different emergency scenarios, public attitudes and emotions during crises, public perceptions and behaviors toward risks, and communication networks. Among these research topics, the diffusion patterns of risk information and the development of risk communication strategies have received much attention in the social media era. One study examined the role of hub users and crowd users on social networks in the diffusion of situational information during Hurricane Harvey. The study found that early intervention by hub users increased the speed of information propagation (Fan et al. 2020). Scholars contributing to this research theme primarily come from public administration, other social sciences, and engineering. Several public administration scholars have extensively examined emergency management networks for communication and information exchange (Kapucu and Hu 2016; Wukich et al. 2019). Studies on this theme also have appeared in these disciplines' journals such as *American Review of Public Administration* and *Journal of Risk Research*.

As manifested in the diverse research themes and topics, the multidisciplinary nature of the current emergency management research can be traced back to the 1984 workshop organized by FEMA and the National Association of Schools of Public Affairs and Administration (NASPAA). This workshop helped nurture a community of scholars from different disciplines with a focus on emergency management research and practice (Comfort et al. 2012). In addition, in the early 2000s, following the 9/11 terrorist attacks and Hurricane Katrina, a growing consensus emerged among scholars and practitioners for multi- and interdisciplinary approaches to emergency management (McEntire 2007).

As shown in Table 2, each research theme attracts scholars from multiple disciplines. This reflects three practical knowledge demands that inherently require interdisciplinary input. First, understanding the causes and influencing factors of emergencies and their immediate impacts draws on different disciplinary advantages for unpacking the causes of various emergencies. Geoscientists are well positioned to help understand the causes of natural hazards, while scholars from public health and other life and health sciences are better equipped to analyze public health emergencies. Second, understanding the societal antecedents and consequences of emergencies requires insights from public administration, sociology, political science, and human geography, as many emergencies have deep social roots and are often the consequences of long-term socioeconomic and political processes (Tierney 2019). This demand has attracted a large number of researchers from various social science disciplines. Finally, more innovative and effective methods, tools, techniques, and engineering solutions need to be developed, which is why many engineering scholars contribute to these emergency management research themes.

5.3 Knowledge Links between Emergency Management Research Themes and Research Areas in the United States

This section quantifies and visualizes the knowledge linkages between different emergency management research themes (Fig. 6) and research areas (Fig. 7), based on the similarity measure defined in Eq. 1 in Appendix D.[2] In both

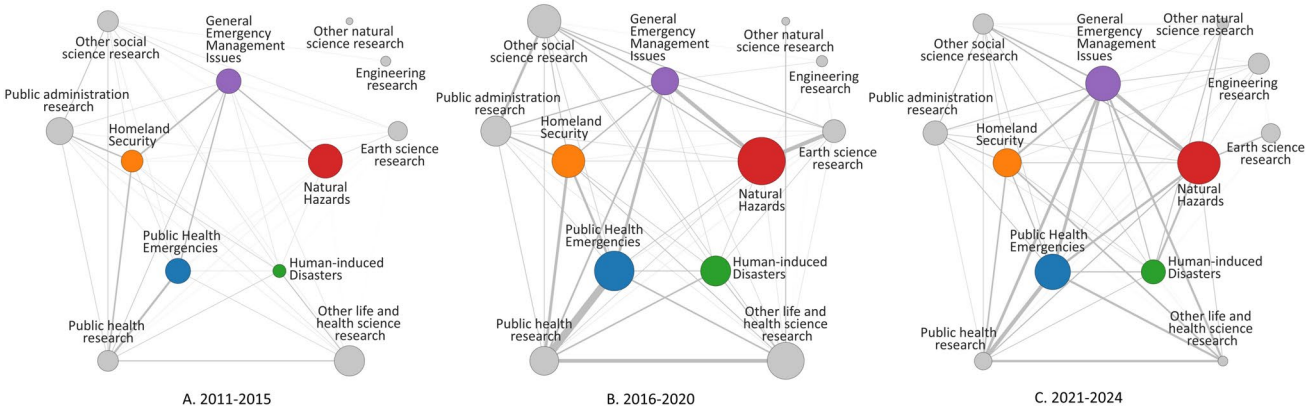

Fig. 7 Knowledge links between emergency management research areas

figures, node size reflects the number of publications in a given research theme or area, while edge thickness indicates the strength of the knowledge connection between nodes. Node color distinguishes different research areas. The gray nodes denote non-emergency-management research areas, including public administration research, research in other social sciences, public health research, research in other life and health sciences (excluding public health), Earth science research, research in other natural sciences (excluding Earth science), and engineering research.

At the research theme level, the analysis revealed that most knowledge links between emergency management research themes have similarity values below 0.07. For example, links between themes in the research areas of homeland security and human-induced disasters range from 0.03 to 0.07. The strongest observed connection is between "Natural Hazards-Resilience" and "Natural Hazards-Preparedness," with a similarity value of 0.317. Overall, the weak linkages suggest that many research themes, despite addressing similar types of emergencies, remain largely independent and lack a shared knowledge foundation. Nevertheless, the networks display a gradual increase in density from 2011–2015, to 2016–2020, and to 2021–2024, suggesting a growing tendency toward integration. While most knowledge links between emergency management research themes remain weak, several notable exceptions stand out. A small number of themes exhibit high association strength, and interestingly, these strong connections often span across different research areas (see Appendix E[2] for details). These themes pairs suggest the gradual emergence of conceptual bridges that may facilitate broader knowledge integration over time. Further analysis of their shared references revealed three key features of these knowledge relationships.

First, certain themes are connected through a shared theoretical or methodological foundation, as indicated by their frequent citation of a common set of core literature. This type of linkage is often found among research themes within the same research area—for example, "Natural Hazards-Resilience" and "Natural Hazards-Preparedness," or "Public Health Emergencies-Food Safety" and "Public Health Emergencies-Malnutrition." Themes addressing similar emergency scenarios or mission areas tend to align more closely in research content and demonstrate strong knowledge ties.

Second, multiple linkages arise from asymmetric knowledge transfer, where one theme draws extensively on the literature of another, while the latter primarily cites its own disciplinary sources. For example, between 2016 and 2020, studies on accidents and disasters frequently cited public health literature on evidence-based decision making and the effectiveness of health interventions. Similarly, "Natural Hazards-Risk Assessment" incorporated ecological vulnerability research originating from Earth science. From 2021 to 2024, both food safety and pandemic mitigation adopted theories and methods from the resilience literature.

Third, the shared references reflect growing conceptual integration across research themes, drawing from diverse disciplinary origins. Resilience theory has been a persistent bridge, linking studies on vulnerability, disaster resistance, ecological risk, food safety, and pandemic mitigation over time. Influential works such as Cutter et al. (2003) and Norris et al. (2008) are among the most frequently cited shared references.

At the research area level, the five emergency management research areas remain weakly linked (Fig. 7). In contrast, homeland security, public health emergencies, and natural hazards show strong knowledge links with their parent disciplines—social sciences (including public administration), public health, and Earth science, respectively. For example, the similarity measure for knowledge links between public health emergencies and public health research far exceeds the similarity values for its links with other emergency management areas. This pattern indicates that most emergency management research areas

remain anchored in disciplinary silos, consistent with earlier observations of fragmentation in the field (Urby and McEntire 2015). This limited cross-area integration reflects deeper structural barriers within the field.

Although emergency management is inherently interdisciplinary, emergency management research in the United States has traditionally been shaped by different, well-established academic disciplines, each with its own knowledge base, methodological approaches, and professional networks. For example, natural hazard-related disasters are primarily studied in geography, geology, and meteorology, while accidents are often addressed by safety science experts. Public health emergencies like pandemics are typically examined by scholars in public health, whereas social security issues fall within public administration, sociology, and law. These areas have traditionally developed within separate academic disciplines, leading scholars to publish in discipline-specific journals and interact mainly within their own communities. The lack of interaction has impeded knowledge sharing, preventing cross-disciplinary fertilization. Because researchers are dispersed across departments, collaboration opportunities remain limited, and weak incentives further discourage interdisciplinary engagement. As a result, the field's knowledge base remains largely rooted in respective supporting disciplines, and weak knowledge linkages persist within the field.

Despite the persistent weakness of these knowledge linkages, some research areas are gradually becoming more integrated over time. Association strengths were relatively low in 2011–2015 but increased noticeably in 2016–2020 and remained high in 2021–2024. For instance, knowledge flows between public health emergencies and public health research became substantially denser, as did connections between natural hazards and Earth sciences, and between homeland security and public health.

In addition, the evolving knowledge linkages reveal a widening scope of interdisciplinary integration in emergency management research. Research on human-induced disasters, which previously relied heavily on public health and life-science literature, increasingly incorporates natural hazards and other natural science research after 2021, reflecting growing scholarly attention to compound risks and the all-hazards approach in emergency management.

5.4 Emergency Management Research Conducted by the U.S. Public Administration Scholars

Emergency management has been a recognized field within public administration (Comfort et al. 2012). Public administration scholars constitute the largest group in the emergency management programs examined in this study. As shown in Table 3, about one-third of their publications focused on emergency management research themes such as risk communication and crime and public safety, mainly within the research areas of homeland security and general emergency management issues. In the homeland security area, public administration scholars have studied topics such as gun violence (Zhu et al. 2020) and emerging terrorism (Koblentz 2020). Within the research area of general emergency management issues, public administration scholars focused on economic impacts of disasters (Xie et al. 2018), collaborative networks in crises, and public risk perception and communication (Kapucu and Garayev 2016).

As noted by Comfort et al. (2012), many public administration scholars studying emergency management also pursue research in core public administration areas such as bureaucracy and red tape (Kaufmann et al. 2019). Not surprisingly, public administration scholars devote part of their time and efforts to conducting emergency management research. It is unknown whether those public administration scholars would identify themselves as emergency

Table 3 Emergency management research themes by the U.S. public administration scholars

Research field	Research theme	Number of publications	Percentage (%)
Emergency management	General Emergency Management Issues-Risk Communication	61	6.7
	Homeland Security-Crime and Public Safety	57	6.3
	General Emergency Management Issues-Risk Analysis	44	4.8
	Homeland Security-Civic Disorder and Polarization	36	4.0
	Public Health Emergencies-Pandemic Mitigation	33	3.7
	Nature Hazards-Resilience	33	3.7
	Nature Hazards-Preparedness	31	3.4
Others	Public administration	252	28.0
	Social sciences other than public administration	155	17.2
	Public health	19	2.1

Research themes with percentages less than 2% are not shown

management scholars. Their emphasis on homeland security and general emergency management issues aligns with Fig. 7, which shows stronger connections to these areas but weaker ties to others such as public health emergencies. This pattern suggests that there is still great potential for public administration scholars to play a broader role in advancing emergency management research in the United States.

6 Conclusion

This section provides a summary of key findings, contributions, and future directions for interdisciplinary knowledge integration in emergency management research.

6.1 Multidisciplinary Growth and Evolving Integration in U.S. Emergency Management Research

This study mapped the landscape of U.S. emergency management research from 2011 to 2024. Our study revealed four findings. First, emergency management research in the United States has demonstrated steady growth in both scale and complexity over the past decade, paralleling the increasing frequency and severity of major disasters. This expansion is also reflected in its disciplinary breadth: research has been published across 722 journals, spanning fields such as public administration, Earth science, public health, and engineering.

Second, the knowledge structure of U.S. emergency management research encompasses 22 distinct research themes across five major research areas: homeland security, public health emergencies, natural hazards, human-induced disasters, and general emergency management issues. These themes have attracted scholars from a wide array of disciplines and appear in diverse publication outlets. This thematic diversity reflects three practical knowledge demands of the field: understanding the causes of emergencies, addressing their social ramifications, and developing effective technical solutions.

Third, while the overall knowledge linkage within the field remains generally weak, it has evolved over time. At the research theme level, a fragmented thematic structure persists. Yet, integration has grown, especially among themes such as resilience, preparedness, pandemic mitigation, and food security. Analysis of shared references suggests three possible integration mechanisms: (1) common theoretical foundations or methodological foundations, addressing similar emergency scenarios or emergency management missions; (2) asymmetric knowledge borrowing (for example, disaster studies drawing on public health); and (3) growing conceptual integration. Resilience theory in particular has emerged as a key connector across otherwise distinct themes.

Finally, although public administration scholars constitute the largest contributor group in our sample, their research is concentrated on a narrow subset of themes—particularly risk communication, crime and public safety, and economic impacts of disasters, mainly within the research areas of homeland security and general emergency management issues. Their engagement with other research areas, especially public health emergencies and natural hazards, remains limited, reflecting missed opportunities for broader interdisciplinary collaboration. While public administration theories such as collaborative governance and government-society coordination have begun to inform emergency management research, their broader application remains underutilized.

6.2 Contributions and Implications to Knowledge Integration

This study made several contributions to the literature on emergency management. To address concerns about disciplinary silos, this study provided both a theoretical framework and empirical evidence to assess knowledge integration in the field. The analysis identified three distinct mechanisms that explain how knowledge integration is taking place: shared theoretical foundations, asymmetric knowledge borrowing, and conceptual integration. These mechanisms help explain how certain research themes and areas began to connect, even within a largely fragmented research landscape.

Taken together, the findings suggest that emergency management, as it has developed in academic programs, continues to reflect a mix of disciplinary perspectives shaped by shared institutional demands. While some integration is happening, it is not evenly distributed nor self-sustaining. Strengthening integration will require purposeful interventions that build conceptual bridges and institutional incentives for sustained interdisciplinary collaboration.

The implications are both academic and practical. Knowledge integration in emergency management is both structurally constrained and selectively activated. It is not a natural outcome of disciplinary diversity, but rather a contingent process shaped by institutional arrangements, intellectual platforms, and timing of collaboration opportunities. To be effective, integration needs both conceptual alignment across research themes and sustained institutional support.

From a thematic perspective, resilience theory emerges as a cross-cutting conceptual anchor that connects diverse research themes. A persistent challenge lies in the absence of a shared academic language, as scholars often approach emergency management through divergent conceptual and methodological traditions (McEntire 2007; Peek and Guikema 2021). Addressing this challenge may require

identifying and amplifying integrative research themes and areas that can serve as common ground for cross-disciplinary dialogue and conceptual coherence.

From an institutional perspective, opportunities for integration exist within scholar communities, curriculum design, and institutional academic platforms. The ongoing fragmentation at both the theme and area levels underscores the need to move beyond rhetorical commitments to interdisciplinarity. In the United States, the emergency management community has established several platforms that appear to have facilitated greater intellectual exchange in recent years. These include specialized journals such as *Journal of Homeland Security and Emergency Management* and *Journal of Emergency Management*, as well as professional associations such as the Section on Emergency and Crisis Management of American Society for Public Administration, which routinely organizes research panels and webinars. Building on these efforts, further integration could be supported through joint research initiatives, cross-disciplinary funding opportunities, and interdisciplinary training programs that foster collaboration and cross disciplinary boundaries.

6.3 Limitations and Future Research

This study has several limitations. One limitation concerns the identification of faculty members affiliated with emergency management programs. Although this study used the Internet Wayback Machine to search for those faculty members who may have left their positions, the resulting list may still be incomplete due to inherent constraints in that archival tool. Another limitation lies in the scope of literature sources. This study relied solely on the Web of Science database and did not include other forms of scholarly outputs such as books, book chapters, dissertations, and conference papers, which may also contribute valuable insights. A further limitation is the focus on the well-established programs within the top 60 universities listed in FEMA's Higher Education Program directory. The focus may overlook contributions of smaller or emerging programs, which, while less visible, can still play an influential role in shaping the field. Despite these limitations, we hope that this research provides a useful foundation for understanding the multidisciplinary composition and interdisciplinary evolution of emergency management in the United States. The current knowledge architecture reflects both the enduring influence of disciplinary traditions and the emerging demands of compound emergencies. Future research may further examine why certain research areas exhibit stronger linkage, helping uncover the drivers of knowledge integration across the field.

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