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AI-Driven Chatbots for Emergency and Disaster Response: A Global Bibliometric Analysis

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Abstract

The objective of this study is to analyze the global scientific production on the use of chatbots in emergencies and disaster response, identifying research trends, collaboration patterns, and thematic evolution. A bibliometric analysis was conducted using 97 documents indexed in Scopus between 2019 and July 2025. The analysis employed MASHA and VOSviewer to combine performance indicators with science mapping, enabling the visualization of research networks and emerging topics. Findings reveal an annual growth rate of 34.17%, encompassing 75 publication sources and 367 contributing authors, with a 100% co-authorship rate. Articles and conference papers account for 51.5% and 42.3% of the literature, with an average of 7.1 citations per document and an overall h-index of 15. The United States, China, and India lead global contributions, while keyword co-occurrence analysis indicates increasing interest in human-centered communication, coordination, and artificial intelligence applications. However, topics such as healthcare integration, crisis data management, and ethical governance remain underexplored. This study advances the field by systematizing a previously dispersed body of research, revealing the conceptual foundations and intellectual structure of chatbot applications in emergency contexts. By combining bibliometric evidence with a human-centered perspective, a comprehensive framework is introduced that assesses the ethical, social, and technological dimensions to develop resilient and reliable emergency response systems for the future.

Keywords: Chatbots; Disaster Response; Emergency Management; Bibliometric Analysis; Human-Centered AI.

1. Introduction

In an increasingly volatile world, exposed to health crises, disasters, and humanitarian emergencies, the need for rapid, accurate, and scalable response systems has become a global priority for governments, humanitarian organizations, and vulnerable communities [1]. In this context, Artificial Intelligence (AI)-based technologies, particularly chatbots, have become promising tools for information management, public communication, and decision support in emergency situations [2]. Their ability to maintain real-time interaction, provide continuous assistance, and operate autonomously positions them as valuable assets in crisis response ecosystems [3]. In this sense, the growing deployment of chatbots must be understood in the context of the broader digital transformation in emergency management. As Kayyali [4] points out, conversational agents are increasingly being incorporated into decision-making and coordination frameworks to

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improve situational awareness. Likewise, Arora et al. [5] described how advances in natural language processing and adaptive learning have expanded the ability of chatbots to function in uncertain and dynamic contexts. These advances were particularly relevant during the COVID-19 pandemic, when chatbots were used to mitigate misinformation and support communication in the healthcare field [6].

Despite the advances made in the use of AI-powered chatbots for emergency management, the current body of knowledge remains dispersed and lacks an integrative vision that articulates the different disciplines and domains of application. Branda et al. [2] highlighted that few studies systematically analyze the practical implementation and ethical governance of chatbots in real emergency conditions. In the same vein, Talebi [7] showed that the adoption of chatbots in triage and emergency nursing is still incipient and underscores the absence of research that evaluates their performance in complex and high-risk environments. In addition, Huo et al. [8] warned that studies on chatbots in the healthcare field have deficiencies in methodological transparency and rarely address broader ethical or regulatory implications. For their part, Grineski et al. [9] noted that existing research tends to focus on isolated cases, such as the use of bots during Hurricane Harvey, without establishing conceptual or methodological connections that allow us to understand the general evolution of conversational technologies applied to crisis situations. This thematic dispersion reflects a broader trend in the literature on emergency management, characterized by heterogeneous approaches, little interdisciplinary articulation, and limited attention to the historical processes that explain the development of the field. Collectively, these works show that, although the technical promise of chatbots is unquestionable, the scientific understanding of their evolution, integration, and multidisciplinary implications is still insufficient and requires a more cohesive and transversal analytical approach.

Taking into account the above and assessing it from a meta-scientific perspective, the absence of bibliometric synthesis studies highlights the need to address the existing gaps in the literature. Wibowo et al. [10] noted that while there are bibliometric analyses on artificial intelligence applied to disaster management, there is still a lack of research examining the evolution of the field, collaborative networks, and the thematic structure of chatbot applications within this critical domain. In the same vein, Hassan & Duarte [11] argued that bibliometric analysis is an essential approach to overcome such knowledge gaps by allowing researchers to systematize the available evidence, identify patterns of development, and map the current state of knowledge about chatbots in the field of emergencies and disasters. Addressing this gap, therefore, requires a data-driven interdisciplinary perspective capable of visualizing the intellectual landscape of the field, revealing its conceptual connections, and pointing out areas that are still underexplored to guide future lines of research [12].

Based on the previously identified gaps and the studies that motivate the present research, this work seeks to respond to a critical need within the field by addressing the lack of an integrative and evidence-based understanding of the evolution of research on chatbots applied to emergency and disaster management. Although some previous studies have explored specific technical applications or cases linked to the health field, none have systematically examined the intellectual, thematic, and collaborative development of this domain, which limits the possibility of understanding its scientific maturation and interdisciplinary interconnections. Consequently, the central objective of this study is to carry out a bibliometric analysis of the world's scientific production on the use of chatbots in emergency and disaster contexts between 2019 and July 15, 2025, using data indexed in the Scopus database and analyzed using the MASHA and VOSviewer tools, which allow combining performance indicators and scientific mapping techniques to identify the authors, most productive institutions and countries, track the most influential sources of publication, examine thematic evolution, and detect emerging clusters that delineate current research trajectories. From this perspective, the research not only seeks to describe the state of the art but also to outline the intellectual knowledge and degree of scientific maturity of a field that is progressively consolidated at the intersection between artificial intelligence, crisis communication, and disaster resilience, providing an integrative vision that contributes to defining the conceptual bases and future directions for ethical development. Human and technologically sustainable chatbots in emergency environments. For this purpose, the article is structured as follows. Section 2 details the methodology adopted in the study. Section 3 presents the main results of the bibliometric analysis. Section 4 develops a critical discussion on the evolution and impact of chatbots in emergencies and disaster management. Finally, Section 5 presents the conclusions and proposes future lines of research.

2. Method

The present study adopts a bibliometric methodological approach with the purpose of offering a comprehensive understanding of the scientific landscape around chatbots powered by artificial intelligence in the field of emergency and disaster response. Given the rapid expansion of research on applications of artificial intelligence in crisis management, bibliometric analysis was the most appropriate strategy to map the intellectual structure, research dynamics, and global trends in this field. Bibliometric methods make it possible to identify, quantify, and visualize patterns in scientific production, making it possible to detect emerging topics, influential authors, and collaboration networks between countries and institutions. To ensure methodological rigor, this section is organized into three subsections. The first subsection, called bibliometric analysis, presents the theoretical foundations and justification for

the use of this technique, highlighting its value in the exploration of large-scale knowledge structures. The second subsection, data collection, describes the procedures used to retrieve relevant scientific records, including database selection and search strategies and inclusion and exclusion criteria, as well as information preprocessing. The last subsection, Data Analysis Procedure, details the tools and indicators used, such as co-citation analysis, keyword co-occurrence, and visualization methods.

2.1. Bibliometric Analysis

With the exponential growth of electronic publications, bibliometrics has gained ground as a rigorous approach to exploring scientific production, allowing the development and evolution of specific areas of knowledge to be traced. According to Brimblecombe & Grossi [13], this methodology has become an effective tool for unravelling patterns in the academic literature. Its versatility is reflected in the diversity of techniques it covers, including the analysis of bibliographic coupling, the co-occurrence of terms, and the study of citations and co-citation, as described by various authors [14, 15]. Although its application was initially consolidated in the field of information sciences, today it is a fundamental resource for evaluating trends, impact, and interconnections in various fields of knowledge. Bibliometrics, understood as the application of statistical methods to the study of bibliographies, allows not only quantifying the influence of certain works but also identifying nodes of knowledge and gaps in research. In the context of this study, focused on the use of chatbots in emergency and disaster response scenarios, the science mapping approach is used as a way to graphically represent the relationships between publications, facilitating a structured understanding of the field under analysis [16].

In this way, the research adopts the methodological approach of bibliometric evaluation proposed by Donthu et al. [17], which provides a systematic structure for examining and synthesising scientific knowledge in a specific domain. This approach is articulated in four fundamental phases that guide the development of the study. First, the objective and scope of the bibliometric analysis are clearly established, focused in this case on identifying global trends and research evolution on the use of chatbots in emergency and disaster response scenarios. Second, the most appropriate evaluation technique for the purposes of the study is defined, opting for a combination of keyword co-occurrence analysis, co-authorship networks, and thematic mapping to graphically represent the dynamics of the field. Third, the systematic collection of bibliographic data is carried out, ensuring its relevance, timeliness, and quality through previously established thematic and temporal filters. Finally, bibliometric analysis is carried out using specialized tools, and the findings are interpreted based on structured visualizations and relevant metrics that allow inferring collaboration patterns, emerging areas, and gaps in existing literature. This methodological framework guarantees a rigorous and reproducible approach, suitable for exploring in depth the current academic landscape on chatbots in critical contexts.

2.2. Data Collection

The data collection phase in a bibliometric analysis demands a rigorous selection of reliable academic sources. Among the most recognized databases for scientific mapping are Google Scholar, Scopus, and Web of Science [18]. For this study, the Scopus database was chosen due to its comprehensive coverage, high update frequency, and indexing quality, aspects widely acknowledged in previous bibliometric research [13]. The methodological workflow for data extraction, cleaning, and analysis is summarized in Figure 1, which outlines the main stages of the bibliometric process.

The search strategy was structured around the fields “article title,” “abstract,” and “keywords,” using “chatbot” as the main term combined with expressions such as “emergency response” and “disaster management.” To ensure precision, Boolean operators and truncations were adjusted iteratively during a pilot phase conducted in June 2025. This pilot included iterative testing of search strings and parameter refinements, incorporating feedback from two domain experts in artificial intelligence and emergency management to enhance precision and recall. During this validation process, potential language-related biases were also addressed through the adoption of a bilingual search strategy, incorporating keyword variants in both English and Spanish (e.g., “gestión de emergencias”, “emergencias y desastres”). These bilingual terms were tested and refined to ensure semantic consistency across languages, enabling the inclusion of studies from Latin America and other Spanish-speaking regions. The search chain is illustrated in Figure 1.

To guarantee the quality and representativeness of the corpus analyzed, inclusion and exclusion criteria were defined according to best practices in bibliometric research. Only documents indexed in Scopus that met the following conditions were considered:

- Studies between 2019 and 15 July 2025;
- Belong to the documentary categories of scientific articles, reviews, and conference proceedings;
- Contain in the title, abstract, or keywords related to chatbots, emergency response, disaster management, or conversational agents in crisis situations;
- Articles in English and Spanish.

On the other hand, those publications that:

- They did not present an explicit link between conversational agents and emergency or disaster management scenarios;
- Studies that correspond to grey literature or documents are not available;
- They lacked data essential for analysis (such as author, year, or institutional affiliation);
- Languages other than English or Spanish.

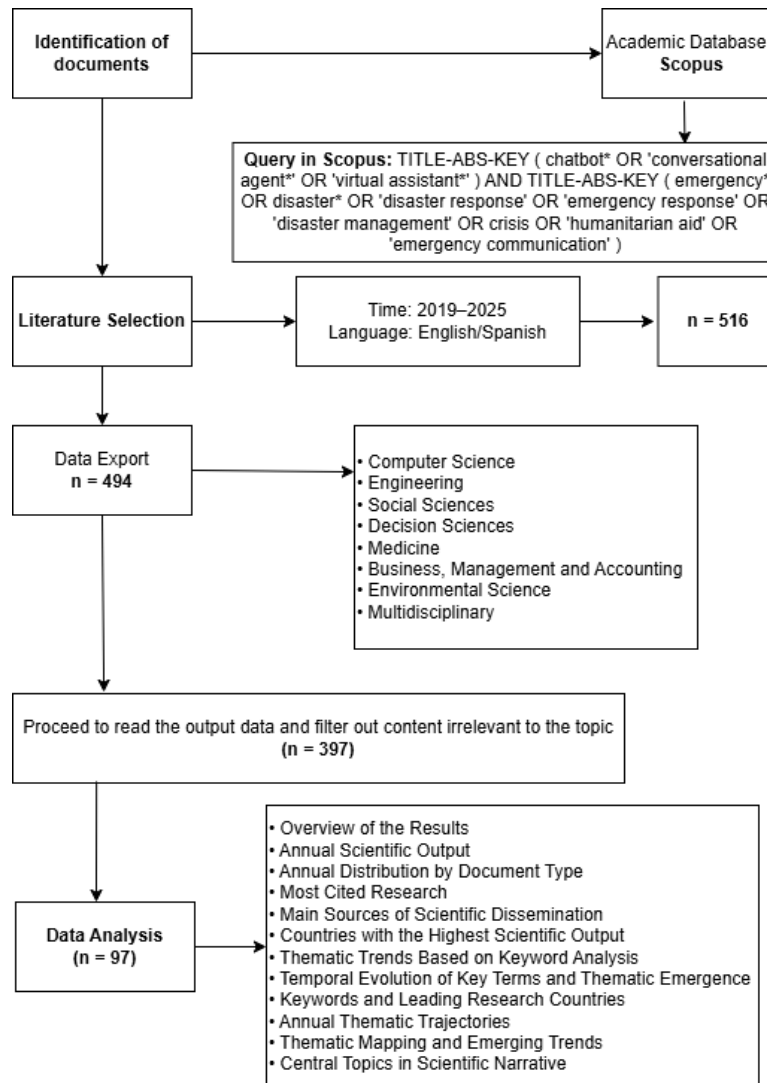


Figure 1. The actual process of conducting bibliographic analysis

After applying these debugging criteria, a final set of 97 valid records was consolidated. This number reflects a representative and up-to-date base, consistent with the recent boom in AI applications in critical contexts. Figure 1 summarizes the methodological process of search, filtering, and validation, ensuring thematic coherence and traceability of the data used in the bibliometric analysis.

2.3. Data Analysis Procedure

To effectively represent and interpret the patterns of scientific production in the field of chatbots applied to emergency and disaster response, two tools were used. In the first instance, MASHA (Metrics – Analysis – Science – Hub – Analytics) and VOSviewer. MASHA is an open-access platform designed to facilitate bibliometric analysis from data extracted from Scopus, allowing refined searches, thematic segmentations, and systematic extraction of metadata with an analytical approach. Its modular design allows the initial stage of bibliographic exploration to be optimized through customized filters and reproducible criteria [19]. For its part, VOSviewer is a software widely recognized for its ability to build and visualize high-quality scientific maps [20]. This program allows generating graphical representations of bibliometric networks based on keyword co-occurrence, citation networks, co-authorship, publication

sources, and reference co-citation. Thanks to its capabilities to project multidimensional data, VOSviewer facilitates the identification of thematic clusters, semantic relationships, and emerging academic communities within the field of study. The combination of these two tools provides a solid foundation for both quantitative exploration and visualization of knowledge, allowing more accurate conclusions to be drawn about the development, key actors, and emerging trends in the use of conversational agents in critical contexts.

3. Results

3.1. Overview of the Results

This section presents an overview of the information that constitutes the quantitative basis of the study, providing a preliminary framework to understand the evolution, characteristics, and scope of the scientific production analyzed. The bibliometric analysis carried out on scientific literature related to the use of chatbots in emergency and disaster response contexts covers the period between 2019 and July 15, 2025, which shows a time horizon of seven years. During this period, a total of 97 documents published in 75 scientific sources have been identified, including specialized journals, conference proceedings, and book chapters. All this information is summarized in Table 1.

Table 1. Summary of the main bibliometric data

Description	Results
<i>Main Information About Data</i>	
Timespan	2019 – 15.07.2025
Number of years covered	7
Sources (Journals, Books, etc.)	75
Documents	97
Annual Growth Rate	0,3417
Document Average Age	1,92
Average Citations per Doc	7,1
Citation Overview (h-index)	15
<i>Document Types</i>	
Article	50
Conference paper	41
Review	4
Book chapter	2
<i>Keyword Coverage and Density</i>	
Avg. Keywords/Doc.	5,69
Average length	14,96
Maximum length	40
Minimum length	2
<i>Authors</i>	
Authors	367
Single-authored Docs	0
Co-authorship rate (≥ 2 authors)	1
Co-authors for Doc	4,31

The annual growth rate of scientific production is 0.3417, an indicator that, although modest, shows a progressive consolidation of academic interest in the subject. The average age of the documents is 1.92 years, which demonstrates a field in recent development and with high dynamism. This fact is reinforced by an average of 7.1 citations per document and an h-index of 15, which reveals an acceptable capacity for impact and citation within a scientific community that is still emerging. In terms of document types, research articles (50 papers) predominate, followed by papers presented at conferences (41 papers), while systematic reviews (4) and book chapters (2) are underrepresented. This distribution demonstrates a predominance of exploratory and applied work, typical of technological domains under construction, where knowledge is generated more from methodological innovation than from theoretical consolidation.

Regarding the coverage and density of keywords, an average of 5.69 keywords per document is observed, with an average length of 14.96 characters, reaching a maximum of 40 and a minimum of 2 characters. This variability indicates a certain semantic dispersion in the use of terms, possibly associated with the multidisciplinary nature of the field, which

involves everything from chatbots to artificial intelligence to risk management. Regarding authorship, 367 authors were identified, without the presence of individual authorship documents, which evidences a total co-authorship rate (1), with an average of 4.31 co-authors per document. This data is especially revealing, since it points to a strong scientific collaboration, probably inter-institutional or even international, in a field that requires the integration of diverse knowledge and complementary expertise.

The results presented in Table 1 show an expanding academic ecosystem, characterized by its youth, a growing collaborative density, and a predominantly technical and experimental orientation. However, the limited presence of theoretical reviews and the terminological dispersion observed shows that the field still lacks a consolidated epistemological architecture. This circumstance represents both a weakness and an opportunity to move towards greater conceptual cohesion and sustained empirical validation that will be decisive in consolidating the place of chatbots as critical technologies in disaster management.

3.2. Annual Scientific Output

After having outlined the general characteristics of the corpus analyzed, it is now time to examine the temporal evolution of scientific production, with the aim of identifying patterns of growth, consolidation, or stagnation of academic interest around chatbots applied to emergency and disaster contexts. This analysis is essential to understand not only the maturity of the field but also its capacity for intellectual attraction and its progressive positioning within the global scientific ecosystem. Figure 2 shows the annual distribution of publications from 2019 to mid-2025. In 2019, 6 publications were registered, a figure that remained constant in 2020. In 2021, an increase of 50% was observed, reaching nine documents. In 2022, production grew significantly to 15 publications, representing an increase of 66.7% compared to the previous year.

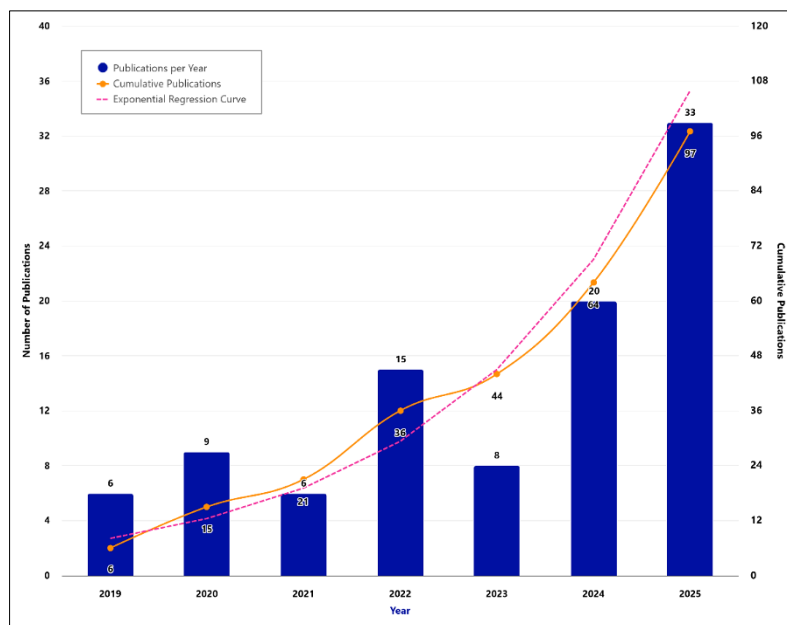


Figure 2. Annual scientific productions

However, in 2023, there was a contraction with eight publications, which represented a drop of 46.7% compared to 2022. The contraction observed in 2023, with only eight publications, appears to be related to a temporary shift in global research agendas following the COVID-19 pandemic. During this period, several studies redirected their attention to topics such as psychological assistance, digital education, and socio-technical inclusion, rather than focusing on traditional emergency management. Similarly, there has been a conceptual transition from crisis containment to post-crisis adaptation. At the same time, more participatory approaches began to emerge, with projects focused on joint design with local communities and the use of messaging platforms or IoT systems for early warning, evidencing growing intercontinental collaboration between Europe, Latin America, and Asia. Meanwhile, in 2024, a 150% rebound was observed, reaching 20 studies, and as of July 15, 2025, 33 documents were already counted, an additional increase of 65% compared to the previous year. In total, 97 publications were registered during the period analyzed. The cumulative curve in Figure 2, adjusted by exponential regression, confirms a sustained and growing interest, reflecting the progressive consolidation of the field within the scientific ecosystem of artificial intelligence applied to emergency management. The behavior of production is consistent with what has been reported in other emerging technological areas. Wibowo et al. [10] identify a sustained increase in artificial intelligence in disaster management, although they caution against the need to disaggregate specific subdomains, such as conversational systems, to better understand their

development and collaboration networks. Similarly, Argumedo-García et al. [21] demonstrated that productivity peaks often coincide with global crises, stimulating interdisciplinary cooperation, but noted the lack of conceptual coherence between studies. In this case, the recovery seen in 2024 and 2025 could be attributed to renewed interest in conversational technologies powered by extensive language models and their increasing adoption in public communication and risk management.

At the applied level, various studies show how this quantitative expansion responds to the search for scalable and AI-assisted solutions in highly vulnerable environments. Tahernejad et al. [22] show an increase in studies on automated triage in emergencies, although they highlight the methodological heterogeneity and the scarcity of rigorous clinical validations. Meanwhile, Urbanelli et al. [23] analyzed the development of operational chatbots for comprehensive emergency management, finding significant advances in communication and response, but also gaps in benchmarking and standardization of metrics. In summary, the findings show that the increase in the volume of publications must be accompanied by greater theoretical and methodological consistency that allows the expansion of the field to be transformed into sustained scientific progress with verifiable social impact.

3.3. Annual Distribution by Document Type

Analyzing the quantitative evolution of scientific production requires examining how knowledge dissemination formats have been distributed over time to understand which channels of scholarly communication have been favored in this emerging field. Figure 3 shows that conference papers maintained a consistent presence from 2019 to 2025, with slight variations. During the first three years, three presentations were recorded annually, a number that tripled in 2022 to nine. In 2023, a minor contraction occurred, with seven papers, followed by a rebound in 2024 with 11 and a steady count of five in 2025. This persistence indicates that conferences continue to serve as spaces for rapid validation and collaborative dialogue, especially during the initial stages of research development.

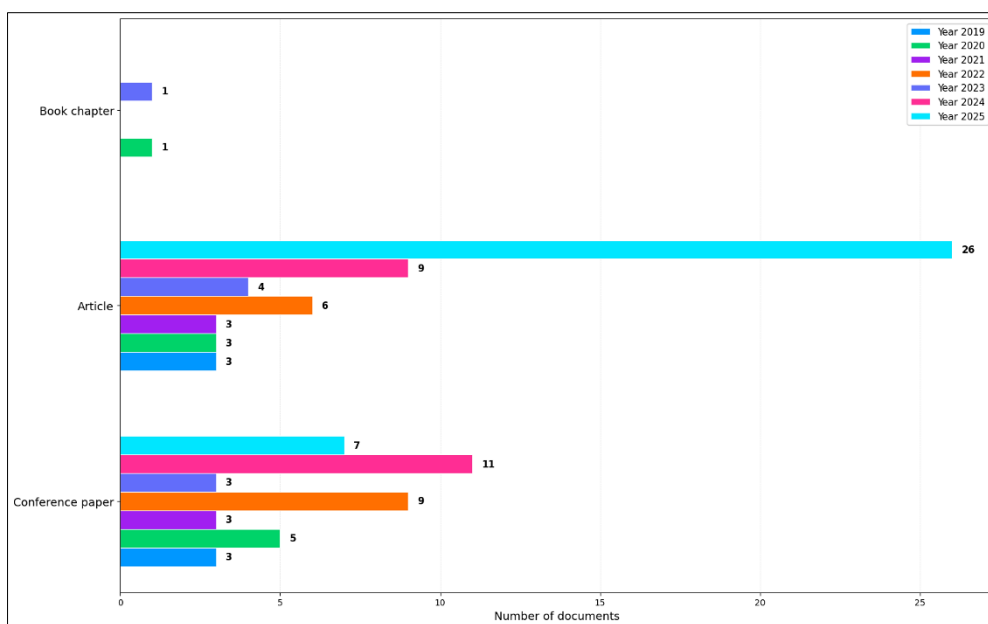


Figure 3. Annual publications by type of document

Journal articles show a more marked trajectory, revealing a clear change in the publication pattern. From an average of three articles per year between 2019 and 2021, production increased to six in 2022 and nine in 2024, reaching a peak of 26 articles in 2025, representing 52% of the cumulative total. This progression confirms a gradual shift from preliminary dissemination to consolidation in peer-reviewed journals. This pattern coincides with the observations of Wibowo et al. [10], who report that conference proceedings constitute almost half of all publications on artificial intelligence applied to disaster management and serve as an essential platform for preliminary validation prior to formal publication in journals. These trends show that conferences continue to function as entry points for collaboration and dissemination, especially during the exploratory stages, when research agendas are still being consolidated.

Journal articles show a steeper growth trajectory, with marked increases during 2024 and 2025 that indicate greater methodological and theoretical formalization. This evolution mirrors the conference-to-journal transition described by Kim [24], who found that authors in computer science tend to begin publishing collaboratively in conferences but later consolidate their findings in peer-reviewed journals, demonstrating the complementary role of both publication channels. Likewise, Wu et al. [25] observed that articles derived from conference work tend to receive more citations than standalone proceedings but fewer than standard journal papers, reflecting a qualitative progression when research migrates from conference presentation to journal validation.

In contrast, book chapters remain marginal, with only two records between 2020 and 2021 and no continuity thereafter, suggesting limited integration of the topic into theoretical or interdisciplinary volumes. This scarcity parallels findings by Aktas et al. [26], who analyzed multi-criteria decision-making in disaster management and found that most scholarly communication occurs through journal articles and conference papers, while chapters remain underrepresented. The pattern underscores a broader tendency toward specialized, data-driven dissemination rather than synthetic or conceptual works. Expanding the field's presence in edited volumes could encourage broader theoretical frameworks and strengthen interdisciplinary dialogue linking chatbots, artificial intelligence, and disaster resilience.

3.4. Most Cited Research

After examining the temporal evolution and typology of the documents, it is important to identify those studies that have achieved the greatest impact on the scientific community, measured according to their accumulated citations. This analysis allows us to recognize not only the most influential works but also the themes and approaches that have set trends in research on chatbots applied to emergency and disaster management. Table 2 summarizes the most representative studies.

Table 2. Ten most cited studies

Ref.	Title	Citations	%
Jiang et al. (2022) [27]	Chatbot as an emergency exist: Mediated empathy for resilience via human-AI interaction during the COVID-19 pandemic	76	0,2043
Bhuvana & Arul (2019) [28]	Facebook and WhatsApp as disaster management tools during the Chennai (India) floods of 2015	55	0,1478
Maniou & Veglis (2020) [29]	Employing a chatbot for news dissemination during crisis: Design, implementation and evaluation	53	0,1425
Tsai et al. (2019) [30]	Ask Diana: A keyword-based chatbot system for water-related disaster management	41	0,1102
Rodríguez-Arrastia et al. (2022) [31]	Experiences and perceptions of final-year nursing students of using a chatbot in a simulated emergency situation: A qualitative study	30	0,0806
Shinde et al. (2021) [32]	Healthcare Chatbot System using Artificial Intelligence	28	0,0753
Chan & Tsai (2019) [33]	Question-answering dialogue system for emergency operations	26	0,0699
Ouerhani et al. (2020) [34]	SPeCECA: a smart pervasive chatbot for emergency case assistance based on cloud computing	24	0,0645
Boné et al. (2020) [35]	Disbot: A Portuguese disaster support dynamic knowledge chatbot	20	0,0538
Christopherjames et al. (2021) [36]	Natural Language Processing based Human Assistive Health Conversational Agent for Multi-Users	19	0,0511

As mentioned above, Table 2 shows the ten most cited studies in the corpus analyzed, reflecting those works that have had the greatest influence on the development of knowledge about chatbots applied to emergency and disaster management. These studies not only stand out for their number of citations, but also for the innovative approaches and the impact they have generated in academic and professional communities. A detailed analysis of each is presented below. The most cited study corresponds to Jiang et al. [27], with 76 citations, and addresses the concept of AI-mediated empathy in crisis situations, particularly during the COVID-19 pandemic. This work proposes that chatbots can go beyond informational functionality to take on an emotionally containing role, supporting people's resilience through empathetic interactions. This is an essential contribution that breaks with the technical vision and proposes a turn towards the affective dimension of conversational artificial intelligence.

Secondly, the study of Bhuvana & Aram [28], with 55 quotes, explores the use of Facebook and WhatsApp as community tools for disaster management during the Chennai floods. Although not exclusively focused on chatbots, the work lays the foundation for understanding how messaging platforms can be adapted to structure collective information flows, organizing spontaneous responses with great efficiency. It is a reference study for the design of chatbots integrated into existing communication systems. The work of Maniou & Veglis [29], with 53 citations, studies the role of chatbots in disseminating news during crises. Its focus is on digital media and the use of conversational agents to distribute verified information in a fast and personalized way. This approach poses a robust alternative to disinformation and offers guidelines for the ethical automation of journalism in emergency contexts.

The fourth study, Tsai et al. [30], develops Ask Diana, a keyword-based chatbot geared towards flood management. The proposal focuses on offering immediate and contextually relevant responses to citizens exposed to hydrometeorological events, demonstrating how a simple conversational design can generate high social impact in critical scenarios. In fifth place, Rodríguez-Arrastia et al. [31], with 30 quotes, analyze the experience of nursing students interacting with a chatbot in emergency simulations. The study reveals how these tools can improve clinical training in high-stress scenarios, favoring the development of practical skills before actual exposure. This is a novel approach that links chatbots with experiential health education. Shinde et al. [32], on the other hand, present a conversational system based on artificial intelligence for automated medical care. Their study addresses not only the technical design but also the performance of the chatbot in adverse conditions, where the overload of hospital systems demands efficiency and permanent availability.

Chan & Tsai [33] developed a question-and-answer dialogue system for emergency operations. Their model proposes a structured, hierarchical logic that allows users to navigate between options and quickly access key recommendations. This approach is relevant in environments where immediate decisions are vital, such as fires, earthquakes, or health crises. Eighth, the work of Ouerhani et al. [34] introduces SpeECCA, an intelligent cloud-hosted chatbot, designed to provide ubiquitous assistance during emergencies. This model represents a leap towards scalable and resilient architectures, capable of operating with multiple users simultaneously and adapting to variable contexts. Boné et al. [35] developed Disbot, a Portuguese national solution focused on natural disasters. Its proposal stands out for integrating natural language analysis with an intuitive interface, and for evaluating user acceptance and trust in the system, aspects that are rarely addressed in technical studies. Finally, Christopherjames et al. [36] present a multi-client conversational agent oriented to the field of health, using natural language processing. This study sits at the intersection of artificial intelligence, personalized healthcare, and scalable design, opening new possibilities for simultaneous interventions in diverse communities.

The most cited body of research reveals the richness and thematic diversity of the field. From emotional support to operational logistics, from health education to massive data processing, chatbots are emerging as a multipurpose tool in dealing with emergencies. However, this panorama also exposes gaps that cannot be ignored. The most influential studies tend to privilege a functional approach, often focused on efficiency and responsiveness, but with little theoretical, epistemological, or normative development. The ethics of automation, uncontrolled algorithmic biases, digital exclusion in vulnerable populations, or the socio-psychological impacts of interacting with machines during traumatic experiences remain as side issues, when they should be at the center of the debate. Added to this is a notorious lack of intercultural approaches that address real-world linguistic, technological, and cultural diversity, as well as the absence of longitudinal studies to assess the sustained performance of these systems under field conditions. In this sense, celebrating the high number of citations without paying attention to the quality, depth, and responsibility of the research is a form of incomplete recognition. If the field wishes to evolve towards a true instrument of social transformation, it will be essential to abandon the fascination with technological novelty to embrace a more critical, humanistic, and sustainable vision of artificial intelligence applied to emergency management.

3.5. Main Sources of Scientific Dissemination

Based on the analysis of the most influential works, it is also necessary to examine the role that scientific journals have played in consolidating the field. It is not only a matter of counting where it is published the most, but also of identifying which publishing spaces are acting as key platforms to legitimize, make visible, and disseminate emerging knowledge about chatbots applied to emergency and disaster management. This dimension allows us to understand not only the thematic trajectory but also the logic of circulation and scientific validation. According to the data presented in Table 3, the International Journal of Disaster Risk Reduction (Elsevier) leads with six publications and 88 citations, resulting in an average impact of 14.67. Its leadership is not only due to the volume, but also to the ability to attract research with high academic projection. This journal has managed to consolidate itself as a multidisciplinary reference, articulating debates between risk management, technology, and social innovation. Secondly, the Proceedings of ISCRAM, a recognized technical and scientific forum in the field of crisis response, brings together four articles with a total of 22 citations, reflecting its role as a privileged space for experimental proposals, emerging methodologies, and frontier explorations. It is followed by Springer's Lecture Notes in Networks and Systems series, with eight citations in 4 papers, which represents a technical path more oriented to applied engineering and the presentation of recent developments in computational environments.

Table 3. The ten most cited journals in the field of study

No.	Journal	Publisher	Number of Works	Total Citations	Average Impact
1	International Journal of Disaster Risk Reduction	Elsevier Ltd.	6	88	14,67
2	Proceedings of the International ISCRAM Conference	ISCRAM	4	22	5,5
3	Lecture Notes in Networks and Systems	Springer	4	8	2
4	American Journal of Emergency Medicine	W.B. Saunders	3	10	3,33
5	Dental Traumatology	John Wiley & Sons Inc.	2	6	3
6	ACM International Conference Proceeding Series	ACM	2	2	1
7	Future Internet	MDPI	2	2	1
8	2020 5th International Conference on Computer and Communication Systems, ICCS 2020	IEEE	2	36	18
9	Journal of Advances in Information Technology	Engineering and Technology Publishing	2	4	2
10	AIP Conference Proceedings	American Institute of Physics Inc.	2	0	0

Other relevant journals include the American Journal of Emergency Medicine (3 articles, 10 citations), with a clinical profile that reflects the insertion of the chatbot in the health ecosystem; and the journal Dental Traumatology, which is surprising with two papers and six citations, suggesting an initial exploration of the chatbot in emergency dental contexts. This finding, although marginal, reveals how even disciplines traditionally far from the digital field are beginning to adopt conversational tools, which deserves attention. Also noteworthy is the inclusion of specialized conferences such as the International Conference on Computer and Communication Systems (ICCCS 2020), which, with only two papers, accumulated 36 citations, evidencing that certain academic events generate high-impact contributions, even above consolidated journals. This phenomenon is important because researchers often underestimate the strategic value of publishing in select conferences, which are cutting-edge spaces that provide quick visibility and direct contact with global networks.

The analysis of the most cited journals reveals that the visibility of a field depends not only on scientific production but also on the editorial architecture that supports it. Journals act as mediators of academic prestige, as they not only select works based on their technical quality but also on their ability to engage with a thematic agenda considered strategic. This selection constructs invisible hierarchies that determine which lines of research are recognized and which remain on the periphery. A clear example is represented by publications in large publishers such as Elsevier, Springer, or IEEE, which concentrate global attention and become showcases of legitimacy. However, this phenomenon raises a question about the risk of dependence on dominant publishing circuits that can limit the diversity of approaches, especially those that are more disruptive or interdisciplinary.

On the other hand, the impact of some conferences, which surpass consolidated journals in the number of citations, reveals that influence is not always associated with traditional prestige. These platforms allow the early circulation of cutting-edge ideas, generating agile discussions that can set the course for new research. This aspect is often underestimated by many authors, who prioritize the impact factor without recognizing that innovation is often born in less rigid spaces, but is more permeable to debate and experimentation. The real challenge for researchers is to understand that publishing is not only a quantitative goal but also a way of participating in an ongoing intellectual dialogue. The choice of journal should be guided not only by the impact index but also by the media's ability to connect with a like-minded academic community and to project the work towards emerging debates. A publication with high thematic coherence, methodological rigor, and a well-positioned narrative has more chances of transcending than an article randomly placed in a renowned journal. Editors value a clear vision, solid argument construction, and the potential for long-term influence. Taking this critical perspective is essential not to reduce research to an exercise in metrics but to turn it into a genuine contribution that shapes the future of the field.

3.6. Countries with the Highest Scientific Production

After having examined the leading journals that support and project the development of the field, it is pertinent to investigate the geography of scientific production. Understanding which countries are leading the publication of research on chatbots applied to emergencies not only allows us to identify centers of intellectual activity but also to unveil global dynamics of leadership, collaboration, and knowledge concentration. Table 4 shows that India ranks first in terms of volume, with 16 papers representing 25.4% of the total, and an outstanding figure of 120 cumulative citations. Its average impact of 7.5 citations per publication reveals a strong presence not only quantitatively, but also qualitatively. This positioning can be explained by the country's rapid technological expansion, investment in artificial intelligence applied to public services, and the existence of active academic communities at the intersection between ICT and disaster management.

Table 4. Top 10 most productive countries

Rank	Country	Words	%	Citations	%	Average Impact
1st	India	16	0,254	120	0,2864	7,5
2nd	United States	11	0,1746	23	0,0549	2,09
3rd	Germany	6	0,0952	23	0,0549	3,83
4th	Taiwan	6	0,0952	112	0,2673	18,67
5th	Peru	5	0,0794	9	0,0215	1,8
6th	Japan	4	0,0635	49	0,1169	12,25
7th	Spain	4	0,0635	52	0,1241	13
8th	Turkey	4	0,0635	6	0,0143	1,5
9th	Italy	4	0,0635	5	0,0119	1,25
10th	Portugal	3	0,0476	20	0,0477	6,67

In second place, the United States contributes 11 publications (17.46%) and 23 citations, which reduces its average impact to 2.09. Despite its historical centrality in science and technology, its influence in this specific field appears

moderate, perhaps due to thematic dispersion or the focus on other emerging technologies that are more consolidated in its national agenda. Taiwan, with only six jobs, shows an average impact of 18.67, the highest among all the countries listed. This data, notable for its contrast between low volume and high influence, indicates a publication strategy focused on quality, innovation, or international visibility.

Something similar occurs with Japan (impact of 12.25) and Spain (13), which, although they do not lead by volume, manage to position their works with a high level of citation. As for Peru, it is in fifth place, with five publications that accumulate nine citations, which represents a still modest average impact. However, its presence in this ranking signals an incipient insertion in the global conversation about conversational technology and disasters. Portugal, with only three publications, has an average impact of 6.67, indicating that specific works have received a good reception. Meanwhile, Germany, Italy, and Turkey complete the list with relevant but irregular participations in terms of impact. Overall, the data reveal a geographically diverse participation, although disparities persist between scientific production and its level of influence. To illustrate this relationship, Figure 4 shows the overlap of the most influential countries. In the graph, the X-axis represents the number of published papers, while the Y-axis indicates the number of citations each country has received.

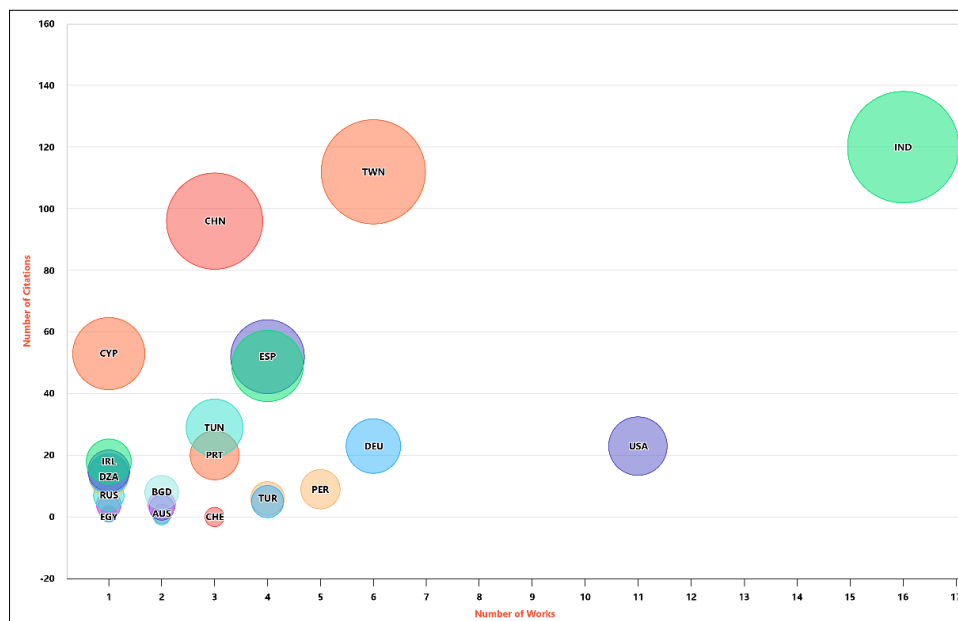


Figure 4. Works and citations by country

Scientific production is not only measured by the number of articles, but also by the way in which they transform academic debate and guide future agendas. The concentration of publications in certain countries could be interpreted as a sign of structural strength, although the uneven impact suggests that visibility does not always accompany volume. Some countries manage to position themselves with a few, but highly influential, works, which indicates a more precise editorial commitment, strategic alliances, or a particular sensitivity to emerging issues. This reality invites us to rethink the models of measurement of scientific leadership. Hegemony in publications must give way to a more qualitative assessment, where not only productivity is recognized but also the ability to connect fields, formulate original questions, and anticipate transformations. The case of countries such as Taiwan or Spain confirms that impact can be built with editorial intelligence and thematic focus.

On the other hand, the emergence of Latin American countries such as Peru opens a window of opportunity for the Global South, which must consolidate cooperation and open access networks if it wants to sustain its presence in this conversation. A more equitable scientific geography requires not only funding research but also democratizing its channels of legitimation. The science of the future cannot depend on a few centers but on multiple voices capable of building solutions from their own contexts. After analyzing the ten countries with the highest production in the field of study, a treemap is presented in Figure 5 that shows, in a general way, the distribution of scientific production by country. This graphical representation facilitates the identification of relevant patterns in the academic field, since it allows us to simultaneously observe both the magnitude and the influence of the work carried out by each nation. The size of each block within the treemap corresponds to the total number of scientific publications generated, which gives a clear idea of the volume of production. On the other hand, the number of citations associated with each block provides a measure of the impact of this production, which makes it possible to distinguish between countries with high productivity but little impact and those that, although with a lower volume, have achieved a notable influence in the scientific community.



Figure 5. Treemap of scientific production by country

Although India, the United States, and Taiwan dominate in terms of citations and publication volume, countries such as Peru, Turkey, Italy, and Portugal have comparatively fewer citations. This difference is largely due to the fact that most of their contributions have been published recently, concentrated between 2023 and 2024, and have not yet had enough time to accumulate citations. Therefore, these countries show limited participation in international co-authorship networks, a factor that often amplifies the global visibility of scientific work. However, their emerging presence is significant, as it reflects the decentralization of research on AI-powered chatbots beyond traditional academic centers in Europe and North America. The relatively modest impact indicators in these regions should not be interpreted as a lack of relevance, but rather as evidence of structural disparities in research funding and access to collaborative infrastructures. In this regard, academic organizations in the aforementioned countries need to promote equitable participation in transnational projects in order to improve access to open research platforms, which could foster greater inclusion and increased citation impact in the long term for these developing research communities.

To complement the above, it is important to note that beyond quantitative productivity, the studies cited reflect different ethical and user-centered approaches depending on regional research cultures. For example, work from the United States and Germany tends to emphasize human-centered design and transparency in the use of AI-powered chatbots, reflecting greater ethical alignment in technological development. In contrast, countries such as India, Taiwan, and Peru prioritize functional efficiency and the deployment of conversational agents for communication in health or disaster situations, often in response to infrastructural constraints. This diversity reveals that the ethical dimension of chatbot research is not homogeneous but context-dependent and determined by local priorities and socio-technical realities. Regarding citation dynamics, the analysis did not include self-citation filtering, as the scope of the study focused on mapping overall influence rather than author impact. However, no evidence of excessive citation concentration in any particular region was observed, pointing to an increasingly diverse and collaborative international research landscape.

3.7. Thematic Trends According to Keyword Analysis

Understanding the evolution of a research field requires examining not only its most productive authors, countries, or journals but also the vocabulary that shapes its conceptual identity. Keywords provide a semantic cartography that maps the cognitive structure and intellectual priorities of a scientific community. As shown in Figure 6, the central term is

3.8. Temporal Evolution of Key Terms and Thematic Emergence

After examining the overall semantic density of the field, it becomes essential to understand how the academic discourse on artificial intelligence (AI)-based chatbots for emergency and disaster management has evolved over time. Analyzing not only which terms are most frequent, but also when they emerge and how long they persist, makes it possible to identify cycles of scientific attention and thematic transitions that reflect the shifting priorities of the research system. This temporal analysis, illustrated in Figure 7, displays the 25 keywords with the highest burst intensity between 2019 and 2025, offering insight into how global crises, technological advances, and institutional demands have shaped the scientific vocabulary of this domain.

Within this panorama, “artificial intelligence” stands out with the highest burst strength (12.00) and sustained relevance from 2020 to 2025, followed by “chatbots” (6.50), “human” (5.20), “COVID-19” (4.20), and gender-related terms such as “female” (4.00) and “male” (4.00). This constellation reflects a discourse in which technology is closely intertwined with human dimensions and contexts of vulnerability. Terms such as “COVID-19” and “disasters” show brief but intense peaks, responding to the immediate impact of the pandemic and specific catastrophic events. In contrast, expressions like “machine learning,” “natural language processing,” and “virtual assistants” maintain a continuous presence, revealing their consolidation as structural foundations in the development of conversational solutions for emergency response. A similar behavior was identified by Sajja et al. [40] in their review of conversational intelligence, where initial technological surges gave way to the stabilization of core concepts once technical maturity was reached. From this evolution, it becomes evident that research on chatbots in emergency contexts does not follow a linear trajectory but rather responds to impulses driven by global crises and technological transformations.

Keyword	Strength	Begin	End	2019 – 2025
artificial intelligence	12.00	2020	2025	
chatbots	6.50	2020	2025	
human	5.20	2020	2025	
covid-19	4.20	2020	2022	
female	4.00	2020	2025	
male	4.00	2020	2025	
natural language processing	3.57	2019	2025	
chatbot	3.29	2019	2024	
article	3.00	2022	2025	
disaster management	2.67	2019	2019	
machine learning	2.57	2019	2025	
humans	2.33	2022	2025	
disasters	1.86	2019	2020	
virtual assistants	1.67	2022	2022	
adult	1.50	2020	2025	
first aids	1.33	2020	2024	
deep learning	1.33	2022	2022	
language processing	1.25	2022	2025	
natural languages	1.25	2022	2025	
conversational agents	1.25	2021	2025	
emergency	1.25	2020	2024	
emergency care	1.00	2023	2025	
health care	0.75	2021	2021	
natural language processing systems	0.67	2019	2022	
emergency services	0.67	2020	2024	

Figure 7. Top 25 keywords with the strongest bursts

The persistent centrality of terms such as “artificial intelligence” and “chatbots” reveals the consolidation of a techno-scientific agenda oriented toward automation and operational efficiency, often at the expense of social or ethical reflection. Yuan et al. [41] noted that most AI-based systems for emergencies prioritize resource optimization over equity in communication or informational justice, thereby reproducing a structural bias that favors functional response rather than human resilience. This trend, also observable in our corpus, suggests that the field continues to privilege instrumental innovation over a more comprehensive understanding of the sociotechnical processes underlying crisis management.

In the past two years, the emergence of terms such as “generative AI,” “large language models,” and “explainability” has marked a turning point in the thematic maturity of the field. This new lexicon denotes a transition from reactive chatbots to autonomous systems capable of interpreting context and providing meaningful explanations. Rong et al. [42] emphasized that recent research on human-centered explainable AI seeks to design interactions in which transparency and trust are as relevant as technical accuracy. Similarly, Kim et al. [43] analyzed how user-centered evaluation is redefining the purpose of explainable systems by placing human understanding at the core of system development. These contributions demonstrate that chatbots for emergency response are evolving toward collaborative models oriented toward providing both informational and emotional support in critical scenarios.

Nevertheless, significant gaps remain. The limited presence of terms associated with accessibility, diversity, or governance reveals that ethical and cultural dimensions still lag behind technical progress. Aboelmaged et al. [44] argue that although conversational agents are increasingly expanding into social and healthcare domains, literature continues to lack inclusive methodological frameworks that account for differences in age, language, or ability. In the same vein, Sadek et al. [45] highlighted the relevance of co-design as a mechanism to incorporate citizen perspectives in the creation of conversational agents, ensuring legitimacy and usability in crisis contexts. These approaches reaffirm that scientific progress in this field should not be measured solely by technical sophistication but by its capacity to integrate ethical sensitivity, human participation, and cultural diversity into the architecture of conversational systems.

In the same vein, analysis of the keyword for the period 2024–2025 has identified the presence of terms linked to generative AI, large language models, and explainability, which points to a shift toward more reflective discourse on the use of chatbots in emergencies or disasters. However, as mentioned above, there is a lack of dimensions that recognize community dynamics, cultural diversity, and inclusive communication during critical situations. Future studies should explore how chatbots can be adapted to local contexts, respect cultural sensitivities, and strengthen trust between authorities and the affected population. Integrating these variables into the formulation of response and early warning strategies would not only improve technological performance but also strengthen empathy, mutual understanding, and communicative effectiveness in AI-mediated emergency management.

3.9. Keywords and Leading Research Countries

After identifying the most productive countries and assessing their relative impact, it becomes essential to understand how each contributes to the thematic configuration of the field. Beyond publication volume, what matters is the orientation of national research agendas, the types of scientific languages they consolidate, and the technological narratives they reinforce. This perspective allows nations to be interpreted not merely as producers of knowledge but as architects of global imaginaries surrounding artificial intelligence-based chatbots for emergency and disaster management. Figure 8 presents a Sankey-type visualization that links the most frequently cited keywords to their countries of origin, showing the distinct semantic orientations and technological priorities of global research.

Within this landscape, India emerges as the leading contributor with a strong technological and engineering orientation. Dominant keywords such as “chatbot,” “machine learning,” and “natural language processing” reveal a focus on developing functional conversational systems, particularly in medical and educational domains. Chellasamy et al. [46] emphasized that India’s strength lies in the synergy between academia and the technology sector, driving the design of diagnostic and decision-support chatbots in public health. However, the literature remains largely centered on technical optimization with limited exploration of user experience or ethical governance, an imbalance that challenges the social sustainability and acceptance of these systems in real-world crisis communication. The United States displays a more human-centered and interaction-oriented profile. Its dominant terms, including “disaster preparedness,” “alert notification,” “human–AI collaboration,” and “generative chatbots,” indicate a commitment to trust, transparency, and cultural adaptability in emergency communication. Karimiziarani et al. [47] documented that American research prioritizes frameworks of human–AI interaction that integrate generative models into alert systems while emphasizing both responsiveness and interpretability. This approach has contributed to a socially grounded scientific culture where conversational technologies are optimized for efficiency but also designed to foster empathy and clarity during critical decision-making processes.

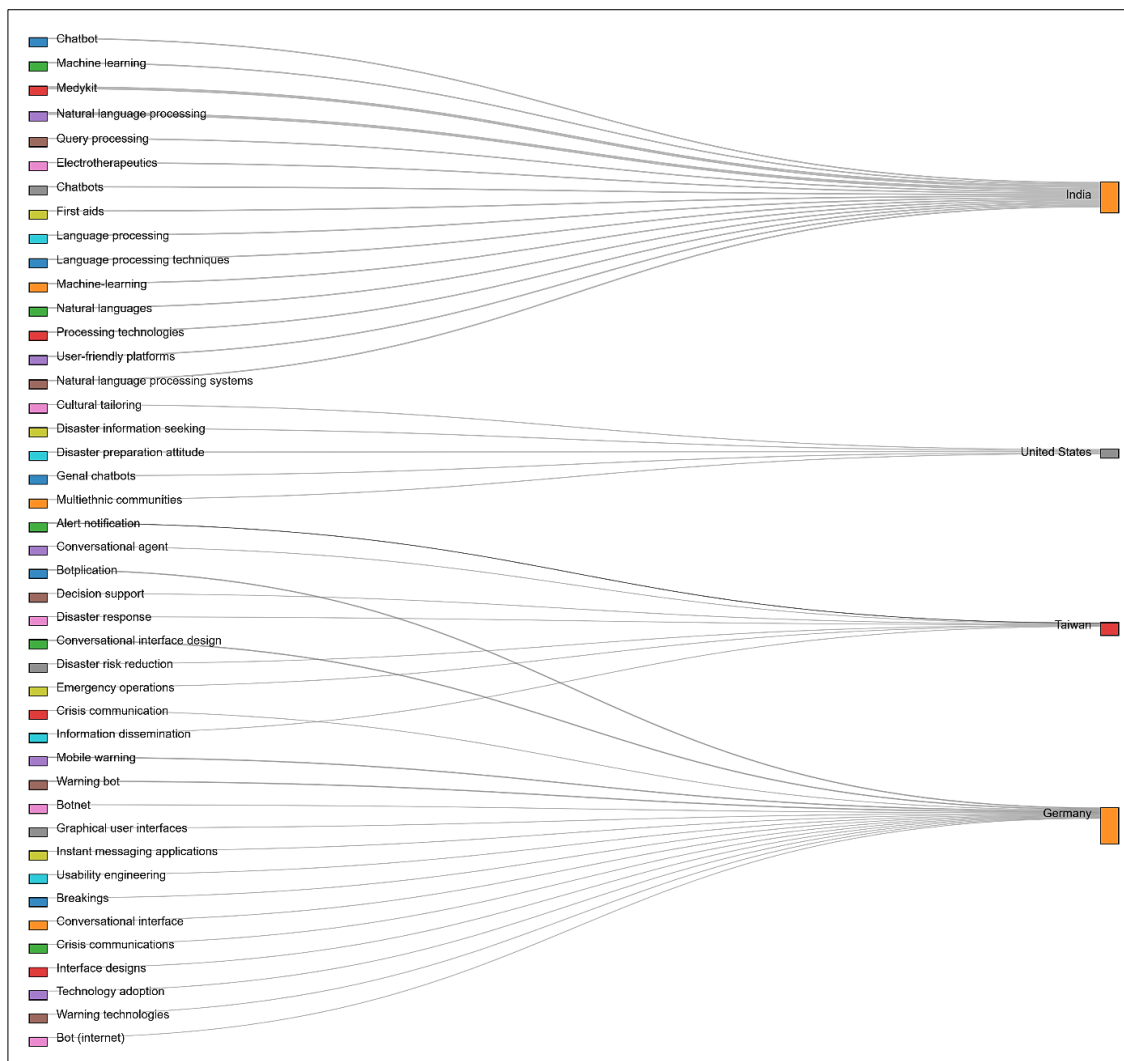


Figure 8. Keyword frequency by country (Topmost cited)

Taiwan’s research trajectory reflects a focus on resilient infrastructures and real-time crisis communication. Keywords such as “decision support,” “crisis communication,” and “mobile warning” demonstrate an emphasis on interoperability and the robustness of communication networks. Chang et al. [48] reported that Taiwan’s government has advanced civic AI strategies that promote data sharing and participatory governance, reinforcing technological resilience against natural disasters. Meanwhile, Germany presents a broader thematic diversity, balancing interactive system design with ethical evaluation. Ghaffarian et al. [49] highlighted that German research has contributed significantly to the conceptualization of explainable and human-centered interfaces, proposing methodological frameworks for the evaluation of conversational AI in high-risk environments. The thematic distribution among countries reveals a geopolitics of knowledge that is far from neutral. Each nation produces science through the lens of its institutional capacities, historical contexts, and technological priorities. India prioritizes functional efficiency, the United States focuses on user experience, Taiwan strengthens infrastructural resilience, and Germany emphasizes ethical legitimacy. Cantini et al. [50] pointed out that such heterogeneity reflects not only innovation diversity but also epistemic asymmetries that shape global cooperation in AI research. The future of AI-based chatbots for emergency and disaster response depends on recognizing these differences as opportunities for a more dialogical and plural science where methodological diversity and cultural inclusivity form the foundation of technological resilience.

3.10. Annual Thematic Trajectories

As the field of study consolidates, it is essential to observe how specific topics are maintained, fluctuate, or disappear over time. Keywords don't just set trends; they also express what's considered scientifically relevant in a given period. Analyzing their annual distribution allows us to detect cycles of attention, explore the helpful life of concepts, and anticipate possible shifts in the research agenda.

Figure 9 shows a heat matrix with the annual frequency of the top keywords between 2019 and 2025. The term "Chatbot" has been a consistent presence since its inception, with notable spikes in 2019 (8), 2020 (9), 2024 (10), and

2025 (9), indicating sustained interest with intermittent upticks. Its plural, "chatbots", shows a more recent rise, especially in 2024 (10) and 2025 (13), which could indicate a transition from studying the phenomenon as a general concept to analyzing its multiple applications or varieties.

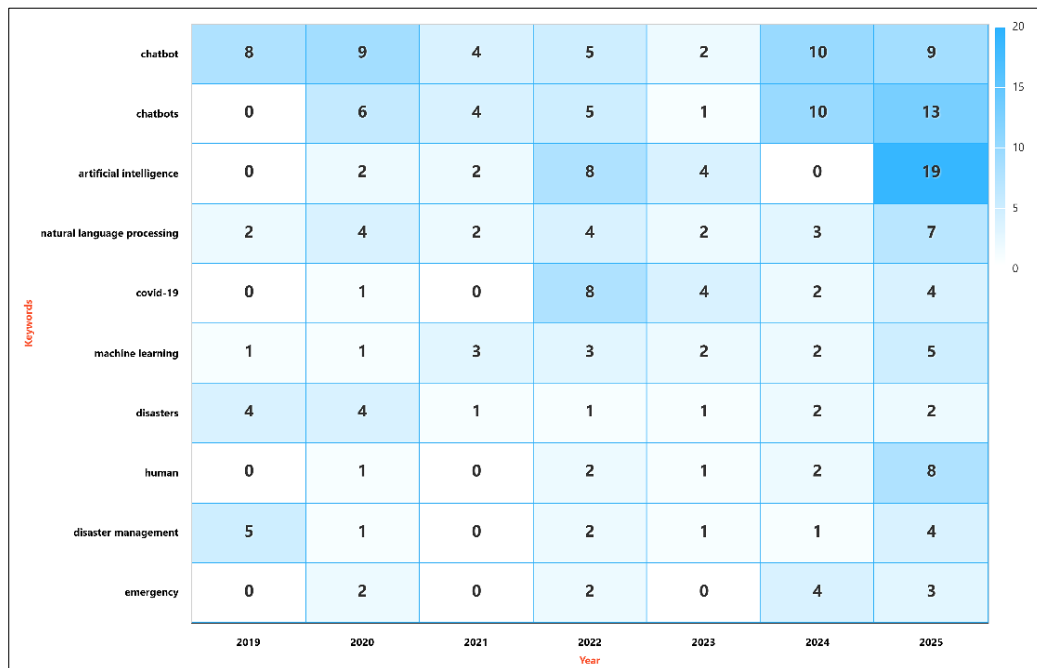


Figure 9. Keywords frequency per year

On the other hand, the term "Artificial Intelligence" reflects a sharp rise. From being barely mentioned in 2020 and 2021, its appearance intensifies in 2022 (8), with outstanding growth in 2025 (19), becoming the term most frequently used that year. This trajectory suggests that the field is absorbing recent developments in generative AI and deep learning, partially shifting to more specific or sectoral terms. Other keywords such as "natural language processing", "machine learning", and "human" have a more moderate but upward curve, consolidating their presence towards the most recent years. On the other hand, "COVID-19" exhibits a different pattern after a peak in 2022 (8); its use is rapidly decreasing, highlighting its conjunctural nature as a focus of research.

However, terms such as "disaster management", "disasters", and "emergency" have maintained a relatively low and stable presence, with no explosions or disappearances. This behavior can be interpreted as a sign that these concepts structure the field as a background framework, but they are not the true engines of semantic innovation. To complement this analysis, Figure 10 synthesizes, in a clear and minimalist timeline, the most recurrent keywords per year, reflecting how certain terms have monopolized scientific attention at different times during the period analyzed. Between 2019 and 2021, "chatbot" consistently dominated, reaffirming its role as a structuring node of the emerging field. The year 2022 bursts in with one significant exception: "COVID-19" is positioned as the central term, revealing the field's ability to adapt quickly to real emergencies and resignify its approach according to the global context. In 2023, a turning point is marked, "artificial intelligence" takes center stage, a displacement that deepens in 2025 with a peak of 19 appearances, consolidating its centrality. The alternation in 2024, where "chatbot" momentarily regains leadership, shows a symbolic competition between instrumental technologies and structural concepts.

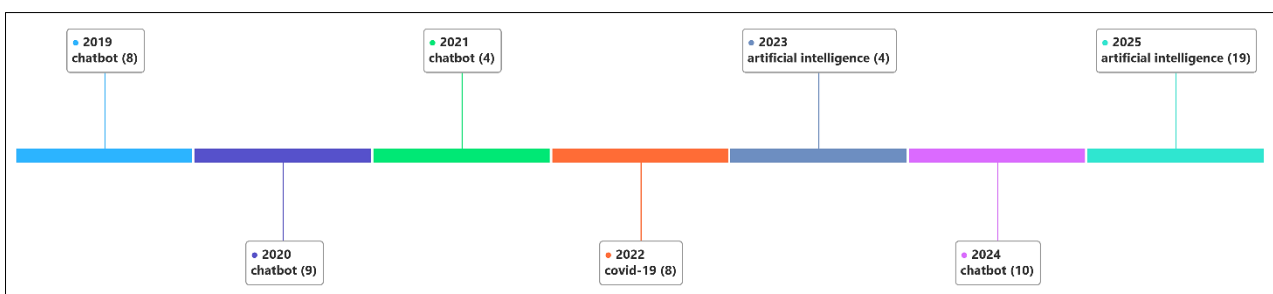


Figure 10. Timeline of most frequent keywords

The yellow cluster, composed of terms such as “chatbot,” “emergency,” and “COVID-19,” functions as a bridge between the technical and human domains. This thematic zone reflects how the pandemic acted as a catalyst for empirical validation of chatbots in real-world scenarios. Zhao et al. [53] demonstrated that AI-powered chatbots played an essential role in disseminating information and providing initial medical guidance during COVID-19, yet their deployment also exposed limitations in multilingual and multicultural contexts, underlining the need for cultural sensitivity in design. This hybridization of technology, communication, and health marks a pivotal moment in the evolution of the field toward collaborative systems capable of integrating both emotional and cognitive support in times of crisis. Finally, the purple cluster and peripheral nodes encompass emerging yet strategic research areas, including “disaster risk reduction,” “decision support,” and “mobile warning.” These concepts indicate a shift toward proactive models that integrate predictive analytics, data visualization, and intelligent early-warning mechanisms. As Ghaffarian et al. [49] noted, the development of such systems must balance technical precision with social responsibility to ensure that automation does not exclude ethical and human considerations in disaster management.

The analysis of emerging trends through co-occurrences has made it possible to understand that the scientific development of chatbots in emergency and disaster contexts is still in an evolving phase. Although there is a clear thematic expansion, this does not guarantee conceptual depth or strategic integration. What this visualization provides is not only a map of frequencies but a cartography of priorities, exclusions, and unfinished promises. Instead of consolidating an agenda focused on the complexity of disasters and their human dimensions, many approaches fragment into specializations that rarely dialogue with each other. This finding allows us to affirm that the field grows, but it does so without a shared direction. We believe that the actual value of this analysis lies in the possibility of reorienting scientific production towards a more balanced and committed model. For chatbots to truly become effective agents within critical scenarios, it is not enough for them to respond quickly or process natural language accurately. They must be designed from frameworks sensitive to the social context, the diversity of the affected populations, and the ethical risks of automation.

3.12. Central Topics in the Scientific Narrative

This subsection analyses the semantic structure of the abstracts of the most relevant articles on chatbots in emergency and disaster contexts, allowing us to visualize the conceptual foundations that organize the scientific discourse of the field. Based on a co-occurrence mapping of terms, Figure 12 reveals five conceptual clusters distinguished by color. The red cluster concentrates words such as “system,” “crisis,” “patient,” and “COVID,” suggesting a conception of the chatbot as a reactive tool in high-urgency contingencies. In contrast, the blue cluster brings together concepts such as “decision,” “effectiveness,” “community,” and “disaster,” which introduce a perspective focused on collective management, participatory planning, and the social impact of digital technologies. According to Zhao et al. [53], this line of research has expanded notably in multiethnic communities, where chatbots have been used to improve risk communication and disaster preparedness, although persistent challenges remain regarding cultural sensitivity and linguistic inclusion.

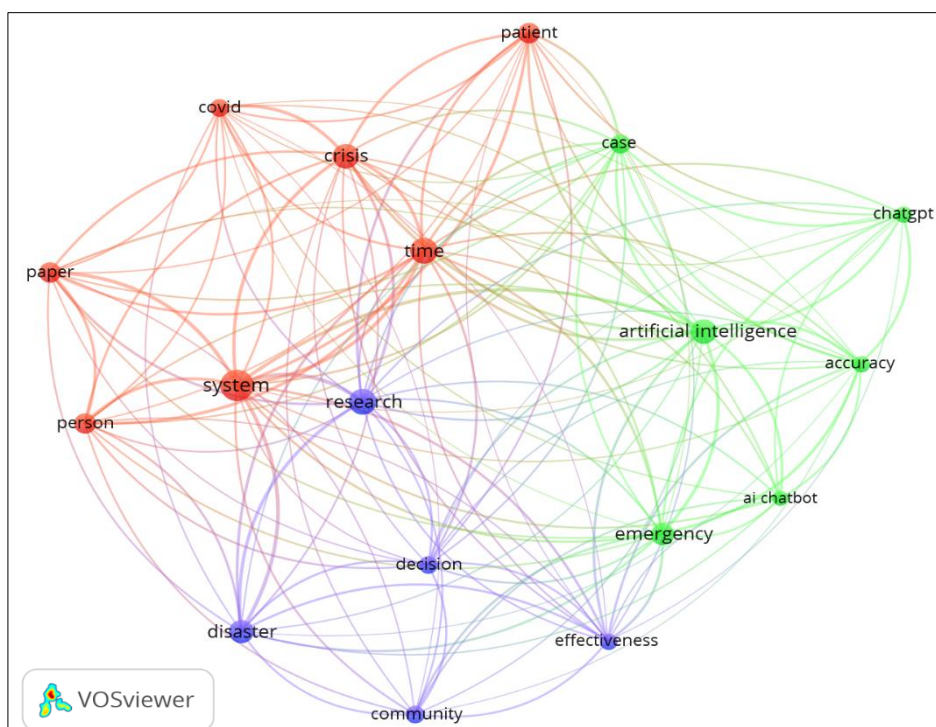


Figure 12. Topics with the Highest Presence in Abstracts

What is most revealing in this conceptual map is not what appears but what remains absent or weakly connected. Despite the apparent density of links, there is little articulation between technical efficiency and algorithmic justice. Visave [54] emphasized that AI systems in emergency management often prioritize speed and accuracy while neglecting transparency and accountability mechanisms. Similarly, Adam et al. [55] warn that the absence of comprehensive ethical frameworks in automated decision-making can reinforce structural biases that disproportionately affect marginalized populations. These semantic gaps point to a troubling trend: the scientific narrative on chatbots in disaster contexts continues to be dominated by a technocratic logic that treats social and emotional dimensions as secondary, overlooking factors such as trust, empathy, and cultural context that determine communicative effectiveness.

From a critical standpoint, this finding calls for a rethinking of future conversational systems not as purely technical products but as sociotechnical artifacts that embody values, contexts, and human relationships. Wu [5] noted that the acceptance of chatbots in healthcare depends as much on emotional trust as on perceived social legitimacy, a lesson that can be extended to crisis management. Along similar lines, Tan et al. [56] demonstrated that empathetic chatbots designed around psychological first aid principles can reduce anxiety and improve adherence to emergency protocols. What is truly disturbing about this conceptual map is not so much what it shows but what remains absent or weakly connected. Despite the density of links and the appearance of thematic coverage, the analysis reveals a lack of concepts that address algorithmic justice, inclusive accessibility, or community preparedness in the event of a disaster. There is talk of precision and systems, but not of citizen trust or deliberative processes that validate the deployment of these technologies in vulnerable populations. This omission is not minor; it renders invisible the socio-technical dimensions that shape the actual impact of chatbots in crisis management. As a critical contribution, this finding invites us to rethink the design of future conversational models not as technical products but as social artifacts. From this perspective, scientific development needs to migrate from a logic focused on efficiency to one that recognizes the urgency of a contextual, ethical artificial intelligence co-built with the communities it intends to serve.

4. Discussion

The bibliometric analysis revealed not only the sustained growth of scientific production on chatbots applied to emergency and disaster management but also the conceptual and methodological diversity that characterizes their evolution. However, the expansion of the field has not always been accompanied by epistemological maturity or a critical reflection on the social and ethical impacts of these technologies. The literature exposes persistent tensions between the technical and the human, the operational and the normative, and the quantitative and the qualitative.

In this regard, the discussion is organized around five thematic axes that allow for a deeper interpretation of the patterns observed in both the bibliometric results and the literature review. The first axis examines technological evolution and adaptive architectures that mark the transition from automated triage systems to intelligent conversational platforms. The second analyses the lack of empirical validation and the methodological gaps that still limit rigorous assessment of chatbot impact in real-world contexts. The third addresses the misalignment between technological innovation and sociocultural context, highlighting the risks of non-contextualized technology transfer. The fourth focuses on ethical dilemmas, trust, and explainability, emphasizing the need to incorporate humanistic principles into conversational system design. Finally, the fifth axis proposes an interpretative synthesis that advocates for advancing toward a humanly responsible science of chatbots, one that integrates cultural sensitivity, equity, and ethical governance.

4.1. Technological Evolution and Adaptive Architecture

The development of chatbots in the field of emergency and disaster management has followed an upward trajectory marked by technical sophistication and the diversification of their applications. The earliest systems were limited to automated assistance and basic triage functions, constrained by rigid architectures and predefined responses. However, studies by Duangdee et al. [57] and Haunschild et al. [58] documented the transition toward adaptive conversational models [36, 59], in which chatbots integrate machine learning capabilities to adjust their behavior according to situational context. This qualitative leap signifies a shift from reactive tools to autonomous agents capable of managing dynamic information and interacting more naturally with users in critical environments. The application of reinforcement learning techniques represents a pivotal milestone in this process. Huang et al. [60] proposed a bi-layer reinforcement learning framework designed to optimize coordination and decision-making during post-disaster rescue operations. This approach not only improves operational efficiency but also enables the modeling of changing environments and system feedback through accumulated experience, thereby enhancing adaptability and reducing human dependency in high-risk situations. In parallel, advances in artificial intelligence have driven the development of systems for public health management [61, 62], digital first aid [23, 63], and educational simulations [64], consolidating conversational automation as a fundamental tool for real-time communication during health or natural crises.

However, technological progress has also revealed structural inequalities. In rural and coastal contexts, Peña-Cáceres et al. [65] demonstrated that the coverage and efficiency of chatbots largely depend on connectivity and the digital literacy levels of communities. These constraints highlight the need for solutions adapted to environments with fragile

infrastructure. On another front, Maniou & Veglis [29] and Sweidan et al. [66], consistent with the arguments of Sadek et al. [45], emphasize the importance of co-design and multimodal integration as strategies for developing culturally relevant and socially legitimate chatbots. This participatory approach seeks to incorporate users' voices into the design and validation phases, ensuring both functional and symbolic adequacy. Despite these advances, evidence indicates that the field still lacks robust empirical validation in real-world scenarios. Models continue to be evaluated under laboratory or simulated conditions, limiting the understanding of their behavior under pressure or during prolonged emergencies [56, 67, 68]. This methodological gap prevents the consolidation of practical effectiveness and poses a crucial challenge for future research: to translate technological advancement into effective resilience, where chatbot adaptability is measured not only by algorithmic precision but also by its ability to foster trust, reduce uncertainty, and sustain human communication in critical moments.

4.2. Empirical Validation and Methodological Gaps

Although scientific production on chatbots applied to emergency management has increased significantly, empirical validation of their outcomes remains one of the field's most critical weaknesses. Research tends to focus on technical performance and algorithmic improvement, while the social, cultural, and psychological aspects of implementation remain poorly documented. Laymouna et al. [38] and Grassini et al. [39] pointed out that, despite the proliferation of projects, most lack inclusive methodological protocols that allow for comparing system impact across diverse populations or under real stress conditions. This methodological bias reflects a structural imbalance: the emphasis on technical efficiency overshadows understanding how conversational technologies influence the social and emotional dynamics of the communities using them. Abinivesh et al. [69] and Barabas et al. [70] deepen this concern by highlighting that, in many cases, impact assessments of chatbots are limited to accuracy or user satisfaction metrics, without considering the context of use, vulnerability conditions, or long-term sustainability [71]. While these indicators capture functional performance, they provide insufficient insight into communicative reliability or the system's ability to build trust in crisis environments. Consequently, the literature shows a significant gap in scalable studies that analyze how chatbot performance evolves under changing conditions or multiple events, such as recurring natural disasters or prolonged health emergencies.

Nonetheless, several studies indicate gradual maturity in certain application areas. In risk management, Huang et al. [60] proposed a hierarchical reinforcement learning framework that enhances coordination between agents during rescue missions, demonstrating the potential of AI for autonomous support in chaotic environments. Similarly, Ahmady & Uchida [72] developed a multilingual Telegram-based chatbot that facilitates real-time information exchange among foreign communities in Japan, effectively reducing language barriers during emergencies. In another example, Aksoy & Kara Arslan [73] compared the performance of various AI tools in emergency medicine, revealing that response accuracy alone does not ensure contextual understanding or adaptability to unforeseen scenarios. These contributions mark an important step toward methodological diversification and the recognition of the complexity inherent in real-world environments. However, most research still occurs under controlled conditions, with limited samples and no external validation. The lack of replicability and international standards hampers the accumulation of solid evidence. From an epistemological standpoint, this indicates that the field remains in a phase of incomplete consolidation—knowledge is being produced, yet without consistent verification mechanisms. The immediate challenge is to transition from a paradigm centered on instrumental efficiency to one grounded in empirical evidence and systematic comparison. Only through rigorous methodologies, multicultural studies, and experimental designs will it be possible to determine not just whether chatbots work but how, why, and for whom they are truly effective in emergency and disaster management.

4.3. Misalignment Between Technological Innovation and Sociocultural Context

The comparative analysis of the literature reveals that, although advances in conversational design and natural language processing have significantly increased the sophistication of chatbots, most proposals still lack meaningful integration with the sociocultural contexts in which they are deployed. This gap between innovation and territorial reality is reflected in the limited cultural adaptation of systems, the absence of community participation in design, and the low appropriation of these technologies by end users. Boulesnane et al. [74] and Richards et al. [75] illustrated this disconnection by presenting technically advanced systems that nonetheless show low effectiveness in real-world implementation due to insufficient local contextualization. These findings reaffirm that the success of a technological tool is not measured solely by its precision or efficiency but by its ability to address concrete needs and be perceived as legitimate by the communities it seeks to serve. Similarly, Chuquiwanca-Carhuapoma et al. [76] observed that even in open technologies applied to critical environments, a unidirectional transfer pattern persists in which innovation is exported without adaptation or civic participation. This model of technological transfer reproduces a form of epistemic dependency, where solutions are designed from distant centers of knowledge while disregarding local expertise and cultural specificities. In the case of chatbots for emergencies, this gap translates into systems that, while functionally effective, lack semantic sensitivity to the languages, customs, and communicative practices of user populations. In vulnerable or crisis situations, this lack of contextual adequacy can directly affect message effectiveness, understanding of instructions, and ultimately, the community's capacity to respond.

The challenge, therefore, lies in transcending the paradigm of decontextualized innovation to advance toward models of technological co-creation. The works of Maniou & Veglis [29] and Sadek et al. [45] emphasized the importance of co-design as a path for incorporating citizen perspectives and translating them into technical decisions. This participatory approach not only enhances the sociocultural relevance of chatbots but also reinforces public trust and institutional legitimacy [66]. By integrating users from the earliest stages of development, it becomes possible to create systems that reflect local priorities and evolve organically alongside communities. Ultimately, the misalignment between technology and culture is not merely an implementation problem but an epistemological one. It represents a tension between two modes of knowledge production—technical efficiency and cultural reciprocity. Achieving balance between these requires a shift in research and development approaches, where success indicators include social and ethical variables alongside algorithmic metrics. Only through this reorientation will it be possible to consolidate a new generation of truly inclusive chatbots, designed not as unilateral assistance tools but as agents of intercultural dialogue that strengthen social resilience in emergency situations.

4.4. Ethical Dilemmas, Trust and Explainability

The deployment of chatbots in emergency contexts introduces complex ethical dilemmas that extend far beyond the technical domain. Although the literature confirms notable progress in the efficiency and functionality of these systems, there remains a structural deficiency concerning their social legitimacy, transparency, and the way they manage user trust. The studies by Tsai et al. [30] and Butterby & Lombard [77] demonstrated that conversational agents can significantly improve response speed and coordination during crises, yet they fail to analyze the social acceptance and ethical implications of their deployment. This omission becomes particularly concerning in scenarios where users experience emotional or cognitive vulnerability, and where trust in technology can determine both the effectiveness of the message and civic cooperation. Similarly, Rodríguez-Arrastia et al. [31] and Chandel et al. [78] explored new forms of interaction between humans and conversational systems, but they overlook the psychological impact that automated responses may have, especially when these replace human presence during critical situations [79, 80]. Meanwhile, Lindner & Ravioli [81] highlighted trust as a decisive variable in chatbot acceptance, noting that users often value perceived empathy and clarity of language more than technical sophistication. Nonetheless, most current models continue to prioritize AI-driven process optimization over relational quality, perpetuating an instrumental bias that reduces the human dimension to a functional variable.

This imbalance between technical performance and ethical legitimacy aligns with what Yuan et al. [41] describe as a divided dilemma in artificial intelligence for emergency management, where communicative justice is subordinated to operational efficiency. Within this framework, the incorporation of explainability principles becomes strategically essential. Rong et al. [42] and Kim et al. [43] emphasized that transparency in chatbot reasoning processes, as well as the user's understanding of how and why certain recommendations are made, are crucial for building sustainable trust. When users comprehend the internal logic of the system and perceive coherence between its responses and their own expectations, social acceptance increases while uncertainty declines.

In addition, Aboelmaged et al. [44] and Chellasamy et al. [46] demonstrated that institutional trust directly influences users' intention to adopt chatbots, particularly in contexts where institutional legitimacy is fragile. In such environments, perceptions of technological intrusion or skepticism toward the source can hinder adoption, regardless of technical quality. This phenomenon reaffirms that innovation cannot be isolated from its political and social context. Finally, Peña-Cáceres et al. [82] contributed a critical perspective by stressing the need for chatbot solutions that integrate cultural sensitivity, equity, and territorial relevance into their design. Consequently, ethics in artificial intelligence should not be conceived as an add-on but rather as a foundational architecture guiding the relationship between technology and humanity. Genuine technological trust is not imposed through technical sophistication; it is built through transparency, empathy, and accountability—conditions that are indispensable for chatbots to become reliable and human-centered tools in emergency and disaster management.

4.5. Towards a Humanely Responsible Chatbot Science

The preceding analytical trajectory demonstrates that research on chatbots applied to emergency and disaster management stands at a critical turning point. Technical progress is undeniable, yet the field's theoretical maturity and ethical coherence remain embryonic. The rapid quantitative growth of publications has not always translated into qualitative advances capable of consolidating a solid epistemological foundation. Most developments still focus on linguistic efficiency and response accuracy, while human, cultural, and moral dimensions continue to be treated as peripheral. This situation calls for an urgent redefinition of the purpose of conversational intelligence, shifting the emphasis from automation toward the humanization of technology. In this regard, the findings of Sajja et al. [40] provided a valuable methodological reference, demonstrating how bibliometric studies can be used to map the conceptual evolution of conversational intelligence in domains such as hydrology and environmental sciences. These approaches help visualize the emergence of scientific communities and the interconnections between fields, serving as a model for examining the evolution of chatbots in crisis management. However, translating these insights into human-centered contexts remains

limited. The literature reveals a trend toward fragmented specialization, where technological and social advances evolve in parallel but with little dialogue. This phenomenon reinforces the need for an integrative paradigm that acknowledges the interdependence between technology, society, and ethics, placing explainability and equity at the core of chatbot development.

Furthermore, the contributions of Grassini et al. [39] offer a concrete path forward by emphasizing the importance of accessibility and inclusion as essential criteria for evaluating chatbot quality in healthcare environments. Extending this logic to emergency management implies recognizing that communicative equity is as critical as technical precision. An ethically designed chatbot must be capable of adapting to different languages, literacy levels, and sociocultural conditions. In doing so, artificial intelligence ceases to be a homogeneous tool and becomes a contextualized actor capable of engaging with human diversity in vulnerable situations. In this sense, the science of humanly responsible chatbots cannot be limited to assessing algorithmic efficiency; it must evaluate their capacity to strengthen social resilience, institutional trust, and civic participation. Future research should move toward hybrid models that combine bibliometric analyses, experimental studies, and participatory methodologies. Such an approach would enable the construction of more balanced knowledge, where technology does not dominate humanity but complements it.

Ultimately, the greatest challenge lies in transforming artificial intelligence into ethical and responsible intelligence, capable not only of responding to emergencies but also of contributing actively to their prevention. This transformation requires embedding empathy, justice, and transparency into the scientific and design processes, steering AI toward social well-being. Ethical AI must ensure that automated decisions are not only effective but also fair and understandable to society. In doing so, technology can emerge as an ally that promotes safety, equity, and justice—fostering a science that acts with responsibility and human commitment in risk management and preventive protection.

5. Conclusion

Bibliometric analysis has made it possible to identify not only the nuclei of scientific productivity but also the ways in which the academic community conceptualizes emergency and disaster from the perspective of conversational automation. Far from being an exclusively technological phenomenon, the chatbot is shown as an instrument of symbolic mediation that translates institutional logic into patterns of interaction. In this sense, the literature reviewed reflects a latent tension between operational simplification and the social complexity inherent in critical contexts. This ambivalence shows that the development of chatbots in emergencies cannot be understood only as an evolution of technical systems, but as a reorganization of roles, voices, and responsibilities at the interface between citizens, institutions, and algorithms. Rather than accumulating solutions, scientific production has revealed a diversity of attempts to imagine alternative ways of governing uncertainty. The findings reveal that chatbots not only mediate information but also expectations, anxieties, and forms of obedience. Therefore, its design cannot be neutral or universal. Each chatbot incorporates visions of what is considered an "effective response," which opens a fertile space to incorporate critical perspectives from decolonial studies, complex systems theory, and philosophy of technology.

The future of the field depends less on how much technical innovation is done and more on how the questions that guide that innovation are reframed. Instead of asking what else a chatbot can do, research should ask for whom, with what consequences, and under what conditions. This requires reviewing the entire production chain, from model training to adoption dynamics in technologically constrained territories. Future research could be aimed at mapping silences. For example, what issues are not being addressed, what populations are being excluded, and what emerging uses are challenging institutional frameworks? Only in this way will it be possible to emerge with an agenda that, beyond identifying trends, contributes to redefining the conditions of possibility of truly people-centered technologies during a crisis.

5.1. Theoretical Implications

The findings of this study demonstrate that research on AI-driven chatbots in emergency and disaster contexts is grounded in the convergence of natural language processing, machine learning, and human–computer interaction. The theoretical core of the field has evolved from deterministic, rule-based models to adaptive systems capable of contextual reasoning and emotional alignment with users. This transformation represents a paradigm shift in which the interpretability of chatbot behavior is not only a computational challenge but also a cognitive and epistemological problem involving how machines represent, reason about, and communicate uncertainty in high-stress environments. Similarly, the co-occurrence and literature analyses reveal that the field still shows gaps due to limited multidisciplinary participation, which hinders the consolidation of a unified conceptual framework. In the same vein, the coexistence of psychological, linguistic, and algorithmic approaches—each with its own success metrics—demonstrates the absence of a standardized taxonomy that enables comparison of results and evaluation of their applicability across domains such as public health, crisis communication, or risk management. Therefore, the theoretical development of AI-driven chatbots requires the creation of a meta-framework of explainability that combines computational precision with ethical transparency and user trust.

Furthermore, this study confirms that the epistemological foundations of conversational intelligence remain insufficiently defined. While engineering sciences focus on performance and the improvement of technical efficiency, social sciences emphasize relational dynamics of trust and empathy. Bridging these paradigms requires the construction of theoretical models that explain how credibility, emotional cues, and decision support interact within human–AI collaboration during emergencies. Advancing toward an explanatory theory of chatbots thus implies transcending the purely technical domain and moving toward a comprehensive science of communication under uncertainty, where technologies serve as mediators of human resilience rather than mere transmitters of information.

5.2. Practical Implications

The practical relevance of AI-driven chatbots is increasingly evident in sectors such as public health, humanitarian logistics, and emergency coordination, where they act as mediators between institutions and citizens. However, their implementation faces significant challenges related to trust, accessibility, and contextual intelligibility. Many systems remain designed for expert users, limiting their effectiveness among populations with linguistic, cultural, or educational diversity. As shown by the results of this study, the lack of adaptive communication layers that adjust the level of explanation according to the user's profile represents one of the main obstacles to effective adoption. To achieve functional implementation, explainability tools must be oriented toward multilevel interpretive interfaces capable of translating complex inferences into useful and understandable information. Chatbots deployed in crisis contexts should not only provide accurate responses but also foster trust and emotional support, particularly when interacting with vulnerable groups. This requires incorporating human-centered design principles, prioritizing empathy, and managing cognitive load in high-pressure scenarios.

On the other hand, bibliometric analyses reveal a low level of international collaboration, indicating that scientific production remains regionally compartmentalized. Without global standards, the interoperability of conversational systems applied to emergencies will continue to be limited. Aligning the development of these systems with international AI governance frameworks, such as those promoted by UNESCO and the OECD, would strengthen transparency, accountability, and cross-border reliability. Therefore, it is considered that the growing influence of ethical regulations in AI on chatbot design marks a turning point for the field. The future adoption of these technologies will depend on compliance with the principles of transparency, privacy, and responsibility, transforming ethics from a secondary requirement into a central component of design. The results of this study can serve as a foundation for developing international collaborative policies aimed at reducing knowledge gaps and promoting the development of explainable, trustworthy, and human-aligned chatbots in emergency and disaster management.

5.3. Limitations and Future Lines of Research

This study presents several limitations that should be considered in future research. First, the exclusive use of the Scopus database, although it provides a broad and up-to-date overview, may have excluded relevant publications indexed in Web of Science, IEEE Xplore, or the ACM Digital Library, which could partially affect the representativeness of the corpus. Second, the temporal scope analyzed—from January 2019 to July 2025—captures the most recent trends in the field but omits the final months of the year, which may slightly limit longitudinal consistency. Nevertheless, the inclusion of early 2025 data ensures an updated view of the latest changes and turning points in a technologically dynamic domain. Although the temporal analysis reveals a phase of thematic stabilization, this trend may be better understood as a diversification toward specialized applications, such as medical triage, disaster communication, or autonomous coordination systems, rather than a decline in innovation. In this regard, future studies should examine whether this evolution reflects conceptual maturity or specialization within the field of conversational intelligence applied to emergency and disaster management.

According to the findings, future research should focus on the following lines:

- Assessing the impact of emerging AI regulations on the design and ethical deployment of chatbots across different regions and institutions.
- Developing standardized interpretability metrics and validating their applicability through extrapolable studies in real-world emergency scenarios.
- Exploring hybrid architectures that integrate deep learning with symbolic reasoning and causal inference, strengthening contextual explainability.

Ultimately, the future of AI-driven chatbots for emergency and disaster response will depend not only on technological advances but also on the development of transparent, trustworthy, and culturally sensitive systems. Without a unified framework for assessing performance, reliability, and social legitimacy, large-scale adoption will remain limited. The consolidation of this field will require effective synergy among researchers, regulators, and industry, aimed at creating global standards that ensure both technical feasibility and ethical responsibility, thus enabling a truly responsible and human-centered implementation of artificial intelligence.

6. Declarations

6.1. Author Contributions

Conceptualization, O.P.C., M.M.M., and A.T.R.; methodology, O.P.C.; software, T.C.C. and O.P.C.; validation, T.C.C., A.T.R., and O.P.C.; formal analysis, O.P.C.; investigation, O.P.C.; resources, A.T.R.; data curation, T.C.C.; writing—original draft preparation, O.P.C.; writing—review and editing, M.M.M. and O.P.C.; visualization, O.P.C.; supervision, M.M.M.; project administration, O.P.C.; funding acquisition, O.P.C. All authors have read and agreed to the published version of the manuscript.

6.2. Data Availability Statement

The data presented in this study are available in the article.

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6.5. Institutional Review Board Statement

Not applicable.

6.6. Informed Consent Statement

Not applicable.

6.7. Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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