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Mapping risk communication practices in public health emergencies: a scoping review and comparison with Italian regional pandemic plans

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Title: Mapping risk communication practices in public health emergencies: a scoping review and comparison with Italian regional pandemic plans

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Abstract

Background: Effective risk communication is a cornerstone of public health emergency preparedness and response. The COVID-19 pandemic and other recent crises have highlighted both the centrality of communication in sustaining trust and compliance, and the persistent gap between theoretical frameworks and operational practice.

Methods: Within the framework of the CreSP project (Comunicare il Rischio nelle Emergenze per la Sanità Pubblica), we conducted a scoping review to map international evidence on risk communication in public health emergencies, comparing it with Italian regional pandemic preparedness plans. Following PRISMA-ScR guidelines, we searched PubMed, Scopus, and Web of Science (1 January 2019–16 May 2024). Peer-reviewed studies addressing health risk communication in emergencies were included. In parallel, 18 Italian regional pandemic plans were identified and analysed using a structured checklist derived from inductive thematic analyses.

Results: Of the 12,479 records identified, 173 studies were included. Most publications originated from high-income countries and focused on COVID-19 pandemic response. Mass

communication strategies, especially via social media, predominated, while targeted and participatory approaches were less frequent. The emergency response phase was far more represented than the preparedness or post-emergency phases. Key principles such as timeliness, transparency, and trust were widely discussed across studies, whereas equity, citizen engagement, and infodemic management were less consistently operationalised. Analysis of Italian regional pandemic plans revealed substantial heterogeneity. Although communication was universally acknowledged as important, it was often framed as top-down information dissemination. Structured mechanisms for monitoring, evaluation, citizen participation, and infodemic management were inconsistently addressed.

Conclusions: Although the concept of emergency risk communication is well-developed, its implementation varies across different levels of governance. The misalignment between scientific evidence and institutional frameworks—particularly regarding inclusivity, participatory models, and infodemic management—underscores the need for a more integrated and standardised national approach. Incorporating communication into preparedness infrastructures, supported by measurable indicators and workforce capacity building, is essential to strengthen resilience, equity, and public trust in the event of future emergencies.

Keywords: Risk communication; Public health emergencies; Pandemic preparedness; Infodemic management; Public health policy**.**

Background

Effective communication is a critical component of public health emergency preparedness and response. During crises such as pandemics, natural disasters, or environmental hazards, the ability to deliver timely, accurate and accessible information can determine the extent to which populations adopt protective behaviours, maintain trust in institutions, and mitigate health risks, especially when access to care is limited [1]. The COVID-19 pandemic has reaffirmed that communication is not only instrumental in conveying protective measures but also in sustaining trust in institutions, reducing panic, and fostering adherence to recommended behaviours [2].

Risk communication in public health encompasses more than the transmission of information. It involves building and maintaining a two-way exchange between health authorities and the public, where information is shared while also allowing questions, concerns, and feedback to be addressed, that supports informed decision-making, encourages compliance with health recommendations, and addresses uncertainty. Clear and transparent communication of risks, benefits, and preventive strategies empowers individuals while simultaneously promoting widespread adoption of protective behaviours essential to controlling threats [3, 4]. Conversely, ineffective communication—characterised by inconsistency, lack of cultural sensitivity, or absence of feedback mechanisms—can generate scepticism, reduce compliance, and weaken institutional credibility [5]. The translation of these principles into operational practice remains inconsistent across health systems and levels of governance. Variations in institutional capacity, messaging coherence, and community engagement mechanisms often hinder the effectiveness of emergency communication strategies [6].

The accelerated digitalisation of information flows has created new challenges for emergency risk communication. Notably, the phenomenon of "infodemics," defined by the World Health Organisation (WHO) as an "overabundance of information – some accurate and some not – that occurs during an epidemic" [7], has highlighted the need for institutions to develop more adaptive and evidence-based approaches. While misinformation has historically accompanied outbreaks [8], the COVID-19 pandemic demonstrated the unprecedented scale and speed of its dissemination across both traditional and digital platforms [9, 10], with tangible impacts on public trust, behaviours, and health outcomes [10–13].

Understanding how risk communication is conceptualised and implemented within public health systems is essential. The aim of this scoping review is to analyse and map current practices of risk communication during public health emergencies at international, national and regional levels. Specifically, the review aims to:

1) Explore the main risk communication methodologies, practices, and theoretical frameworks documented in the scientific literature at the international level.
2) Identify and systematically map existing regulatory frameworks and operational guidelines adopted in Italy, at national and regional levels.
3) Assess alignment of Italian national and regional regulatory frameworks with the scientific evidence.

By integrating these perspectives, this review aims to highlight prevailing models, best practices, and critical gaps, thereby contributing to the development of more coherent, inclusive, and evidence-based strategies for emergency risk communication.

Methods

This review was conducted within the framework of the CreSP project (Comunicare il Rischio nelle Emergenze per la Sanità Pubblica – Communicating Risk in Public Health Emergencies), carried out between 2023 and 2024. The project, funded by the Italian Ministry of Health through the CCM Program (National Centre for Infectious Disease Prevention and Control), aimed to strengthen national capacity for risk communication during health and environmental emergencies.

We conducted this study in accordance with the scoping review guidelines [14] and reported the results in accordance with the Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) [15].

A scoping review approach was deemed appropriate given the heterogeneity of available evidence and the exploratory aim of mapping how risk communication is framed and implemented across international and Italian contexts, at both national and regional levels. This methodology allows for the inclusion of diverse study designs and policy documents, enabling the identification of key themes, frameworks, and knowledge gaps. As per scoping review methodology, we did not formally assess the quality of included studies [16], nevertheless, we recorded the ranking of the journals in which the selected articles were published according to the SCImago Journal Rank, in order to identify the most significant contributions. The study protocol is reported in *Supplementary Material 1 – Study protocol*.

Search strategy

We focused on two different types of documents: scientific literature and national and regional regulatory framework and pandemic preparedness and response plans. Regarding the scientific literature review, searches were limited to the period 1 January 2019 – 16 May 2024, with no geographical limitation on the origin of the study. The search strategy was designed around four core concepts: risk communication, emergency events, preparedness and response, and public health/healthcare. The complete search strings are reported in *Supplementary Material 2 – Search strategy*. Scientific literature was retrieved from three databases: PubMed (via MEDLINE), Scopus, and Web of Science.

In line with the study objective of comparing evidence from the scientific literature with institutional practices, Italian national and regional pandemic preparedness and response plans were identified through targeted searches of institutional websites (Italian Ministry of Health, regional health authorities) and expert consultation. We included regional plans because in Italy, the National Health Service and its functions, including those relating to preparedness, are managed and regulated at the regional level. Reference lists of included articles, reviews and documents were hand-searched for additional eligible sources.

Eligibility criteria

We included peer-reviewed literature regarding health risk communication related to public health emergencies. We define health risk communication as all communication measures related to risks to human health in emergencies, including both direct and indirect risks. We define emergencies as unforeseen or extraordinary conditions that require immediate action to

avoid or limit serious consequences for the public health of one or more communities. Communication measures include those aimed at the general public or specific populations to support awareness, understanding, and decision-making, as well as those addressed to particular stakeholders or contexts for organisational or procedural purposes. A broad range of publication types was considered, including research articles, expert opinions, letters to the editor, viewpoints, scoping reviews, systematic reviews, and meta-analyses. Preprint articles were excluded.

At the same time, normative documents refer to official plans, strategies, and guidance issued at the level of Italian Regions, including regional pandemic preparedness and response plans and related public health emergency frameworks. We considered regional pandemic preparedness and response plans issued in Italy within the last 20 years to understand how risk communication is addressed within institutional preparedness frameworks. To represent all Italian regional healthcare systems, plans were sought for each Region. For all the sources, we considered only documents written in English or Italian.

Selection of sources of evidence

All records from scientific literature were imported into Rayyan [17] for deduplication and screening. The entire study selection was conducted by six independent reviewers. The selection process was performed in three steps:

- Following an initial calibration phase on 500 records to ensure alignment among reviewers, the full dataset was divided among six reviewers for single-reviewer title and abstract screening. Each record was classified as included, excluded, or unclear.

- Potentially eligible articles underwent full-text screening. Articles were distributed among the reviewers, and each document was assessed by a single reviewer. Any uncertainties were resolved through team discussion. Reasons for exclusion were recorded for each article and subsequently summarised in the *Supplementary Material 3 – Articles excluded in full text*.
- Additional exclusions were made during the data extraction phase of selected articles (e.g., duplicate studies, insufficient outcome data, inappropriate publication type, or language not meeting inclusion criteria).

For the regulatory framework and pandemic plans, inclusion was based on relevance, prioritising the most recent available document.

Data extraction

Data extraction from the scientific literature was conducted using two standardised forms: (I) a descriptive and quantitative form applied to all included articles; and (II) a qualitative form applied exclusively to qualitative mixed-method studies, narrative reviews and theoretical frameworks, systematic reviews and meta-analyses.

Data extraction was performed individually by the six investigators involved in the study selection process. Both forms were piloted and refined by the research team before full implementation.

For (I) the quantitative form, extracted variables included bibliographic information, country of study, study design, setting, population, length of study, communication tools and channels, characteristics of the communication intervention (including the entity responsible for its management or delivery), type of emergency (pandemic, outbreak, terrorism, environment, climate change), emergency phase (preparedness, response, or recovery), and main outcomes (details provided in *Supplementary Table 4 - Data extraction elements*). For analyses of geographical distribution, each country represented in a study was counted separately. Therefore, multicountry studies contributed to the count of each country involved, and percentages were calculated using the total number of country occurrences rather than the total number of included studies.

For studies included in (II) the qualitative form, one or more quotations representative of the reported outcomes were identified from the main findings of each article. For each quotation,

the main theme was assessed, along with the intervention's implementability, whether it described a concrete intervention or a theoretical model. Subsequently, two qualitative content analyses were conducted: (a) quotations were coded deductively according to the communication principles identified by Savoia et al. [18] and Wardle et al. [19] which were used as predefined categories; and (b) an inductive analysis was performed, leading to the identification of a set of thematic domains. These domains were then used to evaluate the regulatory frameworks and pandemic preparedness plans. This evaluation was conducted independently by two researchers, with discrepancies resolved through collegial discussion.

Synthesis of results and statistical analysis

A mixed descriptive and qualitative approach was employed to synthesise the findings. For the scientific literature, descriptive statistics (frequencies and percentages) were applied to summarise publication characteristics and descriptive variables. We defined “Mass communication” as all studies reporting communication delivered through traditional media (e.g., TV, newspapers, magazines), new media (e.g., social media), and graphic and promotional materials. For those interventions targeting a wide audience that did not fall into the above categories, we introduced the category “One-to-many communication (miscellaneous)”. Otherwise, we defined “targeted/narrow communication” as all studies reporting learning experience (e.g. simulation of communication) and one-to-one/small-scale communication.

As reported above, for qualitative analysis we classified quotations into a) the 9 principles of communication identified by Savoia et al. [18]: 1) Timeliness, 2) Transparency, 3) Coordination, 4) Accuracy and Consistency, 5) Accountability and Integrity, 6) Independence from politics, 7)

Responsiveness, 8) Equity, 9) Trust and Empathy; Moreover, we added 3 other domains from the technical document “Information disorder: Toward an interdisciplinary framework for research and policy making” by Wardle et al.[19]: 1) Agent, 2) Message, 3) Interpreter. These twelve categories have been defined as “the guiding principles of effective risk communication”, and we have used them for the deductive analysis. This step allowed us to interpret the content of the literature in relation to established theoretical frameworks of risk communication.

In addition, b) an inductive analysis was performed on the quotes extracted from the selected articles, leading to the identification of a set of domains that were subsequently used to evaluate the regulatory framework and pandemic preparedness plans. Each domain considered was coded as “explicitly addressed,” “partially addressed,” or “not addressed”, allowing for a systematic assessment of policy coverage. Any additional textual excerpts illustrating practical strategies or omissions were collected. The full list of domains is reported in the results section.

An inductive analysis of the quotes extracted from the scientific literature was conducted to identify thematic domains emerging iteratively from the data. Although primarily data-driven, the process was informed by the deductive framework, ensuring continuity with existing theories. The resulting set of domains offered a more practice-oriented representation of how risk communication is described in the literature, extending beyond the predefined categories proposed by Savoia et al. [18] and Wardle et al. [19]. These domains were subsequently used as an analytical framework to evaluate regulatory frameworks and pandemic preparedness plans. Each domain was coded as “explicitly addressed,” “partially addressed,” or “not addressed,” allowing for a systematic assessment of policy coverage. This approach was adopted because the inductively derived domains provided a flexible and operational set of categories, better suited

to capturing how risk communication is articulated within policy documents. Any additional textual excerpts illustrating practical strategies or omissions were also collected.

All descriptive analysis was performed with Microsoft Excel [20].

Results

The database search retrieved a total of 12,479 records: 626 from PubMed, 7,699 from Scopus, and 4,154 from Web of Science. After removal of duplicates, 10,961 records remained. Screening of titles and abstracts led to the exclusion of 10,431 records. The remaining 530 full-text articles were assessed for eligibility, of which 173 were finally included in the scoping review [8, 18, 21–191]. The PRISMA-ScR flow diagram summarising the screening process is reported in Figure 1.

FIGURE 1

In addition, 18 regional pandemic [192–209] plans were identified and analysed through the checklist of thematic domains. For two of the twenty Italian regions (Basilicata and Aosta Valley) and one independent province (Bolzano), no pandemic plan was publicly available.

Descriptive and quantitative analysis

All extracted variables are reported in *Supplementary Material 5 – Data extraction table*.

Among the 173 studies included, the majority were published in 2021 (n = 49; 28.3%), followed by 2023 (n = 40; 23.1%) and 2020 (n = 36; 20.8%). Most contributions originated from high-income countries. Considering country occurrences (with multicountry studies counted once for each country represented), the United States was the most frequently represented country (n =

44; 19.6%), followed by China (n = 16; 7.1%), the United Kingdom (n = 14; 6.3%), and Germany (n = 13; 5.8%). Figure 2 shows the geographical distribution of the studies included in the analysis.

FIGURE 2

Regarding study design, narrative or theoretical reviews were the most frequent format (n = 66; 38.2%), followed by mixed-methods studies (n = 42; 24.3%). Only a minority adopted an experimental design (n = 9; 5.2%). The general population was the main target group (n = 126; 72.8%). Only a limited number of studies reported analyses stratified by gender (n = 25; 14.5%). In terms of communication strategies, most studies focused on mass communication campaigns (n = 150; 86.7%), including social media–based interventions (n = 56; 32.4%). The remaining 23 studies (13.3%) referred to a targeted/narrow communication. Almost all studies addressed pandemics (COVID-19 and flu) (n = 144; 83.2%), while a smaller proportion examined climate- or environment-related emergencies (n = 19; 11.0%) or other outbreaks (n = 10; 5.8%). Finally, the emergency response phase was by far the most frequently investigated (n = 133; 76.9%), with fewer studies focusing on preparedness (n = 39; 22.5%) and only one specifically addressing the post-emergency phase (0.6%). The 173 included articles were published across 115 different journals. Details on journal impact factors and quartile rankings are provided in *Supplementary Material 5 – Data extraction table*.

TABLE 1

Qualitative analysis

A qualitative analysis was conducted on the 97 representative quotes extracted from the included mixed-method studies, narrative reviews, theoretical frameworks, systematic reviews, and meta-analyses. Each quote was analysed individually to identify underlying concepts, theoretical orientations, and practical applications. Overall, most quotes referred to practice-oriented activities related to the implementation and delivery of risk communication (n = 53, 54.6%, of which n = 42, 79.2% were reported as already implemented), while a smaller proportion (n = 44, 45.4%) addressed theoretical or conceptual aspects. The following sections report the analysis of a) guiding principles of effective risk communication and b) inductive analysis.

a) Deductive analysis

Based on Savoia et al. [18] and Wardle et al. [19], quotes were also categorised according to the guiding principles of effective risk communication. Among these, trust and empathy were the most represented principles (n = 78; 80.4%), followed by responsiveness (n = 67; 69.1%) and coordination (n = 61; 62.9%). Transparency was identified in 50 quotes (51.5%), while accuracy and consistency emerged in 48 (49.5%), indicating that these principles were reflected in approximately half of the material analysed. References to the presence of an Interpreter were found in 47 quotes (48.5%). Quotes concerning the Agent responsible for delivering the communication (n = 39; 40.2%) and the characteristics of the Message itself (n = 39; 40.2%) occurred with the same frequency. Accountability and integrity were identified in 35 quotes (36.1%). Equity and timeliness were each represented in 27 quotes (27.8%). Finally,

Independence from politics was the least frequently identified principle, appearing in 3 quotes (3.1%).

b) Inductive analysis

Through the second part of the qualitative content analysis, we conducted an inductive thematic analysis, allowing thematic domains to emerge iteratively from the data through close reading and comparison of the quotes. This process resulted in the identification and refinement of 10 thematic domains. Once the domain structure had been identified, each quote was reviewed and assigned to the most relevant domain, with dual attribution applied when concepts overlapped. The domains most frequently represented among the original selected articles were communication resilience (n = 24; 15.9%), targeted and appropriate messaging (n = 23; 15.2%), and public health infrastructure (n = 22; 14.6%). The distribution of quotes across thematic domains is presented in Table 2.

TABLE 2

Regulatory framework and pandemic preparedness plan

Finally, the 18 Italian regional pandemic plans [192–209] were reviewed according to the ten thematic domains, assessing whether these were “explicitly addressed,” “partially addressed,” or “not addressed”. Checklists specifically designed to evaluate pandemic preparedness plans are available in *Supplementary Material 6 - Checklist for pandemic preparedness plan*.

TABLE 3

Table 3 presents a comparative assessment of Italian pandemic preparedness and response plans across ten key dimensions of communication and preparedness. Overall, the analysis shows substantial heterogeneity among regions, with a clear concentration of efforts on structural and health-system–oriented components, and comparatively limited attention to participatory and advanced communication dimensions. The most consistently addressed dimensions are Public Awareness & Policy Preparedness and Healthcare System Preparedness, both explicitly included in all 18 regional plans (18/18, 100%), followed by Public Health Infrastructure, which was explicitly addressed in 17 of 18 plans (94.4%). International & Cross-sector Collaboration was explicitly addressed in 16 plans (88.9%) and partially addressed in 2 (11.1%). In contrast, Citizen Engagement & Participation and Infodemic Management emerge as the weakest dimensions. Citizen Engagement & Participation was explicitly addressed in only 2 of 18 plans (11.1%), partially addressed in 11 (61.1%), and not explicitly addressed in 5 (27.8%). Similarly, Infodemic Management was explicitly addressed in 3 plans (16.7%), partially addressed in 10 (55.6%), and not explicitly addressed in 5 (27.8%). In most cases, communication remains predominantly institutional and unidirectional.

The dimensions of Inclusivity & Equity and Targeted & Appropriate Messaging are most often classified as partially addressed. Inclusivity & Equity was explicitly addressed in only 2 plans (11.1%), while 16 plans (88.9%) addressed it only partially. Targeted & Appropriate Messaging was explicitly addressed in 11 plans (61.1%) and partially addressed in 7 (38.9%). While several plans acknowledged equity principles or proposed differentiated communication by phase or audience, these elements were rarely translated into systematic, operational strategies targeting vulnerable or marginalised groups. As well, Trust & Transparency and Communication Resilience

were addressed in all represented regions, either partially or fully. Trust & Transparency was explicitly addressed in 8 plans (44.4%) and partially addressed in 10 (55.6%), while Communication Resilience was explicitly addressed in 7 plans (38.9%) and partially addressed in 11 (61.1%).

Discussion

This scoping review examined the scientific literature on risk communication during public health emergencies together with Italian national and regional regulatory documents. The analysis was conducted in two steps. First, the review of the scientific literature allowed us to identify the main thematic domains through which risk communication is conceptualised and studied. This analysis also provided insight into how these domains have been explored in the literature to date, including the relative emphasis placed on different aspects of risk communication and the methodological gaps and areas for further development.

Second, these domains were used as an analytical framework to examine Italian national and regional pandemic preparedness plans, with the aim of assessing how they are operationalised within institutional preparedness documents. Taken together, the findings indicate that the implementation of risk communication remains uneven across contexts and governance levels, despite its recognised role within emergency preparedness and response [4].

This comparison should be interpreted in light of the different analytical levels considered. The domains identified in the scientific literature reflect practices, conceptual models, and recommendations widely recognised as relevant to effective risk communication. In contrast,

regional pandemic preparedness plans are normative and regulatory documents, shaped by legal, organisational, and administrative constraints.

As a result, the comparison is intended as an analytical framework for examining how concepts developed in the scientific literature are reflected and operationalised in institutional documents, rather than as a normative assessment of the completeness or quality of individual plans. Against this background, the scientific literature reviewed in this study provides the conceptual foundation for understanding how risk communication has evolved in recent years into a complex, multidirectional, and systemic component of public health preparedness.

In the qualitative analysis of the selected studies, we identified ten thematic domains describing how risk communication is conceptualised and operationalised. The most frequently identified domains concerned communication resilience, targeted and appropriate messaging, and public health infrastructure. In this context, public health infrastructure refers to the organisational structures, institutional capacities, governance arrangements, and technical resources that enable the planning, coordination, and delivery of risk communication within public health systems, including surveillance systems, trained personnel, communication units, and intersectoral coordination mechanisms. These categories underscore how risk communication has increasingly embraced adaptive and network-based communication models designed to maintain functionality under conditions characterised by uncertainty. On the other hand, the thematic domains of inclusivity and equity and of health system preparedness, although present and recognised in the literature, are represented to a limited extent. Several authors have emphasised that communication inequities (i.e. differences in the ability to access, understand,

and use health information) mirror broader social determinants of health [210, 211]. Vulnerable populations, including those with lower literacy, linguistic barriers, or limited digital access, remain at higher risk of exclusion from emergency communication channels [212], highlighting the need for communication strategies that are adapted to diverse cultural, linguistic, and digital contexts [213].

In a similar way, the domains of trust and transparency, although not among the most frequently coded, remain central in established models of risk communication [214, 215]. Evidence from multiple outbreaks and pandemics demonstrates that institutional trust influences adherence to protective behaviours, perception of risk, and willingness to cooperate with public health authorities [216, 217].

Also infodemic management was identified as an underdeveloped area, despite its growing recognition as a core public health function [218, 219]. The literature on this topic—developed primarily in the context of the COVID-19 pandemic—has framed misinformation as both a behavioural and a governance challenge [220, 221]. Yet, most studies included in our analysis addressing infodemic management are descriptive and focus on monitoring information flows rather than evaluating the effectiveness of corrective interventions or the institutional capacities required to manage them. Future research should therefore prioritise the generation of empirical evidence on governmental and media collaborations, fact-checking strategies, and algorithmic accountability, together with the development of standardised evaluation frameworks and metrics to assess the effectiveness of infodemic management interventions [92]. This aspect is becoming increasingly important considering the emerging role of artificial intelligence (AI) in risk

communication. Although this topic is not addressed in the studies included in this analysis—likely due to the limited prevalence of AI during the period under consideration—it is now particularly relevant given its potential implications for the information ecosystem during health emergencies. On the one hand, AI may increase the volume, speed, and apparent credibility of misinformation, challenging traditional monitoring and response mechanisms [222, 223]. Integrating this dimension into preparedness frameworks may become increasingly important for anticipating and mitigating AI-driven infodemic risks. On the other hand, AI could also support the rapid production and dissemination of evidence-based information. Further research is needed to better understand the implications of the use of AI for risk communication strategies.

The scientific literature review shows uneven coverage of emergency phases. Most research concentrates on the response phase, with minimal attention to preparedness and little to no focus on the post-emergency period phase. This imbalance suggests that communication is still largely conceived as a crisis-response mechanism rather than as an integrated function of routine public health planning [224]. WHO and ECDC guidance explicitly emphasise continuous preparedness communication, including pre-crisis engagement and post-event evaluation, yet these aspects remain insufficiently addressed in both research and practice [225, 226].

Taken together, these findings reflect the rapidly evolving nature of risk communication, which is increasingly framed as a crucial component of health system resilience, grounded in principles of trust, transparency, and adaptability.

When examining the coverage of the risk communication domains in the Italian regional preparedness plans, in light of the domains identified in the scientific literature, we found

considerable heterogeneity in how these principles were translated into operational practices. While all documents acknowledged the importance of communication in the emergency response, their depth and operationalisation varied substantially. Most regions included measures to enhance communication resilience, such as rapid-response communication units and predefined coordination channels, as well as targeted messaging for healthcare workers and the general public. However, domains such as inclusivity, citizen engagement, and infodemic management were addressed inconsistently or only in general terms [224]. This pattern suggests a stronger emphasis on operational and health-system preparedness components than on participatory and information-management dimensions. The predominance of Public Awareness & Policy Preparedness, Public Health Infrastructure, and Healthcare System Preparedness may reflect the historical orientation of preparedness planning in Italy, which has traditionally prioritised healthcare capacity, surveillance systems, emergency coordination, and continuity of essential services [227].

Citizen engagement and participation remain marginal in Italian regional pandemic preparedness plans. Although participatory and bidirectional communication models are increasingly recognised in the scientific literature, regional documents largely conceptualise risk communication as a top-down, institutional process. In practice, bidirectional communication can be operationalised through a range of structured and scalable mechanisms, even within predominantly institutional systems. These include community advisory boards and citizen panels, which allow for the integration of community perspectives into decision-making processes. In addition, digital tools such as structured feedback platforms, surveys, and participatory monitoring systems can support the systematic collection of public input. Social

listening systems, already adopted in some public health contexts [228, 229], can also be used to identify concerns, information needs, and emerging perceptions among different population groups, going beyond disinformation monitoring [230].

Furthermore, co-production approaches involving civil society organisations, community leaders, and local stakeholders can facilitate the adaptation of communication strategies to specific cultural and social contexts, particularly for hard-to-reach populations [231]. While these mechanisms require additional organisational capacity and coordination, their integration into preparedness frameworks could enhance legitimacy, trust, and responsiveness of public communication systems [232].

The weak integration of infodemic management in official plans contrasts with the growing attention this issue has received in international public health practice [218, 233]. During the COVID-19 pandemic, some countries introduced dedicated infodemic management capacities, such as social listening systems, rumour-tracking mechanisms, and specialised coordination roles, to support national response efforts and improve the management of circulating information [230, 234–236]. Although robust evidence on the effectiveness of these strategies remains limited, partly due to the methodological challenges of evaluating communication interventions, these experiences suggest that integrating infodemic management capabilities into preparedness planning may strengthen health systems' capacity to anticipate and respond to information-related risks during health emergencies. Strengthening these capacities within regional communication systems may therefore represent an important area for future preparedness planning. In this context, strategies to counter misinformation should also be

institutionalised through collaboration with fact-checking organisations, media outlets, and civil-society actors [116].

Across nearly all plans, the absence of explicit monitoring indicators or formal evaluation mechanisms for communication activities was a common limitation. The limited presence of such mechanisms in regional preparedness plans therefore suggests that communication is often addressed at a strategic level but less frequently operationalised through measurable objectives and structured evaluation processes. This finding is noteworthy because international risk communication guidance emphasises monitoring and evaluation as core components of preparedness [224, 237]. For example, the Crisis and Emergency Risk Communication (CERC) framework developed by the U.S. Centers for Disease Control and Prevention highlights the importance of continuously assessing communication activities through defined indicators, feedback mechanisms, and audience monitoring in order to adapt messages and strategies during emergencies [238]. Similarly, WHO guidance on risk communication and community engagement recommends integrating evaluation processes to assess the reach, credibility, and impact of communication interventions [239].

The heterogeneity observed across regional preparedness plans, together with the limited integration across several risk communication domains, underscores the need for stronger national coordination. While the local articulation of communication strategies has clear value—allowing messages and interventions to be adapted to territorial contexts, population characteristics, and regional health systems—ensuring a consistent minimum standard of communication preparedness across regions requires a stronger central framework. A unified

national approach could define minimum standards, evaluation metrics, and response protocols that regional authorities can adapt to their specific contexts. At the same time, centrally coordinated communication mechanisms could support local implementation through shared resources and guidance. For example, a nationally coordinated framework could provide pre-approved communication materials (e.g., FAQs, infographics, social media content), shared key messages, and rapid guidance on emerging issues. It could also support the training of local communicators and coordinate national-level monitoring and social listening activities. Such an approach would help ensure coherence in communication during public health emergencies while preserving the flexibility needed to tailor interventions to local contexts.

Strengths and limitations of the review

This scoping review offers a comprehensive synthesis of both academic and policy sources, combining quantitative and qualitative analyses and applying a structured checklist to normative documents. However, several limitations should be acknowledged. The inclusion was restricted to documents in English and Italian, potentially excluding relevant material in other languages. The lower number of articles retrieved from PubMed compared to Scopus and Web of Science likely reflects the interdisciplinary nature of the topic, which extends beyond the strictly biomedical field. Risk communication in public health emergencies is addressed not only within medical and epidemiological research, but also across disciplines such as communication studies, social sciences, and policy research. As a result, databases with broader disciplinary coverage may better capture the full spectrum of relevant literature. The heterogeneity of study designs and the absence of a formal critical appraisal limit the ability to assess quality or causality. In

addition, the qualitative analysis relied on the selection and interpretation of representative quotes extracted from heterogeneous sources, which may have introduced interpretative bias and may not fully capture the breadth or nuance of the original studies. Furthermore, not all regional pandemic plans were publicly available, and some regions were therefore excluded from the analysis. While the literature review included studies conducted outside the Italian context, the analysis of regional pandemic plans has a strong local focus, and its generalisability may therefore be limited. Nevertheless, the findings may be relevant to other countries with decentralised healthcare systems, where similar gaps in risk-communication preparedness could arise.

Conclusions

This review depicts the current landscape of emergency risk communication as a field characterised by consolidated principles but uneven implementation. Public health infrastructure, public awareness, and policy preparedness emerge as well-established foundations guiding institutional responses, whereas inclusivity, citizen engagement, preparedness, and infodemic management remain insufficiently integrated into both research and Italian policy frameworks. The evidence represents a system that is conceptually mature but still fragmented in practice, with marked variability across contexts and governance levels. Closing the gap between scientific knowledge and operational practice, including the use of indicators and qualitative tools for monitoring and evaluation, is therefore critical to advance toward a coherent, equitable, and adaptive model of public health communication, capable of sustaining trust and effectiveness across all phases of future emergencies.

Declarations

Ethics approval and consent to participate

Not applicable

Consent for publication

Not applicable

Availability of data and materials

Not applicable

Competing interests

Guglielmo Arzilli is an Editorial Board Member of the BMC Public Health Journal. All the other authors declare no competing interests.

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Authors' contributions

EDV and GA contributed to data curation, formal analysis, methodology development, project administration, and resource management; they conducted the investigation, performed the

visualization, and drafted the original manuscript. FG, VC, ADP, and DR contributed to validation and critically revised the manuscript for important intellectual content. MP, GC, FT, and FTecchio contributed to investigation and data curation. CB contributed to validation, writing – review & editing, supervision, project administration, and resources. CR contributed to validation, writing – review & editing, funding acquisition, supervision, project administration, and resources. All authors read and approved the final manuscript.

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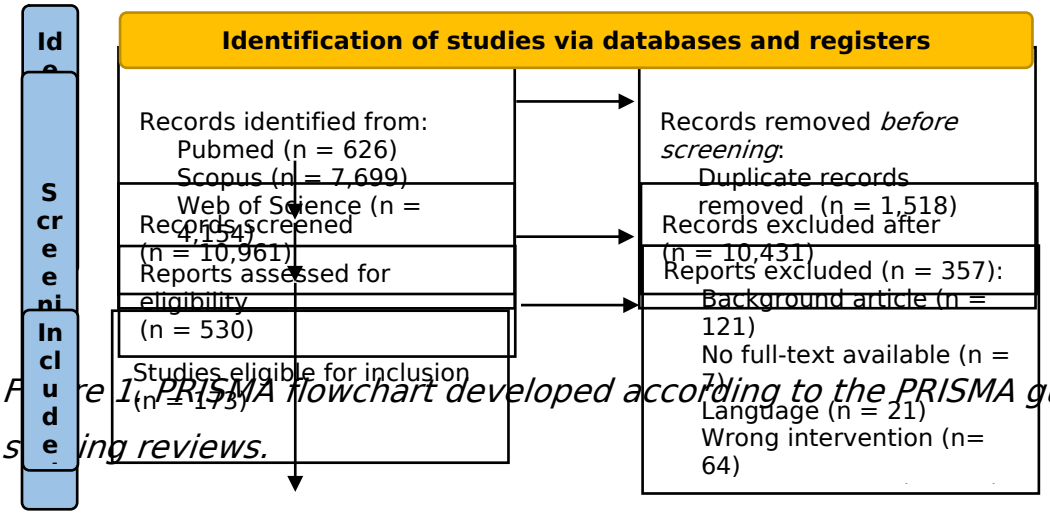

Figure 1. PRISMA flowchart developed according to the PRISMA guidelines for scoping reviews.

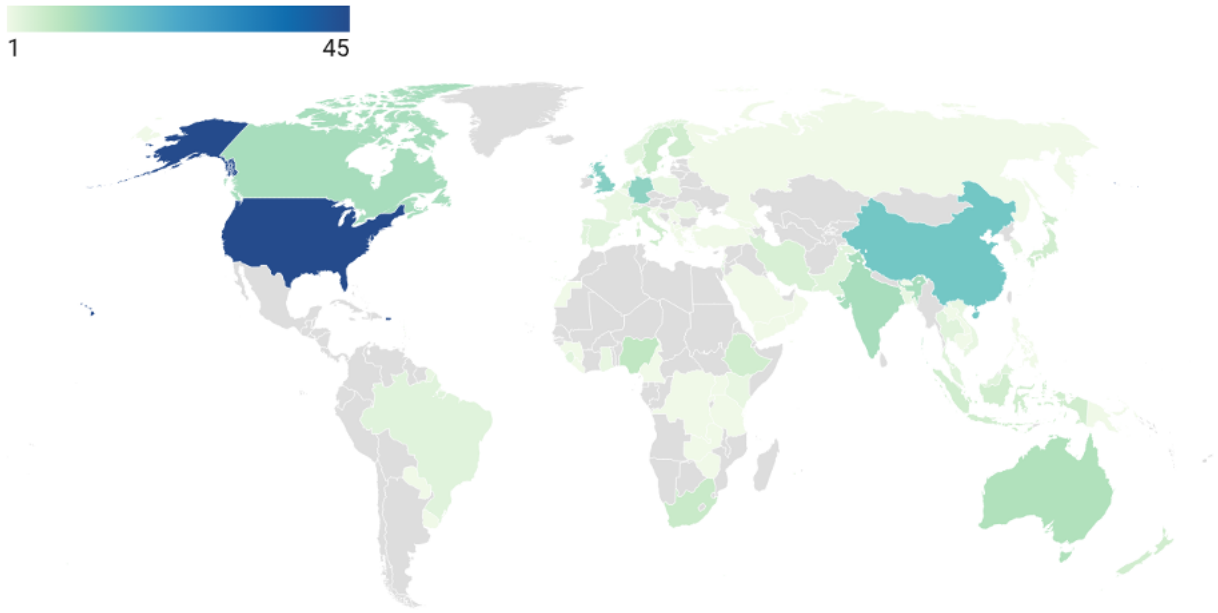

Figure 2. Geographic distribution of included studies by country. For multicountry studies, each country was counted separately. Consequently, the total number of country occurrences exceeds the number of included articles.

Table 1. Descriptive results of studies included in the scoping review. Some studies reported multiple values for some variables (e.g. Country)

Variable	**N.**	**%**
Year of Publication		
2019	6	3,5%
2020	36	20,8%
2021	49	28,3%
2022	29	16,8%
2023	40	23,1%
2024	13	7,5%
Country		
US	44	19,6%
China	16	7,1%
UK	14	6,3%
Germany	13	5,8%
Australia	10	4,5%
Canada	10	4,5%
India	10	4,5%
Nigeria	7	3,1%
South Africa	6	2,7%
Sweden	6	2,7%
Other less of 5	74	33,0%
Not reported	14	6,3%
Study design		
Cross sectional	16	9,2%
Experimental studies including RCTs	9	5,2%
Mixed method study	42	24,3%
Narrative review and theoretical framework	66	38,2%
Prospective observational study	11	6,4%
Retrospective observational studies (i.e. case control)	16	9,2%
Systematic review and Meta-analysis	13	7,5%
Target population		
General population	126	72,8%
Healthcare Workers	9	5,2%
Minorities	8	4,6%
Other professionals	7	4,0%
Policy maker	7	4,0%
Specific communities	16	9,2%
Gender		
No	148	85,5%

Yes	25	14,5%
Communication channel		
Traditional media (newspaper, TV, magazines, etc.)	13	7,5%
Social media	56	32,4%
Graphic and Promotional Materials	4	2,3%
One-to-many communication (miscellaneous)	77	44,5%
Simulation of communication	2	1,2%
One-to-one/small-scale communication	16	9,3%
Not reported	5	2,9%
Setting of emergency		
Climate change	2	1,2%
Environment (flood, earthquake)	17	9,8%
Outbreak	10	5,8%
Pandemic	144	83,2%
Phase of emergency		
Post-emergencies	1	0,6%
Preparedness	39	22,5%
Response	133	76,9%

Table 2. Frequency of thematic domains identified within the analysed quotes.

Topic Domain	**Count of Topic Domain**	**%**
Communication Resilience	24	15,89%
Targeted & Appropriate Messaging	23	15,23%
Public Health Infrastructure	22	14,57%
Public Awareness & Policy Preparedness	19	12,58%
Infodemic Management	15	9,93%
Trust & Transparency	14	9,27%
Citizen Engagement & Participation	12	7,95%
International & Cross-sector Collaboration	11	7,28%
Inclusivity & Equity	9	5,96%
Healthcare System Preparedness	2	1,32%

Table 3. Comparative assessment of Italian regional pandemic preparedness plans across ten key dimensions of communication and preparedness. Green cells marked with [✓] indicate dimensions explicitly addressed in the plans; yellow cells marked with [×] indicate dimensions partially addressed; and red cells marked with [−] indicate dimensions not explicitly addressed.

	Inclusivity & equity	Targeted & Appropriate Messaging	Public Awareness & Policy Preparedness	Trust & Transparency	Citizen Engagement & Participation	Public Health Infrastructure	Infodemic Management	In Co
Abruzzo	×	×	✓	✓	×	✓	−	✓
Apulia	×	✓	✓	×	×	✓	−	✓
Calabria	×	✓	✓	✓	×	✓	×	✓
Campania	×	×	✓	×	✓	−	−	✓
Emilia Romagna	×	×	✓	×	×	✓	×	✓
Friuli Venezia Giulia	×	✓	✓	✓	×	✓	×	✓
Lazio	×	✓	✓	×	−	✓	−	✓
Liguria	✓	✓	✓	✓	×	✓	×	✓
Lombardy	×	✓	✓	✓	−	✓	×	✓
Marche	×	✓	✓	✓	✓	✓	✓	✓
Molise	×	×	✓	✓	×	✓	×	×
Piedmont	×	×	✓	×	−	✓	✓	✓
Sardinia	×	✓	✓	✓	×	✓	✓	✓
Sicily	✓	✓	✓	✓	×	✓	×	✓
Trento	×	×	✓	✓	×	✓	×	×
Tuscany	×	✓	✓	×	×	✓	×	✓
Umbria	×	✓	✓	×	−	✓	−	✓
Veneto	×	×	✓	×	−	✓	×	✓