World Health Organization
Department of Communications

Evidence Syntheses to Support the Guideline on Emergency Risk Communication

Q10: What are the best social media channels and practices to promote health protection measures and dispel rumours and misinformation during events and emergencies with public health implications?

Final Report

Submitted by
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1.0 INTRODUCTION

1.1 Background

The World Health Organization (WHO), as an agency of the United Nations (UN), commissioned systematic reviews and syntheses of existing evidence to support the development of new emergency risk communication guidelines. The systematic reviews were required to focus on emergency risk communication to inform the development of recommendations for the WHO Risk Communication Guideline on Emergency Risk Communication, which refers to any risk communication done before, during, and after health emergencies.

As defined by the WHO, risk communication refers to the real-time exchange of information, advice, and opinions between experts and/or officials and/or the publics who face a threat (hazard) to their survival, health, or economic or social wellbeing.

The purpose of the proposed guidelines is to assist the WHO as it communicates with multiple stakeholders, exchanging information that will enable everyone at risk to make informed decisions about protective and preventive actions that will mitigate the effects of a threat (hazard).

As noted by the WHO, emergency health risk communication is distinguished from non-emergency health risk communication exchanges by a combination of the following characteristics: The existence of a perceived public health threat; a dramatically increased demand for information to protect health that often outstrips the ability of health authorities to provide it; a need to communicate with potentially at-risk populations before recommendations are certain; a rapidly evolving situation in which information about the health threat and how to prevent its continuation or spread is incomplete and changing as public health investigation proceeds.

A public health emergency event, such as an earthquake, wildfire, flood, and emergent infectious disease, is usually characterized as having four major phases: Preparation; onset; containment, which includes the peak of the emergency event; and recovery. Another characterization, also with four phases, but conceptualized slightly differently, includes: Prevention; readiness/preparedness; response; and recovery. A fifth phase, evaluation, generally follows the recovery phase although it commonly occurs along with the earlier four phases as well.

The WHO sought systematic reviews and syntheses of existing evidence regarding twelve questions of interest related to emergency risk communication. Of these, the Wayne State University team was responsible for six questions, and this report presents the findings for one of them.

1.2 Rationale

Communication via social media with the public during mass emergencies is a complex process involving multiple stakeholders. Social media messages from authorities to the general public, and to specific communities, must be carefully designed to successfully influence health protection behaviors. Emergent health emergency events tend to be both global and local problems; thus, successful communication in these situations must also take into account the political and cultural context in which the social media messages will be received and understood. Further, it is crucial to understand which social media platforms different stakeholders in different locations utilize and how those who are not reachable via social media can be communicated with via other channels.

Yet, the creation of such social media messages is relatively inexpensive in terms of national and international public health infrastructure, albeit it is time-intensive and demands training for those who will take up and consistently use this tool. Although the use varies, depending on location and socio-economic background, social media are a relatively inexpensive and accessible communication channel for the public to contact authorities, peers, and other stakeholders directly.

1.3 Objective

1.3.1 Question

The objective was to conduct a systematic review of the extant literature on best practices for use of social media during emergency health risk communication. Specifically, the purpose of the systematic review is to address the following question:

What are the best social media channels and practices to promote health protection measures and dispel rumours and misinformation during events and emergencies with public health implications?

1.3.2 SPICE Framework Question Explication

As provided by the WHO, the question is explicated using the SPICE (Setting, Perspective, Phenomena of Interest, Comparison, Time Scope) framework as follows:

Setting: In the context of preparing for and responding to events/ emergencies with public health implications in high, low, middle income and fragile states.
Perspective: National governments and relevant subnational authorities (e.g., local/ district health departments), responding and implementing partners; at-risk communities and stakeholders.
Phenomena of Interest: Ability of different social media channels and practices to promote health protection information and dispel rumors and misinformation: extent of reach, level of influence, outcomes, types of audiences.
Comparison: Source of social media messages (health authorities, community leaders, celebrities, NGOs, etc.); types of social media (SMS, Twitter, Facebook, etc.). Variations in social media channels, practices, and outcomes related to equity considerations such as local contextual and population characteristics.
Evaluation: Impact on public trust in health protection information, level of coverage of information sharing, unanticipated negative consequences, distortion of health protection messages/ information, impact on community engagement.
Time Scope: 2003 to present.

1.3.3 Review Question and Rapid Knowledge Map

To ascertain the availability of existing reviews and primary studies relevant to the question, we conducted a preliminary literature search and created a Rapid Knowledge Map. The map showed existing reviews were available as were sufficient number of primary studies with a wide coverage of type, phase, and country of emergency public health events. The Rapid Map also allowed us to refine the objective of and the approach to the present review as noted below.

1.3.4 Phenomena of Interest and Outcomes/ Effects Associated with Review Question

The phenomena of interest are best social media practices and channels to promote health protection measures and to dispel rumours and misinformation during public health crises events.

To foreground the phenomena of interest that could potentially be measured, observed, or described in affected populations (communities/ publics, stakeholders, etc.), we parsed the phenomena of interest and review question to focus on social media practices and channels that were effective or in the absence of evidence of effect appeared to work best as follows:

Social media
- → Increase/ decrease of health promotion via best practices and channels.
- → Increase/ decrease of rumors and misinformation via best practices and channels.

1.3.5 Phenomena of Interest and Comparison Category for Outcomes/ Effects/ Impacts and Best Practices

Given the corpus of research studies relevant to the objective for this systematic review, the SPICE framework descriptions (as noted above) of the setting, perspective, phenomena of interest, and time scope categories do not require any clarification.

However, the description of the comparison category requires additional interpretation for studies that do not include a comparison group. For such studies, we have interpreted the comparison descriptors not as comparison conditions/ groups in a research study, but as concepts/ variables that may have an association with the concepts/ variables contained in the questions. The SPICE description for the comparison category includes concepts/ variables such as source of social media messages; types of social media; and variations in social media channels, practices, and outcomes related to equity considerations such as local contextual and population characteristics. Instead of seeing these terms as comparison groups, as may be the case in a randomized trial, we took these concepts/ variables to be potentially associated with social media use to identify what works and for whom and in what contexts..

As such, when we extracted data from individual studies that were not group comparisons (randomized or nonrandomized), we did not compare (or contrast) the key concepts/ variables in a question with the concepts/ variables in the comparison category; instead, we checked for associations between the question concepts/ variables and comparison category concepts/ variables and focused on identifying best practices as directed by the review objective.

1.3.6 Data and Population of Interest

The primary data of interest were from field studies of populations that were *directly* affected by a relevant public health emergency event. Of interest were also data from studies of populations who may be likely to be affected by a relevant public health emergency event, particularly studies that focused on questions promoting individual preparedness for such events. Also of some interest were data from studies that addressed how organizations, predominantly government organizations or individuals employed by governments, respond to or work to develop risk communication messages.

2.0 EXISTING SYSTEMATIC REVIEWS

2.1 Approach to Existing Systematic Reviews

We did not conduct a structured review of the existing reviews and did not extract detailed findings from this literature. We appraised the quality of these reviews, and then identified key relevant findings from the reviews that were judged as high and moderate quality.

2.2 Quality Rating and Relevant Findings

The literature search for the present review revealed 12 existing systematic reviews that were relevant to the review objective. All were narrative reviews and none were quantitative meta-analyses.

The relevancy was assessed using the criteria in Noyes et al. (in press) that provides four categories, direct, indirect, partial, and uncertain. Two coders assessed the relevancy independently and there was very little agreement between them for the indirect, partial, and uncertain categories. As such, we combined indirect, partial, and uncertain assessments and labeled them as indirect; thus, we ended with two categories for relevance, direct and indirect.

The quality of the reviews was rated using a modified Assessment of Multiple Systematic Reviews (AMSTAR) quality appraisal checklist (Shea et al., 2007). AMSTAR consists of 11 elements that address the reviews' design (i.e., a priori), data extraction, details of the literature search, inclusion of grey literature, characteristics, methods, and scientific quality of included studies, publication bias, and acknowledgement of conflict of interest(s). Each area in AMSTAR is assessed using "yes," "no", "can't answer," or "not applicable." Studies received a final rating of "high" (no significant flaws), "moderate" (minor flaws impacting credibility/validity), or "low" (some flaws likely to impact credibility/validity). Two coders did the coding independently with high agreement. The final quality assessment was judged after the coders resolved any differences.

Reviews that were rated as low quality were "unpacked" for their data-based primary studies, which were added to the literature for the present review. Existing reviews that were appraised as high or moderate quality were read for key relevant findings. The quality ratings and key findings are noted in Section 2.2.1.

2.2.1 Existing Reviews: Ratings and Findings Summary

Notes for Table
. All reviews are narrative synthesis.
. Relevancy judged as only direct and indirect (see above).

Review Citation (first author) and Review Purpose	***Modified AMSTAR Quality Rating***	***Relevancy***	***Key Relevant Findings***
Bean (2015) Mobile public warning messages. What is the state of research regarding terse vs. longer messages and public warning messages via	Low	---	---

wireless emergency alerts?			
Bradley (2014) Effectiveness of disaster risk communication. What is the state of research regarding interventions during different disaster phases?	High	Indirect	Little evidence on what works in risk communication in response and recovery phases exists as many complex interventions in response to disasters used many methods of communication at once but did not detail how each one was used. High quality trials for disaster communication are absent; randomized trials in risk communication may have become more difficult to conduct in recent years because of likelier information sharing between intervention and control groups. Additionally, differences between the studies did not allow concluding that one method of risk communication is superior to others. Two-way dialogue between the public and professionals happened during preparedness interventions, but was not common during response phase, which mostly followed a unidirectional model of risk communication. Social media offer opportunities for risk communication research to facilitate evaluation of risk communication strategies as people are reachable on mobile devices.
Crowe (2010) Social media manifesto. What is the impact of social media on emergency management?	Low	---	---
Gesser-Edelsburg (2015) Emerging infectious disease communication during H1N1. What were risk communication channels, content and strategies used?	Moderate	Indirect	Studies in risk communication, especially related to infectious disease, have made a turn from predominantly using quantitative methods before 2013 to using more often qualitative methods. Research shows that studies should use triangulation based on input from different stakeholders via interviews and discussions to understand questions and needs of all in the population. Studies conclude that health agencies need to collaborate with media to ensure evidence-based coverage and make key information available. Further studies should address the potential of social media for dialogue with the public.
Kraut (2013) Public response to alerts and warnings using social media. What is the use of and public response to social media for alerts; what are past, current and future research efforts?	Low	---	---
Landwehr (2014) Social media in disaster relief. What are usage patterns, data-mining tools, and current research directions?	Low	---	---
Lin (2014) H1N1 epidemic. What have we learned about	Moderate	Indirect	Trust in public officials, knowing the source of information, worry and knowledge about a disease, routine media exposure and information-seeking behaviors make it likelier

communication inequalities during the H1N1 pandemic?			that people adopt recommended infection prevention practices. Including these measures into interventions and understanding the socio-economic factors of a population help tailor public health communication messages and channels to the target audience. When addressed in interventions, it can close the gap of communication inequality and increase the effectiveness of the preparedness and response to influenza pandemics. It is critical to work with community leaders, physicians, communication specialists and mass media to improve the reach, accuracy, and timeliness of public health messages.
Newbold (2011). Media and social media in public health messages. What sources are most accessed and preferred by contemporary consumers for health information? Are traditional and social media outlets able to reach consumers and improve their health knowledge in an effective way? What types of media outlets are most effective in delivering health messages to consumers?	Moderate	Direct	Social media use in public health campaigns is not well documented. More research on the efficacy of social media messages as part of public health campaigns is needed, particularly the use of social media by public health organizations and comparisons with other media campaigns. The few available reports on social media promise induction of social media into regular public health practices but a universal best practices document is needed for guidance for practitioners and for evaluation of social media campaigns for researchers.
Revere (2011) Health care providers. What are most effective ways for public health agencies to communicate their messages to HCP? What is the role of health care providers in public health emergency preparedness and response? What systems are used to evaluate PHEPR?	Moderate	Indirect	Few articles assessed public health emergency preparedness and response communication systems, messaging methods or outcomes. Little is known about the effectiveness of communications from public health entities to health care providers. But studies already show that the potential for health care providers to experience message overload is high due to redundant messages in multiple formats and/or through different message delivery systems.
Ruggiero (2013) Terrorism communication. What are the characteristics and emerging perspectives in the scientific literature 2002–2011 on terrorism communication?	Moderate	Indirect	Terrorism crises call for fast updates through multiple channels tailored to fit different needs and (social) media habits. The role of communication is broader than just issuing instructions to the public because it is important that leaders show empathy and facilitate sense making during times of crises. Communication can support such crisis response, for instance by spreading evacuation guidelines. Social media are on way to distribute such information yet social media discourse is difficult to monitor and media discourse may further add to conflict. It is important to closely monitor the risk perceptions and information needs of the public, including misperceptions. This requires

			competences in social media, monitoring tools, and methods of data interpretation for better decision-making on communication strategies.
Simon (2015) Social media in emergency situations. How have social media tools been used in disasters by the public, emergency organizations and academic institutions?	Low	---	---
Veil (2011) Social media in risk and crisis communication. How can communicators embrace social media tools to better manage a risk or crisis? What are best practices in risk and crisis communication?	Low	---	---

2.3 Summary of Relevant Findings From Existing Systematic Reviews

The existing reviews focus on a variety of public health emergency events, including crises in general, natural hazards, terrorist attacks, and emergent infectious diseases. The reviews draw predominantly (and in some cases exclusively) on studies in the developed world; nations with developed public health care/emergency infrastructure; and largely democratic political systems. The reviews also approach risk communication as a multi-disciplinary project. In terms of review quality, six of the existing reviews were evaluated to be of either low quality, six of moderate or high quality. With this context in mind, the following findings span the reviews:

- The role of social media in risk communication remains little understood as few studies address social media; only one review focused on social media in public health messages: another one analyzed the use of social media for terrorism events.
- Studies emphasized a need for public health agencies and providers to become familiar with and employ social media in their communication strategy in conjunction with established communication channels in risk communication for a multi-channel approach.
- They urged to undertake future research on the use of social media during crises, specifically research on the efficacy of social media is needed, the use of social media by public health organizations and comparisons with other media campaigns.
- Existing studies point toward social media becoming a regular communication practice in health communication in the future but documented universal best practices are needed to guide and evaluate social media campaigns and to research the use of social media during crisis communication.
- Members of health organizations should receive training specific to working with social media, including the ability to monitor public risk perceptions and responses and to use two-way communication with t eh public before, during and after a crises event occurs.

2.4 Summary of Research Gaps Identified by Existing Systematic Reviews

The existing reviews note the following gaps in the literature:

- Studies on the efficacy and use of social media by public health agencies and health care providers
- Studies on best practices for social media use in risk communication.
- Evidence on what which specific communication methods work in risk communication in response and recovery phases.
- High quality trials and randomized trials as likelier information sharing between intervention and control groups make them more difficult to conduct.

2.5 Use of Existing Systematic Reviews

The findings from the existing reviews were used to contextualize the present systematic review. Where appropriate, the findings from the high or moderate quality existing reviews were mapped against the findings from the present review in the discussion section and were used to underpin the Evidence to Decision (DECIDE) frameworks (Alonso-Coello et al., 2016).

3.0 METHOD

3.1 Protocol and Process Design for Evidence Synthesis

A detailed protocol for the review was developed. It is available on request from the contact persons for the report.

The process design for the evidence synthesis for the review is presented in Section 3.3. Findings were extracted only from data-based primary studies. The design shows that the findings were grouped and processed within the type of study methodology stream and then brought together in an overarching synthesis of the findings across the methodology streams. Details of the process are presented below in Sections 3.9 to 3.15.

3.2 Determining Study Methodology of Data-based Primary Studies

The WHO Minimum Methodological Expectations document in Section 2.2 required production of a knowledge map and noted the following categories for data-based primary studies: Quantitative randomized control trials; qualitative (ethnographic research, case studies, process evaluations, and mix-methods designs); mixed-method studies (combining different types of designs to explore a phenomenon of interest); observational and cross-sectional surveys; and grey literature reports.

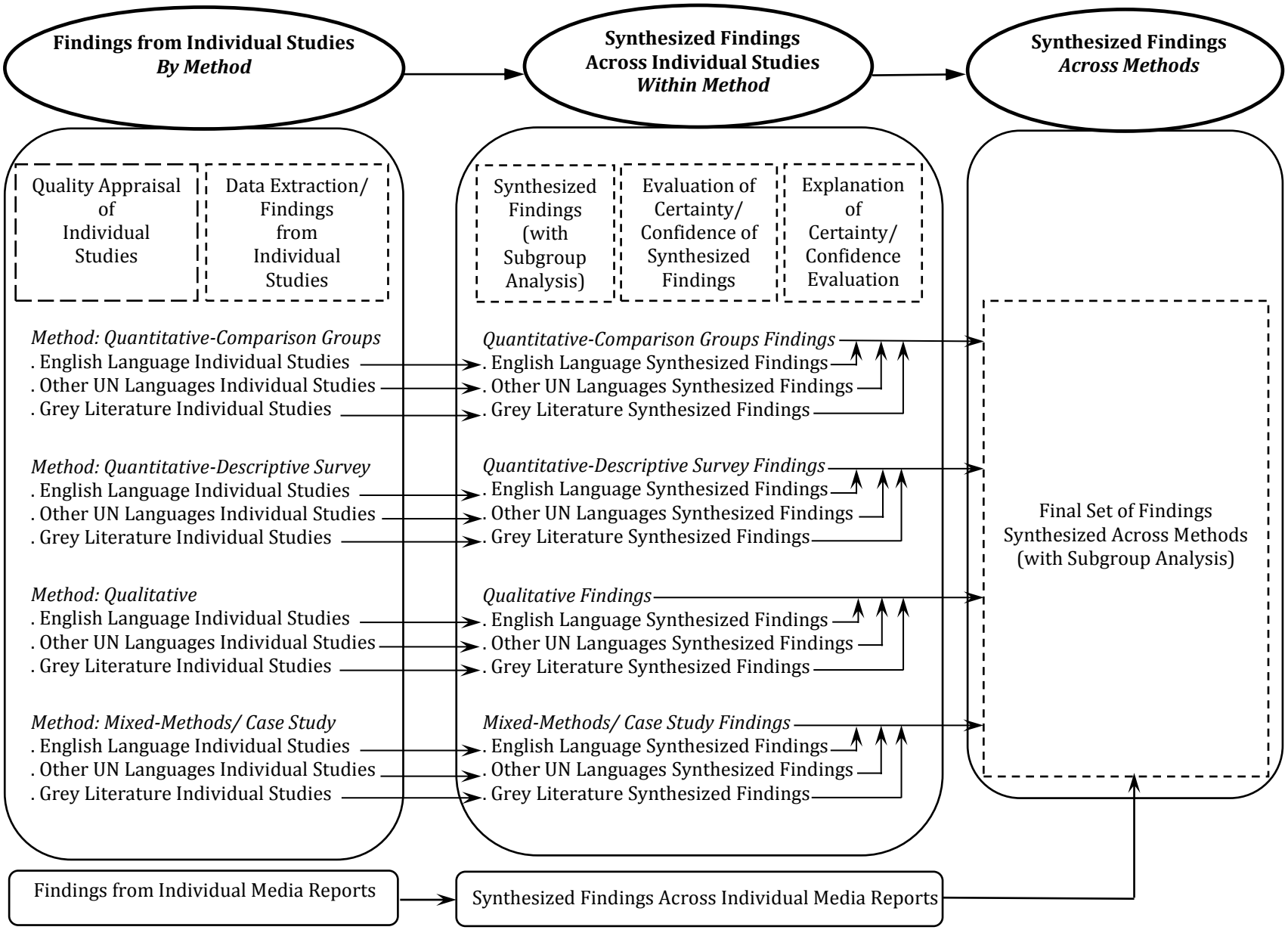
Using the above methodological groupings as a starting point, in the initial Rapid Knowledge Map we identified five methodological streams that best covered the method types found in the primary studies selected for the review:

- Quantitative – randomized group comparison and non-randomized group comparison.
- Quantitative – descriptive survey and similar designs.
- Qualitative – open-ended questionnaire survey, interview, focus group, ethnography/ participant observation, and textual analysis.
- Mixed-method – use of both quantitative and qualitative methods, where the different methods usually address different hypotheses and/ or research questions.
- Case study – use of several methods, where usually all methods address the same research question and focus on one particular event/person/location.

After a more in-depth perusal of the mixed-method and case study article/ reports, we did not find any appreciable methodological differences as both types utilized quantitative and qualitative methods with similar procedures. In consultation with the WHO methodologist consultant, we combined these two methodological streams. Thus, we ended up with four methodological streams:

- Quantitative-Comparison Groups (QN-CG)
- Quantitative-Descriptive Survey (QN-DS)
- Qualitative (QL)
- Mixed-Method and Case Study (MM, CS).

3.3 Process Design of Synthesis of Evidence from Data-based Primary Studies



3.4 Existing Reviews, Guidelines, Media Reports, and Grey Literature

As noted in Section 2.1, we did not conduct a systematic review of the existing reviews. We identified key findings and used them to contextualize the findings of the present review.

We did not include guidelines, recommendations, and other such literature in the present review. Only data-based primary studies were selected for data extraction and synthesis of evidence.

English language media reports that included some type of risk communication relevant "data," such as direct quotations or detailed descriptions of events, from populations affected by an emergency event were included. As shown in Section 3.3, the findings from media reports served as a separate input for the final synthesized set of findings.

Grey literature non-academic reports were included only if they were data-based primary studies. Academic unpublished data-based primary study masters theses and doctoral dissertations were treated as grey literature. As shown in Section 3.3, these grey literature studies were treated similar to the academic primary studies.

3.5 English and Other UN Languages

3.5.1 Languages Included in Review

The primary search was for literature in the English language. Additionally, we conducted searches for studies published in the other UN languages as well, which included Arabic, Chinese, French, Russian, and Spanish.

3.5.2 Review Process for Other UN Languages

As seen from Section 3.3, we followed the same process for both English and other UN languages articles/ reports for data extraction from individual studies and synthesis of findings within methodological streams. That is, the individual studies from Arabic, Chinese, French, Russian, and Spanish were grouped into the four methodological streams, irrespective of the language, after which synthesized findings were generated within each methodological stream.

We did not completely translate Arabic, Chinese, French, Russian, and Spanish language studies into English. Portions of the studies were translated into English as needed to meet the requirements of the review. As the other UN language findings from individual studies came from studies that were only partially translated into English, we treated these findings as a separate "sub-stream" at the time of synthesis of findings within methodological streams.

3.6 Information Sources for Literature Search

3.6.1 Information Sources for English Language Literature

We conducted a general search using the Wayne State University Library Summon function, which indexes all holdings in the library, Google Scholar, and general Google search.

We also searched within individual databases including: Web of Science; PubMed/Medline-National Library of Medicine (NLM); Cumulative Index of Nursing and Allied Health Literature (CINAHL); CINAHL Complete; Communication and Mass Media Complete (CMMC); PsychInfo; and WHO databases.

3.6.2 Information Sources for Other UN Languages Literature

Native readers of Arabic, Chinese, French, Russian, and Spanish who were fluent in English conducted the search. The following information sources were searched.

For Arabic, the information sources were: Al-Manhal, Dar-Al-Manduma, Google Scholar, general Google search, Wayne State library, and WHO databases.

For Chinese, the information sources were: CNKI (China National Knowledge Infrastructure), Wanfang Patent Database, Google Scholar, general Google search, Wayne State library, and WHO databases. In addition, contact persons suggested by the WHO were solicited for suggestions for relevant studies.

For French, the information sources were: Archive ouverte UNIGE, Cairn.info, Google Scholar, general Google search, Government of Canada publications, HAL archives ourvertes, JSTOR, La Houille Blanc, Persee.fr, Revues.org, Wayne State library, and WHO databases.

For Russian, the information sources were: Cyberleninka.ru, Google Scholar, general Google search, Mgimo.ru/library/ehd, Msu.ru/info/struct/dep/library, Nbmgu.ru, Wayne State library, and WHO databases.

For Spanish, the information sources were: CONACYT, Cuiden, Elsevier, Google Scholar, general Google search, Public Health institute Mexico, Wayne State library, and WHO databases.

3.6.3 Information Sources for Grey Literature

The search for grey literature in all languages used Google Scholar and general Google search as the primary information sources. In addition, an experienced librarian at the National Hazards Center library at the University of Colorado-Boulder, United States conducted a search specifically for grey literature. The search was conducted in close consultation with a team member who was physically present on location.

3.6.4 Social Media Company Sourced Studies

For the specific objective of the present review, we additionally utilized contacts provided by the WHO to acquire relevant grey literature and reports from social media companies. Contacts included Facebook's Head of Global Policy Programs, Google's Social Responsibility Regional Manager, Twitter's Public Policy Lead, and LinkedIn's Head of LinkedIn for Good. Facebook and Twitter contacts responded and each provided several links and leads to promising material, which yielded ten reports. Of these, four were data-based primary studies, relevant regarding the research topic, and offering the benefit of being very recent publications. Hence, these four studies, Corrigan (2014), Kryvasheyeu (2016), Ntalla (2015), and Olteanu (2015), were included in the final literature set for the review.

3.7 Literature Search Strategy, Search Terms, and Search Inclusion and Exclusion Criteria

3.7.1 Search Strategy

We adopted a two-phase strategy for literature searching. In the first phase we did a general search that was intentionally broad in scope. In the second phase, a search focused narrowly on the objective of the present review was conducted.

3.7.2 Search Terms

We used the search terms noted below. Not all terms worked in all databases; therefore, thesauri were consulted for each database to find synonyms, if they existed, for each term, or any functionality that allowed the word to be "exploded" or "expanded."

Disaster*	Trust	Social media
Disaster plan*	Public health	New media
Communication	Messages	Twitter
Risk communication	Warning messages or warning	Facebook
Emergenc*	Media	(Sina) Weibo
Hazard*	Health campaign	tweet
Risk*	News	SMS
Threat*	Journalism	Text message
Emergency preparedness	Public participation	mobile
Emergency management	Community participation	Cell phone
Cris!s (or other truncation used in a specific database:?,#)	Timing	
Disaster preparedness	Safety	
Hazard communication	Motivat*	
Emergency communication	Governmen* and governance	
Catastrophe communication	Public notice or information	
Health communication	Information dissemination	

3.7.3 Search Inclusion Criteria

The following broad inclusion criteria were used in the search for literature:

- Research related to the practice of risk communication and the process of disaster management with no preference for any specific emergency or health hazards.
- Research within the viewpoint or scope set by the risk communication field including, but not limited to: trust, uncertainty, communities, health, misinformation, health protection, media (including social media), messages, and stakeholders.

3.7.4 Search Exclusion Criteria

The following exclusion criteria were used in the search for literature:

- Research in organizational risk communication and disaster management such as technology failures.
- Research outside of the specified scope of the study, such as laboratory studies and those related to chronic disease, lifestyle, or personal living/ attributes (such as personal health, mental health, etc.).
- Pre-2003.

3.8 Article/ Report Selection

3.8.1 General Process

The hits generated by the literature search process were narrowed to select data-based primary articles and reports. The general process for selection of the articles/ reports for all languages was in two stages.

In the first stage:

- The hits obtained using a search were scanned by reading their title and abstract or summary;
- After scanning, the hits that were judged as related to risk communication during disaster/ emergency events were quickly read as full-texts and downloaded if found still broadly related;
- The downloaded full-texts were read carefully and selected if found related to the objective and phenomena of interest of the present review. These included, both academic and grey literature, data-based studies, reviews, guidelines, and media reports.

In the second stage:

- The full-texts of the selected articles and reports were again read and this time categorized as a data-based primary study or not. This included the grey literature.
- If an article/ report was a data-based primary study, it was further judged for relevancy to the review objective and phenomena of interest. A study that was judged as directly, indirectly, partially, or uncertainly relevant (as opposed to not relevant at all), was selected for extraction of its key findings. *Only these relevant primary study articles/ reports were directly used to generate the systematic review for this report.* These included studies used quantitative, qualitative, mixed-method, and case study methods.

To summarize, the article/ report selection process occurred in two broad stages. In the first stage, all literature that was related to disaster/ emergency risk communication, and review objective and phenomena of interest was selected. In the second stage, this literature was narrowed to select only relevant data-based primary study articles/ reports using quantitative, qualitative, mixed-method, and case study methodologies.

3.8.2 Quality Assurance of Selection Process

The first stage of the search and selection for English language articles/ reports was conducted by an experienced librarian with subject-matter expertise in the discipline of communication. Two training and norming sessions were conducted with the librarian. The second stage selection was done by all primary members of the research team, who had gone through a training and norming session.

Both the first and second search and selection stages for other UN languages were done by fluent readers and writers of Arabic, Chinese, French, Russian, and Spanish who were also fluent in English. Four norming and training sessions were conducted with this group in a group setting. In addition, individual training sessions were provided as needed.

3.9 Quality Appraisal of Selected Individual Studies

The individual data-based primary studies selected for the review were appraised for their quality. The quality appraisal for primary studies for all languages was done using the following tools:

- Quantitative-Comparison Groups done by EPOC Risk of Bias
- Quantitative-Descriptive Survey done by adaptation of Davids and Roman (2014)
- Qualitative done by CASP
- Mixed-method and case study done by McGill University MMAT.

Quantitative control/comparison groups were individually appraised using the Effective Practice and Organisation of Care (EPOC; 2015) Risk of Bias tool. This tool provides nine criteria for assessing randomized control trials, non-randomized control trials, and control before-after studies. Detailed information on the definitions of levels of risk used in this tool is available in section 12.2.2 of the Cochrane Handbook.

Quantitative descriptive survey studies were individually appraised using an adapted version of Davids and Roman's (2014) quality appraisal criteria. This tool assessed on a 0 to 1 scale (0-not reported, 1-reported) the following areas: sampling, response rate, validity and reliability, sources of data, content and focus of study, and relevancy to the corresponding question. Final ratings were determined by percentage; weak (0-33.9%), moderate (34-66.9%), and strong (67-100%).

Qualitative studies were individually appraised using Critical Appraisal Skills Programme (CASP) (2013) checklist. Areas of the study appraised by CASP include appropriateness of qualitative methodology, data collection, relationship between research and participants, ethics, rigor of data analysis, clarity of findings, and value of research. Each area in CASP is assessed using "yes," "no", or "can't tell." Studies received a final rating of "high" (no significant flaws), "moderate" (minor flaws impacting credibility/validity), "low" (some flaws likely to impact credibility/validity), or "very low" (significant flaws impacting credibility/validity).

Mixed method and case study studies were appraised using Pluye et al.'s (2011) Methods Appraisal Tool (MMAT). Studies were assessed for the employed methods and methodological quality (i.e., qualitative, quantitative randomized control trials or non-randomized control trials, quantitative descriptive, and overall implementation of mixed methods). Each area in MMAT is assessed using "yes," "no," or "can't tell." Studies received a final rating of "high" (no significant flaws), "moderate" (minor flaws impacting credibility/validity), "low" (some flaws likely to impact credibility/validity), or "very low" (significant flaws impacting credibility/validity).

Individual media reports were appraised for their quality using the Authority, Accuracy, Coverage, Objectivity, Date, and Significance (AACODS) tool (Tyndall, 2008). Each area in AACODS is assessed using "yes," "no," or "can't tell." Studies received a final rating of "high" (no significant flaws), "moderate" (minor flaws impacting credibility/validity), "low" (some flaws likely to impact credibility/validity), or "very low" (significant flaws impacting credibility/validity). An important factor in weight with AACODS is given to aspects of authority.

3.10 Extraction of Data from Selected Individual Studies

3.10.1 Extraction of Data: Study Characteristics

The following study characteristics were extracted from individual data-based primary studies of all method types: Method; country focus; disaster/ emergency type; disaster/ emergency phase; and whether at-risk/ vulnerable population.

3.10.2 Extraction of Data: Study Findings

The purpose of extraction of findings from the individual data-based primary studies was to identify and note evidence of interest that mapped onto the phenomena of interest and the outcomes/ effects related to the review question. To extract the findings, we used the general process of reading and re-reading the abstract, results/ findings/ analysis, and discussion and conclusion sections to isolate the findings of interest. We did this process for all four methodological streams.

A quantitative meta-analysis was not suitable for the review due to the very small number of studies that used comparison groups (randomized or non-randomized). As such, as recommended in Section 11.7.2 of the Cochrane Handbook dealing with results without meta-analyses, we followed a narrative summary approach to extraction of findings from studies in all four methodological streams.

Narrative findings were, thus, extracted from primary studies of all method types. The findings focused on the phenomena of interest and the outcomes/ impacts of the review objective. Each finding was written as a statement. The findings were extracted separately for each outcome.

Quantitative and qualitative evidentiary support for each finding was also extracted. From quantitative studies we extracted numerical data, such as means, standard deviations, and probability values. While extracting these data we kept in mind whether the study was a group comparison (randomized, non-randomized) or descriptive. From qualitative studies we extracted key phrases, sentences, and direct quotations. From mixed-method and case study studies we extracted numerical data and key phrases, sentences, and direct quotations as appropriate related to each method. The extraction included page and paragraph numbers for the supporting evidence for every finding for all methodological streams.

3.10.3 Quality Assurance of Extraction of Data

An initial codebook for extracting study characteristics and findings was developed based on examples provided by the WHO. After receiving feedback on a draft from team members and the WHO, the document was suitably revised. Training sessions for the use of the codebook were conducted with the research team.

A pilot test of the codebook portion for extracting study characteristics was conducted with approximately 1% of the English language articles/ reports. For the pilot test, three team members coded each article. An analysis of the coding showed high agreement (approx. 80%) between the three coders.

For the codebook portion for extracting findings, a pilot test was conducted with approximately 1% of the English language articles/ reports with two readers. Results showed high agreement (approx. 80%) between the two readers.

The two pilot tests generated suggestions for refinement from the team members. The final codebook was created after incorporating this feedback.

3.11 Synthesis of Findings

3.11.1 General Process of Synthesis of Findings

The synthesis of findings was done in two stages as presented in the process design in Section 3.3. In the first stage, findings from individual studies were synthesized within methodological streams and then these within-method synthesized findings were evaluated for certainty/ confidence using appropriate tools.

In the second stage, the within-method synthesized findings were synthesized across methodological streams, taking into account the certainty/ confidence evaluations.

3.11.2 Subgroup and Equity Analyses

In both the within-method and across-method stages, the synthesis of findings included subgroup analyses. These included examination of type of emergency event, phase of emergency event, country of emergency event, and presence of vulnerable population. The last two subgroups allowed considerations of equity in the synthesized findings.

3.11.3 Quality Assurance of Synthesis of Findings

The synthesis of findings was done by the lead author of the report. The synthesis process and the synthesized findings were discussed with all team members in weekly meetings. One team member closely read the synthesized findings and offered critique. The synthesized findings were developed based on the discussion and critique.

3.12 Synthesis of Findings Within Each Methodological Stream

For each methodological stream, the synthesized findings were created by building explanatory and higher level analytical statements supported by quantitative and qualitative evidence from individual studies.

For the two quantitative methodological streams, we again took directions from Section 11.7.2 of the Cochrane Handbook dealing with results without meta-analyses and followed a narrative summary approach to synthesis of findings.

For the qualitative methodological stream, we broadly followed the framework synthesis model (Barnett-Page, & Thomas, 2009; Pope, Ziebland, & Mays, 2000). We found this model suited to organize and analyze large amounts of data, which for us was represented by the corpus of findings and supporting evidence. The model is a mix of deductive-inductive processes. We started with a list of a priori framework categories generated from review objectives and phenomena of interest concepts, and modified the list as appropriate based on prior subject matter knowledge and reading of individual studies. Our goal was to synthesize the findings by identifying themes that emerged across the findings from individual studies and fit the framework categories.

For the mixed-method and case study methodological stream, the individual studies typically did not differentiate their overall findings based on type of methodology. For this stream, thus, we looked at the findings holistically and followed a broadly narrative summary approach.

3.13 Evaluation of Certainty/ Confidence in Synthesized Findings Within Methodological Stream

The assessment of certainty/ confidence of synthesized findings was done separately for each methodological stream using the following tools:

- Quantitative-Comparison Groups (randomized, non-randomized) done by GRADE
- Quantitative-Descriptive Survey done by applying the principles of GRADE
- Qualitative done by GRADE-CERQual
- Mixed-Method and Case Study done by applying the principles of GRADE and GRADE-CERQual.

Quantitative-comparison groups within methodological stream synthesized findings were assessed for certainty using the Grading of Recommendations Assessment, Development, and Evaluation (GRADE) approach (GRADE Working Group, 2004; Guyatt et al., 2010; Higgins & Green, 2011). Findings were assessed on allocation sequence and concealment, baseline outcomes and characteristics, protections against contamination(s), presence of selective outcome reporting, and other possible forms of bias. Each category was given a rating of "low risk," "high risk," or "unclear risk." Detailed information on the definitions of levels of risk used in this tool available in section 12.2.2 of the Cochrane Handbook. Findings received a final rating of "high quality" (it is highly likely that new research will not modify the finding substantially), "moderate quality" (it is somewhat likely that new research will not modify the finding substantially), "low quality" (it is somewhat likely that new research will modify the finding substantially), or "very low quality" (it is highly likely that new research will modify the finding substantially).

Quantitative-descriptive survey within methodological stream synthesized findings were assessed for certainty using a tool developed for the present review that was based on the principles of Grading of Recommendations Assessment, Development, and Evaluation (GRADE) as noted above. Adjustments were made to the GRADE process to create the tool for evaluation of certainty of findings from quantitative cross-sectional surveys that did not have comparison groups for outcomes of interest. There were four evaluation categories: High quality (highly likely that new evidence will *not* substantially modify the study findings); moderate quality (somewhat likely that new evidence will *not* substantially modify the study findings); Low quality (somewhat likely that new evidence will substantially modify the study findings); and very low quality (highly likely that new evidence will substantially modify the study findings). The evaluation categories were based on factors that can reduce the quality of study findings: Limitations in study design or execution; inconsistency of results; indirectness of evidence; imprecision of results; and publication bias for findings collated across multiple quantitative studies. See Appendix 8.1 for the tool.

Qualitative within methodological stream synthesized findings were assessed for confidence using GRADE-CERQual (Lewin et al., 2015). Findings were assessed on methodological limitations, relevance, coherence, and adequacy of data supporting the finding. Each finding was then given a rating of "high confidence" (it is highly likely that the finding is a representation of the phenomena), "moderate confidence" (it is likely that the finding is a representation of the phenomena "low confidence" (it is possible that the finding is a representation of the phenomena), or "very low confidence" (it was not clear if the finding is a representation of the phenomena).

Mixed method and case study within methodological stream synthesized findings were assessed for certainty/ confidence using GRADE and GRADE-CERQual approaches.

3.14 Synthesis of Findings Across Methodological Streams

We synthesized the findings across the four methodological streams to develop an overarching synthesis of findings. The synthesized findings within a methodological stream were compared and contrasted with findings from the other methodological streams. Whenever the findings supported and amplified each other, they were combined into higher order findings that represented synthesis across the method streams. The evaluation of certainty in the within-method synthesized findings was kept in mind during this process.

All methodological streams did not yield the same kind or similar number of synthesized findings. We did not consider this a problematic issue as we were seeking to find the points of alignment of the findings across the method streams rather than simply merging them together, which would have given some methodological streams more importance than others.

Within-method findings that did not contribute to an across-method higher order finding were analyzed thematically. These thematic analyses were used to uncover a nuance or modification to the across-method findings, which were then either used to create a new higher order across-method finding or incorporated into an existing across-method finding.

A very few synthesized findings within a methodological stream provided evidence that countered the synthesized findings from other methodological streams. Whenever this happened, we strived to retain this finding as a separate finding in the final set of across-method findings or used it to modify an existing across-method finding.

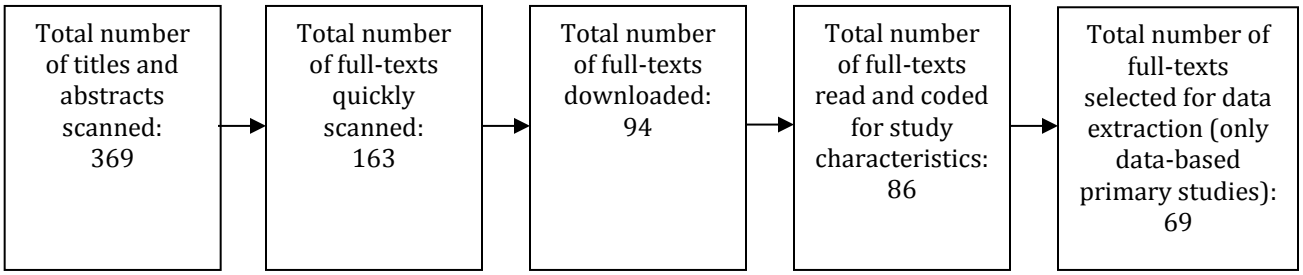
3.15 Media Reports

We extracted findings from individual media reports and then synthesized these findings across the individual reports. We used these across-media reports synthesized findings as another input for the final set of synthesized findings. A modified version of the AACODS tool was used for quality appraisal of the media reports as noted above.

4.0 RESULTS

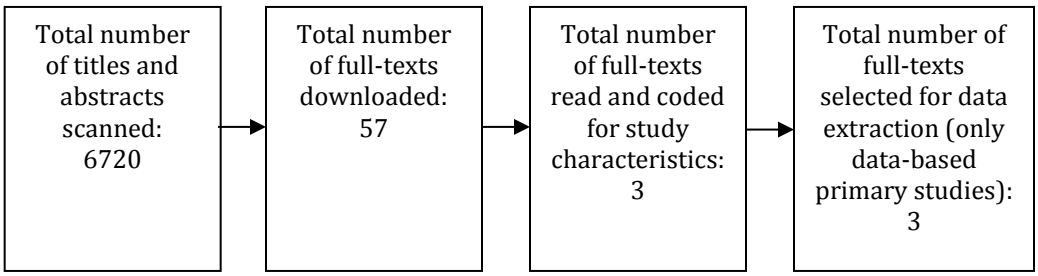
4.1 Study Selection

4.1.1 English Language

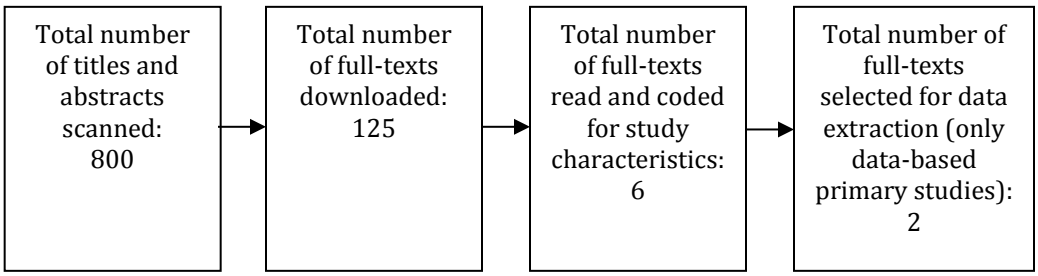


4.1.2 Other UN Languages

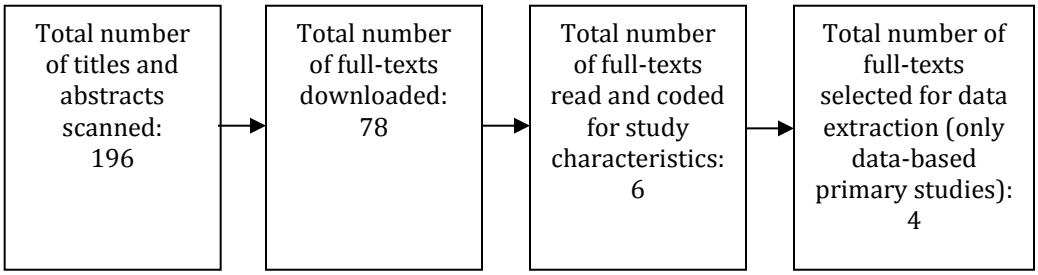
Arabic:



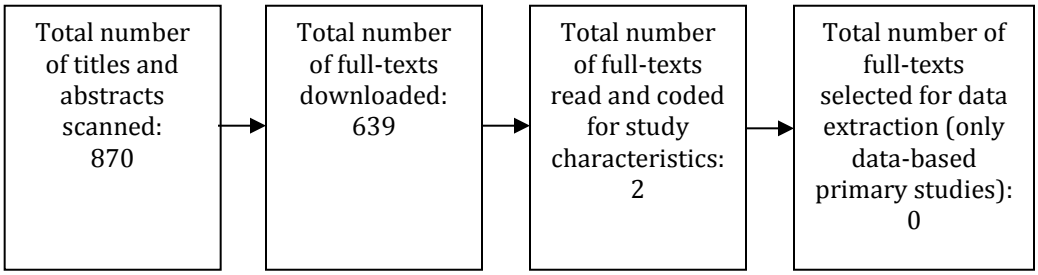
Chinese:



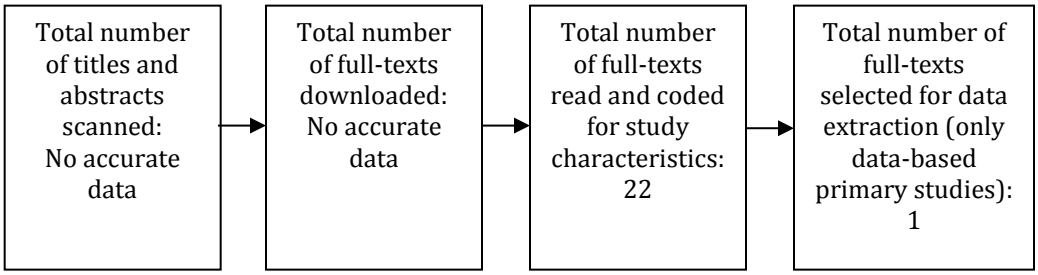
French:



Russian:



Spanish:



4.2 Study Characteristics

A knowledge map of the study characteristics is provided in Section 4.2.1 for English language studies and in Section 4.2.2 for other UN languages studies.

4.2.1 Knowledge Map of Characteristics of Studies-English Language

Key to Table
. Total English language data-based primary studies (includes grey literature): 69
. Grey literature studies: 6
. Some categories are not mutually exclusive and so the frequencies will not sum to the total of 69.
. Method: Quantitative-Comparison Groups (QN-CG); Quantitative-Descriptive Survey (QN-DS); Qualitative (QL); Mixed-Method/Case Study (MM, CS)

Relevancy	***Method General***	***Country Focus***	***Disaster/ Emergency Type***	***Disaster/ Emergency Phase***	***At-risk Groups***
Direct: 66 Indirect: 3 Partial: 0 Unclear: 0	QN-CS: 2 QN-DS: 29 QL: 15 MM, CS: 23	General/Global: 1 Australia: 4 Belgium: 1 China: 4 Chile: 1 Europe/ EU General: 6 India: 1 Japan: 8 Jordan: 1 Haiti: 2 Netherlands: 1 New Zealand: 3	General/ Multiple: 8 Drought: 1 Earthquake: 18 Flood: 8 Food: 2 Hurricane/ Cyclone/ Typhoon: 12 Infectious Disease: 9 Mass panic: 1 Radiological: 3	All Phases: 5 Preparation: 5 Onset: 0 Containment: 29 Recovery: 4 Preparation, Onset & Recovery: 1 Preparation & Onset: 3 Preparation & Containment: 2 Onset,	Yes: 3 (refugees in refugee camp; low income people)

		Nigeria: 1 Philippines: 3 Thailand: 1 Taiwan: 1 United Kingdom: 3 United States: 32 Not Specified: 1	Refugee camp Crisis: 1 School Shooting: 1 Terrorism: 2 Tsunami: 2 Storm/ Tornado: 3 Wildfire/ Grassfire: 4 Not Specified: 2	Containment & Recovery: 4 Onset & Containment: 11 Containment & Recovery: 4	

Of the 69 English language studies examined (see Section 7.1 for the references), 66 were directly relevant and three were indirectly relevant; none were partially or unclearly relevant. Nearly half of the studies used quantitative methods to investigate questions around social media in disaster communication, two studies conducted research via trials, 29 used other quantitative descriptive methods. The other half was weighted slightly more toward mixed methods and case studies (23 combined) than qualitative methods (15).

Regarding countries, nearly half of all studies were situated in the United States (33), several more studies analyzed crises set in other Western and Eastern developed regions and countries such as Japan (8), China (4) Australia (4), Europe/EU (6) and individual European countries such as Germany, the Netherlands, and the United Kingdom. Other Asian countries in which disasters were studied included the Philippines (3), New Zealand (3) and one study each with data from India, Taiwan, and Thailand. Few studies focused on the Southern hemisphere, almost absent were studies from Latin America (with the exceptions of one study each in Chile and Haiti), the Middle East (with the exception of a study on a refugee camp in Jordan) and Africa (with the exception of Nigeria.)

Regarding the types of disasters/ emergencies, earthquakes (18), typhoon/ hurricane/ cyclone (12), infectious diseases (9), and floods (8) were studied most often. Fewer studies focused on fires (4), storms/ tornadoes (3), radiological disasters (3), tsunamis (2), terrorism (2), and food safety (2). Only single studies focused on a drought (1), a school shooting (1), a crisis in refugee camp (1), and a mass panic (1).

Most studies analyzed the use of social media during the containment phase (29) or the containment phase in combination with preparation or onset or recovery. A few studies focused only on the preparation phase (5), recovery phase (4) or all phases (5); no study focused on the onset phase alone.

Regarding vulnerable populations, most studies focused on the general population or health agency officials, only a small minority of studies revealed in sample demographics to be focusing on minority groups such as very low to low income people and refugees in Jordan. It must be noted that many studies that analyzed the use of Twitter did not reveal demographics of the users of Twitter beyond stating the frequency of posts, re-tweets and/or followers.

4.2.2 Knowledge Map of Characteristics of Studies-Other UN Languages

Key to Table
. Total other UN languages data-based primary studies: 10
. Some categories are not mutually exclusive and so the frequencies will not sum to the total of 10.
. Method: Quantitative-Comparison Groups (QN-CG); Quantitative-Descriptive Survey (QN-DS); Qualitative (QL); Mixed-Method/Case Study (MM,CS)

Relevancy	***Method General***	***Country Focus***	***Disaster/ Emergency Type***	***Disaster/ Emergency Phase***	***At-risk Groups***
Direct: 7 Indirect: 3	QN-CS: 0 QN-DS: 3 QL: 2 MM, CS: 5	Canada: 2 China: 2 France: 1 Poland/Czech Republic/ Germany/ United States/ France: 1 Saudi Arabia: 1 Spain: 1 United Arab Emirates: 1 Yemen: 1	General: 3 Avalanches: 1 Nuclear: 1 Flood: 1 Infectious Disease: 3 Terrorism: 1 Volcano: 1	All Phases: 1 Preparation: 1 Onset: 0 Containment: 1 Recovery: 0 Evaluation: 2 Preparation, Onset & Evaluation: 1 Preparation, Recovery, & Evaluation: 1 Onset & Containment: 3	Yes: 3 (Pregnant women, adolescents, children, older adults, people with compromised immune systems/chronic diseases, immigrants, people with disabilities)

Of the 10 other UN languages (i.e., not English) data-based primary studies (see Section 7.2 for the references), there were three Arabic, two Chinese, four French, and one Spanish studies. Seven studies were directly relevant and three were indirectly relevant. The relevancy was judged as only direct and indirect due to lack of sufficient clarity for the partial and unclear categories.

Three of the studies used quantitative methods to investigate the questions around social media in disaster communication, two employed qualitative methods, two employed mixed methods, and three employed a case study approach.

Regarding countries, two of the studies focused on Canada, with the remaining articles focusing on an array of regions. These countries include China, (2), France (1), Poland/The Czech Republic/Germany/United States/France (1), Saudi Arabia (1), Spain (1), United Arab Emirates (1), and Yemen (1).

The types of disasters were also varied. The studies focused on avalanches/nuclear disasters (1), avian influenza (1), floods (1), general influenza/H1N1 (2), terrorism (1), volcano (1), and three (3) took a general focused approach on disasters.

Only one study focused on all phases of disaster/emergency. Other studies focused on preparation (1), containment (1), evaluation (2), and the remainder focused on a mixture of phases (5). Regarding at-risk/vulnerable groups, most of the studies focused on general populations, with only three examining specific demographic information that identified at-risk/vulnerable groups. The identified at-risk/vulnerable groups included pregnant women, adolescents, children, older adults, people with compromised immune systems/chronic diseases, immigrants, and people with disabilities.

4.3 A Note About the Grey Literature

The grey literature (non-academic) data-based primary studies were treated similar to the academic primary studies. The literature for the review (only English language noted) contained six reports coded as grey literature of which five used case study methodology and one a quantitative descriptive method. Except for one analyzing an earthquake in Haiti, they focused on the USA (one in combination with Germany), and several different disasters, hurricanes, and the H1N1 influenza outbreak.

Two studies looked at social media use during the preparation phase finding that community collaboration with local media and experts are essential for effective response to and recovery from a disaster; but media partnerships need to be established before a crisis happens to have time to build a working relationship with local media and to understand their social media use. Social media were also shown during the preparation phase to be able to trigger people to evacuate when it is in line with their own motivation.

Similarly, two other studies on the use of social media by local and national government and agencies found that social media need to be used as complementary modes of communication to traditional communication channels during a crisis. Further, Facebook was found to be a self-correcting environment and needed no moderating of messages by the governmental agency to verify information to users. The study on earthquake containment and recovery in Haiti found that the Ushahidi platform, which draws information from Twitter, Facebook, blogs and SMS, creates crowd-sourced disaster maps to enable targeted disaster responses; yet a vetting system is needed to rapidly identify misinformation.

4.4 Quality Appraisal of Individual Studies

Of the 69 English language studies used in the present review, two were placed in the quantitative-comparison group stream, 29 in the quantitative-descriptive survey stream, 15 in the qualitative stream and 23 in the mixed methods/case studies stream (six mixed methods; 17 case studies). Within the quantitative-comparison groups stream, both studies were trials and were rated to be of moderate quality (minor risk of bias). In the quantitative-descriptive survey stream 17 studies were rated to be strong quality and 12 were rated to be moderate quality. In the qualitative methods stream three were rated to be of high quality, eight of moderate quality, and four of low quality. In the mixed methods/case studies methods stream seven were rated to be of high quality, 11 of moderate quality, and four of low quality.

See Appendix 8.2 and Appendix 8.3 for tables for English language studies that present the quality rating, as well as relevancy and extracted findings, for each study.

For the other UN languages individual studies, a quality appraisal could not be determined for all the studies. This is noted as needed when evaluating the certainty/ confidence of the synthesized findings (see Section 4.5).

4.5 Synthesis of Findings Within Methodological Stream and Evaluation of Certainty/ Confidence

Key to Table
Method: Quantitative-Comparison Groups (QN-CG); Quantitative-Descriptive Survey (QN-DS); Qualitative (QL); Mixed-Method/ Case Study (MM, CS)
Citations-Language: English has no suffix; Arabic (AR); Chinese (CH); French (FR); Russian (RU); Spanish (SP)
Certainty/ Confidence Evaluation: QN-CG – High; Moderate; Low; Very low
QN-DS – High; Moderate; Low; Very low
QL – High; Moderate; Low; Very low
MM, CS – High; Moderate; Low; Very low

Outcome/ Phenomenon of Interest	***Method***	***Synthesized Finding Statement (with subgroup analysis of type, phase, and country of disaster, and vulnerable population)***	***Citations (first author) Supporting Synthesized Finding Within Method Stream***	***Evaluation of Certainty/ Confidence of Synthesized Finding Within Method Streams***	***Explanation of Evaluation***
Health	QN-CG	In an outbreak of acute hemorrhagic conjunctivitis (AHC) infectious disease in Taiwan, the study compared the cities of Taipei, which received an integrated risk communication program that included short messaging service (SMS) messages sent to all citizens with mobile phones, and Keelung, which did not receive such a program. The analysis showed that Taipei had a shorter epidemic duration (13 vs. 34 days) and attack rate (5 vs. 14 days). SMS should be used by agencies, first responders and the public to monitor public reactions in Taiwan during an AHC crisis among residents to address the public, create situational awareness, for citizens' peer-to-peer communication and aid, and to solicit responses from the ground; this is especially true of those who are directly affected by a disaster in onset and	Yen (2009)	Moderate	Several categories of the evaluation tool were answered with the "cannot tell" option as no information could be found.

		containment phases.			
Health	QN-CG	In an online experiment in Europe, the study used the crisis scenario of the Fukushima nuclear disaster to investigate effects of medium type (Twitter vs. Facebook vs. newspaper) and crisis framing type (human error caused vs. non-human error caused). The results showed that in general the medium type effects were present more than crisis type effects on perception of organizational reputation and willingness to share messages. Social media use should be used together with traditional news media for an integrated communication strategy to spread verified health information as traditional news media enjoy high credibility during a scenario of a combined earthquake and nuclear crisis in Japan during the recovery phase for women and men in a general population	Utz (2013)	Moderate	Several categories of the evaluation tool were answered with the "cannot tell" option as no information could be found.
Health	QN-DS	Use of social media needs to be contextualized for particular populations and crises in Australia, the US, China and Jordan. Practitioners need to find out if and how the general population in Australia and the US, local government officials in the US, and students in China use social media during the onset and containment phases during different types of crisis (public health, political, social) and disaster events such as flood, earthquake, and	Bird (2012); Graham (2015); Lachlan (2014); Lu (2011); Walther (2013)	High	Overlapping findings by five studies of which three were individually appraised to be strong and two moderate

		hurricanes. Except for refugees in a refugee camp in Jordan, no vulnerable populations were reported to be specifically studied.			
Health	QN-DS	Social media use, experiences and affects during the containment and recovery phases differ between people who are directly affected by a disaster/in disaster zone and those who are not directly affected/farther away such as an earthquake in Japan and a mass panic in Germany. No vulnerable populations were reported to be specifically studied.	Cheng (2015); Miyabe (2012); Schwarz (2012)	Moderate	Results were consistent among two studies, one appraised as strong and one as moderate. The third study was focused on a different context and rated as strong. Hence, conservative assessment is moderate, also due to the low number of citations supporting this finding.
Health	QN-DS	Social media, especially Twitter and Facebook, should be used by agencies, first responders and the public to monitor public reactions during a crisis, to address the public, create situational awareness, for citizens' peer-to-peer communication and aid, and to solicit responses from the ground; this is especially true of those who are directly affected by a disaster (also during different phases of disaster). These findings applied to studies analyzing mostly containment but some also preparation and recovery phases. Countries included Australia, Japan, the US, China, Netherlands, Belgium, Italy, Germany, Ireland, Spain, Portugal, Italy, Philippines, Venezuela, Costa Rica,	Bird (2012); Cheng (2015); Freberg (2013); Graham (2015); Hughes (2009); Lachlan (2016); Li (2014); Lu (2011); Kryvasheyeu (2016); Kuttschreuter (2014); Miyabe (2012); Olteanu (2015); Schwarz (2012); Spence (2015); Takahashi (2015); Vos (2016); Walther (2013); Yamamura (2014); Ferris (in press)	High	Overlapping and re-confirming findings by 20 studies which individually were appraised to be strong (12) or moderate (8).

		Guatemala, Brazil, Australia, Russia, Bangladesh, Canada, Singapore, Spain, UK, Jordan. Types of disasters included crises of all types: flood, cyclone/typhoon, earthquake, infectious disease, hurricane, wildfires, mass panic, radiological events, Vulnerable populations included refugees in a refugee camp in Jordan.			
Health	QN-DS	Social media, especially maps need to be incorporated into daily operations of governmental agencies and implementing partners in France before disaster strikes to build familiarity and routine during the preparation phase for diverse crises, but especially for avalanches and nuclear disasters. Unclear if vulnerable populations were discussed.	Glatron (2009) (FR)	High	Finding based on one study assessed as high in study quality.
Health	QN-DS	Social media use should be used together with traditional news media for an integrated communication strategy to spread verified information during the preparation, containment and recovery phases in cases of an earthquake, a radiological disaster, a hurricane, a crisis in a refugee camp and infectious disease outbreaks as traditional news media enjoy high credibility. This was the case in Japan, the US, Netherlands, Belgium, Italy, Germany, Ireland, UK, Spain, Portugal and Jordan. Vulnerable populations studied were refugees in a refugee camp in Jordan.	Cheng (2015); Freberg (2013); Kuttschreuter (2014); Li (2014); Meyer (2014); Walther (2013)	High	Overlapping and re-confirming findings by six studies which individually were appraised to be strong (3) or moderate (3).

Health	QN-DS	Social media, especially maps, should be used by agencies, first responders to address the public in France and help create situational awareness during the preparation and recovery phase of diverse crises, especially avalanches and nuclear disasters. Unclear if vulnerable populations were discussed.	Glatron (2009) (FR)	High	Finding based on one study assessed as high in study quality.
Rumors	QN-DS	Social media, especially Twitter and Facebook, can be used to spread truthful information and to verify information to dispel rumors during the onset and containment phases of a flood and cyclone in Australia, for earthquakes in Japan and Chile, a radiological disaster in Japan and natural disasters in Saudi Arabia. No vulnerable populations were reported to be studied.	Al Khayli (2007) (AR); Bird (2012); Lu (2011); Mendoza (2010)	Moderate	Four studies confirmed these findings of which two were individually appraised to be moderate, one strong; quality appraisal was not available for the AR study.
Rumors	QN-DS	Governmental agencies and implementing partners need to train, employ and pay a dedicated social media officers to build relationships with stakeholders and to use social media consistently to build trust and credibility during the onset and containment phases of a flood and cyclone in Australia, for earthquakes in Japan and Chile, a radiological disaster in Japan, and a terrorist attack in Yemen. No vulnerable populations were reported to be studied.	Bird (2012); Lu (2011); Mendoza (2010); Mutahhar (2011) (AR)	Moderate	Four studies confirmed these findings of which two were individually appraised to be moderate, one strong; quality appraisal was not available for the AR study.
Rumors	QN-DS	Messages on social media, especially Twitter and Facebook, are verified via self-regulation by users on	Bird (2012); Mendoza (2010)	Moderate	Two studies confirmed these findings, one was individually

		the platforms as well as by agencies, which actively use myth-busting messages during the onset and containment phases of a flood and cyclone in Australia and earthquake in Chile. No vulnerable populations were reported to be studied.			appraised to be strong, the other one as moderate.
Health	QL	Use of social media needs to be contextualized for particular populations and crises such as for the general population in city versus rural contexts during the containment phases of a storm and flood in Finland and for the general population depending on income during the recovery phase a typhoon in the Philippines. Practitioners such as the Red Cross in the US need to use the preparation phase to find out if and how different groups use social media in different crises. Low and very low income people were participants in the study in the Philippines.	Briones (2011); Haataja (2014); Madianou (2015)	High	Three studies confirmed these findings, of which two were individually appraised to be high and one moderate.
Health	QL	Social media use, experiences and affects differ between people who are directly affected by a disaster/in disaster zone and those who are not directly affected/farther away.	Acar (2011); Bunce (2013)	Low	Two studies confirmed these findings, one individually appraised to be low, one moderate.
Health	QL	Social media, especially Twitter and Facebook, should be used by agencies, first responders and the public to monitor public reactions during a crisis, to address the public, create situational awareness, for citizens' peer-to-peer communication and aid, and to solicit responses from the ground; this is	Acar (2011); Briones (2011); Bunce (2013); Ding (2012); Haataja (2014); Hughes (2012); Palen (2008); Madianou (2015); Liu (2009); Potts (2011); Reuter (2013); Tang (2015);	Moderate	Overlapping and re-confirmed findings by 17 studies of which 5 were individually appraised to be high/strong, 8 moderate, and 4 low.

		especially true of those who are directly affected by a disaster (also during different phases of disaster). Countries and types of disasters included: infectious disease outbreaks in the US, China and Canada, impact of volcanic ash due to Iceland volcano outbreak affecting the UAE, earthquakes in Australia, Haiti and Japan, floods in Australia and Finland, a storm in Finland, different types of disasters in the US and India including hurricanes, tsunamis, drought and bombings, typhoon in the Philippines, Studies mostly focused on containment and onset phases.	Tapia (2013); Taylor-Robinson (2009); Tyshchuck (2013); Ayyad (2012) (AR); Masse (2011) (FR)		
Health	QL	Social media, especially Twitter (Weibo) and Facebook, need to be incorporated into daily operations of government agencies and implementing partners such as the Red Cross and local governments (in the US and international disaster response organizations e.g., Haiti) during preparation phases before emergencies of any kind (tornadoes and tsunamis) strike to build familiarity, routine, and networks to use social media during onset and containment phases.	Briones (2011); Hughes (2012); Reuter (2013); Tapia (2013); Tyshchuck (2013)	Moderate	Five studies confirmed this finding, of which three were individually appraised to be moderate, one each high and low.
Health	QL	Social media use should be used together with traditional news media for an integrated communication strategy to spread verified health information as traditional news media enjoy high credibility. This was the case for the Red Cross in the US during the	Briones (2011); Reuter (2013); Tyshchuck (2013)	Moderate	Three studies confirmed this finding, of which two were individually appraised to be moderate, and one high.

		preparation phase of any emergency, and the local government during the containment phase of a tsunami in the US and local first responders on Twitter (police, firefighters, local government, electricity providers) during the onset and containment phases of a tornado in the US.			
Rumors	QL	Social media, especially Twitter and Facebook, can be used by public relations officers to spread truthful information and to verify information to dispel rumors as during the onset and containment phases of a volcanic ash crisis that affected air traffic in UAE; by the general public during the containment phase of an earthquake in Japan; by the general public and government agencies during the containment phase of an H1N1 crisis in the US and China; and Californian local government during the preparation, onset and containment phases during a drought in the US.	Acar (2011); Ding (2012); Tang (2015); Ayyad (2012) (AR)	Moderate	Four studies confirmed this finding, of which all were individually appraised to be moderate.
Rumors	QL	Governmental agencies and implementing partners need to train, employ and pay a dedicated social media officers to build relationships with at-risk communities and stakeholders and to use social media consistently to build trust and credibility.	Acar (2011); Haataja (2014); Tang (2015); Taylor-Robinson (2009)	Moderate	Four studies confirmed this finding, of which three were individually appraised to be moderate, and one high.
Rumors	QL	Messages on social media, especially Twitter and Facebook, are verified via self-regulation by users on the platforms as well as by	Tapia (2013); Taylor-Robinson (2009)	Low	Two studies confirmed this finding, of which one was individually

		agencies, which actively use myth-busting messages such as large international disaster response organizations during the onset and containment phases of an earthquake in Haiti and high school students during the oset and containment phases of a meningococcal disease outbreak in the UK.			appraised to be moderate, and one low.
Health	MM, CS	Use of social media needs to be contextualized for particular populations and crises. Practitioners need to find out if and how different groups use social media in different crises. This was the case in studies on the use of social media by US college students in the fictional scenario of a containment phase of different types of disasters; the general population in the US during the onset and containment phases of a wildfire; local government's use during the preparation and containment phase of different disasters in the US, the work of first responders, NGOs and the general public in Nigeria during the onset, containment and recovery of an Ebola outbreak and by a university administration in New Zealand during the containment of an earthquake.	Austin (2012); Sutton (2007); Chavez (2010); Corrigan (2014); Dabner (2012)	Moderate	Five studies confirmed this finding, of which three were individually appraised to be moderate, and two high.
Health	MM, CS	Social media, especially Twitter and Facebook, should be used by agencies, first responders and the public to monitor public reactions during a crisis, to address the public, create situational	Austin (2012); Fraustino (2015); Freberg (2012); McNeill (2016); Ntalla (2015); Novak (2011);	High	Overlapping and re-confirmed findings by 30 studies which 11 were individually were appraised to be

		awareness, for citizens' peer-to-peer communication and aid, and to solicit responses from the ground; this is especially true of those who are directly affected by a disaster (also during different phases of disaster).This applied to a range of countries, during the preparation, onset, and most often containment but also recovery phases of a range of disasters. Populations studied included the general population, local governments and agencies and NGOs.	Shaw (2013); Starbird (2010); Sutton (2007); Archut (2011); Earle (2010); Chavez (2010) Chew (2010); Corrigan (2014); Dabner (2012); Heinzelman (2010); Kongthon (2012); Kotsiopoulos (2014); Latonero (2011); Plantin (2015); Qu (2011); Reynolds (2010); Sticher (2013); Sutton (2015); Taylor (2012); Sauvaget (2000) (FR); Lord (2009) (FR); Menendez (2010) (SP); Zhang (2011) (CH)		high/strong, 14 moderate, three low; one other UN language study was not appraised.
Health	MM, CS	Social media, especially Twitter (Weibo) and Facebook, need to be incorporated into daily operations of governmental agencies and implementing partners before disaster strikes to build familiarity, routine, and networks. This was the case for local government officials, university administrators, media, and police in the US during the preparation, onset, containment and recovery phases of different disasters, including fires and hurricanes; city officials during the onset and	Chavez (2010); Latonero (2011) Mathes (2013); Sticher (2013); Sutton (2015); Zhang (2011) (CH)	Moderate	Five studies confirmed this finding, of which two were individually appraised to be high, two low, one moderate; one other UN language study was not appraised.

		containment of a flood in Germany; and the preparation phase of an H1N1 outbreak in China.			
Health	MM, CS	Social media use should be used together with traditional news media for an integrated communication strategy to spread verified information as traditional news media enjoy high credibility. This was found in studies on the use of media of US college students for the containment phase of different fictitious disasters scenes; Twitter users among the general population during the containment phase of an outbreak of H1N1 in the UK; individual and institutional Twitter users during the preparation, onset and containment phases of a grass/wild fire, flood, bombings, and hurricane in the US and flood in Germany; and the use of (social) media by NGOs and the Nigerian population during the onset, containment and recovery phase of an Ebola outbreak.	Austin (2012); McNeill (2016); Starbird (2010); Sutton (2007); Archut (2011); Chew (2010); Corrigan (2014); Mathes (2013)	High	Eight studies confirmed this finding, of which four were individually appraised to be high/strong and four moderate.
Health	MM, CS	Social media, especially Twitter (Weibo) and Facebook, need to be incorporated into daily operations of governmental agencies and implementing partners before disaster strikes to build familiarity, routine, and networks. This was the case for local government officials, fire departments, university administrators, media, and police during the preparation, onset, containment and recovery phases of different	Chavez (2010); Latonero (2011); Mathes (2013); Sticher (2013); Sutton (2015); Zhang (2011) (CH)	Moderate	Six studies confirmed this finding, of which two were individually appraised to be high, two low, one moderate; one other UN language study was not appraised.

		disasters in the US, including fires and hurricanes; city officials during the onset and containment phase of a flood in Germany, and Weibo users in China during the preparation phase of an H1N1 outbreak.			
Rumors	MM, CS	Social media, especially Twitter and Facebook, can be used to spread truthful information and to verify information to dispel rumors. This includes alternative social media not immediately controlled by the government. This was the case in a study on the preparation, onset, containment and recovery phases of floods in Poland, Czech Republic, Germany, The United States, France, which especially focused on Eastern immigrants who may not speak dominant language, elderly, and disable people as a vulnerable populations. Other studies focused on general Twitter users and the US Centers of Disease Control's social media use during the onset and containment phases of the H1N1 outbreak in the US; NGOs and the Nigerian population during the onset, containment and preparation phases during an Ebola outbreak; city officials during the onset and containment phases of floods in Germany; and health officials during the containment phase of a public health emergency in China.	Chew (2010); Corrigan (2014); Reynolds (2010); Sticher (2013); Sauvaget (2000)(FR); Guo (2010) (CH)	Moderate	Six studies confirmed this finding, of which two were individually appraised to be high, two low, one moderate; one other UN language study was not appraised.
Rumors	MM, CS	Governmental agencies and implementing partners need to train,	Chew (2010); Corrigan (2014);	High	Four studies confirmed this finding, of which

		employ and pay a dedicated social media officers to build relationships with at-risk communities and stakeholders and to use social media consistently to build trust and credibility. This was the case in studies on Twitter users during the onset and containment phases of an H1N1 outbreak; NGOs and the Nigerian population during the onset, containment and preparation phases during an Ebola outbreak; users of the Ushahidi platform in Haiti during the containment and recovery phase of an earthquake; and top Twitter users during the containment phase of a flood in Thailand.	Heinzelman (2010); Kongthon (2012)		two were individually appraised to be high/strong and two moderate.
Rumors	MM, CS	Messages on social media, especially Twitter and Facebook, are verified via self-regulation by users on the platforms as well as by agencies, which actively use myth-busting messages. This was the case in studies on the use of Twitter by individuals and institutions in the US during the containment phase of a flood in Australia; preparation phases during an Ebola outbreak; users of the Ushahidi platform in Haiti during the containment and recovery phase of an earthquake; and the US Centers of Disease Control's social media use during the onset and containment phases of the H1N1 outbreak in the US.	Shaw (2013); Heinzelman (2010); Reynolds (2010)	Moderate	Three studies confirmed this finding, of which one each was individually appraised to be high, moderate, and low.

Different method streams of quantitative (comparison groups and descriptive), qualitative, and mixed methods and case studies, included several studies each (except for trials) that found similar phenomena and trends, confirming each other that different social media, but perhaps first and foremost Twitter, are beneficial during crisis communication for government agencies, implementing partners, first responders and the public to create two-way conversations to exchange information, create situation awareness and facilitate delivery of aid. Use of social media was found to be overall focused on spreading verified information and to eliminate rumors via crowd-sourced peer rumor control, and sometimes in combination with quick and effective myth-busting messages by government officials who had routine and expertise in using social media. Nevertheless, many studies pointed out that social media can only be one strategy and channel during crisis communication and needs to be used in combination with other channels and especially with messages on traditional news media as they continue to enjoy high media and were most often referenced on Twitter and social media platforms to distribute information that was deemed credible by the general population.

While nearly half of all studies employed quantitative methods, those were focused on descriptive methods; only two studies used trials to assess social media use. Trials may not lend themselves to study disasters for ethical reasons as well as planning reasons especially in the case of unforeseeable or very rapidly developing crises. Yet, across the other three method streams, which were mostly composed of studies individually appraised to be of high or moderate quality, results confirmed each other across a wide range of countries, mostly addressing the containment phase (often in combination with one or several of the other phases), and across a range of disasters. Few studies paid attention to vulnerable populations, pointing to a vast gap in research on social media during crisis communication.

Similarly nearly half of the studies were placed in a U.S. context or in other developed countries in Western Europe and Asia. Hence the use of social media in crisis communication remains little understood in Central and Latin America, the Middle East and Africa as well as the Indian subcontinent and Eastern Europe.

4.6 Synthesis of Findings Across Methodological Streams

Key to Table
Citations-Language: English has no suffix; Arabic (AR); Chinese (CH); French (FR); Russian (RU); Spanish (SP)
Certainty/ Confidence Evaluation: QN-CG (GRADE) – High; Moderate; Low; Very low
QN-DS (GRADE Adapted) – High; Moderate; Low; Very low
QL (CERQual) – High; Moderate; Low; Very low
MM, CS (as appropriate) – High; Moderate; Low; Very low

Phenomenon of Interest/ Outcome	***Synthesized Finding Across Method Streams (with subgroup analysis of type, phase, and country of disaster, and vulnerable population)***	***Citations (first author) Supporting Synthesized Finding Across Method Stream***	***Evaluation of Certainty/ Confidence*** ***Note: Only English language studies from Section 4.5 considered***
Health	Use of social media needs to be contextualized for particular populations and crises. Practitioners need to find out if and how different groups use social media in different crises. This was the case short message services (SMS) in Taiwan during the onset and containment phases of an acute hemorrhagic conjunctivitis crisis among residents. Use of social media needs to be also contextualized for particular populations and crises in Australia, the US, China and Jordan. Practitioners need to find out if and how the general population in Australia and the US, local government officials in the US, and students in China use social media during the onset and containment phases during different types of crisis (public health, political, social) and disaster events such as flood, earthquake, and hurricanes. Except for refugees in a refugee camp in Jordan. This was also the case for studies on the general population in city versus rural contexts during the containment phases of a storm and flood in Finland and for the general population depending on income during the recovery phase a typhoon in the Philippines. Practitioners such as the Red Cross in the US need to use the	Yen (2009); Bird (2012); Graham (2015); Lachlan (2014); Lu (2011); Walther (2013); Briones (2011); Haataja (2014); Madianou (2015); Austin (2012); Sutton (2007); Chavez (2010); Corrigan (2014); Dabner (2012)	*QN-CG (GRADE):* Moderate *QN-DS (GRADE Adapted):* Moderate to High *QL (CERQual):* Moderate to High *MM, CS (as appropriate):* Moderate to High

	preparation phase to find out if and how different groups use social media in different crises. Low and very low income people were participants in the study in the Philippines. This was the case in studies on the use of social media by US college students in the fictional scenario of a containment phase of different types of disasters; the general population in the US during the onset and containment phases of a wildfire; local government's use during the preparation and containment phases of different disasters in the US, the work of first responders, NGOs and the general public in Nigeria during the onset, containment and recovery of an Ebola outbreak and by a university administration in New Zealand during the containment of an earthquake.		
	Social media use, experiences and affects differ between people who are directly affected by a disaster/in disaster zone and those who are not directly affected/farther away.	Cheng (2015); Miyabe (2012); Schwarz (2012); Acar (2011); Bunce (2013)	*QN-CG (GRADE):* --- *QN-DS (GRADE Adapted):* Moderate to High *QL (CERQual):* Low to Moderate *MM, CS (as appropriate):* ---
	Social media, especially Twitter and Facebook, should be used by agencies, first responders and the public to monitor public reactions during a crisis, to address the public, create situational awareness, for citizens' peer-to-peer communication and aid, and to solicit responses from the ground; this is especially true of those who are directly affected by a disaster (also during different phases of disaster). This was the case short message services (SMS) in Taiwan during the onset and containment phases of an acute hemorrhagic conjunctivitis crisis among residents. These findings were also based on studies analyzing mostly	Yen (2009); Bird (2012); Cheng (2015); Freberg (2013); Graham (2015); Hughes (2009); Lachlan (2016); Li (2014); Lu (2011); Kryvasheyeu (2016); Kuttschreuter (2014); Miyabe (2012); Olteanu (2015); Schwarz (2012); Spence (2015); Takahashi (2015); Utz (2013); Vos (2016); Walther (2013); Yamamura (2014); Ferris (in press); Glatron (2009) (FR); Acar, (2011); Briones (2011); Bunce (2013); Ding (2012); Haataja (2014); Hughes (2012); Palen (2008); Madianou (2015); Liu (2009); Potts (2011); Reuter (2013);	*QN-CG (GRADE):* Moderate *QN-DS (GRADE Adapted):* Moderate to High *QL (CERQual):* Moderate to High *MM, CS (as appropriate):* Moderate to High

	containment but some also preparation and recovery phases. Countries included Australia, Japan, the US, China, Netherlands, Belgium, Italy, Germany, Ireland, Spain, Portugal, Italy, Philippines, Venezuela, Costa Rica, Guatemala, Brazil, Australia, Russia, Bangladesh, Canada, Singapore, Spain, UK, Jordan. Types of disasters included crises of all types: flood, cyclone/typhoon, earthquake, infectious disease, hurricane, wildfires, mass panic, radiological events. Vulnerable populations included refugees in a refugee camp in Jordan. Other countries and types of disasters included: infectious disease outbreaks in the US, China and Canada, impact of volcanic ash due to Iceland volcano outbreak affecting the UAE, earthquakes in Australia, Haiti and Japan, floods in Australia and Finland, a storm in Finland, different types of disasters in the US and India including hurricanes, tsunamis, drought and bombings, typhoon in the Philippines, Studies mostly focused on containment and onset phases. In sum, these findings applied to a range of countries, during the preparation, onset, and most often containment but also recovery phases of a range of disasters. Populations studied included the general population, local governments and agencies and NGOs.	Tang (2015); Tapia (2013); Taylor-Robinson (2009); Tyshchuck (2013); Ayyad (2012) (AR); Masse (2011) (FR); Austin (2012); Fraustino (2015); Freberg (2012); Freberg (2013); Hughes (2012); McNeill (2016); Ntalla (2015); Novak (2011); Shaw (2013); Starbird (2010); Sutton (2007); Archut (2011); Earle (2010); Chavez (2010); Chew (2010); Corrigan (2014); Dabner (2012); Heinzelman (2010); Kongthon (2012); Kotsiopoulos (2014); Latonero (2011); Plantin (2015); Qu (2011); Reynolds (2010); Sticher (2013); Sutton (2015); Taylor (2012); Sauvaget (2000) (FR); Lord (2009) (FR); Menendez (2010) (SP); Zhang (2011) (CH),	

	Social media, especially Twitter (Weibo) and Facebook, need to be incorporated into daily operations of governmental agencies and implementing partners such as the Red Cross and local governments in the US during any emergency and international disaster response organizations in Haiti during preparation phases before disaster such as emergencies of any kind, tornadoes, and tsunamis strike to build familiarity, routine, and networks to use social media during onset and containment phases. This was also the case for local government officials, university administrators, media, and police in the US during the preparation, onset, containment and recovery phases of different disasters, including fires and hurricanes; city officials during the onset and containment of a flood in Germany; and the preparation phase of an H1N1 outbreak in China.	Briones (2011); Hughes (2012); Reuter (2013); Tapia (2013); Tyshchuck (2013); Chavez (2010); Latonero (2011); Mathes (2013); Sticher (2013); Sutton (2015); Glatron (2009) (FR); Zhang, 2011 (CH)	*QN-CG (GRADE):* --- *QN-DS (GRADE Adapted):* --- *QL (CERQual):* Moderate *MM, CS (as appropriate):* Moderate to High
	Social media use should be used together with traditional news media for an integrated communication strategy to spread verified information as traditional news media enjoy high credibility. This was the case during a scenario of a combined earthquake and nuclear crisis in Japan during the recovery phase for women and men in a general population; for the Red Cross in the US during the preparation phase of any emergency; and the local government during the containment phase of a tsunami in the US and local first responders on Twitter (police, firefighters, local government, electricity providers) during the onset and containment phases of a tornado in the US.	Utz (2013); Cheng (2015); Freberg (2013); Kuttschreuter (2014); Li, (2014); Meyer (2014); Walther (2013); Briones (2011); Reuter (2013); Tyshchuck (2013); Austin (2012); McNeill (2016); Starbird (2010); Sutton (2007); Archut (2011); Chew (2010); Corrigan (2014); Mathes (2013)	*QN-CG (GRADE):* Moderate *QN-DS (GRADE Adapted):* Moderate to High *QL (CERQual):* Moderate *MM, CS (as appropriate):* High

Rumors	Social media, especially Twitter and Facebook, can be used by public relations officers to spread truthful information and to verify information to dispel rumors as during the onset and containment phases of a volcanic ash crisis that affected air traffic in UAE; by the general public during the containment phase of an earthquake in Japan; by the general public and government agencies during the containment phase of an H1N1 crisis in the US and China; and Californian local government during the preparation, onset and containment phases during a drought in the US. This was the also case in studies during the onset and containment phases of a flood and cyclone in Australia, for earthquakes in Japan and Chile, a radiological disaster in Japan and natural disasters in Saudi Arabia. This includes alternative social media not immediately controlled by the government. This found in a study on the preparation, onset, containment and recovery phases of floods in Poland, Czech Republic, Germany, The United States, France, which especially focused on Eastern immigrants who may not speak dominant language, elderly, and disabled people as vulnerable populations. Other studies focused on general Twitter users and the US Centers of Disease Control's social media use during the onset and containment phases of the H1N1 outbreak in the US; NGOs and the Nigerian population during the onset, containment and preparation phases during an Ebola outbreak; city officials during the onset and containment phases of floods in Germany; and health officials during the containment phase of a public health emergency in China.	Bird (2012); Lu (2011); Mendoza (2010); Al Khayli (2007) (AR); Acar (2011); Ding (2012); Tang (2015); Ayyad (2012) (AR); Chew (2010); Corrigan (2014); Reynolds (2010); Sticher (2013); Sauvaget (2000) (FR); Guo (2010) (CH)	*QN-CG (GRADE):* --- *QN-DS (GRADE Adapted):* Moderate to High *QL (CERQual):* Moderate *MM, CS (as appropriate):* Moderate to High

	Governmental agencies and implementing partners need to train, employ and pay a dedicated social media officers to build relationships with stakeholders and to use social media consistently to build trust and credibility during the onset and containment phases of a flood and cyclone in Australia, for earthquakes in Japan and Chile, a radiological disaster in Japan, and a terrorist attack in Yemen. This was the case in studies on Twitter users during the onset and containment phases of an H1N1 outbreak; NGOs and the Nigerian population during the onset, containment and preparation phases during an Ebola outbreak; users of the Ushahidi platform in Haiti during the containment and recovery phase of an earthquake; and top Twitter users during the containment phase of a flood in Thailand.	Bird (2012); Lu (2011); Mendoza (2010); Mutahhar (2011) (AR); Acar (2011); Haataja (2014); Tang (2015); Taylor-Robinson (2009); Chew (2010); Corrigan (2014); Heinzelman (2010); Kongthon (2012)	*QN-CG (GRADE):* --- *QN-DS (GRADE Adapted):* Moderate to High *QL (CERQual):* Moderate *MM, CS (as appropriate):* Moderate to High
	Messages on social media, especially Twitter and Facebook, are verified via self-regulation by users on the platforms as well as by agencies, which actively use myth-busting messages during the onset and containment phases of a flood and cyclone in Australia and earthquake in Chile. This was also the case in studies on the use of Twitter by individuals and institutions in the US during the containment phase of a flood in Australia; preparation phases during an Ebola outbreak; users of the Ushahidi platform in Haiti during the containment and recovery phase of an earthquake; and the US Centers of Disease Control's social media use during the onset and containment phases of the H1N1 outbreak in the US. No vulnerable populations were reported to be studied.	Bird (2012); Mendoza (2010); Tapia (2013); Taylor-Robinson (2009); Shaw (2013); Heinzelman (2010); Reynolds (2010)	*QN-CG (GRADE):* --- *QN-DS (GRADE Adapted):* Moderate *QL (CERQual):* Moderate *MM, CS (as appropriate):* Moderate to High

Across all methodological streams of quantitative (comparison groups and descriptive survey), qualitative, and mixed methods and case studies, studies of mostly moderate and high quality repeatedly found that social media, especially Twitter and Facebook, should be used by agencies, first responders and the public to monitor public reactions during a crisis, to address the public, create situational awareness, for citizens' peer-to-peer communication and aid, and to solicit responses from the ground; this was especially true of

those who are directly affected by a disaster. In tandem many studies qualified this finding by emphasizing that the use of social media needs to be contextualized for particular populations and crises. Practitioners need to find out if and how different groups use social media in different crises. Connected to this finding was the important theme that social media, especially Twitter and Facebook, need to be incorporated into daily operations of governmental agencies and implementing partners to build familiarity with them before crises happen. This was especially observed in U.S. agencies, local government and first responders but also for city governments and school administrations in Europe e.g. in Germany and the UK.

These findings were based on studies conducted in a wide range of countries across the Western and Eastern Northern hemisphere analyzing the use of social media across a wide range of natural disasters such as earthquakes, floods, fires, and infectious diseases as well as typhoons/cyclones/hurricanes which were most commonly studied. Most studies focused on the containment phase, in some cases in combination with preparation, onset and/or recovery phases. Only a few studied addressed vulnerable populations such as refugees in a refugee camp in Jordan; immigrants not literate in the host countries' dominant languages, elderly and disabled people and very low income people.

Similarly many studies confirmed across method streams that social media, especially Twitter and Facebook, can be used by public relations officers, governmental agencies and the general public to spread truthful information and to verify information to dispel rumors. When rumors arose, it was most often found that messages on social media, especially Twitter and Facebook, were verified via self-regulation by users on the platforms as well as by agencies, of which some actively used myth-busting messages. Yet this means, as several of the same studies found that governmental agencies and implementing partners need to train, employ and pay a dedicated social media officers to build relationships with stakeholders and to use social media consistently to build trust and credibility before disasters happen.

4.7 Media Reports

Eight media reports (see section 7.3 for the full citations) were identified for the review objective in the search for English-language news stories. Of these eight reports, four referred to the use of social media during the preparation, onset and containment phase of natural disasters in general and in one case specifically to hurricanes. The other four reported on an earthquake in Japan, the Ebola crisis in Sierra Leone, natural disasters in Canada and floods in Indonesia. Reports covered use of social media by local government officials, by international news media, the U.S. Federal Emergency Management Agency (FEMA), and the public. One report described the technology used by the U.S. cellular service provider AT&T in the form of mobile towers to provide wireless communication during disasters when regular towers may be damaged or out of service.

A modified version of the AACODS tool was used for quality appraisal of the media reports (Shea et al., 2007). Of the eight reports, the quality of one report was high, no report was moderate, five reports was low, and two reports was very low.

Findings across the articles suggest that local government officials, disaster aid agencies, international media and the general public should use social media to send and receive early warning messages during the preparation phase; share information on the situation on the ground during the onset and containment phases; to inform friends, families and communities during the containment phase about aid, food and evacuees. Further, Twitter as suggested as a tool to map the spread of floods in an area and to assess damage during a disaster in real time. In the USA, Canada, Indonesia and Japan Twitter and Facebook were specifically mentioned; in Sierra Leone Facebook and WhatsApp were the most popularly used social media during the Ebola crisis. No news story reported on the specific use by or for vulnerable populations.

These findings are in line with the findings of the analyzed studies and grey literature. They confirm that local government officials, aid organizations, news media and the general public should use social media, especially Twitter and Facebook, during the preparation, onset and containment phases of different types of disasters to share information and address misinformation. They also support the findings that news media partnerships are useful to provide credible, verified information and that depending on country different social media may be the most popular and accessible to spread information widely.

5.0 DISCUSSION

5.1 Summary of Results

5.1.1 Overall Summary

For the synthesis evidence for the present review on best practices and channels to promote public health measures and to dispel rumors and misinformation via social media, 69 studies English-language studies and 10 studies in other UN languages were included, appraised for quality, used for data extraction and formulating synthesized statements within methodological streams, which in turn were evaluated for certainty/ confidence, and then synthesized across methods. In this process it was found that studies demonstrated that social media, especially Twitter and Facebook, should be used by global, regional and local government agencies, first responders, health care practitioners and the public to monitor public reactions during a crisis; to address the public and to provide accurate, timely and transparently source information; to create situational awareness; for citizens' peer-to-peer communication and aid; and to solicit responses from the ground. This was especially true of those who were directly affected by a disaster especially during the preparation, onset and containment phases, and during earthquake and typhoon/ hurricane events. Yet, studies emphasized that it is important that the use of social media needs to be contextualized for particular populations and crises. Hereby it was found to be crucial that social media, especially Twitter (and the equivalent service of Sina Weibo in China) and Facebook, need to be incorporated into daily operations of governmental agencies and implementing partners *before* disasters strike to build familiarity, routine, and networks. This included that government agencies and health care practitioners needed to find out if, how and which different groups in their area use social media in different crises. This was the case not only regarding socio-economic status, but also in terms of geography as the experiences and affects differed between people who were directly affected by a disaster or were in disaster zone and those who were not directly affected or farther away. This also meant that governmental agencies need to hire, train and consistently support social media officers to build social media networks with the public and other useful entities. Additionally many studies pointed out that social media should be used in combination with traditional news media for an integrated communication strategy to spread verified information as traditional news media enjoy high credibility and news media reports are very often distributed via links on social media during times of crises. The eight analyzed media reports also suggested that local government officials, disaster aid agencies, international media and the general public should use social media to send and receive early warning messages during the preparation phase; share information on the situation on the ground during the onset and containment phases; to inform friends, families and communities during the containment phase about aid, food, and evacuees.

Social media, especially Twitter and Facebook, can be used to spread truthful information and to verify information to dispel rumors and misinformation during public health crises. This was especially important regarding alternative social media not immediately controlled by the government in countries where people are distrustful of official government messages and campaigns and turn to peers online to find more and accurate information. Studies demonstrated that the vast majority of messages on social media, especially Twitter and Facebook, were verified via self-regulation by users on the platforms as well as by agencies, which actively used myth-busting messages to address rumors and spread truthful information. This means, that while peer monitoring and correcting kept social media messages largely accurate, it was still recommended that governmental agencies and implementing partners train, employ and pay a dedicated social media officer to build relationships with at-risk communities and stakeholders and to use social media consistently to build trust and credibility and to address rumors and misinformation as soon as they arise. The use of hashtags was found to be helpful in cases of myth-busting as has been shown in a row of studies based in Australia during a flood where the social media accounts by local police were celebrated for their prompt myth-busting and reliability to provide consistent, timely updates with

accurate information. Governmental agencies should use hashtags that organically developed on social media, are already used by the majority of the public and are in wide circulation rather than creating and insisting on others using "their" newly branded hashtags for an event/ crisis.

Finally, with regards to at-risk populations, such as (very) low-income people, including refugees, and people in countries with low internet penetration/access, can best be reached via traditional media and alternative means of communication as they may not be reliably reached via social media during emergencies. The potential that social media offer regarding these populations is reverse tracking: via geo-location (for instance via Twitter) it can be determined which populations are not using social media so that these areas then can be targeted by other communication means to make sure messages get through and input from at-risk populations can be received during the preparation, onset, containment, and recovery phases of an emergency event.

5.1.2 Results Vis a Vis Findings from Existing Reviews

The present WHO-commissioned evidence synthesis of studies that address best practices and channels to use social media for risk communication regarding public health offered the needed update to previous reviews. In contrast to the existing 12 reviews, of which only one directly focused on social media use in health messages and which noted the dearth of studies on social media in risk communication, the present review was able to draw on 69 English-language studies and 10 studies in other UN languages. The majority of these used large samples of posts from social media by the public but did not analyze the demographics of the posters beyond such measures as geographic area, frequency of posting (including re-tweets) and number of followers. While much has been learned about the great value of information sharing via social media and the self-regulating practices of social media users to pass on true information and dispel rumors during times of crises, a gap in research persists as to who these social media users in the respective countries and regions are to have the advantage to use this social media technology during the different phases of crises.

In contrast to the previous reviews, it emerged in the present review that most studies on social media in risk communication have focused on posts on Twitter (and its equivalent of Sina Weibo in China), called tweets, and Facebook by the public and government agencies; a minority of studies focused on other social media sites such as Flickr, SMS, blogs, YouTube and mapping apps. Overall, research analyzed in the present review pointed to the continued need for government agencies and practitioners to include social media into their communication strategy for a true two-way communication with the public during all phases of a crisis. This means that agencies need trained staff that knows how to handle social media before disaster strikes and builds networks with the community by consistently providing accurate and timely message, including those that show empathy and support sense-making during times of disaster. Further, social media officers in public health organizations need to consistently respond to inquiries by the public on social media; the key is to develop a conversation rather than only providing a unidirectional flow of instructions. Additionally, in contrast to previous reviews this synthesis found that studies focused more frequently on the relationship between social media use and use of legacy news media such as radio and television. In this regard, this review found that news media remain a crucial part of risk communication as their information was considered to be credible and was most frequently relayed on social media via re-tweets and links to back up messages. Hence, journalism and (local) news media have remained important senders and sources during risk communication with the public and need to remain a part of the communication strategy, especially in collaboration with social media/online journalists.

5.2 Research Gaps

Research gaps appeared regarding the phases of a disaster as few studies on the use of social media during the recovery and preparation phases. Geographically, the Southern hemisphere – except for Australia –, that is Africa, Central and South America, South-East Asia, Central Asia, and the Indian Subcontinent as well as Eastern Europe have remained vastly understudied. Within the regions and countries where social media were studied, the vast majority of studies did not analyze the demographics of the social media users beyond their geographic location, their status of being in the disaster zone or outside this zone, and their frequency and content of posting. Socio-economic demographics were not collected and/or analyzed to drill deeper into the implications of using social media to reach vulnerable populations. Who exactly is reached via social media campaigns and who needs to be reached with other means have remained an understudied areas; social media's impact as one part of a multi-modal communication strategy similarly remains understudied. Studies point toward the information overload and confusion that can arise from social media use during crises events; however, how people can use social media well and can balance online information seeking with offline information seeking measures remains little understood. Few studies used comparative approaches between different countries or regions.

The studies for the present review also suggested a heavy bias toward studies based in the United States, Europe, Australia and some Asian countries such as China and Japan, with little attention paid to Central and South America, the Middle East as well as Africa. Accordingly most studies were based on data from high or middle-income countries. Within the countries, studies focused heavily on two social media platforms, Twitter and Facebook, albeit a few studies specified the user base beyond a geographic area; number of followers and/or tweets; and when users were active. Hence detailed data on gender, ethnicity, age, socio-economic status, (dis)ability etc. were generally not considered and researched in these studies. This might point to a limitation in the discussion of access and literacy issues for people to be able to use social media during disasters; it certainly points to a limitation in research that focuses on vulnerable populations and their intersections with social media use during crises.

Regarding Twitter, studies were mostly interested in the content of messages, including hashtags, re-tweeted material, sources of the message, and links. These features in turn were often discussed to gauge the credibility and verifiability of social media content, including trust in different types of sources (e.g. governmental, user-generated or news media). Most studies analyzed natural disasters such as earthquakes, typhoons/hurricanes, fires and floods or infectious disease outbreak that happen without warming or with little warning time and develop rapidly. Perhaps this is one reason why most studies analyzed social media use during the preparation and containment phases; fewer studies analyzed social use during the recovery phase. It appears that the containment phase, that is to catch social media users in action while the disaster is still ongoing, is considered the most desirable and important phase to study within the subfield of social media study within risk communication. Most studies focused on community and/or affected populations' use of social media as well as on how local governments, NGOs, health organizations, and providers use social media to inform and interact with the public. The types of disasters most often studied were seismic events such as earthquakes and tsunamis; weather phenomena such as storms and floods; and emerging infectious diseases, particularly the H1N1 influenza.

5.3 Limitations of the Present Review

The present review has three main limitations. First, the other UN languages articles and reports were not fully translated into English, which may have led to some information to be missed. Second, the coding, data extraction, and findings synthesis was done only by one person which prevented the calculation of inter-coder reliability as a check for consistency of these data. Third, presently there are no agreed upon quality appraisal or risk of bias tool for big data studies and so no quality assurance was done for such studies.

5.4 Authors' Conclusions

Social media are here to stay as another modality of risk communication to reach at-risk populations in preparation of and during the different stages of crises. Scholars from a range of disciplines have taken up the study of social media in risk communication providing a range of evidence that social media need to be used to monitor and speak *with*, and not only *to*, the public to promote health measures together, based on credible information. Yet, studies on social media used during risk communication have thus far only drawn on populations that were privileged enough to have access and literacy to handle social media as a channel of communication. Only a few studies used inquiry into the use of social media to also find out who is not reachable this way to then make the effort to find ways to communicate with non-social media users. One of the most valuable future research goals in this direction would be more fine-grained analyses on who these social media users are in a particular region or country to better understand which (vulnerable) population may not be able to be reached this way but need other forms of communication to prepare for and survive disasters.

Second, social media are still tools that have not become routine practices in many governmental agencies regarding public health in the countries studied. Obstacles still include the reluctance to learn new ways to communicate, the lack of additional staff to handle the increase of information exchange needs via social media, and missing universal guidelines on best practices of social media in daily operations of public health officials and especially during public health crises events. These obstacles need to be overcome to integrate social media into common strategies of risk communication without overemphasizing their use to not neglect those who cannot benefit from their use.

Third, big data analysis of large amounts of posts from social media have become an increasing trend in social media studies within risk communication. The most valuable studies combine such data collection with approaches that include interviews, focus groups, and/or discussions with the different stakeholders during an emergency event. Otherwise, a de-humanization of content may risk losing insights into the experiences of disaster-affected populations beyond short snippets of texts and hastily shot images. As studies pointed toward the struggle of information overload, confusion, and exhaustion of handling social media, so must researchers in risk communication balance their fascination with big data dumps and computer-assisted quantitative content analyses of these with continued collection of the holistic experiences of affected audiences to triangulate what Twitter, Facebook, and the next most popular platforms can tell us.

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8.0 APPENDIXES

8.1 Adjustments to the GRADE Process for Quantitative Descriptive Surveys (Cross-sectional; No comparison groups for outcomes of interest)

A. Levels of quality of study findings

High quality: It is highly likely that new evidence will not substantially modify the study findings.
Moderate quality: It is somewhat likely that new evidence will not substantially modify the study findings.
Low quality: It is somewhat likely that new evidence will substantially modify the study findings.
Very low quality: It is highly likely that new evidence will substantially modify the study findings.

B. Factors that can reduce the quality of study findings

1. Limitations in study design or execution
We are more confident about the high quality of study results, when we have:
. High validity and reliability of measurement of variables
. Attention to minimization of confounding variables, through, for example, use of control variables

2. Inconsistency of results
We are more confident about the high quality of study results, when we have:
. Homogeneity in the results across disaster types, national/cultural boundaries, etc.
. Heterogeneity of results, if present, has a plausible explanation

3. Indirectness of evidence
We are more confident about the high quality of study results, when we have direct evidence, which is:
. Direct - data are from affected populations, currently or in the past.
  Less direct - data from populations who may be likely to be affected in the future.
  Least direct - data from populations unlikely to be affected in the future
. Study variables directly speak to question of interest and outcomes of interest

4. Imprecision of results
We are more confident about the high quality of study results, when results are more precise, which is:
. Results are statistically significant
. Sample size is at least 90 for single group

*5. Publication bias * (for a finding collated across multiple quantitative studies)*
We are more confident about the high quality of results collated as a finding across individual studies, when:
. There is at least one study that shows nonsignificant/null results

8.2 Quality Appraisal of and Extracted Findings from English Language Individual Data-based Primary Studies (Quantitative-Comparison Group Method)

Key to Table
Method: Quantitative-Comparison Groups (QN-CG)
Relevancy: Direct; Indirect; Partial; Unclear
Quality: QN-CG – High (low risk of bias); Moderate (minor risk of bias); Low (some risk of bias); Very low (significant risk of bias)

Citation (first author); Method; Relevancy; Quality Appraisal Rating; Study Description	***Findings***	***Statistical Information***
Citation: Utz (2013) *Method:* QN-CG *Relevancy:* Direct *Quality Appraisal Rating:* Moderate/ Minor Risk of Bias *Study Description* In an online experiment in Europe, the study used the crisis scenario of the Fukushima Daiichi nuclear disaster in Japan to investigate effects of medium type (Twitter vs. Facebook vs. newspaper) and crisis framing type (human error caused vs. non-human error caused). The results showed that in general the medium type effects were present more than crisis type effects on perception of organizational reputation, willingness to share messages, and valence .	· The choice of using social media influences the effectiveness of the crisis communication, as it is now seen as a cue for the willingness of an organization to quickly inform its stakeholders and to engage in dialog with them. · Social media users mainly talk about news from traditional media because they interpret traditional media as more credible. Hence traditional media remain important for crisis communication strategy · Although crisis communication via Facebook resulted in a more positive reputation and less secondary crisis reactions, organizations should not neglect traditional ways of crisis communication. Journalists still fulfill an important gatekeeping function; news from (online) newspapers is perceived as more credible and consequently shared more often on social media. Organizations need an integrated communication strategy that spreads a consistent message across different channels. · Organizations and PR departments should not only focus on rationalizations, but also address emotions. It is important to reduce anger because anger drives negative secondary crisis communication and secondary crisis reactions. Framing a crisis as victim crisis reduced the perceived responsibility and in turn anger. · Social media will not replace traditional forms of hazard and risk communication but provide another tool to share responsibility of reducing risk, facilitate community involvement and empower people to take action. Social media allow agencies to tap into and review informal communication networks and correct conflicting and	A 3 (medium type: Twitter vs. Facebook vs. newspaper) x 2 (crisis framing type: human error caused vs. non-human error caused) ANOVA. Respondents in the Facebook condition (M = 3.19, SD = 1.06) and in the Twitter condition (M = 3.07, SD = 1.04) evaluated organizational reputation as more positive than respondents in the newspaper condition (M = 2.55, SD = 1.01), $F(2176) = 4.59$, $p < 0.05$. Participants in the newspaper condition were more willing to share the message (M = 2.88, SD = 1.70) than participants in the Facebook condition (M = 2.68, SD = 1.70) and in the Twitter condition (M = 2.17, SD = 1.61), $F(2176) = 2.84$, $p < 0.10$, with the pairwise difference between newspaper and twitter significant at $p < .05$ Effects of crises framing were not significant ($p > .05$)

	inaccurate information	
Citation: Yen (2009) *Method:* QN-CG *Relevancy:* Direct *Quality Appraisal Rating:* Moderate/ Minor Risk of Bias *Study Description:* In an outbreak of acute hemorrhagic conjunctivitis (AHC) infectious disease in Taiwan, the study compared the cities of Taipei, which received an integrated risk communication program that included short messaging service (SMS) messages sent to all citizens with mobile phones, and Keelung, which did not receive such a program. The analysis showed that the intervention program was successful.	· SMS messaging was integral to success for intervention to stop the spread of the crisis. · Obstacles for SMS campaigns are sudden influx of large amounts of messages causing long delay for people to receive messages; only local numbers received message; consumer weariness may have caused some people to ignore the long, unsolicited message before they read it; reaching diverse populations, particularly those with low socio-economic status who may have mobile phones.	Non-randomized treatment city (received an integrated communication program that included SMS) and control city (did not receive program), where both cities where experiencing outbreak of an infectious disease. Overall, results showed that the treatment city had a shorter epidemic duration (13 vs. 34 days) and shorter attack rate (5 vs. 14 days) compared to the control city. The crude attack rate of infectious disease in the treatment city was significantly lower than in the control city (1.95% vs. 14.92%, $p < 0.001$). Overall disease incidence in the treatment city decreased significantly (0.093% before program vs. 0.056% after program, $p < 0.001$) while the incidence rates in the control city continued to increase in the same time period. Parents who received the SMS communication felt more satisfied (on a 5-point scale) with this method as a means of public health communication than those who did not receive SMS messages (3.89 vs. 3.01, $p < 0.05$).

8.3 Quality Appraisal of and Extracted Findings from English Language Individual Data-based Primary Studies (Quantitative-Descriptive Survey, Qualitative, and Mixed-Method/ Case Study Methods; Organized by Method)

Key to Table
Method: Quantitative-Descriptive Survey (QN-DS); Qualitative (QL); Mixed-Method/ Case Study (MM, CS)
Relevancy: Direct; Indirect; Partial; Unclear
Quality: QN-DS – Strong; Moderate; Low
QL – High; Moderate; Low; Very low
MM, CS – High; Moderate; Low; Very low

Citation (first author)	***Method***	***Relevancy***	***Quality Appraisal Rating***	***Findings***
Bird (2012)	QN-DS	Direct	Strong	· Facebook users found information useful. · The majority of Facebook users found information to be accurate. · Moderators of the police Facebook page were prompt in reacting to rumors and confirming accurate information based on official sources. · When official sources were not available, local knowledge and discussions on Facebook often provided confirmation on what was accurate, meaning that self-regulation helped to dispel rumors. · Government Facebook groups and websites ranked higher than community groups for accuracy and trustworthiness. · People who use Facebook before, during and after a crisis do not use Twitter.
Bruns (2014)	QN-DS	Direct	Moderate	· Governmental agencies need to establish a presence on Twitter in non-crisis times to increase trust among puplic over time (compared to a newly established Twitter account during crisis.)
Cheng (2015)	QN-DS	Direct	Strong	· Information from television influences those without direct experience more than social media in how they perceive the crisis. They felt more anxious about future disasters and had a stronger sense of bonds in society from their exposure to disaster related content on television. · Social media, with a much weaker effect, can resonate more with those who were directly affected by the disaster. Social media can provide personalized information that is congruent with individuals' experience of the disaster. This information can reduce anxieties caused by the disaster and increase intentions to participate in post-disaster recovery. · Information from mass media and social media can assist government authorities and NGOs that are working on post-disaster recovery
Chew (2010)	QN-DS	Direct	Strong	· Tweets were primarily used to disseminate information from credible sources, but were also a source of opinions and experiences. · The overwhelming majority of tweets from the public

				provided references and links to news sites to back up information so others could confirm for themselves, but barely directed links to WHO and other health organizations' sites. · Tracking tweeted misinformation and questions is potentially useful for public health agencies to address information needs of the public. · The media's adoption of ''H1N1'' was the primary reason for tweets to use this WHO-recommended term. · Public health and government authorities such as the CDC and WHO were rarely referenced directly by users' tweets. · WHO and health organizations need to get their information posted to the public via news media sites as these are mostly referenced and passed on by the public on Twitter. · Viral dissemination of information on Twitter and Twitter campaigns have a considerable effect on tweet volume and posting behaviour by the public.
Earle (2010)	QN-DS	Direct	Strong	· The number of earthquake tweets may increase as Twitter becomes more popular, but may also decrease if enthusiasm for Twitter wanes. The success of social media hinges on their popularity and spread among the population. · Reading tweets after an earthquake provides brief unfiltered accounts of how Twitter users felt and reacted to an earthquake. · Automatically scanning for data on social media such as Twitter, Facebook and Flickr could yield firsthand accounts and damage photos of an earthquake. · Twitter potentially provides a very inexpensive way to rapidly detect earthquakes and map out their felt areas.
Freberg, Palenchar (2013)	QN-DS	Direct	Strong	· People used CDC and traditional newspapers and their blogs as major information sources · People used traditional and non-traditional news sources to share information via social media · Stakeholders in crisis become credible, strong, persuasive influencers on social media alongside official information with most shared bookmarks
Freberg, Saling (2013)	QN-DS	Direct	Moderate	· Albeit with local variation traditional hashtags are being used consistently in crisis to mark tweets about an event. · Hashtags are useful for crisis communications for institutions to monitoring what others are saying and for the pubic to find information reported by others · Twitter messages often reached the public before the traditional media during a crisis. · Best practice is to include an established source, links to a source, photos, videos and graphics into social media messages during a crisis as people want more than just textual information. · Conversational updates on social media during a crisis were more successful than those in an official tone of voice.
Graham (2015)	QN-DS	Direct	Strong	· More than 70% of government officials engaged in social

				media during crisis; of those slightly more than half used two or one social medium. · Local governments in the smallest communities used social media during crisis to a lesser extent and fewer social media than governments in larger communities. · Social media were used significantly more during public health crises than for natural disaster, transportation, political, social or criminal crises. · Governments' use of social media during crisis to communicate with the public yields positive impact on and impression of their crisis management. · Using one social medium meaningfully is likely more effective than using multiple but not well.
Hughes (2009)	QN-DS	Direct	Strong	· People use Twitter during crisis to share information, including links. · People who join Twitter during a crisis and use it for crisis communication are likely to become long-term Twitter users. · The number of tweet senders decreases as the number of tweets sent increases suggestions that a small number of Twitter users serve as information hubs.
Jin (2011)	QN-DS	Direct	Strong	· If crisis information is sent by a third party through social media, the publics' anger, contempt, and disgust are likely to be intensified or aggravated when the crisis is the fault of the organization. · Organizations should use social media proactively to establish information authority and accessibility if the organization did not cause the crisis.
Kryvasheyeu (2016)	QN-DS	Direct	Strong	· Social media can be used for rapid assessment of damage caused by disaster. · Twitter activity during a natural disaster drops as the distance from the crisis are increases; after a distance of approximately 1200 to 1500 km, the influence of proximity disappears. Areas close to the disaster generate more original content, characterized by a lower fraction of re-tweets. · During a disaster, officials should pay attention to normalized tweet activity levels, rates of original tweet creation, and rates of re-tweets to identify the hardest hit areas in real time. Immediately after a disaster, they should focus on persistence in tweet activity levels to assess which areas are likely to need the most assistance.
Kuttschreuter (2014)	QN-DS	Direct	Strong	· Social media provide complementary information for parts of the public but don't substitute traditional or online media. · Social media users who also use other information channels considered it more important to be well informed, were more motivated to find additional information, were more sensitive to risks in general and perceived the likelihood of a food incident in the future to be larger. They were younger and most of them in Southern Europe. · People with low inclination to seek information on traditional or online media, also had lower use of social

				media. · High-information seeking users may use different channels of information, including social media.
Lachlan (2014)	QN-DS	Direct	Strong	· No significant differences between women and men in tweets regarding expressions of fear, anger or loss of assets. · Tweets by women were more likely than those by men to express concern regarding the magnitude of the earthquake, threats to their health, and number of people potentially affected.
Lachlan (2016)	QN-DS	Direct	Strong	· Social media are a tool to disseminate information and calls for help throughout crisis within minutes. · Official emergency management messages may be difficult to find during crises in a plethora of tweets with different hashtags.
Li (2014)	QN-DS	Direct	Moderate	· Traditional media coverage and governmental re-tweets were more reassuring than Twitter messages which were more alarming. · Twitter is valuable when other communication channels are down. · Traditional media messages were very often re-tweeted.
Lu (2011)	QN-DS	Direct	Moderate	· Social media can distribute information and requests for help, coordinate community activities, and deliver person-to-person relief during a disaster. · Social media also bring challenges to users such as information overload and misinformation. · Institutions' emergency response on social media is more effective when institution members share a vision and language, which needs to be established before a crisis occurs. Institutions need to establish themselves as leaders on social media before a crisis. · Institutions need to provide reliable and relevant messages on social media during crisis, for instance by using moderators who identify valuable and reliable messages from thousands postings and disseminate important information quickly.
McNeill (2016)	QN-DS	Direct	Moderate	· Re-tweets showed that information from official sources dominated discourse. Twitter message during onset and containment of the pandemic were radically different from those by the UK health authorities. · Most tweets linked to reliable, trusted news sources. · Twitter was used by the public to discuss both individual and health authority motivations to vaccinate. · There was no direct correlation between newspaper reporting and discussions on Twitter; perhaps because newspapers deal more with upcoming threats and pay less attention to everyday management of the pandemic as discussed on Twitter. · The high proportion of tweets containing links, to news sources, shows Twitter as a news-sharing network that raises awareness of the pandemic. A significant number of tweets without links contain users' opinions. · Just as media are often having an agenda-setting function, so does Twitter as it promotes certain stories

				as being of particular interest to the public.
Mendoza (2010)	QN-DS	Direct	Moderate	· Aggregate analysis can detect rumors on Twitter during a crisis. · During a crisis Twitter users question rumors more on Twitter than confirmed news spread on Twitter; the Twitter community works like a collaborative filter of information. · Vocabulary used in a crisis on Twitter does not vary much but uses consistent terms.
Meyer (2014)	QN-DS	Indirect	Strong	· The primary source of information during the crisis was television; only a minority used websites and social media to seek information during the crisis.
Miyabe (2012)	QN-DS	Direct	Moderate	· People in the disaster area use Twitter for direct dialogue with each other to spread information. People outside disaster area use Re-tweet function to spread information reported by people in the disaster area. · Information flows from disaster area to other areas via Twitter.
Ntalla (2015)	QN-DS	Direct	Moderate	· Twitter users post messages to enhance situation awareness and to motivate people to act. · Tweets were reliable and provided valuable information. Twitter presents a very good potential to become a useful tool in situations where rapid emergency response is essential. Twitter can act quicker in disseminating information than other media.
Olteanu (2015)	QN-DS	Direct	Strong	· Caution and advice tweets from government sources are more common in progressive disasters than in instantaneous ones. · Twitter provides nuance to assess disaster; it becomes incorporated into the social construction of the disaster, and through which we can understand the detailed differences on a large scale when we look closely at Twitter data.
Schwarz (2012)	QN-DS	Direct	Strong	· Compared to other federal agencies, CDC scored highest for online participation, collaboration and trust. · Some social medias are used by directly affected stakeholders and can be used to observe and address the publics during and after crisis.
Spence (2015)	QN-DS	Direct	Moderate	· Tweets with specific useful information are more difficult to find the closer the onset of the crisis is as the number of tweets with emotions increases. · The number of humorous tweets decreases the closer the crisis on set is. · Barely any tweets in lead up to crisis from governmental agencies: agencies did not use Twitter to respond to people. · Governmental agencies need to use Twitter on a regular basis, responding to public inquiries to build follower base for times of crisis.
Starbird (2010)	QN-DS	Direct	Moderate	· Twitter users are more likely to re-tweet information originally distributed through Twitter accounts run by media, especially the local media, and service organizations. · Identifying re-tweets within samples can lead to

				information that has a higher probability of being relevant to the emergency event, especially in high volume tweet situation. · The most popular re-tweets typically contained general information with broad appeal for a large, distributed audience. · The most popular re-tweets among locals were tweets containing much more locally relevant information.
Takahashi (2015)	QN-DS	Direct	Strong	· Different stakeholders used social media to disseminate second-hand information from news media or government sources, coordinate relief efforts, and memorialize those affected. · News organizations, journalists, and government sources used Twitter for (secondhand) reporting; laypeople and celebrities used Twitter to memorialize affect; NGOs used Twitter to coordinate relief. · Tweets on secondhand reporting and memorialization decreased after the crisis tweets to coordinate relief efforts increased. · Use social media to communicate quickly and proactively rather than only tweeting relief information after a foreseeable crisis.
Vos (2016)	QN-DS	Direct	Moderate	· A large proportion of tweets contained sense making information but few tweets contained efficacy information that would help individuals respond to the crisis appropriately · Sense making tweets placed the crisis in a context, provided details of cases and deaths, showed how people dealt with the unexpected crisis and suggested interaction. Most of the sense making tweets contained hyperlinks. · Some tweets contained misinformation, but most information in the sense making tweets mirrored official report written by the WHO after crisis was over · Practitioners need to distribute specific information via social media before and during the crisis about how to protect oneself
Walther (2013)	QN-DS	Indirect	Moderate	· Social media provide a continuous information flow that can be useful in cases where crises need to be detected, understood, and managed. · General sentiment and its change over time can be deducted from social media data. · Additional information sources linked from within the social media e.g., shared newspaper articles can be helpful information for decision makers that they otherwise might miss.
Yamamura (2014)	QN-DS	Direct	Strong	· Social media through mobile phones were useful and effective in the early days after the crisis. Twitter and Facebook were used to communicate during the disaster. If mobile phones can be used during a disaster, social media may be very useful for communication.
Ferris (in press)	QN-DS	Direct	Strong	· During evacuation window use of Twitter and Instagram increases, while phone and face-to-face communication decreases.

				· Social media play important role during evacuation period of disaster, and can be a trigger to initiate evacuation when it is in line with motivation. · Different social media are just mode of communication that needs to be used during disaster communication.
Acar (2011)	QL	Direct	Moderate	· People in and out of affected areas use Twitter to let others know about their safety situation, send warnings, requests for help. · Unreliable retweets on Twitter are a problem, especially in the absence of government or news media tweeting reliable true information. · Twitter was a more reliable communication tool than TV, radio, landlines, mobile phones, and e-mail.
Briones (2011)	QL	Direct	Moderate	· Satellite offices of an institution look to headquarters for guidance and instruction on how to use social media. Headquarters need to continue to develop rules and training on how to use social media during crisis communication. · It is important for institutions to tailor its messages to specific audience on social to improve communality with chapters' volunteers to improve volunteers' satisfaction with their online engagement with chapters. · Using social media for dialogue between institution and the public increases how the speed of service for the community, generates more media coverage, and brings positive and negative feedback from stakeholders to improve the organization. · Lack of staff and/or time are barriers for institutions to consistently use social media's full potential for dialogue with the public, journalists and volunteers.
Bunce (2012)	QL	Direct	Low	· In preparation phase people used social to facilitate communication and develop awareness · During onset, people used social media to assure each other that property had remained intact or unaffected, that family and friends were safe and out of any immediate danger; to monitor information; to communication and create community; and create awareness.
Ding (2010)	QL	Direct	Moderate	· Institutional and cultural constraints limit open and transparent communication of institutions with the public via social media. · Institutional use of social media is still largely limited to one-way dissemination of information, not two-way interaction. · The public may circumvent the institutional social media to find information on social media provided by other members of the public to find out truth about a crisis situation. · Institutional social media one-way communication excluded public from really voicing their concerns during the risk assessment and policy-making stages as valued partners. · Governments react to perceived subversive social media posts by the public by strategically taking over the media

				and deleting perceived "harmful messages," to regain control of the media and messages on them. · The public can use social media for bottom-up, participatory risk communication to facilitate the mass dissemination of official risk messages or to send inside knowledge to the public and tactically intervene in the official decision making processes.
Hataaja (2014)	QL	Direct	High	· Citizens considered emergency communication to be mostly unidirectional, from authorities to the public; informants' expectation that authorities would welcome their input was low. Credible actors, such as local volunteer organizations, could support public participation. · During crises, the public valued communicating via a mobile phone directly with a human representative from a responsible organization, with neighbors and community members. Especially in rural area this was more valuable than using social media. · Getting information from city government web sites was seen as troublesome because there were not updated often enough during crisis to provide needed information. · Participants were skeptical about reliability of information on social media. Yet, authorities' social media use were acknowledged to be able to quickly correct rumors or misinformation to avoid panic. Participants from rural areas believed that getting a response via social media takes a lot longer than calling authorities by phone. · Participants perceived governments to underutilize web sites and social media to give information to the public. Government's web site updates were seen as slow and inconsistent; governments' social media use was unheard. Participants experience was that most governments send information via news media.
Hughes (2012)	QL	Direct	Moderate	· Social media expand the scope and type of press officer work and information pathways that exist between press officers, media, and public. · The majority of press officers use at least one social medium including photo and video updates in crisis communications; yet no regular use occurs. · Organizations hesitate to give approval to press officers to use social media during crisis communication. · Twitter or Facebook to send crisis updates and website updates reduce the number of inquiries from media and the public.
Liu (2008)	QL	Direct	Low	· Many of the best pictures during a crisis will come from normal people who voluntarily capture, gather and aggregate information through social media, resulting in a very large-scale collection of information. · Large-scale information posted by people on social media provides useful data for disaster response and recovery.
Madianou	QL	Direct	High	· Middle-class social media users can make their voices

(2015)				heard, attract attention to their problems, and often improve their own situation. Lower class people lack access, skills and confidence to participate in social media for discussions. · Social media use during crisis is deeply gendered and classed.
Palen (2008)	QL	Direct	Moderate	· Future emergency management needs to include organizational processes for supporting and leveraging publicly disseminated information. · Social media support critical information distribution among the public that needs to be better integrated with official disaster response.
Potts (2011)	QL	Direct	Low	· Hashtag use during crisis was hampered by different hashtag formats, spellings and word order. · Hashtags during crisis are not effective if too many are used. · The volume and speed of tweets during crisis create problems for users to manage information. · Institutions should use hashtags that are already in use during crisis and not create new ones to reduce variety and connect to the context Twitter users have already created.
Reuter (2013)	QL	Direct	High	· The higher the danger or the perception of the threat is the more active virtual volunteer groups become on Twitter sending warnings. When the threat decreases, help messages by volunteer groups on Twitter increase. · Among virtual volunteer communities Twitter users fall into categories for helper, reporter, re-tweeter, repeater, and reader. Monitoring of the activity these types of Twitter users is valuable to get important and trustful information. · Links and re-tweets on Twitter are important for distributing information. · Informing and helping are typical activities of volunteer communities on Twitter, providing links to external websites for further information and/or help. · Social media support and sustain virtual and offline volunteer groups during crises. · Mechanisms to identify valuable information, for instance, based on the judgment of the crowd, could especially be useful for disaster relief agencies. · Make use of existing social networks by establishing connections or building plugins in those social networking services. · Exchange of information between real/virtual volunteers and officials during crisis brings information advantages. For instance, "the reporters" among Twitter uses sometimes represent news channels, can act as intermediaries and their information is also esteemed by authorities.
Tang (2015)	QL	Direct	Moderate	· State governmental agencies used social media to communicate with professional stakeholders and the public to send and receive information, create situational awareness, control rumor control and make decisions.

				Social media were not used to ask for donations and to manage volunteers. · For governmental agencies, Facebook worked for two-way sharing on risk information. YouTube attracted large number of views on crisis videos to communicate risk and control rumors. Twitter worked for creating situation awareness, one-way information sharing, rumor control, decision-making and reconnecting social networks which expedited the dissemination of crisis risk information. · YouTube was not used for reconnection other social media, to ask for donation or to manage volunteers. · Attractive social media messages and localized information to help citizens where they were missing. · Social media created public awareness of crisis management measures. Social media were able to connect affiliated networks and can quickly influence a large number of information receivers. Major social media sites can be convenient to link citizens with governmental agencies. · Data posted on multiple social media sites helped citizens to predict, prepare, plan and respond to the crisis. · Citizens actively responded to government-posted risk messages on social media, completing a cycle of communication and showing that the public not only received the message, but also interpreted it, removing the fear that messages were not received or that recipients were merely conforming to the information. · The high level of interactions for rumor control messages indicated the robust function of social media in hazard risk communication between governmental agencies and the public. Timely updates were an effective approach to correct information or rumors.
Tapia (2013)	QL	Direct	Low	· Microblogged data are useful to responders in situations where information is limited, such as at the beginning of an emergency response effort, and when the risks of ignoring an accurate response outweigh the risks of acting on an incorrect one. · Microblogged data can serve as an additional information source, albeit presented in an unfamiliar way, becoming suspect because of the new format unfamiliar to emergency responders. · Microblogged data's value as an information source is not constant and varies as a disaster response develops. · Many of the operational decisions to rescue people and provide relief require a very high level of accuracy that microblogged data were not able to provide. This does not mean that people cannot be found and saved based on microblogged data but very concrete data is needed. · The first step is to sort and categorize data as contextual or potentially action-worthy. Second, identify actionable intelligence derived from data, translate data into understandable and useable form, vet source and data content.

				· Responders transferred expertise and trust to outside volunteers processing data derived from social media rather than trusting data themselves. · Rescue organizations' employees should friend and follow each other and become regular users of social media. Having an informal, everyday knowledge of what other humanitarian workers are doing could lead to better organizational efficiency and co-ordination of response and recovery efforts.
Taylor-Robinson (2009)	QL	Direct	Moderate	· Rumours caused confusion and anxiety among students and were spread through informal networks in person or through text and MSN messaging. Accurate information in this period would have been useful to allay potentially unfounded anxiety. · In outbreak situations, rumours spread rapidly without early communication, causing anxiety. Digital communication can seed dependable information that will disseminate rapidly through peer groups. · Many of the respondents looked to the school website for information. Websites should be used to communicate in early stages of an outbreak
Tyshchuck (2013)	QL	Direct	Moderate	· Local government has not developed agreed upon ways to use social media in emergencies. · Social media during disaster close feedback loop between first responders and the public, help to monitoring information flow, and provide regular updates to the public. · Using Facebook reduced the demand on the cell and wired phone communications systems of city administration, leaving phone lines open for true emergencies. · City administration Facebook account effectively disseminated warnings; opened an indirect line of communication between the disaster response team; facilitated on the ground disaster response; addressed the dissemination of inaccurate information issued by national news; provided social cues for people to respond; and provided medium for people to share information. · The relationship on Facebook between local media and the Office of Emergency Services and the community strengthened over time. · During crisis, people use social media to seek information on risks associated with crisis, protections, emergency aid and have their knowledge confirmed by others. · To build a strong relationship with the community via social media, the emergency response team needs to provide an open feedback loop to the public. · When inquiries are specifically directed to an organization's social media account, a social media officer needs to close the loop between the public and first responders. Additionally, regular updates on public inquiries will allow the public to feel engaged and more

				likely to take appropriate protective action.
Archut (2011)	MM, CS (CS)	Direct	High	· It remains unclear if government agencies should use existing social media or develop own platforms. · Adding social media as communication mode during crisis reduces harm and saves lives.
Austin (2012)	MM, CS (MM)	Direct	Moderate	· The public uses social media during crises for insider information and checking in with family/friends; it uses traditional media for educational purposes · Convenience, involvement, and personal recommendations encourage social and traditional media use; information overload discourages use of both. Humor and attitudes about the purpose of social media discourage use of social media, while credibility encourages traditional media use. · Third-party influence in crisis communication is important; hence it is necessary to use traditional and social media in crisis response." Traditional media primarily were used for information needs because participants perceived traditional media, especially broadcast news and newspapers, to be more credible than social media. · Participants passively received information about crises through logging onto Facebook and email. If friends posted links to crisis coverage, participants were more likely to read these links via Facebook than going to the original news sources for information. Yet once participants notice a discussion trend in social medias, they were more likely to seek out traditional media coverage. · Participants were most likely to use the same type of media in which they heard about the crisis to seek information, except in the case of interpersonal communication where participants mostly first heard about crises via social media. · Participants were more likely to seek information through all types of media when initial information came from a third party and not from the organization. Social media should complement traditional media during crises; organizations need to ensure that information comes from other trusted sources, in addition to coming from the organization.
Beneito (2013)	MM, CS (CS)	Direct	Moderate	· The images of and trust in institutions can be improved by using social media. · Barriers to implementing social media for crisis communication are lack of goals of institutions, rules on how to use social media and the age of employees to adopt social media.
Chavez (2010)	MM, CS (CS)	Direct	Moderate	· Staff needs to be adequately trained to use social media. · Social media complement traditional emergency communication tools. · Local governments need to think about the age of their audience, IT, time, financial, staffing, archiving and state law issues to decide which social media to use how and when.

				· Social media may not reach the elderly, the disabled, people without cell phones, people with low incomes, and people in rural communities.
Corrigan (2014)	MM, CS (CS)	Direct	High	· Social media and mobile technology played a central role in containing the crisis. · Short message system (SMS) platforms were used to share information on the signs and symptoms of the virus. Facebook and Twitter were used to increase awareness through 24/7 updates and online chats. Social media campaigns deployed stars to sensitize audiences, manage fear and myths, and reduce stigma. Health workers were provided with mobile phones and an Android app that allowed for immediate and critical information sharing. Each of these strategies led to fast communication, better self-reporting and identification of disease contacts, successful tracking and monitoring - all essential components of an outbreak response that Nigeria got right in record time. · While Twitter was effective, many people were not online. An organization mapped where people weren't online and sent out volunteers to meet with people and report back on their engagement with the virus in real-time. · High quality public safety announcements (PSA) were distributed on Facebook, YouTube, and Twitter. And ran on 10 major TV stations, 4 radio stations, and on 100 public buses, translated into all of the major languages. The funniest PSAs were the most effective, spread the furthest. · A popular Nigerian celebrity starred in the PSAs and used his personal Facebook fan page to promote crisis awareness content. He hosted a live Q&A online, which the CDC said was the most meaningful social exchange they were able to have in Nigeria during containment. · A key power of social media is in spreading hope to defeat stigma around infectious diseases by amplifying stories of survival and how people have returned to society. · Social media were very good at tackling myths. The organization also did contact tracing for such myths by asking people where they heard about it, and then following up with that person and everyone to whom myth had spread.
Dabner (2012)	MM, CS (CS)	Direct	High	· There needs to be a clear purpose and process to integrate social media within an institutions communications for a coordinated flow of institutional information. · Students will use social media when they see an advantage in them. · Social media use can increase collaboration between an institution and its audience/public. · The public uses Facebook pages/groups of institutions to pose questions, provide encouragement, support and concrete advice to each in other during crisis. · It remains a challenge for institutions to employ enough

				staff to tend to social media accounts full time to remove spam, answer questions and update information on a Facebook group/page consistently during ongoing crisis.
Fraustino (2015)	MM, CS (MM)	Direct	Moderate	· Social media can quickly spread information to new publics for minimal cost. · Participants who received the humorous risk message reported significantly weaker intentions to take protective actions compared to those who received the traditional, non-humorous risk message. · When considering using social media for humorous messages, defining campaign goals is of the utmost importance. Humorous strategies, such as those implemented in the zombie apocalypse preparedness campaign, can grab public attention and launch campaign messages into the national spotlight—particularly when communicated via social media, which hold the potential to become quickly popular for little cost. But humorous disaster communication may also trivialize perceived importance and perceived consequences of disasters among the public.
Freberg (2012)	MM, CS (MM)	Direct	Moderate	· Intent to comply with a food recall message was stronger in response to organizational messages than to user-generated messages, but did not vary according to message reliability. · Younger participants distinguished less than older participants between organizational and user-generated sources. · Publics very quickly blur distinctions between "we think we might have a problem," and "we know we have a problem." They intend to behave similarly in response to both types of message. This leads to significant concerns regarding the viral spread of misinformation during a crisis, which must be considered in a crisis management plan. · The message source did not produce significant differences in intention to comply when the information was confirmed. But when participants were presented unconfirmed information, their intent to comply was higher in response to the organizational source than to the user-generated source. User-generated information is held to a higher standard before a person would act on it. · A single type of source is unlikely to be efficient for reaching all affected publics. Constant monitoring of age cohorts' use of social media helps to reach the most people in the shortest amount of time.
Heinzelman (2010)	MM, CS (CS)	Direct	Moderate	· Mobile phones were the most direct means of communication for Haitians during the crisis and emerged as a lifeline for many survivors. · Crowd sourced maps enabled targeted disaster response in a rapidly changing environment. But for crowd sourced reports to be permanently integrated as legitimate and actionable sources of information, a system must be created to rapidly identify inaccurate

				information. · Two solutions to vet crowd-sourced information emerged: a) trusted reporter network/approved participants and b) trusted reporter reports and population reports if they match others within network of trusted reporters. · Triaging crowd-sourced reports helps prioritize by urgency and category and direct reports to appropriate actors. Possible models for triaging include combination of keywords, natural language processing and algorithms, and volunteers to manually monitor and sort inbound messages. · Analyzing crowd-sourced data may help identify and track early warning signs of conflict during disasters by collecting information on issues correlated with violence, such shortages.
Kongthon (2012)	MM, CS (CS)	Direct	Moderate	· People use Twitter during a crisis to tweet information about their situation, alerts, support messages, requests for help and information. · Top Twitters users send the majority of original tweets, which were then re-tweeted by others as they perceived them as credible. These top users were flood/disaster related government or private organizations. · Twitter is effective for obtaining and disseminating up-to-the-minute information in real time, creating situation reports instantly. · Institutions should analyze information from Twitter during a crisis to better coordinate resources and relief efforts and to prepare and plan for future disaster relief. · Institutions should develop protocols that help officials verify incoming information on Twitter and eliminate false information.
Kotsiopoulos (2014)	MM CS (CS)	Direct	Low	· Social media use by citizens during crisis can increase availability of data and help organizations to make sense of existing data via crowdsourcing. · Citizens can use social media for vigilante activity, also if based on false information and to make public sensitive information. · Citizens' use of social media during crisis helps crisis responders to build situational awareness, brings valuable information to direct rescuers of survivors. Organizations' use of social media during crises brings information to the public about rescue efforts and other vital information, adding to a community's resilience during recovery.
Latonero (2011)	MM CS (CS)	Direct	Low	· The agency used Twitter during emergencies for sending one-way messages to the public and for monitoring and responding to tweets by the public. · An early adopter within the organization drives technological change within organizations. · Management often resists implementing social media, which they might not fully understand. · Press officers must now also filter and verify incoming information from social media sites and may be

				overwhelmed by the amount and types of information.
Mathes (2013)	MM, CS (CS)	Indirect	High	· Community collaboration with local media and experts are essential for effective response and recovery to a disaster. Partnerships need to be established before a crisis happens to have time to build a working relationship. · Local media and meteorologists used social media and radio broadcasting effectively to distribute information to the public during onset, containment and recovery of crisis.
Novak (2011)	MM, CS (MM)	Direct	Moderate	· Citizen journalists using new media supplied information valued by local residents compared to what was provided by professional media and first responders. Citizen journalism facilitated crisis communication for affected people. · Citizen journalism providing information that is more comprehensive, specific, and timely than that used or shared by traditional media.
Plantin (2015)	MM, CS (CS)	Direct	High	· Public online mapmakers extracted, aggregated and restructured data to make the distribution of information about the radiation situation more equal between the official actors and the public. · As opposed to PDF reports from the federal government, maps provided easier and more readable access to pertinent information. Map provided location features, aggregated multiple data sources in a single view, and combined radiation data and web-based maps to verify governmental or crowd sourced measurements.
Qu (2011)	MM, CS (CS)	Direct	Moderate	· Situation update messages, of which most were second-hand, spread faster in the network than other types of disaster-related messages. A carefully designed filtering mechanism is needed for users to distinguish first-hand and/or authorized messages from second hand messages. · Situation updates on Sina Weibo (Twitter) in China is of great value in disaster response to improve situational awareness for the public and decision makers. · People used Sina Weibo (Twitter) to spread situation updates and opinions; provide emotional support; and call for action. · Types of messages by the public on Sina Weibo during crises shift from situation update directly after the disaster to requests for help and offers to participate in relief to then expressions of opinions on a national mourning day. · The biggest portion of tweets were situation updates directly after the disaster hit.
Reynolds (2010)	MM, CS (CS)	Direct	Low	· Social media helped an institution during a crisis to provide fast, accurate and credible information to the public. Social media also allowed the institution to recognize the emotional side of a crisis the public goes through and individuality. · Facebook is a self-correcting environment and the institution understood that individuals should be free to

				post their beliefs and concerns, even if some were counter to science and recommendations. Facebook users corrected information rather than the institution. · Social media allowed visitors to the institution's websites to tailor their continued interaction with the institution, asking specific questions about their situation. · People who used social media to engage with the institution, gave the institution higher satisfaction ratings than those who did not, were more likely to return and recommend the institution's site to others and rated the institution as more trustworthy than those who did not use the institution's social media tools. · Compared to other federal agencies, the US Centers for Disease Control (CDC) scored highest for online participation, collaboration and trust.
Shaw (2013)	MM, CS (MM)	Direct	High	· Social media are used for crisis communication, emergency management, and space for users for expressions of emotions and distress. · Public used social media for sense making, sharing personal experience, current situation on the ground and their role in clean up after the disaster. · Personal narrative tweets were used to reassure Twitter followers of the safety of the sender and their family member. · Sense-making practices on Twitter come to take a longer-term perspective that embeds the crisis within an overall historical, social, political, economic narrative. · Twitter account of a police station and other key sources of crisis information within the crisi hashtag community filled information gaps left by other media forms, with aura of authority and reliability. · Appropriate and inappropriate forms of social media participation are communally defined and policed, with expressions of direct and indirect thanks to publicly adopt an appropriate normative stance. · Especially important messages to combat rumours and misinformation were effective because they were so widely re-tweeted. Twitter users were eager to maintain veracity and help official accounts stamp out rumours, leading to a high re-tweet rate for these particular tweets. · Social media have substantial potential for bilateral collaborations between formal emergency authorities and informal crisis communication communities.
Sticher 2013	MM, CS (CS)	Direct	Low	· City administration used social media to inform citizens on the water levels and to answer questions. · Social media need to be incorporated into daily operations of city administrations before disaster strikes. · Arguments of city administration against using social media have been that they are not compatible with the organizational structure (e.g. hierarchical communication); don't comply with legal regulation on data protection (Facebook as commercial actor); and are

				too demanding as qualified trained personnel is missing. · City administration used social media and website during crisis to coordinate help, filter out important information for inhabitants, spread verified news and answer questions of homepage visitors.
Sutton (2007)	MM, CS (MM)	Direct	Moderate	· Sharing of information via text-based sharing sites provide information & psychologically beneficial practice of talking about traumatic events · Social media support the influence of existing public information production and distribution
Sutton (2015)	MM, CS (CS)	Direct	High	· Tweets by officials on hazard impact, public safety and with emotions more often re-tweeted · Tweets by officials with links were not as likely to be re-tweeted · All caps messages in tweets by officials increase likelihood of re-tweeting when including UPDATE or MEDIA ADVISORY as clear language helps. · Tweets with gratitude or thanks had lower rates of re-tweeting. · Follower numbers crucial, the more followers the more re-tweeting; build follower base
Taylor (2012)	MM, CS (MM)	Direct	Moderate	· The public relied on mix of formal and informal information sources & used social media to re-post or re-tweet links from government websites with useful information. The public acted as filters and amplifiers of official information · Most people were seeking information; either general factual information about situation or asking people for specific information; more than a third spend most of their time giving providing general or specific information; a quarter used social media to ask for help; about half offered help or practical assistance; three quarters posted messages of sympathy · Respondents showed moderate level of suspicion about the quality of information they were receiving; a third felt mistrustful of people's information or misled; only 6% would rely only on social media or unofficial sources of information