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ORIGINAL ARTICLE

RHCPP WILEY

Mitigating vulnerabilities with social media: A cross-national study of European disaster managers' practices

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Abstract

In this article, we provide an overview of the ways in which disaster managers in eight European countries use social media to mitigate people's vulnerability to hazards. Our document analysis and 95 expert interviews in Germany, Italy, Belgium, Sweden, Hungary, Finland, Norway, and Estonia revealed six distinct institutional social media practices that may reduce disaster vulnerability: sharing educational guidelines, informing and warning the public, identifying citizens' concerns, identifying missing persons, sharing guidelines during disaster, and organizing volunteers. We discuss how these practices could affect people's ability to access, understand, and react adequately to information about risks and hazards. Our findings can be used to improve guidelines for official crisis communication on social media and demonstrate the value of using social media in disaster risk reduction.

KEYWORDS
crisis communication, disaster management, risk communication, social media, vulnerability

INTRODUCTION

"Vulnerability" typically denotes the susceptibility of individuals to encounter negative consequences as a result of hazard exposure (Tierney, 2019). Vulnerability to disasters is not a static phenomenon but rather a dynamic process that is shaped by human agency, surrounding technologies, resilience of the society, as well as social support from private and state actors (Orru et al., 2022; Sun & Liu, 2023). At the intersection of these factors, the gaps in the functionality of public support structures, including the information and communication services provided by disaster management authorities, may undermine the coping capacities of individuals and societies. Communication-related problems that may make people more vulnerable to disasters and pose threats to their lives include various barriers to accessing and understanding risk and crisis information as well as reacting adequately to warnings and behavioral guidelines (Hansson et al., 2020). In this study, we conceptualize social media communication by disaster management institutions as an important social-structural factor that could potentially alleviate (or sometimes aggravate) these problems.

To advance the field of disaster research, it is necessary to look beyond single cases and find common patterns across events (Tierney, 2013; Wolbers et al., 2021). While overviews of disaster managers' social media usage exist (e.g., Flizikowski et al., 2014; Reuter et al., 2016; Singla & Agrawal, 2022; Torpan et al., 2023; Wukich, 2019; Zhang et al., 2019), cross-national data on how disaster management institutions use social media is limited, especially from the perspective of how they may affect social vulnerability (see Orru et al., 2022). We contribute to this line of research by analysing official documents and 95 expert interviews in eight European countries—Germany, Italy, Belgium, Sweden, Hungary, Finland, Norway, and Estonia —and looking for institutional social media practices that may concern pre-determined vulnerable groups as well as situations stemming from dynamic, contextual factors where potentially anyone may become more vulnerable (see Morsut et al., 2022).

This study supports the aims of the United Nations' (2015) Sendai Framework for Disaster Risk Reduction and the European Commission's (2023) disaster resilience goals by showing how the authorities can increase risk awareness and preparedness of the population via social media and craft necessary regulation for more effective crisis and risk communication.

In what follows, we first review existing literature on the institutional uses of social media in disaster management with a special focus on social vulnerability. We then describe our data and method and present our empirical findings: the six ways disaster managers in the studied countries used social media to identify people in vulnerable conditions and mitigate the possible adverse effects on their lives. We conclude by discussing how institutions could use social media to improve people's capacity to access, understand, and react adequately to information about risks and hazards before and during a disaster.

INSTITUTIONAL USES OF SOCIAL MEDIA FOR MITIGATING DISASTER VULNERABILITY

People's vulnerability to disasters is shaped by an interplay of individual, social-structural, and situational factors (Hansson et al., 2020; Orru et al., 2022). Individual factors include capacities of affected people, such as impairments/disabilities (Ton et al., 2020) and limited skills. Social-structural factors include social inequalities and

disadvantages which may be based on, for example, income (Ur Rahman et al., 2021), culturally ingrained gender roles (Fernandez Turienzo et al., 2021), limited access to information (Nero et al., 2023), and the reliance on informal networks for information and support (Morsut et al, 2022). Importantly, social-structural factors also include deficiencies in public support structures such as emergency services and official crisis information. Situational factors are complications that arise during a particular crisis, such as damaged communication infrastructure (Hansson et al., 2020).

Social media tools support risk and crisis management and communication (Brynielsson et al., 2018; Kaufhold et al., 2019). Authorities are using social media tools, such as internet-based social networks (e.g., Facebook), blogs (e.g., WordPress), microblogs (e.g., Twitter), forums (e.g., Reddit) and wikis (e.g., Wikipedia); and platforms for crowdsourcing (e.g., Safecast.org), digital mapping (e.g., Ushahidi), podcasts (e.g., Soundcloud), video sharing (e.g., YouTube), and photo sharing (e.g., Flickr) (Haddow et al., 2020; Mavrodieva & Shaw, 2021).

Alexander (2014) suggests using social media for *listening*, *monitoring*, *risk reduction and management*, *crowd-sourcing and collaboration*, *creating social cohesion*, *furthering causes*, and *research*. Houston et al. (2015) propose more specifically: *expressing emotions or concerns* or *providing mental health support*. Some authors have built on Houston et al. (2015) and classified real social media use during disasters, such as messaging about *caution and advice*, *affected people*, *infrastructure/utilities*, *need and donations*, and *other useful information* (Imran et al., 2015).

Monitoring social media could reveal vulnerable people (Eriksson, 2018; Havas & Resch, 2021; Kuran et al., 2020; Orru et al., 2022). Crowd-sourced data (e.g., Weyrich et al., 2021), (e.g., Weyrich et al., 2021), and real-time social media data help making decisions (e.g., Thiebes & Winkhardt-Enz, 2022; Zhang et al., 2019). Social media has been monitored during real-life disasters for data-mining (e.g., Huang et al., 2022; Li et al., 2022) or tracing missing persons (e.g., Macias et al., 2009). However, aggregate data might not represent people with limited language skills (Uekusa, 2022), limited access to, or little skill in using, social media (Arora, 2022; Zhang et al., 2019).

Risk and crisis communication via social media could increase exposure to information such as guidelines, warnings, or peer experiences (Wukich, 2019; Zhang et al., 2019). Disaster managers may engage volunteers to improve the reach of social media messages (Kitagawa et al., 2022) or employ volunteer teams (aka *Virtual Operations Support Teams*) who monitor social media in support of disaster incident response (Reuter & Kaufhold, 2018; Reuter et al., 2016).

Authorities using social media does not mean facilitated access. Social media access is limited by individual (e.g., sensory impairment), social-structural (e.g., distrust towards information sources), and situational factors (e.g., broken communication infrastructure). The "streetlight effect" can lead disaster managers to overlook those not on popular platforms (Olteanu et al., 2019), and the "digital divide," the disparity in access to digital technologies, can worsen this issue (Dargin et al., 2021; Manners, 2024). Certain groups, like the elderly, low-income individuals, and rural communities, are often more affected by this divide (Vassilakopoulou & Hustad, 2023), whereas radio and television are still relevant sources of disaster information (Bahfiarti & Arianto, 2022). Uses and gratifications research within media studies (see Ruggiero, 2000) suggests that communicators should consider which media are mostly used and what kind of content people usually engage with. Social media engagement may be shaped by perceived threat severity, perceived susceptibility, and negative emotions (Zhang et al., 2018). During disasters, people may use social media

not only to find real-time disaster information (Niles et al., 2019) but also for reporting, collaborative problem solving, and digital volunteerism (Palen & Hughes, 2018).

Misuse of social media by disaster managers, such as disseminating unverified information or overloading the public with excessive updates, can lead to confusion and thereby actually increase the vulnerability of the population during disasters (Singla & Agrawal, 2022). People may be susceptible to disaster myths (such as the "Dresden syndrome," the exaggerated perception of disaster damage due to media framing), false or misleading claims of obscure origin, malicious disinformation, rumors, or pranks, which may lead people to underestimate the risks and fail to react (or overreact) to official guidelines (Alexander, 2014; Hansson et al., 2020, 2021; Mavrodieva & Shaw, 2021; Wenger & Friedman, 1986).

Admittedly, the use of social media cannot alleviate most of the causes of disaster vulnerability such as poverty, inequality, functional impairments, limited language skills, or broken communication infrastructure. Research points at the disaster managers' challenges of using social media (Singla & Agrawal, 2022) and communication gaps across disaster phases (Palttala et al., 2012; Wukich, 2016). More information on the effects of peer experience and attempted solutions help disaster managers to mitigate the harmful effects of information during disasters (Choy & Chong, 2018; Jin et al., 2014; Kavanaugh et al., 2012). Our study is designed to contribute to this.

METHOD AND DATA

To find out how institutions use social media to mitigate vulnerability to disasters, we collected and analysed empirical material including publicly accessible relevant legal acts, policy documents, official guidelines, and press reports in eight European countries—Germany, Italy, Belgium, Sweden, Hungary, Finland, Norway, and Estonia —between September 2019 and February 2020. The representation of countries reflects the variety of international researchers engaged in this study, as well as the diversity and specifics of past crises experienced across Europe. The analysis of documents concerning emergency management and the related (social) media communication (including government regulations, guidelines, and crisis reports) guided the interviews and respondent selection.

To complement this material, our country study team members carried out 95 semi-structured expert interviews (approximately 60 min each) with disaster managers in the eight European countries. Interviewees were selected with a convenience sample—from local governments, national ministries, and government offices, national and international NGOs, social security agencies, cyber security agencies, national and local rescue boards, vital service (e.g., electricity, water) providers, civil protection agencies, and police forces—with attention to their specialization and experience in emergency management and crisis communication. The semi-structured questions for the informants followed two analytical themes: general use of social media within institutions tasked with resilience/crisis management; and past experiences of using social media in the context of resilience/crisis management. The interviews were carried out in local languages and were then transcribed, after which the authors shared the task of undertaking preliminary analyses of interviews and documents, and summarized them into country case study reports in English. We then did a qualitative content analysis (Kohlbacher, 2006) on the country reports to identify the practices and examples of how emergency managers use social media for mitigating communication-related vulnerabilities (summarized in Table 1).

We further specified the practices by asking the interviewees to describe their experiences of using social media in past disasters. We examined various disasters that have affected European communities: earthquake in L'Aquila, Italy (April 2009); terrorist attacks on a government building in Oslo and at the island of Utøya, Norway (July 22, 2011); Pukkelpop festival severe thunderstorm disaster in Belgium (August 2011); snowstorm in Hungary (March 2013); flood disaster in Germany (June 2013); red sludge flood disaster in Veszprem, Hungary (2013); increase in asylum seekers in Sweden (2015); the terrorist attack on Brussels airport and metro (March 22, 2016); Munich shooting in Germany (2016); drinking water contamination in Nousiainen, Finland (January 2017); critical infrastructure failures due to a storm in Southern Estonia (October 2019). Finally, we considered how the identified practices might help to reduce barriers to accessing, understanding, and reacting to risk and crisis information that shape people's vulnerability to disasters (Hansson et al., 2020).

While examining different administrative systems and cultural contexts, it is inevitable that the document analysis and interviews reflect the overall accessibility of information in each country. The gathered data varied significantly in terms of detail and context, which did not allow for a direct comparison between countries, but rather a wide-specter qualitative exploration. This study focuses exclusively on European disaster managers and their practices at a particular time and may not necessarily reflect evolving practices. Nevertheless, the study provides a useful empirical snapshot of official social media use in European disaster management systems.

USES OF SOCIAL MEDIA FOR MITIGATING VULNERABILITY IN DISASTERS

We identified six ways in which disaster managers in the eight countries used social media for identifying the vulnerable, and for communicating with the aim of mitigating individuals' vulnerabilities. We summarize these in Table 1. The first column indicates whether the practice primarily concerns risk or crisis communication. The second column lists the practices identified through document analysis and interviews, the third column provides concrete illustrations of social media usage in disaster management, and the fourth column explains the ways these practices could contribute to reducing communication-related vulnerabilities (as outlined in Hansson et al., 2020). We will discuss and exemplify these practices in turn.

Sharing educational guidelines

A common practice of using social media for mitigating disaster vulnerability is the sharing of educational guidelines. Without sufficient knowledge regarding preparation, people might not understand the guidance they receive during disasters and fail to react adequately to protect themselves from hazards.

Uses of social media for prevention feature in the case studies of Italy, Finland, and Norway. Italian authorities issue prevention messages, while Finland's case study shows, generally, that emergency services use "social media for preventive action" (FIN1, 1/2020; FIN4, 11/2019; FIN5, 1/2020). The Norwegian DSB informs the public about how to prevent accidents at home via a webpage and Facebook (Sikkerhverdag.no) (DSB 2020b, 2020a).

Only Germany, Belgium, and Finland have explicitly noted education in their official strategies. For example, the German BBK, the Crisis Centre of Belgium, and the Finnish

TABLE 1 How disaster managers use social media to mitigate communication-related vulnerability to disasters.

Stage	Practices	Examples	How it mitigates vulnerability
Risk communication	(1) Sharing educational guidelines	• Educating citizens about potential disaster hazards • Opening disaster-themed discussions • Sharing individuals' (incl. disaster managers') experiences and testimonials • Disseminating guidelines for civic preparedness (e.g., nuclear accident guidelines) • Carrying out awareness campaigns • Regular informative awareness messages for building trust with citizens to increase the effect of risk and crisis communication • Publishing educational videos for children • Publishing history documentaries • Sharing evacuation guidelines • Sharing disaster prevention messages	• Guides people in choosing relevant sources, thus helping them access information that is more significant in their circumstances • Helps people understand the information they receive from crisis communicators, thus leading people to react adequately to protect themselves from hazards
Crisis communication	(2) Informing and warning the public	• Real-time responses to citizens' concerns • Alerts about hazards (e.g., weather warnings, fire alerts, road accident alerts) • Information about injured to warn of potential health effects	• Helps people access relevant information • Has the potential to increase individuals' understanding of disaster-related communication and thus react adequately to protect themselves from hazards • Helps build a habit of information retrieval, thus easing access to relevant information channels during disasters
	(3) Identifying citizens' concerns	• Observing citizens' concerns during disasters • Observing potentially harmful rumors during disasters • Using Virtual Operations Support Teams (volunteers) for identifying citizens' concerns	• Helps to see if people have access to relevant information or if they understand it adequately • Tells disaster managers what kind of information needs to be better available and accessible to the public to increase their understanding of the situation, and it might help people eventually react

(Continues)

TABLE 1 (Continued)

Stage	Practices	Examples	How it mitigates vulnerability
			adequately to protect themselves from hazards • Using volunteers increases reach for identifying citizens' concerns and this way provides them better access and understanding
	(4) Identifying missing persons	• Searching social media groups for hints of disaster survivors and/or positioning missing persons • Using Virtual Operations Support Teams (volunteers) to identify missing persons	• Gives voice to people whose only option for communicating their distress might be their social media access • Witnesses' information and volunteers help increase reach for identifying missing persons and this way provides people better access to information
	(5) Sharing guidelines during disaster	• Short general advice on how to behave • Detailed location-specific advice on how to behave • Providing emotional support to victims during disasters	• Helps people access a wider variety of information channels during disasters, thus helping people understand the information they receive from crisis communicators • Helps people react adequately to protect themselves from hazards
	(6) Organizing volunteers	• Publishing tasks for spontaneous volunteers to collect resources (e.g., clothes, food, water, etc.) • Advocating volunteer action with dedicated apps and websites	• With the help of additional resources from volunteers, help people react adequately to protect themselves from hazards

Police share educational videos. The Belgian authorities offer videos on how to evacuate in disasters, how to respond to a nuclear disaster, and testimonials by professionals on the importance of disaster preparedness. Finnish authorities disseminate short history documentaries, as well as videos on how to act during disasters.

Along the same lines, Italy and Finland use the term citizen "awareness" in their strategy documents. The Civil Protection Department of Italy and the Finnish National Rescue Association (SPEK) use social media for awareness campaigns about false information and everyday safety and security among various groups like youth, migrants, and NGOs (ITA1, 12/2019). For instance, the authorities in Italy invited young people to share testimonials, experiences, and emotions to counter false information online after the L'Aquila earthquake of 2009 in Italy (ITA3, 11/2019).

Similarly, we find strategies toward preparedness and prevention in Belgium, Italy, Sweden, Hungary, and Norway. All use social media for either disaster or civic preparedness. For instance, a major campaign for preparedness in Italy, "Io Non Rischio" (I don't Risk) uses social media to convey messages by video (*Io Non Rischio*

Homepage, 2020; ITA2, 11/2019). Both Sweden and Norway have used social media to promote the civic preparedness guidelines ('If Crisis or War Comes') (SWE1, 12/2019; NOR1, 12/2019; NOR3, 12/2019; DSB 2020b, 2020a), and Hungary has run awareness campaigns related to specific incidents (*BM Országos Katasztrófavédelmi Főigazgatóság*, 2020).

Some organizations publish content about disaster managers' everyday activities to build awareness and maintain trust with citizens. For example, the Finnish SPEK uses social media to share information about its research, the Belgium Crisis Centre shares updates on the activity of the centre, and Italian disaster managers share routine emergency service information. Notably, some official Norwegian Facebook pages have become dedicated to nonurgent information only, because of the distortions that can occur in news channels owing to advertising and hypothetical public misuse (NOR1, 12/2019; NOR2, 12/2019).

Informing and warning the public

By far the most common usage of social media for risk and crisis communication is informing and warning the public. Regularly informing people helps to build a habit of information retrieval, thus encouraging access to relevant information channels during disasters. Furthermore, using warning messages in social media contributes to situational awareness and can help people react adequately to protect themselves from hazards.

Generally, all countries issue some type of alerts. Our research in Germany, Belgium, Sweden, Norway, and Estonia revealed policies of informing and communicating with the population (GER1, 12/2019; GER2, 12/2019; NOR1, 12/2019; NOR2, 12/2019; Government Communication Office, 2018; Ministry of the Interior & Government Office, 2018; MSB, 2019). In Italy, Hungary, and Finland, approaches are more specific. Italian disaster managers, for instance, use social media for real-time responses to citizens' concerns and issuing alerts about hazards and weather warnings. Hungarian disaster managers share information about the injured to warn of potential health effects, while also issuing fire alerts, road accident alerts, and weather warnings. Finland's disaster managers share accident alerts for all types of incidents (FIN1, 1/2020; FIN4, 11/2019; FIN5, 1/2020). In the Nousiainen drinking water poisoning case in Finland, the municipal authorities used Facebook to inform about suspicions of drinking water contamination. In the Belgian Pukkelpop festival case, the authorities failed to provide real-time disaster information via social media, letting Twitter-based erroneous information about the number of casualties proliferate, thus eroding public trust in official institutions.

The choice of social media tools in disaster management is centrally decided in Sweden only by the MSB. In Finland and Estonia, the specific selection is not officially regulated; instead the choice of (social) media channels to be used for crisis communication is up to each institution as long as it serves the aim of reaching varied publics (Government Communication Office, 2018). The Norwegian disaster managers are advised only to use social media if they use it regularly and know how to interact on social media with diverse audiences (DSB, 2016).

Identifying citizens' concerns

Identifying citizens' concerns helps disaster managers to identify the context of vulnerability and then send people relevant information or resources to mitigate this vulnerability.

Finland's Security Strategy for Society states that the actors involved in a disaster must monitor and consider citizen practices and information needs (Turvallisuuskomitea, 2017, p. 89). Similarly, the obligation is pointed out in Estonian documents, which tell that the institutions' communication teams are (among other communication tasks) obligated to monitor social media (Government Office & Ministry of the Interior, 2018; Leib et al., 2011). The usefulness of social media monitoring became evident during the Nousiainen drinking water poisoning case in Finland, where early rumors on social media pressured the authorities to check if the water was contaminated. In that way, the monitoring of social media discussions may have contributed to more effective responses by authorities.

Norwegian and Swedish documents and interviews contained no mention of using social media for monitoring or identifying vulnerable. However, in the case of the sudden increase in asylum seekers in Sweden in 2015, people's questions concerning the disaster were actually identified and answered by the editorial staff at Krisinformation.se via Facebook and Twitter.

Germany and Belgium use professional volunteers, also known as Virtual Operations Support Teams, to search for new information, validate information, and support social media communication during disasters (Lüge, 2014). In the Munich shooting case in 2016, the Virtual Operations Support Teams monitored citizens' activity on social media and discovered that inaccurate information had indicated up to 67 different locations for the attack, while only one existed (Backes et al., n.d.). Similarly, the Belgium Crisis Centre's "virtual volunteers" support crisis communication at provincial and municipal levels, particularly in monitoring and analysing social media data (Federal Public Service, 2017), and in informing citizens on social media (EENA, 2017). The Crisis Centre analyses social media for people's concerns and false disaster-related claims (Centre de Crise, 2020).

Identifying missing persons

During disasters, people may go missing (e.g., trapped earthquake or flood victims) and lose contact with others. Social media posts and discussions can be monitored for position or discourse data to help locate missing persons or identify who is missing. For instance, disaster managers in Hungary used position data from social media to locate people during a major snowstorm in March 2013 (Mandliner, 2013).

In Italy, after the L'Aquila 2009 earthquake, people searched social media groups to find out if there were any survivors under the ruins (Minardi & Salvatore, 2012).

Sharing guidelines during disaster

Besides issuing warnings, social media can be used to share behavioral guidelines during an ongoing disaster response. Greater knowledge about the changing circumstances of a disaster helps people make informed decisions about their subsequent actions.

The German BBK has a dedicated warning app to share basic advice during extreme events (BBK, 2021). In Finland, emergency services use social media for advising people (FIN1, 1/2020; FIN4, 11/2019; FIN5, 1/2020), and the NGOs, churches, and parishes provide emotional support by participating in social media discussions during disasters (FIN2, 11/2019; FIN3, 12/2019).

No clear guidelines were shared by the Civil Protection during the L'Aquila earthquake in 2009 (Minardi and Salvatore, 2012), by the government during the Belgian Pukkelpop festival, or by the government during the Norwegian terrorist attack. The Italian Civil Protection, nevertheless, concentrated on countering an array of online false information that had undermined the public trust towards the government and was initially caused by accusing an amateur scientist in alarmism (Alexander, 2010; Di Bucci et al., 2019; Gabrielli & Di Bucci, 2015). In Belgium, this omission led to public criticism, and in Norway, it caused public dismay because of casualties. However, while false information can complicate disaster response, the direct relationship between false information and increased casualties or reduced trust is complex and influenced by many factors (e.g., Bharosa et al., 2010). During the long-term electricity network interruption (and other vital services including central heating and water) in Estonia, due to the blackout many people, who were not equipped with radio or did not think of using one, could not access municipal social media information.

There are, however, examples of efficient dissemination of guidance materials during disaster in Sweden, Hungary, and Finland. In Sweden, guidelines about the exact procedures of asylum seeking were shared and erroneous word-of-mouth rumors were corrected in 2015 by the MSB and other relevant stakeholders. During the Hungarian snowstorm in 2013, the authorities shared guidelines on how to survive in traffic jams, and in Finland, the municipal authorities advised boiling the contaminated Nousiainen drinking water.

Organizing volunteers

Another noteworthy crisis communication practice from our case studies is publishing tasks for spontaneous volunteers who could help people during crises. In Finland, the National Rescue Association (SPEK) uses social media for advocating volunteer action. In Germany, firefighters organize volunteers on Twitter and Facebook (Sander, 2020). The Hungarian National Volunteer Council and various nonprofit organizations publish tasks for spontaneous volunteers on their website, social media sites, and on an app called "IfYou" (Nonprofit.hu, 2013, 2021; Önkéntes.gov.hu, 2021). During the Hungarian snowstorm of 2013, a dedicated Facebook page was used by volunteers for coordination (e.g., providing warm food and drinks and offering to lend cars and shelter families). The National Directorate General for Disaster Management also recruited volunteers for rescue efforts through Facebook (Huszár, 2013).

A downside of organizing volunteers on social media became evident in the German Elbe floods case when some volunteers were accidentally guided to wrong places (Sächsische Staatskanzlei, 2013, p. 49).

DISCUSSION

We focus our discussion on how official communication on social media might alleviate the problems people may face with (1) accessing information about hazards, (2) understanding the information they receive, and (3) reacting to information related to risks, hazards, and emergencies.

Improving access to disaster information

The practice of informing and warning the public in social media complements awareness and preparedness campaigns and regular informative messages that have long been common features of radio, television, and print media.

The practice of sharing guidelines via social media both before and during disasters improves access to relevant information (e.g., the disaster and civic preparedness campaigns in Belgium, Italy, Sweden, Hungary, and Norway) for those who use social media. However, this does not directly benefit those who have no skills or habit to use social media or cannot use it due to situational factors (e.g., the knock-on effects of the long-term power outage in Estonia).

In some cases, social media data can be used to locate or identify missing persons who cannot seek help themselves (e.g., searching the content of social media groups for the disaster victims in the Italian L'Aquila 2009 earthquake and using mobile positioning data in the Hungarian 2013 snowstorm case).

Leveraging volunteers (and influencers) on social media as proxies can expand reach of warnings to isolated groups lacking direct access. While not novel as a method, the practice evolves from communication tools of the past, but with added benefits of two-way communication (e.g., offering possibilities for fast relocation, or establishing persons of contact).

These practices can mitigate access-related communication barriers by improving the capacity of disaster management institutions to collect and disseminate information, and individuals to receive vital warnings and updates before and during disasters.

Improving understanding of disaster information

Considering the practices specifically designed to increase understanding, we found that the practice of sharing educational guidelines *before* the disaster (e.g., the awareness campaigns in Italy or Finland) prepares people to better comprehend the guideline information they receive *during* disasters. An interesting example of using social media communication to increase understanding is endorsing and spreading online discussions (e.g., the tactics of Finnish SPEK in social media), which in turn fosters dialogue and allows for the clarification of complex disaster-related information. Consequently, it enhances the public's ability to comprehend key safety messages.

Similarly, sharing guidelines *during* a disaster affects people's understanding of the changing circumstances of a disaster. Advising people during a disaster helps to improve self-help knowledge (e.g., sharing guidelines on how to survive traffic during the snowstorm in Hungary or advice on boiling contaminated drinking water in Finland); by explaining complex information (e.g., explaining the procedures of asylum in Sweden); and by correcting contradicting or false information (e.g., debunking of rumors about asylum seeking in Sweden). Offering practical advice, clarifying complex procedures, and correcting false information gives individuals the capacity to process vital alerts and instructions during crises. This does not mean that the public would always panic without guidelines (see Drury et al., 2013). Better understanding of disaster context is not only facilitated by disaster managers' social media usage, but also by the public's own needs and desires in information seeking (Ruggiero, 2000).

The practice of informing and warning the public in social media might also eventually help people better comprehend the situation (e.g., in the 2017 Finnish Nousiainen drinking water poisoning case when authorities at first failed to warn the population, or the Hungarian Veszprem 2013 red sludge case when the authorities at first denied the poisoning and only later warned the population of the adverse effects). This shows that observing citizens' concerns during disasters can indicate to disaster managers which information gaps, misconceptions and evolving needs to address at the time. In the Finnish Nousiainen drinking water contamination case, this is likely to have helped to increase the citizens' understanding of their situation.

The practice of organizing volunteers on social media may also help to alleviate difficulties with understanding disaster information. For example, volunteers could identify peoples' limited language skills, or translate local texts (e.g., the causes of the vulnerability of the Swedish asylum seekers in 2015) and debunk contradictory information (e.g., overcoming this situational vulnerability factor when incorrect locations were published following the Munich shooting in 2016 or volunteers were misguided during Elbe floods in 2013).

These social media practices show how leveraging the two-way communication opportunities of social media and the multimedia information environment (i.e., text, pictures, videos, meta-data, etc.) can improve the understanding of risk in new ways compared to traditional media (i.e., newspapers, TV and radio). Crisis managers can tap into user-generated data, get swift feedback from people, engage in dialogue with various groups, and address individual concerns.

Improving the ability to react adequately to disaster information

Reacting adequately to disaster information is enhanced by the practice of sharing educational guidelines that focus on improving people's skills (i.e., applied knowledge) to protect themselves from hazards before any disaster. Guidelines via social media can enhance support for disadvantaged groups to help them protect themselves from hazards (e.g., the practice of Finland's NGOs, churches, or parishes to provide emotional support in social media during disasters). However, people may sometimes miss important guidelines due to having no access or no skills to access them (e.g., people who did not use neither social media or radio during the power outage in Estonia), or due to mistrusting official sources. This highlights the importance of ensuring that multiple communication channels (i.e., traditional media, SMS alerts, and community outreach alongside social media) are available and used during disasters.

Informing and warning the public helps people make more educated decisions during disasters to protect themselves. This is achieved by increased access to information and an improved understanding of it (e.g., information about suspicions of the drinking water contamination in the Finland Nousiainen case). An example where people's capacity to react to information might have been weakened was the failed communication in the Belgian Pukkelpop festival disaster, during which exposure to erroneous information might have engendered distrust in official institutions. Adversely, disseminating formal and rigid guidelines that do not fit the disaster at hand could lead to adverse effects (e.g., young people coming out of hiding too soon during the mass shooting of Utøya in Norway in 2011).

As noted at the outset, people's vulnerability to disasters is shaped by an interplay of individual, social-structural, and situational factors (Hansson et al., 2020). Our findings suggest that to mitigate any harm arising from individual vulnerability, risk and crisis communicators need to systematically collect and take into account

information about the media consumption habits of various groups (e.g., insights from the media uses and gratifications research) and tailor their messages to their specific needs. Ideally, social media could be used to offer people more personal support (e.g., via the practice of identifying citizens' concerns). To address the social-structural drivers of disaster vulnerability, risk, and crisis management institutions should increase their capacity to interact with and respect the needs of various groups by improving the accessibility and understandability of risk and crisis communication. To be better prepared to deal with various situation-specific complications to communication that may arise during crises, the authorities would benefit from scenario-based training and planning of communication activities.

To conclude, carefully planned use of the identified practices could mitigate communication-related vulnerability, but too much reliance on social media could also put people at risk. In addition to the practices identified in our study, we suggest that disaster managers could further enhance people's capacity to cope with disasters by using social media for mediating donations, promoting therapeutic initiatives, and supporting social cohesion and collaborative development (see Alexander, 2014; Houston et al., 2015).

CONCLUSIONS

This article provides the first cross-national study of European disaster managers' social media practices, focusing on how these practices may affect social vulnerability. Our analysis revealed six practices: *sharing educational guidelines, informing and warning the public, identifying citizens' concerns, identifying missing persons, sharing guidelines during disasters*, and *organizing volunteers*.

We draw attention to how these practices could improve people's access to and understanding of risk and crisis information. By highlighting the need to support people's capacity to react adequately to messages about hazards, our study provides new insights for developing guidelines for official crisis communication on social media. Future research could chart and compare these practices in other parts of the world, zoom in on specific types of crises, and study the evolving practices diachronically.

INTERVIEWS

Germany
    German Firefighters. (12/2019) (GER1)
    German Emergency Organizations. (12/2019) (GER2)
Italy
    Department of Civil Protection. (12/2019) (ITA1)
    Blogger on the topic of disasters. (11/2019) (ITA2)
    President of an NGO. (11/2019) (ITA3)
Sweden
    Swedish Civil Contingencies Agency's (MSB) Risk Communications Office. (12/2019) (SWE1)
Finland
    Regional Emergency Services. (1/2020) (FIN1)
    Evangelical Lutheran Church of Finland (1). (11/2019) (FIN2)
    Evangelical Lutheran Church of Finland (2). (12/2019) (FIN3)
    Rescue Services of Oulu-Koillismaa area. (11/2019) (FIN4)

Rescue Services of Kymenlaakso area. (1/2020) (FIN5)

Norway
Office of the County Governor of Oslo og Viken. (12/2019) (NOR1)
Norwegian Police Security Service. (12/2019) (NOR2)
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