# Social media use in emergency management

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# *Social media use in emergency management*

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## ABSTRACT

***Objective:*** *To identify and illustrate the range of strategies and tactics available for emergency managers using social media.*

***Design:*** *This study uses content analysis of more than 80 related journal articles, research reports, and government documents as well as more than 120 newspaper articles, identified through LexisNexis search queries.*

***Results:*** *Three strategies, information dissemination, monitoring real-time data, and engaging the public in a conversation and/or crowdsourcing, are available to emergency managers to augment communication practices via face-to-face contact and through traditional media outlets. Academic research has identified several message types disseminated during response operations.[1,2] Message types during other emergency phases have received less attention; however, news reporting and government reports provide best practices and inform this study. This article provides the foundation for a more complete typology of emergency management messages. Relatedly, despite limited attention in the academic research, monitoring social media feeds to accrue situational awareness and interacting with others to generate a conversation and/or to coordinate collective action also take place in various forms and are discussed.*

***Conclusions:*** *Findings integrate the fragmented body of knowledge into a more coherent whole and suggest that practitioners might maximize outcomes through a three-step process of information dissemination, data monitoring, and the direct engagement of diverse sets of actors to spur risk reduction efforts. However, these steps require time, personnel, and resources, which present obstacles for agencies operating under conditions of personnel and resource scarcity.*


*Key words: social media, crowdsourcing, situational awareness, emergency management, public safety*

## INTRODUCTION

Emergency management provides one domain in which practitioners and constituents widely recognize the utility of social media. During disasters, relevant and timely information can be the difference between life and death, and social media—such as Twitter and Facebook—can facilitate the rapid dissemination of critical information. Social media is useful during other phases of emergency management as well, particularly preparedness, to build more resilient communities.[3,4] As social media gains prominence, both government and the public increasingly turn to these sources.[5]

Social media's potential to improve government operations and governance in general has been documented.[6,7] Its use during emergency response operations, specifically, has received attention as well.[8,9,2] However, less research has been conducted regarding social media use across other phases of disaster management despite its value.[10] Prior to extreme events, for example, Dufty[3] posits that social media facilitates the building of social capital and promotes the recognition of shared risk, which can lead to more cohesive and resilient communities. A better understanding of social media's potential across different activities, therefore, would be useful for researchers and practitioners alike.

This article offers an analysis and synthesis of the body of knowledge on how emergency managers use social media across disaster phases. The objective of

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this study was to identify and illustrate the range of strategies and tactics available. More than 80 journal articles, research reports, and government documents were reviewed as well as more than 120 newspaper articles, identified through LexisNexis search queries. Findings integrate the fragmented body of knowledge into a more coherent whole and suggest that practitioners might maximize outcomes through a three-step process of information dissemination, data monitoring, and the direct engagement of diverse sets of actors to spur risk reduction efforts. However, these steps require time, personnel, and resources, which present obstacles for agencies operating under conditions of personnel and resource scarcity.

## DEFINING SOCIAL MEDIA

Social media are Internet-based platforms that facilitate communication and content exchange between users.[11] Two types of social media are particularly notable, online social networks and microblogs. Online social networks—such as Facebook—facilitate "peer-to-peer communication and user generated content" and represent one type of social media.[6(p267)] Microblogs—such as Twitter—allow users to post short messages that are available to wide array of actors.

## REDUCING INFORMATION SILOES IN EMERGENCY MANAGEMENT

An inherent problem in emergency management is the inability to quickly communicate across different scales of action, and the results of this type of information asymmetry can include loss of life and extended human suffering.[12,13] Online social networks and microblogs provide platforms through which information silos can be lessened; allowing agencies to communicate with other agencies as well as constituents and vice versa.[14,15] These types of communication networks can facilitate key processes for emergency managers, including risk recognition, the formulation of strategies for action, and coordination with others to implement those strategies.[16] As social media usage rates increase, so too does the opportunity for agencies to reach out to private citizens, community groups, and other agencies.

## KEEPING PACE WITH CONSTITUENTS

Americans are increasingly online (87 percent) and, of those online, 73 percent use social media.[17] More and more people access online social networks and microblogs via their tablets and smartphones—58 percent of all adults own a smartphone.[18] According to a 2012 poll commissioned by the American Red Cross, 19 percent of all respondents selected social media as a preferred source of emergency information during disasters. This number is not insignificant. As more people participate in social media and expand their access to these sites via tablets and smartphones, it is reasonable to expect that social media during disasters will increase in relevance.

While government agencies have made efforts to connect with constituents online, further efforts are needed.[19] The director of Oklahoma's Department of Emergency Management, Ashwood, for example, pointed out that "as far as information sharing is concerned, social media is in its maturity … [but] from a public-safety standpoint, social media is in its infancy."[20(p4)] This comment suggests that while people increasingly use social media, state and local emergency managers' efforts to connect with them are only in inchoate stages. Empirical research reaffirms this proposition at the state level.[10]

Despite an array of strategies and tactics available, emergency managers demonstrate varied willingness and/or ability to adopt them. The independent research firm CNA, for example, conducted a 2012 survey to better understand how state and local emergency managers use social media and how they plan to use it in the future.[21] Results indicated a range of understanding and willingness to implement the technology. At the state level, 95 percent of respondents indicated that their agencies either maintained or planned to maintain an online social network account; however, this contrasts significantly with county level respondents (only 50 percent).

While most emergency managers used social media to disseminate information during disasters, they generally failed to extract actionable intelligence from it. At the state level, 71 percent of respondents planned to monitor social media daily for real-time information; only 33 percent of county level respondents planned

to do the same. In terms of connecting with others and generating dialogue, 61 percent of state level respondents planned to use online social networks to build relationships, compared with 24 percent at the county level. Fewer respondents still planned to use more advanced methods to aggregate and analyze this data (46 percent of state respondents and 11 percent of county respondents).[21(p31)]

While lower usage rates could be due to a lack of dedicated personnel or other resources, one reason leading to this uneven distribution very well could be a lack of understanding of available technologies and the strategies used to implement them. Research that aggregates options available to personnel provides value to both researchers and practitioners. Along those lines, this article illustrates three strategies of social media used by emergency managers, including the following:

1. disseminating information to the public;

2. monitoring open source data to accrue situational awareness; and

3. engaging organizations and citizens directly in conversations or the coordination of actions to reduce risk, including crowdsourcing.

To achieve this, research and news articles were identified and analyzed. The next two sections identify the data analyzed and methods used.

## IDENTIFYING THE BODY OF KNOWLEDGE

Social media's rapid contribution to emergency management has elicited the interest of government agencies, journalists, and researchers across academic disciplines. The most prevalent of this academic research focuses on government social media use leading up to and during disasters. Relevant reporting on government implementation of social media provides additional insights as does research emanating from computer science regarding platform innovation. In addition, sociologists have contributed relevant findings on how individuals use social media during disasters. Best practices from federal agencies and nonprofits such as the American Red Cross available via government reports and news articles also provide relevant insights.

More than 55 academic articles were identified using Google Scholar and other search engines. The National Response Framework, Congressional Research Service reporting, and other government documents (25 in total) provide additional findings as do more than 120 news articles identified through LexisNexis searches.* While this article fails to exhaust the complete body of knowledge on social media use in emergency management, it offers at least a baseline assessment to identify key trends.

## ANALYZING THE BODY OF KNOWLEDGE

The author used the qualitative software program MAXQDA to manually classify concepts related to how officials use—or could in the future use—social media.[22] Documents were examined in three iterations (eg, open, axial, and selective coding) using the Strauss and Corbin[23] approach to qualitative data analysis. Three general categories emerged from this analysis: 1) one-way information dissemination, 2) data monitoring to accrue situational awareness, and 3) the direct engagement of constituents and organizations in bilateral and multilateral conversations. The results provide a wide-ranging list of strategies and tactics available to officials, some of which require more time, effort, and resources than others.

## FINDINGS: STRATEGIES AND TACTICS FOR SOCIAL MEDIA USE IN EMERGENCY MANAGEMENT

Three strategies—information dissemination, monitoring real-time data, and interacting directly with private citizens and other agencies in an effort to reduce risk—are available to emergency managers. Many emergency managers disseminate information via social media during extreme events, and academic research has identified several related message types that this article highlights.[1,2] Message types during other emergency phases have received less attention. However, news reporting and government reports provide best practices that inform this study. Relatedly, monitoring social media to accrue

*LexisNexis Academic searches included the terms of "social media and emergency management" as well as "twitter and disaster."

situational awareness[24,25] and interacting with others to generate a conversation and/or to coordinate collective action also take place in various forms.[10] All three strategies (eg, information dissemination, monitoring real-time data, and engaging the public in a conversation and collective action) complement each other and enable emergency managers to effectively augment traditional communication practices.

*Disseminating information*

A significant portion of the academic research focuses on the types of messages that agencies disseminate. For example, Heverin and Zach[1] examined organizational and citizen use of social media during multiple mass shooting events. Their message typology provides basic descriptions of message types related to opinions, emotions, and action-related content, yet offers limited guidance for practitioners.

Other studies—Bruns et al.,[26] Sutton et al.,[2,27] and Hughes et al.[28]—provided typologies more applicable to officials, specifically with respect to formulating warnings, alerts, and advisories. However, all three studies focused on the response phase of emergency management as opposed to mitigation, preparedness, and/or recovery. A complete typology accounting for all phases has not yet been presented.

This section illustrates a range of message types available across disaster phases. These message types are intended to direct information from an agency to its intended audience, generally a one-to-many communication approach. Findings include the following:

- *Alerts, warnings, and advisories*. Alerts, warnings, and advisories provide constituents with real-time protective action information to assist them in making informed decisions leading up to and during disasters.

- *Resource provision*. The provision of resources offers additional message types to inform and/or coordinate resource distribution among the public or with other agencies.

- *Preparedness education*. Education-oriented messages instruct community members on how to improve their household-level preparedness prior to an extreme event.

- *Administrative news*. Online social network sites can be used to promote public relations and make agency activities transparent in normal, nondisaster situations—what some emergency managers refer to as blue sky conditions.

- *Emotion and opinion-related messages*. Emotion and opinion-related messages provide opportunities to express gratitude, condolences, and commentary to a broad audience.

*Alerts, warnings, and advisories*. Emergency managers have long dealt with generating appropriate alerts, warnings, and advisories leading up to and during a disaster.[29] They craft messages to 1) describe the impact of a hazard to the public; 2) suggest what actions the public should take, including evacuation orders; and 3) announce facility or transportation route closures.[30]

Online social networks provide mechanisms for real-time, direct distribution of these messages from one user to another. Furthermore, Twitter and Facebook have introduced alert systems in the United States, Canada, Britain, Australia, and New Zealand. Through these systems, emergency management and public safety personnel directly disseminate warnings to users, bypassing agency reach limitations created by a lack of followers. Recipients may repost or retweet these messages, therefore, amplifying the official government message.[30,31]

*Resource provision*. The provision of resources offers additional message types to inform and/or coordinate resource distribution among the public or with other agencies. Messages could contain advice regarding where to locate specific resources and whom to contact, and could be relevant during both the response and recovery phases.[26] Lindsay points out that online social networks offer opportunities to

promote resource provision during the recovery phase of a disaster:

> [Agencies] could provide information concerning what types of individual assistance is available to individuals and households, including how to apply for assistance, announcing application deadlines and providing information and links to other agencies and organizations that provide recovery assistance, such as the American Red Cross, or Small Business Administration (SBA) disaster loans for homes and businesses.[32(p22)]

While research focuses on how personnel use online social networks specifically during and immediately following disasters, emergency managers also design messages relevant to other disaster phases. Preparedness messages, for example, provide tactics to promote more resilient households and communities.[3,4]

*Preparedness education and advocacy*. Renee Presler of the Arkansas Department of Emergency Management points out that "social media has enabled the state and local emergency management agencies to prepare their communities by bringing preparedness information to them."[33] Preparedness education and advocacy represent efforts to educate the public and improve community resilience to specific risks[4]; these efforts can be implemented online. Examples include personal preparedness tips such as developing family disaster plans as well as drawing attention to the potential impacts of specific hazards and the related steps to reduce risk.[9,10] Not all messages, though, need be intended to reduce risk. Some agencies use online social networks to make their daily, administrative processes more transparent.

*Administrative news*. Social media provide a forum to communicate agency news to constituents and other agencies. The focus of these messages is generally administrative in nature and intended to improve public relations. Examples include announcing a director's public schedule, posting employment opportunities, and trumpeting agency accomplishments.[9] Again, these messages are not directly related to field operations, but instead focus on administrative accomplishments and public relations.

*Emotion and opinion related*. Online social networks provide opportunities to express emotions: gratitude, regret, disbelief, or condolences to a broad audience. We are after all human and demonstrating emotion can be an important aspect of psychological healing at the community level.[31] Bruns et al.,[26] for example, noted the shock and sadness communicated by the residents and responders affected by large-scale flooding in Australia in 2011.

Constituents may offer commentary on events, political figures, and other issues related to an incident.[34,1] Individuals may want to criticize government action or an action.[35] While agencies likely will prefer to restrict this type of commentary by personnel, it is important to keep in mind that individuals express these types of opinion-related and emotion-related comments, which offer perspectives on how the public is dealing with an incident. Sentiment analysis or the aggregation of these types of messages to characterize public mood represents one method by which emergency managers can elicit meaning from online social network data. In the next section, strategies and tactics to interpret this type of data are considered.

*Accruing situational awareness*

Another use of social media is related to how public officials accrue situational awareness from open source data. Endsley[36] defined situational awareness as a decision maker's 1) recognition and understanding of key environmental components and 2) his or her ability to anticipate future conditions. Comfort's research,[37] while not focused specifically on online social networks, examined how digital information repositories support the creation and maintenance of not just individual situational awareness but a shared common operating picture between an array of actors to better inform decision making. Aggregated information flow of this sort supports sensemaking processes that are vital to emergency management.[38] Open source data available via social media provide

agencies with a potentially valuable component for this common operating picture. In this section, key findings include the following:

- *Real-time information*. Online social networks and microblogs provide useful situational awareness related to hazard impact, the needs of the community, and community reaction and mood in almost real time.

- *Limited adoption*. State and local emergency managers demonstrated limited interest and/or capabilities to monitor, aggregate, and analyze social media data.

- *Manual analysis strategies*. Both manual and automated data monitoring, aggregation, and analysis techniques are available, although many emergency managers rely on manual techniques that do not fully tap into the potential of big data analysis.

- *Automated analysis strategies*. Automated data extraction and analysis platforms offer opportunities to better understand the nature of an incident through online social network data, involving machine-assisting strategies to collect and analyze big data.

*Useful situational awareness*. In his testimony to the U.S. House Subcommittee on Emergency Preparedness, Response, and Communications, Jersey City, New Jersey emergency manager W. Greg Kierce identified useful information available through social media, including

- real-time incident notification through user comments;

- community reaction and response to warnings and alerts; and

- first-hand reports, including photos and videos, used to assess hazard impacts.[39(p1)]

Other useful information includes specific needs during an incident, public sentiment regarding risk prior to extreme events, and the operations of other agencies. This information supports individual situational awareness and helps to build a larger common operating picture for the agencies charged with response activities. Increasingly, emergency managers rely on this data source. For example, during Hurricane Isaac in 2012, *USA TODAY* reporter Natalie DiBlasio described how responders count on social media for critical information:

> Tens of thousands of relief workers, government officials, hospitals and residents looking for up-to-date information are using social media to stay abreast of what's happening with Isaac. It's another example of just how deeply social media outlets have embedded themselves in today's world–particularly when a potential tragedy strikes.[40]

Sutton[41] pointed out that public information officers (PIOs) now monitor social media during large-scale, planned events and Hughes and Palen[24] enumerated the increased number of information sources and audiences PIOs must now consider. St Denis et al.[42] described how emergency managers in Oregon dealt with increased task demands by organizing digital volunteer teams to analyze data and report back to the PIO. Computer scientists have suggested machine-assisted approaches to analyzing data,[43-45] but the extent to which these ideas actually have been adopted has not been systematically addressed in scholarly research.

The aforementioned CNA report provides an indication of the extent to which state and local emergency managers monitor social media. Su et al. suggested limited use and pointed out that "data-extraction efforts at all levels are still reliant on manual review, making monitoring efforts difficult to scale-up during large disasters."[21(p3)] The following two sections differentiate between manual and automated techniques and illustrate the potential benefits of more advanced automated data extraction and analysis techniques.

*Manual techniques*. Manual data monitoring provides useful—if not limited—information for emergency managers. Both Twitter and Facebook users generate microblog content. Following, friending, or liking a user pulls their feed automatically into your dashboard; therefore, an emergency manager could identify potentially valuable information sources—such as local television stations, the National Weather Service, and others—and then monitor them to accrue situational awareness one post at a time. Furthermore, a user need not follow a source to read their messages, especially in open access sites such as Twitter. Search functions allow individuals to search for specific users and/or terms related to any area of interest. The Department of Homeland Security (DHS), for example, assigns personnel to this very task, monitoring online social networks and microblogs "to discover and track incidents that may affect homeland security by using search terms to find items of potential interest."[46(p25)] However, individually monitoring feeds can be challenging.

Su et al.[21] identified problems related to monitoring big data. As the number of messages grow so too does the time commitment of individually analyzing each post. Emily Rahimi of the New York City Fire Department experienced this problem during Superstorm Sandy when she "chained herself to her desk… for a day and a half, monitoring the department's Twitter feed …"[47] This example suggests that one person may not be enough to monitor all feeds and respond to each request. During large-scale incidents, for example, millions of tweets may be posted in a relatively short time[48]; therefore, emergency managers would benefit by establishing systems to manage this data. This, of course, requires expertise and additional resources.

*Automated techniques*. Automated techniques for data extraction and analysis provide methods to account for large-N datasets that may overwhelm an individual's cognitive ability to process. Some of these techniques are built into the online social network platforms—such as trending topics—and others require external platforms.

Twitter's trending topics is a feature built into the site. Twitter identifies spikes in usage rates for specific terms and makes those trends visible to users. Trending topics provide emergency managers with a user generated indication of disturbances or other problems.

Other data extraction and analysis techniques require additional software systems. The American Red Cross's digital operations center created in partnership with Dell, for example, provides a platform through which personnel detect incidents and related need in real time. Wendy Harman, the Red Cross's director for social strategy, pointed out

> [The digital operations center] provides us real-time situational awareness from the actual people affected. For example, we know whether there's a large population of people who can't contact their loved ones, whether there's a big community desire to volunteer, whether people need shelter, food, or other supplies (as quoted in Clolery[49]).

Dell modeled this software design on its corporate listening platforms used to track consumer demographics, sentiment, and the content of their social media messages. Similar attributes are analyzed via the American Red Cross system located in Washington, DC, but the system requires personnel, hardware, and expertise. Within the digital operations center

> "Six wall-mounted monitors display a stream of updates from Twitter and Facebook and a visual 'heat map' of where posts seeking help are coming from. [During Superstorm Sandy] the heat map informed how the Red Cross's aid workers deployed their resources …"[50]

The success of the national Red Cross system led to the creation of a second operations center located in North Texas. Both DC and Texas digital operations centers are staffed by a combination of paid staff and volunteers, who confront a set of challenges in making sense out of this data.[51] Determining message veracity and relevance represent specific challenges as does

determining the mood and sentiment of constituents online. Much time and effort is currently expended in validating data. In the future, automated validation metrics may streamline the process.[52]

Bukhari et al.[25] illustrated the application of the analytic tools Radian6 and Visible Technologies to analyze public sentiment during Super Bowl XLVI in real time. Using similar platforms, emergency managers could ascertain public mood and reaction to protective action messages which could in turn inform key follow-up decisions. Ripberger et al.[48] demonstrated this same potential using archival data to identify levels of public attention and specific reactions to two separate tornado incidents from 2012. Again, whether considering the American Red Cross model or adapting other platforms for emergency management use, major considerations include both the costs and resources required to implement these technologies. With a more informed understanding of public sentiment and need, however, emergency managers could more precisely engage constituents in coordinated collective action and address public need.

*Engaging citizens in the coproduction of knowledge and public services*

The potential to link agencies to constituents through social media is clear. FEMA Administrator, Craig Fugate, stated that "social media provides the tools needed to minimize the communication gap and participate effectively in an active, ongoing dialogue."[53] The dissemination of information—from organization to constituent—and the passive accrual of situational awareness from open source data represent one-directional flows of information. A more robust communication model is possible, however. As Adamski, FEMA's senior manager of digital engagement, pointed out "in true conversation, both participants listen and respond in turn–social media is no different."[54(p4)] This type of two-way communication is feasible online via social media.

Emergency managers can increase the utility of online social networks and microblogs by engaging the public and other agencies in a conversation; a conversation that leads to the coproduction of knowledge and, at times, the coproduction of public goods and services. The American Red Cross, for example, adopted those goals years ago.[55] This section focuses on how emergency managers can contribute to both conversations and efforts to coordinate collective action. Key findings indicate that

- *Adjusting communication strategies based on new information and feedback*. Agencies can use new information and feedback to adjust previous messages and communication strategies.

- *One-to-one conversations and directing content to specific groups*. Agencies foster conversations by responding to messages as well as directing content to specific users and/or groups to engender interaction.

- *Rumor management*. Personnel monitor social media for false rumors and offer corrections based on this two and multiway communication practice.

- *Gamification*. Some agencies have engaged constituents and other organizations in contests with the goal of promoting community and household preparedness. This strategy is referred to as gamification.

- *Crowdsourcing*. Agencies can tap into the potential of their constituents via social media by requesting users directly participate in solving problems, a process referred to as crowdsourcing. Through crowdsourcing, agencies empower people and organizations to coproduce knowledge and, in certain cases, public goods and services.

*Adjusting communication strategies based on new information and feedback*. One-way communication flow denies emergency managers complete information.[12] Effective emergency managers continually scan their environment for risk, often relying on partner organizations and other sources for new

information, interpretation, and feedback.[37,16] Social media facilitates multiway information flows that allow for those critical exchanges.[10] Using social media, emergency managers can accrue actionable intelligence and adjust their message strategy accordingly to better inform the public.

*Receiving information from and directing information to individuals and groups*. Online social network functionality facilitates direct, bilateral information exchange—one-to-one communication—as well as efforts to communicate within larger groups, often within the context of publicly accessible conversations (ie, many-to-many communication). On Twitter and Facebook, users are able to reply directly with other users as well as participate in public conversations via Twitter hashtags.

The most pressing need to use social media comes during an emergency. When telecommunications fail, social media serves as a redundant 911 system of sorts. Even in remote locations and trying conditions, people in need may be able to make contact with relief agencies. Beckerman, the President and CEO of The Internet Association, offered a pertinent example which occurred following the 2010 Haitian earthquake in which local government agencies were knocked off-line and inoperable:

> Within a few hours of the quake, a man trapped with 20 other people under a collapsed building in Port-au-Prince managed to send a photo of the wreckage from his [cell] phone to a cousin in Chicago. The cousin tweeted the photo to "@RedCross" and the Red Cross in turn relayed the location to first responders in Haiti.[56(p2)]

This redundant communication capability can literally make the difference in life and death situations. During Superstorm Sandy, New York City personnel not only monitored online social networks and microblogs for data but also responded directly to constituents based on their specific requests. Red Cross personnel in Washington, DC contributed to the effort as well. "The [message] volume was so large that the Red Cross asked 23 staffers to monitor over 2.5 million social media posts; of which, 4,500 were tagged for first responders to follow up on."[56(p4)]

In addition to bilateral dialogue, Twitter permits users to direct messages to groups via hashtags, which signal specific topics and facilitate the creation of emergent conversation categories accessible to disparate users. Hashtags represent a tactic to manage conversations and direct those conversations to specific audiences. "For example, one might add the tag #oilspill to mark the content as related to [an] oil spill."[27(p64)] In addition to hazard specific hashtags, personnel may also consider specifying geographic region or community group (eg, specific neighborhoods, and senior citizens).

*Rumor management*. The data aggregation and analysis techniques discussed in previous sections can also identify public misconceptions and rumors. During Superstorm Sandy, rumors circulated from the incident's onset.[28] One widely circulated message on Twitter, for example, claimed that the New York Stock Exchange had been submerged underwater. To combat these false rumors:

> FEMA began a Rumor Control initiative … When a rumor was identified, the social media team worked with … staff to track down additional information and gather the correct information. These details were then added to the Rumor Control page, providing clear language about the misinformation and resources where people could find correct information for each rumor. Rumor Control messages were shared widely by FEMA's social media accounts …[57(pR-5)]

During the 2011 catastrophic floods in Queensland, Australia, personnel conducted similar rumor control operations and "introduced innovations such as the #Mythbuster series of tweets, which aimed to intervene in the spread of rumor and disinformation."[26(p37)] Again, this type of activity requires dedicated personnel to identify rumors, validate information, and disseminate responses.

*Gamification*. Through games and contests, agencies can engage constituents with the goal of promoting community and household preparedness. The concept, gamification, is used to describe situations in which games are implemented to incentivize work. One example is the "30 Days, 30 Ways" disaster preparedness game developed by the Clark Regional Emergency Services Agency in Washington state. Every day in September, which is National Preparedness Month, the agency posts a simple preparedness activity. The public is asked to complete the task and post a creative photo and description relevant to that day's theme. Each day a winner is chosen and given a prize. The goal is to generate visibility for preparedness and educate the public on specific tasks.

*Crowdsourcing*. Haddow and Haddow define crowdsourcing as "making an open call to the public asking for solutions to a problem."[11(p27)] Mergel points out that this involves "outsourcing tasks to a relatively large group of people, each of whom contributes to the end result."[6(p264)] In the CNA survey, 33 percent of state respondents and 21 percent of county respondents indicated that they already use social media to "leverage citizens as a force multiplier (e.g., deliver food, clear roadways, engage in search and rescue efforts)."[21(p42)] While these statistics indicate that a sizable minority of agencies already crowd source, the survey results also suggest that most personnel are unfamiliar with even the term crowdsourcing in additional to the platforms used to facilitate it. Work clearly needs to be to more effectively use social media to incorporate the public in emergency management activities.

Evidence suggests that crowdsourcing can be effectively used to coproduce knowledge and public services, including

- *Digital mapping*. Mapping programs such as Google Maps and Ushahidi can be used by multiple users to generate visuals related to hazard impact and community need.[11] Online social networks and microblogs can direct contributors and consumers to these platforms.

- *Hazard assessments*. Agencies can request the public to post photos, videos, and descriptions of hazard impacts coupled with geolocation data to generate data for official hazard assessments.

- *Intelligence gathering*. In addition to hazard impact information, emergency managers can use strategies to gather other pieces of critical information. Law enforcement agencies, for example, have engaged the public via social media for suspect identification; one of the most notable examples being the investigation which followed the Boston Marathon Bombing.

- *Reuniting friends and family*. Agencies can encourage citizens to turn to social networks and microblogs to connect friends and loved ones following a disaster. In addition, applications such as Google Person Finder enable the quick and efficient identification of individuals via simple search processes.

- *Volunteer recruitment, fundraising, and other resource acquisition*. Social media can be used for volunteer recruitment as well as fundraising and resource requests, not just during a disaster but during other disaster phases as well.

Crowdsourcing is particularly useful for volunteer recruitment and coordination. Past research describe emergent, self-organizing volunteers following the Haitian earthquake[58] and Superstorm Sandy.[59] Coordinated tasks vary, but are likely to include emergency support functions such as mass sheltering, debris removal, and search and rescue activities. Oklahoma emergency manager, Ashwood, points out

> Often after a disaster, volunteer work groups come in quickly to assist communities. Without a robust volunteer management

> system in place, the influx of personnel could become a management concern. Social media has been able to bridge the gap between the need for volunteers and the chaos which could occur in the absence of coordination.[20(p5)]

Online social networks and microblogs provide fund-raising capabilities as well.[26] Sutton et al.[27] find evidence of online fundraising following the Boston Marathon Bombing. Whether online or through text messages, concerned individuals are able to donate funds for relief efforts. Online social networks facilitate friend-to-friend fundraising requests as well as solicitations directly from agencies involved.

> In the first 48 hours following the Haitian Earthquake, the Red Cross raised more than $3 million dollars from people texting a $10 donation. 'Crowd funding' empowers citizens to donate to, and solicit donations for, victims of disasters through posts to Facebook, Google+, LinkedIn, Twitter and other social media sites.[56(p3-4)]

Crowdsourcing strategies, if implemented effectively, could significantly improve emergency management outcomes by engaging the public's resources and capabilities. Volunteer recruitment, fundraising, and other resource acquisition tactics represent available approaches.

## DISCUSSION

Based on the analysis of the literature and other documents, emergency managers have several strategies from which to choose regarding social media use; all of which, however, require time, effort, and additional levels of resources. Table 1 recaps key findings from each approach.

First, social media provide platforms by which to rapidly disseminate information to the public. This one-to-many communication approach corresponds with traditional PIO functions but requires the timely approval and release of public information to facilitate real-time distribution.[24] A number of one-way message types can be disseminated across different disaster phases, ranging from alerts and warnings to administrative news.

Second, social media offer open source data from which officials can accrue situational awareness. This

**Table 1. Strategies and tactics available for social media use in emergency management**

| | Information dissemination | Data monitoring & analysis | Conversations & coordinated action |
|---|---|---|---|
| *Description* | Emergency managers disseminate information using a number of message types. | Emergency managers monitor and analyze data to accrue situational awareness. | Emergency managers engage others in conversations and coordinate collective action. |
| *Activities/information products* | Alerts, warnings, and advisories | Individual account monitoring | One-to-one conversations |
| | Resource provision | Team monitoring | Group targeting |
| | Preparedness education | Software analysis of big data | Message adjustment |
| | Administrative news | | Rumor management |
| | Opinion-related messages | | Gamification |
| | | | Crowdsourcing |
| *Direction of information* | One-way: from agency to public | One-way: from public to agency | Two-way or multiway: from public to agency, agency to public, or many to many |

approach can be implemented ad hoc using available search engines or with more sophisticated monitoring platforms.[60] Hughes and Palen[24] described how local emergency managers in Oregon, for example, organized a volunteer team to manually analyze social media data, and the American Red Cross has invested considerable time and resources in implementing their digital operations center, which incorporates both manual and machine-assisted techniques.

Finally, social media empower officials to generate conversations with constituents regarding risk reduction and facilitate coordination between disparate groups and organizations, which may produce positive results. However, to implement this approach at a large scale requires personnel to dedicate time and effort on a regular basis.[20,42] On related note, agencies establishing social media policies should plan for whether accounts will be monitored during extreme events. If not, disclaimers should readily appear on the account as not to mislead constituents seeking help.

While this article provides the foundation for a more complete typology of emergency management messages, future research could empirically demonstrate the extent to which these types across disaster phases are implemented in practice. The accrual of situational awareness through open source data monitoring is another area to examine. Computer scientists have illustrated data monitoring and aggregation tools that allow practitioners to accrue situational awareness.[43-45] However, many of these concepts have not yet made it to market; therefore, many practitioners have yet to be exposed to these concepts. The American Red Cross, for example, has implemented new monitoring technology with positive outcomes, yet this case has not received significant attention. Future research might examine the machine-assisted analytic strategies adopted by DHS and other agencies.[25]

It is important to note the limitations of online social networks and microblogs in terms of access. Social media use varies across demographics and geographic location. It is also important to note that online social networks represent one piece of a larger communication strategy and should be examined within the context of other information and communication technology systems.

Finally, this area of research has broader implications on governance as well. The adoption and use of social media serve three primary functions related to improving government and governance, according to Mergel.[6] Those three functions are increasing transparency, public participation, and interagency collaboration. The analysis of social media research—reported in this article—indicates that these functions are attainable within the policy domain of emergency management. Agencies charged with response have the opportunity to engage the public and other organizations through information dissemination; they monitor real-time data; they engage diverse sets of actors in an effort to reduce risk. In doing so, they empower constituents and other agencies. Future research could examine the extent to which online social networks reduce information silos between government agencies and affect the performance of polycentric systems of emergency management.


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