

**Local emergency management's use of social media during disasters:
case study of Hurricane Irma**

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Abstract

Governments' use of social media during all phases of emergency management, especially during disasters, has dramatically increased in the last 20 years. Yet, implementation at the local government level in the United States remains haphazard. As technology and the role social media evolves, there persists a need to understand the socio-technical aspects of the role of social media use in disasters. Qualitative analysis of 26 Hurricane Irma after action reports from county, state, and federal governments and a four-hour focus group session resulted in dominant and subdominant themes including push/pull information, capacity and technical issues, inconsistent messaging, one-way versus two-way communication, timing of messages, and data collection. The manuscript concludes with lessons learned, remaining challenges, evidence of organizational learning, and recommendations for future research.

Keywords: after action reports, emergency management, Hurricane Irma, social media

Introduction

Governments' use of social media during all phases of emergency management, especially during disasters, has dramatically increased in the last two decades in the United States (U.S.) (Graham, Avery, and Park, 2015; Reuter, Hughes, and Kaufhold, 2018; Reuter and Kaufhold, 2018; Waters and Williams, 2011). This evolution started in the response efforts of the Terrorist Attacks of September 11, 2001, with less than 10% of the U.S. population using social media (Perrin, 2015; Reuter and Kaufhold, 2018). Individuals used wiki pages to locate friends and family members, while the American Red Cross and Federal Emergency Management Agency (FEMA) internally and externally shared information (Reuter et al., 2018). Twenty years later, nearly 72% of the U.S. population (approximately 237 million individuals) use social media (Pew Research Center, 2021). This technology remains one of the biggest changes to the profession – the source and management of public-generated information by emergency managers, staff, and public information officers (Hughes and Palen, 2012).

The public are no longer only considered the “first responders”, but also the “first reporters” or “citizen journalists” who are creating and disseminating essential real-time information (Alexander, 2014; Crowe, 2010; Haddow and Haddow, 2013; Hughes and Palen, 2012; Lin, Spence, Sellnow, and Lachlan, 2016). This means treating the public as a resource and not a liability during a disaster, which aligns with FEMA's whole community approach that values all stakeholders to the success of its mission. As Craig Fugate, Former FEMA Administrator, stated in response to the 2010 Haiti Earthquake, “Through the use of social media, we can disseminate important information to individuals and communities, while also receiving essential real-time updates from those with first-hand awareness” (Fugate, 2011, para. 6).

Ten years following this statement, implementation of this technology remains a challenge for emergency management, as well as the larger public administration profession (Bryer, 2011; Knox, 2016;

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Mergel, 2012). The public assumes and expects local governments will monitor its social media platforms and respond to a message within an hour, especially during a disaster or crisis (Reuter and Kaufhold, 2018; Reuter et al., 2018). Yet, public organizations continue to struggle with political, institutional, technical, and social factors regarding implementing social media platforms (Knox, 2016). As Alexander (2014) argues, emergency management's struggle with top-down versus collaborative management of communication and information sharing impacts the implementation, or lack thereof, of social media.

Researchers are advancing artificial intelligence and computer engineering tools for emergency managers; however, there remains a need to understand the socio-technical aspects of the role of social media use in emergencies (Hilts, Mack, Eidson, Nguyen, and Birkhead, 2016; Lachlan, Spence, Lin, and Del Greco, 2014; Plotnick and Hiltz, 2016). As each level of government increases their implementation of social media during all phases of emergency management, there is a continued need to capture and understand local government's challenges and lessons learned. Unique to this study is the focus on Hurricane Irma, which was the first major hurricane to test Florida since the 2004 Hurricane Season in which less than 10% of the population used social media (Perrin, 2015). Therefore, it was the first time some local jurisdictions used social media at this scale.

This study contributes to a growing literature of the role of social media in local governments before, during, and after a disaster by asking: what challenges remain and what lessons learned are being institutionalized from previous incidents? Qualitative analysis of 26 after action reports (AARs) from 24 counties, the State of Florida, and FEMA, and a four-hour focus group session resulted in dominant and subdominant themes including push/pull information, capacity and technical issues, inconsistent messaging, one-way versus two-way communication, timing of messages, and data collection. This study concludes with lessons learned, remaining challenges, evidence of organizational learning, and recommendations for future research.

Local government's use of social media during disasters

Throughout the literature and in practice, government continues to lag private and nonprofit sectors in implementing social media tools (Alexander, 2014; Graham and Avery, 2013). Most notable is the haphazard or nonexistent implementation of these tools at the city or county levels of government. Studies have highlighted that only half of emergency management agencies are using social media (Plotnick and Hiltz, 2016; Plotnick, Hiltz, Kushma, and Tapia, 2015). Of those who are, the majority are predominantly pushing information with few pulling public-generated information for situational awarenessⁱ or engaging in two-way communication with the public (Houston et al., 2015; Lachlan et al., 2014; Lin et al., 2016; Plotnick and Hiltz, 2016; Reuter, Ludwig, Kaufhold, and Spielhofer, 2016; San, Wardell, and Thorkildsen, 2013; Wukich and Mergel, 2015). With this increased use of social media by the public and government officials, lessons learned and best practices have ensued while some challenges remain as discussed in this section.

Scholars have analyzed government's use of social media platforms to study multiple aspects regarding disaster communication. Most studies have focused on communication during the preparedness and response phases of emergency management, especially case studies from the U.S. (Martin, Li, and Cutter, 2017). For example, pre-disaster crisis communication for Hurricane Harvey in 2017 (Liu, Lai, and Xu, 2018), evacuations during Hurricane Matthew in 2016 (Martin et al., 2017),

response communication during the 2016 Louisiana Flood (Scott and Errett, 2018; Yeo, Knox, and Jung, 2017; Yeo and Knox, 2019), misinformation on Twitter during Superstorm Sandy in 2016 (Murthy and Gross, 2017; Stewart and Wilson, 2016), communication with disadvantaged populations (Pennington-Gray, Kaplanidou, and Schroeder, 2013), and managing public-generated information for situational awareness (Cameron, Power, Robinson, and Yin, 2012; Lin et al., 2016; Vieweg, Hughes, Starbird, and Palen, 2010). As discussed next, these studies have identified the benefits and challenges to implementing social media during disasters.

Benefits of social media use during disasters

Unlike traditional media outlets, social media platforms allow for sharing and amplification of information; co-creation of information; two-way communication between stakeholders; synchronous and asynchronous communication; accessibility on multiple devices; an alternative to 9-1-1 emergency communication systems; and a more direct view of stakeholder perspectives, beliefs, and values (Knox, 2016; Lindsay, 2011; Reuter and Kaufhold, 2018; Stewart and Wilson, 2016; Wirz et al., 2018). For example, two-way communication and co-creation of information enables the use of digital volunteers, which was documented in the use of translators following the 2010 Haiti earthquake (Starbird and Palen, 2011) and strategic implementation of digital volunteers deployed for the 2011 Shadow Lake fire (St. Denis, Hughes, and Palen, 2012); the 2013 Colorado Flood (St. Denis, Palen, and Anderson, 2014); and the 2013 European Flood in Germany (Kaufhold and Reuter, 2016). As Hughes and Tapia (2015) note, coordination and collaboration between emergency responders and digital volunteers during a disaster needs to be improved.

Specifically, during the response phase these platforms have the capability for increased accessibility, dependability, information capacity, interactivity, and timeliness of information. This is important as communication capacity (i.e., within and across organizations and with the public) is a core element in each phase of emergency management but is commonly a weakness in disaster response efforts (Hawkins and Knox, 2014; Houston et al., 2015; Knox, 2013; Rodriguez et al., 2007; Yeo, Haupt, & Kapucu, 2021). This capacity is often diminished when uncertainty and threats are the greatest, which produces an increased demand for information by the public and officials.

During a disaster or crisis, public information officers (PIO) and emergency management staff should engage with social media to disseminate official information quickly, correct misinformation, and pull information for situational awareness (Reuter and Kaufhold 2018; Simon, Goldberg, and Adini, 2015; Stewart and Wilson, 2016; Wirz et al., 2018). For example, during the successful water landing of U.S. Airways Flight 1549 on January 15, 2009, a photo of passengers evacuating the half-submerged aircraft was uploaded to Twitpic.com (a photo-hosting service for Twitter users) by Janis Krums, an individual near the scene. Twitter promptly crashed as thousands of users attempted to view it at once, including traditional news media and emergency managers. As with social media use during a disaster or crisis, the photo was not posted by a government agency or the news media, yet emergency management staff and first responders used it for situational awareness (Graham et al., 2015).

Challenges of social media use during disasters

Effective use of social media platforms by local government agencies can provide multiple benefits, especially during disasters. Yet implementation remains inconsistent. Quantitative and qualitative

studies highlight multiple challenges to adopting and implementing social media platforms by local governments during all phases of emergency management. The first challenge frequently discussed are the administrative costs, which include staffing to monitor and manage social media platforms; training staff; and resources to manage information overload (Hughes and Palen, 2012; Lindsay, 2011; McCormick, 2016; Plotnick and Hiltz, 2016; Plotnick et al., 2015; San et al., 2013). Information overload from social media platforms is linked to higher levels of perceived stress by emergency managers, which has the potential to impact decision making during a crisis (Misra, Roberts, and Rhodes, 2020). The second challenge is managing misinformation, including correcting rumors and outdated or incorrect public-generated information (Lindsay, 2011; Lin et al., 2016; Stewart and Wilson, 2016). Early and continuous monitoring of social media platforms is essential to combat negative sentiments, which if left unchecked can shift public attention and cause unintended conflicts (Yeo, Knox, and Hu, 2020), and call into question the accuracy of information for situational awareness and safety of first responders (Lindsay, 2011). Other challenges include lack of a guiding policy or organizational document; leadership and organizational support; and time and other resources (Hughes and Palen 2012; Hughes, St. Denis, Palen, and Anderson, 2014; Knox, 2016; Plotnick and Hiltz, 2016; Plotnick et al., 2015; Reuter et al, 2016; San et al., 2013; Verma et al., 2011).

For example, during the response efforts to the Boston Marathon Bombing in 2013, government officials struggled with managing the city's social media accounts. This crisis was a watershed moment that changed the role of social media in breaking news events and coverage. It was "America's first fully interactive national tragedy of the social media age" (Kakutani, 2013, para. 1). Within 80 minutes after the explosions, Twitter had more than 300,000 mentions of "Boston explosions"; 20 minutes later (around 4:30 p.m.), there were more than 700,000 mentions. When the suspect was captured, the first official announcement was not made at a press conference; the news was shared in two tweets (Stern, 2013).

The Boston Police Department's PIO struggled with disseminating information without jeopardizing the ongoing investigation. The PIO also corrected false claims that were spreading across social networks and warned news media not to compromise safety or police tactics by broadcasting live video of officers approaching search locations. In the AAR, city officials detailed the need to increase staffing (Knox, Linskey, and Tyler, 2021). Specifically, "agencies should ensure that more than one person within the agency can access notification tools and official social media accounts" (Massachusetts Emergency Management Agency, 2014, p. 122).

As local governments increasingly adopt, implement, and manage social media platforms before, during, and after disasters, there remains a need to capture and understand the benefits, challenges, and lessons learned (Hilts et al., 2016; Lachlan et al., 2014; Plotnick and Hiltz, 2016). The following section provides details about Hurricane Irma, which is the focus of this case study.

Case study: Hurricane Irma

Hurricane Irma was the seventh named storm of the active 2017 hurricane season and made two U.S. landfalls on September 10th first as a Category 4 in Cudjoe Key, FL, and then as a Category 3 in Marco Island, FL. The outer bands stretched across the entire state with central and south Florida residents enduring hurricane strength winds and precipitation (Cangialosi, Latta, and Berg, 2018). It is selected as the case study because the size and unpredictable path led to a record evacuation of 6.5 million

individuals. Those remaining filled nearly 700 shelters which housed approximately 200,000 people. Destruction resulted in over 6.7 million people without power from a few days to weeks (Florida House, 2018).

Hurricane Irma was the first test of many recommended policy and institutional changes derived from the 2004 Hurricane Season, in which three major hurricanes (i.e., Charley, Frances, Jean) directly impacted central Florida within six weeks. Recommendations included a continued need to improve communications within and between responding agencies, mandatory implementation of pet-friendly shelters, increased training for emergency operations center (EOC) and shelter staff, building codes, and residential property insurance coverage (Hawkins and Knox, 2014; Mang and Santurri, 2009; Newman, 2006). Moreover, with the increased and widespread use of social media since the 2004 season, Hurricane Irma was the first real test of local government's social media use before, during, and after the storm.ⁱⁱ In fact, social media was not mentioned in eight Central Florida county AARs from the four 2004 hurricanes (Hawkins and Knox, 2014). In Florida, social media monitoring and management falls under the Emergency Support Function (ESF) #14 – Public Information.

Methods

After Action Report data collection and analysis

For this study, we used AARs from 22 counties from Florida Division of Emergency Management's Regions 4 -7 (the remaining 9 counties did not complete an AAR), 2 counties from Region 3, the Florida Division of Emergency Management, and FEMA (74% response rate). These counties were directly impacted from Hurricane Irma and had federally approved disaster declarations. All of reports were completed within one year of the hurricane's landfall with dates ranging between November 2017 to August 2018.

AARs are summaries of (1) what did and did not go well before, during, and shortly after the disaster and (2) provide recommendations to improve upon identified weaknesses. They are completed by local, state, and federal government agencies, as well as private and nonprofit sector organizations. These reports are required for all training and exercises as per the Homeland Security Exercise and Evaluation Program; however, they are not required following a disaster (Barnett et al, 2020; FEMA, 2020). While they are considered a best practice, many jurisdictions do not have the capacity to complete the data collection process across all ESFs for the incident (Hawkins and Knox, 2014). Scholars have used these reports as data sources to analyze hurricanes Andrew and Katrina (Knox, 2013), Superstorm Sandy (Hilts et al., 2016), 2004 Florida Hurricane Season (Hawkins and Knox, 2014), Boston Marathon Bombing (Hu, Knox, and Kapucu, 2014; Knox et al., 2021), hurricanes Katrina, Rita, and Harvey in Texas (Barnett et al., 2020), and Hurricane Irma (Kapucu, Hu, Harmon, and Toro, 2020).

The reports were open and axial coded using an inductive and deductive approach (Corbin and Strauss, 2015). Based on the literature, we inductively coded using the following search terms: "Social Media", "Facebook", "Twitter", "posts", "users" and "ESF14". Then in the deductive coding, the data provided new search terms: "Nextdoor", "Instagram", and "Flickr". Then the researcher used axial coding to induce the relationships that existed between these themes related to the relationships identified during previous open coding. The analysis resulted in multiple themes and relationships, which created the foundation for focus group session questions.

Focus group data collection and analysis

To compliment the analysis of these reports, the research team held an in-person focus group session with emergency managers from three counties (two coastal, one inland), one major city (population greater than 250,000), the Florida Division of Emergency Management (FDEM), the Florida Department of Transportation, a regional planning council, and two private sector organizations. This was a purposeful sampling technique (Rivera, 2019; Suri, 2011) as we selected individuals who responded to Hurricane Irma, completed an AAR, and used social media before, during, and after the storm. Additionally, they had responded to multiple recent disasters including Pulse Nightclub Shooting in 2016, hurricanes Matthew in 2016, Michael in 2018, and Dorian in 2019, as well as being the receiving communities for Hurricane Maria survivors from Puerto Rico in 2017.

Prior to the session, we sent participants an Institutional Review Board approved invitation via email, which included a paragraph summary of the National Science Foundation funded project. We did not request for them to bring materials to the session; yet a coastal emergency manager brought their county's social media analysis from the storm. The four-hour, semi-structured focus group session included two groups of questions, with one focusing on social media use during Hurricane Irma.

The emergency manager representing the major city hosted the session in their EOC's executive conference room. Before starting, the facilitator observed the friendly mannerisms of the participants as they had worked together in multiple disasters. As such, the research team observed few power dynamics during the focus group session; the participants were receptive to the questions, were not aggressive, and did not self-segregate (Rivera, 2019). The session was audio recorded, facilitated by the lead researcher, and involved three trained graduate students taking detailed notes. The verbatim transcription and detailed notes resulting in a nearly 13,000-word transcript, which was open and axial coded using the same codes as the AAR analysis.

Findings and discussion

Of the 24 county-level AARs, 88% (n=21) included one or more comments about social media in the report. The remaining 12% (n=3), as well as the State of Florida and FEMA AARs, did not include any social media references. Analysis of the reports and focus group session resulted in the following dominant themes (see Table 1) and are discussed below.

Table 1: Dominant and Subdominant Themes

Dominant Themes	Subdominant Themes
Social Media Use	One-way versus two-way communication Push/pull information Replacement for 911
Challenges	Information overload Rumor control Technical issues Lack of a whole community approach to messaging Capacity issues
Lessons Learned/Institutional Changes	Increasing capacity Embedding traditional media in EOC Implementing monitoring software

	Expanding social media platforms Message timing Time/date stamp Control of government social media pages
Strategic Planning	Data collection Core capabilities Policy recommendations

Local government's use of social media in Hurricane Irma

As mentioned above, the majority of local offices of emergency management used social media before and during Hurricane Irma. For at least two counties, this storm marks its first implementation of social media. As discussed in the literature (e.g., Houston et al., 2015; Reuter et al., 2016; San et al. 2013), most emergency management organizations continue to use social media to push information to the public. In this case study, 81% of the counties discussed pushing information via social media in the AARs, while 48% implemented two-way communication. As noted in 19% of the AARs and in the focus group sessions, emergency managers used pull information for situational awareness, answered public questions in the call center, managed rumors, and supplemented internal communications when there was a break down between the county and municipality PIOs. One important aspect to note was a southwest county's use of social media to supplement emergency communications when it lost 9-1-1 communications during the hurricane. As experienced in other disasters (e.g., Superstorm Sandy; Hurricane Gustav), this alternative means of communication provided a lifesaving option for the county's residents (Lindsay, 2011; Stewart and Wilson, 2016).

As indicated in the AAR analysis, a city emergency manager also noted that some counties are still not using social media, which is in part due to capacity issues. However, he notes that although *it is a critical element that adds more stress to emergency management side of the house...emergency managers need to know the technology even if they are not an end user. As an emergency manger, you have to have a clear-cut understanding of the utilization of social media and how can it help you accomplish your goal, mission, and task.*

The three emergency managers in the focus group discussed the evolution of social media use in their jurisdictions. As a male, local emergency manager summarized:

I think we've have come full circle with social media and technology. When I first started, information was either news, radio, newspaper, and a website. Over the years with social media and all the information coming in, it bombarded people with information. What do I follow? What do I do? What action do I need to take? People are dropping off social media.

The vast majority of the AARs (95%) discussed the use of social media before and during the hurricane in positive terms. Local jurisdictions discussed the platforms as *"a benefit"* or *"value added"* when pushing information to the public and felt the *"PIOs were able to amplify their voices"*. Yet for many counties, this was the first time using social media at this scale. Managing these tools and transitioning from one-way to two-way communication quickly overwhelmed the staff's capacity and led to challenges, which are discussed next.

Challenges using social media

The need for additional staffing, technology, and funding to fully implement and monitor social media through all phases of emergency management remained a constant theme in 47% of the AARs and throughout the focus group discussions. Recommendations from the AARs included, “engage mutual aid and Emergency Management Assistance Compact resources for additional public information surge staffing” (southwest county); use the county’s Citizens’ Information Center to respond to social media inquiries and email messages (two west coast counties); accessing the county’s Emergency Staffing Assignment Program (central Florida county); and coordinate with community partners (e.g., United Way) to amplify social media messages (central Florida county). Meanwhile a South Florida county used volunteers in the field who monitored and responded to social media feeds, similar to the use of digital volunteers (Hughes and Tapia, 2015; Starbird and Palen, 2011; St. Denis et al., 2014).

Another challenge discussed was the abundance of information coming from social media. As a city emergency manager stated: it is like “*drinking water out of a fire hydrant.*” For example, information stemmed from public, private, and nonprofit sector organization accounts, and questions from concerned family members outside the hurricane impacted area, as well as rumors and misuse of photos that impacted evacuations. Aligning with existing literature is the need for technological solutions to assist emergency managers, PIOs, decision makers, and other staff to manage and filter information from social media. Early and continuous monitoring of social media platforms is essential and is an activity the public assumes the local government is completing before, during, and after the disaster (Reuter and Kaufhold, 2018; Yeo, Knox, and Hu, 2020).

Technical issues plagued 14% of the counties implementing various aspects of social media during the storm. These included not having the proper equipment (using personal cell phones instead of a dedicated tablet with stand for Facebook Live sessions); mistakenly posting documents (e.g., situation reports) on social media; staff not having the log-in details for Everbridge or social media accounts; staff creating long Facebook live videos that drained a user’s phone battery; tweets referencing another social media platform that the end user did not have an account for; or spacing for personnel in the EOC.

Finally, for three counties (14%), there was an over-reliance on social media compared to traditional means of communication. For example, a local government posted disaster-related information on the county’s website and notified the public that additional information is available on the local government’s Facebook or Twitter page. This assumes that those individuals have a social media account, which is not always the case. In another Central Florida county, officials communicated road closures and gas availability post-storm only on Facebook, which left many residents unable to obtain this information.

Lessons learned and institutional changes

More than half of the counties (57%) that used social media during Hurricane Irma discussed modifications that has led or is leading to one or more institutional or policy changes within the emergency operations center, ESF 14, or the emergency management office. These changes are discussed below.

Increasing capacity

Nearly half of the counties (43%) discussed capacity issues in the AARs, especially surrounding staffing to use social media during the storm. Staffing for ESF 14, and more specifically for social media monitoring, varied across each county. From 1 or 2 people on the PIO team per shift to 18 for one jurisdiction. After responding to hurricanes Doran, Matthew, and Irma, many counties increased the number of PIOs and related staff to work in ESF 14. Some counties have staff designated for social media. As a female county emergency manager stated:

We had one person dedicated for Facebook, one for Nextdoor, one for Twitter, which allowed for 1-on-1 communication. We were able to push the key messages and engage in discussions, comments, etc. If they had follow-up questions, we were able to go through that with them. Social media was beneficial because it allowed for “bite-size” tidbits.

As discussed previously, the AARs provided innovative recommendations to overcome the struggle to find qualified and certified staffing to assist with ESF 14 and public information.

We see evidence of institutionalizing social media within emergency management functions in the EOC and within the emergency management department. An east coast county created the PIN – Public Information Network - so all PIOs from municipalities, counties, any major private industry, and sheriff’s office would be on one messaging platform. A Central Florida county created and activated a Social Media Intelligence Unit within the Joint Information Center, which enabled staff to assess, review, and monitor county and emergency management social media accounts. Another solution was to embed the media into the EOC. *“We were able to get up-to-date information out to our traditional media partners and they are obviously tweeting, sharing, and retweeting. That was beneficial for us.”* Finally, a Central Florida county created a “quality control/content position in the EOC (an executive staff member of the County Management team) during activations” specifically to coordinate consistent messaging between social media and the county’s websites.

Meanwhile 14% of the counties adopted software to aid in managing, monitoring, and sharing information across multiple social media platforms. The most discussed in the data is Hootsuite, which allows users to set up and follow multiple social media on one screen; monitor specific people, groups, and keywords; schedule messages; manage messages on multiple platforms and apps; and use desktops and mobile tools.

Expanding to other platforms

Scholars note the dominant use of Facebook and Twitter as the preferred social media platforms used by emergency managers (Reuter et al., 2018). While this case study confirms that those two platforms remain the preferred choice, we document a strategic, evidence-based shift in 24% of the counties to adopt other social media platforms that target community residents. Based on collected data and observations regarding how their community used social media in previous disasters, emergency management staff expanded the platforms to include Nextdoor, Instagram, YouTube, Periscope, and Flickr. Specifically, a male inland county emergency manager noted how Facebook followers were in other counties, states, and even countries. *“We used to think Facebook was the thing, but we learned that people following us on that platform were in Saudi Arabia, etc.”* Therefore, the emergency manager reviewed previous data, created a Nextdoor account, and added it to the county’s social media platform matrix to better communicate with its residents.

Another reason provided for this shift to other platforms was the frustration with Facebook and Twitter's use of algorithm. This can cause the emergency management agency's message to carry less weight than the user's friends and family postings, thereby not appearing as frequently on the user's homepage or main feed.

Timing and time stamping posts

In addition to expanding the number of platforms used to connect with their residents, emergency managers are modifying when they post information, especially post-storm information. All the counties in this study pushed information via social media before, during, and after the storm. Using data from Hurricane Irma, the emergency managers learned that the public engaged the information before the storm and not after. Unlike previous research (e.g., Houston et al., 2015), we document a shift of posting recovery information via social media pre-storm. As a male county emergency manager explained:

One thing we learned after Hurricane Irma was that people don't go to social media a lot after the storm; they do before ... after the storm they are out fixing their roof or house ... We are pushing a lot of information post storm ..., we have videos of what to expect post-storm that we are playing pre-storm for [Hurricane] Dorian. What you should expect for obtaining gas. What you should expect for disaster recovery. What you should expect for power outages and generators.

This is one of many institutional changes documented in the AARs and the focus group session; others are discussed later in this manuscript.

In addition to the timing of the posts, a previous lesson learned that PIOs adopted during this hurricane was to time and date stamp any social media posting. This is vital because the public will "anchor" to outdated information. For Hurricane Irma, a female county emergency manager elaborated:

One of our lessons learned from [our county] after Hurricane Matthew [in 2016] was to time stamp all of our social media posts: its date, time we put it out, the line, and then the actual message. During [Hurricane] Irma [in 2017], we found people going back and finding information from [Hurricane] Matthew and thinking it was still relevant.

This lesson learned was a main topic discussed in the PIO training during the 2017 Governor's Hurricane Conference.

Control of social media pages

Management of multiple county social media pages and accounts remained a challenge for 29% of the counties during Hurricane Irma. For example, Orange County has 28 social media accounts and the City of Orlando has more than 50 accounts. Nearly a third of the counties (29%) had specific recommendations in the AARs about the need for consistent messaging across all its platforms and website pages within the jurisdiction, especially those in which the emergency managers do not control, to avoid miscommunication. As a male county emergency manager discussed:

There are so many different local government pages – parks and recreation, animal services, fire rescue, sheriff, school board, etc. There are county institutions that we have no control over that also have pages. Most citizens think "county is county"... and that is absolutely not true. Consistency of message across multiple platforms and government pages - some that we don't

even own or manage - is a huge challenge. Then talking about misinformation. There is miscommunication is occurring between those pages. That's a big challenge for us.

Emergency management staff in two east coast counties and a major city managed the flow of information by assuming control over government social media pages through ESF 14; once the decision was made, ESF 14 staff completed this task within 10 to 15 minutes. A female county emergency manager discussed their solution:

In Hurricane Irma, we saw multiple pages up like parks, fire rescue, etc. and we were able to shut down various pages and different avenues on the website so we can push everyone to one messaging platform. This allowed us to control the message.

When asked about the origin of this solution, she explained that it “*was one of the big takeaways from the response to the Pulse Nightclub Shooting for us. We want to ensure our residents were getting verified information.*” This aligns with research indicating the public’s need for information during a disaster or crisis results in them turning to common, familiar channels of information they trust (Simon et al., 2015).

Managing information and rumors

Managing social media information, questions from the public, and misinformation (i.e., rumors, incorrect information, etc.) was discussed in 38% of the county AARs. An east coast county emergency manager explained solutions for handling misinformation and consistent messaging:

We used #rumorcontrol to handle misinformation. In [our county], the one question we always received was “when will the bridges close?” We don’t close bridges, so we started “#rumorcontrol Bridges don’t close”...Then there was a wall in the EOC that we kept putting up correct messages. That communication between the community information center and our public information staff was really critical. So, when we are looking at doing targeted messages, we would talk to the community information center manager and see what they keep getting asked. Is it evacuation zone questions? Shelter questions? That’s what we would then put out on social media.

An inland county emergency manager discussed the legal concerns about managing misinformation on social media during the focus group session; none of the AARs mentioned legal concerns. Florida’s Government in the Sunshine Law (Florida Statute 286) complicates a local government’s ability to manage social media platforms. As he elaborated:

A new after action item is what comments can be hidden, what can be deleted, and what should be left open to the public. We have so much misinformation in comments that it confuses the residents. Community Information Department and the County Legal Team is trying to find the right answer.

Documenting lessons learned in AARs, such as those discussed above, is an important aspect of organizational learning, as is data collection for strategic planning, which is discussed in the following section.

Data collection for strategic planning

Scholars note that most case studies analyzing social media use during disasters focus on governments pushing or pulling information – one-way versus two-way communication – with the public. Missing

from this literature is the government's use of social media information/data from an incident into the strategic planning process. In this case study, we find evidence of emergency managers using data from their use of social media for strategic goals. Specifically, 33% (n=7) of the counties using social media during Hurricane Irma detailed data collected in their AARs. Due to the nature of these reports, the data discussed was input data (i.e., number of social media posts, new followers, total followers, post engagements, inquiries, page/video views, and users reached). A west coast county also used feedback from post-storm resident surveys regarding social media usage as a data source. These counties included detailed institutional and policy recommendations based on this collected data. Some examples include:

"Develop a dedicated social media monitoring function of the EOC."

"Ensure social media releases are synced to EOC/PIO messages."

"CC-TV could do the Facebook Live broadcasts with talking points provided to them so that PIO Leads are freed up."

"Coordinate linkage with all social media pages to provide consistent messaging across all platforms and continue enhancement of disaster webpage and information."

"Engage mutual aid and Emergency Management Assistance Compact resources for additional public information surge staffing."

Four of those counties tied the data and recommendations directly to two core capabilities (i.e., Public Information & Warning, Operational Communications) that aligned with the department's mission and strategic goals.

Conclusion

After 20 years, social media is still changing the communication landscape in each phase of emergency and crisis management and allowing the profession the opportunity to better apply the whole community approach. While the federal and state levels of government are consistently using social media before, during, and after a disaster, local government's use remains haphazard. As technology and the role social media in society evolves, there remains a need to study social media implementation and management during disasters at the local government level.

This case study posed two questions: what challenges remain and what lessons learned are being institutionalized from previous incidents by local governments implementing social media during disasters. While 95% of the counties who used social media discussed it in positive terms in the AARs and focus group discussions, less than half of the counties engaged in two-way communication or pulled information for situational awareness or rumor management. There were various technological, managerial, financial, and coordination challenges detailed, including insufficient staffing, space for staffing in the EOC, funding, and technical equipment; coordination issues across multiple platforms and accounts within the county; and over-reliance on social media which resulted in portions of the population without critical information.

Yet, there is evidence of organizational learning occurring and institutionalization of social media within emergency management functions in the EOC and within the emergency management department. In the AARs and focus group session, there were details about modifications emergency managers and their staff made based on previous hurricanes as well as the Pulse Nightclub shooting. These details included time stamping posts, shutting down other county social media platforms, posting

post-storm videos before landfall, and adding other platforms (e.g., Nextdoor, YouTube, Flickr) to reach more of their residents. Most notable is the increase in data collection for strategic planning. Of the counties in this study, a third included detailed data collection strategies for Hurricane Irma. However, not all counties have the capacity to collect this data. As noted in this study, some remain at the crossroads of whether to use social media, while nearly all expressed a need for more sunny day training for emergency management public information communications and partnerships for real-time expansion of communication staff. Finally, all the emergency managers in the focus group session called for analytical tools for decision makers, especially when social media information feels like “drinking water out of a fire hydrant.”

Each case study has limitations. One limitation for this case study is the use of AARs, which are internal facing and vary in detail across counties. Although the researchers included a focus group session to add depth to the coding analysis of these reports, interviews or a state-wide survey would provide additional details. During the focus group session, the state representative and males dominated the discussion. While the facilitator noted this dynamic and strategically engaged the other participants, this could have impacted the data generated. Finally, this case study analyzed county levels of government in Florida. While characteristics of counties across the U.S. vary, there may be limitations to generalizing these findings since “contextual factors and situational variables” impact the widespread adoption of best practices in social media (Seeger, 2006).

Future research could include coding the social media posts from the local governments before, during, and after the hurricane and apply the results to one or more communication theories. To measure longitudinal organization learning, future research could replicate this analysis with AARs from Florida hurricanes Matthew in 2016, Michael in 2018, and Dorian in 2019 and compare the results. Conducting follow-up interviews with these emergency managers could also provide additional insight into the implementation of policy and institutional recommendations in the AARs.

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Data Availability Statement

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

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ⁱ Situational awareness is the "ability to identify, process, and comprehend critical elements of an incident or situation. Obtaining real-time information as an incident unfolds can help officials determine where people are located, assess victim needs, and alert citizens and first responders to changing conditions and new threats" (Lindsay, 2011, p. 4).

ⁱⁱ For this study, local level is defined as the county as per Florida Statute 252, which requires every county to have a designated emergency manager and approved comprehensive emergency management plan.