SOCIAL MEDIA USAGE AMONG FIRST RESPONDERS TO HURRICANE HARVEY

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Social media plays an important role during multiple phases of a disaster. While it is widely known that citizens turn to social media during disasters to gain information and send help requests, there is a significant gap in our knowledge of how, or if, first responders use social media to conduct disaster response operations. To help address this gap this study employed qualitative, semi-structured interviews with a sample of first responders (N = 20) who were deployed to Hurricane Harvey in 2017. The interviews sought to gain a better understanding of how social media was used to conduct response operations and identify both limitations and advantages of social media as perceived by first responders. Through a systematic coding process the analysis identified four themes related to social media usage among first responders to disasters: (1) more than just Twitter; (2) rumor has it; (3) one size does not fit all; and (4) timing is everything. The findings of this research highlight the importance of social media for both organizations and individuals involved in responding to disasters.

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CHAPTER 1

INTRODUCTION

Social media plays an increasing role in how people communicate, and while it may have originally been constructed for personal use, it is now the fourth most popular way to obtain information during a disaster (FEMA, 2018; Lindsay, 2016). Research indicates that citizens turn to social media for help during all disaster phases when they are unable to reach emergency services through the proper channels (King, 2018; Reuter et al., 2012; Yang et al., 2017), and citizens are now said to have changed from simply information consumer, to information provider (Houston et al., 2015; Keim & Noji, 2011). First responders, such as police and fire, and emergency managers, turn to social media to share and obtain information during a time of crisis for constant situation awareness (Crowe, 2011; Terpstra et al., 2012). After a 2010 Congressional report came about outlining social media usage by government agencies during a disaster it was found that “the focus of agencies is now shifting from passively observing on social media to actively communicating with people.” (Abbasi et al., 2012).

While there is a plethora of research on social media and disaster response, there is a paucity of research that focuses on the perceptions and usage from a first responder perspective. This study addresses two research questions:

> RQ1: How did first responders utilize social media to conduct operations during Hurricane Harvey?
>
> RQ2: What are the perceived limitations and advantages of social media usage during a disaster as viewed by first responders?

To answer these questions I conducted 20 semi structured telephone interviews with responders from Hurricane Harvey in order to gain an understanding of those at the

forefront of the disaster.

1.1 Definitions

For the purposes of this study, a first responder refers to a firefighter, EMS technician, medical doctor, emergency manager, or responder acting within the context of a first response agency or within a government setting. For the study, the responder must have been actively responding; for this study, “actively responding” refers to being employed by a governing or response agency and enacting orders or job duties as needed by the employer. The time frame considered is the duration of the landfall of the hurricane and during the ensuing days of rainfall and significant flooding.

This study relies on Trottier and Fuchs’ social theory approach of clarifying the notion of social media (2015). This approach identifies three forms of sociality, or the nature and tendencies of groups of people. The three forms of sociality are (1) cognition, (2) communication, and (3) cooperation. The cognition form is related to Emile Durkheim’s concept of social actions and is concerned with shared knowledge that is similar in nature which is provided to the masses; this allows for newspapers, websites and television to be considered social media. Communication as a form of sociality is related to Max Weber’s notion of social interactions and social relations, which allows for email, texting or chat, or discussion boards to be considered social media. Finally, cooperation is related to the notions of communities and collaborative work. If this form of sociality is the focus, then independent acts that contribute to community goals are considered social media, such as crowdsourcing, Wikipedia, or games that are played online via any device, such as computers or independent gaming systems (Treem et al., 2016).

It should be noted that theorists are able to adopt any of these forms as a focal point as there are different social processes and media types within each. Depending on one's theoretical point of view and the challenges they are attempting to address, the definition of social media may change (Treem et al., 2016). Therefore, for the purposes of this research study, social media is defined as cognitive, communicative, or cooperative sociality in which information is provided or received in a digital format.

1.2 Social Media's Cultural Impact

Starting in 2005 the Pew Research Center began collecting data on many aspects of social media (SM), including who uses it, the reasons for using it, and the overall spread of the usage among adults throughout the world (Perrin, 2015). From 2005 through 2015 there has been a documented considerable expansion of technology throughout the population, including a change from 2% of those 65 and older using social media in 2005, up to 35% in the same age range in 2015. Additionally, the usage among those ages 18-29 was only 12% in 2005, whereas in 2015 it was found to be 90%, and even those in the 30-49 age range increased from 8% in 2005 to 77% in 2015. It was found that those with a higher education levels are more likely to utilize social media, however it was also found that those with a high school diploma or less has still grown tenfold over the course of those ten years and the growth rate of usage has remained relatively on par with those who have some college experience and those who have a bachelor's degree or additional education. There was not found to be any statistical difference in gender usage or race and ethnicity usage, though there was discrepancy when it came to socioeconomic status. In 2005 the Pew Research Center found that only 4% of those in households that earned less than $30,000 used social

media, while 12% of those whose households earned more than $75,000 were users. This gap has continued to widen, and while the usage among these households is 56% and 78% respectively, that is a 22-point difference (Perrin, 2015).

1.3 Problem Statement

The research that has been conducted in this field tends to focus on the organization or departmental use (for example, Hughes et al., 2014; Liu et al., 2018; Yang & Stewart, 2019), rather than from the responders themselves. Communication in times of disaster is paramount in decision making, and social media now plays a key part in disaster response and communication (Maron, 2013; Sutton et al., 2011). Additionally, citizens expect social media to be monitored by response agencies in times of disaster (American Red Cross, 2011, as cited by Graham, Avery, & Park, 2015; Harman, 2011; Lindsay, 2016; Reuter & Spielhofer, 2017; Wendling et al., 2013) and during Hurricane Harvey, over 5,200 requests for rescue and assistance were made via social media (Villegas et al., 2018). For these reasons, it is important to understand how those on the front lines interpret and utilize the information.

1.4 Research Objectives and Questions

The aim of this study is to explore the ways in which first responders utilized social media in order to conduct operations during Hurricane Harvey, and to understand the perceptions of limitations and benefits of social media use from a responder perspective. As presented earlier, the first research question addresses the uses of social media by first responders; more specifically, how it was used - when and for - conducting operations during Hurricane Harvey. The second research question focuses

on how social media is perceived by first responders when applied to conducting disaster operations.

To fill this research gap, I performed 20 qualitative semi structured interviews to produce a case study of first responder usage during Hurricane Harvey. The primary goal of this research is to gain an understanding of first responder usage during disaster events and understand perceptions of social media from those on the front lines of disaster.

1.5 Thesis Overview

This thesis begins with an introductory chapter. Chapter 2 is a literature review of current and previous literature focusing on the importance of communication during a disaster, crisis informatics, the background of social media, published case examples, a background on Hurricane Harvey and why that disaster was chosen, and finally the benefits and limitations of social media. Following this, there is discussion of the background of social media followed by usage during disasters as conducted by citizens, first responders, governmental agencies, and other organizations, both domestically and internationally. Finally, perceptions of benefits and limitations from these same users are covered. Chapter 3 describes the methodology of the study, sampling method used, and analysis process. Chapter 4 focuses on the analysis of the data and provide information of discovered themes within usage and perceptions, as well as limitations and findings. There were five themes identified, with a review of each, along with quotes directly from the interviewees. The closing of the thesis occurs in Chapter 5 with a final overview of the implications and limitations of the research, along with potential future research directions.

CHAPTER 2

LITERATURE REVIEW

In order to understand the basis of and reasons for this research, it is important to understand the previous research on the topic. This literature review begins with the importance of communication, especially during a disaster, and addresses the communication classification matrix of Reuter et al. (2012), followed by a brief discussion of crisis informatics, which is the focus of this study. Next there is a background of social media beginnings and usage up to current day; the social media background is important in realizing how quickly our information communication has evolved and shows the importance of first responders adapting to new technology in order to assist those in need. Following this, there is discussion of the literature addressing how social media was used before, during, and after both international and domestic disasters and crises. After this, a brief overview of Hurricane Harvey follows to help the reader understand why this disaster was chosen for this study, and a thorough, though incomplete, listing of previous research involving both Hurricane Harvey and social media is given to show that although the topic of social media and its use during Hurricane Harvey has been researched thoroughly, there is still more to be learned. Finally, the benefits and challenges of social media are addressed in an attempt to provide an overall picture of the importance of the topic.

2.1 Communication

Communication is an essential part of disaster in all of the phases (Houston et al., 2015); the *Handbook of Disaster Research* states that effective communication can help create positive outcomes during a disaster, while ineffective communication can

contribute to negative outcomes (2007). All disaster communication, including the following examples, require communication amongst agencies, citizens, companies, organizations, or a combination thereof. Mitigation communication can include preparedness activities such as pre-planning and non-structural mitigation measures; for example, preparing building codes and obtaining insurance. Additionally, communication is needed in order to produce other mitigation measures, such as educational campaigns and large-scale drills and exercises. Preparedness communication can include how a disaster is anticipated to affect an area, as well as evacuation route and shelter identification messages, warnings and watches, and sirens. During a disaster it is crucial that response agencies provide timely and accurate information. The utilization of social media as a communication tool is presented later in this section. Following a disaster, recovery communication may come in the form of messages regarding where and how to find various types of support, and will also include mitigation measures, thus completing the disaster cycle. (McEntire, 2007; Phillips et al., 2017).

According to the 2x2 classification matrix created by Reuter et al. (2012), when it comes to crisis information there are four information patterns with two actors, citizens (C) and authorities (A). The categories for this matrix were created based on Quarantelli's categories of organizational behavior (1988; Reuter, Hughes, et al., 2018). The two categories in which the authorities are the sender are *crisis communication*, in which authorities communicate to citizens, and *inter-organization crisis management*, in which authorities communicate with other authorities. The remaining two categories are those in which citizens are the sender of information; the first category is *self-help*

communities in which citizens send information to other citizens, and *integration of citizen generated content*, in which citizens communicate to authorities. This research focuses on crisis informatics as it relates to the citizen generated content category of the classification matrix.

2.2 Crisis Informatics

Crisis informatics is known for its role in the study of social media in disaster (Soden & Palen, 2018), with research upon the subject of social media and disasters growing around 2006 (Lindsey, 2011; Reuter & Kaufhold, 2018; Reuter, Hughes, et al., 2018; Sawaneh, 2020). Crisis informatics comes from the combination of the fields of computing and the social science field of disaster science (Palen & Anderson, 2016). The field of crisis informatics focuses on the behavior of those involved in a disaster and investigates the impact of the use of technology within the disaster context (Palen et al., 2020). Crisis informatics has greatly contributed to practitioner understanding of information distribution via technology during disasters (Soden & Palen, 2018) and can provide data for use during and after a disaster (Villegas et al., 2018), providing situation awareness to some users. For this paper, I focus specifically on social media as the technology function in crisis informatics, and the behavior of first responders in regard to usage during the response phase of a disaster.

2.3 Social Media Background

It can be argued that social media began in 1792 with the use of the telegraph, or in the late 1800s with the use of the radio or telephone. It could be said that it began in the 1960s when email was invented, or the 1970s with virtual role-playing games, interactive chat, and bulletin board systems. Others may say that it was in the 1980s

when Listserv, which allowed the ability to email multiple people at one time instead of sending the message repeatedly to different individuals, came about, or in the 1990s with the invention of IRC, or internet relay chat. Still others say it began with Napster, a peer-to-peer file sharing software which was also popular in the 1990s and early 2000s. The 2000s also brought about social networking sites including, but not limited to, Friendster and Myspace (Edosomwan et al., 2011). It can even be argued that social media truly began in 3100 B.C. with the use of hieroglyphics -- words combined with pictures to create meaning -- with some arguing that emojis are the modern version (Hruby, 2003). Regardless of where, when, or how social media originated, it is now a part of everyday life for almost anyone with access (Dolan et al., 2016; Gan & Wang, 2015; Greenwood et al., 2016; Reuter & Kaufhold, 2018; Whiting & Williams, 2013). For the purposes, and constraints, of this study, the time of social media creation and takeover began in 2003 with the launch of the social networking site Myspace. By 2004 the site reached over a million monthly active users marking what is known as the "beginning of social media" (Ortiz-Ospina, 2019).

Since that time, social media has been utilized in a plethora of ways, quickly moving past the original social media of online message boards and IRC. Social media is being used for keeping in touch with family and friends, marketing of businesses, professional networking, and disseminating creative business works. While social media's original design did not consider it as a tool in emergencies, it is becoming an essential component nonetheless, and when surveyed, was found to be the fourth most popular way to gather information during a disaster (Lindsay, 2011; Imran et al., 2015;

Lin et al., 2016; Sawaneh, 2020; Villegas et al., 2018; Wojdylo, 2015; Yates & Paquette, 2011).

Social media accessibility also grew from supercomputers and stand-alone desktops; social media can now be accessed by mobile applications (apps), computer browsers, mobile browsers, and even tablet apps (Herhold, 2018). Additionally, it is not only individuals that contributed to the growth of social media. Government agencies now interact not only within their own agency, but also with the public outside of their organizational boundaries by posting on their own websites and social networking sites (Criado et al., 2013). Digital information is now being presented on websites from newspapers; this has increased each year while print versions have declined, and in 2018 it was estimated that there were 11.6 million monthly unique visitors to the top 50 newspapers in the country (Barthel, 2020). Additionally, Pew research found that about 55% of social media users got their news from a social media site (Shearer, 2018). One survey of over 4,000 physicians found that doctors now interact with patients using social media to disseminate information, their own research, or participate in health outreach (Ventola, 2014). Companies are utilizing social media for marketing purposes, with nearly nine out of ten companies that employ at least 100 workers utilizing this concept ("Will Marketers Ever Grasp Social ROI Measurement? - eMarketer", 2015).

One survey in 2018 found that 86% of individuals use social media at least one time per day, and 72% of people access it multiple times per day (Herhold, 2018). The possibilities for individuals are now endless -- you can create travel arrangements; order food; share recommendations; read a book or magazine; watch television shows or movies; monitor your blood sugar, heart rate, and diet; keep up with family and friends

across the country using text, pictures, and video; search the entire internet; and much more. No matter what one wishes to accomplish with social media, a quick internet search shows that the possibilities are endless. Given this course of events, it should also be expected to be utilized in a disaster or emergency event (Reuter, Hughes, et al., 2018).

2.4 Published Cases

The use of social media during a disaster applies not only to domestic disasters, but also internationally. In the aftermath of the September 11, 2001, terrorist attacks on the World Trade Center in New York City, wikis were created to gather and disseminate information about those missing (Palen & Liu, 2007), and the Federal Emergency Management agency along with the American Red Cross utilized social media to share information with the public (Harrald et al., 2002). It is said that 2005 brought about the first time social media was used during a disaster; during the course of the terrorist attacks in London, Wikipedia and Flickr were used to publish information and pictures about the attacks, and the new cell phone capability of capturing videos allowed citizens to send videos to others who then posted the videos using their computers ("Cell Phones Capture", 2005, as cited by Peary et al., 2012). Twitter and Flickr were filled with postings of text, pictures, and videos from citizens during the Mumbai terrorist attacks in 2008 as it happened (Arthur, 2018). After the 2010 Haiti earthquake citizens took to Twitter, Flickr, Facebook, and even YouTube to document the experience and devastation (Gao et al., 2011). This response of citizen social media utilization during the Haiti earthquake has been said to have completely changed the response to disaster-related challenges (Keim & Noji, 2011). The Haiti earthquake also marked the

first time that US governmental agencies had used social media as the central information sharing systems (Yates & Paquette, 2011). In the Great East Japan earthquake of 2011, cell phone communication went down and citizens took to posting and gathering information on Facebook and Twitter (Jung, 2012; Jung & Moro, 2014; Kaigo, 2012).

The United States is no different in terms of citizen generated content via social media during disasters. The 2007 Virginia Tech shooting saw students reaching out via message boards, Facebook, and MySpace to obtain and share information, along with text messaging and creating a Wikipedia page (Palen, 2008; Wigley & Fontenot, 2010). When Flight 1549 had to make an emergency landing in the Hudson River in 2009, the first photos of the event were posted by passengers and those on the waterway to the Twitter website. This event is cited as Twitter's defining moment and is even credited by Twitter co-founder Jack Dorsey as the event that "changed everything" for the social media service, putting it on the map (Langer, 2014; Memmott, 2020). During Hurricane Sandy in 2012 and Hurricane Harvey in 2017, many turned to social media when other forms of communication went down and utilized Facebook and Twitter as information sources both during and after the storm (Floating Sheep", 2016, as cited by Sadri et al., 2018; Prakash, 2020; Villegas et al., 2018). The events discussed are but a small fragment of examples of social media usage during a disaster; for a more thorough, while still incomplete list, please see Reuter & Kaufhold, 2018. This research focuses on the disaster event of Hurricane Harvey.

2.5 Hurricane Harvey

In August of 2017, the first major hurricane of the Atlantic hurricane season

formed Hurricane Harvey (Harvey). Harvey made landfall near the Houston area on August 26, 2017, stalled in place for four days, and then moved out to the Gulf of Mexico on August 28 (Brown, 2017). Harvey set itself apart from the beginning; while hurricanes are usually notable for their wind, rain was the major driving force of destruction this time (Shultz & Galea, 2017). During the first two days of the hurricane over 9 trillion gallons water was poured onto the city, and by the end of Day 5 over 33 trillion gallons had fallen on Louisiana and Texas, setting a new record for continuous rainfall, reaching 51.88" (Bogost, 2017; Schultz & Galea, 2017). The extensive rainfall in such a short period of time led to extensive flooding through the region (Brown, 2017) causing many people to need rescuing (Harden, 2018). According to the *Houston Chronicle* some high-water rescue personnel would work the same call for up to 20 hours (Harden, 2018). This lengthy response time, along with the immense amount of rain and downed communication led to the 911 system becoming overloaded (Greenhalgh, 2018; King, 2018).

Hurricane Harvey was the first major hurricane, defined as a Category 3 or higher, to strike southern Texas since 1970, when Hurricane Celia hit (Ratcliffe, 2017), and caused 107 deaths nationwide. Included among those dead were 103 people in Texas alone; of the Texas deaths, 68 of those were blamed on direct effects of the hurricane, thus causing the highest number of deaths in the state from a hurricane since 1919 (Blake & Zelinsky, 2018). Harvey also comes in just after Hurricane Katrina for the second-costliest cyclone on record. Overall, Hurricane Harvey caused $125 billion in damages, though it has been estimated that the amount could be as high as $160 billion (Mooney, 2017; "Hurricane Costs", 2019).

With the additional knowledge that was gained from Hurricane Katrina research, it can be shown that researching Hurricane Harvey has the same potential to provide crucial information regarding a devastating disaster (Villegas et al., 2018). This research focuses specifically on social media utilization by first responders, however, due to the increasingly involved aspect of social media in the lives of people, this information may be utilized in the future by other researchers and academics when investigating other aspects of social media, disaster, crisis informatics, or the field of first response.

While this list is not complete, Harvey and the use of social media have been studied for a multitude of reasons. This topic has been researched regarding how citizens utilized social media to spread health information - their own and others (Smith et al., 2018) forensic disaster identification (Yuan & Lui, 2018); using crisis informatics for the purpose of identifying urban resilience (Villegas et al., 2018); studying government organizations usage (Liu et al., 2018); the usage of social media cries for help as it correlates to relationships (Li et al., 2019); using social media to examine the social ties in regard to evacuation behavior (Metaxa-Kakavouli et al., 2018); geographic disparities in social media usage and the effects (Zou et al., 2019); sentiment and retweet patterns of messages (Chen et al., 2020); the strategies of social media organizations (Marx et al., 2020); to identify high hazard flood areas (Sebastian et al., 2019); citizen-led disaster response by way of social media information gathering (Smith et al., 2018); the links between materials, people, materiality, and the technology used by those being rescued (Stephens et al., 2020); and even an analysis of sense-giving patterns from the messages sent on social media during the hurricane in order to understand the tweets from the COVID-19 pandemic (Mirbabaie et al., 2020).

Social media usage during the time frame of August 25th through September 8th, 2017, produced over 1 million tweets were sent out via the social media site Twitter – this does not include the information from any other social media sites (Villegas et al., 2018). Upon realization that the 911 system was overloaded and unavailable, citizens created the crowdsourcing social media tool, CrowdSource Rescue (CSR). CSR was created in six hours during the time of Harvey's landfall and allowed geo-spatial mapping to be created from tickets of help requests, which is a form of social media called VGI, or volunteered geographic information (Sebastian et al., 2019). Word spread quickly via messages and postings on social media that there was an official way to request help, and although it was not an official in the sense of being run by an organization or agency, by the morning after creation over 1,500 help tickets had been received. By the end of the third day, over 3,000 requests were received. CSR utilized other citizens with boats who went around and rescued those in danger from the rising flood waters (Greenhalgh, 2018); this SM tool helped to create a common operational picture for the many individuals involved who had no prior experience with each other before the storm. Although extremely beneficial, CSR was not the only social media utilized to request help, and ultimately over 7,800 help requests were sent out from various platforms requesting assistance (Harden, 2018; Villegas et al., 2018). The finding of the large numbers of help requests that were sent out by citizens, along with a discussion of how first responders may use social media to conduct operations, led to the research questions in this study. Hurricane Harvey has been studied extensively, however the first responder usage has yet to be researched.

2.6 Benefits to Social Media

Prior to social media (SM), traditional news outlets such as radio and television news stations usually had little to no information about the overall disaster impact (Quarantelli, 1991); SM is said to have many benefits over traditional media, making it the choice for not only journalists, but also those in places of authority, those responding, and citizens (Houston et al., 2015; Mills et al., 2009). One major benefit to SM usage during a disaster is the swift, prompt, substantial influx of information from multiple perspectives (Sawaneh, 2020; Sutton et al., 2008; Villegas et al., 2018; White et al., 2009; Xiao et al., 2015). This influx of information can help to create a common operational picture for all involved, and also help with decision making and risk perception – when other citizens are posting about possible danger, it is taken more seriously than just the basic knowledge of a hazard (Dash & Gladwin, 2007). Social media allows for the unique opportunity for those involved inside the disaster area and those outside of the disaster area to connect and share information (Abdullah et al., 2015; Stephens et al., 2020). Additionally, individuals in times of disaster are known to improvise and adapt in order to overcome the negative consequences, assist those in need, and even form ad hoc volunteer response groups – all of which is made easier with social media (Kendra & Wachtendorf, 2003; Smith et al., 2018; Palen & Liu, 2007; Tierney et al., 2002).

Social media also provides an opportunity to share information among users, whether they be citizens or authority figures (Jaeger et al., 2007; Mills et al., 2009; Stephens et al., 2018; Sutton et al., 2008; Xiao et al., 2015; Xu et al., 2012). One way to utilize this intercommunication is for authorities to view, gather, and utilize the

information from those in the area. Citizens utilizing SM can be utilized as a unique type of ‘human sensor’, meaning they are already in the disaster area and they are providing information which then only needs to be gathered by others in order to be useful to first responders (Dave et al., 2013). This public participation helps involve a larger audience and provides an ability to gather more information than utilizing only those trained or official resources on the ground alone (Sawaneh, 2020).

Additionally, SM provides additional support to the official channels that typically get overloaded during a disaster, such as the 911 system (Sawaneh, 2020; Villegas et al., 2018) and can provide missing information that is needed in order to conduct a proper, effective, and efficient response (Palen & Anderson, 2016; Sutton et al., 2008). Social media channels typically have a greater capacity and are more dependable than some of the official response systems currently in place (Jaeger et al., 2007). Additionally, the use of hashtags and geo-tagging of information is beneficial to responders in organizing and easily identifying the content related to the disaster (Palen & Anderson, 2016; Stephens et al., 2020) such as damaged infrastructure (Fan & Mostafavi, 2019). Social media is also a low-cost option for those wishing to disseminate information, it can be scalable, and it has a built-in geographic information system (GIS) which is ideal for ever-changing response situations (Mills et al., 2009). Social media provides many opportunities for us to rethink our current response system and it can also be used in conjunction with other tools to improve response operations (Villegas et al., 2018).

2.7 Challenges of Social Media

The main challenge of social media in disaster response is the communication of

accurate information (Manoj & Baker, 2007). Combatting the misinformation posted is a lengthy process, and while it has been found that the amount of misinformation is relatively low (Reuter et al., 2012; Vieweg et al., 2008), and that citizens typically correct their own or others misinformation and provide sources (Bird et al., 2012; Mendoza et al., 2010; Reuter et al., 2012; Stephens et al., 2018) it is still a main concern mentioned from those in the response and disaster fields (Hiltz et al., 2014; Houston et al., 2019; Huang et al., 2015; Sawaneh, 2020; Valenzuela et al., 2019). Misinformation typically occurs during time periods of information scarcity or ambiguity (DiFonzo & Bordia, 2007); the rumors are easily and quickly spread, and while research shows the main reason for retweeting misinformation is the desire to be helpful (Abdullah et al., 2015; Stephens et al., 2018), the misinformation ultimately produces a negative regard for social media.

Another challenge to social media is that there is a lot of information coming in from many sites all at the same time which can become overwhelming (Hiltz et al., 2014; Houston et al., 2019; Manoj & Baker, 2007; Smith et al., 2018). This leads to a need for personnel to monitor this information at all times as it is a continual stream, and be trained on how to respond and utilize the information to conduct the best response (Bird et al., 2012; Houston et al., 2019). The safety and security of those responding has also been addressed as a challenge of social media, with responders citing safety concerns when their whereabouts are known (Goolsby, 2010). Further, resource deployment – getting the right resources to the right area in the right time, hierarchy in personnel and decision-making, and jargon used between differing response organizations and agencies alongside citizen unfamiliarity with said jargon are all

important challenges that must be overcome when utilizing social media during a disaster (Manoj & Baker, 2007; Sawaneh, 2020).

A majority of disaster research, while well-intentioned, ignores the social vulnerability component which can lead to distorted data (Flanagan et al. 2011). In an effort to discuss all challenges of social media and disasters, vulnerability is addressed in this study as a challenge of social media and disasters. Previous research conducted on social media and vulnerable populations in regard to disasters has focused on hurricanes (Wang et al., 2019; Xiao et al. 2015; Zou et al. 2019); since this research also has a focusing event of a hurricane, the previous literature is applicable to this study.

Vulnerability can be of two forms, and they are usually intertwined – one form of vulnerability being physical, meaning the physical nature of the hazard and how it impacts an area, and the other form of vulnerability being social, meaning the likelihood of a place to be affected by a disaster and also how well it can recover from said disaster (Wang et al., 2019). Communities that meet these criteria have been found more likely to become victims of a disaster (Wang et al., 2019) and have a more difficult time recovering from disasters (Flanagan et al., 2011).

One major attribute of vulnerability is low socioeconomic status; research has found that those in low socioeconomic areas are less likely to utilize social media both before and during a disaster (Samuels et al., 2018; Wang et al., 2019; Zou et al. 2019), and Samuels and Taylor (2020) found that even before Hurricane Harvey made landfall, there was less usage of social media, specifically Twitter, from certain vulnerable

populations, in particular, those who were unemployed, disabled, minorities, and those living in multi-family dwellings.

Those with access to social media and smart devices have an advantage in that they are able to request assistance via multiple platforms; those who are vulnerable may be unable to request assistance via social media because they do not have access to it. This creates a distorted picture as previous research has shown that there is a smaller amount of disaster data available from vulnerable populations (Samuels and Taylor, 2020; Zou et al. 2019). Lack of access also creates inaccurate situational awareness during the response phase (Xiao et al., 2015) and can actually contribute to the inequitable division of resources, including personnel and supplies (Sawaneh, 2020; Xiao et al., 2015).

2.8 Summary

Communication is exceedingly important during all disaster phases. When there is a breakdown in communication, it makes responding to disasters that much more difficult. There are typically four channels for crisis communication, with citizens and authorities being both senders and receivers of communication, though this study focuses on the citizen to authority (C2A) channel. Crisis informatics is the combination of information from a computing standpoint and the behavior of people in a disaster; social media usage during Hurricane Harvey fits perfectly into this field. The background of social media shows how quickly the technology and information field have advanced, and the statistics from the years 2005-2015 shows how important it is to involve social media in the field of disaster science. There is a plethora of published case studies

regarding social media use during a disaster, and this study did not begin to scratch the surface of what is available, thus showing the importance of the topic at hand.

There is no doubt that the field of disaster science will continue to research the topic of social media usage during a disaster as the involvement of social media use by citizens and authorities alike will only grow along with the technology. Hurricane Harvey was a disaster of importance, both in terms of damage caused and people affected; this storm aligns with Hurricane Katrina and shows that the data gathered by researchers can be beneficial to those in the academic and practitioner fields alike. While the topic of social media use during this disaster has been heavily researched, there is still more to be discovered, especially in an area as lacking in the literature as that of first responder usage. This information can also be beneficial to the practitioner field and be utilized to create training and improve response. While there are many benefits to social media, there are just as many challenges; research into this topic can provide information that may help those in crisis informatics, communication, first response, trainings, and other fields improve their individual pieces of the puzzle in order to provide a more efficient, effective, and beneficial response to the public.

CHAPTER 3

METHODS

The purpose of this chapter is to provide an in-depth look at the methods used in the data collection for this study and the organization of the findings. This chapter contains an overview of the study, the research questions, how participant selection was determined, data collection methods, and an overview of how data was analyzed.

3.1 Overview

In order to understand how first responders utilize social media to conduct disaster response, I researched answers to the following research questions:

> RQ1: How did first responders utilize social media to conduct operations during Hurricane Harvey?
>
> RQ2: What are the perceived limitations and advantages of social media usage during a disaster as viewed by first responders?

Based on the research questions and available literature at the time of this study, an emergent design was followed which allowed for learning “about the problem or issue from participants and to address the research to obtain that information” (Creswell & Creswell, 2018, p. 182). It was further determined that the use of an inductive, nondeterministic approach would be beneficial. An inductive, non-deterministic approach allows for an observation first, followed by a theory, and for patterns in data to naturally emerge (Creswell & Creswell, 2018).

For this study, the usage of social media by citizens during a disaster is well known, however, the usage by those responding to citizens is not, thus the need for a qualitative study. The meaning of qualitative research is defined as the intent to “understand a particular social situation, event, role, group, or interaction” (Locke,

Spirduso, & Silverman, 1987, as cited by Creswell & Creswell, 2018, p. 204), or put another way, it is “an organized method of describing people’s experiences and internal feelings” (Abedsaeidi, Amiraliakbari, 2015, as cited by Naderifar et al., 2017). Qualitative research can help us to understand why responders choose to, or not to, utilize social media during a disaster response. An emic approach was also taken in order to “better understand the beliefs, customs, and values of the groups being studied” (Fetvadjiev & van de Vijver, 2015). Grounded theory was utilized as it seeks to generate a theory from questions (Creswell & Creswell, 2018); interviews were conducted for the purposes of this research, which fits this theory. The lack of literature available at the time of this study specifically regarding first responder usage of social media to conduct operations during a disaster validates the usage of these study approaches.

The intent of this research is to provide a perspective on social media usage during a disaster that is lacking in the literature. Due to the dearth of literature on this topic, and the importance of an all-encompassing point of view, this literature is beneficial to those in the first response community and the academic community alike.

This study utilized telephone interviews with a total of 20 individuals. All of the individuals responded to Hurricane Harvey in an official response capacity of either the local, state, or federal government. Individuals from nine different fire departments responded to interview requests, along with personnel from one hospital. There were seven firefighter/paramedics, two driver/engineers, four fire department captains, five various ranking fire chiefs, one emergency management officer, and one emergency

medicine physician. Total years of service in a first response capacity between all individuals ranked from 9 to 43.

3.2 Participant Selection

During Hurricane Harvey more than 19 trillion gallons of rainwater fell on parts of Texas and there were over 780,000 citizens that evacuated from their homes. More than 17 federal agencies, 31,000 federal employees, and over 300 volunteer organizations with an unknown amount of personnel responded to this disaster ("Historic Disaster Response to Hurricane Harvey in Texas", 2017). Responders at the local, state, and federal level also rescued 122,331 people along with 5,234 pets during this disaster. Knowing the numbers of those affected builds a case for understanding how social media was used as a tool for conducting response during this disaster.

Snowball sampling (also called “purposive sampling” or the “chain method”) was utilized due to difficulties accessing those who responded to Hurricane Harvey. Though a staggering number of responders were involved, multiple years had passed since the disaster, and personal information, such as names, is not generally known about those who respond. Organizations do not, or for legal reasons cannot, share that information, making identification of those who responded difficult without the utilization of this method. For this research, I knew the initial subject which made it easier to access other responders. The first subject was interviewed, and afterwards was asked to provide names and contact information for other interviewees who may be beneficial and qualified to participate in the study; there were a total of 20 respondents. In addition, this technique made it easier to create a working relationship between researcher and interview subjects as they shared a common relationship. The initial interviewee also

sent out requests via listserv sites that were active during Hurricane Harvey. This method did take more time than other methods of recruiting subjects, such as convenience sampling, but was useful in identifying those who qualified for the study (Naderifar et al., 2017).

3.3 Data Collection and Interview Methods

The initial study participant was asked to participate and following this he provided contact information to others who may be interested and qualified in the study. A listserv email was sent out to various fire department contacts and other response organization contacts to gather interviewees. The email detailed the study purpose and the relationship between the researcher and the initial interviewee – this process provided full disclosure to those receiving the request and allowed for the chance to decline participation. Interviews lasted from 5 to 40 minutes. Phone interviews were conducted to allow for time constraints and location access, further, the occurrence of Covid-19 created rules handed down by the IRB which did not allow for research of this nature to be conducted in person. The interviews were audio-recorded with participant permission, then transcribed to identify themes. Participants were provided informed consent notices which were approved by the IRB, though they were not required to sign and return them for recordkeeping. All confirmation and permission to conduct interviews was audio-recorded.

The interviews followed a semi-structured format from an interview guide. This allowed for the interview to progress in any direction that was beneficial to the research, while providing a structure to follow should the interview veer away from the purpose of the study. The interview guide for this study focused on the positions and duties of

responders both during disaster response as well as their daily career position outside of a response, and the agency from which they were deployed. Additionally, the type and name of any and all social media viewed was gathered, along with the primary objective for utilizing the SM. There was discussion of previous SM usage as well as potential future SM usage. Finally, the limitations and benefits of SM from each responder's point of view was discussed. The questions in the interview guide were based on gathering as much information as possible while still being open-ended and available to interpretation; this allowed for the respondents to guide the discussion as needed for the purposes of this research.

Participants were encouraged to expand upon their answers and provide detailed explanations in order to help gather the most beneficial information for this qualitative study. The goal was to allow the interviewees to share as much information as they were comfortable with to allow for a more complete understanding of their experience, and reasoning for their perception of usefulness. The research sought to stay objective within the questions asked and allow respondents to voice their experiences and opinions in their own words and thoughts without interruption or interjecting possible bias, jargon, or other information which may have swayed the interview. Interviews were conducted until no further potential candidates were identified. There was an original intention of interviewing until information saturation occurred, however the lack of participants did not allow for this.

3.4 Coding Process

The coding process was a systemic approach to the data. This process consisted of open coding, axial coding which is sometimes referred to as focused coding, and

selective coding. Open coding is the process through which large chunks of raw data are broken down to find general concepts and receive labels. Open coding not only allows the data to guide the research, it also allows the researcher to avoid subjectivity and bias – two aspects of qualitative research that must be carefully avoided. Axial coding occurs after open coding and allows for large concepts to become broken down into sub-categories or themes, or in other words, provide a focus for the information. Focused coding is also used in grounded theory research. Finally, selective coding is a process in which the information, in this instance, interview notes and transcripts, is reviewed to pull out relevant quotes to illustrate the identified themes (Corbin & Strauss, 1990).

The coding process began after the first interview was transcribed, at which point the transcription was read without any form of analysis, in order to fully understand what the participant had experienced. Following the first read-through, a second read was conducted of the transcript, along with any of the notes that had been taken during each interview. During the second read-through, a spreadsheet of detailed information was created; this spreadsheet included such information as the participants' position when deployed, years of service, duties when responding, position in the Hurricane Harvey timeline when deployed, any social media that was used, and potential benefits and limitations mentioned. This process was repeated for each interview and allowed for generalized concepts or themes to be identified then narrowed down and cross-checked for validity before the final coding phase, selective coding. During the final coding process the information was validated once more by inspecting the transcripts and notes to find quotes from the participants; these quotes provided additional

substantiation to the discovered themes. The next chapter presents the results of the data analysis and themes identified.

CHAPTER 4

FINDINGS

The respondents were intrigued by the purpose of the study and very interested in sharing their experiences. The timeframe of response from these individuals varied from before Hurricane Harvey landfall through two weeks after landfall. Information was gathered through social media using different modalities and helped provide data into the big picture as well as insightful information. Overall, since there is not a lot of research conducted from a first responder viewpoint, there was not a lot of opportunity to identify existing theories, and therefore the focus on theories is outside of the realm of disaster science. The original intent of this research was to identify how first responders utilized social media to conduct their response as an alternative to 9-1-1 services; this proved untrue, at least within the small subset of responders interviewed for this research. Additionally, there was an expectancy of Media Synchronicity Theory (Dennis & Valacich, 1999) – the theory of the ability that media is able to support synchronous behavior between individuals that are working together. This theory was found to have only been true in certain groupings, specifically, those in small cluster groups, such as Ambulance Strike Teams. The other responders did not utilize media for a number of reasons; as it was found that most responders would receive their information in a top-down format, communications were so intermittent that media was not useful, or other clusters or groupings of people worked in such close contact that there was no need for media to coordinate activities. Finally, rumor theory (Shibutani, 1966, as cited by Aguirre & Tierney, 2001) was identified and is addressed further on in this chapter.

An analysis of the interviews was conducted, despite the scarcity in available theories. As was expected, due to the sharing of a profession, and the location of the first responders all being in the North Texas area, themes eventually began to emerge. It is supposed that the emergence of themes did not appear right away due to a deficiency in theories available, therefore this new territory had to be transcribed and coded before the emergence of themes occurred. Upon coding four key themes emerged. The themes are as follows:

- More than just Twitter: Half of the respondents (10/20) utilized both geographical social media, such as location (maps) or weather information and social media networking sites.
- Rumor has it: Of the respondents who did not utilize social media during the response (a total of 4), they all gave the same answer when asked about the limitations of social media - they didn't trust the misinformation.
- One size does not fit all: How social media was used by the respondents depends on the job duties that they were assigned.
- Timing is everything: Those deployed before and during landfall had a harder time accessing social media than those who were deployed later, such as the second wave.

The following sections describe each of these themes in detail and provide direct quotes from respondents. At the conclusion it is apparent that social media usage during disaster response is still a foreign concept to first responders which is due to a number of reasons. Rationale given by those interviewed included but was not limited to: federal, state, or local policy, employer policy, or responding agency policy; unfamiliarity with social media platforms; unaware of citizen expectations; no knowledge of how responders have used it previously to conduct operations during disasters; and distrust of misinformation. At the same time, this research aligns with other previous research which found that the government can and does utilize social media information

shared by those outside of the responding agencies to gain insight during disasters (Sutton et al., 2013). The information presented in this research is beneficial to all levels of government, response agencies both formal and informal, training agencies, and those in the academic field as the data found from this research can be utilized in future trainings, policies, procedures, events, and may help provide a better response to the citizens and those in need of assistance throughout the impacted area (Wukich & Mergel, 2016). If the ultimate goal is to help those in need during times of disasters, the importance of social media during those times cannot be overlooked.

4.1 More Than Just Twitter

One of the themes that emerged from this research was that of those responders who utilized social media (16/20) only three did not utilize more than one form of social media. This makes sense when considering that using different modalities in gathering information helps to present a well-formed big picture and can provide beneficial insight information which provides more details, such as what is needed at that moment in time (Palen & Anderson, 2016; Nazer et al., 2017; Ofli et al., 2020). Furthermore, previous research has found that when presenting information in multiple forms, such as when one message relies mostly on text, followed by one that relies on image, or vice versa, the message and information become more powerful (Liu et al., 2016). The utilization of multiple forms of social media can be advantageous to responders. When asked what information he was looking for when scanning social media, and which agencies or forms of social media he was using, one respondent replied:

> A lot of the stuff that I was looking for disaster related was either from TDEM, or the Forest Service, or TIFMAS, because that's kind of some of the broad communication we used.

Many other respondents stated they used different avenues of social media including weather and radar applications on their phone to track the storm as it happened. Some data they were looking for was not only severity of weather and possible impact, but also how much damage to expect and where the storm was impacting at different times. One respondent stated he utilized those specific sources of information as it was easy to access and provided accurate data. These large applications such as those utilized for weather and radar helped respondents with the big picture data they needed.

> [We] were all obviously utilizing social media or just when they're being used or weather radar, and I was no different. Paying attention to DPS Facebook pages, in terms of evacuations, possible severity, damage expected that kind of stuff points of impact. Just following those state pages that really disseminate that information in a really good context and a really accurate manner.

Another responder stated that he used social media to view posts from those in the community and gain information from their perspective. The use of videos, pictures, and written statements from the citizens themselves helped to provide details and information that certain large applications were unable to provide. These sources were used before, during, and after the storm hit.

> I constantly used social media to follow the weather updates and looked through different social media platforms to look at people in the community as it was approaching just to get updates, video images. And then of course after hit, same thing again look back at various social media platforms to assess damage using social media, videos and images and just actual written statements from whether that be from official social media pages of local agencies or just individual citizens.

This is a great example of using text and image modality to gather information (Ofli et al., 2020) which is a topic currently being explored within the disaster science and data gathering realm, and one which may be beneficial to the aspect of information overload.

Additionally, this backs up prior findings that eye-witness information can be more beneficial in disaster response than official news sources (Palen et al., 2009; Roy et al., 2020).

One respondent utilized social media in order to help others provide assistance during the response. Damage assessments were critical when evaluating hospitals in order to know where to send victims to, however there needed to be constant updates and a flow of information. One specific hospital was destroyed completely due to the storm and the hospital was updating citizens and responders alike via their social media on multiple platforms. This is an example of a crisis within a disaster that contained vital information that wasn't readily available to deploy to first responders due to communication problems. Social Media allowed for information distribution across multiple platforms that was accessible to those that needed it – in this case, those responders who were trying to work with the hospital.

> I was specifically looking at social media on specifically the local response agencies for the damage assessment, but also at like, for example, hospitals. There was a particular hospital that was completely destroyed and, and that was updates of the status of the hospital were provided on their social media pages. And then. And then other than that, it was just trying to gather some additional Intel that wasn't otherwise provided to us that may have not hit admin or the news yet, but was just posted by someone.

The usage of social media in this way backs up the claims of previous researchers who state that social media provides timely and accurate information which improves situational awareness for those responding (Luna & Pennock, 2018). This also confirms findings from Hurricane Sandy which found that information on social media networks spread at a significantly faster speed than that of external information (Yoo et al., 2016). These first responders relied on social media for up-to-the-minute news that

was otherwise unable to be conveyed to them in an appropriate time frame, for whatever reasons.

4.2 Rumor Has It

Rumors are a form of information convergence which happens beginning in the earliest stages of a disaster by citizens in a state of ambiguity who are attempting to spread information and solve problems, real or not (Shibutani, 1966, as cited by Oh et al., 2013; Zhao et al., 2015). Rumors are typically thought of as false information, although prior research shows that rumors do not mean untrue information, and sometimes the term “false rumor” is used when referring to rumors that have been proven true. To better define the term rumor for the purposes of this research, a rumor is a piece of information which needs further validation and is typically viewed with skepticism (Zhao et al., 2015); for the purposes of this paper, the interviewees appeared to hold these same beliefs about rumors, though they were not outright asked for their definition.

All respondents were questioned about benefits and limitations to social media usage. Of those interviewed, 8 people mentioned misinformation, rumors, or lack of message control as a limitation; interestingly, 5 of those people had utilized social media during their response, and only 3 of them had not. These results show that while misinformation was a concern, the concern was not strong enough to deter responders from utilizing important information sources during their response. One interviewee, who did use social media when responding, discussed his concerns regarding the speed in which information can be shared, and how anyone can reshare posts without anything being confirmed.

> That ability to be fast about releasing information or sending information out. It's not vetted properly. If it's not checked and balanced. Basically, inaccurate information will be sent out then and people can, without a better way of putting it, pull the trigger off sending out information before it's actually deemed to be 100% accurate.

Another individual who did not use social media in his response reiterated the problem of unvetted information. Going further, he related the problem to being deleterious to the ongoing emergency operations.

> The biggest issue is misinformation. A large percentage of the information will be wrong and not vetted. […] You could have some things that turn out not to be true as well. […] But as I said before, the biggest problem is inaccuracies or information that is detrimental to emergency operations.

This same individual went on to describe his perception of misinformation in detail, linking it to social crises that were ongoing at the time of the interview. Adding in the social aspect he points out how the point of view from one person may not be accurate, or how the information posted may be only a portion of the story, leaving others to interpret the posts as they choose, even if it is erroneous.

> The downside of that is a lot of time those perspectives are not line with reality, sometimes they are very much exaggerated. And it's kind of like you know, the old game of telephone. And by the time it goes from one party to the next, it's taking on a life of its own and a lot of stuff. As we've seen over the last few months with social media, things are taken out of context because only a small video audio clip is posted. And people generate their own thoughts and opinions about something based on that specific little post so the information could be completely inaccurate.

Lack of information and misrepresentation was mentioned from others during the interview process as well. One respondent went further in his discussion of leaving out details by discussing that there is information that cannot be divulged or has yet to be divulged to the public for various reasons, adding to the already difficult job of those responding.

> There's so many facts that have yet to be talked about that are not out there and plus, the thing is, sometimes the social media people represent things as fact, when in fact they're not facts. And that just those can be really challenging.

Lack of censorship has made social media an ideal platform for rumors; combined with a lack of fact-checking and the amount of time and personnel required for those tasks, it's no wonder that rumors are frequently cited as a limitation to response (Cha et al., 2020).

Although misinformation, or rumors, are known to spread quickly by citizens within and outside of the impacted area, more research is being conducted than ever before on rumors (de Souza et al., 2020) and findings show that this information can be quickly fact-checked and proven or disproven using the same social media that was used to post the false information (Banerjee & Rao, 2020). Citizens and others tend to correct the information in multiple ways, for example, when a credible source, such as an expert, provides accurate information on a post that is inaccurate, or when an individual knows someone that holds credible information and requests their advice before reposting questionable information (Zhao et al., 2015). Furthermore, research found that rumors are typically debunked by information gained from other social media sources, showing that gaining information from multiple platforms is beneficial, which confirms the findings from the prior theme discussed in this paper, 'Multiple Perspectives' (Starbird et al., 2014; Wang & Zhuang, 2018).

4.3 One Size Does Not Fit All

An interesting theme in the responses gathered shows that the ways in which social media was used depends on the job that was assigned to responders. The respondent who was more involved in logistics and the emergency management side of

things utilized social media differently than did the respondent who was the team physician, and it was used still differently by those on an Ambulance Strike Team versus those on an Engine Response Team. Social media is imperative to situational awareness during times of disaster (Wang & Ye, 2019), and while it is known to be used to help coordinate response by citizens (Smith et al., 2018), it is important to understand how those on the front lines make use of this technology.

One responder who was interviewed was in a position related to logistics and coordination. He described the utilization of social media in an effort to organize and track resources to help the smaller local jurisdictions who were most in need of assistance. He also described how he used social media to help gather information during a time when little to none was available, even at an emergency management level.

> Because part of what we were doing was advising and assisting the smaller local jurisdictions, but we were also then trying to figure out what resources we need to bring in […] when we're trying to figure out how bad is bad, how big is big, with limited information, and also try to advise and assist those locals with the same limited information.

While those responders on an Ambulance Strike Team were not in charge of logistics, they were still in charge of precious cargo, specifically, trapped citizens needing assistance. Ambulance Strike Teams were in charge of moving patients and victims out of hospitals, nursing care facilities, and assisted living communities; these transports could last anywhere from 2 hours to 10 hours, depending on the location and flooding activity within the transportation route. One member of an Ambulance Strike Team recalled how he and other members of his team utilized social media to track the storm in as close to real time as they could. Social media was viewed before getting to a

location, when traveling to and from a location, and even when attempting to evacuate patients.

> I used AccuWeather, and I was using that often to see exactly where the storm was and where we were going and how it was tracking in that area. […] If we got dispatched and told to go to a certain area I would just get on while we would be traveling and see what was going on maybe in that area, or hashtag in that area.

The usage of geographic social media platforms goes along with prior discussions that state that geographic features of social media are needed during and after disasters (Simon et al., 2015), and they are now being recognized as one of the most important features of the technology (Slamet et al., 2018). When interviewing another member of an Ambulance Strike Team, he shared the same information, stressing the importance of constant weather updates throughout the region and the ability to view this information in real time.

> We're on our phone looking at AccuWeather or the weather channel or looking up the path of the hurricane the whole time. I mean, there's not there's not a whole bunch of time that goes by that we're not looking at the phone. Seeing what the latest news updates are and where it's expected to hit or how much rain has fallen.

The final group of responders that utilized social media differently than logistics or Ambulance Strike Teams was those who had been deployed on an Engine Response Team. An Engine Response Team is a group of responders whose disaster tasks most closely resemble their routine non-disaster related tasks at their own fire stations, such as responding to emergencies, fires, and other 9-1-1 calls. These teams were deployed to replace the personnel of fire houses in areas affected by the storm in order for the local responders to switch from responder role to citizen role and address any personal needs that arose due to the hurricane.

The members of these response teams were also able to utilize social media to

help with resource management and logistics. While material convergence is a known problem in disasters and this problem could easily have overwhelmed the responders and created more problems (Suzuki, 2020), social media was utilized in order to help provide a solution to the logistics of where to deliver and store supplies. When discussing how social media was beneficial to his response, one individual discussed how an overwhelming amount of supplies, like bottled water, came in with no direction or instructions from anybody. He used the local Facebook page of the department he was responding for and put out the information, shortly thereafter local community businesses and organizations were able to help him with creating a distribution and delivery setup.

> After Harvey I had to run various ice and water distribution centers throughout the city. That was kind of what I was tasked for from the EOC. So we had 18 wheelers come in with ice and bottled water. And so I'd have to organize people to go out there and help distribute this to the vehicles as they drove up and how the vehicles access this with traffic lights and road conditions and things like that.

The flexibility of social media helped three different groups of responders; while they all needed help with logistics and coordination, it was in very different manners. Social media was beneficial to all three groups in ensuring they were able to conduct their responsibilities to the best of their ability under some of the most extreme and difficult conditions.

4.4 Timing is Everything

A benefit to this research is that the timeframe of response varies between interviewees which can help to provide information on social media usage throughout different stages of the disaster. Some respondents were in the area and responding before the storm hit, such as those whose job duties included logistics and resources,

another group was in the area right before the storm made landfall as well as through the duration of the storm, such as those who were part of an Ambulance Strike Team. One other group of responders was deployed to the area during the time the storm was progressing across the area as well as from a few days to a week or two after landfall, such as those on Engine Response Teams. Those deployed before and during landfall had a harder time accessing social media than those who were deployed later, such as the second wave.

One interviewee had been deployed as an Ambulance Strike Team Leader, and he spoke of his experience both before and during the storm and trying to obtain information during those times. While he was in charge of keeping his crew safe, he also had to ensure that they were fulfilling their job duties and keeping those they transported safe. He mentioned trying to stay ahead of the needs by tracking the storm and anticipating where the greatest need might be, as well as utilizing maps and weather media or the social media pages of state agencies to track road closures or flooding.

> I would use those to kind of track and see where the greatest amount of need is where we might anticipate having to go on our next duty; that was kind of early as we're waiting on the hurricane. And then as we began to respond, I used social media quite a bit to find open roads. One of the biggest things in Houston was every road was flooded. And we would get on social media and TxDOT pages to see which roads are open, which roads are closed because they were changing so fast and so rapidly due to the flooding, that that was a big choice for us.

One responder who had a logistics and resources position was deployed originally to Sinton, Texas. He spoke of the problem of no cell phone coverage for a duration of time during and after the storm which limited his ability to monitor social

media. Those in his group had multiple days where they would have to drive to another area in order to get signals on any of their devices.

> I was 15 miles from where landfall was at, and we were there without cell phone for a couple days. And we weren't able to monitor social media or read or apps or news apps or any of that, we actually would have to drive about 20 something miles to get a signal to send in State Resource Requests to the State Operation Center. It really wasn't until about probably day three or four that we had signal.

While the logistics officer had problems in his region, a little over 230 miles away in Fort Hood County, the Ambulance Strike Team Leader did not experience any outages during his deployment. These findings show that availability of towers and other communication infrastructure may affect how or if social media is used during response. The responder who was in Fort Hood County spoke of times when he would use social media in between transports to help locate resources for his crew.

> We used it at occasions when we would get into a new town that had been evacuated. Sometimes we'd get on social media to see who's open for food. So we would use it to find restaurants in the town, and kind of gauge are we going to be able to eat in this town? Can I get fuel in this town? So that was another big way I utilized it as well.

When speaking to someone who had been deployed on an Engine Response Team 3 days after the storm occurred, he stated that he had no connectivity issues. He spoke of the way he was able to find those that needed assistance in the area he was responding.

> Once we got started following the Rockport volunteer fire department page, we would kind of see people that posted stuff and that's how we would know that people needed assistance for different things.

These findings further back previous research by Eismann et al. (2016) which found that there are various limitations that responders and authorities face when attempting to utilize social media in a disaster. A main limitation of social media in

disaster response is communication failure (Nakayama et al., 2017); when communications go down, the job of responders not only becomes more difficult, but it can render response tools – such as social media – useless (Raza et al., 2020). The findings from this paper show that while social media can be used throughout all disaster phases, there may be communication errors which affect the amount of time or usefulness of social media, and therefore may skew research in this arena.

4.5 Summary

Responders were deployed to Hurricane Harvey before it even made landfall. They utilized multiple sources of information via social media platforms in the form of Facebook pages, Twitter streams, weather and radar apps, GroupMe messaging, and more. This helped to provide an overall big picture as well as insightful details. Rumors and misinformation were the number one limitation mentioned by those that responded, and also the top reason given by those who chose not to utilize social media in their response. Depending upon the job duties that were required, individuals utilized social media in differing ways. While the three different groups that were interviewed for this research all used social media to conduct various job duties, it was also found that they all had some form of resource or logistics duty that social media helped complete. Timing of deployment was the final theme found during transcription, and, depending on the time of arrival to the disaster area, social media was useful in different ways.

CHAPTER 5

CONCLUSION

The aim of this study was to understand how first responders to Hurricane Harvey utilized and perceive social media. The main questions were: First, how did first responders utilize social media in order to conduct their response? Secondly, what are the perceived limitations and benefits of using social media as a first responder? In order to answer these questions, a qualitative semi-structured interview was undertaken with respondents of Hurricane Harvey. The main goal of this thesis was to understand more about the usefulness of social media when conducting operations during a disaster, and how social media is viewed by those on the front lines.

A number of key takeaways were found during this study. The information found may apply to first responders, but it could also be utilized by others that work alongside or with first responders, such as government agencies, those in academic fields, technological or social media companies, and those involved in various training positions.

5.1 Takeaways

After transcribing interviews and a review of previous literature, there are a number of takeaways that can be identified as well as information to take notice of. As first noted, the use of multiple forms of social media provided not only an overall big picture to responders, but it helped to fill in missing details. The usage of multiple forms of media was utilized by a majority of respondents in order to better understand the disaster situation. Those on the front lines should take notice of this trend – if they choose to use social media during their response, they should use forms that not only

incorporate text, but also images. Emergency Managers, Public Information Officers, representatives of agencies and organizations, and any others running social media sites that citizens interact with should have more than one area of social media presence, such as a Facebook Page, Twitter feed, and Instagram account, as relaying the same message multiple ways helps to solidify the information being shared. They should also remember that not only are citizens looking at these sources, but authorities and officials that are responding also view them and they may be the only form of communication that is available at that time, as was pointed out by one of the interviewees for this study.

A second finding was that while misinformation or rumors was listed from a total of 8 respondents as being a perceived limitation of social media, 5 of those people still utilized it while conducting their response duties. While rumors can start quickly and spread faster during disasters, previous research has found that citizens will often self-correct information (Banerjee & Rao, 2020). It has also been found that utilizing multiple forms of social media to gain information, such as discussed prior, helps to stop or control rumors. It has also been found that when authorities respond to rumors and correct misinformation, the rumors end faster than if no response is given; this is one job of the Virtual Operations Support Teams (VOST), which can be utilized during a disaster to help responders. Their job is not to stifle the information being given by citizens or others, but to verify the accuracy and correct any misinformation. Additionally, another way to combat misinformation and rumors is to train and exercise first responders on how to spot false information so that resources are not being diverted to unconfirmed needs. There are many other ways to combat this

misinformation and learn how to spot false information so that the response would not be jeopardized. Those with concerns should reach out to FEMA or other organizations and agencies to create partnerships (Countering False Information on Social Media in Disasters and Emergencies, 2018).

Third, it was found that the job duties that the individual was assigned changed how they utilized social media, what sources they used, and how it was applied to their work. All respondents have a form of resource management or logistics within their job duties, whether that was helping local jurisdictions gather supplies, transporting supplies and patients, or managing what resources were available after the storm – social media was useful in some way. Additionally, each individual was able to modify their actions or plans to achieve their goals by utilizing information obtained by this technology – logistics was able to relocate so that their State Supply Requests reached their destination for fulfillment, Ambulance Strike Teams utilized maps and radar to ensure their patients stayed safe and were evacuated from the area, and the Engine Response Teams were able to remotely coordinate stations for incoming material convergence. These actions show the importance of allowing responders the freedom to access and utilize social media; it is known that some agencies, departments, and organizations do not allow their employees to utilize social media for fear of liability or repercussions should something go wrong, however, the utilization found in this research shows the benefits of allowing access.

Finally, the timing of responders' deployments and arrivals at the disaster location varied their usage of social media. It is well known that communication is one of the first things that go down during disasters, however, it is also known that while phone

lines can be jammed and cell towers are not at their highest functioning ability, things like SMS and small amounts of internet data are still capable of working (Reynolds, 2011). Further, it was found that locations just 15 minutes from each other had varying cell phone and internet access and capabilities. Those in the fields of Information Technology, Electronics, Engineering, and Telecommunications can take this information into account for future creations so that the availability and capabilities of their designs continue to grow with the needs for their products.

5.2 Future Research

Upon coding the data for this research study, a correlation was found between the number of years of service each participant had, and the perceived limitations and benefits, as well as the usage of, social media during Hurricane Harvey. Specifically, this study found that those who began their response career after the social media popularity shift in 2004 and have less than 15 years of first response service were more likely to use social media and perceive it as beneficial; this finding was the same for those with more than 25 years of service who came into the response career field before social media. Those who have between 15 and 25 years of service whose careers began right before social media became popular or in the beginning phases of the social media boom were more likely to not use the technology and to perceive it in a negative light.

This is a relatively unknown possible theme that emerged, and the author had difficulty locating previous literature that addresses this topic. Since this correlation emerged after interviews, there was no discussion with the respondents regarding the

topic. This is an area that needs to be researched further as there are limitations to this study.

5.3 Future Implications

As was found in this study, there is a generational hesitancy when it comes to the use of social media. Organizations and employers who put social media policies and procedures into place should take into account the concerns of all employees; while some employees may be more likely to use social media, they should not disregard the opinion and thoughts of those who hesitate. Hesitation may stem from a personal view, from the perceptions of the quality of content posted, or even from the associated risks (Han, Tan, Lee, Lee & Mahendran, 2021), or it may come from fear of the repercussions of accidental use or how one will be perceived by others on the internet.

Society today has become a ‘cancel culture’, and when something on social media is viewed as negative or offensive, whether or not that was the intention, the people, company, or organization that has posted or is even associated with said posting face serious repercussions; people who have been ‘canceled’ have lost their credibility, their families, their homes, and even their careers over what others deem moral injustices (Norris, 2020). As such, it is important that agencies and organizations are sensitive to the hesitancy of some employees and take cautionary measures when implementing social media usage and restriction policies

A second implication is the need to enhance the Information Technology (IT) infrastructure. As was shown by the research cited previously in this study, as well as others, social media and other technological tools such as GIS and crowd sourcing are becoming essential to disaster response. As has been shown by disasters such as

Hurricane Harvey, it is not uncommon for the IT infrastructure to fail during the greatest times of need., proving the need for an enhancement of these tools and their resilience as they are becoming utilized more often during disasters and their multiple phases (Comes, Meesters, & Torjesen, 2019; Firdhous & Karuratane, 2018).

5.4 Limitations

There are some limitations to this study. The first limitation is the sample size of interviewees; while 20 is a good number for a thesis, it is not a good indicator of all responders; it is estimated that there were upwards of 300,000 people that responded to Hurricane Harvey ("Historic Disaster Response to Hurricane Harvey in Texas", 2017). Further, of those interviewed, the majority are members of the fire service, with one physician and one emergency manager – this leaves out countless professions, organizations, companies, and governmental agencies.

One other limitation is that while snowball sampling was used, many responders had changed fields, positions, departments, or declined further deployment opportunities when contacted about participation. Additionally, during the time of interviews, there were 2 other hurricanes, Hurricane Laura and Hurricane Marco, as well as additional wildfires raging throughout the country which were being responded to by those who were requested to interview; unfortunately, time and availability was a major limitation for this research.

5.5 Summary

As social media becomes more prevalent in our lives, it cannot be removed during times of disaster. First responders can, and do, utilize social media in much the same way that citizens do – to gain information. Although much literature exists on how

citizens, governmental agencies, organizations, and companies utilize social media during a disaster, there is a paucity of literature examining how first responders utilize this tool to conduct their response. Through qualitative interviews with first responders of Hurricane Harvey, this study has focused on that aspect of emergency management and disaster science. This research found four key themes through these interviews.

5.5.1 More Than Just Twitter

First responders utilized information from multiple social media channels and avenues in order to conduct their response. The information helped these responders in gaining a big picture of the disaster as well as gain important smaller detailed pieces of information with which they utilized to conduct their response.

5.5.2 Rumor Has It

Misinformation, rumors, and inaccurate information was the biggest perceived limitation of social media. This applied not only to those who did not use social media in their response, but also to some responders who did. Knowing there is misinformation is important when conducting response in order to ensure accurate distribution of resources and assets.

5.5.3 One Size Does Not Fit All

Depending on the job duties assigned, responders used social media tools in differing ways. All responders had some form of resource management or logistics and were able to perform their job duties by accessing the social media resources that best worked for them. This shows there is not a one size fits all social media platform.

5.5.4 Timing is Everything

Deployment and arrival dates also influenced the responders and how they used social media. Those who arrived pre-storm were able to access social media until the storm hit. Once the storm made landfall some respondents did not have access to social media while some did, depending on their physical location. After landfall, some responders were without access for multiple days while others never lost service, and after landfall the accessibility of social media seemed to return to normal, allowing those who arrived after the storm to have normal access to services.

In conclusion, social media played an important role in the response duties of those who responded to Hurricane Harvey. Social media has become an integrated part of society and individuals' lives, therefore it is important to understand how it can be incorporated into disaster response. As was shown through the literature review, communication is essential to the disaster process, and social media can be a key component in both communication and disasters. Crisis informatics is known to be crucial in the study of social media in disasters as it focuses on the behavior of those involved and the impact of technology within the disaster context. Social media's birth can be argued from the beginning of time however the popularity rose quickly in 2004 with the invention of MySpace. Since that time, the inventions, platforms, applications, and other various forms of social media have not slowed down in invention or use, and social media is now integrated into our everyday lives, making it extremely important to recognize the importance of technology and to understand how it can be incorporated into disaster response.

While there is a plethora of research on social media, case studies, technologies

used, behaviors within, and various aspects of social media in regard to its use in disaster science, there is a lack of research on how first responders use it to conduct their job duties. Hurricane Harvey is on par with Hurricane Katrina in terms of damage caused, it was the first category 3 or higher hurricane to hit the state of Texas in nearly 30 years, and it led to many deaths. After the multitude of information gained by studying Hurricane Katrina, it makes sense to also contribute the same effort to researching Hurricane Harvey.

Many lessons can be learned from this study, as were discussed prior in this chapter. Retrieving information from multiple social media streams can help provide needed information to first responders; rumors and misinformation is still a concern when using the technology, but there are ways to make it safer and dissolve the false data. Additionally, there are many opportunities for future research as the limitations of this study include a small sample size and a limited scope in terms of response career paths that were interviewed. Further, there is a need for future research into the possible correlation between years of service (or age), perceptions of social media, and usage by first responders. Further, the vast array of agencies, formal and informal, and individuals that responded to Hurricane Harvey provide ample opportunities to understand how social media was used by those outside of this research group.

Social media was useful and contributed greatly to the group of responders that were interviewed for this specific study. With the growth and popularity of social media, we should expect that it will continue in this pattern and seek to understand how to better incorporate it into disaster response.

APPENDIX

INTERVIEW GUIDE

- What agency did you respond with during Hurricane Harvey?
    - What is your official title?
    - What are your primary duties during a disaster response?
        - How do these differ from your routine, non-disaster response duties?
- At what points in time did you view social media when responding to Hurricane Harvey?
    - What social media outlets did you view?
    - What was the objective when viewing social media?
    - Did you specifically look for disaster-related information? Yes/No
        - What information did you come across?
        - Who posted the disaster related information?
    - Did you utilize any information from social media when conducting response? Yes/No
        - In what way?
    - Did you pass disaster-related information on to others? Yes/No
        - In what way?
- Had you previously utilized social media during your non-disaster response duties? Yes/No
    - Which outlets?
    - What did you use it for?
- Have you utilized social media since Hurricane Harvey in order to conduct non-disaster response duties?
    - Which outlets?
    - What did you use it for?
- What limitations do you perceive from social media and disaster response?

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