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Hurricane Impact on Emergency Services and Use of Telehealth to Support Prehospital Care

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BRIEF REPORT

Hurricane Impact on Emergency Services and Use of Telehealth to Support Prehospital Care

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ABSTRACT

The impact of hurricanes on emergency services is well-known. Recent history demonstrates the need for prehospital and emergency department coordination to serve communities during evacuation, storm duration, and cleanup. The use of telehealth applications may enhance this coordination while lessening the impact on health-care systems. These applications can address triage, stabilization, and diversion and may be provided in collaboration with state and local emergency management operations through various shelters, as well as during other emergency medical responses.

Key Words: disaster, hurricane, prehospital, shelter, telehealth

Hurricanes are multifaceted incidents that threaten life, property, and infrastructure with effects that range from inconvenience to extended disaster. Local emergency and health-care services may be significantly impacted, and changes in patient volume may necessitate staffing modifications.[1] The effect on individuals is also profound and may be greater for those with limited means or a reliance on daily medical support, especially in the event of an evacuation. In South Carolina, these individuals may seek shelter in general population shelters (GPS), while those requiring more comprehensive outpatient medical care may relocate to special medical needs shelters (SMNS).[2,3] Generally, SMNSs are geographically distant from a disaster area to allow medically dependent people and caregivers to wait in safety, accessing electricity, other resources, and assistance from a SMNS nurse. Unfortunately, not everyone in shelters has an uneventful stay. If a medical emergency occurs, an emergency medical services (EMS) ambulance is dispatched, if local emergency crews are able to respond,[3] to transport the patient to an emergency department (ED). However, these medical transports are expensive, difficult for patients, potentially risky, and may be preventable through telehealth.

The versatility of telehealth is increasingly recognized as a valuable tool in both routine prehospital use and disaster applications.[4-14] Previous EMS experience has successfully implemented this technology to reduce ED utilization for low acuity and psychiatric patients, as well as to improve access to provider education and specialty care for stroke, cardiac, and trauma patients.[14-19] Telehealth has been used for disaster planning and education.[20-23] There has also been some use during and after disasters, with models primarily focusing on triage and improving access to care.[8,24-31] This experience suggests that telehealth models could be used to address select medical issues encountered at shelters and in emergency responses during a disaster, which may enable patients to shelter in place.

In this study, we describe the use of telehealth technologies to assist shelters and prehospital providers near Charleston, South Carolina, during Hurricane Florence. We detail surrounding events to demonstrate telehealth potential, assess feasibility after a pilot study, describe steps for future disaster preparation, and explore the applicability of telehealth-support to shelters and emergency medical services.

NARRATIVE

Recent hurricanes have taxed EMS resources in the Charleston, South Carolina, region, even before making landfall. Facing large-scale evacuations, EMS has been tasked with the movement of nursing home and hospital patients and individuals with medical or mobility challenges. Some ambulances may be unavailable for hours while relocating patients inland, reducing emergency response resources, while also impacting receiving communities with the population increase. Changes in traffic flow related to evacuations and impassable roads also impact local EMS operations. Additional challenges result when medical providers, including staff from dialysis centers, clinics, and home health agencies, evacuate and leave patients with minimal support and little recourse other than accessing EMS to obtain critical services.

Shelters may impact EMS when individuals have medical needs not addressed by onsite services. GPS staff may have little to no medical training and may call EMS for assistance lifting patients or other minor medical emergencies. Further, occupants of shelters may not bring all needed medications and medical devices to shelters, resulting in requests for assistance. While the provision of medical support to community shelters is a critical responsibility of EMS, it can strain a system facing other operational challenges and decreased available personnel.

Once recent storms have made landfall, emergency operations have been further impacted. EMS stops responding when wind speeds are sustained above 39 miles per h and does not resume until winds subside. Any calls received in this period are held and triaged until EMS resources can safely respond. This backlog can initially tax responders, as can an increase in EMS volume after the storm. Extensive flooding and traffic impediments have presented additional response and transport challenges, often for extended periods. Simultaneously, local hospitals have looked to reduce patient volume in anticipation of a hurricane. These infrastructure challenges impact local shelters. For example, during Hurricane Florence, 13 SMNSs were activated with 1 shelter operating for 23 continuous days due to ongoing dislocation of residents.

With the myriad of challenges faced by emergency services, alternative approaches to care and operations are critical. Telehealth applications are increasing in use, especially in South Carolina.[32] Local EMS has partnered with the academic medical center to use telehealth to link EMS with physicians and other health-care providers for various needs, including neurologic evaluations and psychiatric assessments.[33]

Before Hurricane Florence, agencies collaborated to create a telehealth model to support local shelters and EMS operations, including mental health emergencies. Vidyo, a Health Insurance Portability and Accountability Act (HIPAA) -compliant meeting room, creates a virtual space where patients can connect with providers for a video assessment. EMS providers at the bedside can facilitate assessment by an emergency physician (EP) and assist with vital signs, physical examination, limited point-of-care testing, and cardiac monitoring. The EP can then implement triage decisions, limited interventions, and electronic prescribing of medications, if needed. In addition to hosting secure meeting rooms, Vidyo was also selected to take advantage of the H.264 standard for video compression, Scalable Video Coding (SVC), which is effective in rural areas with limited bandwidth.[34] The use of real-time video to assess patients is highly dependent on the quality of the cellular connection and bandwidth availability. During hurricanes and mass evacuations, cellular towers can become oversubscribed, which limits connectivity, although prioritized first-responder networks are available.[35]

DISCUSSION

Even though Hurricane Florence passed north of the Charleston area, a mandatory evacuation of the coast and storm surge did create challenges in the region and impacted local emergency services. Charleston-area shelter occupancy increased in advance of the storm, while local EMS transports to EDs decreased then rebounded after the storm (Figure 1). This increased shelter population suggests that these sites may be areas to focus telehealth applications, while changes in workload for EMS and ED staff may allow for reallocation of resources to support such initiatives.

Although shelter populations during Florence did not impact EMS volume, previous hurricanes had a more profound effect on EMS operations. Overall, Florence did not impact the average call length for EMS, although staffing levels were reduced approximately 20% at the time of the storm. Impact to ED operations was more significant. During evacuations and continuing through the storm, EMS limited patient transports to the closest appropriate medical facility. As a result, many hospitals saw significant changes in ED patient volume, with hospitals further inland experiencing marked increases. Hospitals in flood zones saw large decreases in ED volume around the storm, with the academic medical center requiring 5 days to recover to prestorm volume.

Before the storm, EMS personnel were equipped with laptops configured with Vidyo software to connect EPs at the academic medical center to EMS personnel, allowing for real-time patient assessment and treatment with hopes of reducing unnecessary transports. Test calls were routed through the hospital Admit Transfer Center, which helped EPs connect with on-scene EMS personnel and access charting software to create a record of the encounter. EMS followed their routine care and documentation protocols. EMS units were able to use their usual cellular networks, but future use will likely access secure networks that prioritize first-responder network traffic. The feasibility of these telehealth interventions was successfully piloted during prestorm activations.

Due to the path Hurricane Florence took through South Carolina, there was a lack of significant usage data with this pilot. Shelters, both GPSs and SMNSs, were delayed in opening due to the uncertain path of the hurricane and the expected intensity of the storm. Only after the storm track shifted north did the less-severe forecast minimize the number of shelters operating in the Charleston coastal zone.

Still, the team conducted an after-action report, and feedback from EMS personnel centered on 2 areas. First, there were technical issues surrounding initial deployment of telehealth enabled laptops, requiring coordination among EMS, ED, and telehealth staff. Second, EMS leadership requested expanded deployment, but the shifting storm spared the region from worse impact. Additional EMS support was

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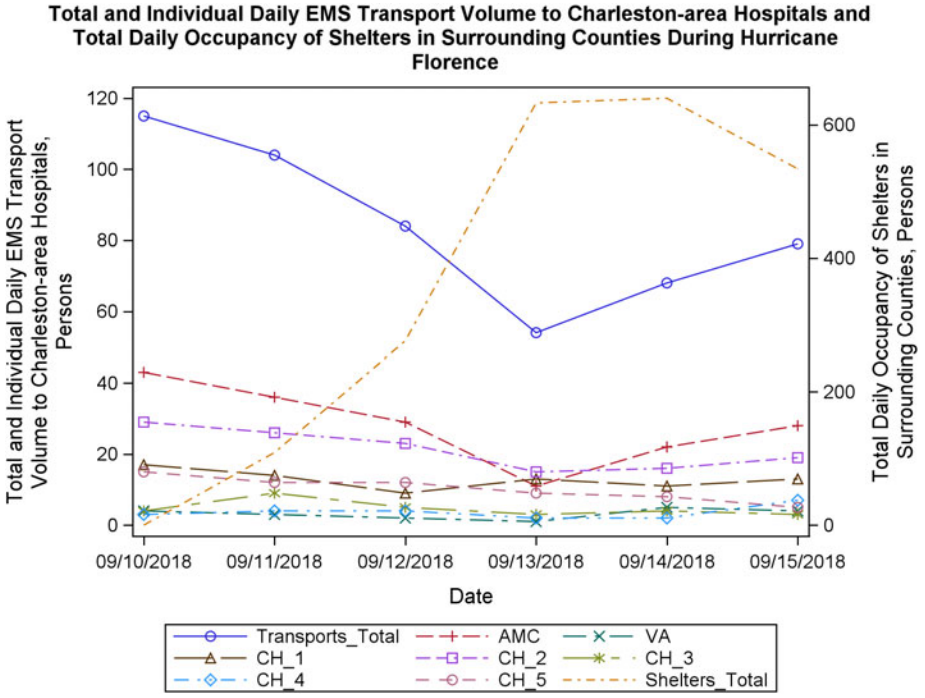
FIGURE 1

Total Daily EMS Transport Volume to Charleston-Area Hospitals and Total Daily Occupancy of Surrounding Area Shelters During Hurricane Florence. Legend indicating mileage from Academic Medical Center (AMC): Veterans Administration (VA) 1.0 miles; Community Hospital 1 (CH1) .5 miles; Community Hospital 2 (CH2) 7.2 miles; Community Hospital 3 (CH3) 8.1 miles; Community Hospital 4 (CH4) 13.9 miles; and Community Hospital 5 (CH5) 17.8 miles.



provided to affected counties to the north during the weeks following Hurricane Florence, and some units were equipped with telehealth services for mental health triage.

Strengths

This case demonstrates that implementation of telehealth applications to support medical needs at shelters is feasible. Furthermore, EMS can use the technology for medical and psychiatric emergencies during a disaster, and embedding telehealth with EMS allows for expanded community access and improved on-scene assessment and intervention when compared with other telehealth models. This implementation was accomplished with minimal changes to infrastructure and hardware for EMS and hospitals.

Limitations

The biggest limitation is that there were no actual uses to report. While feasible, demonstration of successful interventions is important. Further, there were no impacts to local infrastructure or cellular connectivity, which might limit telehealth use in a disaster.

Implications to Practice

After the pilot, discussions with local and state agencies have been ongoing to expand future use to support both GPSs and SMNSs with triage, assessment, and management of minor medical complaints, psychiatric evaluations, and access to specialty care. Evaluation of local connectivity for security and durability is also ongoing. Development of such infrastructure will allow telehealth applications to be applied to multiple situations in the prehospital environment to assist with weather-related and other events where the community is impacted for an extended period. In addition, this may allow for extension of community paramedicine models with routine home visits to patients. Regardless of use, ongoing conversations with federal, state, local, and nonprofit partners need to be prioritized to ensure that connectivity is addressed and that agencies can fully meet community needs.

CONCLUSIONS

Telehealth is increasingly recognized as an important asset in disaster management, but infrastructure to support these applications must be established in advance. Partnerships to support care and connectivity are critical components of these

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programs. Ultimately, growing trends toward frequent and severe weather events necessitate addressing these challenges and opportunities in a proactive and replicable manner, and telehealth should be deployed as an innovative tool to meet emergent community needs.

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Conflicts of Interest

These authors have no conflicts of interest to disclose.

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REFERENCES

1. McQuade L, Merriman B, Lyford M, et al. Emergency department and inpatient health care services utilization by the elderly population: Hurricane Sandy in the state of New Jersey. *Disaster Med Public Health Prep*. 2018;12(6):730-8.
2. South Carolina Department of Health and Environmental Control. special medical needs shelters: a preparedness guide. https://www.scdhec.gov/sites/default/files/Library/ML-025588.pdf. 2018. Accessed March 4, 2019.
3. Florida Health Emergency Preparedness & Response. Special Needs Shelter Program. http://www.floridahealth.gov/programs-and-services/emergency-preparedness-and-response/disaster-response-resources/spns-index.html. 2018. Accessed March 4, 2019.
4. Doarn CR, Latifi R, Poropatich RK, et al. Development and validation of telemedicine for disaster response: the North Atlantic Treaty Organization Multinational System. *Telemed J E Health*. 2018;24(9):657-68.
5. Lurie N, Carr BG. The role of telehealth in the medical response to disasters. *JAMA Intern Med*. 2018;178(6):745-6.
6. Greenwald PW, Hsu H, Sharma R. Planning for future disasters: telemedicine as a resource. *Ann Emerg Med*. 2018;71(3):435-6
7. Kim TJ, Arrieta MI, Eastburn SL, et al. Post-disaster Gulf Coast recovery using telehealth. *Telemed J E Health*. 2013;19(3):200-10.
8. Uscher-Pines L, Fischer S, Chari R. The promise of direct-to-consumer telehealth for disaster response and recovery. *Prehosp Disaster Med*. 2016;31(4):454-6.
9. Ajami S, Lamoochi P. Use of telemedicine in disaster and remote places. *J Educ Health Promot*. 2014;3:26.
10. Latifi R, Tilley EH. Telemedicine for disaster management: can it transform chaos into an organized, structured care from the distance? *Am J Disaster Med*. 2014;9(1):25-37.
11. Case T, Morrison C, Vuylsteke A. The clinical application of mobile technology to disaster medicine. *Prehosp Disaster Med*. 2012;27(5):473-80.
12. Alverson DC, Edison K, Flournoy L, et al. Telehealth tools for public health, emergency, or disaster preparedness and response: a summary report. *Telemed J E Health*. 2010;16(1):112-4.
13. Centers for Medicare & Medicaid Services. Emergency Triage, Treat, and Transport (ET3) Model. 2019. https://www.cms.gov/newsroom/fact-sheets/emergency-triage-treat-and-transport-et3-model. Accessed June 28, 2019.
14. Amadi-Obi A, Gilligan P, Owens N, et al. Telemedicine in pre-hospital care: a review of telemedicine applications in the pre-hospital environment. *Int J Emerg Med*. 2014;7:29.
15. Langabeer JR, Gonzalez M, Alqusairi D, et al. Telehealth-enabled emergency medical services program reduces ambulance transport to urban emergency departments. *West J Emerg Med*. 2016;17(6):713-20.
16. South Carolina Department of Mental Health. The DMH telepsychiatry program. https://scdmh.net/dmhtelepsychiatry/telepsychiatry/. Accessed June 30, 2019.
17. Boniface KS, Shokoohi H, Smith ER, et al. Tele-ultrasound and paramedics: real-time remote physician guidance of the Focused Assessment with Sonography for Trauma examination. *Am J Emerg Med*. 2011;29:477-81.
18. Itrat A, Taqui A, Cerejo R, et al. Telemedicine in prehospital stroke evaluation and thrombolysis: taking stroke treatment to the doorstep. *JAMA Neurol*. 2016;73(2):162-8.
19. Winburn AS, Brixey JJ, Lanagabeer J, et al. A systematic review of prehospital telehealth utilization. *J Telemed Telecare*. 2018;24(7):473-81.
20. Dorigatti AE, Pereira BMT, Simoes RL, et al. In-person and telemedicine course models for disaster preparedness: a comparative analysis. *Rev Col Bras Cir*. 2018;45(3):e1710.
21. Follmann A, Ohligs M, Hochhausen N, et al. Technical support by smart glasses during a mass casualty incident: a randomized controlled simulation trial on technically assisted triage and telemedical app use in disaster medicine. *J Med Internet Res*. 2019;21(1):e11939.
22. Xiong W, Bair A, Sandrock C, et al. Implementing telemedicine in medical emergency response: concept of operation for a regional telemedicine hub. *J Med Syst*. 2012;36(3):1651-60.
23. Doarn CR, Merrell RC. Telemedicine and e-health in disaster response. *Telemed J E Health*. 2014;20(7):605-6.
24. Der-Martirosian C, Griffin AR, Chu K, et al. Telehealth at the US Department of Veterans Affairs after Hurricane Sandy. *J Telemed Telecare*. 2019;25(5):310-7.
25. Uscher-Pines L, Fischer S, Tong I, et al. Virtual first responders: the role of direct-to-consumer telemedicine in caring for people impacted by natural disasters. *J Gen Intern Med*. 2018;33(8):1242-4.
26. Vo AH, Brooks GB, Bourdeau M, et al. University of Texas Medical Branch telemedicine disaster response and recovery: lessons learned from Hurricane Ike. *Telemed J E Health*. 2010;16(5):627-33.
27. Augusterfer EF, Mollica RF, Lavelle J. A review of telemental health in international and post-disaster settings. *Int Rev Psychiatry*. 2015;27(6):540-6.
28. Callaway DW, Peabody CR, Hoffman A, et al. Disaster mobile health technology: lessons from Haiti. *Prehosp Disaster Med*. 2012;27(2):148-52.
29. Hu M, Sugimoto M, Hargrave AR, et al. Mobile healthcare system for health checkups and telemedicine in post-disaster situations. *Stud Health Technol Inform*. 2015;216:79-83.
30. Rolston DM, Meltzer JS. Telemedicine in the intensive care unit: its role in emergencies and disaster management. *Crit Care Clin*. 2015;31(2):239-55.
31. Piza F, Steinman M, Baldisserotto S, et al. Is there a role for telemedicine in disaster medicine? *Crit Care*. 2014;18(6):646.
32. Ford D, Cristaldi KK, McElligott J. MUSC national beacon of telehealth excellence: case use for future deployment. In: Converge2Xcelerate (ConV2X) Special Podcast Edition - Telehealth and Medicine Today.

https://doi.org/10.1017/dmp.2019.101

2018. https://telehealthandmedicinetoday.com/index.php/journal/article/view/120. Accessed March 4, 2019
33. McClain L. Highlights from second day of health: further – Nashville Medical News Blog. Nashville Medical News Blog. 2018. https://nashvillemedicalnews.blog/2018/08/30/highlights-from-second-day-of-healthfurther/. Accessed March 4, 2019.
34. Video Conferencing | Video Banking | Telehealth | Cloud Video | Vidyo. https://www.vidyo.com/. Accessed March 4, 2019.
35. Hochgraf C, Nygate J, Bazdresch M, et al. Providing first responders with real-time status of cellular networks during a disaster. In: 2018 IEEE International Symposium on Technologies for Homeland Security (HST). IEEE; 2018:1-4.