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THE IMPLEMENTATION OF AN EMERGENCY MEDICINE TELEHEALTH SYSTEM DURING A PANDEMIC

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☐ **Abstract—Background: In March of 2020, the World Health Organization declared coronavirus disease 2019 (COVID-19)—a disease caused by a novel coronavirus—a pandemic, and it continued to spread rapidly in the community. Our institution implemented an emergency medicine telehealth system that sought to expedite care of stable patients, decrease provider exposure to COVID-19, decrease overall usage rate of personal protective equipment, and provide a platform so that infected or quarantined physicians could continue to work. This effort was among the first to use telehealth to practice emergency medicine in the setting of a pandemic in the United States. Discussion: Outside the main emergency departments at each of 2 sites of our academic institution, disaster tents were erected with patient care equipment and medications, as well as technology to allow for telehealth visits. The triage system was modified to appropriately select low-risk patients with symptoms suggestive of COVID-19 who could be seen in these disaster tents. Despite some issues that needed to be addressed, such as provider discomfort, limited medication availability, and connectivity problems, the model was successful overall. Conclusions: Other emergency departments might find this proof of concept article useful. Telehealth will likely be used more broadly in the future, including emergency care. It is imperative that the health care system continues to adapt to respond appropriately to challenges such as pandemics.** © 2020 Elsevier Inc. All rights reserved.

☐ **Keywords—COVID-19; pandemic; telehealth; disaster medicine**

INTRODUCTION

In late 2019, coronavirus disease 2019 (COVID-19)—a disease caused by a novel coronavirus—emerged as a worldwide threat. In March of 2020, the World Health Organization declared this disease a pandemic, as it continued to spread rapidly across the globe. With the advantage of time and experience gained from observing the challenges faced by frontline providers in other parts of the world, departmental efforts to prepare for the pandemic and reduce the negative impacts of a looming large influx of patients became paramount. The implementation of an emergency medicine telehealth system was identified early as a potential mechanism to assist in managing some of the unique challenges of this pandemic, chiefly those related to large patient volumes, provider safety, inadequate global supplies of personal protective equipment (PPE), and physician staffing shortages.

The implementation of this emergency medicine telehealth system sought to expedite care of stable patients, decrease provider exposure to COVID-19 by decreasing face-to-face contact with potentially infectious patients,

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decrease overall use rate of PPE, and provide a platform that infected or quarantined physicians could continue to work in spite of being unable to assess and treat patients in person. This effort was among the first, to our knowledge, to use telehealth to practice emergency medicine in the setting of a pandemic in the United States.

DISCUSSION

Background

The use of telehealth by emergency physicians has generally been limited to staffing rural emergency departments (EDs) and in the triage of patients in both the hospital and prehospital settings. Previous efforts in rural Australia to use telehealth to bring emergency physician expertise to departments primarily staffed by nurses with minimal in-person physician support proved feasible (1,2). Tolia et al. used telehealth with emergency physicians to treat patients at the point of triage prior to evaluation by onsite emergency physicians; in this program, emergency physicians either completed patient care and disposition or handed off care to the onsite physician (3). This program was associated with reduced patient throughput time.

In addition, telehealth in the emergency medicine setting has been leveraged to increase availability of consultant services by bringing specialists to the bedside when such face-to-face consultation is not possible. It has been used extensively to help bring the expertise of pediatric intensivists and pediatric emergency physicians to departments that otherwise do not have this expertise (4–6). It has also been used to increase the availability of psychiatry services in EDs in the United States (7). In the prehospital setting, it has enabled mobile stroke units to have virtual direction from a neurologist, thereby allowing for shorter time to thrombolysis (8).

There is precedent for the use of telehealth during natural disasters; however, in these circumstances it has generally been used to reach patients for ongoing provision of primary care and mental health services (9). It has been used increasingly for these purposes since the beginning of the COVID-19 pandemic, as well as to reduce the need for in-person visits for mental health and primary care (10–12). However, this has been taking place primarily in the outpatient setting.

METHODS

In preparation for the pandemic, large patient care tents were erected in parking lots outside the EDs of our two quaternary academic medical centers (Figure 1). The tents were set up in the same manner and with the same proximity to each ED. These tents were furnished with chairs and gurneys to accommodate approximately 10–15 patients each. Each patient station was isolated by a physical plastic barrier to limit patient cross contact. Critical equipment, such as vital sign devices, oxygen, point-of-care glucometers, electrocardiogram machines, code carts, and a portable x-ray machine, was available in the tents. A limited formulary of therapeutic medications, such as intravenous fluids, acetaminophen, ibuprofen, oral disintegrating ondansetron, and metered-dose inhalers were present. Laboratory diagnostic testing was also available; however, it required staff to carry patient blood and other samples a short distance from the tent to the main hospital. A wireless access point was deployed in addition to several laptop computers for staff to document visits, message providers, and track patients in the electronic health record (EHR). Each tent was staffed with at least two registered nurses (RNs) and one emergency medical technician (EMT). This required working with nursing staff to ensure that there were enough staff available each day to manage the tent and the main ED. Regarding physician staffing, the telemedicine concept allowed, in theory, for attending physicians to conduct medical screening examinations from home in the event that they were required to quarantine. The tents were cleaned regularly, social distancing was observed, and masks were worn by staff and patients at all times.

Because the tents were generally open from 12:00 PM until 9:00 PM, the area was prepared with space heaters and blankets for patients and staff to use during cooler hours, with outdoor lighting for darker hours, and with fans and ample drinking water to use during warmer hours. We did have some days of rain, which required us to keep electrical equipment off the ground and inside the waterproof tents during these periods as well as overnight. We had the distinct advantage, due to our location in California (coastal, western United States), of a moderate spring climate. Tents erected in other locations around

Figure 1. Two large disaster tents were erected outside of the main emergency department.

the world, and during other times of the year, might also have to prepare for issues such as snow removal and excessive heat.

Our triage system was modified to group patients into potential COVID-19–related symptoms vs. non-COVID-19–related symptoms. Patients were evaluated by a triage team consisting of an RN and an EMT in a controlled environment outside the front entrance of our ED. The patients were masked and registered. A pulse oximeter was applied to collect oxygen saturation and pulse rate. If the patient's reported symptoms were concerning for COVID-19 infection (respiratory screen), they were then asked a series of scripted questions to screen for pre-existing conditions and severe symptoms. Patients presenting with possible COVID-19 symptoms but without significant comorbidities or unstable vitals signs were triaged to a disaster response COVID-19 tent, where telehealth could be performed (Figure 2). If additional relevant comorbidities were identified later in treatment, or if patients developed significant vital sign abnormalities or work of breathing on reassessment, they were sent back into the main ED for additional face-to-face evaluation and treatment by our normal process. If patients presented with symptoms concerning for COVID-19 infection and were not suitable for a telehealth tent evaluation, they were placed in a designated isolated waiting room area called the "red zone" or were placed directly into a room in the ED if unstable and in need

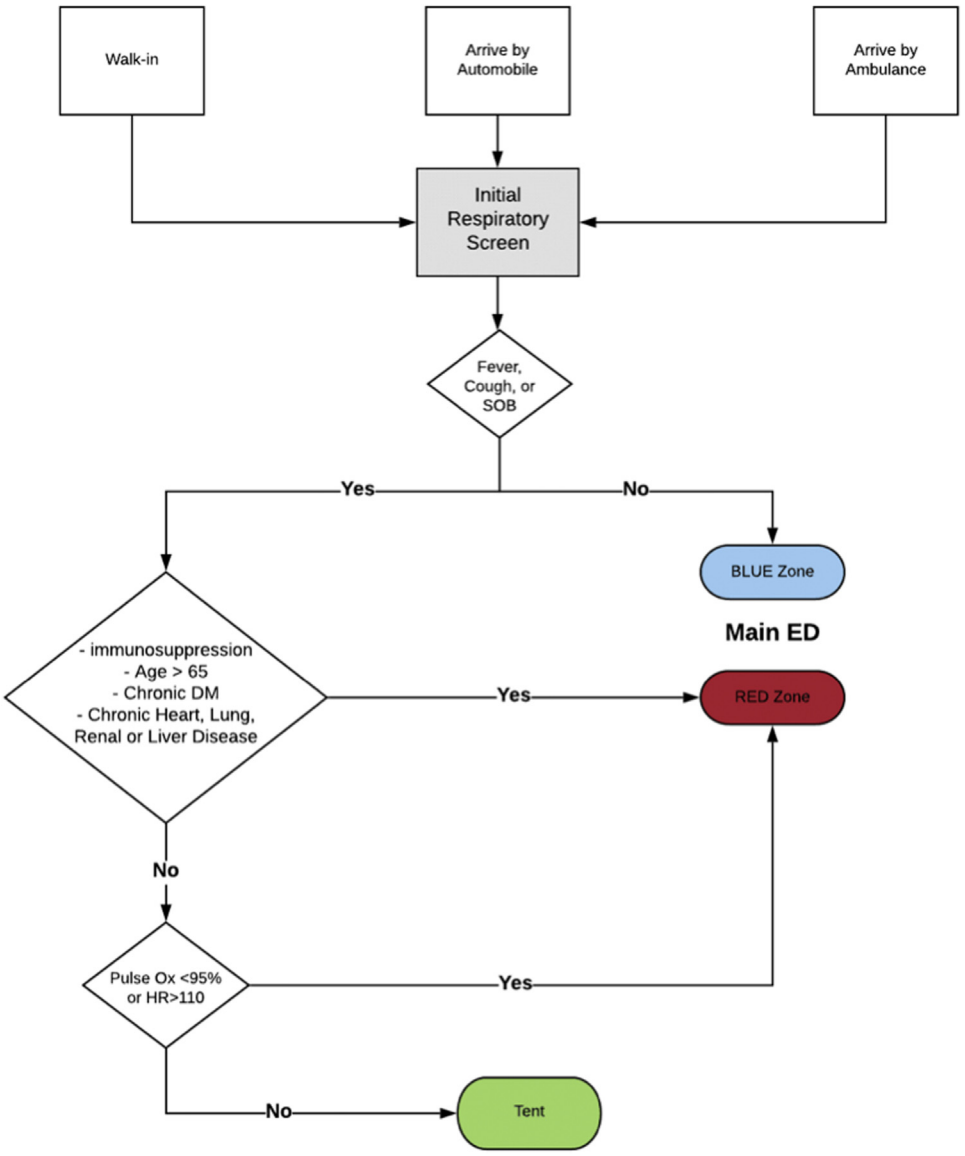

Figure 2. An algorithm was developed to appropriately triage patients into the tent or the main emergency department (ED). DM = diabetes mellitus; HR = heart rate; Ox = oximetry; SOB = short of breath.

of emergent intervention. If patients presented with symptoms not consistent with COVID-19, they were placed in a designated isolated waiting room area called the "blue zone," and underwent our normal triage and non-telehealth evaluation and treatment process.

Patients triaged to the telehealth workflow were then escorted by ED staff to the tent after verbally consenting to a video encounter. A nursing assessment was performed and documented in the EHR. Nursing staff then securely messaged the remote telehealth emergency physician digitally through the EHR signaling the patient was ready for the encounter. A tablet computer (Apple iPad, 6th generation; Apple, Cupertino, CA) with an Internet-connected, high-resolution webcam mounted on a mobile cart was placed in front of the patient. Nursing staff was trained to position the cart ensuring the entire torso and head of the patient was visible on the screen to ensure work of breathing could be assessed. Real-time two-way audio video communications were performed by a widely available software application (Zoom, version 4; Zoom, San Jose, CA]. Emergency physicians performed telehealth history and physical examinations in real time and were assisted by nursing or technician staff when needed. Translation services were available for patients who did not speak English.

There was one difference between the workflow of our two sites. At one of the two EDs, which is primarily staffed by residents with supervising attending physicians, a hybrid telehealth model was used intermittently. A resident assigned to the tent would see the patient face to face and perform a standard history and physical. Residents would then present the evaluated patients to a remotely located attending emergency physician using the same telecommunication platform, and the attending physician then would perform their own history and physical examination via telehealth. At the other of the two sites, the telehealth encounters were performed by attending physicians via telehealth only. At both sites, electronic health record messaging was used to notify attending providers of when patients were ready for evaluation.

Lessons Learned

The COVID-19 pandemic has provided an opportunity for emergency medicine providers to learn many lessons. It has also required a creative and dynamic approach to solving new and unforeseen problems. Throughout the health care system, it has been important to address issues with the supply chain, workforce, and other elements of disaster planning. For example, as it became necessary to use PPE more frequently and with a larger set of patients, it became apparent to all that the supply of PPE was finite and all care providers participated in an effort to conserve it. Providing telehealth in our emergency disaster tent was one way that we contributed to reducing PPE use. There was also concern, given evidence from locations such as Italy and New York City, which had faced the pandemic to a greater magnitude at an earlier stage than we had in our location in California, that many providers would be exposed and may have to be quarantined. This led to concern about inadequate personnel to care for an expected influx of patients. This system helped to reduce the number of staff members who were exposed to patients with suspected COVID-19. These problems and others highlighted the need for a significant shift in health care system disaster preparedness.

Appropriate pandemic response also required flexibility in solving problems on a smaller scale, primarily affecting the tent alone rather than the full health care system. Internet connectivity, computing infrastructure, incomplete medication formularies, staffing, and workflow difficulties were common early in the response. Although our initial formulary included intravenous fluids, acetominophen, and ibuprofen, we found that some of our patients would benefit from metered-dose inhalers with bronchodilators (albuterol), and these were added to the medications available in the tent. In addition, although we had included ondansetron as an antiemetic, we had not included the disintegrating form of this medication, which is often better tolerated by patients, so we added this as well. There were some concerns about slow and inconsistent Internet connectivity at the beginning of the project, resulting in Internet technology services engagement and enhancement in wireless coverage through new hardware deployment. Health system and ED leadership on COVID-19 response prioritization allowed rapid iterative improvements to our process. In addition, multidisciplinary leadership involvement from nursing, technical staff, advanced practice providers, and physicians proved a prerequisite to this successful approach.

Triage presented another limitation to this system. Inherent to the triage process is the phenomenon of both undertriage and overtriage, or judging a patient's presentation to be less complicated than it is and more complicated than it is, respectively. In the chaos of a pandemic response, this phenomenon can be amplified, as the acuity of patients might not be clear initially. Fortunately, these situations were rare, and the vast majority of patients triaged to the tent were appropriate for treatment in the tent. We did not find it necessary to modify the triage algorithm, because the few cases that were not appropriate for treatment in the tent had been sent there as a result of omission by the patient rather than omission by triage staff. In the rare instances where patients were found to be inappropriate for telehealth evaluation in the disaster tent, patients were escorted back to the main ED for further evaluation. These included patients

who presented with symptoms of COVID-19 with significant comorbidities, such as active cancer, chronic obstructive pulmonary disease, autoimmune conditions, or pregnancy. Although medical history was assessed in triage, some patients might not disclose significant comorbidities, such as active malignancy or other chronic diseases, until speaking with a physician. The proximity of tents to hospital infrastructure is key to ensuring rapid transport of patients to higher levels of care and expanded resources. Interestingly, however, some patients were reluctant to be transferred back to the main ED out of fear of exposure to the virus, and felt safer being cared for in the tent. Some patients who were evaluated in the tent stated that they had only felt comfortable coming for evaluation because of the existence of the tent, and stated that they would not have come for evaluation if they had to be seen in the main ED. Most patients were very receptive to being treated by telehealth. Patients verbally consented to a telehealth visit prior to being evaluated in the tent.

Medical screening examinations (MSEs) as defined by the Centers for Medicare and Medicaid Services (CMS) were performed in the tent structures by qualified medical person teams (QMPs) composed of in-person nursing staff, in-person resident physicians, and attending physicians by telehealth. These QMPs must perform within their scope of practice in their state. CMS, in response to the COVID-19 pandemic, issued updated guidance to the Emergency Medical Treatment and Labor Act (EMTALA) to allow for MSEs to be performed at previously prohibited "alternative site," as long as such sites are located "on campus" in places such as alternative hospital buildings or parking lots (13). Institutions, however, must be careful to comply with their state's pandemic or emergency preparedness plan. In addition, the updated EMTALA guidance allows for the MSE to be performed by QMPs using telehealth.

Physician experiences of the telehealth platform varied. Most physicians used the system consistently and without difficulty. In March of 2020, the Department of Health and Human Services, as well as the Office for Civil Rights, issued statements relaxing penalties associated with using non–Health Insurance Portability and Accountability Act (HIPAA)–compliant audio or video remote communication tools to care for patients (14). Physicians previously facile with technology and particularly modern Internet-based audio-video telecommunication platforms, such as Facetime (Apple), Zoom, and Hangouts (Google, Mountain View, CA) quickly adopted the new workflow and needed little formal technical training to perform these telehealth encounters. Some physicians required several training sessions and were reluctant to use the technology, instead opting to see patients in person or request other physicians treat the telehealth tent patients.

A majority of providers had reported initial discomfort with performing physical examinations over video, and a general unfamiliarity with telehealth prior to this response. Physical examinations over telehealth are limited to visual and audio examinations only. This was less limiting at one of the two sites, which had resident physicians present in the tent who could perform physical examinations and report their findings to an attending physician; at the second site, however, there were no physicians in the tent itself. This is a risk inherent in all telehealth encounters; it is important to have a careful method of selecting appropriate patients for telehealth and to make patients aware of the limitations of telehealth encounters. Given the limitations of the telehealth system, a low threshold to transfer patients to the main ED for a higher level of care was established.

CONCLUSIONS

With the sharing of this model, pearls, and pitfalls, other EDs might find this proof of concept article useful. There is a plan to continue to keep the ED telehealth encounters through the duration of the pandemic and expand or reduce tent operations, depending on the ED census and the burden of the pandemic on the health care system and local community.

When considering broad institutional planning, this pandemic has caused many to wonder about ways that health care institutions can be more prepared for another such disaster in the future. This may include having larger supplies of PPE available; it was surprising to some providers to realize the limits on the supply available. Having larger stockpiles of PPE—in particular, N95 masks, eye protection, and gowns—has the potential to be useful in the event that there are repeat surges of previous pandemics such as COVID-19, that there are new pandemics, or potentially in the event of a mass biologic agent exposure. It might also include having an emergency system prepared to activate personnel more efficiently. Specifically, it might be appropriate to prepare in advance an emergency schedule that reduces the number of people initially exposed to infectious diseases, and to conserve personnel for backup in the event that primary personnel become ill or quarantined.

The model explored in this article has also led to some consideration of what telehealth might look like in the future, even when society is not facing a pandemic such as COVID-19. It will be important to explore ways to continue to use telehealth in the ED in nonpandemic times and integrate it into normal operations. However, doing this would require robust infrastructure. It would involve training for residents, attending physicians, nurses, technicians, and other core ED staff on the utility, limitations, and goals of telehealth in the ED. There is

hope, however, that it might allow for more rapid assessment of patients with lower-acuity symptoms and decrease length of stay. Because of reduced HIPAA restrictions that were in place during the pandemic, the model described in this article was able to use readily available telecommunications platforms. In the future, there would be need for HIPAA-compliant telecommunications platforms that are integrated into the patient portal; hopefully, these platforms will also have more reliable connectivity.

Eventually, telehealth can allow providers to reach patients who are having emergencies in their own homes. This would also require thorough development of infrastructure and would require development of very reliable systems for hemodynamic monitoring. It would also need to be connected to Emergency Medical Services (EMS) systems, to allow for rapid transport of certain patients to EDs for more in-depth care. In the model described in this article, there was the ability to send patients back to the main ED easily because our tents were located just outside the main ED. The patients did not incur EMS charges and the system did not monopolize scarce EMS resources or place EMS providers at risk. In a stand-alone system, careful consideration to community resources and patient safety and cost would need to be considered.

As society moves increasingly into a virtual world, it is likely that the majority of physicians will eventually practice some sort of telehealth. It is unclear what this will look like. However, as in all aspects of medicine, shared decision-making and patient-centered care is of the utmost importance and patients also need to be aware of the benefits and limitations of telehealth. Of course, this requires physicians to have a thorough understanding of the benefits and limitations as well, and this can ultimately become a part of medical education. The COVID-19 pandemic has forced a reckoning with the way that our health care systems currently operate. As this has happened, it has presented an opportunity to be better prepared for the future and to think creatively and dynamically about how to use resources, including, but not limited to, telehealth, to improve the way health care functions for patients, providers, and communities.

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