Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

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Computers in Emergency Medicine

OFF THE SHELF: RAPID DEPLOYMENT OF AN EMERGENCY DEPARTMENT TELEMEDICINE PLATFORM USING READILY AVAILABLE CONSUMER PRODUCTS

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☐ **Abstract—Background: For 20 years, telemedicine has been waiting in the wings for its time in the spotlight. The Coronavirus Disease 2019 (COVID-19) pandemic, with its emphasis on personal protective equipment (PPE) and reducing high-risk contacts, was the catalyst needed to bring telemedicine into mainstream consciousness and acceptance. Objectives: We first review some of the key factors that precipitated this abrupt alteration of the perception of telemedicine. We then detail the creation of a department-wide telemedicine network using off-the-shelf consumer products. Our goal was to very rapidly install a system that was familiar to end-users for the purpose of reducing high-risk contacts and conserving PPE. Sourcing from the consumer realm proved to be advantageous over enterprise-level equipment when these goals were desired. Discussion: After a rollout of 1.5 weeks from zero to fully operational, we showed an immediate decrease in high-risk contacts and PPE use. All 80 rooms plus all triage areas in our department were outfitted with Apple iPads running Zoom. User adoption was high and telemedicine use increased from ∼17 to ∼90 instances a day, a 429% increase. We saw a decrease in high-risk contacts of about 75%, with a concomitant cost savings in PPE. Conclusions: We propose that the use of consumer products sourced from local vendors is a viable solution for telemedicine systems focusing on speed, reducing costs, and ease of deployment. Future work will focus on studying its performance characteristics vs. other systems in an evolving landscape.** © 2020 Elsevier Inc. All rights reserved.

☐ **Keywords—telemedicine; telehealth; PPE; emergency medicine; pandemic; coronavirus; ePPE; consumer products; COVID-19; triage; iPad; zoom; cost savings**

INTRODUCTION

Although telemedicine has been in existence as an organized field for nearly two decades, it is only after recent events that it has finally become broadly accepted as a medium to augment traditional care (1). Coronavirus Disease 2019 (COVID-19) forced the world to focus on reducing exposure risk and minimizing usage spikes in the medical system. We review some of the legislative changes that occurred due to this new focus, and share our experience utilizing off-the-shelf consumer products to rapidly (<1.5 weeks) purchase and deploy a telemedicine platform. Our focus was reducing personal protective equipment (PPE) use, managing costs, and mitigating exposure risk in an 80,000-annual visit, suburban emergency department (ED).

Consumer telehealth applications have existed on the Apple (Apple Inc., Cupertino, CA) and Android (Mountain View, CA) App stores since 2009 (2,3). Despite this longstanding availability, adoption of telemedicine by the general public has been low. As recently as July 2019, JD Powers and Associates (Costa Mesa, CA) reported that only one in 10 Americans used telehealth and 75% lacked awareness of its availability (4). This poor utilization rate cannot be attributed solely to lack of access to hardware. Pew Research reported 81% of adults in the United States owned a smartphone as of June 2019 (5). Although both hardware and software were available, consumers were not highly interested in seeking medical care via this medium.

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Poor consumer adoption has not been the only hurdle. Health care institutions and providers have also been slow to adopt telemedicine as a platform for communication. In 2018, Deloitte Consulting reported that only 14% of physicians had video virtual visits capability and that only 18% had interest in adding it within 1–2 years (6). Physicians cited security concerns, reimbursement limitations, and capital expenditures as leading detractors to installing virtual health systems.

Novel severe acute respiratory syndrome coronavirus 2 (Sars-CoV-2) invaded the continental United States in 2020 and forced massive, rapid change in all aspects of life, including medical care. To slow the spread of the virus and mitigate impacts to health care systems, governments enacted shelter-in-place orders. Strong messaging advised against co-mingling, especially among the elderly. Instead of commuting into the workplace, it is estimated that 20–60% remained at home using virtual meeting platforms as surrogates for meetings in vivo (7–9). Social events also moved online with happy hours, dating, and even marriage available via video solutions (10). This forced adoption of virtual interactions into daily activities led to their normalization and acceptance by the general public. Telemedicine, in particular, saw record increases in usage (11–15).

With consumer acceptance, telemedicine's rapid growth also needed support from health care systems (6,11). Legislation at state and federal levels historically presented hurdles that were not of sufficient return on investment to surmount. Again, the COVID-19 pandemic provided impetus for change. The desire to reduce points of contact and moderate the use of PPE forced regulators to revisit previous policies that existed as barriers to telemedicine implementation.

Concerns for patient privacy were often cited as a friction point for some systems (6,11,13). To eliminate this issue, the U.S. Department of Health and Human Services revised regulations concerning telemedicine use and privacy. Specifically, they stated that providers would not be fined for violations of the Health Information Privacy and Accountability Act (HIPAA) as long as good faith measures were made to protect patient confidentiality (16). This eased concerns for hospital Information and Technology Services (IT) teams that had referenced this issue as adding to the cost and time to deployment. Removal of this key barrier allowed for the expeditious rollout of consumer products to locations that previously would not have been acceptable, such as patient rooms, open work areas, homes, and offices.

Additionally, video conferencing platforms such as Skype (Palo Alto, CA), FaceTime (Apple Inc.), and Jabber (Cisco Systems, Inc., San Jose, CA) were approved for use (17). IT teams were unshackled, and the use of systems not intended for telemedicine (but still encrypted) were able to be rapidly set up. Other changes were made as well. For education, attending physicians could see patients with residents via telemedicine and attest to the supervision if they supervised the encounter via telemedicine.

Finally, and perhaps most importantly, payments between traditional in-person and telemedicine visits were equalized by the Center for Medicare and Medicaid Services (18,19). State, and many large, private insurance groups followed suit (19–22). This eased concerns of both consumers and providers. With billing and reimbursement issues assuaged, users on both sides of the screen sought out telemedicine solutions at unprecedented levels.

In California, a statewide shelter-in-place order was mandated on March 19, 2020 (23). With PPE conservation and reduction of contact as key goals, our institution fast-tracked telemedicine deployment. By March 30, all 80 rooms were equipped with our new telemedicine system. We share our experience using off-the-shelf consumer hardware and software to rapidly install a virtual triage and electronic PPE system in our ED.

IMPLEMENTATION

We chose to source our equipment from local consumer suppliers to maximize our speed to go live. Our department purchased 400 Apple iPad Airs from Apple.com, which has warehouse facilities in the region (24). Consumer-grade rolling stands were sourced from Amazon.com (Seattle, WA), which also has nearby fulfillment centers (25). Each unit was loaded with Zoom video conferencing software (Zoom Video Communications, Inc., San Jose, CA) (26). Units deployed to patient rooms were configured to answer automatically without the receiver needing to take action. Units for provider use were configured with an address book used to directly call patient rooms. iPads and Zoom were chosen due to consumer, provider, and IT services familiarity. It should be pointed out that prior to this deployment, each room did have telehealth capability, with Jabber on Hewlett-Packard (Palo Alto, CA) desktops equipped with Logitech (Newark, CA) MeetUp Cams, with daily usage of ~17/calls per day (27–29). These units were not mobile, not easily brought to all points of care, and not useful in an infectious control setting.

New telemedicine units were deployed in several use cases throughout the ED. At the initial point of contact, patients could be shunted to either a drive-through, rapid COVID-19 evaluation, or to the main ED. This drive-through area utilized a virtual interaction for all patient contact and saw only low-acuity, Emergency Severity Index level 4–5 patients. The patient would remain in their vehicle. At any point, the patient could be converted to a

standard ED patient and seen in the traditional manner. In the drive-through, all providers used one set of PPE during their shift unless contaminated or otherwise soiled.

Registration teams used the same virtual interface to obtain appropriate information for any patient designated as a Patient Under Investigation (PUI). This included all patients with chief complaints of fever, cough, sore throat, or dyspnea. Previously, registration occurred via direct contact in patient rooms, using computers on wheels, with registration staff wearing a new set of PPE for every encounter.

Medical teams within the ED utilized telehealth whenever possible. This included nurses, physicians and residents, and consultants. Initial contact may have been person to person, with full PPE, but subsequent interactions often transitioned to telemedicine. Attending physicians had the option to supervise history and physical examinations via this virtual platform as well.

DISCUSSION

Impact

From March 30, 2020, our telemedicine go-live date, through May 30, 2020, we tallied ∼5500 discrete telemedicine interactions lasting longer than 2 min (90/day). During the same time period, 3708 patients were tested for SARS-CoV-2 out of 7167 visits. Before the iPad/Zoom combination was implemented, we saw an average of 17/day via the desktop-based system described above.

Exposure Reduction

Modeling of workflows designed for COVID19 pre- and postimplementation of our Zoom/iPad solution, we estimate this reduced higher-risk interactions by 75%. Though not formally reported here, serologic testing of our staff yielded approximately 0.3% positive for SARS-CoV-2 antibodies, which is lower than other reported studies reporting from 1–3% (30–33). Future studies will delve further into this relationship.

Cost Savings

The reductions in high-risk contact impacted resource consumption as well. Without telemedicine, several sets of PPE would be consumed for each patient. At our institution, full PPE for PUIs included a disposable gown, goggles (or face shield), N95 respirator, and two sets of gloves. All would be disposed of after each patient contact. Those who could not fit test for an N95 used powered air-purifying respirator units. Due to supply chain disruptions and increased use, stores of PPE have been strictly rationed. It has been highly publicized that profiteers have inflated charges for PPE given this high-demand, low-supply situation (34). Nontraditional suppliers have been found vending counterfeit products (35,36). Simple procedure masks that have historically been available on the open market for < $0.10 are now up to $1.00 per piece (Amazon.com, May 27, 2020). Prior to the pandemic, N95 respirators that commonly sold for $0.50 are now as much as $5.00 each (Amazon.com, May 27, 2020). Conservation of these resources remains of paramount concern, and many hospitals have resorted to accepting public donations of these items. A modest sparing of just one set of PPE (∼$15) per patient equates to a savings ∼$50,000 during our reporting period. Our modeling suggests that 3–4 × this number were actually saved.

Limitations

Telemedicine is not without its limitations, and not all interactions are amenable to its use. Our ad hoc system emphasized rapid installation and end user familiarity. It did not focus on data collection to facilitate the study of efficaciousness. It lacked robust security and privacy measures, which, as COVID-19 declines, will again become a concern. Additionally, there was no integration with the electronic medical record for charting or billing purposes. Again, this will have to be revisited as we move out of the emergent phase of the pandemic.

CONCLUSION

We conclude that the rapid provisioning of a telemedicine system based on consumer products was exceptionally feasible and ideal in the setting of a global pandemic where alacrity is of paramount concern. By eschewing purpose-built products, we saved time, decreased PPE use, and mitigated high-risk contacts. With this experience as a foundation, we can build and support a more robust system that addresses all of our needs. Next steps will be to look at its efficacy vs. in-person visits. Formal comparisons of time and resources saved are already underway. Best practices for its use in the emergency setting still need exploration and refinement, with formal training for all users. If time and cost are primary drivers, off-the-shelf products should be considered for all settings needing telemedicine services.

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