Information Technology in Support of Our Heroes during the COVID-19 Pandemic: A Commentary

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Heroes Work Here

It is difficult to describe the debt of gratitude that is owed to our first responders, the emergency room teams, and those at Hospital for Special Surgery (HSS) who stepped out of their comfort zone to care for the sickest-of-the-sick COVID-19 patients as HSS transitioned from a specialty hospital to a general hospital. They indeed are our heroes. And as with all highly functioning teams, there are many others who labored tirelessly behind the scenes (and at times side-by-side) to support the mission.

Here we describe the work of one such team at HSS: Information Technology (IT). A bit like air and water, IT is hardly noticeable, until the supply is disrupted. And as with air and water, IT is crucial to the survival of an organization in times of stability, and even more so in times of crisis [1, 3, 6].

After COVID-19 swept through China and Europe, and then arrived on the West Coast of the USA, it became clear that the New York City area was likely to become the epicenter of the pandemic. Predictions became increasingly dire. Hospitals and intensive care units (ICUs) would be overrun. In response, in late March 2020, New York State Governor Andrew Cuomo ordered hospitals to increase their bed capacity by 50 to 100% and to submit a surge plan.

Founded in 1863 as the Hospital for the Ruptured and the Crippled, HSS has been in continuous operation ever since, with a singular focus on the treatment of musculoskeletal diseases. Not even the Civil War interrupted its mission. Yet this was the scene that HSS was facing when by order of Governor Cuomo all elective surgery was halted. HSS had already taken critical steps to ensure its ability to respond to the oncoming catastrophe. By March 17, HSS had voluntarily reduced its operating room procedures to only urgent and emergent cases and its occupancy by 80% to be able to create surge capacity.

Leadership Lessons in Interconnectivity and Communication

A senior leadership team at HSS was quickly established and situated in the board room to function as the incident command center. This team provided crucial guidance as the crisis unfolded. The infection prevention and emergency support teams were located in nearby rooms. It was obvious that these leadership teams needed to communicate with each other, as well as with colleagues onsite and elsewhere. Many IT tools were implemented to support these critical functions. These included deployment of a customer relationship management (CRM) tool (Salesforce), which enabled centralized issue management, as well as large screen monitors and other videoconferencing and teleconferencing tools. Additional monitors to display dashboards were installed. Equally important were methods that allowed leadership to communicate more broadly, with the medical staff and the entire HSS community. Existing livestream capabilities were scaled-up, with regular sessions broadcast. Over a thousand viewers were able to tune in in real-time. These broadcasts were recorded and saved online for later viewing as well.

The use of well-known video conferencing tools such as Skype for Business, Zoom, and Microsoft Teams were critical, not only for leadership but also for the entire
organization as appropriate social distancing was maintained. These tools have various advantages and disadvantages. One popular tool had a well-publicized security breach, which required IT to carefully evaluate and mitigate. Each of these tools had unique requirements regarding enterprise-wide licensing, security analysis, contracting, and training.

**Work from Home**

In March, it was decided that any employee who could perform their work remotely should do so. Prior to the pandemic, approximately 200 people worked from home on any given day. Within a very short period, this number increased to 2000 each day (Fig. 1). To accommodate this increase, several structural changes were made: the internet bandwidth was increased tenfold, from 1 gigabit per second (GBPS) to 10 GBPS. Citrix infrastructure (myaccess.hss.edu) was increased 80%, to permit more than 3500 users. Virtual private network (VPN) user licenses were doubled. Changes were made to Kronos to allow time-stamping from home. Over 400 laptops or tablets were deployed with sophisticated software to allow staff to access specialized tools required for their job functions (e.g., softphones for call center staff). Technology was acquired to allow internal and external PDFs to be filled and signed online. Digital check requests and paperless purchasing and tracking were also implemented. The ability to use videoconferencing technology was key to the success of work from home (WFH). The press was replete with tech advice on how to WFH successfully [7].

**Telehealth**

As mentioned, 1 week before elective surgery was banned in New York State, HSS made the decision to stop performing all but “essential services.” All other patients were offered telehealth (TH) visits (Fig. 2). Telehealth has long been a part of a pandemic response, and its role in managing this pandemic is clear [2]. Although HSS had established a TH strategy and implemented TH tools available in the electronic medical record system (Epic) more than a year prior, the pandemic offered an exceptional opportunity to accelerate those efforts.

The Epic TH workflows and functionalities were quickly scaled-up to accommodate hundreds of providers. This work included the addition of TH visit types and templates, new MyHSS (patient portal) questionnaires, icons to patient schedules indicating the patient was connected to Zoom, patient location, start/stop time, and level of service buttons. Smart phrases and note types were built to support compliant documentation. Updates were made to billing to accommodate changing payor requirements. Dashboards were created to monitor TH usage. Training included webinars and e-learning. Twenty new tip sheets were created for providers and office staff. At-the-elbow support and an analyst-led command center were established. Extensive training of office staff was given. Changes in security settings were made to Zoom, which was the platform used with Epic for TH. Ambra, software for sharing images (X-ray, magnetic resonance imaging, for example), was integrated with Epic, allowing patients to download outside images to be reviewed during the visit. The IT service desk was scaled to accommodate a dramatic increase in calls, and revised scenario scripting was provided to educate service desk analysts as to the issues patients and providers may encounter. A key success factor was the implementation of a cloud voice recognition solution for dictation of clinical notes by the providers (Dragon Medical One). This allowed clinicians to dictate with near-perfect accuracy into the medical record.

Within a short period, 215 attending physicians, 60 physician assistants and fellows, and 180 physical therapists were using TH. Virtual visits increased from a few hundred in March to over 20,000 by early May!

**Ambulatory Essential Services**

Although TH was able to accommodate large numbers of patients, significant numbers still required essential services onsite. Outpatient areas were consolidated into a few locations. Controlling patient flow in order to properly screen and socially distance was also more easily accomplished with fewer locations. The consolidation required a large IT contribution. New offices and departments had to be created within Epic, along with decision-tree logic to ensure that correct forms were completed electronically by the patient prior to arrival. Automated telephone calls were re-scripted and used to communicate important COVID-19-related information to patients prior to arrival. Electronic COVID-19 screening questionnaires, as well as other instructions that were needed before in-person visits, were created and implemented in Epic. Additional automated text messages were created to send to patients. Hardware, such as wristband printers, was acquired, formatted, and installed at these locations. IT security and access team members provisioned over 2500 users to be able to schedule patients into the new departments. As always, training and analytics were involved to support the education for, and real-time analysis of, these new workflows.

**Building a New Ambulatory Orthopedic Triage Center**

Our initial focus was to serve our community by doing what we do best, providing comprehensive musculoskeletal care. We therefore converted the first floor of our hospital from a foot and ankle specialty ambulatory surgery unit to an “orthopedic triage center” (OTC). The intent was to offload all emergent orthopedic care from the NewYork-Presbyterian (NYP) system to allow them to focus on the surge of COVID-19 patients. This required a large “lift” by IT to support this transition. Changes in Epic and related software were made to allow scheduling, registration, arrival, admission, triage, and discharge. Modification of the physical space required changes in computer, monitor, and printer locations and device mapping within Epic. Point-of-care
Building a New Hospital

As the crisis deepened, New York City became the epicenter of the pandemic. Hospital emergency departments were overflowing with critically ill COVID-19 patients. In late March, Governor Cuomo issued an executive order requiring all hospitals to increase their bed capacity by at least 50%. That was when leadership decided that HSS would pivot to become a general hospital, able to accept transfers of all patient types from the entire NYP system. At first, non-COVID-19 medical-surgical patients were transferred. But as the crisis deepened, COVID-19 patients, including extremely ill ICU patients on ventilators, were admitted to HSS. This required a massive effort by all, including those in IT. Within days to weeks, HSS operating rooms, post-anesthesia care units, and orthopedic special care units were turned into ICUs [5]. Some floors were converted into COVID-19 units, including a floor with telemetry capabilities. Others were converted to non-COVID-19 medical-surgical units. Other units continued to handle post-operative emergent orthopedic patients. This astounding transformation required an extraordinary effort, with close coordination among leadership, clinicians, operations, and IT.

As HSS clinicians began to care for NYP patients, it became clear that access to each other’s electronic records was required. This was accomplished quickly, by providing HSS clinicians with read-only access granted to the patient’s originating NYP electronic medical record. In addition, legal, compliance, and informatics worked together to allow compliant access to electronic records residing in any Epic organization, using Epic’s Care Everywhere functionality.

Critical Care

Caring for critically ill patients requires an order of magnitude more complicated workflow and content than the orthopedic content in the HSS electronic medical record. New and complex order sets were developed to care for these patients. These included ICU admission, tracheostomy, ventilation, and nursing items. Prior to the COVID-19 crisis, this process would have taken many weeks. Proposed changes would travel sequentially through the process of drafting, review by service-line leadership, prioritization...
and approval by governance, implementation, and training. In order to dramatically shorten the time frame, an executive clinical informatics governance group was established and empowered to make rapid decisions on behalf of the entire group. In addition to content, these patients required new telemetry, ventilation, and tracheostomy workflows. As with virtually all other efforts, the IT security, access, training, and analytics teams made significant contributions along with their Epic clinical analyst colleagues.

Medical-Surgical Floors

IT build was not limited to the ICUs. Many order sets for the med-surg floors were built to accommodate patients we typically do not care for. These sets included general medical admission, pediatric admission, and infection isolations sets. Medications not previously used at HSS but needed for the care of these patients were built into the system. Where necessary, changes to panels and order-sets were made. Isolation status and COVID-19 polymerase chain reaction (PCR) test result were added to the “storyboard” (a banner visible in a patient’s chart). Discharge instructions for COVID-19 and hospice patients were created. Critical laboratory results workflow was built into our text messaging system (Perfect Serve). An entire workflow for those transitioned to the “Alternate Level of Care” was built. In addition, the ethics committee, spiritual care, do not resuscitate, and advanced directives required IT build.

Cross-Cutting Fundamentals

Staff and Patient Safety

Patient and staff safety are of the utmost importance, even more so in a pandemic. Key to keeping patients and staff safe was the creation and implementation of several screening tools created to assess patients for COVID-19 before they enter the institution. Thermal cameras were evaluated to monitor body temperature of those entering the building. Patients were required to complete a screening questionnaire (built into Epic) to assess for symptoms and other risk factors of COVID-19. The screening questions were continually updated based on changing clinical recommendations. At first, questions centered on travel to and from China. But as the situation evolved, multiple versions of the questionnaire reflected new risk factors. When PCR and antibody testing started to be performed on both patients and visitors, they were built into the lab system (with required regulatory verbiage, different for each manufacturer). Knowing a patient’s isolation status is critical to safety. New statuses indicating that COVID-19 test results were positive, negative, or pending were added and highlighted in the Epic chart, with additional alerts presented to clinicians in their workflow (clinical decision support). Some orders require second signing by nurses (such as transfusion orders). Previously done face-to-face, because of the need for social distancing, nursing devices (Rover) were configured to allow second signing at an appropriate distance. Similarly, Vocera (an auditory communication device) was upgraded to allow hands-free communication for clinicians. Over 100 iPads were deployed so that patient-family, patient-clinician, and clinician-clinician communication could occur without physical proximity. This has been described in the literature as ePPE, or electronic personal protective equipment [8]. Contact tracing, a key element used to contain pandemics [2], relies on both automated and manual processes. IT is working intensively with operations to explore options and develop a contact tracing approach “right-sized” to HSS [9].

Cybersecurity

Cyberthreats have increased dramatically since the beginning of the pandemic [4]. At HSS, there has been a 25% increase in the number of attacks. Every day, over 10,000 COVID-19-related phishing attacks occur. Furthermore, there has been a 70% worsening of “phishing resilience” (a metric we measure monthly, it is the ratio of those who report vs. those of who open and click links in phishing emails) among HSS staff members. These facts highlighted the need to increase our cybersecurity vigilance. All new solutions, as well as all vendors, undergo security assessments. Nine such assessments have occurred since the beginning of the pandemic. In addition, increased end-user training regarding phishing attacks and the appropriate use of video streaming has been implemented.

Analytics

Data, its availability, presentation, and interpretation are crucial for baseline institutional function and even more important at times of crisis. During the pandemic, the analytics team has produced large numbers of new dashboards, Epic reports, and items to support research. They have addressed many requests for new products and services, answered scores of data requests, and supported automation and infrastructure changes. The need for real-time vs. near-time automation was recognized and the IT analytics team quickly built this capability.

Training

New workflows such as WFH-remote access, live video streams, and new Epic configurations required augmented training. Self-service tools were developed including dozens of tip-sheets, online videos, and training in virtual classrooms. Additional in-person support was also provided.

Service Desk

Calls in March and April to the service desk rose from approximately 10,000 for that period in 2019 to over 17,000 in 2020. Without proper scripting and an increase in the number of agents available to answer calls, there could have been significant disruption to care. The number of calls from patients regarding MyHSS (our online patient portal) more than doubled from 3170 (January and February) to 7431 (March and April). This was largely attributable to the need for assistance to access telemedicine visits via the portal.
Lessons Learned

The culture and spirit of our institution that has placed us in the forefront of musculoskeletal medicine for over a century and a half allowed us to succeed in responding to this crisis. IT teams quickly realized that their efforts would be critical to ensuring that our clinicians would be able to treat COVID-19 patients in a safe manner. While most staff members were able to work remotely, many IT staff came into the hospital during the worst of the crisis to implement various technology solutions previously mentioned. Teams, both on-site and remote, went above and beyond to deliver the technology clinicians required. The entire HSS IT team was grateful to be able to contribute in a meaningful way during this time of crisis.

At the beginning of the crisis, HSS leadership established and clearly communicated the guiding principles of protecting our staff, protecting our patients, and protecting the community. These principals allowed IT governance to reorganize and streamline. The result was focused decision-making and an acceptance by end users of technology solutions that were rapidly deployed and then improved as required (a “minimum viable product”). We were able to implement technologies in a matter of hours and days, versus the weeks and months before COVID-19. With little question of what had to be done and by when, and by using agile methodology, a much nimble and more directed IT response was facilitated.

Having a robust technology infrastructure in-place was critical. HSS spent the last 8 years investing in a modern, scalable, and flexible technical and software infrastructure. With this foundation, we increased services to meet the demands placed on our data network and its architecture by a large remote workforce, which we largely achieved through closely monitoring key performance metrics. We also were extra-vigilant in cybersecurity monitoring since it was clear from the outset of the pandemic that cyber criminals would take advantage of personal and technical vulnerabilities that were created.

The acceptance and growth of telemedicine by both patients and clinicians was much higher than expected. Having the foundational TH configuration built in Epic and in use with a limited set of providers allowed HSS to quickly scale-up from a technology perspective to meet the very high increase in demand for its use. Operationalizing TH was labor intensive and required a great deal of communication with patients to have them successfully join the visit. Critical success factors were having staff reach out to patients in advance of the visit to provide technical assistance and training the physician office staff so that they were familiar with the technology and able to troubleshoot.

Communication methods used by IT leadership including weekly all-hands Skype meetings, continued updates through the established weekly chief information officer blog, daily operational huddles, and leadership stand-ups all helped with the rapid dissemination of information and fostering a feeling of connectedness among remote and on-site staff. HSS leadership also coordinated a comprehensive set of communications to the entire staff, which set the standard. HSS immediately used the best practice of all COVID-19 communications coming from a single, recognizable email address that assured the validity of the content.

It is fair to say that the most important lesson learned was that in every crisis, lies opportunity. As the crisis unfolded, every segment of HSS played its role in supporting the following guiding principles and priorities:

- To keep our employees, staff, and patients safe
- To support our partner health system, NewYork-Presbyterian Hospital
- To support our community

The IT team is proud to have partnered with our operational and clinical leaders, not only in the climb up the seemingly endless mountain but also in the transition to “new normal.”

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Compliance with Ethical Standards

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