Residency Program Preparedness for Prolonged Downtime: Lessons Learned From a Cyberattack

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Hospital systems have become almost totally dependent on computers, the internet, and electronic medical records (EMRs) to function. This reliance on technology brings vulnerabilities. In October 2020, the Federal Bureau of Investigation issued a warning of increased and imminent cybercrime threats to hospitals.[1] One month prior, our hospital system, spanning 400 facilities, was the victim of the largest ransomware attack on a health care system in US history.[2] At our university hospital, inpatient services endured 7 days of complete computer downtime (including loss of wireless internet) and 14 days of partial information technology (IT) recovery. Our ambulatory and hospital care are delivered by separate entities with separate EMRs and IT infrastructure. Consequently, downtime impact on ambulatory care was minimized as its EMR was not affected by the cyberattack. The major area of impact was delay in availability of laboratory, pathology results, and surgical and procedural reports.

Downtime challenged patient care, affected mass communication, and had a disproportionate impact on trainees. We speak from the perspective of impact on general medicine wards and information obtained through a comprehensive health system debrief that identified consistent areas of focus. Because care on general medicine wards relies on interaction with nearly all other departments, the internal medicine resident experience may be generalizable to other trainees.

Downtime began unexpectedly prior to morning sign-out, requiring the overnight trainees to provide patient care and handoff to day teams with only paper forms from the prior night. We quickly learned that our existing downtime processes, designed for brief scheduled downtimes, were inadequate to provide patient care during extended IT disruptions. As trainees experienced this disruption, they encountered unanticipated challenges. In most teaching institutions, trainees deliver the majority of direct physician-led care and often lack experience delivering paper-based patient care. Our internal medicine residency's "downtime processes" folder contained only paper templates for handwritten orders and progress notes. Within 21 days, this folder markedly expanded in size and scope. We hope other residency programs may learn from challenges we faced and institute preparations for potential extended downtime.

Our experience highlights the importance of a hospital-wide, coordinated, multidisciplinary downtime response plan. This response plan should include a special focus on trainee support. Based on our experience, we propose a proactive approach with focus on 4 areas: documentation, order entry, interdisciplinary communication, and centralized information (FIGURE 1).

Documentation

Documentation is the cornerstone of communication among health care teams. It serves to relay real-time information and forms a permanent legal record. Downtime immediately converts that record to a paper chart with loss of access to prior notes and results. Efficiently accessing and documenting in the paper chart is critical to ongoing care, avoiding medical errors, and creating historical records. Standard documentation templates (eg, admission, progress and nursing notes, discharge instructions, discharge summaries, prescription pads, standardized handoff forms) support standardized hospital-wide documentation processes while maintaining comprehensive documentation.[3] Hospital-wide standardized chart organization and location are key to timely access of results. By agreeing on chart format proactively, programs can create a document that orients trainees to the paper chart as part of the "downtime processes" folder. This is important for all health care professionals and pertinent to trainees as

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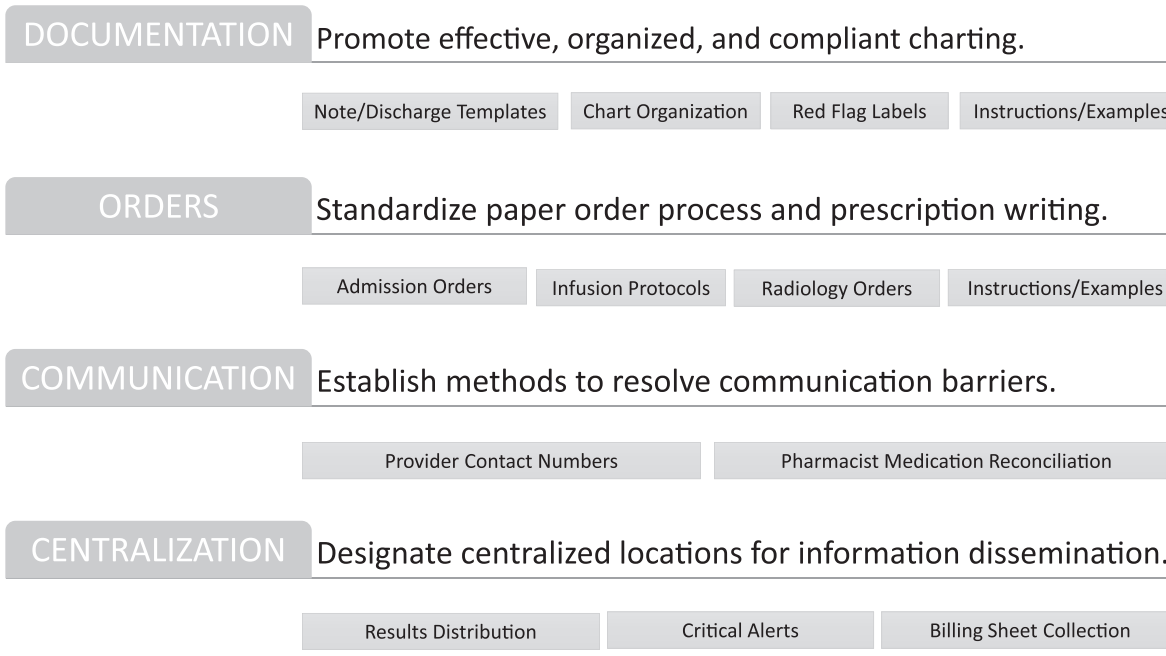

FIGURE 1
Essential Components of a Coordinated Downtime Response

they access charts most often for documentation and results review.

Many trainees lack experience writing unformatted medical notes. Along with standard templates, downtime procedures should include disseminating how-to documents for handwritten medical documentation (FIGURES 2 and 3). We were surprised to realize trainees needed basic instructions, such as how to write a prescription: using black ink, drawing a single line through errors, avoiding Joint Commission "never" abbreviations, and including title, date, time, signature, printed name, and contact information on each note.[4] Our downtime folder now includes the above templates, how-to documents, and examples to guide clear and effective documentation, transitions of care, and prescribing.

Order Entry

Electronic order entry makes patient care safer and more effective through suggested order details, predetermined order sets, and interaction checks.[5] Hospitals like ours require electronic orders; trainees are unlikely to have experience giving verbal or handwritten orders, and decision support tools may make them less likely to carefully check interactions prior to prescribing. We recommend creating paper templates for the most common order sets, such as standard admission and discharge orders, and for the most common admission diagnoses. This approach would replicate in paper form the important roles of an electronic order set, including reminders for commonly forgotten orders.

Interdisciplinary Communication

Expectations for interdisciplinary communication, a cornerstone of safe and effective patient care during normal operations, remain critical during downtime. During normal operations, much of our communication occurs electronically. During IT downtime, emphasis must be placed on robust verbal communication and paper documentation. In our experience, specialty consultants had to be reminded of the importance of written notes documenting their recommendations, as several were inclined to rely on verbal communication only. These undocumented plans could not be verified by supervising members of the care team.

Some hospitals such as ours have replaced pagers and phone-based communication with hospital-approved free-text mobile applications (apps). At our institution physicians communicate with each other and nurses via apps on mobile phones and computer workstations. Downtime severed these essential lines of communication. In response, scheduled check-in times and multidisciplinary rounding with the patient, bedside nurse, medical team, and other support staff facilitated timely and effective patient care during downtime. We recommend utilizing templates to ensure efficient and effective

HANDWRITTEN ORDERS:	HANDWRITTEN NOTES:
Write in BLACK INK. (No colors or pencil.) Write legibly. Check spelling and doses. SIGN, PRINT YOUR NAME, DATE, TIME, and phone #. Joint Commission never abbreviations list: • NEVER write "qd" (write daily), or "u" (write units) or "IU" (write international units). • ALWAYS put the 0 before a decimal point (write 0.5 mg lorazepam PO once), and NEVER put the 0 after the decimal point (20 mg omeprazole po daily NOT 20.0 mg). • Write out fully "magnesium sulfate" and "morphine sulfate" so that abbreviations for the 2 are not confused for each other. VERBAL ORDERS – if you give a verbal order, the nurse writes it down, but you must sign it later. ADMISSION ORDERS – use paper template for admission order sets to ensure you include all components.	Write in BLACK INK. (No colors or pencil.) Write a TITLE with your TEAM NAME and the TYPE of note (eg, Med1 Team Progress Note, Nightfloat H&P, Med4 Team SBAR, Cardiology Consult Note). Put patient sticker or write patient name and MRN on EVERY page. Notes must be one-sided. Don't write on back of paper. (They will be scanned.) If your note is more than 1 page long, on the bottom of the pages write "Page 1 of 2" and "Page 2 of 2." Sign the bottom of EACH page. Try to leave space on the paper for the attending to cosign on each page of the note and write their addendum at the end—don't squeeze your writing to fit on one page. At the end of the note, SIGN, PRINT YOUR NAME AND TITLE, DATE, TIME, and phone #. If you make a mistake, put just one line through it like ~~this~~. And then initial it like that.

FIGURE 2
Sample Handwritten Orders and Notes Templates

multidisciplinary rounds. Such templates can also contribute to nursing documentation.

Communicating laboratory and radiology results created a unique challenge. Although our laboratory retained the ability to run specimens, results could not be entered into the EMR. Instead, "runners" brought paper results to medical units for filing into patient charts. It was important to have prespecified times of day for delivery of routine results as well as a system for rapid delivery and/or phone calls for "stat" results. We also realized that medical teams calling radiologists for results disrupted workflow. We recommend instead that radiologists keep a handwritten list with patient name, medical record number, type of study, and major findings at a central location in the reading room to be referenced. Full, handwritten reports can subsequently be brought to unit coordinators for chart filing as is done with other results. Adequate support for "runners" to relay results is necessary to avoid radiology or pathology trainees becoming the default "runners" with resulting loss of learning.

Centralized Information

Frequent centralized information dissemination to clinicians and staff is critical during a rapidly changing environment that lacks email and "push" notification abilities. Frequent centralized updates, as well as those that are unit- or team-based, help ensure comprehensive communication and identify new issues quickly. For example, our trainees were initially unaware that white boards would replace computerized unit boards for patient location and assigned nurse, creating delays in care while trainees searched for newly admitted patients. This delay likely could have been prevented by proactive trainee education regarding downtime procedures.

Summary email communications are critical to ensure all health care professionals receive and can reference important information. This can be especially challenging if downtime also affects email access. Alternatively, we suggest centralized communication boards in each unit, where reference material can be posted and updated in real time. These boards relay important system updates, process changes, and

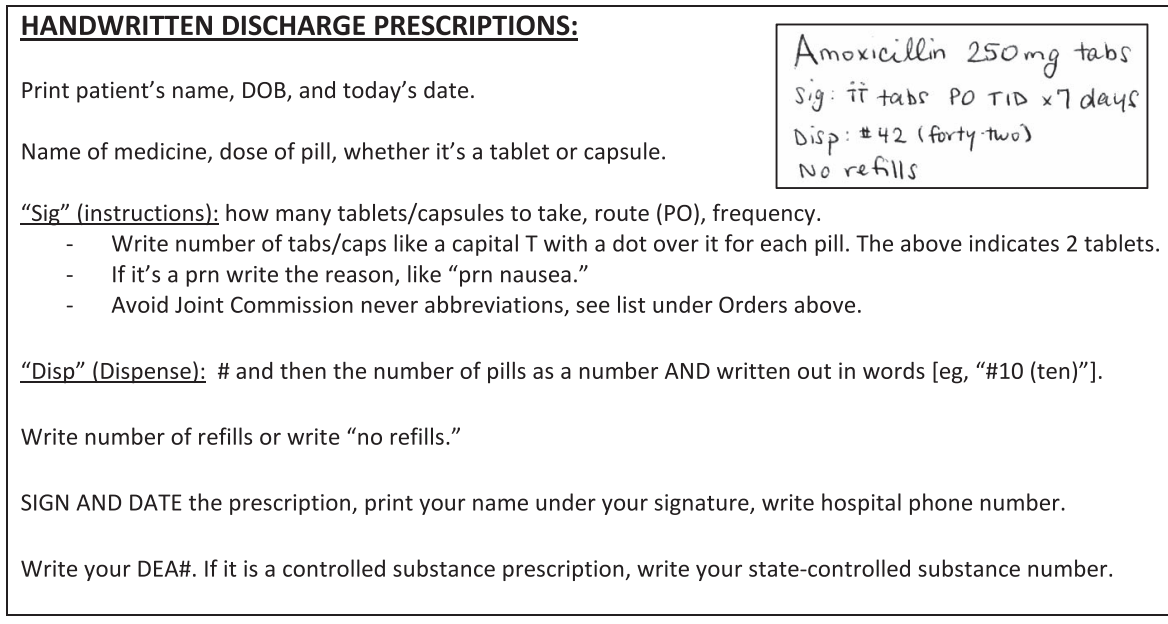

FIGURE 3
Sample Handwritten Discharge Prescriptions

IT recovery updates. At the same time, redundancy in communication modalities is crucial in a pervasive downtime. At our institution, the chief medical residents' office became the central location for dissemination of paper templates and verbal updates to trainees. Dissemination can also take the form of scheduled team huddles.

Supporting Trainees During Downtime

During our downtime, incorporating resident feedback in real time was key to identifying safety and system issues and instituting rapid changes. After full resolution of downtime, we conducted a debrief with trainees to identify impacts. Residents reported that educational conference cancellations during downtime reduced formal learning. Although objective data on work hours was lacking, trainees reported prolonged work hours, and many suspected they committed work hour violations. Trainees also identified positive aspects of downtime: more direct patient contact time and more robust interprofessional interactions. One resident said, "I felt most like a doctor during downtime."

Large-scale downtime strains the balance between service and education for trainees. Creating a proactive, multifaceted plan focused on documentation, order entry, interdisciplinary communication, and centralized information may support trainees' ongoing education as well as meet work hour requirements.

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