

Learning During Crisis: The Impact of COVID-19 on Hospital-Acquired Pressure Injury Incidence

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ABSTRACT

The impact of COVID-19, on the health and safety of patients, staff, and healthcare organizations, has yet to be fully uncovered. Patient adverse events, such as hospital-acquired pressure injuries (HAPIs), have been problematic for decades. The introduction of a pandemic to an environment that is potentially at-risk for adverse events may result in unintended patient safety and quality concerns. We use the learning health system framework to motivate our understanding of the impact of the COVID-19 pandemic on the incidence of HAPIs within our health system. Using a retrospective, observational design, we used descriptive statistics to evaluate trends in HAPI from March to July 2020. Hospital-acquired pressure injury numbers have fluctuated from a steady increase from March–May 2020, hitting a peak high of 90 cases in the month of May. However, the trend in the total all stage HAPIs began to decline in June 2020, with a low of 51 in July, the lowest number since March 2020. Patients evaluated in this study did not have a longitudinal increase in HAPIs from March–July 2020 during the COVID-19 pandemic, despite similarities in illness severity between the two time points. Our experience has demonstrated the ability of our organizational leaders to learn quickly during crisis.

Keywords: hospital-acquired pressure injury, COVID-19, patient safety

Introduction

The impact of the novel corona virus, or COVID-19,¹ on the health and safety of patients, staff, and healthcare organizations, has yet to be fully uncovered. As larger volumes of patients are entering the healthcare environment with COVID-19 infections, traditional practices to ensure safe, quality care are being challenged by patient isolation protocols, lack of family member presence, and staff limitations with the availability of personal protective equipment (PPE).

Patient adverse events associated with hospitalization such as pressure injuries have been a challenge in the healthcare environment for decades.^{2,3} The introduction of a pandemic to an environment that is potentially at-risk for adverse events may result in latent and additional, unintended patient safety and quality concerns. Given that COVID-19 is primarily believed to spread through airborne droplets, inpatient areas and providers exposed to airborne droplets may face difficulties in ensuring both patient and staff safety.⁴⁻⁷ Changes to processes and care

delivery models by healthcare teams within a healthcare facility such as those intended to reduce airborne particle movement may produce errors and adverse events that remain undetected until larger volumes of COVID-19 positive patients require hospital care.⁸

Hospital-acquired pressure injuries (HAPIs) are a significant and costly adverse event associated with hospitalization.⁹⁻¹⁴ According to the Centers for Medicare and Medicaid Services (CMS), HAPIs are considered an event that should “never” occur during hospitalization. As an adverse event, the Agency for Healthcare Research and Quality measures and compares hospital volumes of pressure injuries as a Patient Safety Indicator (PSI-03-Pressure Ulcers).¹¹⁻¹⁶ For healthcare providers, the key to reducing or mitigating the risk for HAPI development is continuous patient evaluation, reduction of pressure, and use of evidence informed best practice protocols.¹⁵

Given the significant challenges that pressure injuries may pose to the hospitalized patient, healthcare providers and leaders are faced with the task of HAPI risk mitigation that factors in the unknowns of the COVID pandemic. The usual strategies for reducing or eliminating risk based on past evidence may not work in a pandemic requiring social distancing and reduced airborne exposure. The

Journal for Healthcare Quality, Vol. 43, No. 3, pp. 137–144

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The authors declare no conflicts of interest.

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DOI: 10.1097/JHQ.0000000000000301

learning health system (LHS) framework may support improvement during crisis.

Organizations that subscribe to the LHS model are defined by the Institute of Medicine (now the National Academy of Medicine) as those that engage in and seek to (1) generate and apply the best evidence for each patient in a collaborative relationship with a provider, (2) drive discovery for new processes and care delivery as a byproduct of care, and (3) ensure innovation, quality, safety, and value in healthcare.^{17,18} In the LHS, every patient experience is a learning experience; best practice is embedded into the front line of care; process improvement is iterative and continuous and evaluated for patient centric care, and the culture of the organization is one in which the workforce is committed to delivering safe, quality care.¹⁹ Generally, a LHS improvement process begins scanning and surveillance to identify a problem or gaps in patient care. Interventions are then designed and implemented based on evidenced-based practices and frontline worker intuition. Timely evaluation and subsequent adjustments ensure that the intervention is adapted to the unique needs of the organization and the specific problem. Finally, evaluation findings are disseminated both within the organization and to external communities.²⁰ The LHS model provides the ideal structure for learning during crisis, such as the COVID-19 pandemic, and creates a framework for improvement despite challenges that may exist in a complex care environment. In this study, we use the LHS framework to motivate our understanding of the impact of the COVID-19 pandemic on the incidence of HAPIs within our health system.

Background

The 2020 COVID-19 pandemic resulted in the reduction of inpatient services at almost every hospital in the country.⁸ At a large, urban, academic medical center in the southeastern United States, the hospital and university executive leadership team modified inpatient services in March 2020 to create both intensive care and medical care units specific to the care of COVID-19 positive patients. The service modifications included elimination of elective hospital surgical procedures, and nursing units were designated to cohort and quarantine patients based on their COVID-19 status.

The medical intensive care unit (MICU) became the primary site for ICU care, with two other ICUs,

cardiopulmonary critical care unit and neurology intensive care unit, providing overflow support. Two medical-surgical, hospitalist units (HSP) were designated as the primary nursing units for non-ICU care. Patients requiring ventilator support were admitted to the designated ICUs, whereas all other patients were admitted to the HSP units unless there were no available beds in the medical/surgical units, and the ICU was not at capacity, in which case an ICU bed may be used for the medical/surgical patient.

Beginning in March 2020, patients with COVID-19 were admitted to these designated units to ensure adequate care by a dedicated staff and to reduce the risk of spread to other patients. As the number of COVID-19 cases increased, the nationwide stock of PPE was diminished because of increased demand across the country. Family/caregiver visitation on COVID-19 units was eliminated to mitigate community viral spread, with the exception of compassionate care at the end of life.

The hospital workflow and normal hospital operations slowly returned to normal during the month of May 2020 and have remained at full operations. The purpose of this article is to discuss the authors' findings from a descriptive analysis of HAPI development among patients who were COVID-19 positive, comparing HAPI characteristics at two time points to reflect the organizational learnings that transpired as the pandemic progressed. The 2 time points were March–May 2020 and June–July 2020.

Methods

Setting

The setting for this project is an urban academic health science center located in the southeastern United States. The academic health center is the third largest public hospital in the United States. The medical center has 1,157 beds and sees an average of 55,000 admissions per year and 6,000 ambulatory visits per day, has 1,400 physicians, 3,600 nurses, 800 advanced practice providers, and since 2002 has received American Nurses Credentialing Center Magnet²¹ status five consecutive times (in 2002, 2006, 2011, 2015, and 2019).

Institutional Review Board

Exempt institutional review board approval was obtained from the organization's IRB for conducting this study.

Study Design

In this descriptive study, we retrospectively examined the prevalence and characteristics of HAPI among COVID-19 positive patients from March–July 2020.

Data Collection and Analysis

An Excel²² spreadsheet was used by the team to collect the electronic health record data associated with HAPI events. Using the organization's cost accounting system and admission, discharge, and transfer information (ADT), we obtained data from final billed and coded records of patients discharged between April 1, 2020, and July 31, 2020. These data represent patient admissions during the months of March–July 2020. Our earliest patients were admitted to the hospital in March but were discharged in the month of April. From March to May 2020, treatment modalities were changing rapidly, and hospital operations were modified from the middle of March to the end of April to limit elective procedures, resulting in a reduced patient census. In May 2020, hospital operations slowly began to return to normal, and by June 1, 2020, hospital operations teams, faculty, and staff had resumed consistent pre-COVID service delivery. During this time, treatment modalities were standardized to the current science and available therapeutics. Therefore, we evaluated COVID patients admitted between March and May 2020 separately from those admitted in June–July 2020 of the pandemic cycle to reduce bias and provide a longitudinal view of COVID patients.

Using the International Classification of Diseases-10²³ (ICD-10) code of U07.1, we collected all patient encounters with a COVID-19 diagnosis in the primary or secondary fields. In keeping with the National Pressure Injury Advisory Panel definition, a HAPI is a localized injury to the skin and/or underlying tissue during an inpatient hospital stay.²⁴ The patient encounter number was used as the unique identifier to connect patients' financial and ADT information to staged pressure injury data within the organization's HAPI analytical tool. The HAPI analytical tool was built by an improvement team within the hospital to collect staged pressure injury attribution assigned by the Wound, Ostomy, and Continence (WOC) Team.²⁵ These HAPI data are considered the most accurate attribution of staging and are stored within the HAPI analytical tool managed by the hospital finance department. These data are identified by the date of attribution in the month when the injury is acquired and connected to the ICD-10 data for the month of discharge.

The study team populated the COVID-19 encounter spreadsheet with the following variables from the information systems described: encounter number, admission/discharge dates, pressure injury stage, and anatomic location of the staged pressure injury. We also included a severity of illness and risk of mortality (ROM) measure for each patient, based on 3M coding software.²⁶ The study team created an additional column to represent potential device-related HAPIs, attributed by the study team based on the anatomic location of the HAPI. There was no need to collect information on the presence of the pressure injury on admission because preadmission pressure injuries are not collected within the HAPI analytic tool; it only collects pressure injuries that are acquired during the hospital stay.

Hospital census patient days were collected and used to calculate rates of COVID-19 per 1,000 patient days. Patient days were summed for the five study units during the months of March–July 2020. Counts of HAPIs for the COVID-19 patients were summed across all 5 units, divided by the summed patient days for the 5 units, and then multiplied by 1,000.

Patient identifiers were necessary to merge data from the separate data sources; however, all reporting for the study was performed in aggregate with no unique patient identifiers. To analyze these data, the study team used the functionality within the Excel spreadsheet to create descriptive statistics, pivot tables, frequencies, and percentages.

Results

A total of 772 inpatients discharged between March 1, 2020–July 31, 2020 were diagnosed and coded with a U07.1 ICD-10 diagnosis code, indicating a COVID-19 positive diagnosis. Of these, there were 226 (29%) patients coded with a COVID diagnosis in a principal ICD-10 diagnosis field. In the month of April 2020, there were 26 (12%) cases, in May 41 (18%) cases, in June 39 (17%) cases, and in July 120 (53%) cases in a principal ICD-10 diagnosis field. The mean age of the COVID patients was 58 years, median age 60 years, with a standard deviation of 19 years. The race of the patients was 52% Black or African American and 32% White with approximately 53% male and 47% female. The majority, 48% of the patients, had some form of Medicare, with 18% private insurance, 11% Medicaid, and 7% self-pay.

Patient ROM and Severity of Illness (SOI) determined through 3M coding software²⁶ had little variation in the two time periods reviewed. From

March to May 2020, 100% of the COVID HAPI patients were classified in the ROM categories of 3 or 4 (major/severe), and 97% were classified in ROM categories of 3 or 4 in June and July 2020. One hundred percent of COVID HAPI patients were rated as category three or 4 (major/severe) in SOI at both time periods.

From March 1 to July, 2020, a total of 322 HAPI were documented on 220 unique patients. Of these, 39 (18%) were COVID-19 positive patients who had 62 documented HAPIs (19% of total HAPIs). Fifteen COVID-19 positive patients had more than 1 HAPI. Forty-four (71%) of the 62 HAPIs documented on the COVID-19 positive patients were staged by the WOCT, and 18 (29%) by staff nurses. Hospital-acquired pressure injury staging included: Stage 1 ($n = 5$), Stage 2 ($n = 16$), Stage 3 ($n = 3$), Stage 4 ($n = 1$), unstageable ($n = 19$), and deep tissue injuries (DTIs) ($n = 18$). Table 1 provides the detail by month.

The study team considered HAPI locations on the neck or face as potentially associated with positioning or medical devices, such as tubing or neck collars. We attributed 26 (42%) of the 62 HAPI anatomic locations identified within the patient cohort as potential device or positioning-related events during the study timeline.

From March 1 to May 30, 2020, the total number of HAPIs among all patients was 207 compared with June 1–July 31, 2020, when the total number of HAPI was 115. This change reflects a 45% difference from the two time periods during the pandemic. For the same time periods, the number of COVID-19 positive patients with HAPI March–May was 39 compared with 22 in June–July, reflecting a 44% difference from the 2 time periods. Figure 1 depicts the patterns of HAPI from March to July 2020.

Because the patient numbers varied greatly between the 2 time periods, rates per 1,000 patient days were calculated. The rates of COVID-19 HAPI per 1,000 patient days ranged from a low of 0.6 to a high of 8.5. The following were the calculated rates per month: 0.6 (March), 5.0 (April), 8.5 (May), 3.8 (June), and 2.7 (July).

Limitations

This study is limited to a single institution and the COVID patients admitted during the study period. Therefore, because of small numbers, we were only able to describe the affected population; we did not have a sample size large enough to predict risk or conduct inferential analyses.

Discussion

In this organization, HAPI reduction has been a targeted focus area for improvement over the last 4 years. At the onset of the COVID-19 pandemic, organizational leaders and clinical staff struggled to determine the most effective patient management and treatment protocols, as well as adjusting unit processes and staff workflow, potentially increasing adverse events and creating care delivery challenges. During the pandemic, HAPI numbers have fluctuated from a steady increase from March to May 2020, hitting a peak high of 90 cases in the month of May. However, the trend in the total all-stage HAPIs began to decline in June 2020, with a low of 51 in July, the lowest number since March 2020 when the patient census was at its lowest point (Figure 1).

Because our hospital is a tertiary care and regional referral center, the risk of mortality and severity of illness measures of our patients generally remains relatively stable over time, as it did during the early pandemic periods we are reporting in this study. We demonstrated that these measures for mortality risk were slightly lower in the June–July period, and the illness severity ratings were identical in the two time periods. Therefore, we did not attribute the reduction in HAPI to a lower risk of mortality or severity of illness among our patients.

Our 4-year HAPI improvement efforts are framed within the context of the LHS model. Fluctuations and variations in the number of HAPIs during the study period likely occurred due to organizational learning about how to manage patients with COVID 19. Our efforts to improve HAPI scores during the pandemic were framed within our 4-year efforts using the LHS model to reduce pressure injuries among our patients. As opportunities for improvement are identified, workflow and processes are quickly adapted. In relation to pressure injuries, high volume COVID units, such as the MICU, unit staff consistently observed COVID patients, and were able to identify trends and patterns in the HAPI occurrence and make real-time adjustments in care delivery and, therefore, mitigate the risk for continued increases in HAPI.

Beginning in March 2020, organizational workflow and processes were modified to account for COVID-19 patient isolation. Pre-COVID, the WOC nurse would evaluate every staged pressure injury documented by a staff nurse at the point of care. In the months of March and April, the WOC team evaluated wounds using teletechnology in the form of iPads outside the patient room rather than inside

Table 1. Summary Data Hospital-Acquired Pressure Injury March–July 2020

Month 2020	Count HAPI/Count COVID HAPI	Count unique patients/ count COVID unique patients	Count COVID patients >1 HAPI	COVID HAPI count staged by WOC/count staged by staff nurse	COVID HAPI stage (count)
March	56/2	43/1	1	1/1	DTI (2)
April	61/12	46/10	3	9/3	Stage 2 (4) Stage 4 (1) Unstageable (4) DTI (3)
May	90/26	55/13	7	20/6	Stage 1 (3) Stage 2 (9) Stage 3 (1) Unstageable (7) DTI (6)
June	64/13	36/9	2	12/1	Stage 1 (1) Unstageable (7) DTI (5)
July	51/9	40/7	2	2/7	Stage 1 (1) Stage 2 (3) Stage 3 (2) Unstageable (1) DTI (2)
Total	322/62	220/40	15	44/18	Stage 1 (5) Stage 2 (16) Stage 3 (3) Stage 4 (1) Unstageable (19) DTI (18)

DTI = deep tissue injuries; HAPI = hospital-acquired pressure injuries; WOC = wound, ostomy, and continence.

to conserve PPE. The staff nurse caring for the patient would assess the patient and provide a telelink to the WOC nurse. Those data that we identified with a lack of attribution by a WOC team member may have occurred due to isolation protocols or lack of appropriate documentation, such as documentation in a wound care nurse note and not in a structured field.

After the institution of teletechnology, the WOC nurses evaluated potential HAPI through images from a mobile device sent from a nurse within the patient's room. The use of electronic devices by the medical team resulted in greater observation access to the COVID-19 patient, but had limitations on the ability to directly observe, touch, and treat the patients in the patient room, and in situations where patient care is dependent on visual and tactile processes. The WOC team was still able to provide

direction to the nursing staff for wound treatment, but isolation protocols may have resulted in more limited patient access for effective management and treatment of pressure injuries during the early months of the pandemic when processes and protocols were still being established.

The peak of HAPI numbers and rates in May 2020, both overall and in the COVID-19 positive patients may have been a result of the workload effects of the gradual return to normal operations during that month. Elective surgical cases resumed, and the overall inpatient hospital volume gradually returned to near prepandemic months. Increases in HAPI may have also been associated with patient isolation; family members or other caregivers, critical members of the healthcare team, were restricted from patient visitation on COVID units. These patient caregivers may be key stakeholders in reducing adverse events. Families often become the eyes and ears

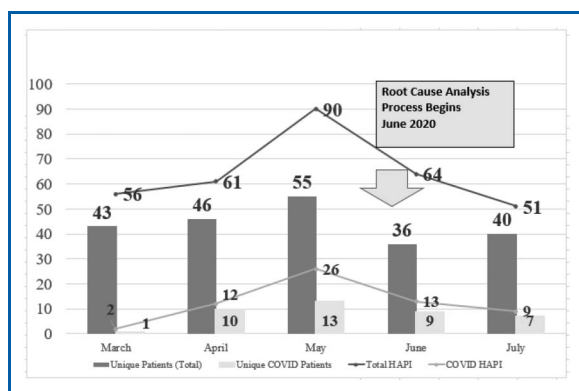


Figure 1. Patterns of hospital-acquired pressure injury March–July 2020.

for best practice within a healthcare environment such as a hospital room. Limiting families and caregivers may have decreased patient repositioning and potentially created a lack of communication to the primary team by the family or caregiver on behalf of the patients.

Patient positioning may be an important factor in the development of pressure injuries for COVID-19 patients. Proning,²⁷ or positioning a patient on the stomach with the chest down and back up, may be a factor in the development of pressure injuries, particularly on the face and neck for this population of patients. The benefits of prone positioning for respiratory patients includes better aeration of the lungs, an important consideration for the respiratory distress experienced with COVID-19.²⁸⁻³² Although proning is beneficial for oxygenation, it is a challenge for mitigating the risk for pressure injury development.³² We identified that 42% of the 62 COVID HAPI cases were potentially related to positioning or devices impacting anatomic positions above the neck (i.e., face, head, and neck).

Noting the increase in HAPIs, in June 2020, the chief nursing officer committed resources to the development of a HAPI root cause analysis (RCA) process and designated a WOC nurse with a primary focus to evaluate and provide feedback on the RCA findings. The WOC nurse also performed quality rounds to ensure appropriate pressure injury prevention strategies were implemented in high risk COVID/non-COVID units. Learnings from the RCA process were quickly translated to improvement interventions. Based on the evidence associated with increase for positional pressure injury with proning³¹ and early identification of increases in upper-body pressure injuries in our ICU environments, our nursing leadership team quickly responded with an

intervention. Silicon adhesive dressings have been used successfully to mitigate pressure points in our organization. This intervention was applied to the prone patients for those upper-body regions.

Our organization continuously monitors all stage HAPI but has a specific focus on HAPI at stages 3, 4, or unstageable, considered a PSI-03.³³ Organizations do not receive full monetary reimbursement from CMS for PSI-03. We found that 37% of the COVID HAPI evaluated were at Stage 3 or above. Our PSI-03 pattern for March–July aligned with total HAPI counts; thus, we believe this pattern continues to reflect clinical learning and rapid improvement in care delivery.

In summary, we found that patients evaluated in this study did not have a longitudinal increase in HAPIs from March to July 2020 during the COVID-19 pandemic, in part due to the process of continually evaluating the prevalence of HAPIs among patients and the ability to easily develop and adapt appropriate interventions.

Conclusions

The COVID-19 pandemic has created a myriad of complex challenges for patients, providers, and healthcare organizations. Patient adverse events are likely to increase as modifications to care delivery are implemented to mitigate the risk of viral spread. Healthcare delivery personnel must be able to balance the risk of spread with the complications that may be inadvertently caused by prolonged isolation and limited staff exposure.

Implications

There are positive aspects of using a LHS framework that may result in improved care delivery, even during a pandemic. This case study demonstrates the importance of health systems being able to quickly assess and document a problem, deploy resources to fix the problem, as well as evaluate the effectiveness of an intervention. Having such a LHS structure in place will allow providers to quickly adapt processes and workflow as new data and information are uncovered, and thereby mitigate and reduce adverse events proactively.

Authors' Biographies

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