Blending Evidence-Based Practice and Lean Six Sigma Methodology to Reduce Hospital-Acquired Pressure Injuries in a Progressive Care Unit

CE 1.0 Contact Hour

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ABSTRACT

Background: Hospital-acquired pressure injuries (HAPIs) continue to challenge acute care facilities. Best practice to reduce HAPI includes assessment, documentation, positioning, and treatment.

Local Problem: In spite of using evidence-based practices, the hospital's gastrointestinal/genitourinary progressive care unit had more HAPIs each month than the other units in the hospital.

Methods: A combination of Lean Six Sigma and evidence-based practice was used to decrease HAPIs.

Interventions: The T^3 program (turn, touch, and tidy) was developed to address the areas of concern identified in the root cause analysis.

Results: HAPIs were reduced from 22 in the previous 2 quarters to zero for 3 consecutive quarters with a cost avoidance to $379 767.

Conclusions: The successful implementation of the T^3 program was the result of blending Lean Six Sigma and evidence-based practice.

Keywords: evidence-based practice, hospital-acquired pressure injuries, Lean Six Sigma, quality improvement

Hospital-acquired pressure injuries (HAPIs) affect 2.5 million patients annually, costing up to $11.6 billion per year in the United States.[1] HAPIs are multifactorial, making interventions for prevention complex and challenging. Assessing and treating patient skin care needs are critical for optimal pressure injury prevention. Health care organizations have steered efforts to systematically improve practices.[2] Quality improvement (QI) methods and innovative practices have been used to improve HAPI rates. This Magnet-designated, Southern California community hospital applied Lean Six Sigma methodology and evidence-based practice (EBP) to improve practice and prevent pressure injuries. The purpose of this article is to describe how merging these 2 methodologies successfully decreased HAPI.

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BACKGROUND

Sharp Grossmont Hospital is a 540-bed acute care hospital and part of an integrated regional not-for-profit health care system. The hospital averages 85 admissions per day. The state-of-the-art facility includes service for emergency care, oncology, orthopedic, cardiac, and women's health. The hospital's wound team trends and treats HAPI on an ongoing basis. Despite using EBPs, the hospital's gastrointestinal/genitourinary (GI/GU) progressive care unit had more HAPI each month than the other units

in the hospital. The GI/GU progressive care unit averaged 7 HAPIs per quarter with additional cost of treatment and lost revenue of $233 118.

The staff had participated in the National Database of Nursing Quality Indicators pressure injury training modules online prior to the project.[3] Utilization of EBPs alone did not improve patient outcomes; therefore, the hospital sought to integrate the Lean Six Sigma methodology to improve their HAPI rates.[4]

Hospital-acquired pressure injuries

HAPIs are defined as localized injuries to the skin or underlying tissue, usually over a bony prominence, because of pressure or pressure in combination with shear or friction.[5] The National Pressure Ulcer Advisory Panel states a pressure injury may present as intact skin or an open ulcer. Pressure injuries are staged according to the extent of the damage to the layers of skin, ranging from stages 1 to 4, unstageable, and deep tissue pressure injuries. The California Department of Public Health as directed by the Centers for Medicare & Medicaid Services requires that hospital organizations report stages 3 and 4 and unstageable HAPI for investigation and assessment.[5]

HAPIs are painful for patients and can negatively affect their quality of life and, in some cases, can result in death.[6] For most organizations, HAPIs result in lost revenue and additional finances expended to care for a patient. The patient treatment costs range from $20 900 to $151 700 per pressure ulcer.[6]

Pressure injury prevention

Skin care is a fundamental nursing skill with a goal of injury prevention. Since 2004, the American Nurses Association identified HAPI as a nurse-sensitive indicator. Nurse-sensitive indicators are defined as structures, processes, and outcomes that are directly related to the care provided by nursing staff.[7] The quality of nursing practices in pressure injury prevention and skin care is reflective of the organization's HAPI incidence and prevalence rate.

The formation of a pressure injury is dependent on multiple variables including prolonged pressure, shear, friction, moisture, or a combination of these 4 variables. Evidence-based preventive strategies focus on frequent assessment, repositioning, and the use of moisture barrier products and pressure-reducing devices to reduce the risk of pressure injury development.[8,9]

Lean Six-Sigma methodology

The health care industry has identified approaches to patient care that can improve the quality of care and reduce costs.[10,11] One approach is the adoption and application of Lean Six Sigma methodology to improve processes and transform performance. Lean Six Sigma methodology is a combination of 2 methods, *Lean* and *Six Sigma*.[12,13] Fundamental to Six Sigma is the DMAIC model approach to improvement. DMAIC is an acronym for the improvement process: define, measure, analyze, improve, and control. With this approach, cyclical improvements are made by analyzing data and refining processes to optimize performance and reduce variations that result in an error.[13] This QI approach has been adopted by the health care industry for patient safety. Lean principles focus on eliminating waste in work and Six Sigma principles focus on reducing variation within a process. By combining the strength of both analytical principles, Lean Six Sigma provides an organization with a method to problem-solve and decrease potential weaknesses in work processes and improve performance.[14]

Evidence-based practice

The 6 A's EBP model[15] was used when applying clinical practice to HAPI on the GI/GU progressive care unit. The 6 A's EBP model consists of assessing, asking, acquiring, appraising, applying, and analyzing. However, after several months with high numbers of HAPI, the unit needed a different approach to adopt and sustain best practice and improve outcomes. Re-education of best practice alone was insufficient to reduce the number of HAPI. With the understanding of the strength of Lean Six Sigma methodology, an opportunity presented itself to combine Lean Six Sigma methodology and EBP as a way to facilitate and sustain practice change. Each method provided a foundation to enhance processes, implement, and sustain change.

The project began with the DMAIC model and quickly merged into the EBP process. Initially, the project's goals were defined (D-Define), then followed by the review of the current data (M-Measure), which indicated a problem with rising HAPI. During the analysis phase of the current practice, the root causes of the problem were identified, which began the 6 A's EBP process. The 6 A's model provided an opportunity to review the literature to highlight best practices

and align processes to instill these practices. The project continued to implementation (I-Improve) and sustainability (C-Control) of the renewed practice (Figure 1).

METHODS

The project was implemented on the GI and GU progressive care unit, a 36-bed unit that specializes in providing care for the medical and surgical gastrointestinal or urinary patient population. Patient care is provided in a collaborative environment to a diverse patient population.

A team assembled, consisting of a nursing assistant, clinical nurse, nurse lead, nurse manager, department director, wound team specialist, clinical nurse specialists, and Lean Six Sigma Black Belt/PhD-prepared nurse, to conduct the first of 3 Kaizen events. *Kaizen* is a Japanese word for "change for the better" or "improvement." During the kaizen events, the team gathered to map the existing process and to solicit buy-in from all parties related to the process while initiating the DMAIC QI model. During the early stages of the project, a nutritionist, physician, and the medical librarian were consulted.

Kaizen event 1

The team participated in a 4-hour workout. During the first meeting, the project was defined, measured, and analyzed. Preliminary analysis of the HAPI cases revealed that the most common locations of HAPI were on the patient's sacrum and heels. Braden scores for predicting pressure injury risk indicated that moisture and friction were the most common low-scoring categories. It was evident there was a system failure in that the current clinical practices did not have a defined and consistent process for nurses to follow for skin assessment and prevention measures. This was identified with the use of a process flow map called a swim lane. A swim lane is a visual map used to illustrate the separate processes into lanes that represent different functions, departments, or individuals.[13]

The team conducted a root cause analysis of the current process, using silent brainstorming and multivoting to construct a cause-and-effect diagram, also called a fishbone diagram or Ishikawa diagram (see the Supplemental Digital Content, Figure, available at: http://links.lww.com/JNCQ/A673). The fishbone diagram is a visual tool for categorizing potential causes of a problem in order to identify its root causes.[13] Members of the team voted on the most significant causal factors, highlighting 4 gaps in the nurses' process: (1) lack of situational awareness among the team of the level of acuity on the unit, (2) lack of assistance when needing to reposition the patient in bed, (3) lack of a comprehensive skin assessment, and (4) timely cleaning of the patient and changing of the linen. To improve HAPI on this unit, these 4 practice gaps needed

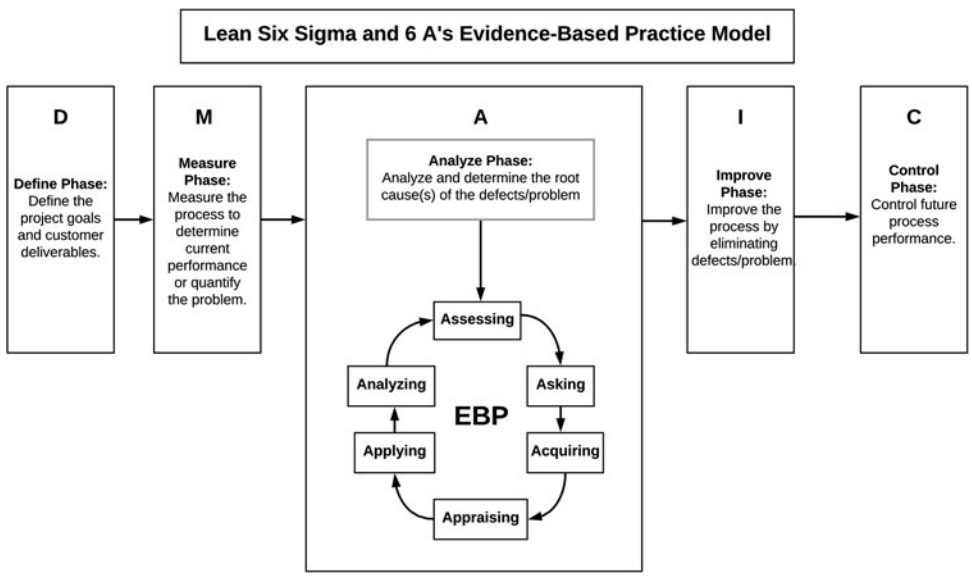

Figure 1. Lean Six Sigma and evidence-based practice model (Copyright Sharp HealthCare). Reprinted with permission.

to be addressed. Although all causal factors were important to address, the top 4 selected were based on strength of the evidence and the team's ability to implement the changes that would result in a favorable outcome.

EBP after the root cause analysis

After the analysis was complete, the 6 A's model was initiated (Figure 1). A review of the literature was conducted by the team to search for evidence on assessment and prevention of HAPI, specific to the issues on the unit. Databases searched included PubMed and the Cumulative Index to Nursing and Allied Health; the team also searched resources at and the Agency for Healthcare Research and Quality Web site. After reviewing the literature and focusing on the gaps in practice, a program was developed using the following acronym, T^3 program (turn, touch, and tidy). The T^3 program addressed the areas of concern. *Turn* the patient at a scheduled time; *touch* the patient to assess skin (especially bony prominence); and *tidy* (clean) the patient, change, linen, tidy bed; and confirm next repositioning time. By implementing the T^3 program, the problem with moisture and friction was addressed.

Kaizen event 2

To address the lack of situational awareness among the team about the level of acuity on the unit and the timely cleaning of the patient and changing of the linen, new processes were put into place for consistency and to reduce variation. The nurses' team assignments were redesigned with consideration of patient acuity and unit layout; however, the change did not affect the staffing level on the unit. The new clinical team on the unit consisted of 3 nurses and 1 nursing assistant for a total of 4 teams per shift. By optimizing the unit's physical layout, the teams were strategically organized at each quadrant of the nursing unit. To clarify expectations, roles were defined. The nurse and a nursing assistant would meet at the beginning of the shift to schedule and confirm repositioning times. By collaborating, the dyad would effectively and safely reposition the patient and thoroughly assess the patient's skin integrity. Education was provided to standardize documentation of a comprehensive skin assessment in the electronic medical record.

Kaizen event 3

The final Kaizen event focused on the appropriate amount and linen type used on the beds. The nursing assistants were responsible for ensuring that patients received the appropriate linen based on their mobility and continence status. An algorithm was created (incontinent and ambulatory, incontinent and nonambulatory, and patients not at risk [Braden score >18]) to assist in the use of proper linen specific to patient condition and the proper interventions specific to each patient. Once the team identified and addressed the 4 practice gaps with clear, defined processes, EBPs were applied to improve HAPI.

RESULTS

Prior to the implementation of the T^3 program, the GI/GU progressive care unit had 22 HAPIs in the previous 2 quarters. The additional cost of treatment and loss revenue totaled $233 118. Following implementation of the program, HAPI rates reduced to zero the following quarter and remained at zero for 3 consecutive quarters (Figure 2). The reduction of HAPI resulted in a total of $379 767 in care cost avoidance for HAPI. Qualitative results from the project postsurvey indicated improvement in teamwork, communication, and nurse satisfaction in providing skin care.

DISCUSSION

Providing optimal skin care is a fundamental nursing skill, but with today's chronically ill population, skin care is often overshadowed by the complexity of the patient's condition. HAPIs cause unnecessary patient pain and suffering. In addition, health care organizations have a monetary consequence in penalties, lost reimbursement, and reputation ramifications. Subsequently, it is not the practices that hospitals need to question, but the processes to apply best practice.

The introduction of EBP has steered clinical efforts to optimize patient outcomes. Occasionally, the practices do not improve patient outcomes, which leads to clinicians question the effects of EBP. This project illustrated that the application of evidence should not be called into question, but the processes that revolve around applying best practices should be considered. This notion of addressing application of best practice is beginning to emerge in the literature, as numerous EBPs are implemented with partial success

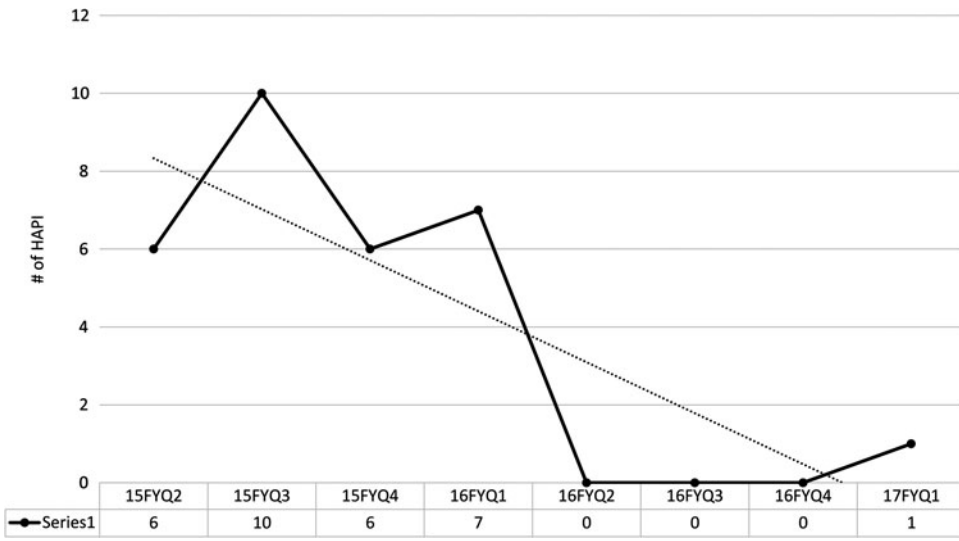

Figure 2. Hospital-acquired pressure injuries.

or limited sustainability. Others have introduced new frameworks to assist in the application of EBP.[16,17] This project used Lean Six Sigma, which focuses on the processes that allow a clinician to apply EBP consistently with minimal variation. The nurses at this hospital understood the clinical evidence needed to support skin care for their patients. However, the consistent application of best practice varied. Once the barriers were identified and processes were applied to reduce variation in the application, the practice was implemented successfully. The T^3 program provided the structure to allow for best practice, while the DMAIC model identified root causes and processes to apply best practices.

The success of the program led to improved patient outcomes, positively influenced the work environment, and enhanced nurse satisfaction. The project improved the staff's relationship with the patient and improved unit culture of teamwork and communication. By providing structure to the process, the nursing staff was able to implement best practice and provide optimal care for their patients.[18] To sustain and control efforts, a control plan was created to include debriefing after each defect, HAPI task force participation, and frequent monitoring and tracking by the wound team with the clinical nurse specialist oversight.

Limitation

The T^3 program was implemented in only 1 GI/GU progressive care unit at an acute care community hospital. This limits the generalizability to other nursing units and hospitals. The hospital's background may also be a limitation. The hospital had already adopted a culture of safety providing the foundation to utilize Lean Six Sigma methodology and EBP. Resources were in place to access trained personal (Lean Six Sigma Black Belt, Nurse PhD) to aid in the implementation of QI methods. As a Magnet-designated facility since 2006, Sharp Grossmont Hospital has assumed the culture of empowering the nurses to consistently apply EBP daily. The resources (personnel, equipment, and fiscal) are provided to sustain best practice.

CONCLUSIONS

Hospitalizations that result in additional pain and suffering, as with HAPI, are contrary to what nurses strive for in their practice. Nurses enter the profession with the desire to care for their patients with dignity and respect. The T^3 program has allowed these nurses to practice evidence-based skin care in a structured and consistent model that allows for optimal outcomes. The 3 components of the program, touch, turn, and tidy (T^3), reinforced application of best practice to reduce HAPI. Using both the 6 A's EBP model and Lean Six Sigma methodology, the processes in the program were defined to enhance consistent practice. This ensures quality care for the patient and reinforces the nurses' desire to provide the best care possible. In future efforts in which implementation of best practice does not

result in a favorable outcome, rather than questioning the practices, nurses should consider the processes that have been put in place to implement and sustain the practice change.

REFERENCES

1. Agency for Healthcare Research and Quality. Preventing pressure ulcers in hospital. https://www.ahrq.gov/patient-safety/settings/hospital/resource/pressureulcer/tool/index.html. Published 2018. Accessed October 26, 2019.
2. Kwan S, Daniels M, Ryan L, Fields W. Creating a standardized process to meet core measure compliance. *J Nurs Care Qual*. 2015;30(4):331-336.
3. National Database of Nursing Quality Indicators. Pressure injury training 6.0. https://membersnursingquality.org/NDNQIpressureUlcer.training/ Accessed October 10, 2019.
4. Halm MA, Always A, Bunn S, et al. Intersecting evidence-based practice with a lean improvement model. *J Nurs Care Qual*. 2018;33(4):309-315.
5. National Pressure Ulcer Advisory Panel. International support for NPUAP terminology and revised definitions. https://npuap.org/news/news.asp?id=451815&hhSearchTerms=%22change+and+terminology%22. Published February 9, 2018. Accessed October 15, 2019.
6. Agency for Healthcare Research and Quality. Estimating the additional hospital inpatient cost and mortality associated with selected hospital acquired conditions. https://www.ahrq.gov/professionals/clinicians-providers/guidelines=recommondations/index.html. Published 2014. Accessed June 2015.
7. Boyle DK, Jayawardhana A, Burman ME, et al. A pressure ulcer and fall rate quality composite index for acute care units: a measure development study. https://www.ncbi.nim.nih.gov/pmc/articles/PMC5154684/. Published 2016. Accessed June 2017.
8. Rondinelli J, Zuniga S, Kipnis P, Kawar LN, Liu V, Escobar GJ. Hospital-acquired pressure injury: risk-adjusted comparisons in an integrated healthcare delivery system. *Nurs Res*. 2018;67(1):16-25.
9. Padula WV, Gibbons RD, Valuck RJ, et al. Are evidence-based practices associated with effective prevention of hospital-acquired pressure ulcers in U.S. academic medical centers? *Med Care*. 2016;54(5):512-518.
10. D'Andreamatteo A, Ianni L, Lega F, Sargiacomo M. Lean in healthcare: a comprehensive review. *Health Policy*. 2015;119(9):1197-1209.
11. Taner MT, Sezen B, Antony J. An overview of six sigma applications in healthcare industry. *Int J Healthc Qual Assur*. 2007;20(4):329-340.
12. Dean M. *Lean Healthcare Deployment and Sustainability*. New York, NY: McGraw-Hill Education; 2013.
13. Pyzdck T, Keller P. *The Six-Sigma Handbook*. 4th ed. New York, NY: McGraw Hill Education; 2014.
14. Donovan EA, Manta CJ. Using a Lean Six Sigma approach to yield sustained pressure ulcer prevention for complex critical care patients. *J Nurs Adm*. 2016;46(1):43-48.
15. Sackett D, Strauss S, et al. *Evidence-Based Medicine—How to Practice and Teach EBM*. 2nd ed. London, England: Churchill Livingstone; 2000.
16. Brown CE, Ecoff L. A systematic approach to the inclusion of evidence in healthcare design. *HERD*. 2011;4(2):7-16.
17. Gillespie BM, Chaboyer W, Sykes M, O'Brien J, Brandis S. Development and pilot testing of a patient-participatory pressure ulcer prevention care bundle. *J Nurs Care Qual*. 2014;29(1):74-82.
18. Barakat-Johnson M, Lai M, Res M, Wand T, Coyer F, White K. Systemwide practice change program to combat hospital-acquired pressure injuries: translating knowledge into practice. *J Nurs Care Qual*. 2019;34(1):1-7.