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Implementing a Pressure Ulcer Bundle

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Author Note

Amy Johnson is a graduate student at the University of Tennessee at Knoxville.

Abstract

Background: A quality improvement DNP project in a rural southern hospital was implemented to improve hospital-acquired pressure ulcers by implementing an evidence-based pressure ulcer prevention policy and education. **Framework:** The Evidence-Based Practice framework utilized in the project's development, implementation, and evaluation was the John Hopkins Evidence-based Practice Model. **Local Problem:** The hospital had no pressure ulcer bundle in place. **Design:** Quality improvement project utilizing the plan-do-study-act (PDSA) cycle. **Methods:** An educational presentation on pressure ulcers and the steps to implement a bundle. A pre-and post-test using Pieper's Pressure Ulcer Knowledge Test, modified from Agency for Healthcare Research and Quality (AHRQ) website, determined the nursing knowledge before and after the educational presentation. **Data Analysis:** A pre-and post-test analysis, percentage of nurses on the medical surgical floor that attended the training, the number of Hospital Acquired Pressure Ulcers (HAPU) pre-and post-implementation, and the number of times the bundle was implemented post-educational sessions. A paired sample t-test was used to analyze the pre- and post-test analysis. **Results:** There was a 100% completion of the educational sessions by the wound care nurse before implementing the HAPU bundle. Participants scored higher during the post-test ($M=87.524$, $SD= 6.534$), a statistically significant mean increase of 4.891, 95% CI [1.621, 8.160], $t(17) = 3.156$, $p= .006$. The wound care nurse observed every chart. Information gathered from the review demonstrated 77.05% compliance with the implementation of the HAPU bundle. **Conclusion:** There was high compliance with the nurses attending the educational sessions and implementing the HAPU bundle. The bundle can promote early identification of risk factors related to a HAPU. Implementation of preventative measures

included in this bundle is considered best practice in the fight against HAPUs. The education program and the HAPU bundle have become part of the hospital policy.

Keywords: pressure ulcer bundle, pressure ulcer, skin assessment, risk assessment, AHRQ Pieper test, treatment of pressure ulcers

Implementing a Pressure Ulcer Bundle

Introduction

Pressure ulcers, known as pressure injuries or decubitus ulcers, are often preventable. Pressure ulcers are "localized damage to the skin and underlying tissues, typically over bony protrusions, as a result of pressure or pressure combined with shear forces" (Strube-Lahmann & Lahmann, 2021, p. 1362). The development of a pressure ulcer is detrimental to the patient, family, and the hospital. Pressure ulcers can increase a patient's length of stay in the hospital, which is costly and can lead to other medical issues. It is essential for the hospital and patient that measures are in place to prevent pressure ulcers.

According to Soy Buğdaycı & Paker (2021), preventing pressure ulcers is more important than treating them. Pressure ulcers can occur in all genders, races, and ethnicities. Hospital Acquired Pressure Ulcers (HAPU) increase morbidity through pain, discomfort, and possible sepsis, which increases the risk for mortality (WOCN, 2016). Evidence-based care that includes the implementation of a policy of assessing and identifying all patients at risk of pressure ulcer development has become the expected level of care for all patients.

Prevention of pressure ulcers became a mission of the Centers for Medicare and Medicaid Services as part of their value-based purchasing. The Centers for Medicare and Medicaid Services described eleven preventable adverse outcomes which could result in monetary penalties (Sung-Heui, 2016). Studies estimate that the national cost of treating a HAPU range from \$3.3 billion (about \$10 per person in the US) to \$11 billion (about \$34 per person in the US) annually (Padula & Delarmente, 2019). Due to this improvement in care, they included HAPUs stage III or IV are no longer eligible for hospital reimbursement. Therefore, the hospital is incentivized to implement a HAPU bundle to prevent new or worsening pressure ulcers.

Overall, early risk assessment, skin assessment, evaluation, and interventions are essential to providing the best patient care. The aim is for all nurses that work on the medical-surgical floor to receive training. The project began by assessing the current knowledge of the nursing staff by administering a pre-test, followed by an educational session discussing wound care, and a post-test. After the training session, the wound care nurse followed up with all the nursing staff to discuss any questions resulting from the training. The wound care nurse monitored records daily for implementing the HAPU bundle and documented the results.

Available Knowledge

The population of interest was adult patients on a medical surgical floor admitted to a rural hospital in the southeastern United States. As the population ages and the number of patients with obesity and diabetes increases, chronic wounds will become one of the most relevant medical conditions worldwide (Ennis et al., 2017). Therefore, patients with increased age, obesity, and chronic diseases are at an increased risk of developing a pressure ulcer. A risk assessment should determine the potential for developing a pressure ulcer upon admission to the hospital. The project site has a high population of high-risk patients, is a rural hospital, and has no pressure ulcer prevention program. The site did, however, have a wound care nurse recently hired, demonstrating the hospital leadership's commitment to their patients.

The patient, intervention, comparison, outcomes (PICO) model was used to determine the clinical need and organize the project. The PICO question is as follows: In a rural hospital in the southeastern United States, (P), how does the implementation of an evidence-based HAPU bundle and education to nursing staff (I) compare with no bundle or education (C) affect the practice of nurses and the number of HAPU occurrences (O)?

P- (Patient, population, or problem)- rural hospital in the southeastern United States

I-(Intervention)- implement an evidence-based HAPU bundle and educate the nursing staff.

C- (Comparison with other interventions)- no bundle or education

O- (Outcomes)- affect the practice of nurses and the number of HAPU occurrences

A literature search began with a thorough review of the peer-reviewed articles related to the PICO question. The PICO question focused on adult patients, implementing HAPU bundles, and educating the nursing staff. The literature suggests that a bundle of interventions has a practical approach to changing behavior (Richardson et al., 2017). It is clinically significant for the hospital to implement a HAPU bundle. According to Padula & Delarmente (2019), a single HAPU episode could cost anywhere from \$500 to \$70,000. More importantly, HAPUs are responsible for 70,000 deaths annually. Although one occurrence does not sound like an issue, it could have costly and deadly outcomes for the patient and hospital.

The search strategy utilized the databases of PubMed, CINAHL, and Cochrane through the University of Tennessee's online library. The approach used keywords and Boolean connectors. The keywords and Boolean connectors utilized were Wound Care & Nurse Training or Education; Wound Staging & Healing & Nurse Training or Education; Pressure Injury & Braden Scale & United States; Wound Care; Wound Care & Assessment; Prevention & Pressure Injury; HAPU Bundles & Rural Hospitals; Rural Hospitals & Pressure Injuries or Ulcers; CMS reimbursement & Pressure Injury; and Pressure Injuries or Bedsores or Pressure Ulcers & Bundles or Bundles of Care or Protocols. The filters applied with the CINAHL databases were peer review, English language, and full text; the PubMed database applied were abstract, free full text, full text, and five years; and no filters were used with the Cochrane database.

The highest number of search returns was Wound & Healing, with 12,784 returns through the CINAHL database. When "nurse care" was added, returns dropped to 137. There were 22 abstracts reviewed, and kept 9 for critical appraisal of the article. The keyword Pressure Ulcer & Bundle had 63 returns. Only seven articles appeared in the search for Rural Hospitals & Pressure Injuries. The highest number of search returns through the PubMed database came from the keyword Pressure Injuries & Interventions, with 787 returns. The lowest number of search returns through the PubMed database came from the keyword Pressure Injuries & Braden Scale & United States with 16 hits. The Cochrane database search returns range from 147-203 hits per keyword.

Review of Literature and Synthesis

The John Hopkins Evidence-Based Practice (EBP): Research Evidence Appraisal Tool was utilized and guided the critical assessment of each research article. The first question in Appendix E is, "Does this evidence answer the EBP question?" If the answer is yes, continue the appraisal. Each appraisal must list the author, article title, population size, and setting. Under the article appraisal workflow section, the article is reported as quantitative, qualitative, or mixed. After defining the article type, the appraiser answers questions to help determine the evidence level, quality, and study findings.

Seventeen total articles were assessed and critically appraised. These preventions include staff education and bundle implementation interventions such as mattresses, pillows, or other bundle interventions. The search focused on educating nurses and preventing pressure injuries, precisely appraising the bundle approach—twelve papers were excluded because of content related to unclear findings or interventions not focused on pressure injury prevention. Table I evaluates the evidence that was discovered during the literature review.

Table I*Evaluation of Evidence- Literature Review*

Article Citation	Conceptual Framework and Purpose	Design/ Method	Sample/ Setting	Major Variables Studied (and Their Definitions)	Measure- ment	Data Analysis	Findings	Appraisal: Worth to Practice
Shi, C., Dumville J., & Cullum N., (2018). Support surfaces for pressure injury prevention: a network meta-analysis. <i>PLoS One</i> , 13, (2) https://doi.org/10.1371/journal.pone.0192707	No conceptual framework Purpose: To determine the relative effects of different SS in reducing PU incidence and comfort to rank these SS according to their effectiveness.	The systematic review used a literature search to identify RCTs comparing SS for PU prevention. GRADE is used to assess the certainty of evidence. Utilized network meta-analysis to estimate the relative effects and effectiveness of ranking of the groups for the outcomes of PU incidence. Level I Quality Grade- A High Quality	N= 2,816 Full text screening n= 108 Rejected n=43 Studies included n= 65 (14,332 participants) Characteristics: RCTs= N=65 Setting: literature review	IV: <ul style="list-style-type: none"> Support Services (Powered active air surfaces) Standard hospital surfaces DV: Outcomes <ul style="list-style-type: none"> Pressure Injury incidence 	Meta-analysis based on random effects model. All estimates are based on RR with 95% CIs	Sample Size Relative Risk CI Main Findings	Sample Size n= 14,332 (65 studies) RR= SS compared to SHS=0.42 CI= SS compared to SHS= 95% Main Findings: SS reduced the PU Incidence	Strength: a robust systematic review. Weakness: Defining intervention groups: reposition and S.H.S. Conclusion: Moderate-certainty evidence that SS reduces the incidence of PU by 58% and 78% on an average

PU= pressure injuries, RCT(s)=Randomized control trial(s), RR=Relative Risk, CI= Confidence Intervals, SS= Support Services, SHS= Standard hospital surfaces

Article Citation	Conceptual Framework and Purpose	Design/ Method	Sample/ Setting	Major Variables Studied (and Their Definitions)	Measurement	Data Analysis	Findings	Appraisal: Worth to Practice
Zubkoff L., Neily J., McCoy-Jones S., Soncrant C., Young-XU Y., Boar S., & Mills P. (2020). Implementing evidence-based pressure injury prevention interventions. <i>Journal of Nursing Care Quality</i> , 36, (3). 249-256. https://doi.org/10.1097/NCQ.0000000000000512 .	No conceptual framework Purpose: The Veteran Health Administration implemented a breakthrough series (VBTS) to improve outcomes related to PUs.	QI project is broken into 3 phases: Prework, Action, and Continuous Improvement Level V Quality Grade- B Good Quality	12-month QI project to address the improvement needs of VHA facilities. Distance coaching with clinical and QI experts. The sites had interdisciplinary teams and leadership support. Setting: acute and long-term care VHA facilities in the US.	IV: • Change • Package DV: Outcomes • Measure the FAPI rate among all units	Number of Facility Acquire Pressure Injuries	Sample Size Main Findings	Sample Size n= 28 V.H.A. facilities Main Findings: The goal of 50% reduction in PUs was surpassed with the interventions noted. VHA improvement teams implemented changes at the bedside and reduced the FAPI rate.	Strength: The most commonly implement Interventions were staff education and equipment and supplies. Weakness: The project was done in VHA, and the results are self-reportable. Conclusion : The findings are suggested that a large-scale QI can lead to successful changes and improved outcomes.

PU= pressure injuries, VBTS= virtual breakthrough series, FAPI= facility-acquired pressure injury, VHA= Veterans Health Administration, QI= Quality Improvement

Article Citation	Conceptual Framework and Purpose	Design/ Method	Sample/ Setting	Major Variables Studied (and Their Definitions)	Measure- ment	Data Analysis	Findings	Appraisal: Worth to Practice
Richardson A., Peart J., Wright S., & McCullagh I. (2017). Reducing the incidence of pressure injuries in critical care units: a 4-year quality improvement. <i>International Journal for Quality in Health Care</i> , 29,(3) https://doi.org/10.1093/intqhc/mzx040	No Concept- tual framework Purpose: To decrease PU in the critical care areas	QI project to reduce the incidence of PUs by using an evidence- based bundle approach Level V Quality Grade- B Good Quality	Setting: Four adult critical care units with a total of 88 beds Cardio CCU- 24 beds General CCU beds General CCU (complex GI and plastic surgery)- 20 beds Neuro/traum a CCU- 22 beds A bundle of technical and non- technical intervent- ions was implem- ented and supported by clinical leadership in each unit.	IV: • Bundle Intervent- ion s DV: Outcomes • Pressure Injury incidence	Number of Facility Acquired Pressure Injuries	Sample Size Main Findings	Sample Size n= 88 beds Main Findings: Over the 4-year study period, there was a significant and sustained reduction in PUs, especially in the more severe grade. The RRR was 63% over the 4 years. The average cost saving was 2.6 million range. Evidence appraisals were components of the success, including change of mattresses, focused risk assessment, repositioning every 2 hours, and staff training.	Strength: Their efforts to reduce PUs came simultaneou sly as national policy directives. Weakness: The study design could have confounding factors that can't be excluded. Conclusion: a bundle of intervent- ions packaged together had a practical approach to changing behavior.

PU= Pressure Injuries, R.R.R.- Relative Risk Reduction, CCU= Critical Care Unit, QI= Quality Improvement, G.I.= gastrointestinal

Article Citation	Conceptual Framework and Purpose	Design/Method	Sample/Setting	Major Variables Studied (and Their Definitions)	Measurement	Data Analysis	Findings	Appraisal: Worth to Practice
Riley-Baker J., Flores B. & Young-McCaughan S. (2020). Outcomes educating nursing students using an evolving, simulated case scenario. <i>Clinical Simulation in Nursing</i> , 39, 7-17. https://doi.org/10.1016/j.ecns.2019.10.001 .	No conceptual framework Purpose: With patients becoming more complex and presenting with multiple comorbid diagnosis, exposing students to a multi-dimensional care situation in a controlled simulated environment is optimal.	Descriptive evaluation of safety, communication, and assessment, and educational intervention. Level V Quality Grade- B Good Quality	Setting: educating undergraduate healthcare students. N= 253 undergraduate nursing students	IV: <ul style="list-style-type: none">Achievement of skills through simulated environment DV: Outcomes <ul style="list-style-type: none">CommunicationSafetyAssessmentEducational interventions	% of students successfully demonstrating the four skill sets in each of the three scenarios.	Sample Size Main Findings	Sample Size n= 253 Mental Health Unit- 76% achieved all 14 physical and mental health assessment. 57% achieved communication skills. Home Visit- 96% achieved communication skills. 67% achieved all 14 physical and health assessment. Obstetrical Unit- 84% achieved communication skills. 74% achieved all safety skills.	Strength: simulated environment Weaknesses: Revising some of the scenarios. Conclusion: Simulated labs can be powerful arenas for learning. They can provide students opportunities to practice skills.

Article Citation	Conceptual Framework and Purpose	Design/ Method	Sample/ Setting	Major Variables Studied (and Their Definitions)	Measurement	Data Analysis	Findings	Appraisal: Worth to Practice
Alshahrani B., Sim J., & Middleton R. (2021). Nursing interventions for pressure injury prevention among critical ill patients: a systematic review. <i>Journal of Clinical Nursing</i> , 30. 2151-2168. https://doi.org/10.1111/jocn.15709 .	No conceptual framework Purpose: PI prevention focuses on nursing care in critical care units. The aim is to synthesize the evidence on the most effective nursing intervention to prevent PIs among critical care patients.	A systematic review of literature and meta-analysis (PRISMA) and synthesis without meta-analysis. Four electronic databases were searched for relevant studies. Data were analyzed and reported using a narrative synthesis. Level III Quality Grade- B Good Quality	N= 2366 identified N=1119 were duplicates and removed N=Full-text was 45, 31 excluded. N= 14 studies It included: RCTs, quasi-experimental, case series, and cross-sectional studies. Four broad categories: PI prevention bundles, repositioning and use of SS, prevention of MDRPI, and access to expertise.	IV: <ul style="list-style-type: none">Prevent PI bundleRepositioning and Use of Support Surface DV: Outcomes <ul style="list-style-type: none">Development of a PI.	Summary of articles researched	Sample Size Main Findings	Sample Size n= 14 PI prevention bundles-evidence-based PI bundles can decrease the incidence of PIs. Repositioning- to reduce the incidence of PI, repositioning and turning patients is recommended every 2-3 hours. Prevention of MDRPI-most are included in PI prevention bundles, and there was a decrease in PIs. Access to expertise-played a significant factor in PI prevention.	Strength: multiple studies Weaknesses : Meta-analysis was not possible. Conclusion: Not all preventative PI bundles are created equal and prevent PIs. Need to choose effective strategies. Education and training are essential for the prevention of PIs.

PI= Pressure injuries, SS= Support Services, MDRPI= Medical device-related pressure injuries, RCTs=

Randomized Control Trials

Assessment and critical appraisal of the remaining articles concluded that prevention of HAPUs is essential for the hospital and the patient. Clinical significance is geared toward HAPU bundle implementation and the best way to educate nursing staff. The John Hopkins Nursing Evidence-Based Practice Evidence Level and Quality guide was utilized to critically appraise each article. The level of evidence suggested in Table I for practice change was Level I/Grade A, Level III/Grade B, and three articles at Level V/Grade B.

Level I evidence includes experimental studies, randomized control trials (RCT), and systematic RCT reviews with or without meta-analysis (Dang et al., 2021, p. 146). Level III evidence includes non-experimental studies, a systematic review of a combination of RCTs, quasi-experimental and non-experimental studies, or non-experimental studies only, with or without meta-analysis (Dang et al., 2021, p. 147). Level V non-research evidence includes literature reviews, quality improvement, case reports, and opinions of nationally recognized experts based on experiential evidence (Dang et al., 2021, p. 163).

HAPUs impact patient outcomes and increase the cost of hospital care (Holbrook et al., 2021). The Agency for Healthcare Research and Quality (AHRQ) is charged with improving the quality and safety of American healthcare. Standards of care for the prevention of pressure ulcers, best practices for implementing a HAPU bundle, and an implementation guide for facilities are available from the AHRQ (Agency for Healthcare Research and Quality, 2016). The hospital may notice an increase in the number of HAPUs documented at earlier stages since the focus will be on early evaluation and assessment of the skin. Therefore, successfully implementing a HAPU bundle will improve patient outcomes and decrease the cost of hospital care.

Table II synthesizes the evidence and supports preventative pressure ulcer bundles, including supported air mattresses, skin assessments, and foam wedges (Richardson et al., 2017). The articles evaluated the effectiveness of bundle interventions related to the care of adult patients. Two of the four articles found clinical significance and a decrease in the incidence of pressure ulcers once the bundles were implemented. In three articles, education and staff training with online assessment or in-person training were found to reduce the incidence of pressure ulcers (Alshahrani et al., 2021). In addition, in-person training using interactive clinical activities strategies such as flipped classrooms, use of technology, and simulation was found to promote higher levels of engagement and deeper learning (Vetter & Latimer, 2017).

Specific Goals and Aims

The project focused on implementing an evidence-based Pressure Ulcer Bundle on the medical-surgical floor, where nursing staff would receive education training. As stated previously, before the bundle and training implementation, there was no bundle in use. The aim was to implement an evidence-based pressure ulcer prevention bundle.

The goal of the project is to implement a hospital-acquired pressure ulcer bundle. One of the critical goals of nursing is to protect our patients from harm. HAPUs cause harm to patients and result in pain, infection, and an increased hospital stay of up to 20 days (Latimer et al., 2021). Prevention of HAPUs will improve the patient's quality of life by decreasing pressure ulcer incidence and the chance of complications leading to sepsis or death.

Significance and Implication

As stated in the introduction, the hospital did not have a pressure ulcer bundle before this project's development. The clinical issue of pressure ulcers is vital because most hospital-acquired pressure injuries are preventable. Approximately 2.5 million individuals (about twice

the population of Hawaii) in the United States develop pressure injuries yearly in acute care facilities (Padula & Delarmente, 2019).

Table II
Synthesis of the Evidence-Based Literature

Intervention	Author #1 Zubkoff et al. (2020)	Author #2 Shi et al. (2018)	Author #3 Alshahrani et al. (2020)	Author #4 Richardson et al. (2017)	Author #5 Riley-Baker et al. (2019)
Education and training for staff	√	⊙	√	√	√
Standard Care: Pillows, foam wedges, mattresses, and/or rolled towels	Included in bundle	√	√	Included in bundle	⊙
Bundle: Skin Assessment, prevention strategies, and friction protection	√	⊙	√c↓	√	⊙
Prevention Strategies: air surfaces	Included in bundle	√c↓	Included in bundle	Included in bundle	⊙
Sample Size	N=35 applied to participate N=28 completed the program	N=14,332 participants in 65 studies	14 studies # of participants ⊙	4-year study ↓ (All per 100) Baseline- 8.08 n= 204 At 1 yr- 5.49 n=148 At 2 yr- 3.78 n=103 At 3 yr- 3.05 n=82	N=253 undergraduate nursing students
Level of Evidence	Level V	Level I	Level III	Level V	Level V
Quality of Evidence	Grade B Good Quality	Grade A High Quality	Grade B Good Quality	Grade B Good Quality	Grade B Good Quality
Any other information essential to the PICOT question	Overall, the project decreased the incidence of PUs.	Air surfaces reduce the incidence of PUs.	Systematic Reviews and Meta- analyses; Synthesis without meta- analysis	A bundle of interventions packaged together had a practical approach to changing behavior.	Teaching strategies implemented in a simulated environment.

Legend: √=discussed in article; ⊙=not discussed in article; c= clinical significance; ↓= decrease incidence of PUs;
PUs= pressure injuries;

The benefit of the project was multifactorial: increased nursing knowledge and understanding of pressure ulcers, standardizing skin assessment for all patients, and implementation of care to prevent pressure ulcers before they occur. The prevention of pressure ulcers is a benefit for the hospital and patients. Medicare beneficiaries' annual claims related to pressure ulcer care accounted for about \$22 billion (Padula & Delarmente, 2019).

The project will be sustained through yearly training classes for nurses in the project hospital, and the continued surveillance of all patients found at risk by the newly hired wound care nurse. The wound care nurse aids the medical surgical nurses in identifying and examining any patient at risk for HAPUs. The project integrated the American Association of Colleges in Nursing (AACN) 10 Essentials Domains for Nursing throughout the process. The ten domains ensure that the patient is kept at the center of nursing care while implementing evidence-based practices.

Context

The quality improvement project was implemented on a 15-bed medical-surgical floor in a rural Joint Commission-accredited hospital in the southeastern US. The United States Department of Health and Human Services approved the project hospital for participation in Medicare and Medicaid programs. The project participants included the 18 nursing staff on the medical-surgical floor. The staff consisted of 5 licensed practical nurses (LPN) and 11 registered nurses (RN). The educational sessions were developed using the evidence-based toolkit from the Agency of Healthcare Research and Quality (AHRQ). This toolkit assists hospital staff in implementing effective pressure ulcer prevention practices through an interdisciplinary approach to care. The evidence-based pressure ulcer bundle includes a risk assessment, skin assessment, and interventions based on the risk assessment. The staff education sessions discussed pressure

ulcer facts, skin assessment, risk assessment, prevention interventions, nutrition and hydration importance, pressure ulcer staging, interventions, and documentation. The sessions were conducted over several days, each lasting two hours, and multiple sessions daily to accommodate schedules.

Ethical Considerations

Data was blinded and secured by the wound care nurse. Each nurse that took the pre-and post-test utilized a four-digit code to identify themselves to protect any personally identifiable information data. In addition, the nurses were to identify themselves as an RN or LPN and if they were classified as a full-time or part-time employees. The wound care nurse checked the charts daily on the medical-surgical floor to determine if the bundle was implemented. The wound care nurse maintained the data in a secure spreadsheet. No specific patient health information was included in the study. The study underwent a human subject determination via the University of Tennessee at Knoxville Institutional Review Board (IRB). It was determined that the project was not human subjects research and was exempt. The IRB review ensures that participating research subjects' rights and welfare will be adequately protected (Grady, 2015).

Methods

The Quality Improvement project utilized the Plan-Do-Study-Act (PDSA) design cycle. The purpose of the Plan-Do-Study-Act (PDSA) cycle is to develop a plan, make changes, observe, and modify the project. According to Finkelman (2020), three questions are considered when applying this cycle: (1) What are we trying to accomplish? (2) How will we know that a change is an improvement? (3) What changes can we make that will result in improvement? The PDSA cycle is used for continuous improvement within the healthcare setting.

In the PDSA cycle, researchers can plan, do study, and act. In the planning step, the team describes a method for change (Finkelman, 2009, p113). Planning should consider the five W's: who, what, when, where, and why data (Finkelman, 2009, p113). "Do" is the second step of the cycle. It involves a small test pilot for the recommended change. The "study" is the third step of the process, focusing on collecting and analyzing data to understand the outcomes (Finkelman, 2009, p113). The "act" is the last phase of the cycle. It is adjusted based on discovering the outcomes in the small test trial. If the outcomes are positive for the hospital, then the project will move to full implementation.

As the project was in the planning step of the PDSA cycle, the hospital focused on improving patient care quality. The project "plan" developed was to implement an evidence-based Pressure Ulcer Bundle by conducting educational sessions for all nurses on the medical-surgical floor, and if successful in increasing compliance with skin assessments on all patients, then the project would move to include all nursing units/nurses. The "do" was to conduct a project utilizing a pilot unit on the hospital's 2 North medical-surgical floors. The "study" was to collect and analyze data from October to January. The "act" was to implement a bundle hospital-wide based on the study phase information.

Intervention

The project was implemented in the fall of 2022 over a 12-week timeline. The first three weeks focused on staff education. A teaching plan comprises the purpose, goals, content outline, and methods to identify and treat a pressure ulcer. The evidence-based education material was modified from the AHRQ's website and presented to the nurses during the educational sessions. The educational sessions provided information on measures to identify pressure ulcers and to utilize prevention strategies such as risk assessment and evidence-based skin assessment. During

the educational sessions, bundle interventions were discussed if a pressure ulcer was noted during the assessment. The bundle was implemented per AHRQ's recommendation.

The wound care nurse assessed pressure injury knowledge using the Pieper Pressure Ulcer test, which was administered as a pre-test before the educational sessions and post-test after the education. The pre-and post-test was derived from the Pieper Pressure Ulcer Knowledge test from AHRQ's website (AHRQ, 2017). It was modified to meet the needs of the hospital. This 56-item test developed by Pieper and Mott measures nursing knowledge regarding pressure ulcers in prevention, staging, and wound description (AHRQ, 2017). For each question, the staff can answer "true," "false," or "do not know." Each nurse that took the pre-and post-test utilized a four-digit code to identify themselves to protect any personally identifiable information data. In addition, the nurses identified as either an RN or LPN and if they were classified as full-time or part-time employee. The post-test was given after the nurses completed the training and had the opportunity to meet with the wound care nurse to answer questions related to the training.

Weeks nine through twelve entailed the collection of data regarding if the HAPU bundle was implemented. The wound care nurse checked charts daily and documented the findings on an Excel spreadsheet. The wound care nurse would document "yes" or "no" if the bundle was appropriately implemented.

Statistical Methods Utilized

The DNP project had outcome measures to determine if there was a reduction in the number of HAPUs in the facility. Although the number of Stage III or Stage IV reportable HAPUs have been zero in the last six months, the prevention of any stage HAPUs is of utmost importance for the facility. Table III lists the outcome measures. These measures include the following: a pre-and post-test to assess the knowledge of the nursing staff on pressure ulcers

before and after the education sessions; the percentage of staff that completes training compared to the overall staff; the percentage of times the bundle was implemented versus not implemented and the occurrences of HAPUs post-bundle implementation.

Once the data was collected, a paired sample t-test was used in the pre-and post-test to determine the mean difference between the two data samples taken at various times. The plan was to note the number of HAPU occurrences by utilizing a chi-square test to determine the percentage of patients who had a HAPU before compared to the percentage of post-implementation. The chi-square test is based on observations of a set of variables.

Table III

Evaluation Plan

Variable Name	Variable Code	Variable Description	Data Source	Possible Range of Values	Level of Measurement	Time Frame for Collection
Pre-Test	PRE	Score on Pre-test	Test	0%-100%	Continuous	Prior to Training
Post-Test	POST	Score on Post-test	Test	0%-100%	Continuous	After training was complete
Nurse Training	NUR-TRA	The % of staff that completed the training.	Attendance Sheet	0%-100%	Continuous	Training Dates
Staff	STAFF	The % of each categorial staff member that completed the training.	Attendance Sheet	1. RN 2. LPN	Categorical-Ordinal	Training Dates
Bundle	BUN	Was the bundle implemented on each patient?	E.H.R.	1. Yes 2. No	Categorical-Dichotomous	Monitor for three months after training
Occurrences	OCC	Number of HAPUs after implementation	EHR	#	Continuous	Monitor for three months after training

%= percentage; RN= Registered Nurse; LPN= Licensed Practical Nurse; CNA=Certified Nursing Assistant; PCT= Patient Care Technician; EHR= Electronic Health Record; HAPUs= Hospital-acquired pressure injuries

Analysis

Once all data was collected, the statistician at The University of Tennessee at Knoxville ran the results from the collected data. A paired sample t-test analyzed the pre-and post-test data to determine the mean difference between the two data samples taken at various times. No HAPUs were noted three months prior to and after the implementation of the bundle. The percentage of times that bundle was implemented was calculated by determining the number of "yes" and the "no" from the data collected per the wound care nurse and placed in the Excel spreadsheet.

Results

The project goal and outcomes focused on educating nursing staff on the risk factors associated with HAPUs. During the project, the floor employed 18 bedside nurses. 100% of the RNs (Registered Nurse) and LPNs (Licensed Practical Nurse) on the floor completed the educational training sessions. Thirteen (72.22%) of eighteen were RNs, and five (27.78%) were LPNs. Eighteen nurses completed the pre-test with a mean score of 82.63. Eighteen nurses completed the post-test with a mean score of 87.52. There was an improvement in the test scores.

A paired samples t-test was used to determine whether there was a statistically significant mean difference between the pre-and-post-test after the educational sessions. The normality assumption was not violated, as assessed by Shapiro-Wilk's test ($p=.772$), and there were no significant outliers in the data. Participants scored higher during the post-test ($M=87.524$, $SD=6.534$), a statistically significant mean increase of 4.891, 95% CI [1.621, 8.160], $t(17) = 3.156$, $p=.006$.

Another outcome focused on whether the bundle was implemented post-educational sessions. Forty-seven (77.05%) times the bundle's elements were implemented compared to fourteen (22.95%) times that it was not implemented. The bundle elements included the risk

assessment, skin assessment, and evidence of interventions if required. There were no HAPUs occurrences post-educational session. Table IV and Table V discuss the Paired Samples T-Test run by SPSS.

Although there was no statistical difference in pre and post-HAPU occurrences, early identification of at-risk patients is critical to prevent HAPUs from occurring. Nurses need regular educational sessions, including nutrition, hydration, use of medical devices, duration of load, friction, and shear to prevent HAPUs.

Table IV

T-Test Paired Samples Statistics

<i>T-Test- Paired Samples Statistics</i>					
		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Score on Posttest	87.5244	18	6.10678	1.43938
	Score on Pretest	82.6339	18	6.53347	1.53995

Table V

T-Test Paired Samples Test

<i>Paired Samples Test</i>										
		Paired Differences					t	df	Significance	
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				One-sided p	Two-sided p
Pair 1	Score on Posttest- Score on Pretest	4.89056	6.57402	1.54951	1.62137	8.15974	3.156	17	.003	.006

Dissemination Plan

The evidence of the data collected will be presented to key stakeholders at the facility.

The facility plans to include regular education on skin care, early identification of at-risk

patients, HAPU prevention, and the most up-to-date treatment plans for pressure ulcers. A poster presentation will be submitted to Wound Source online poster hall, and a manuscript will be submitted for Trace.

Discussion

This quality improvement project provided evidence-based practices in establishing a HAPU bundle, including early risk assessment and interventions to prevent the new onset or worsening pressure ulcers. Results showed high compliance with the attendance of the nursing staff at educational sessions. These results were a direct result of 77% of the patients implementing the pressure ulcer bundle at admission.

Anderson et al. (2015) focused on staff education and engagement to implement a quality improvement project successfully. The increase in knowledge from the pre-test to the post-test was noted and was statistically significant. After the educational session, the wound care nurse could work individually with nurses as needed. The wound care nurse made daily rounds to the medical surgical floor to monitor HAPU bundle implementation, provided the nurses with education opportunities, and was available to discuss any issues a patient may have with wounds. This open access to the wound care nurse was critical in maintaining no new HAPU cases during the implementation.

Limitations

There were limitations to this quality improvement project, including the length of study of around 120 days (about 4 months), a small study population of sixty-one patients, and a small nursing population of eighteen nurses. The strength of this project is that the facility hired a wound care nurse specializing in wound care who works one-on-one with nursing staff daily.

The wound care nurse, hired just before project implementation, reviews all new patient charts daily to determine if the bundle elements were implemented.

Conclusions

It is vital for patient outcomes for nurses to be educated on the prevention of HAPUs. Discussion of patient risk for skin breakdown, the use of a risk assessment tool, performance of skin assessment every shift, and implementation of interventions to prevent or, if needed, treat HAPUs, is of the utmost importance for positive patient outcomes. Leadership recognized the importance of this evidence-based project and hired a wound care nurse to educate, guide and lead the nurses daily. Given the continued need for HAPU prevention, the wound care nurse will sustain this project.

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Appendix A

SWOT Analysis



Appendix B

Pieper's Knowledge Test for Pressure Ulcers

QUESTIONS	TRUE	FALSE	DO NOT KNOW
1. Slough in a wound bed is typically pale yellow to tan, necrotic/devitalized tissue but can present as other colors.			
2. A pressure injury/ulcer is a sterile wound.			
3. Foam dressings increase the pain in the wound.			
4. Hot water and soap may dry the skin and increase pressure injury/ulcers risk.			
5. Chair-bound persons should use a cushion.			
6. A stage 3 pressure injury/ulcer is a partial thickness skin loss involving the epidermis or dermis.			
7. A person confined to a bed should be repositioned based on the individual's risk factors and support surface characteristics.			
8. A pressure injury/ulcer scar will break down faster than unwounded skin.			
9. Eschar is healthy tissue.			
10. The skin over a bony prominence or under/around a device that does not blanch when pressed is a stage 1 pressure injury/ulcer.			
11. The goal of palliative care is wound healing.			
12. A stage 2 pressure injury/ulcer is a full-thickness skin loss.			
13. Dragging the patient up in bed increases friction.			
14. Small position changes may need to be used for patients who cannot tolerate major shifts in body positioning.			
15. An incontinent patient should have a toileting care plan.			
16. A stage 2 pressure injury/ulcer may have slough in its base.			
17. If necrotic tissue is present and if bone can be seen or palpated, the ulcer is stage 4.			
18. High-protein oral nutritional supplements should be used in addition to the usual diet for patients at high risk for pressure injury/ulcers.			
19. When necrotic tissue is removed, an unstageable pressure injury/ulcer will be classified as a stage 2 injury/ulcer.			
20. Donut devices/ring cushions help to prevent pressure injuries/ulcers.			

QUESTIONS	TRUE	FALSE	DO NOT KNOW
21. Foam Dressings may be used on areas at risk for shear injury.			
22. Persons at risk for pressure injury/ulcers should be nutritionally assessed (i.e., weight, nutrition intake, blood work)			
23. Critical care patients may need slow, gradual turning because of being hemodynamically unstable.			
24. Blanching refers to whiteness when pressure is applied to a reddened area.			
25. A blister on the heel is nothing to worry about.			
26. Staff education alone may reduce the incidence of pressure injuries/ulcers.			
27. Early changes associated with pressure injury/ulcer development may be missed in persons with darker skin tones.			
28. A footstool/footrest should not be used for an immobile patient whose feet do not reach the floor.			
29. Deep tissue injury (DTI) may be difficult to detect in individuals with dark skin tones.			
30. Bone, tendon, or muscle may be exposed in stage 3 pressure injury/ulcer.			
31. It may be difficult to distinguish between moisture-associated skin damage and a pressure injury/ulcer.			
32. Dry, adherent eschar on the heels should not be removed.			
33. Deep tissue injury is a localized area of purple or maroon discolored intact skin or a blood-filled blister.			
34. Massage of bony prominences is essential for quality skin care.			
35. Poor posture in a wheelchair may cause a pressure injury/ulcer.			
36. For persons with incontinence, skin cleaning should occur at the time of soiling and at routine intervals.			
37. Patients with spinal cord injuries need knowledge about pressure injury/ulcer prevention and self-care.			
38. Pressure injury/ulcers can occur around the ears in a person using oxygen by nasal cannula.			

QUESTIONS	TRUE	FALSE	DO NOT KNOW
39. Persons, who are immobile and can be taught, should shift their weight every 30 minutes while sitting in the chair.			
40. Stage 1 pressure injury/ulcers are intact skin with non-blanch-able erythema over a bony prominence.			
41. When the ulcer base is covered by a slough, it cannot be staged.			
42. It is unnecessary to have a patient with a spinal cord injury evaluated for seating.			
43. To help prevent pressure injury/ulcers, the head of the bed should be evaluated at a 45-degree angle or higher.			
44. Urinary catheter tubing should be positioned under the leg.			
45. Pressure injury/ulcers may be avoided in patients who are obese with the use of properly sized equipment.			
46. A dressing should keep the wound bed moist but the surrounding skin dry.			
47. Hydrocolloid and film dressings must be carefully removed from fragile skin.			
48. Nurses should avoid turning a patient onto a reddened area.			
49. Skin tears are classified as stage 2 pressure injuries/ulcers.			
50. A stage 3 pressure injury/ulcer may appear shallow if located on the ear, malleolus/ankle, or heel.			
51. Pressure injury/ulcers are a lifelong concern for a spinal cord patient.			
52. Alginate dressings can be used for heavily draining pressure injuries/ulcers or those with clinical evidence of infection.			
53. Deep tissue injury will not progress to another injury/ulcer stage.			
54. Film dressings absorb a lot of drainages.			
55. Non-sting skin prep should be used around a wound to protect surrounding tissue from moisture.			
56. A stage 4 pressure injury/ulcer never has undermining.			