Pressure Injury Prevention in the Inpatient Setting

Jonathan Holloway, BSN, RN

Mentor: Judith Ochieng, PhD, DNP, MSN-ED, RN, FNP-BC

Arizona State University

Abstract

Background: Pressure injuries inflict a major, preventable burden onto hospital systems, healthcare providers, and patients. The purpose of this evidence based project was to evaluate the impact of a pressure injury prevention education program on nursing staff knowledge and pressure injury rates in an Arizona post-cardiac care unit.

Method: A single group pre-test post-test design was utilized to evaluate nursing staff knowledge before and after an education program on pressure injury prevention. Staff knowledge was evaluated using a modified version of the Pressure Ulcer Knowledge Assessment Tool 2.0. Participants completed pre- and post-education surveys. Rates of hospital acquired pressure injuries were obtained via chart review.

Results: Pre- and post-education scores were analyzed in participants who completed both surveys using a paired *t*-test. Post-education scores (M = 0.73, SD = 0.07) were significantly higher than pre-education scores (M = 0.59, SD = 0.09); $t(7) = -5.39$, $p = .001$. Pre- and post-education median scores of all participants were analyzed using two-tailed Mann-Whitney U test. Post-education scores (Mdn = 0.71) were significantly higher compared to pre-education scores (Mdn = 0.56); $U = 102.5$, $z = -4.05$, $p = .001$. Monthly incidence of pressure injuries on the unit increased following education.

Discussion: Increase in scores from pre- to post-education surveys indicate staff knowledge improved. The increased incidence of pressure injuries is thought to be secondary to staff's increased ability to detect pressure injuries. Staff education is recommended, but more research is needed regarding the impact on pressure injury rates.

Keywords: Pressure injury, pressure injury prevention, pressure injury education, pressure injury prevention program, nursing knowledge.

Pressure Injury Prevention Programs in the Inpatient Setting

The Problem

Hospital Acquired Pressure Injuries (HAPI)s are a major burden for nurses, hospitals, insurance agencies, and patients alike. Since the development of the Center for Medicare and Medicaid's (CMS) hospital-acquired conditions policy in 2008, CMS no longer reimburses hospitals for most pressure injuries not documented at the time of admission (Center for Medicare and Medicaid Services [CMS], 2018). The purpose of this policy was to push hospital systems to develop new ways to prevent these kinds of injuries (CMS, 2018). Pressure injuries (PI) occur in the hospital setting as a result of intense, prolonged pressure which is sometimes in combination with shear forces. The pressure tolerance of soft tissue is affected by multiple factors including microclimate, nutrition, perfusion, and patient comorbidities. This tissue damage can appear as many different stages of tissue injury ranging from erythematous non-blanchable skin to open wounds with exposed bone (NPUAP, 2016).

In 2016, the National Pressure Ulcer Advisory Panel (NPUAP) held a consensus conference where the term "pressure ulcer" was replaced with "pressure injury" in an attempt to help healthcare workers more clearly understand this type of wound. The NPUAP went on further to define a PI as, "localized damage to the skin and underlying soft tissue usually over a bony prominence or related to a medical or other device" with or without shear (NPUAP, 2016).

Most research shows that the true cost of HAPI is not clear. This is due to variances in how prior studies, as well as hospital systems, looked at bill and coding. These differences make for poor comparisons when trying to analyze the real cost of these injuries (Chan et al., 2017; Padula & Delarmente, 2019). Though the data is not clear, it is projected that PIs cost are much higher than previously expressed in data (Chan et al., 2017).

HAPIs have a significant impact on the health and wellbeing of patients. HAPIs lead to both physical and emotional distress for patients while also increasing patient's length of stay, cost of care, and readmission rates (Dreyfus, Gayle, Trueman, Delhougne, & Siddiqui, 2018).

Nursing staff's knowledge is an important aspect in both the prevention of HAPIs and in ensuring appropriate care of patients (Barakat-Johnson, Lai, Wand, & White, 2018). Research has shown that, nursing knowledge is often limited regarding HAPIs (Dalvand, Ebadi, & Gheshlagh, 2018).

Purpose and Rationale

Starting with the decision by the Center for Medicare and Medicaid Services in 2008 to stop payment for hospital acquired pressure injuries (CMS, 2018), there has been a push to decrease the number of HAPIs in the United States. With this change, hospitals and other health care organizations have had more incentive to develop programs and implement preventive measures to stop the formation of HAPIs in their patients. Healthy people 2020 is one such organization. Healthy people 2020 has set a goal to lower PI related hospitalizations among the elderly by 10% or more by the end of 2020 (U.S. Department of Health and Human Services, Office of Disease Prevention and Health Promotion, 2020). Achieving this goal not only serves to decrease unnecessary costs and expenses for each hospital system, but also improves patient safety and satisfaction. Patients who are PI free spend less time in the hospital and suffer from less pain, injury, and death than those who develop HAPIs during their hospital stay (Bauer, Rock, Nazzal, Jones, & Qu, 2016).

The purpose of this evidence based project is to address barriers to prevention, management, and care related to the development of HAPIs. This will be accomplished by evaluation of staff knowledge and its impact on these barriers. This project will also explore the

known evidence-based practice options to decrease pressure injuries in the inpatient hospital setting as they relate to staff knowledge.

Epidemiological Significance

In 2014, PI wounds in the Medicare population was around 2.5% with an assumed Medicare cost per wound between $3,696 to $21,060 US dollars (Nussbaum et al., 2018). These wounds have the potential to become non-healing chronic wounds that can lead to the amputation of limbs or even death (Nussbaum et al., 2018). Research supports the fact the most PIs are preventable with one such recent Swedish study determining that about 91% of PIs in the hospital setting are likely preventable (Gunningberg, et al., 2019). The impact of these wounds and their general preventability have been a significant oversight in the health care system today.

The real cost of PIs is unclear. Most modern research shows a limited understanding of the total cost of HAPIs in the United States (Chan et al., 2017; Padula & Delarmente, 2019). Systematic reviews have found that the cost of a PI is often skewed due to much of the research on the subject not clearly outlining coding standards. This leads to poor comparison of studies and unclear final costs of these injuries. Regardless, the cost of these chronic ulcers are likely substantial (Chan et al., 2017). This unknown cost has been found throughout other research studies (Padula, & Delarmente, 2019). Medicare costs due to wound care are likely far greater than what was thought in the past, given that most studies previously done have failed to evaluate the impact that loss of work or other social dynamics had on patients (Padula, & Delarmente, 2019). Cost simulations suggest that the cost of PIs in the United States exceeds 26.8 billion dollars per year (Padula & Delarmente, 2019). This equates to a 10 billion dollar increase in the total cost of PI over the last ten years (Padula & Delarmente, 2019).

HAPIs result in longer healing times, extended hospital stays, loss of limbs, and increased risk of death. All of this has an impact. The impact on patients, families, hospitals, staff members, taxpayers, and insurers leads to unnecessary stress for all parties involved (Bauer et al., 2016). Mortality rates for hospitalized patients with pressure injuries are 9.1% compared to 1.8% for patients without pressure injuries (Bauer et al., 2016). The patient's quality of life is drastically impacted when they have a chronic PI. The patient's physical, mental and social wellbeing are often times negatively affected (Jackson, et al., 2018).

There are multiple modalities that can be implemented to prevent HAPIs from developing or worsening. One international systemic review and meta-analysis covering eight different countries evaluated the knowledge level of nurses, nursing students, and nursing assistants on care measures to prevent the formation of HAPIs (Dalvand et al., 2018). A knowledge deficit was identified in all three groups regarding pressure injury prevention. The study found that pressure injury prevention knowledge was below the recommended 60% acceptable cut off score for all three groups (Dalvand et al., 2018). Moreover, knowledge regarding preventative measures for pressure injuries was the lowest score for all three groups (Dalvand et al., 2018).

Multiple sources report that since the CMS change in insurance reimbursement, many hospitals have sought to implement changes to decrease HAPIs with variable success in their long-term sustainability (Padula et al., 2016; Dreyfus, et al., 2018). Pressure Injury prevention programs (PIPP) have been a fundamental tool in the prevention of HAPIs in these systems (Lin, Wu, Song, Coyer, & Chaboyer, 2019). PIPP can have several different educational and knowledge improvement components to include e-learning modules, booklets, videos, conferences or meetings, and posters (Lin, et al., 2019; Cowan, et al., 2018). All of these educational modalities seek to improve nursing staff knowledge. another technique for

prevention programs includes consult driven huddles as a popular choice of hospital quality improvement project (Padula et al., 2015). These huddles have been found to be extremely effective when utilizing wound care staff or management (Lin et al., 2019). One large scale study involving nursing staff working in the Department of Veteran Affairs hospital system found that education delivered in shorter segments over a larger period of time was superior compared to a single longer education period (Cowan, et al., 2018). Literature supports different modalities of education in the prevention of PI. PIPP that are tailored to the needs of hospital systems may be a viable prevention and evidence-based improvement project.

Internal Evidence

Data gathered from a Southern Arizona non-profit government hospital system from 2017 to late 2018 regarding HAPIs showed a total decrease of HAPIs between the two years from 113 to 88. However, it is noted that several floors in the hospital had marked increases in their total number, with an orthopedic floor having a 33% increase and a medical-surgical floor with a 600% increase in HAPIs. Both floors have gone through major staff changes in leadership, nursing staff turnover, and acquisition of new nurses. It is likely that these floors are suffering the same difficulties as stated in the above background assessment. The Wound care team associated with the hospital system is looking into an education system that is lightweight and possible transferable to other sections of the hospital that may improve staff knowledge as a solution to the noted increase in PI.

PICO Question

This clinical inquiry has led to the following PICO question: In the adult inpatient nursing population (P), does providing knowledge based education on pressure injury management and prevention, like a pressure injury prevention program (I), compared to current

education (C) result in a decrease in pressure injuries and improved nursing staff knowledge of wound management (O).

Search Strategies

An exhaustive electronic search of databases was performed between January 2019 to March 2019. All aspects of the PICO question were evaluated. Three article databases were searched to retrieve the studies used for this project. The databases searched include Cochrane library, CINAHL Plus, and PubMed. After searching the databases using key terms such as *pressure ulcer, pressure injury, prevention, therapy, control education, training, inpatient, hospital acquired,* and *nursing knowledge.* The terms were searched via mesh and truncated options when possible in the databases. Following this, ten papers were selected for their appropriateness and inclusion in this search for information. The inclusion criteria consisted of articles with strong scientific underpinnings, studies completed in the last five years, studies done on humans, participants over 18 years old, studies publish in English, and studies with a focus on pressure injury prevention or education. Searches with less than 200 results had their titles and abstracts evaluated for further use.

The first database search was PubMed. PubMed is a United States government operated database maintained by the National Center of Biotechnology Information and the United States National Library of Medicine. Because of PubMed's strong scientific and research-based underpinnings, it was selected for use. The database search used the terms *pressure ulcer, nursing knowledge,* and *pressure injury* with the mesh terms of *therapy* and *control* with the truncated term *education*. This revealed 998 results. After application of the exclusion criteria to include only data completed in the past five years, data done on humans, and adjusting for 19 years of age and above, the number of results was reduced from 998 to 102. Other terms with

and without truncation like *randomized control trial* and *systematic review* were used to further limit the number of data results found from the initial 102 down to four, so these terms were not used.

CINAHL Plus is a research database for nursing and other health journals. The initial search of the database included the bullion terms *pressure ulcer* and *education*. Both terms were truncated to increase results. An initial search found 515 results. After applying limitations like English language, and adjusting for research performed within the last five years, 150 results were left for evaluation. A further reduction of results was found when the terms *systematic review* and *randomized control trial* were used. Use of these terms resulted in a decrease of search results from 150 down to one so these terms were not used.

The Cochrane Library was chosen as a database search because of its high quality reviews. The search started with the mesh term *pressure ulcer,* which gave a total of 672 results. After adding *prevention* or *education,* the search was narrowed to 357 total results. After applying the filter of date ranges from 2014-2019, 27 Cochrane Reviews were found and 103 trials. There are no options available to filter for experiment type or participant age, so these criteria were not applied in this database search. Data saturation was reached in all three databases.

Critical Appraisal and Synthesis

Ten articles were retained from the literature search for this review and are presented in the synthesis table (Appendix B). Only one study was done in the United States (US) with the majority of other studies coming from Canada or Australia and the remaining studies coming from other countries around the world (Appendix A). All ten articles evaluated were performed within five years from the date of literature search. There was a moderate level of heterogeneity

regarding study design. Study designs included one systematic review, one randomized control trial, and one mixed method Study. Three studies were a form of quasi-experimental studies using a pre- and post-test design. The remaining studies were either prospective, cross sectional, or quantitative in nature and design (Appendix A & B). This provided a broad perspective of information relating to the topic which was needed due to the limited amount of stringent research that has been done on the topic.

All ten articles were evaluated using Joanna Briggs Institute's critical appraisal tools specific to the type of article used (Joanna Briggs Institute, 2017). The level of evidence for most articles was a level III, or moderate level of evidence, with the systematic review and randomized control trials being high with a I or II level due to their robust design. All studies seemed to have some limitations to their stringencies but still provided a clear level of utility regarding their data (Appendix A & B).

All studies evaluated were performed within the inpatient setting. Aside from the systematic review, all studies provided demographic information regarding patient age. Regarding age groups, most studies had a level of homogeneity with the majority of study participants over the age of 50 years old. One study looked at the education scores and age of medical staff and reported an age range between 26-55 years old (Appendix A & B).

There was a moderate level of homogeneity regarding measurement tools with the patient's chart, Braden scale, and some variant of the Pressure Ulcer Knowledge Assessment Tool (PUKAT) being utilized in the studies. An intervention tool commonly utilized was some form of a Pressure Injury Prevention Bundle which provided different forms of education regarding PI prevention (Appendix B). There was a high level of homogeneity regarding the

idea that education would improve outcomes. Seven of the ten studies found this to be true in some way.

The timelines for the ten studies varied greatly with a moderate level of heterogeneity to them. This was due to some of the studies looking at patient outcomes while other studies evaluated staff knowledge. Because of this difference, timeline of interventions spanned anywhere from months to years (Appendix B).

Conclusion from Evidence

This synthesis of evidence most predominantly suggests that there is a positive outcome when some form of staff education is applied to PI prevention. The synthesis also supports that data coming from a PIPP is a viable and common means to communicate educational information in the inpatient setting. The limited amount of level I and II data suggest a need for more development in this topic as there are limited high level research studies on the topic at this time. The synthesis also strongly supports the use of standardized tools like the PUKAT, Braden scores, and chart reviews as key components to evaluate success in the implementation of PIPP.

Conceptual Framework and EBP Model

The Knowledge to Action Framework is a conceptual framework that was proposed by Graham, et al. (2006) (Appendix C). It was designed to help facilitate the use of developed knowledge to the appropriate knowledge utilizers. It was chosen as the model guide for this project due to its appropriateness regarding education development and implementation into practice.

The knowledge to action framework starts with knowledge creation and then action. These two processes are further broken down into separate phases.

Knowledge creation involves knowledge inquiry, synthesis, and products. The design is an upside-down triangle and highlights the refinement of knowledge to a usable product.

Knowledge action is then adapted to context, assessed for barrier and implemented. This process is well suited for the development of a PIPP or education bundle (Appendix A & B). The action goes on to describe how to implement this knowledge via monitored, evaluated, and sustainment steps. All steps and phases can be dynamic, complex, and without boundaries to highlight the author's conceptualization that the components of the framework can move between phases and steps fluidly if necessary (Graham et al., 2006). This framework's fluid and dynamic use will be useful in the implementation of an educational program for hospital staff to help create a structure of implementation that can be easily followed.

The Conner's Conceptual model of research utilization evaluation was developed by Conner (1980) (Appendix D). It was chosen as a model for its simple four step process of implementing new research knowledge and evaluating the utilization of that knowledge. It emphasizes four key components: goals, inputs, processes, and outcomes (Conner, 1980).

The first component of the model is to set a goal to evaluate the success of the knowledge utilization. Input is the knowledge findings to be evaluated via its quality and importance. Process is the monitoring of knowledge utilization. Outcome of the knowledge utilization is the last step of the model and looks at the outcome of the set goal (Conner, 1980). These steps are simple and follow the goal of evaluating the knowledge gained by hospital staff after the provided education.

Methods

A one group pre-test post-test design quality improvement project was conducted between November 2019 and January 2020. The project received exemption from Arizona State

University's Institutional Review Board on September 13, 2019. Participation in the project was not mandatory and a consent form was provided to all participants before taking part in either the pre- or post-education survey. Consideration for the anonymity of participants in the project was done via participants creating an anonymous personal identifier that would be used for both the pre- and post-education survey. Participants were instructed to create unique personal identifiers using any combination of numbers or letters. Participants were advised to create personal identifiers that could be remembered by the participant in order to properly match pre- and post-educational surveys. Before the participants created the identifier, an example of how to create a memorable anonymous identifier was provided. All data collected was saved on a password protected laptop within an encrypted Excel file. The hospital system and employers had no access to individual scores or data.

The population to be evaluated was the inpatient nursing staff working the post-cardiac care unit in a Southern Arizona hospital system. Though float nurses were permitted to attend all educational sessions and complete surveys, their responses were excluded from statistical analysis given inability to attend educational sessions. In 2019, the unit had between an average of 7.8 to 8.7 nurses per day staffing the unit with a patient to nurse ratio of 3 to 3.4 patients per nurse. During that same year, HAPI rates for the unit ranged from zero to three instances per month. There were a total of 10 pressure injuries documented in the post-cardiac care unit in 2019.

This project utilized a modified version of the Pressure Ulcer Knowledge Assessment Tool 2.0 (PUKAT 2.0) developed in 2017. The tool is an updated version from 2010 (Manderlier et al., 2017). Permission to utilize the tool was obtained via email communication with creators of the tool.

The PUKAT 2.0 has been found to have good psychometric properties and validity (Manderlier et al., 2017). The survey was also chosen due to its simplicity compared to other tools as it contained only 25 questions compared to other tools. The survey covered 6 themes: etiology, classification and observation, risk assessment, nutrition, prevention, and special patient groups.

Recruitment into the study began November 2019. Participants were provided information regarding the project to include information on how to access the pre-education survey online. Laptops and tablets were made available for staff interested in the survey. Staff were also instructed on the importance of remembering their anonymous personal identifiers for completion of the post-education survey. A drawing for participants who completed both the pre-education and post-education survey was established to both incentivize participants to remember their anonymous personal identifier and to create a benefit for taking time to be a part of the survey. The drawing consisted of four twenty-five-dollar gift cards to be provided at the end of the project.

The education phase began December 2019 with a series of ten-minute-long education sessions on PI prevention. These sessions focused on low scoring domains from the pre-education modified PUKAT 2.0 survey. Educational sessions were provided by the primary investigator, who was a member of the wound ostomy care team. The investigator also posed questions to nursing staff regarding prior subject areas covered to promote reinforcement and retainment of information. Nursing staff was also was given the opportunity to ask questions at the end of each educational session. Questions most often addressed general PI care. A small board with focused education was displayed in the nursing charting area. The board was updated weekly with new information for staff to evaluate.

The post-survey phase began January 2020. The education board was removed, and nursing staff was again given access to the online post-education modified PUKAT 2.0. This was done about three times a week for both day and night staff. Laptops and tablets were again made available to staff during these times to take the post-education survey.

A chart review began in February 2020 to evaluate pressure injury rates in order to determine whether there was any immediate impact of education on PI rates. The chart review data was provided by the IT department of the hospital system with data representing the number of PI on the floor for the past year up until the end of February. Data analysis began in March with the use of Intellectus Statistics software.

A budget was created that looked at direct cost such as office supplies and promotional supplies. The budget also covered indirect costs to include employee time and hospital equipment utilization. Savings and cost of individual patient care were also considered. A projected $965 total cost was calculated with a total projected savings of $27,516 possible should the project prevent one pressure injury (Appendix E). No direct funding was provided, and all expenses were covered by the project investigator.

Results

A total of 42 participants took either the pre-education survey, post-education survey, or both. 28 participants completed the pre-education survey. 22 participants completed the post-education survey. Eight participants completed both surveys. All participants were post cardiac care nursing staff. Gender reported showed 11 (26.2%) of the participants were male, 29 (69.1%) were female and two (4.7%) preferred not to say. When asked “What is your education level?”, 24 (57.1%) participants reported having a bachelor’s degree in nursing. 12 (28.6%) reported an associate degree in nursing, and six (14.3%) reported master’s degree in nursing.

Age reports of participants showed five (11.9%) were under 25 years old. 20 (47.7%) participants were between the age of 25 to 34. 10 (23.8%) participants were 25 to 44 years old. Five (11.9%) participants were 45 to 54 years old. Two (4.7%) were over the age of 55.

Looking at years worked as a nurse, eight (19.0%) participants reported less than one year of work. 11 (26.2%) reported one to two years of work. Six (14.3%) reported three to four years of work. Three (7.2%) reported five to six years of work. 14 (33.3.8%) reported seven or more years of work.

A two-tailed paired samples t-test was conducted to examine whether the mean difference of the matched pre-education survey and post-education survey were significant. In order to meet the assumptions of a two-tailed paired samples t-test, a Shapiro Wilk test and a Levene's were conducted.

The Shapiro-Wilk test was conducted to determine whether the differences in matched pre-education surveys and post-education surveys could have been produced by a normal distribution (Razali & Wah, 2011). The results of the Shapiro-Wilk test were not significant based on an alpha value of 0.05, $W = 0.91$, $p = .365$. This result suggests the possibility that the differences in matched pre-education surveys and post-education surveys were produced by a normal distribution cannot be ruled out, indicating the normality assumption is met.

The Variance Levine's test was conducted to assess whether the variances of matched pre-education surveys and post-education surveys were significantly different. The result of Levine's test was not significant based on an alpha value of 0.05, $F(1, 14) = 0.04$, $p = .848$. This result suggests it is possible that matched pre-education surveys and post-education surveys were produced by distributions with equal variances, indicating the assumption of homogeneity of variance was met.

The result of the two-tailed paired samples t-test was significant based on an alpha value of 0.05, $t(7) = -5.39$, $p = .001$, indicating the null hypothesis can be rejected. This finding suggests the difference in the mean of matched pre-education survey data and the mean of matched post-education survey data was significantly different from zero. The mean of matched pre-education survey data was significantly lower than the mean of matched post-education survey data (Appendix F).

Due to the limited number of matched samples for the two-tailed paired samples t-test, a two-tailed Mann-Whitney U test was conducted to examine whether there was a significant difference in scores between the levels of the pre-education survey and post-education survey data. The two-tailed Mann-Whitney U test is an alternative to the independent samples *t*-test and does not share the same distributional assumptions (Conover & Iman, 1981). There were twenty-eight observations in the pre-education survey group and twenty-two observations in the post-education survey group.

The result of the two-tailed Mann-Whitney *U* test was significant based on an alpha value of 0.05, $U = 102.5$, $z = -4.05$, $p < .001$. The mean rank for the pre-education survey group was 18.1 and the mean rank for the post-education group was 34.84. This suggests the distribution of scores for the pre-education survey group was significantly different from the distribution of scores for the post-education survey group. The median for pre-education surveys ($Mdn = 0.56$) was significantly lower than the median for post-education surveys ($Mdn = 0.71$) (Appendix G).

A chart review was also conducted to check the rates of HAPIs on the post cardiac care unit floor. November and December rates were zero. January had one HAPI on the floor and Decemeber there were three. March 2020 there were no HAPIs and has stayed since the time of this works completion.

Discussion

There was a noted statistical significance between the pre-education survey and post-education scores. These results suggest an improvement in nursing staff knowledge regarding PI prevention and management. This increase in staff knowledge should correlate with a decrease in HAPI rates. However, after a chart review of PI rates in the post cardiac care unit, there was a paradoxical increase in PI rates immediately after education. PI rates increased from one to three in the two months following education completion but then dropped to zero and have stayed since the time of this work. This is thought to be attributed to the nursing staff's awareness and ability to appropriately recognize newly developed HAPIs after receiving education. Staff's increased ability to quickly identify HAPIs, although showing an increase in numbers following education, will likely account for improved prevention and decreased harm as it has allowed for identification at an earlier stage.

These findings correlate with other studies that showed the use of PIPPs improve staff knowledge (Martin, et al., 2017; Baron, et al., 2016). Other studies support the use of tools like the Pressure Ulcer Knowledge Assessment Tool as a means to measure knowledge (Dalvand, Ebadi, & Gheshlagh, 2018).

The potential impact of the evidence-based project on staff includes an improved workflow for nursing staff as a decreased stress and increased knowledge would likely improve the staff's ability to prevent and manage PIs. The impact on the wound care team would include an improvement in resource allocation as the wound care team would be better equipped to transition to an education and prevention focus due to a decrease in consults related to pressure injury management and development. Regarding patient impact, there would be a reduced cost to patients due to wound prevention. Adequate care to prevent the development of PI would result

in the development of trust in nursing staff from both patients and family members. Patients would also have potentially decreased lengths of stay due to complications associated with PIs as well as increased quality of life being PI free. Patients would likely also have a decreased hospital mortality rate as PI rates would decrease. The healthcare system itself would have improved cost savings regarding Medicare and Medicaid reimbursement. There would also be a decrease in burden and utilization within the healthcare system as rates of HAPIs decrease.

Sustainability of this evidence-based research project is expected as the program has shown improvement in staff knowledge regarding pressure injury prevention. The project was also undertaken as part of the wound care team's goal to transition from a pressure injury management perspective to a prevention focus. This internal organizational shift, project success as well as framework design to be evolving supports the sustainability of the project as a whole. Furthermore, education and investment in nurses promote a culture where staff are motivated to implement actions of prevention. This change in culture is likely to assist in the continued sustainability of the project.

Limitations of this evidence-based study include low numbers of matched data for a more clear, statistical analysis. This was likely due to the extended timeline between staff education and the need for an improved method to match pre- and post-education data. It was found upon starting the post-education survey that multiple staff members reported they did not remember their anonymous identifier thereby limiting the numbers of matched data available. Another limitation was the lack of use of a control group to mitigate the impact of confounding variables. This use of control groups was not used due to the increased number of staff that would be necessary to incorporate a control group. In addition, the study's goal of having minimal impact on the workflow of staff thereby limiting the ability to have a large number of participants. There

is also a potential for the Hawthorne effect on staff, causing staff to potentiality to find ways to improve scores aside from educational sessions provided. To reduce the potential for this bias in the study, the staff was educated multiple times to include in the consent that scores would have no impact on their work status.

The need to limit the development of HAPIs is important not only to hospitals and staff but also to the patients they care for. Proper staff education in prevention measures and practices are important tools in this process. This evidence-based quality improvement project found that the use of PIPP did improve staff knowledge but did not immediately improve PI rates. This shows the need for more quality studies regarding the immediate change of PI rates after staff education. Other recommendations for further research would include studies to further evaluate the long-term impacts of education as well as the implementation of other education modality on HAPI development.

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Sving, E., Högman, M., Mamhidir, A., & Gunningberg, L. (2016). Getting evidence-based pressure ulcer prevention into practice: A multi-faceted unit-tailored intervention in a hospital setting. *International Wound Journal, 13*(5), 645-654.

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Appendix A

Table 1

Evaluation Table

Citation	**Conceptual Framework**	**Design/Method**	**Sample/Setting**	**Major Variable & Definitions**	**Measurement**	**Analysis**	**Findings**	**Decision for use**
Suva et al., (2018). Strategies to support pressure injury best practices by the inter-professional team: a systematic review **Funding:** Via email correspondence: Ministry of Health and Long-Term Care. **Bias:** Self-reports no search of grey literature and only English articles searched. **Country:** Canada.	Via email correspondence with author: none used though several were reviewed.	**Design:** SR **Purpose:** Identify Edu barriers, enablers, and strategies for supporting PI care. Assess organizational and system level barriers, enablers, support (PI) care. Find future research on the subject.	**(EDU) N:**3728 **(EDU) n:**22 **Systems N:** 6347 **Systems n:** 12 **DS:** CINAHL, Cochrane CT, Cochrane SR, DARE, Embase, Eric, MEDLINE, PsychINFO **IC:** Published between 06-14, >18YO, English, all study designs. **EC:** Not English, grey lit., outside timeline, white papers, case studies, guidelines, without research methodology,	**IV-** Edu and Training, systems, experience, team-based approach, organizations, policy, communication, identification of barriers and enablers, guidelines, staff. **DV-** Impact on PI rate, management	Standardized data extracting form, independent review	Screening-, CA, Critical Appraisal Skills Program (CASP), Assessing the Methodological Quality of Systematic Review (AMSTAR) tool.	Lack of PI prevention knowledge, Barriers to change Multiple Edu strategies improve knowledge. PI prevention and management knowledge improves nurses' confidence and competence. Multiple factors impact PI best practice	**LOE: 1** **Strengths:** Vast discussion of different factors impacting PI prevention including Edu **Weaknesses:** Studies results were heterogeneous, so no MA. **Conclusion:** Good evidence supports education as an important component to improve PI prevention. **Feasibility/Applicability to pt.**

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			studies with animals.				Unclear role of clinical experience Importance of communication Barriers to PI prevention include time, resources, cooperation Enablers include group, leaders, teamwork, support, networks.	**population:** Education is a feasible option to implement at TMC. Education systems could be introduced to any population at the hospital.
Citation	**Conceptual Framework**	**Design/Method**	**Sample/Setting**	**Major Variable & Definitions**	**Measurement**	**Analysis**	**Findings**	**Decision for use**
Martin et al., (2017). Healthy Skin Wins: A Glowing Pressure Ulcer Prevention Program That Can Guide Evidence-Based Practice **Funding:** None listed.	Diffusion of Innovation model	**Design:** Explanatory sequential mixed method NRNCT (pre- & post-test) & DQ (focus groups) purposive sampling **Purpose**: Determine the effectiveness of	**PU reduction n:** 239 **Online Edu n:**80 **Setting:** 304 bed community hospital, Winnipeg, Canada.	**IV:** PIPP implementation, use of hands on and online tutorials regarding PIPP. **DV:** PU rates, Post tutorial knowledge score.	**NRNCT:** Pre- and post-testing, PU knowledge assessment tool **DQ:** Focus groups, voice recordings, narrative screening tool,	**RNCT:** Pre-test and post-test T-testing Pre- and post-PIPP implementation used chi-squared testing **DQ:** 12 transcripts	**NRNCT:** Tutorial knowledge pre-tests (M = 13.3, SD = 1.98) and post-tests (M = 14.3, SD = 2.00) scores; t (79)= -4.80, p < .001 The initial reduction in the	**LOE:** 3 **Strengths:** Better perspective of the whole situation when utilizing a mixed method. More appropriate for nursing.

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Bias: None recognized. **Country:** Canada	the PIPP in reducing PU prevalence. Determine effectiveness of online tutorials to increase staff knowledge about PU prevention and perspective of PIPP.	Inpatient hospital setting. **Sample Demographics:** Male: 6, Female: 74, 18-25YO: 11, 25-35YO: 34, 36-45YO: 14, 45-55YO: 17, >56YO: 5, Allied health: 29, RN: 41, LPN: 7, Health care aids: 3. **IC:** All admitted patients over 18 who provided verbal consent, nursing, and staff who volunteered for the study. **EC:** Casual employees. Patients less than 18YO. **Attrition:** None listed	**Q:** From your viewpoint, what changes worked best to prevent PUs? What other strategies could healthcare providers use to protect patients' skin? What physical resources (equipment, supplies, staff) could be made available to you to help your team prevent PUs? Please describe the support that you receive from hospital management to prevent PUs. Is there anything else?	semi-structured interview guide, individual interviews	recorded from focused groups and individual interviews resulted in two major themes.	PU prevalence post-PIPP was X2(1)=51.9308, p<.0001 PIPP implementation Reduction in PU incidence 6-day repeat was found at X2(1) = 9.5798, p < .002 **DQ:** Themes from focus groups found "It's definitely a combination of everything" multifactorial contributing to PU prevention. "There's a disconnect between what's needed and what's available."	Provided data on the experience of staff. Proper population and looks at the education of staff. **Weaknesses:** No data on how themes are developed. LOE not as strong as other studies due to design. **Feasibility/Applicability to patient population:** The study's use of a PIPP with Edu to decrease PU rates in a community base inpatient setting makes this an ideal study to support the PICO question.

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Citation	Conceptual Framework	Design/Method	Sample/Setting	Major Variable & Definitions	Measurement	Analysis	Findings	Decision for use
Tayyib et al., (2015). A Two-Arm Cluster Randomized Control Trial to Determine the Effectiveness of a Pressure Ulcer Prevention Bundle for Critically Ill Patients. **Funding:** None listed.	None listed.	Two-Armed Clustered RCT **Purpose:** To test the effectiveness of a PU prevention bundle in reducing incidence of PU in critically ill patients in a Saudi hospital	**Total** **N:** 140 **n:**70 **Group that developed PU** **N:** 28 **N control:** 23 **N intervention:** 5 **Setting:** Two Saudi Arabian ICU's	**IV:** PU prevention bundle **DV:** Development of PU. **Definitions** PU prevention bundle**:** Bundle of best available evidence based international guidelines for PU prevention from the European pressure ulcer advisory panel. Checklist of task completion for bundle.	Braden scale, survey of demographics and clinical data, sequential organ failure assessment, skin assessment tool, PU staging.	Two-tail statistical analysis used to find sample size of 48 per group. Long-rank and cox proportional hazards analyses used to compare time and determine	PU incidence different between the intervention group (7.14%, 5/70 patients) and the control group (32.86%, 23/70 patients; X2 =14.46, df=1, p<.001) PU bundle 12 in intervention. 37 control.	**LOE:** 2 **Strengths:** Due to the nature of RCT's the LOE is high. This study also looked at more than one hospital. **Weaknesses:** PU prevention bundle only implemented in ICU. Limited discussion on

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BIAS: None recognized. **Country:** Saudi Arabia.	**Sample Demographics:** **Total:** Male: 98, Female: 42, Mean age of control 52. Mean age of intervention: 50 **Group that developed PU** Total Male: 19, Total Female: 9 Number of PU control: 37 Number of PU intervention: 12	hazard ratio between groups. Poisson regression used to compare the incidence ratio between groups. Generalized linear model variance estimator was used to account for repeated measures. PU staging between groups used a chi-square test of independence.	(Breslow's generalized Wilcoxon=11.130, df=1, p<.001) PU rates over study period intervention (12/70) and control (37/70) groups (expβ=0.30, 95%CI, 0.158-0.588, p<.001).	what was implemented. **Conclusion:** PU prevention bundles significantly decrease PU outcomes when utilized in the ICU. **Feasibility/Applicability to Pt. Population:** The study was performed in Saudi Arabia but supports the idea that a PU prevention bundle with RN Edu helps translate knowledge to practice which could be utilized at TMC.

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Anderson et al., (2015) Universal Pressure Ulcer Prevention Bundle with WOC Nurse Support. **Funding:** Grant support via Sage Products, Inc., Center for Clinical investigation. **Bias:** Possible issues with funding from Sage though researchers state this had no impact on the study. **Country:** USA	Concept of Core Implementation. and Core intervention in developing the PIPP bundle.	**Design:** QE pre- and post-intervention design. Descriptive Method for WOC nurses. **Purpose:** Examine the effectiveness of a PUP applied to ICU patients with WOC nursing rounds. .	**Initial SS:** n= 1017 **Exclusion:** With PU, age, prior study, declined, consent, no English: n=: 505 ICU LOS <24: 174 Missing data:11 **SS:** n=327 Pre-intervention: n=181 Post-intervention: n= 146 **IC:** Over 18YO, able to get family and Patient consent, LOS >24 Hrs. **EC:** Presence of PU, under 18 YO, Previous study enrollment,	**IV:** Study phase- PIPP bundle intervention with WOC nurse rounding. **DV:** Incidence of unit acquired PU	Admission/discharge skin assessment, chart reviews, WOC nurse rounding logs.	Mean and standard deviation for patient characteristics. Frequencies used for ICU admin, assignment, and transfer stats. T and X2 testing for pre- and post-patient characteristics. Differences pre- and post-test used t-test, multiple logistic regression Covariant analyzed with bivariate analyses if P<.25.	Nagelkerke R squared was .396 (P<.001) PIPP bundle and WOC rounds increased Nagelkerke R squared value by 0.099 (P<.001) >0.297 when only covariant in model. Intervention effect statistically significant at P<.001 (Wald x2 = 11.695, df =1)	**LOE:** 3 **Strengths:** Quantitative data collected. Multipole Hospital ICUs evaluated Shows that training via WOC or Education for PUP bundle I decreased PU rates. Large sample size. Data collected over 6 months. **Weaknesses:** Benefit from control group. Unclear if the outcome is due to WOC intervention or Bundle

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			non-English speaking **Setting:** 3 ICUs North Memorial Medical Center Minneapolis, Minnesota. **DI:** 6 months					**Conclusion:** PUP bundle and WOC intervention decrease PU rates. **Feasibility/Applicability to Pt. population:** It can be applied to any floor and easily implemented.
Citation	**Conceptual Framework**	**Design/Method**	**Sample/Setting**	**Major Variable & Definitions**	**Measurement**	**Analysis**	**Findings**	**Decision for use**
Coyer et al., (2015) Reducing Pressure Injuries in Critically ill Patients by Using a Patient Skin Integrity Ce Bundle (inspire). **Funding:** Grant by Royal Brisbane and Women's Hospital Foundation and the School of Nursing, Queensland	None listed.	**Design:** QE before and after design with control group. **Purpose:** Test a PUP bundle (InSpire Protocol) for reducing PI in the critically ill Adult ICU population	**SS total:** n= 207 Control group: n = 102 Intervention group: n= 105 **IC:** Admitted to ICU, expected LOS >24 Hrs., Age >18YO. **EC:** Community acquired loss of skin integrity on admission, PI within 24 Hrs. of	**IV:** Intervention with PIPP bundle **DV:** Incidence of PI	Data collection form, skin assessment tool, PI staging tools, Digital images,	SPSS, Descriptive statics for means and SD for continuous variables. Freq and % for categorical variables. Kaplan-Meier survival analysis to compare	PI cumulative incidence significant difference (x2=4.3, P=.05). Intervention fewer PI events over time. (log-rank [Mantel-Cox] = 11.842, df=1, P<.001)	**LOE:** 3 **Strengths:** Clear cause and effect. Well balanced control and intervention groups. Groups similar. First study to look at device related PI

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University of Technology. Purchase subsidy provided by Sage Products Global and Mayo Healthcare, Australia. **Bias:** None recognized. **Country:** Australia			ICU admission, Medical orders contraindicating intervention. **SETTING:** 36 bed general adult ICU **DI:** Conducted for 12 months. Recruitment to discharge.			time to new PI between groups. X2 Test of independence used to determine differences in PI stage and process of care. Logistic analysis used to adjust confounders	Heel PI more common in control (P=.02) Mucous injury less often in control (P<.001)	**Weakness:** only QE. Unclear what initial assessment of eligibility No mention of patient consent. **Feasibility/Applicability to Pt. population:** Utilizes a PUP bundle that can be implemented in a hospital.
Citation	**Conceptual Framework**	**Design/Method**	**Sample/Setting**	**Major Variable & Definitions**	**Measurement**	**Analysis**	**Findings**	**Decision for use**
Sving et al., (2016). Getting evidence-based pressure ulcer prevention into practice: a multi-faceted unit-tailored	PARIHS framework.	QE clustered pre and Posttest. **Purpose:** Evaluate if multi-faceted, unit-tailored EB interventions affect PI	**Total Patient** n = 506. **Patient Pretest** n = 251. **Patient Posttest**	**IV:** Intervention with PIPP bundle **DV:** Pressure ulcer prevalence	Data collection prevalence, observation, review or records. Modified northern scale to assign at	SPSS Logistic regression for intervention effect on dichotomous variables.	Post-test PUP care increase P=0.021 Increase in offloading of heals P=0.001	**LOE: 3** **Strengths:** good use of frameworks.

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intervention in a hospital setting. **Funding:** Center for Research & Development, Uppsala/County Council. **Bias:** None recognized. **Country:** Sweden.	prevention, PI prevalence, Knowledge and attitudes of nurses and staff.	n = 255. **Total nurses** n = 276 **Nurse pretest** n=145. **Nurse Posttest** N= 130. **IC:** Consenting patients Over 18 YO admitted before midnight on day when PI survey done Nurses working units. **EC:** None listed. **Setting:** 5 Swedish general hospital units. 3 surgical 2 medical units. **DI:** between 6-8 months per unit.	risk, Questionnaire, PUKAT, APUP	Between group differences tested Student's two-tailed T-test significance set to .05.	Use of sliding sheets increase P=0.026 24 Hr. assessment of PI increased P=0.008. Nurse knowledge increased P=.001 mean sore 63%.	Units included at different points of time. Multiple units from different parts of hospital provided a more diverse population. Demographic data the same A good description of the intervention. **Weakness:** Likely to soon to look at effect as data for PI showed no change. **Feasibility/Applicability to Pt. population:** Useful to see data on nurse knowledge and

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								change in practice. Multiple areas of hospital evaluated. Usable framework and data collection method. Lessons learned about the time frame for data collection.
Citation	**Conceptual Framework**	**Design/Method**	**Sample/Setting**	**Major Variable & Definitions**	**Measurement**	**Analysis**	**Findings**	**Decision for use**
Mallah et al, (2015). The Effectiveness of a Pressure Ulcer Intervention Program on the Prevalence of Hospital Acquired Pressure Ulcers: Controlled Before and After Study. **Funding:** None listed.	None listed.	Prospective research design with pre and post-intervention data. **Purpose:** Determine efficacy and asses which component of the intervention was most predictive of decreasing HAPI.	**SS:** n= 486 patients. **IC:** verbal consent, admitted to the hospital. **EC:** None listed. **Setting:** 19 inpatient units in a tertiary medical	**IV1:** LOS. **IV2:** Braden Score. **IV3:** Prevention Strategies. **DV:** Development of HAPI. **Definition:** HAPI- Any ulcer noted 24 or more Hrs. after admission.	Survey, Braden Scale, NPUAP PI staging guideline. Electronic PI reporting.	SPSS Univariate analysis to describe sample. Percent for categories. Mean and SD for continuous variables. X2 testing for before	HA PI reduced after intervention x2= 7.64, P<0.01. Braden scale sensitivity =92.3%. Specificity = 60.4%. LOS significant PI	**LOE: 3** **Strengths:** Good sample size. Broad-spectrum across the hospital. **Weaknesses:**

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Bias: None recognized. **Country:** Lebanon.	center in Lebanon. **DI:** 6 months pre-intervention 6 post-intervention.	and after HAPI. Sensitivity and specificity analysis for Braden scale. T-tests and univariate analysis comparing potential risk for with and without HAPI. Multivariate logistic regression analysis for impact of the potential risk Model validation with Hosmer and Lemeshow	development (t = 3.06, P=0.032). Braden scale significant (t= 4.55, P=0.023). Braden score and skin care significant with multiple logistic regression Braden score OR1.187 (CL=1.031-1.546, p =0.03) Skin care OR = .058 (CL=.036-0.092, p = 0.98)	Value in evaluating other risk factors. Only looks at rate of PI not incidence. **Conclusions:** Skincare management and Braden scores best indicators for the development of PI **Feasibility/Applicability to Pt. population:** A similar population looks at multiple areas of hospital. Disuses the use of nursing education as part of intervention.

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						goodness-of-fit statistic chi-squared test.		
Citation	**Conceptual Framework**	**Design/Method**	**Sample/Setting**	**Major Variable & Definitions**	**Measurement**	**Analysis**	**Findings**	**Decision for use**
Baron et al., (2016). Experimental study with nursing staff related to the knowledge about pressure ulcers. **Bias:** None recognized. **Funding:** None stated. **Country:** Brazil.	None listed.	Quantitated QE design with control groups. **Purpose:** Evaluate knowledge of PI interventions after before and after education.	**SS:** total n=71 Nurses n = 12 Nurse technicians n=74 **IC:** Staff that agreed to participate with informed consent. **EC:** Staff not available for initial questioner. Staff that score over 90% on questioner, staff that scored under 75% on questioner.	**IV:** 10 weeks of PI prevention education. **DV:** Knowledge scores	Soci-demographic questioner. Adapted Piper Knowledge test	SPSS, Independent double typing EpiInfo. Distribution tested with Kolmogorov-Smirnov test. Non-normal distribution data tested with non-parametric tests. Demographic data	Similar demographic characteristics between groups. No difference found between pre-test group scores (P> 0.05). Post testing found significant difference (P= 0.001) 87.8% correct. Post-test control group	**LOE: 3** **Strengths:** multiple sights. Clear description of testing questions. Good support from other studies on results. Also looks at Nursing technician knowledge. **Weaknesses:** Did not make

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	Setting: 3 ICU's in general hospitals in Brazil. One large hospital two medium hospitals. **DI:** 4 months total Intervention education once a week for 10 weeks for one Hr. each.	shows distribution and frequency as means and SD. Chi-square test assesses relationships in demographic data and knowledge. used to verify association of scores. Mann-Whitney test used to verify possible differences of correct scores between groups. Wilcoxon test for pre- and	no significant difference in scores (P>0.05) 79.1% correct. No relationship between gender, knowledge. Age, knowledge. Training time, knowledge.	90% improvement. Unclear number of participants from what hospital. Exclusion inclusion criteria weak. **Conclusions:** Education improves knowledge scores. **Feasibility/Applicability to Pt. population:** Would be worth looking into nursing technicians as part of the study population as they also are part of care. In-patient population.

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						post-periods. Significance a<0.05.		
Citation	**Conceptual Framework**	**Design/Method**	**Sample/Setting**	**Major Variable & Definitions**	**Measurement**	**Analysis**	**Findings**	**Decision for use**
Smith et al., (2018). Evaluation of a multifactorial approach to reduce the prevalence of pressure injuries in regional Australian acute inpatient care settings. **Bias:** None recognized. **Funding:** None listed. **Country:** Australia	Knowledge translation theory. Modified theory of planned behavior. .	Quantitative Retrospective cross-sectional study. **Purpose:** Compare changes in PI prevalence in relation to staff behavior after implementation of the Crystal model.	**SS:** 2008 n= 1407. 2010 n= 1331. 2014 n = 1199. **IC:** In hospital at the time of prevalence check over 18 YO, verbal consent, **EC:** Pediatric patients, obstetrics patients, psychiatric patients, OR patients, same day surgery patients. **Setting:** Public health care with	**IV:** The change over time in the PUP model to reflect international guidelines regarding education, Best Practice evidence and, surveillance. **DV:** Current PI rate at time of prevalence survey over 6 years.	Point prevalence survey tool. PI risk tool.	Descriptive statistics to identify changes and patterns in data. Compared means and percent of categorical and numerical data.	N for pressure injuries decreased from 414 in 2008 to 173 in 201 to 137 in 2014. Documented repositioning increased to 74% from 20.6%. Documentation of PI risk assessment increased from 78.9% in 2008 to 84.3% in 2014.	**LOE: 3** **Strengths:** A retrospective look at PI data when implementing a PIPP. **Weaknesses:** Needs more control for outcomes. Evaluation tool changed with time. PIPP changed over time. **Conclusions:** There is some supporting evidence that a

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			4organization in North Southwest Wales Australia with 41 inpatient facilities. **DI:** 2008-2014 prevalence surveys.					PIPP with an e-learning component does improve PI rates over time. Evaluation tool changed over time. **Feasibility/Applicability to Pt. population:** Modality of multiple hospitals as well as utilizes a prevalence survey gives some idea of long-term impact of PIPP.
Citation	**Conceptual Framework**	**Design/Method**	**Sample/Setting**	**Major Variable & Definitions**	**Measurement**	**Analysis**	**Findings**	**Decision for use**
Dalvand, et al., (2018). Nurses' knowledge on pressure injury prevention: A systematic review and meta-analysis based on the	None Listed	SR and meta-analysis **Purpose:** Assess the overall knowledge of nurses on PI prevention based on their scores on	**SS:** 8 studies 11 groups N=4766 **IC:** use PUKAT reported required data.	**IV:** The application of the PUKAT to measure staff knowledge. **DV:** Nursing staffs having appropriate wound care knowledge	Pressure ulcer knowledge assessment tool questionnaires STROBE	Statistical analysis done with STATA version 12 software Binomial distribution	All Below desired 60%. Knowledge score all commers 53.1% (95%	**LOE: 1** **Strengths:** Easily represented data.

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Pressure Ulcer Knowledge Assessment Tool. **Funding:** No funding was received for the study. **Bias:** tested for publication bias found not to be significant. Reported no conflicts of interest. **Country:** Iran	the Pressure Ulcer Knowledge Assessment Tool and its subscales in different settings.	**EC:** lack of access to article's full text use of other tools **DS:** PubMed, Science Direct, Scopus, Web of Science	formula for variance Weighted mean for percent of each study. Random effect model to combine studies and estimate dimension scores.	CI: 47.5-58.8) Nursing knowledge (55.4% 95% CI: 42.3-68.4) Lowest scores on prevention	Good sample size. Broader population type than most available studies currently. Commonly used tool with good evidence for use. **Weaknesses:** Limited depth of use with other tools. DS several outside normal. **Conclusion:** Evidence supports that nursing staff knowledge is limited worldwide. The use of PUKAT useful in

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						determining knowledge. **Feasibility/Applicability to Pt. population:** analysis shows target change to be nursing staff knowledge. Use of evaluation tool fit well with situation at projected sight.

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Appendix B

Table 2

Syntheses Table

Author	Suva et al.,	Tayyib et al.,	Martin et al.,	Anderson et al.,	Coyer et al.,	Sving et al.,	Mallah et al.,	Baron et al.,	Smith et al.,	Mahalingam et al.,
Year	2017	2015	2017	2015	2015	2016	2015	2016	2017	2018
Design	SR	RCT	MMS	QE PIPI	QEPIPI	QEPIPI	PRPIPI	QS/ED	CSRQR	SR
LOE	1	2	3	3	3	3	3	3	3	3
Study Characteristics										
Demographics										
Age	N/A	52YO and 47.5YO	85% between 26-55YO	Pretest mean age: 63.25 Posttest mean age: 62.03	Mean age: 55	Patient's mean age: 78	Mean age: 44.69	Intervention group mean age: 33.8	N/A	N/A
Setting:										
In-patient	N/A	X	X	X	X	X	X	X	X	X
Sample Size/ # of Studies Included	17 papers	140 patients	80 staff tested	327 PIPI total	207 patients	506 patients, 208 HCS staff	420 patients	71 total staff 1/3 MA	3937 patient charts	4,766

CSRQR- Cross-sectional retrospective quantitative research, **HAPI-** Hospital Acquired Pressure Injury, **HCS -** Health Care System, **N/A-** not applicable, **MA-** Medical assistants, **MMS-** Mixed method study, **NRNCT-** Nonrandomized Noncontrolled Trial, **PI-** Pressure Injury, **PIPI-** Pre-intervention Post-intervention, **PR-** Prospective Research, **PTPT-** Pre-test Post-test, **PU-** Pressure ulcer, **PUKAT-** Pressure Ulcer Knowledge Assessment Tool, **PIPP-** Pressure Injury Prevention Program, **QE:** Quasi- experimental, **QS/ED-** Quantitative study with experimental design, **RCT-** Randomized control trial, **SR-** Systematic Review, **YO-** Years old.

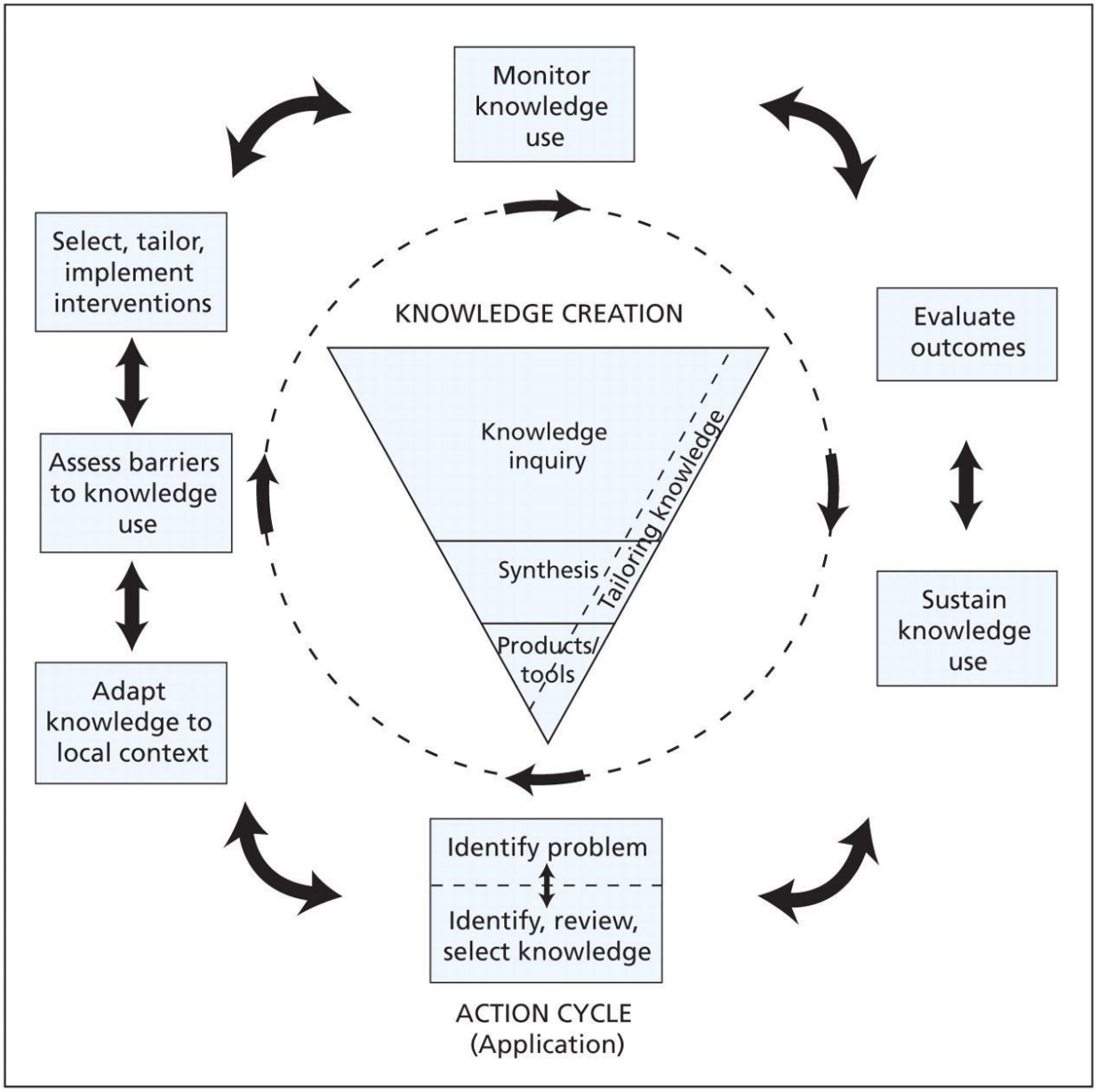
Measurement Tools	N/A	PU count	PUKAT shortened	# of PI	# of PI	Staff PUKAT and APUP. Patient modified Norton scale # PI	Braden scale, chart review	Piper test	Survey data	PUKAT
Duration	N/A	784 days	15 min online tutorial and roll out of PIPP	Four months pre-intervention five months post-intervention	12 months of data collection, one-month training	17 months	Six-month pre, six-month post	Once a week for ten weeks	Six years	N/A
PIPP used		X	X	X	X		X		X	N/A
Education Improved Outcomes	X	X	X			X		X	X	N/A

CSRQR- Cross-sectional retrospective quantitative research, **HAPI-** Hospital Acquired Pressure Injury, **HCS -** Health Care System, **N/A-** not applicable, **MA-** Medical assistants, **MMS-** Mixed method study, **NRNCT-** Nonrandomized Noncontrolled Trial, **PI-** Pressure Injury, **PIPI-** Pre-intervention Post-intervention, **PR-** Prospective Research, **PTPT-** Pre-test Post-test, **PU-** Pressure ulcer, **PUKAT-** Pressure Ulcer Knowledge Assessment Tool, **PIPP-** Pressure Injury Prevention Program, **QE:** Quasi- experimental, **QS/ED-** Quantitative study with experimental design, **RCT-** Randomized control trial, **SR-** Systematic Review, **YO-** Years old.

Appendix C

Figure 1

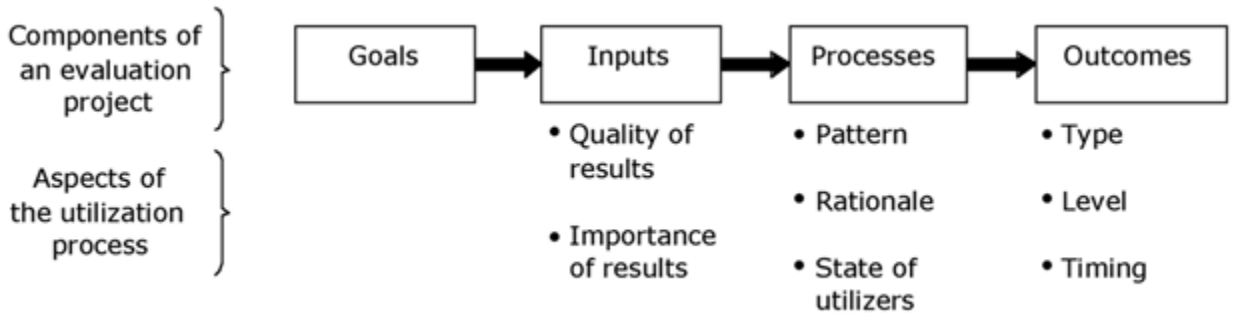
Diagram of Knowledge to action framework (Graham, et al., 2006).



Appendix D

Figure 2

Diagram of Conner conceptual mode for research utilization evaluation (Conner, 1980).



Appendix E

Table 3

Budget

Pressure Injury Education evaluation cost analysis table		
	Description	Cost
Direct Costs		
	Supplies and handouts	$150.00
	Promotional supplies	X4 $25.00 gift cards
Indirect Cost		
	Utilization of hospital equipment (Room with computers)	$100.00
	Employee time $29 per hr for 20 employees for 1 hr.	$615.00 likely much less as a quiz can be taken after work or on break.
Funding		
WOC Budget	$100.00	
Unit Budget	-	
Hospital Budget	-	
Cost Savings		Savings
Development	$35.66 an hr for >200 hr	$7,132.00 for 200 hr
Cost of individual patient care for one pressure Injury	$20,000.	$20,000
Online evaluation tool	Self-developed google form	$384.00
PUKAT	Permission to use free	unknown
Total cost	$965.00	
Total saved	$27,516.00	

Appendix F

Table 4

Two-tailed Paired Samples t-Test

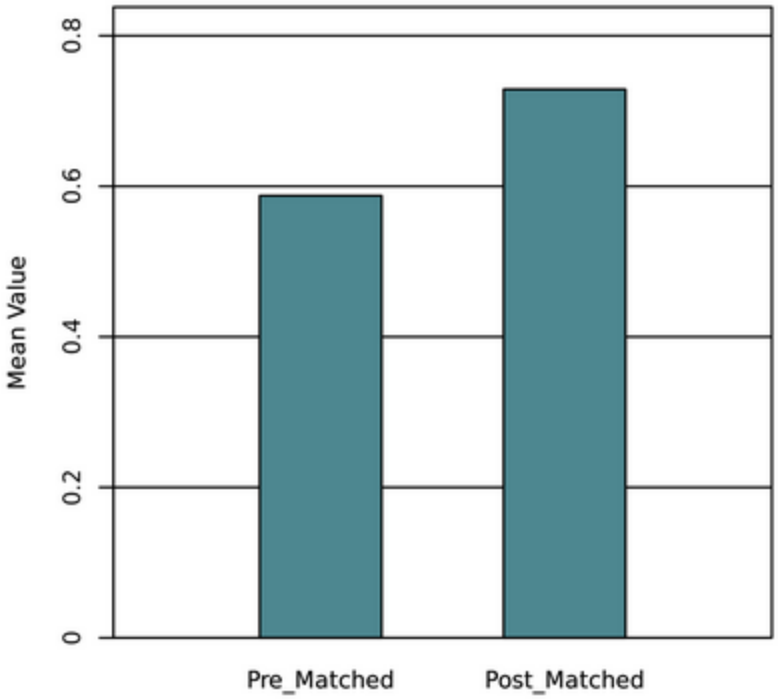
Two-Tailed Paired Samples t-Test for the Difference Between Pre_Education_Summary and Post_education_Summary

Pre_Quiz_Summary		Post_Quiz_Summary				
M	*SD*	*M*	*SD*	*t*	*p*	*d*
0.57	0.09	0.69	0.14	-3.46	.009	1.15

Note. N = 9. Degrees of Freedom for the *t*-statistic = 8. *d* represents Cohen's *d*.

Figure 3

The means of Pre_Matched and Post_Matched



Appendix G

Table 5

Two-Tailed Mann-Whitney Test for scores by test

	Mean Rank				
Variable	pre	post	*U*	*z*	*p*
scores	18.16	34.84	102.50	-4.05	< .001

Figure 4

Ranks of scores by test