Reducing Hospital Acquired Pressure Injuries among Spinal Cord Injury Patients

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Abstract

Problem: The spinal cord injury (SCI) unit of a local rehabilitation hospital in Baltimore, Maryland experienced hospital acquired pressure injury (HAPI) incidence rates above the facility standard rate of 0.77. HAPI incidence rate was 1.53 in 2021. A new benchmark was established in 2022 based on the Uniform Data System reporting at 1.20%. Despite implementation of interventions to address this problem, the HAPI rate was 3.45% at the end of August 2022. **Purpose**: the purpose of the quality improvement was to implement a HAPI prevention admission bundle on the SCI unit to reduce HAPI rates. **Methods:** Nurses (RN and LPN) were educated on the HAPI prevention admission bundle and took a paper-based post-test to evaluate assimilation of the educational objectives. Implementation of the bundle began on the second week. Within four hours of admission, two nurses initiated a comprehensive skin assessment. The admitting nurse (RN) documented the skin findings in the electronic health record (EHR) visual skin tool, inserted the tool into a progress note, and requested a co-sign from the second nurse. All new admissions ages 18 years and older were included. Bundle compliance was measured weekly by chart audits in the EHR. **Results:** 86% of nurses (n = 13) were trained with a post-test average score of 95%. Over a period of 14 weeks, 64 patients were admitted to the unit. Overall HAPI bundle compliance rate was 90% (n = 57), and 97.4% of admissions (n = 62) had an admission skin assessment completed within 4 hours of admission. Documentation on the visual skin tool was completed for 91% of admissions (n = 59) and two-nurse co-sign completed for 90% (n = 57)**.** Post-implementation HAPI rates dropped to 1.87%. **Conclusions:** The HAPI prevention admission bundle was effective in reducing HAPI rate. Formal staff education, unit champions, leadership involvement, and staff reminders were important tactics utilized for the adherence and adoption of the implementation.

Reducing Hospital Acquired Pressure Injuries among Spinal Cord Injury Patients

Hospital-acquired pressure injuries (HAPIs) are a challenging healthcare issue for many hospitals and other health institutions across the nation. In 2017, the national incidence rate of HAPIs was estimated at 23 per 1000 discharges with an approximated cost of $14,506 dollars per injury (Agency for Healthcare and Research Quality, 2020). HAPIs are largely avoidable events that are attributed to multiple factors including co-morbidities, immobility, decreased or loss of sensation, incontinence, advanced age, poor nutrition, and poor perfusion (Baernholdt et al., 2020; Rivera et al., 2020; Cowan et al., 2019). HAPIs are the second most common complications among spinal cord injury (SCI) patients and are associated with increased morbidity, mortality, extended length of stay, increased pain, decreased in quality of life, and increased rates of infection (Irgens et al., 2020; Rondinelli et al., 2018).

The SCI unit of a local acute rehabilitation hospital in Baltimore, Maryland had experienced HAPI incidence rates above the facility benchmark of 0.77. Upon the original conception of the project and recognition of the issue in December 2021, a six-month overall HAPI incidence rate on the unit was 1.53. During the developmental phase of the project, the overall HAPI incidence rate worsened, increasing to 1.8 by the end of the fiscal year in June 2022. A new benchmark was established in July 2022 based on the Uniform Data System reporting at 1.20%. The new incidence rate was calculated in percentages by dividing the number of admissions who developed new or worsening HAPIs over the length of stay. At the end of August 2022, the overall SCI unit HAPI rate was 3.45%. Despite the implementation of interventions to address this problem, HAPI rate on the SCI unit remained high. It was essential to not only prevent HAPIs but also correctly identify present on admission (POA) pressure injuries so that interventions could be implemented early to prevent deterioration. A root cause

analysis revealed multiple contributing factors to this issue including nurses' knowledge deficit on skin assessments, a lack of formal training on skin assessments, inconsistencies in documentation, and a lack of accountability leading to inaccurate initial skin assessment and missing POA skin abnormalities (figure 1).

The purpose of the quality improvement project was to implement a HAPI prevention admission bundle on an acute SCI rehabilitation unit with the goal of reducing HAPI incidence rates. This unit previously had components of a HAPI bundle in place that included a skin assessment on admission and interventions if a pressure injury was present, but the skin assessment practices were not congruent with the current literature and had influenced the increased in HAPI incidence rates. The aim of this project was to update the current HAPI prevention bundle by including a comprehensive skin assessment by two nurses within four hours of admission, improving documentation accuracy and consistency of skin findings in the electronic health record (EHR) visual skin tool, and cosigning of skin notes.

Available Knowledge

The proposed evidenced-based solution supported by the literature was the use of a multi-intervention approach, or pressure injury prevention (PIP) bundles (Table 1 and Table 2). Using a bundle had been shown to effectively prevent pressure injuries, thus decreasing HAPI incidence and prevalence rates in multiple hospital settings (Amon et al., 2019; Anderson et al., 2015; Sving et al., 2016; Tayyib et al., 2015). Bundled interventions had included a head-toe skin assessment within four to 24 hours of admission, frequent repositioning, risk assessment, and education of nurses on the pressure ulcer prevention bundle (Tayyib et al., 2015; Anderson et al., 2015). Edwards et al. (2017) also found that appointing unit skin champions, educating and training the champions, were effective in reducing the prevalence of pressure ulcers. Likewise,

Amon et al. (2019) used a PIP bundle that included a thorough skin assessment on admission, nursing staff education on skin care, unit skin champions and found that the bundle was effective in reducing HAPI incidence and prevalence rates to zero in a 32-bed medical-surgical unit for three consecutive years. Multi-component, unit-tailored approaches had also been found to be particularly efficacious (Delmore et al., 2020; Sving et al., 2016).

Rationale

The Knowledge-to-Action Framework (figure 2) was originally developed in 2006 and describes the translation of knowledge to action (Graham et al., 2006). The knowledge creation phase has three concepts which are knowledge inquiry, knowledge synthesis, and knowledge tools or products, and the action cycle has seven concepts that relate to identification of the problem, adaptation of knowledge to local context, and implementation of the interventions (Graham et al., 2006). The framework provides structured consecutive steps that can be used to guide the change process during the implementation of the HAPI prevention admission bundle to track and evaluate the practice change. The steps related to knowledge creation were accomplished through the completion of a review of the literature, and a HAPI prevention admission bundle was found to be an effective intervention to address the identified problem. An assessment of the unit and culture were completed to ensure adequate adaptation and recognize potential barriers to innovation. In line with this framework, during the implementation phase, uptake of knowledge was monitored, and outcomes were evaluated to determine the need for any changes. The intervention was expected to be successful because this framework allowed adaption of the concepts to the local context and ongoing evaluation of barriers to change that were addressed during the implementation phase.

Methods

Context

This quality improvement initiative was implemented on a 20-bed SCI adult inpatient rehabilitation unit of a local rehabilitation hospital in Baltimore, Maryland with an average of four to six weekly admissions. All patients 18 years and older were included. The unit had fifteen regular and per diem staff nurses (RNs and LPNs). Other nurses were floaters, contractors, and agency nurses. All nurses working on the unit were invited to attend the educational sessions.

The previous components of the HAPI prevention bundle on the unit included a skin assessment, documentation, and referrals if skin issues were identified. The charge nurse performed admission skin assessments within an undetermined timeframe, was not required to document abnormal skin findings on the visual skin tool and cosign skin assessment notes. For skin abnormalities, a referral was placed to wound and ostomy care if needed, and interventions were initiated to prevent further skin breakdown. Nurses were not held accountable for the accuracy of their skin assessment, the timeliness of the assessment, or the proper documentation. In addition, present on admission pressure injuries, areas of skin at high risk for breakdown, and documentation of admission skin findings were inconsistent. A desired process map of admission skin assessment and documentation was established as presented in figure 3.

Intervention

Implementation began the week of August 31st with educating bedside nurses on the HAPI prevention admission bundle. This was accomplished using a poster board presentation on the unit during two in-person educational sessions. After the posterboard presentation, a computer was used to demonstrate the different steps for accessing and documenting on the visual skin tool and creating and cosigning the skin note. The educational sessions were held in the morning after change of shift to allow nurses from both morning and night shifts to attend.

Implementation at the bedside was initiated on the second week of the project. Within four hours of admission to the unit, two-nurses performed a comprehensive skin assessment. The admitting nurse (RN) documented the skin findings in the electronic health record (EHR) visual skin tool, inserted the tool in a progress note, and requested a cosign from the second nurse. A 24-hour timeline was considered appropriate to allow the second nurse to co-sign the skin note.

The project was implemented at the end of August 2022 for a total of 15 consecutive weeks. Collaboration and communication with the nurses, unit champions, and leadership facilitated the implementation process. Identifying and training unit champions occurred during the first week of implementation. Leadership support impacted the success of the implementation by reinforcing with staff nurses that the initiative was the new standard of care for skin assessments on admission. A resource binder containing information on the HAPI prevention bundle was provided on the second week of the implementation to aid in ongoing education (Appendix E). Charge nurses presented the resource binder during morning and night huddles at the beginning of each shift for one week. Afterwards, the binder was kept in the nurses' documentation room. Unit champions and unit manager/clinical site representative (CSR) received performance updates every two weeks and shared with the staff. Updates on bundle compliance was also shared with other leaders who were invested in the success of the project during formal monthly improvement meetings. In addition to flyers that were posted on the unit, the leadership team played a great role by sharing the flyers via email to all nurses to attend the training sessions. To promote sustainability of the intervention, one nurse was identified and trained on performing weekly audits which occurred during week 11 of implementation.

Measurements

The primary outcome was the HAPI incidence rate which was determined using data collected from the monthly HAPI incidence report and calculated in percentages by dividing the number of new or worsening HAPIs over the length of stay. The structure goal was to educate nurses on the HAPI prevention admission bundle. Nurses were educated using an education lesson plan (Appendix A) that outlined the learning objectives. A HAPI prevention admission bundle education sign-off sheet (Appendix B) was provided to monitor nurses' participation. This goal was measured by evaluating nurses' knowledge after completion of the training using a post-test questionnaire (Appendix C), a measurement tool widely used in the literature (Delmore et al., 2020; Sving et al., 2016). The average post-test score was calculated in percentages to determine if learning was achieved. Weekly chart audits were used to measure process goals. Multiple studies and quality initiatives have used these tools to measure outcomes (Anderson et al, 2015; Edwards et al, 2017; Tayyib et al., 2015). A HAPI prevention admission bundle audit checklist was developed and used to collect weekly compliance data (Appendix D). Data collected included skin assessments completed within four hours, co-signed skin notes by two nurses, and documentation of the skin findings on the visual skin tool in the EHR.

Pre-implementation HAPI rates were obtained from the unit monthly dashboard report. Weekly chart reviews in the EHR were performed, and data was collected manually on all admissions on the bundle compliance. Accuracy of data collected was ensured by adding patients' personal protected information, such as medical record number during data collection. The observed outcome could not be solely attributed to the intervention given that multiple factors influenced the development of HAPIs during the length of stay; however, an improvement in the compliance and HAPI rates during the implementation phase could be attributed to the implementation of the intervention.

Descriptive statistics were used to analyze weekly data on compliance rates to determine if the goals were achieved. Using data from the post-test questionnaire, an average post-test score was calculated in percentages to evaluate assimilation of the training objectives. Weekly average of compliance rates was calculated in percentages to analyze the process goal of documented comprehensive skin assessment performed by two nurses within four hours of admission. This was accomplished by dividing the number of admitted patients who had a skin assessment completed accurately by two nurses with EHR documentation over the total number of new patients who were admitted to the unit multiplied by 100. Weekly mean of compliance rate calculated in percentages was used to analyze the process goal of admitted patients completed visual skin tool in the EHR, by dividing the number of completed visual skin tools in the EHR over the total number of admitted patients multiplied by 100. Weekly averages of the above goals were displayed in Run Charts to identify trends in data. Variations in data originated from multiple factors. Factors considered included lack of training of nurses who were not trained, admissions arriving at change of shift, and low number of admissions in some weeks compared other weeks. As nurses who were unfamiliar with the bundle received education, they became more proficient in using the bundle over time leading to increase bundle compliance.

Ethical Considerations

This project was conducted under a Non-human Subject's Research determination from the Human Research Protections Office (HRPO) of the UMSOM Institutional Review Board (IRB). Confidentiality of the data was ensured with the use of REDCap, a HIPPA compliant and password-secured program. All data exported from REDCap was de-identified. During data collection, the DNP student used a password protected login credentials to access charts in the EHR in computers located in the nurse's documentation room to maintain

privacy. The education sign-off sheet was kept in a locked drawer in the charge nurses' office. The post-test questionnaire was administered unanimously to staff nurses. This project had no potential conflict of interest and did not pose a threat to patients, staff, or the unit.

Results

Overall, 86% of nurses (n =13) were trained and took the 10-question post-test. Scores ranged from 80 to100% with an average score of 95% (median = 100%). Over a period of 14 weeks, 64 patients were admitted, and weekly compliance rates were calculated. The overall HAPI prevention admission bundle compliance rate was 90% (n= 57; median = 100%), ranging from 50% to 100% (figure 4). In weeks 4 and 7 through 14, 100% compliance rate was achieved. Bundle compliance rate was lowest (50% and 66.7%) in week 2, 6 and 7 (figure 1). About 97.4 % of admissions (n = 62; median = 100%) had an admission skin assessment completed within four hours of admission (rates ranging from 80% to 100%) as shown in figure 5. Approximately 91% of admissions (n = 59; median = 100%) had documentation on the visual skin in EHR completed, ranged from 50% to 100% (figure 6). As illustrated in figure 5, week 1 and week 6 had the lowest compliance rates, 57.1% and 50%, respectively. Overall, 90% of admissions (n = 57, median = 100%) had two-nurse co-sign completed (figure 6). Compliance with two-nurse co-sign increased in weeks 2 to 5 and weeks 7 to 14; however, a decreased was observed in week 6 (50%) due to the lack of training of the admitting nurse on the bundle. The overall HAPI incidence rate decreased from 3.45% to 1.87% post-implementation from September to December 2022.

The structure goal to educate nurses (RN and LPN) on the HAPI prevention admission bundle was achieved. With a goal of 90%, the overall score of the post-test was 95% showing that nurses demonstrated knowledge assimilation of the training material on the HAPI

prevention bundle. Analysis of the weekly bundle compliance rate showed that compliance increased above the project goal of 80% for seven consecutive weeks after implementation, meaning more patients had all three components of the bundle completed. A run chart of comprehensive skin assessment completed within four hours of admission revealed that this project goal was met with most data points observed above the goal of 80%.

The results illustrated in the run charts accounted for 14 data points depicting trends, runs and astronomical data points with no shifts. An upward trend of nine consecutive data points (week 6 to 14) and one astronomical point (week 6) were observed in figure 4, 6, and 7. A run in data points was identified in figure 5. A decrease in the overall bundle compliance rate below the goal was observed in weeks 1, 6, and 7. Upon investigation, it was determined that a few nurses admitting patients on those weeks had not received training on the bundle. Actions were taken by the unit manager/CSR to ensure that education was provided to those nurses by the unit champions. Additionally, the variation in the number of weekly admissions impacted the overall bundle compliance rate. Weekly unit admissions ranged from one to six patients. Weeks with the lowest number of admissions and lowest adherence to the bundle negatively affected the compliance rates. Education and re-education of nurses by champions using the resource binder were effective in achieving the goals. After nurses received education on the bundle in week 6, All components of the bundle as well as the overall HAPI bundle achieved 100% compliance rates which were maintained for seven consecutive weeks. The outcome goal was met with greater than 50% reduction of the unit HAPI incidence rate from the pre-implementation rate.

Discussion

This quality improvement initiative provides initial support regarding the feasibility of implementing a HAPI prevention admission bundle, consisting of a two-nurse comprehensive

skin assessment within four hours of admission, documentation of the findings in the visual skin tool, and two-nurse co-sign completed in EHR, on the SCI acute rehabilitation unit. The project demonstrates that using evidence-based interventions to address a local problem can be achieved when the project, unit, and facility goals are aligned, and the organization values a change in practice. The project's intervention improved the SCI unit process of admission skin assessment by improving skin assessments, documentation of skin findings and nurses' accountability. The intervention resulted in decreasing HAPI incidence rate on the unit which was the expected outcome goal. Findings from this project are similar to outcome findings from published literature (Amon et al., 2019; Anderson et al., 2015; Tayyib et al., 2015).

Even though the project goals were achieved, various barriers were identified preventing weekly achievement of some of the goals. The project was limited by the small sample size of admissions (n = 64) and a short implementation period. Other barriers identified included finding a second nurse to perform admission skin assessments within four hours and co-signing notes within 24-hours leading to compliance rates below the goal of 80%. Another limitation that negatively impacted compliance rates was the lack of nurses' training performing admission assessments. This limitation was consistent with the literature (Amon et al, 2019; Delmore et al, 2020; Edwards et al. 2017). An improvement in weekly compliance rate was observed after all unit nurses received the education on the bundle. One final limitation is that improved HAPI incidence rate cannot be solely attributed to the intervention since multiple factors can lead to patients acquiring HAPIs during their stay. This limitation is also highlighted in the evidence demonstrating the importance of using multiple targeted interventions to decrease pressure injuries in multiple settings (Amon et al., 2019; Anderson et al., 2015; Sving et al., 2016; Tayyib

et al., 2015). Despite the limitations, achievement of the progress and outcome goals demonstrated that the intervention was successful in reducing HAPI incidence rate on the unit.

Conclusion

HAPIs can result in increased morbidity and mortality among spinal cord injury patients, increased healthcare cost, and prolonged length of stay. Using a HAPI prevention admission bundle is cost-effective and efficacious in early identification of patients at risk of present on admission pressure injuries. Formal staff education, unit champions, leadership support, and staff reminders were critical components to achieve successful implementation. Key practice change strengths were the utilization of unit champions, identification of barriers to achieving the weekly goals and finding timely solutions and providing staff with feedback on the bundle compliance. Continuously addressing barriers and providing feedback to staff may influence staff performance to continuously achieve 100% compliance with the bundle. Other tactics for sustainability include a standardization and incorporation of the bundle in the workflow for all admissions, developing an easier process for performing audits, designating unit champions to ensure continued education and reinforcement, and leadership involvement.

This quality improvement initiative suggests that implementation tactics and strategies may be useful in the successful implementation of pressure injury prevention interventions such as the HAPI prevention admission bundle, to reduce and eliminate HAPIs. Future quality improvement work pertaining to this topic should focus on incorporating ongoing education, the use of champions, providing staff with timely feedback on performance, and leadership involvement, as these were critical components of the success of this project.

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Table 1

Evidence Review Table

Citation: Amon, B., David, A., Do, V., Ellis, D., Portea, D., Tran, P. & Lee, B. (2019). Achieving 1,000 days with zero hospital-acquired pressure injuries on a medical-surgical telemetry unit. *MEDSURG Nursing*, *28*(1), 17–21. https://eds-s-ebscohost-com.proxy-hs.researchport.umd.edu/eds/pdfviewer/pdfviewer?vid=3&sid=c82236ed-5568-430d-be0d-d8aa1f6995bd%40redis					**Level and Quality V-B**
Purpose/ Hypothesis	**Type of Evidence Research Design**	**Sample – Population, Size, Setting**	**Intervention/Procedures**	**Primary Outcome/Measures**	**Results/Conclusions**
The purpose of this quality improvement project was to reduce the prevalence and incidence rates of hospital acquired pressure injuries (HAPIs) using comprehensive preventive bundled program	Practice: evidence-based quality improvement project	**Sampling Technique**: Convenience sampling **Setting**: 32-bed medical surgical telemetry unit in an urban academic teaching hospital **Eligible:** all new admissions and transfers on the 32-bed medical surgical telemetry unit **Excluded**: patients who refused the recommended interventions from the bundle **Accepted/ Intervention**: all new admissions and transfers # **Control**: no control group	**Control**: no control group **Intervention**: The implementation program consisted of six interventions including: a comprehensive skin assessment by two nurses on admission and transfer, individualized pressure injury risk factor reduction based on the skin risk assessment, prophylactic skin products and pressure reducing surfaces, early patient mobilization, nursing staff education on skin care, and unit skin champions **Intervention Fidelity:** patients admitted or transferred to the unit during the intervention period	**Dependent variable (DV)**: HAPI incidence and prevalence rates **Measurement (reliability), time and procedure**: between the second quarter in 2014 and fourth quarter in 2017, monthly data on pressure injuries was collected using a National Database of Nursing Quality Indicators (NDNQI) survey tool by unit champions and evaluated by leaders and certified wound and ostomy nurses (CWOCN).	**Statistical Results**: the incidence and prevalence of HAPIs decreased from 1.1 to 0 for 1000 days from June 2014 to 2017. The unit achieved HAPI incidence and prevalence rates of zero for 3 consecutive years. **Conclusions**: using a bundle of preventive strategies was effective in decreasing the incidence and prevalence rates of HAPIs in hospitalized patients.

		Power analysis: not applicable **Group Homogeneity**: not applicable	received the pressure injury prevention bundle unless patients refused.		
Citation: Anderson, M., Finch Guthrie, P., Kraft, W., Reicks, P., Skay, C., & Beal, A. L. (2015). Universal pressure ulcer prevention bundle with WOC nurse support. *Journal of Wound, Ostomy & Continence Nursing*, *42*(3), 217–225. https://doi.org/10.1097/WON.0000000000000109					**Level and Quality II-B**
Purpose/ Hypothesis	**Type of Evidence Research Design**	**Sample – Population, Size, Setting**	**Intervention/Procedures**	**Primary Outcome/Measures**	**Results/Conclusions**
The purpose of the research study was to determine the efficacy of a universal pressure ulcer prevention bundle (UPUPB) with semi-weekly wound ostomy care (WOC) nurse rounds in intensive care units (ICUs) patients	Research: quasi-experimental pre- and post-intervention	**Sampling Technique**: Convenience/nonprobability sampling **Setting**: three ICUs (trauma/neurological, medical/surgical, and cardiovascular) of a level I trauma center **Eligible:** 512 subjects met initial inclusion criteria on admission/transfer to ICUs. 185 subjects excluded from final study. Inclusion criteria: 18 years or older, admitted > 24 hours to ICU. Subjects excluded were those with existing PUs, previous enrollment in a study, younger than 18 years old, LOS < 24 hours, lack of consent, and missing data.	**Control**: no control group **Intervention**: Pre-intervention phase (June 2012 to October 2012) used a standard guideline or usual care, including 31 interventions implemented based on patient's PU risk (Braden Scale Score) and wound care nurse consult for patients at high risk. Post-intervention (January-June 2013) used a UPUPB guideline which had similar interventions as the standard guideline combined semi-weekly wound care rounds. UPUPB guideline differed from the standard guideline in accessibility, length, and complexity and number of interventions. WOC nurse	**Dependent variable (DV)**: pressure ulcer (PU) occurrence and nurse adherence to UPUPB. Pressure ulcer was defined as "localized injury to the skin and/or underlying tissue usually over a bony prominence, as a result of pressure, or pressure in combination with shear." Adherence was defined as the extent to which recommendations in the guideline were followed. **Measurement (reliability), time and procedure**: no tool was used in this study.	**Statistical Results**: Multiple logistic regression with covariates was statistically significant ($p < 0.01$), indicating that the UPUPB and WOC nurse rounds were effective in preventing unit-acquired PUs. The unit-acquired incidence rates of PUs in the pre-intervention phase were 15.5% compared 2.1% in the post-intervention phase. Chi-square/T-test comparison revealed

		Accepted/ Intervention: 327 subjects. **Pre-intervention**: 181 patients **Post-intervention**: 146 patients. **Control**: no control group **Power analysis**: first analysis required 385 subjects to meet power of 0.80 and alpha of 0.05. After hospital restructuring near completion of enrollment, a second power analysis required 343 subjects to achieve 79% beta and 0.05 alpha- power analysis was not met. **Group Homogeneity**: subjects in the study intervention groups (pre and post) were homogenous based on p values in table 3 for sample characteristics showing no significant differences.	rounds were conducted semiweekly and focused on motivating, coaching, and educating staff at bedside. Two WOC nurses conducted semiweekly rounds. The prevention bundle had five selected core implementation components with the acronym **SAFER**: skin emollients (S), head-toe skin assessment (A), floating heels off the bed (F), early identification of pressure sources (E), and repositioning (R). **Intervention Fidelity**: staff nurses were assigned a learning module on the bundle and rounds two months before the post-intervention phase. The units selected multiple skin nurse champions two years prior to the study. Head-to-toe skin assessment was performed on admission or transfer to ICUs and documented EHR by skin champions. After admission or transfer to ICU, the presence of PUs and nurse adherence to	Outcomes were measured using chart reviews and WOC nurses' rounding logs. PU occurrence was measured via chart reviews on EHR post-ICU admission or transfer. Adherence score was calculated using the average number of 24-hour EHR documentation of the five prevention interventions over the number of expected entries during the subjects' length of stay. Expected number of entries in 24 hours were determined by hospital policies. A score of 1 indicated full adherence. Composite adherence score was determined by adding the 5 adherence scores.	no statistically significant difference for composite adherence scores in the five interventions between the pre- and post-intervention phases (t=-1.549, p=0.123). The scores were 4.34 (mean SD = 1.40) and 4.65 (mean SD = 2) in the pre- and post-intervention phases, respectively. **Conclusions**: the study concluded that universal pressure ulcer prevention bundle (UPUPB) together with ongoing WOC nurse rounds decreased the likelihood of acquiring PUs in ICU and increased nurse adherence to the bundle.

			implementing core components was documented in the EHR. Skin champions' skin assessment process on admission or transfer was validated by the WOC nurses.		
Citation: Delmore, B., Smith, D. J., Savage, E., & Ayello, E. A. (2020). Evaluating the impact of an innovative educational program for skin care champions using the Pieper-Zulkowski Pressure Ulcer Knowledge Test. *Advances in Skin & Wound Care*, *33*(5), 252–259. https://doi.org/10.1097/01.ASW.0000658580.19702.11					**Level and Quality II-C**
Purpose/ Hypothesis	**Type of Evidence Research Design**	**Sample – Population, Size, Setting**	**Intervention/Procedures**	**Primary Outcome/Measures**	**Results/Conclusions**
This research study aimed to assess the effect of a learner-designed educational intervention on pressure injury knowledge	Research: single group pretest/posttest design	**Sampling Technique:** Convenience sampling **Setting:** hospital with 761-beds **Eligible**: 77 nurses **Accepted:** 77 nurses. 19 participants were lost before the posttest. **Control:** no control **Intervention:** 58 nurses completed the posttest evaluation. **Power analysis**: no power analysis was performed. **Group Homogeneity**: N/A	**Control**: none **Intervention**: participants were stratified in four different groups for a one-day interactive educational program referred to as the "Skin Care Council Boot Camp" conducted in a simulation center of a local hospital. The educational training was conducted over a one-month period in which participants attended only one training. **Intervention Fidelity**: after enrollment, participants received a pretest, received the intervention, and a posttest three months after. Participants were assigned to	**Dependent variable (DV)**: PI knowledge **Measurement (reliability), time and procedure**: the study used the second version of the Pieper-Zulkowski Pressure Ulcer Knowledge Test (PZ-PUKT), a validated instrument with 72 items in three pressure injury categories (prevention/risk, staging, and wound description). This instrument is used to test nurses' knowledge on PI to design tailored	**Statistical Results**: Paired-sample T-test comparison revealed a statistical difference in the PI knowledge between the results of pretest and posttest ($p < 0.01$). The mean score of the pretest was 78.9 compared to 85.3 on the posttest. For the categories the PZ-PUKT test, there was a statistically significant improvement after the intervention ($p < 0.01$). mean differences were 4.6

			different camps based on the results of the pretest. Multiple modalities were used to facilitate the learning process.	educational intervention.	(t = 5.356), 4.1 (t = 3.668) and 10.5 (t = 7.938) for prevention/risk, staging, and wound description, respectively. **Conclusions**: the investigators concluded that Skin Care Council (SCC) participants' knowledge on PIs was increased using a targeted education program designed to support staff.
Citation: Edwards, H. E., Chang, A. M., Gibb, M., Finlayson, K. J., Parker, C., O'Reilly, M., McDowell, J., & Shuter, P. (2017). Reduced prevalence and severity of wounds following implementation of the Champions for Skin Integrity model to facilitate uptake of evidence-based practice in aged care. *Journal of Clinical Nursing*, *26*(23–24), 4276–4285. https://doi-org.proxy-hs.researchport.umd.edu/10.1111/jocn.13752					**Level and Quality III-B**
Purpose/ Hypothesis	**Type of Evidence Research Design**	**Sample – Population, Size, Setting**	**Intervention/Procedures**	**Primary Outcome/Measures**	**Results/Conclusions**
The purpose of this study was to examine the effectiveness of implementing a multi-faceted champions for skin integrity (CSI) model in	Research: longitudinal observational, pre/post design	**Sampling Technique**: Random sampling **Participants/setting**: residents in seven residential aged care facilities (RACFs) with 20 to 495 beds in metropolitan and rural of two states Australia	**Control**: no control **Intervention**: A Champions for Skin Integrity (CSI) team developed a multi-component CSI model of best evidence-based wound care and management. The components of intervention included appointment of unit	**Dependent variable (DV)**: prevalence of wounds, preventive strategies, and staff knowledge of evidence-based wound management. **Measurement (reliability), time and**	**Statistical Results** Chi-square revealed a statistically significant decrease in the proportion of any type of wounds in the post-implementation group (p = 0.04),

reducing the prevalence and severity of wounds		**Eligible**: all residents and staff involved in wound care management in the facilities **Accepted**: random selection of 200 residents in pre-implementation and 201 residents in post-implementation phases. **Staff**: 126 staff in pre-implementation phase and 143 in the post-implementation phase. **Control**: none **Intervention**: 201 residents and 143 staff. **Power analysis**: Not performed **Group Homogeneity**: N/A	champions, education and skill enhancement workshops, and wound specific education on pressure ulcer identification and staging and types of wounds. Skin integrity assessment and staff surveys were conducted pre-implementation and post-implementation phases. **Intervention Fidelity**: After prevalence and severity of wounds and assimilation of evidence-based practice of staff data was collected at baseline, implementation phase was initiated in sequences in each RACF. The research team introduced the CSI strategies in a one-week long visit where champions were appointed. One to one or group education and hands-on skills were performed. Ongoing audit and feedback were conducted.	**procedure**: no tools were used. Outcomes were measured using surveys. Data was collected at implementation phase and six months after implementation using observations and chart audits.	53% compared to 43% in the pre-implementation group. The prevalence of pressure injuries significantly decreased ($p < 0.001$), 10% post compared to 24% pre-implementation. T-tests revealed a significantly increase in the use of preventive strategies post-implementation ($p < 0.001$), 20% post versus 6% pre-implementation. There was an increase in skills and knowledge of EBP wound management in the post-implementation survey compared to the pre-implementation survey (46% pre versus 55% post)

					Conclusions: the research team concluded that using a multi-faceted approach compared to a single intervention to implement EBP strategies effectively improved EBP practices in wound management and the prevalence and severity of wounds.
Citation: Sving, E., Högman, M., Mamhidir, A. - G., & 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. https://doi.org/10.1111/iwj.12337					**Level and Quality II-B**
Purpose/ Hypothesis	**Type of Evidence Research Design**	**Sample – Population, Size, Setting**	**Intervention/Procedures**	**Primary Outcome/Measures**	**Results/Conclusions**
The purpose of this study was to examine if a multi-component, unit tailored intervention using evidence-based pressure ulcer prevention has an impact on the prevalence and	Research: quasi-experimental clustered pretest and posttest	**Sampling Technique**: convenience sampling **Setting**: three surgical and two medical units in a 344-bed general hospital from January 2012 to June 2013. Units had 18 to 26 beds, 22-32 registered nurses, and one to 11 nursing assistants **Eligible**: 506 patients, 169 nurses, and 39 nursing assistants.	**Control**: none. **Intervention**: the PARISH framework was used to create a multi-disciplinary team and develop the intervention. The team including two nurse champions and skin experts, who first identified the barriers to the evidence-based pressure ulcer prevention. The intervention consisted of an introduction	**DV**: pressure ulcer prevention and prevalence and nurses' knowledge and attitudes regarding pressure ulcer prevention. **Measurement (reliability), time and procedure**: 1. Pressure ulcer prevalence was assessed using	**Statistical Results** Logistic regression models were used. There was a statistically significant increase with pressure ulcer prevention at posttest survey ($p = 0.001$). prevention rates were 18% at posttest compared to 8% at pretest.

prevention of pressure ulcers and on nursing assistants and nurses' knowledge and attitudes regarding pressure ulcer prevention (PUP).		**Included**: patients 18 years of age and older admitted before midnight during pressure ulcer prevalence survey days. Nurses working on the units studied were all included. **Excluded pretest:** 19 patients denied (19) and had other reasons (34). Nurses did not participate (2) and no reasons (2). **Excluded Posttest:** patients denied (13) and had other reasons (44). Nurses did not participate (37) and excluded (2). **Accepted:** **Pretest**: 251 patients, 145 nurses **Posttest**: 255 patients, 130 nurses **Control:** None **Intervention**: 251 patients and 145 nurses. **Power analysis**: study required 22 patients at risk in each unit to reach a power of 80% and alpha of 0.05. power could not be met individually, so units were analyzed together to increase power of 80%.	(information to first-line manager), a 1-day training session for unit nurses and nursing assistants, and quality measurements and feedback. **Intervention Fidelity**: at the start of the study, the surveyors first obtained the permission from heads of departments and provided information to managers who then informed the nursing staff on the unit. At pretest, verbal and written information about the study were given, questionnaires were completed, then a one-day training session was offered to first-line managers followed by nurses in each unit. Quality measurements on prevention interventions and prevalence of pressure ulcers were collected monthly, analyzed, and shared with the first-line manager who provided feedback to the nursing staff monthly. At pretest survey, patients were given information	recommend method by the European Pressure Ulcer Advisory Panel (EPUAP). Risk assessments were measured using the Modified Norton Scale. Total score on the tool is 28. A score of 20 or less indicated a risk for developing pressure ulcers. 2. Pressure ulcer prevention was measured through chart reviews for documentation and observation at bedside. 3. Nurses' knowledge was assessed using a Knowledge Assessment Tool (PUKAT). Attitudes towards Pressure Ulcer Prevention (APuP) was used to assess attitudes. Posttest questionnaires and surveys were administered on the same day after training.	The use of multiple preventive interventions was significant at posttest compared to pretest ($p = 0.021$, 5.2% versus 1.6%). Risk assessment documentation within 24 hours of admission was also significant ($p = 0.008$, 52% versus 29% at pretest) Pressure ulcer prevalence decreased from 4 in 16 patients pretest survey to 0 in 15 patients posttest survey. There was a statistically significant increase in nurses' knowledge about pressure ulcer prevention ($p = 0.001$, 63% posttest versus 57% pretest). Attitudes' mean score was 90% in the pre- and post-intervention

		Group Homogeneity: N/A	about the study one day prior to data collection and consents were obtained.	Surveys of pressure ulcer prevalence was measured in two-week intervals on three different days.	**Conclusions:** the researchers concluded that the use of a multi-faceted approach or bundle at unit level was effective in preventing pressure ulcers and increased nurses' knowledge about pressure ulcer prevention strategies.
Citation: Tayyib, N., Coyer, F., & Lewis, P. A. (2015). A two-arm cluster randomized control trial to determine the effectiveness of a pressure ulcer prevention bundle for critically ill patients. *Journal of Nursing Scholarship*, *47*(3), 237–247. https://doi.org/10.1111/jnu.12136					**Level and Quality I-A**
Purpose/ Hypothesis	**Type of Evidence Research Design**	**Sample – Population, Size, Setting**	**Intervention/Procedures**	**Primary Outcome/Measures**	**Results/Conclusions**
The purpose of this research study was to examine the efficacy of pressure ulcer prevention in decreasing the incidence of pressure ulcers among patients in an intensive care unit in Saudi Arabia.	Research: two-arm cluster experimental randomized controlled trial	**Sampling Technique**: convenience sampling with randomization of research sites (A or B) **Setting**: intensive care units (ICUs) in two Saudi Arabian tertiary referral hospitals. # **Eligible**: 167 patients, 18 years or older admitted during the research period and expected to remain in	**Control (site B)**: received ICU standard skin care practices, which included no risk assessment scale of PUs, skin assessment per unit per policy, skin care using antiseptic soap containing 2% hydrogen peroxide, nutritional assessment on admission, repositioning every two hours per ICU policy, no policy on mobilization out of bed and use of lifting device and drawsheet, no documentation	**Dependent variable (DV)**: cumulative pressure ulcer (PU) incidence rate and differences in incidence rate between groups. Incidence rate refers to the number of new developed Pus. **Measurement (reliability), time and procedure**: no instrument was used. The DV was measured using the number of	**Statistical Results**: Log-rank and Cox proportional hazards analyses were performed to compare time to PU development between the groups determine the hazard ratio. PU prevention bundle implementation was associated with a delayed time to developing PU in the

		the ICU for greater than 24 hours. **#Excluded**: 27 patients with an existing PU, admitted < 24 hours, patients with burns, and patients admitted with hip fracture # **Accepted**: 140 # **Control**: 70 # **Intervention**: 70 **Power analysis**: sample size needed was 48 patients per group to meet 80% power and alpha of 0.5 and moderate effect size- power analysis was met. **Group Homogeneity**: intervention/control homogenous based on p values on table 2 for demographic and clinical characteristics of patients showing no significant differences	requirement, use of air mattresses, no ongoing nurses' education and training, and no policy on skin assessment under medical devices. **Intervention (site A):** Received the PU prevention bundle including: - risk assessment: Braden Scale completed and documented within 24 hours after admission -skin assessment: performed and documented within 4 hours of admission and every 8 hours continuously -skin care: daily bed baths with pH balanced cleanser and skin moisturizers -nutrition: assessment done on admission by nutritionist -repositioning: use of "turn clock" following a three hourly turning schedule, use of drawsheets and lifting devices -support surface: use of air mattresses -education and training provided to nurses on risk assessment tool and PU bundle	participants who acquired a new PU within a specified time period divided by the overall number of participants who were at risk for acquiring a pressure ulcer.	intervention compared to the control group. The Poisson regression model, used to compare the incidence rate ratio differences showed significant difference between the two groups. PU incidence was 7.4% (5 out of 70 patients) in the intervention and 32. 86% (23 out of 70 patients, $X^2 = 14.46$, $df = 1$, $p < 0.01$). **Conclusions**: The researchers concluded that the use of a pressure ulcer bundle is effective in reducing the incidence, severity, and number of pressure ulcer per patient. The researchers also concluded that

			-assessment of skin under medical devices every 12 hours. standard of care was modified to add PU prevention bundle. **Intervention Fidelity**: ICU Nurses were informed on PU prevention bundle via in-service at bedside, individually, or during meetings by the researcher. Two nurses conducted the skin assessments (research nurse and primary bedside nurse) within four hours upon admission and every eight hours thereafter. Endpoint of the research was guided by patient's death, discharge before 28 days and ICU stay greater than 28 days.		increased staff awareness about PU prevention interventions and training and education can contribute largely to patient care improvement.

Table 2

Evidence Synthesis

Category (Level Type)	Total Number of Sources/Level	Overall Quality Rating	Synthesis of Findings
Level 1 - Experimental study · Randomized Controlled Trial (RCT) · Systematic review of RCTs with or without meta-analysis	1	I-A	Tayyib, Cover, and Lewis (2015) found that using a pressure ulcer prevention bundle was effective in delaying the time to acquire a PU and in reducing the incidence of pressure ulcers in two ICU units. The PU incidence rate in the control group was 32.86% compared to 7.4% in the intervention group. The authors found out that components of the bundle such as admission skin assessment and documentation and education and training provided to nurses and PU were important interventions.
Level II · Quasi-experimental studies · Systematic review of a combination of RCTs and quasi-experimental studies, or quasi-experimental studies only, with or without meta-analysis	3	II-B II-C	Anderson et al. (2015) found that using a pressure ulcer bundle with the best evidence-based interventions and adding to a wound and ostomy care nurse (WOC) was effective in reducing unit-acquired pressure ulcers and nurses' adherence to the components of the bundle. Sving et al (2016) found that using a framework (PARISH) to implement a multi-faceted approach or bundle at the unit level was effective in reducing the prevalence and incidence of pressure ulcers. The authors also found that multi-faceted approach that staff training and education on preventive interventions increases compliance. Delmore et al. (2020) found that assessing and designing a learner-specific educational intervention was

			effective in increasing nurses' knowledge on pressure injuries. The authors also determined that targeted education should focus on enhancing nurse's knowledge about PIs on areas where knowledge is lacking.
Level III · Non-experimental study · Systematic review of a combination of RCTs, quasi-experimental, and non-experimental studies, or non-experimental studies only, with or without meta-analysis · Qualitative study or systematic review of qualitative studies with or without meta-synthesis	1	III-B	Edwards et al. (2017) found that using a multi-component Champions for Skin Integrity (CSI) model (appointing units skin champions, educating and training staff, and targeted wound education) was effective in reducing the prevalence and severity of wounds while increasing the use of preventive strategies and skills and knowledge on wound care management.
Level IV · Opinion of respected authorities and/or reports of nationally recognized expert committees/consensus panels based on scientific evidence	0	n/a	n/a
Level V · Evidence obtained from literature reviews, quality improvement, program evaluation, financial evaluation, or case reports · Opinion of nationally recognized expert(s) based on experiential evidence	1	V-B	This quality improvement project, Amon et al (2019) used a bundle approach that found that implementing a pressure injury prevention bundle program was effective in reducing HAPI incidence and prevalence rates to zero continuously for three years in a 32-bed medical-surgical unit. Three of the six interventions included a thorough skin assessment on admission and transfer by two RN nurses, nursing staff education on skin care, and unit skin champions The authors also concluded using an intervention bundle was more efficacious than a single intervention at preventing pressure injuries.
Recommendations Based on Evidence Synthesis: good and consistent to support the use of a tailored PIP bundle to prevent pressure injuries and reduce hospital-acquired pressure injuries (HAPIs).			

Table 3

Measures and Measurement Plan

PLAN		
Project Goals	Measure Pre-Implementation	Measure During Implementation
Structure Goal(s)		
1. Nurses (RN and LPN) will be educated on the PIP bundle	n/a	**Post-test questionnaire**: average score of the post-test questionnaire calculated in percentages
Process Goal(s)		
1. 80% of newly admitted patients will have a comprehensive skin assessment performed by two nurses within 4 hours of admission and documented with cosign in the EHR	**Numerator**: # of admissions who had a comprehensive skin assessment documented **Denominator**: # of admissions to the unit	**Numerator**: # of admitted patients who had a skin assessment done accurately by two nurses with EHR documentation **Denominator**: # of admitted patients to the unit
2. 80% of newly admitted patients will have the visual skin tool completed in the EHR	**Numerator**: # of newly admitted patients with completed visual skin tool in the EHR **Denominator**: total # of newly admitted patients to the unit	**Numerator**: # of newly admitted patients with completed visual skin tool in the EHR **Denominator**: # of admitted patients to the unit
Outcome Goal(s)		
1. Hospital acquired pressure injury (HAPI) rate will decrease by 25% over the three-month implementation period.	**Numerator:** number of admissions who developed new or worsening HAPIs **Denominator**: length of stay multiplied by 100.	**Numerator**: number of admissions who developed new or worsening HAPIs **Denominator**: length of stay multiplied by 100.

Figure 1

Fishbone Diagram of HAPIs on the Spinal Cord Injury Unit

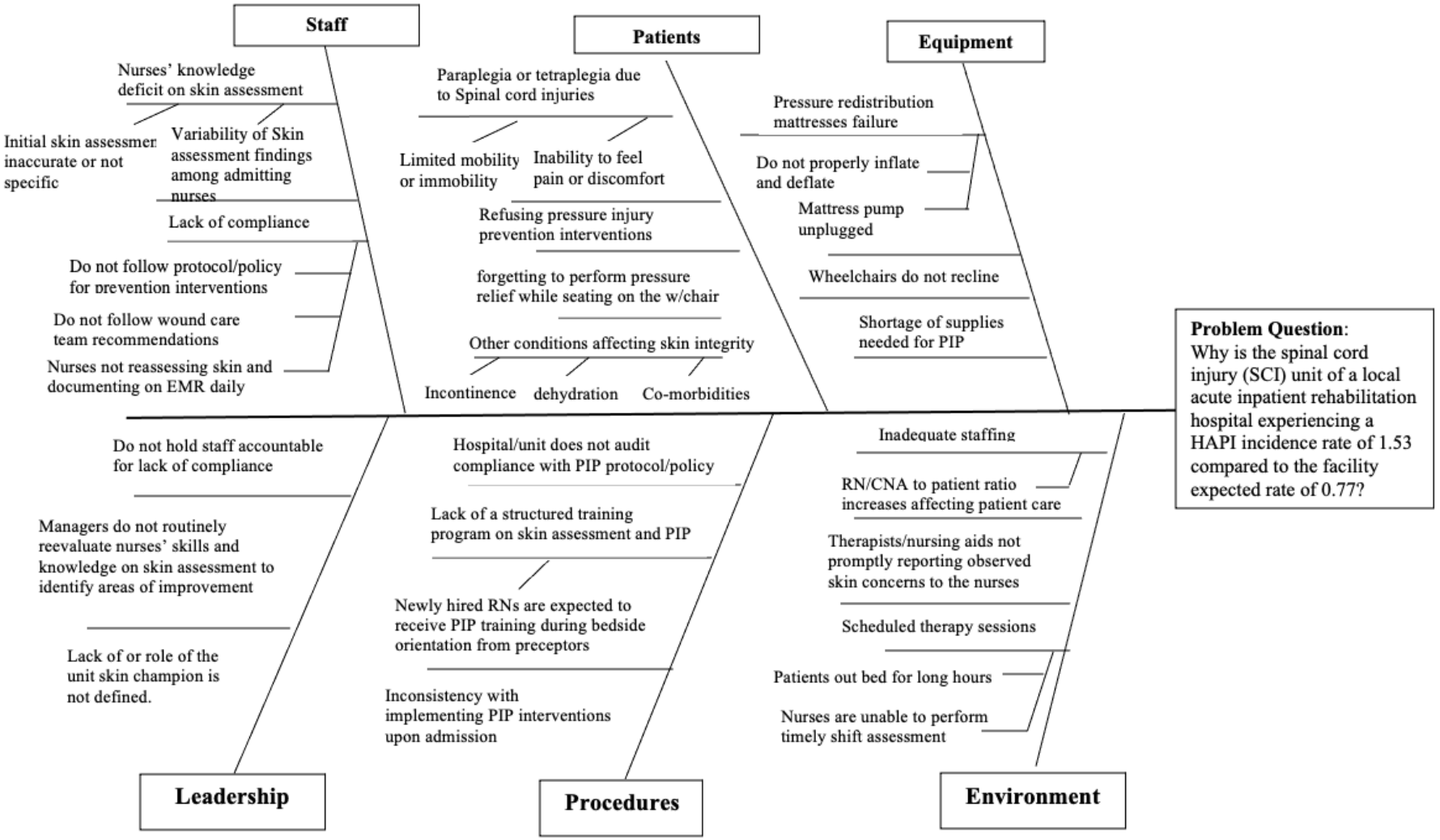


Figure 2

Knowledge to Action (KTA) Framework

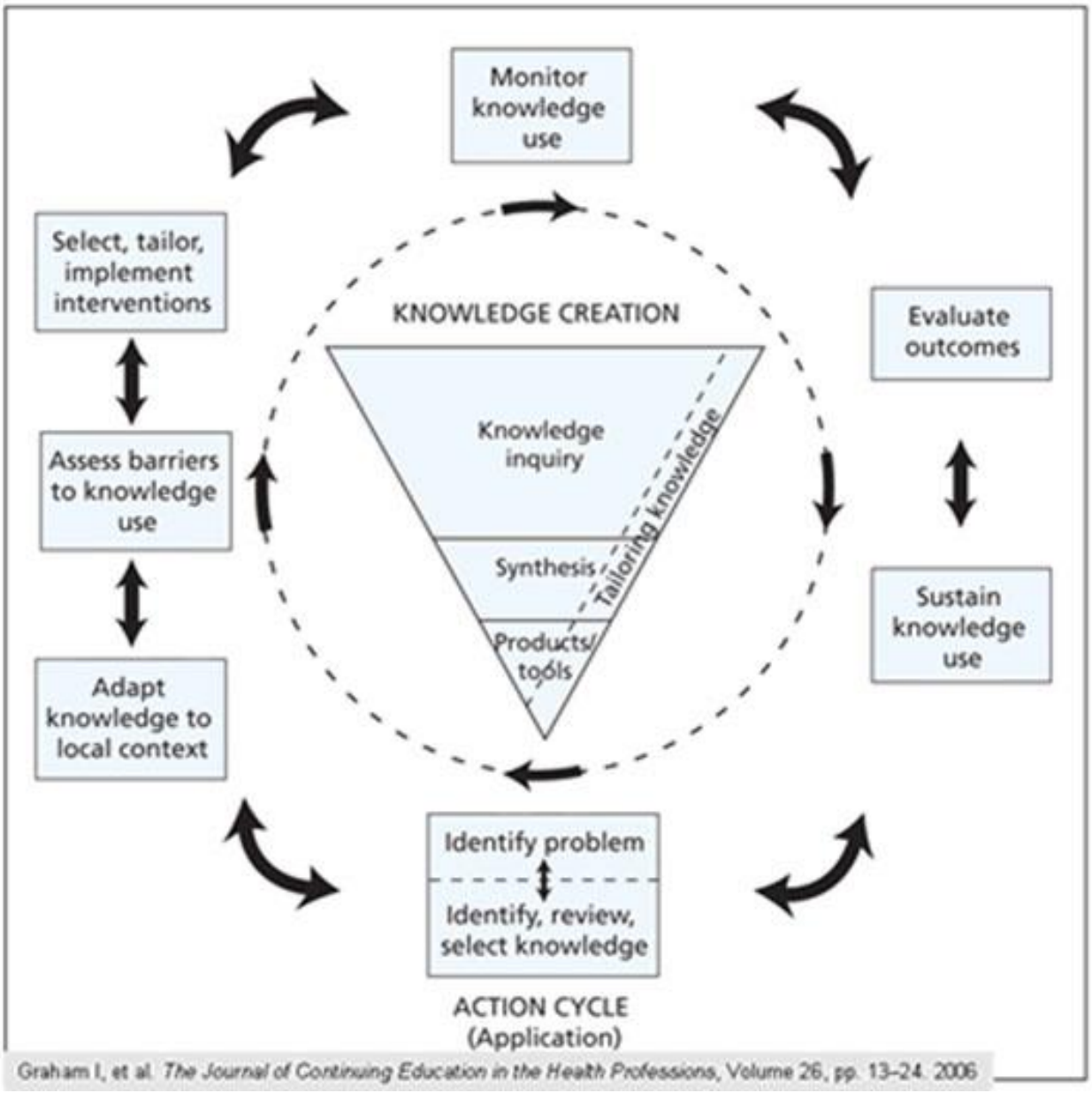


Figure 3

Desired Process Map of Admission Skin Assessment and Documentation

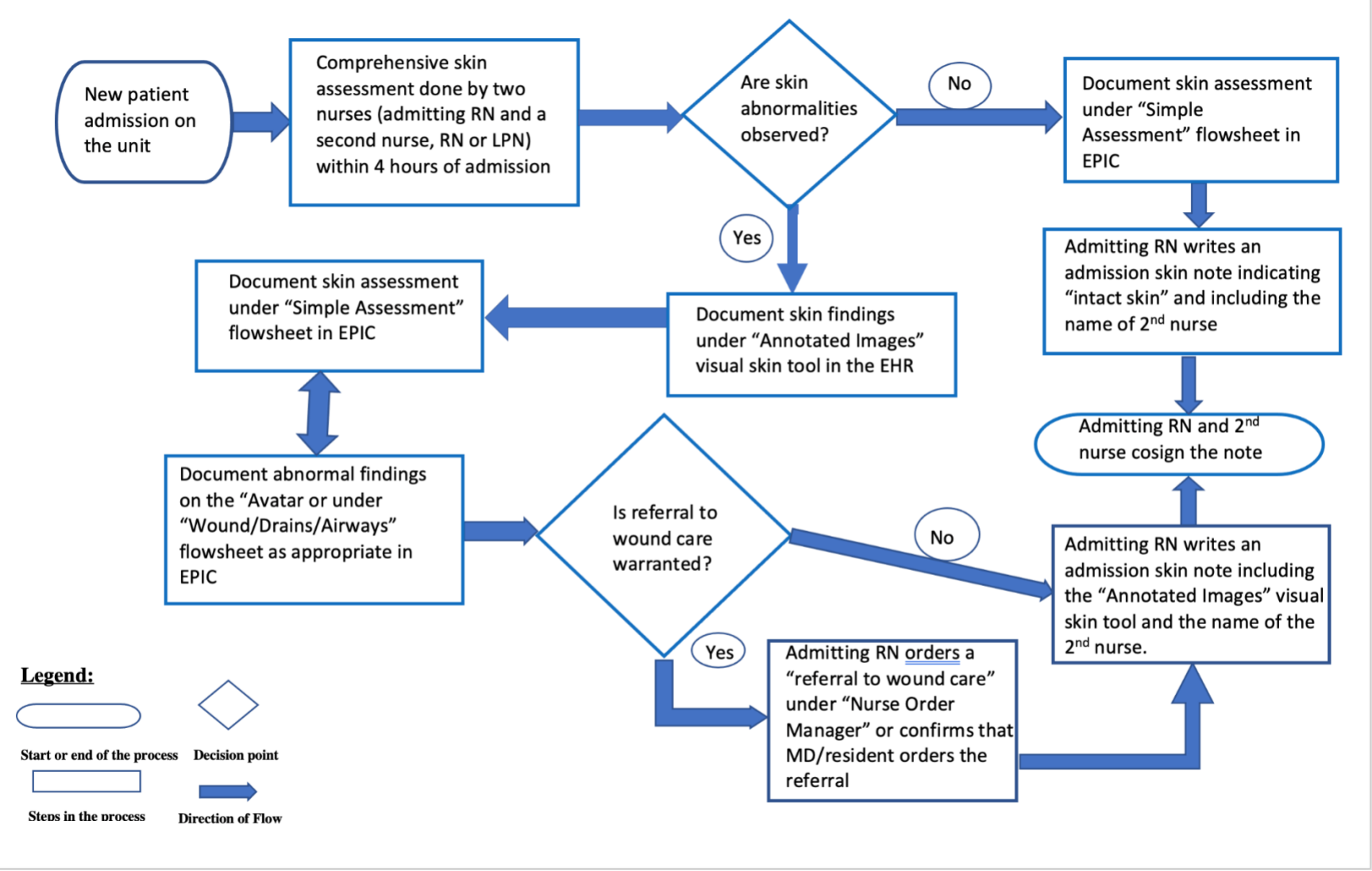


Figure 4

Run Chart: Overall HAPI Prevention Admission Bundle Compliance

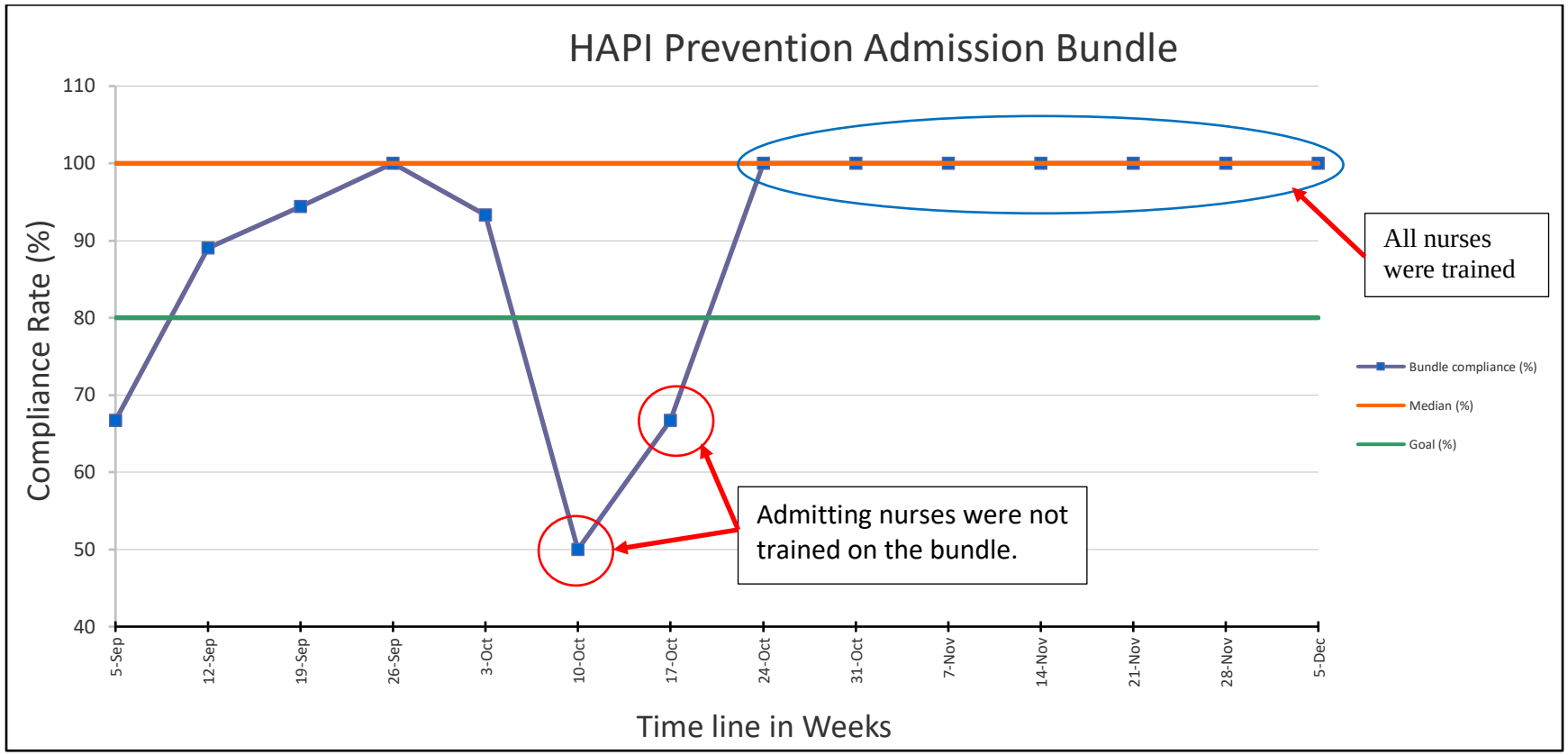


Figure 5

Run Chart: Compliance with Comprehensive Skin Assessment within 4 hours

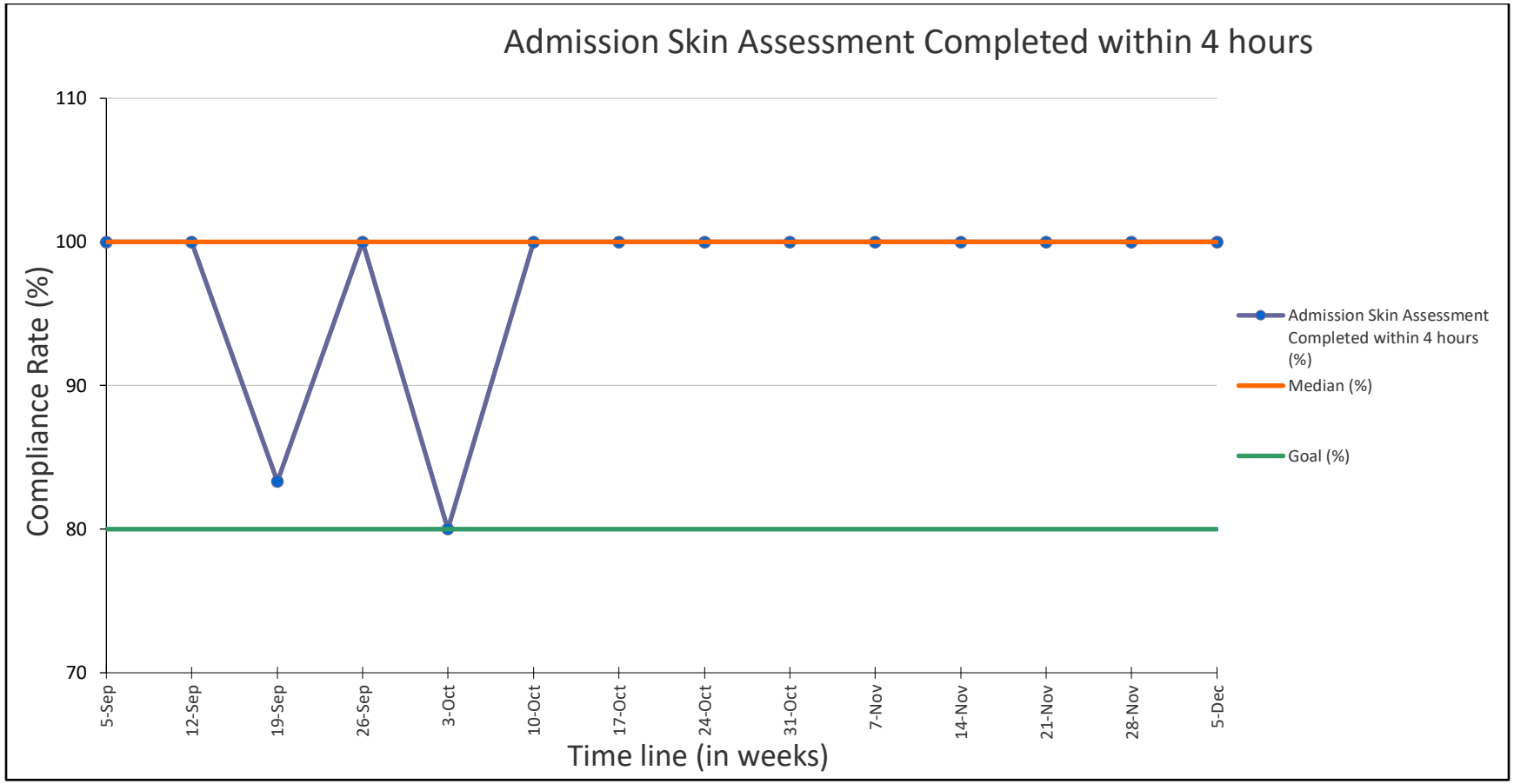


Figure 6

Run Chart: Compliance with Documentation on the Visual Skin Tool in the EHR

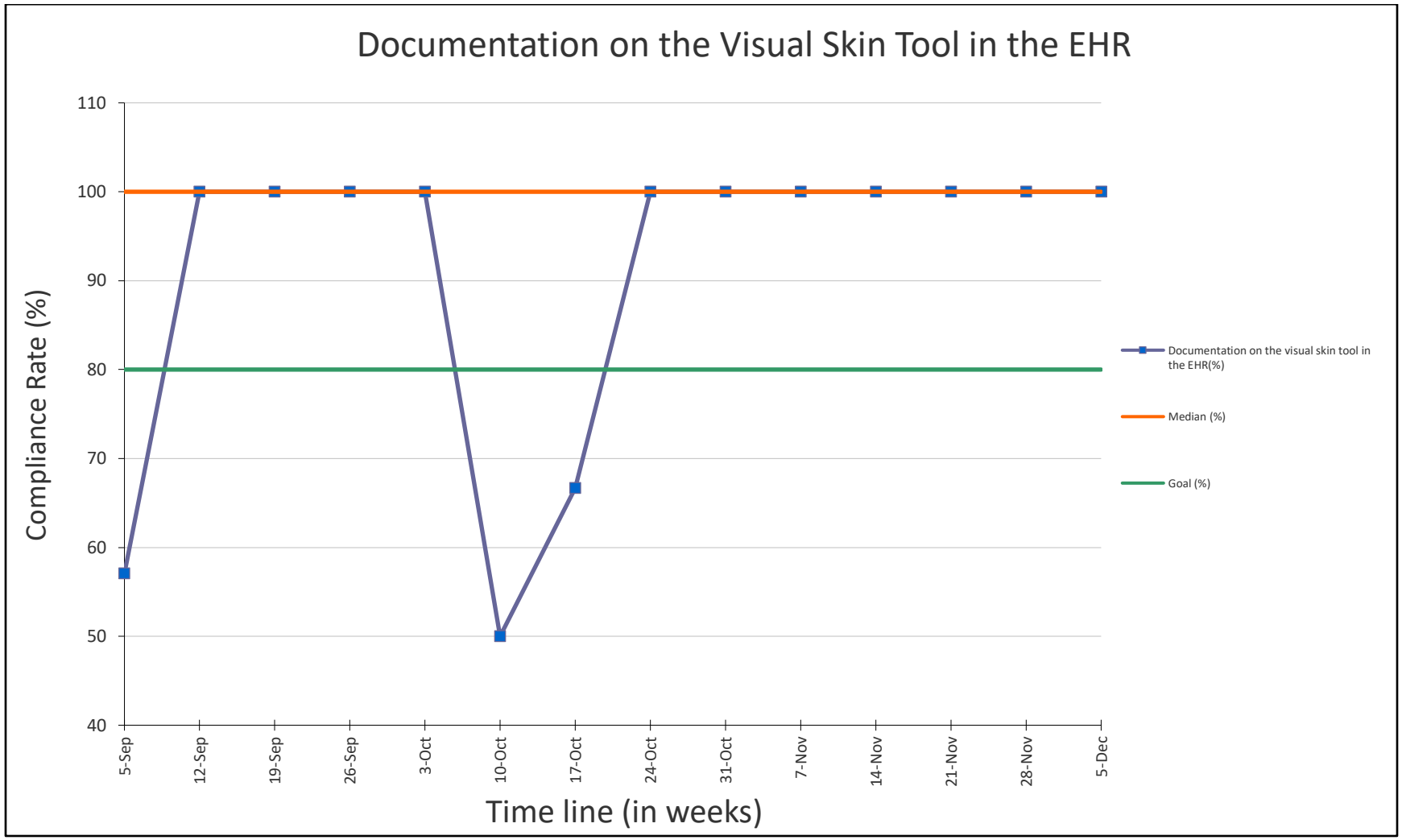
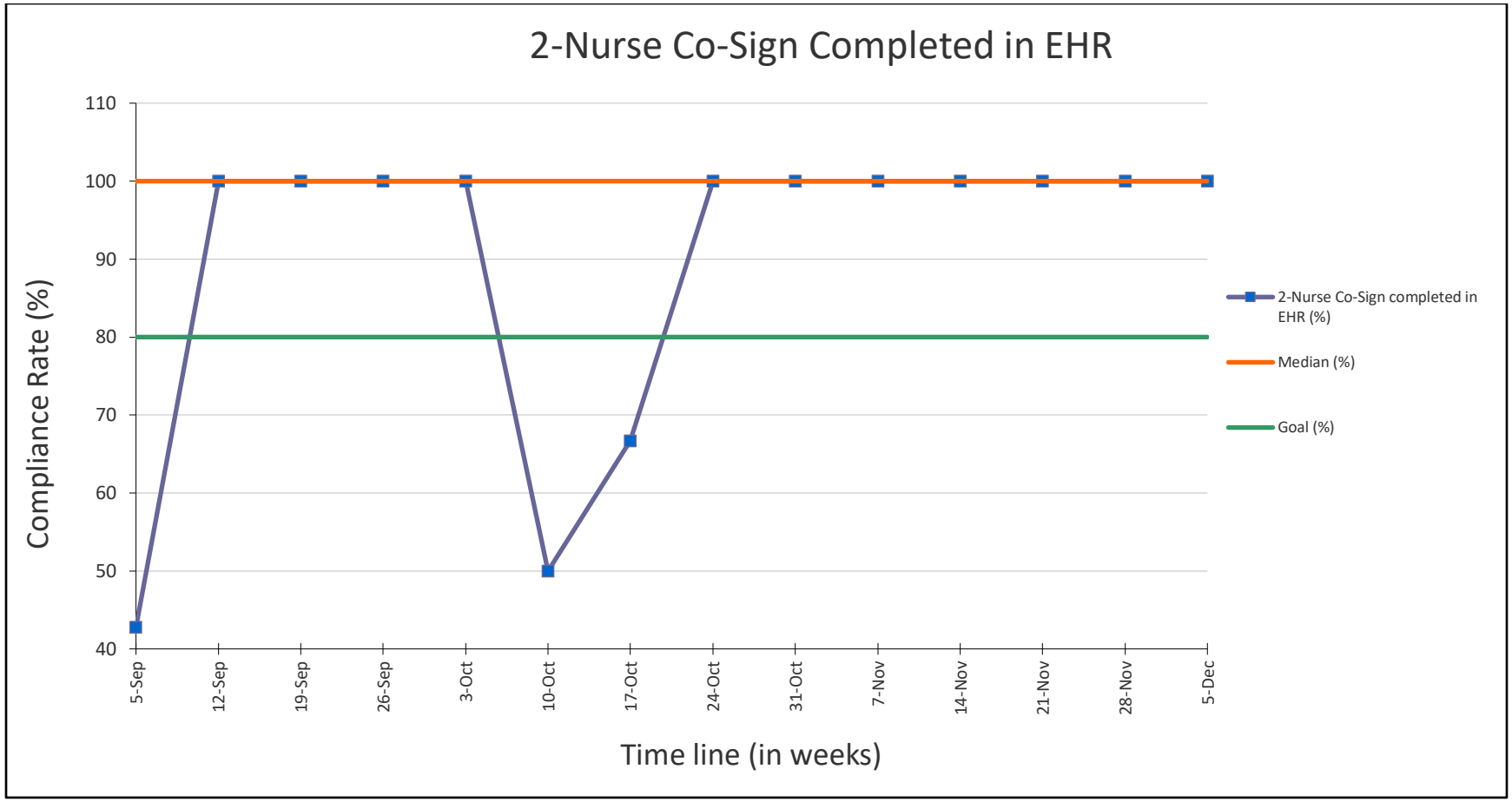


Figure 7

Run Chart: Compliance with 2-Nurse Co-Sign Completed in EHR



Appendix A

Education Lesson Plan

Learning Objectives	Content Outline	Method of Instruction	Time Spent	Method of Evaluation
The learner will be able to: 1. State the purpose and components of HAPI Prevention Admission Bundle 2. State the elements of a comprehensive skin assessment 3. Explain the use of the EHR skin tool and documentation process of skin findings 4. Describe the process of creating and co-signing a skin note in the EHR	1a. Purpose of HAPI Prevention Admission Bundle (HPAB) • The purpose of the HPAB is to reduce the HAPI rate on the SCI unit trough preventive measures on admission 1.b Components of HAPI Prevention Admission Bundle • Comprehensive skin assessment by two nurses within 4 hours of admission to the unit o Performing a comprehensive skin assessment with two nurses increases accuracy of skin findings (Amon et al., 2019) • Documentation of skin findings in the EHR skin tool • Documentation of a skin note co-signed by two nurses in EPIC 2. Elements of a comprehensive skin assessment during admission • A thorough skin assessment includes 5 components: color, temperature, integrity, moisture, and turgor • Each element needs to be assessed correctly to identify areas of the body at high risk of developing pressure injuries • Other important considerations during skin assessment: dark skin patients (examples with images) 3. Use and Documentation of skin findings on the visual skin tool • Documenting skin findings on the skin tool serves as a reference for skin conditions present on admission • Steps to access and document in the visual skin stool (using screenshots and demonstration on the computer) 4. Creating and co-signing the skin note • Step-by-step process using screenshots and demonstration on the EHR using a computer	Presentation, demonstration, and Q & A session	15-20 minutes	Post-test

Appendix B

HAPI Prevention Admission Bundle Education Sign Off Sheet

Date of Training	First and Last Name	Title (LPN, RN)	Primary shift Day/night

Appendix C

HAPI Prevention Admission Bundle Education Posttest Questionnaire

Instructions: Please do not write your name or employee ID number on this document

1. What are the elements of a correct comprehensive skin assessment?
    a. **Color, temperature, integrity, moisture, turgor**
    b. Temperature, density, color, moisture, turgor
    c. Color, temperature, Integrity, turgor, playability
    d. Temperature, integrity, moisture, turgor, porous
2. On the SCI unit, a comprehensive skin assessment on admission should be performed by:
    a. A nurse and a nursing assistant
    b. **An admitting nurse and a second nurse**
    c. An admitting nurse and a nursing assistant
    d. None of the above
3. When should a two-nurse skin assessment be performed with EHR cosign?
    a. When the admitting nurse is done assessing the patient
    b. Every 12 hours during day and night shifts
    c. **Within 4 hours of patient admission to the SCI unit**
    d. Once a day and as needed
4. When should the nurse initiate admission skin findings documentation on the visual skin tool or “annotated body image”?
    a. When discharging a patient
    b. **After performing a skin assessment on newly admitted patient**
    c. With the routine skin assessment every shift
    d. None of the above.
    e. All of the above
5. Staff education alone may reduce the incidence of pressure injury/ulcers.
    a. True
    b. **false**
6. When performing a skin condition check during admission, the nurse assesses which of the elements?
    a. Intactness
    b. Color
    c. Sensation
    d. Temperature
    e. **All of the above**
7. Early changes associated with pressure injury/ulcer development may be missed in persons with darker skin tones
    a. **True**
    b. false
8. Patients who are spinal cord injured need knowledge about pressure injury/ulcer prevention and self-care because pressure injury/ulcers are a lifelong concern for a person who is spinal cord injured.
    a. **True**

b. false

9. In this facility, who is the *primary* person accountable for patient skin assessment, pressure ulcer prevention, and documentation?
   A. Wound and ostomy care Nurse
   B. Nurse (RN or LPN)
   C. Nursing assistant
   D. All of the above
10. Within the electronic health record (EHR), where should an admitting nurse and a second nurse document completion of a 2-nurse skin assessment on admission?
    a. In the note section
    b. In the admission navigator
    c. In the care plan
    d. In the Education navigator
    e. In the wounds/Drains/Airways (WDA) flowsheet

Appendix D

HAPI Prevention Admission Bundle Audit Tool

Medical Record Number (MRN)	Date of patient admission (mm/dd/yy)	Time of patient admission	Admission Skin Assessment Completed within 4 hours Yes =1 /No = 0	Documentation on the visual skin tool in the EHR Yes =1 /No = 0	2-Nurse Co-Sign completed in EHR Yes =1/No = 0	Name of Admitting Nurse

Appendix E

HAPI Prevention Admission Bundle Resource Binder