

**Implementation of Pressure Injury Prevention Bundle in Surgical Intensive Care**

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A DNP Project Manuscript  
Submitted in Partial Fulfillment of the Requirements for the  
Doctor of Nursing Practice Degree

University of Maryland School of Nursing  
May, 2024

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### Abstract

**Problem:** In a 10-bed adult Surgical Intensive Care Unit (SICU) at an academic medical center, seven incidents of hospital-acquired pressure injury (HAPI) were recorded from January to December of 2022. The average pressure injury intervention and documentation compliance rate was 72.27% within the first 24 hours of admission, 69.17% with  $\geq 48$  hours of stay, and 68.76% for the entire stay. **Purpose:** The aim of the quality improvement (QI) was to implement a standardized pressure injury prevention intervention bundle (PIPB) and checklist to improve staff compliance with HAPI prevention strategies and documentation. **Methods:** The implementation was from August to December 2023. Participants included 14 registered nurses (RNs) and two certified nursing assistants (CNAs) who completed the education and training. RNs performed the Braden Scale Risk Assessment and skin inspection/assessment for all patients in the SICU on admission, every shift, and with any significant change in condition and documented details in the Skin Inspection/Assessment Note in the electronic health record (EHR). Patients with Braden scores of  $\leq 18$  received bundle interventions, which were recorded in the PIPB Checklist Audit Tool. Compliance was measured weekly over 14 weeks and analyzed using a run chart. **Results:** Data showed a consistently high compliance rate of 96.88% (n=1028) with skin inspection/assessment and documentation over 14 weeks. The PIPB intervention and checklist compliance of 90.05% (n=543) demonstrated the effectiveness of implementing the evidence-based intervention, strategies, and tactics. **Conclusion:** Implementing a standardized PIPB and checklist in SICU can increase staff compliance with HAPI prevention intervention and documentation practices for accurate assessment, intervention, monitoring, and early detection of pressure injuries.

*Keywords:* hospital-acquired pressure injury, care bundle, intensive care unit, compliance

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### **Implementation of Pressure Injury Prevention Bundle in Surgical Intensive Care**

Hospital-acquired pressure injuries (HAPI) are a significant issue in the United States (US). More than 2.5 million people in the US developed pressure injuries (*Preventing Pressure Ulcers in Hospitals*, 2012). A retrospective nationwide study found that between 2008 and 2012, there were an estimated 60,000 deaths from pressure injury complications each year, costing an estimated 26.8 billion dollars annually (Bauer et al., 2016 & Padula & Delarmente, 2019). Patients admitted to the intensive care units (ICUs) are two times more likely to develop HAPI than acute care patients. Increasing HAPI severity has been associated significantly with a greater risk of in-hospital mortality, hospital readmissions, and developing other hospital-acquired conditions, such as pneumonia, urinary tract infections, and venous thromboembolism (Wassel et al., 2020). In addition, pressure injury development among critical care patients dramatically impacts patients' functional recovery and quality of life. It interferes with the ability of family members and providers to render appropriate care to patients.

In a 10-bed academic surgical intensive care unit (SICU), the prevention and management of hospital-acquired pressure injury (HAPI) remains a challenge. In 2022, the SICU had seven incidences of HAPI. The compliance rates for pressure injury intervention and documentation were suboptimal: 72.27% within 24 hours of admission, 69.17% for more than 48 hours of length of stay (LOS), and 68.76% for the entire LOS. Root causes identified contributing to this problem include a lack of standardized interventions, poor documentation practices, inconsistent availability of supplies, inadequate education and training for staff, and the shortage of wound care nurses (Figure 1). Other leading causes include factors related to critical care patients, such as old age, multiple comorbidities, increased use of medical devices, hemodynamic instability, and use of vasoactive drugs.

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This quality improvement (QI) project aimed to implement an evidence-based standardized pressure injury prevention bundle (PIPB) interventions and checklist in a 10-bed SICU to improve staff compliance with HAPI prevention strategies and documentation. The PIPB is a set of evidence-based practices (EBPs) used to prevent HAPIs in at-risk patients (Braden score  $\leq 18$ ).

### **Available Knowledge**

A total of eight studies were selected and appraised in an evidence search and review conducted using scientific databases. The strength and quality of the existing evidence were evaluated based on the Johns Hopkins Evidence-Based Practice Model and Guidelines (Dang et al., 2022). Studies included were three systematic reviews, an observational prospective study design, a prospective interventional, descriptive cross-sectional survey, a pre-specified mixed methods process evaluation, and a quasi-experimental, pre- and post-intervention design (Table 1).

Patients in any ICU are at high risk for developing HAPI. Research supports the idea that implementing pressure injury prevention can reduce the number and severity of pressure injuries in critically ill patients (Alshahrani et al., 2021). Trisnaningtyas et al. (2021) showed that the PIPB of care decreased pressure injury incidents by 4.3%-36.2% in developed countries and 4.16%-25.72% in developing countries. The study by Zhang et al. (2021) also found a reduction in HAPI incidence by 29.5% within six months. These studies identified key core features of the PIPB, including risk assessment and ongoing skin assessment, skin hygiene, heel elevation, regular repositioning, nutrition, and education. Other interventions that supported the reduction of pressure injuries were surface support, early mobility, targeted medical device-related pressure injury prevention, and nursing expertise to support clinical practices.

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Tayyib et al. (2016a) and Zhang et al. (2021) conclude that implementing a PIPB has a beneficial effect on nurses' compliance with pressure injury prevention interventions. Study participants demonstrated high compliance towards the PU prevention bundle implementation (78.1%), with 100% participant acceptance (Tayyib et al., 2016a). Also, there was a significant effect on the time in the implementation compliance (Wilks Lambda=0.29,  $F(3, 8)=6.35$ ,  $p<0.016$ ), implying that registered nurses (RNs) needed time to become familiar with the bundle and routinely implement it into their practice. Zhang et al. (2021) showed that the compliance rate of nurses increased significantly from 55.15% to 60.15% before and after the implementation of the care bundle ( $\chi^2=16.72$ ,  $P=0.00$ ). These findings were attributed to the care bundle education and training for nurses and the audit during the intervention.

A systematic review by Lin et al. (2020) of multi-component pressure injury prevention programs found that these bundles effectively reduced pressure injuries in critical care units. Implementation strategies commonly used were education, audit and feedback, and standardizing documentation. Yilmazer and Tuzer's (2022) study showed a non-statistically significant reduction in the incidence of stage one pressure injury rate after implementing a care bundle. However, the study found that nurses complied with the pressure injury prevention care bundle three months post-implementation. Also, studies by Tayyib et al. (2016b) and Roberts et al. (2017) examined the nurses' attitudes and acceptance of the pressure injury prevention care bundle. Both studies found high recruitment and reach among RNs and individuals, indicating that participants are willing to engage with the intervention and promote EBP. Perceived barriers and facilitators provide essential information identifying context-specific factors that may influence implementing pressure injury prevention interventions in the ICU. In summary,

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evidence supports that implementing the PIPB improves nurses' compliance to support practice change and effectively reduces pressure injuries in the ICU (Table 2).

### **Rationale**

The implementation of the PIPB was guided by the Promoting Action on Research Implementation in Health Services (PARIHS) framework (Figure 2). The PARIHS framework had three dynamic elements (evidence, context, and facilitation) with simultaneous relationships (Kitson et al., 1998). A study by Sving et al. (2016) applied this framework to develop an intervention for pressure injury prevention, highlighting its utility in identifying important implementation areas and facilitating planning and evaluation processes. The PARIHS framework was applied in this project by integrating robust and scientifically relevant evidence, understanding the organizational context and readiness, and selecting appropriate facilitation strategies. Some of the strategies employed during the project implementation include providing comprehensive staff education and training, using the validated PIPB checklist, and recruiting unit champions to drive effective implementation efforts. The project's intervention was aligned with the principles of the PARIHS framework, creating a cohesive and structured approach that optimized the adoption and sustainability of the PIPB. This strategic utilization of theory provided a systematic framework for implementation and fostered a holistic understanding of the complex interplay between evidence, context, and facilitation in driving successful interventions.

### **Methods**

#### **Context**

This QI project occurred in an urban academic medical center with 124 licensed beds. The pilot unit is a 10-bed SICU that consists of 17 full-time and two part-time RNs, four attending physicians, four nurse practitioners, three CNAs, and a multidisciplinary team of

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professionals from various departments, including respiratory therapy, physical/occupational therapy (PT/OT), clinical nutrition, case management, social work, and wound care nursing. The SICU provides critical care for surgical patients recovering from ear, nose, and throat (ENT), general, neurological, orthopedic, orthopedic spine, thoracic, and vascular surgeries, and overflow patients from the medicine service. The medical center's electronic health record (EHR) was used for data collection.

The Preventing and Managing Wounds policy supports the current process of pressure injury prevention (Figure 3). All ICU patients are assessed using the Braden scale score tool to predict pressure injury risk. The original authors analyzed the tool's sensitivity and specificity in a clinical trial, with a sensitivity of 83% and specificity of 64% based on a Braden score of  $\leq 16$  (Bergstrom et al., 1987). Recent research has indicated that the Braden scale has moderate predictive validity, with a sensitivity of 89% and specificity of 28% (Wei et al., 2020). The assessment of the project site workflow revealed a gap in practice due to the lack of uniformity and standardization of the pressure injury prevention intervention. Also, annual staff competency does not cover this crucial topic, which is a part of clinical practice, including pressure injury identification and staging, assessment, documentation, intervention, reporting, and wound care consultation.

The presence of leadership provided the highest support and resources for the project. The Wound Care Nurse Specialist (WCNS) served as a subject matter expert. Another enabler identified in the cultural assessment includes the availability of supplies intended for pressure injury prevention. However, the nasogastric (NGT) tube holder, which was found unsafe to use, still needs to be replaced. Also, the approval for the nasal gel pad to be regularly stocked for the unit is still pending.

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To ensure patient safety and quality of care in preventing HAPI, continuous improvements are essential. Identifying areas for improvement and promptly addressing them can elevate patient outcomes and enhance overall care quality. Also, providing appropriate supplies is a crucial component of this process.

### **Intervention**

The QI project was conducted in a 10-bed SICU at an academic medical center. Approval of the QI project implementation was granted by the site. The 14 SICU RN participants completed the education and training. Additionally, two CNAs were included in the education to assist nurses with interventions. The implementation timeline was 15 weeks (from August 28, 2023 to December 11, 2023). The first week was dedicated to education and training on the bundle and checklist, and the remaining 14 weeks for implementation.

The intervention included the PIPB and checklist. The bundle utilized is a set of evidence-based practices used to prevent HAPIs in at-risk patients (Braden score  $\leq 18$ ). Components include risk assessment, skin/tissue assessment, preventative skin care, pressure redistribution, and nutrition management. This bundle and checklist were adapted from the Standardized Pressure Injury Prevention Protocol or SPIPP 2.0 checklist (Table 4). The SPIPP 2.0 checklist was based on the 2019 International Guideline on Prevention and Treatment of Pressure Ulcers/Injuries and received a high content validity index (CVI) of 0.93 (Pittman et al., 2023). Permission to use the tool was obtained from Dr. William Padula (Appendix A).

The intervention process followed a comprehensive approach (Figure 4). Upon admission, during every shift, and in the case of any significant changes in condition, registered nurses (RNs) conducted a thorough Braden Scale Risk Assessment along with skin inspection and assessment for all SICU patients. The details were documented in the Skin

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Inspection/Assessment Note in the CPRS. Patients with a documented Braden score of 18 or less were provided with bundle intervention. The Prevention Bundle Checklist Audit Tool (Appendix B) was utilized as a reference guide and auditing tool since it is not integrated within the EHR system. The Prevention Bundle Checklist Audit Tool content was adapted from the SPIPP 2.0 checklist and consists of the evidence-based pressure injury preventive actions to implement at the bedside. To ensure compliance with the PIPB interventions, RNs completed the Pressure PIPB Checklist Audit Tool by choosing a URL link or a QR code created from Research Electronic Data Capture (REDCap), a HIPAA-compliant, password-protected software. This audit tool allowed RNs to check if all the necessary interventions were performed to prevent pressure injuries.

Strategies and tactics employed during the project implementation include recruiting unit champions, providing staff education and training on bundle and checklist, establishing designated supplies logistics, managing daily supplies inventory, providing oversight of the project 2-3 times a week, facilitating staff feedback, communication, and re-education, implementing incentives and recognition, reinforcing reminders and coaching, and setting up QR code and URL for quick access to the bundle checklist tool.

### **Measures/Study of the Intervention**

To monitor the progress and effectiveness of the intervention, data collection and analysis of measures were performed every week for a period of 14 weeks (Table 3). Two key structure measures were used, which included staff education and training (calculated as the number of RNs who received education about the bundle in person, divided by the total number of participants (RNs)). The second key structure measure was the daily supplies inventory (calculated as the number of daily supplies in stock and ready for use, divided by the total

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expected supplies). The Weekly Skin Inspection/Assessment Note documentation was recorded in the EHR system, and PIPB audit was performed through a generated QR code or URL link on REDCap. The data was tracked using a run chart. The process measure was calculated as the number of completed Skin Inspection/Assessment Notes per week divided by the total number of weekly Skin Inspection/Assessment Notes. The outcome measure was determined as the number of completed PIPB checklists for patients with a Braden score of  $\leq 18$  per week, divided by the total number of patients with a Braden score of  $\leq 18$  per week.

### **Ethical Considerations**

The Non-human Subject's Research determination from the Human Research Protections Office (HRPO) of the University of Maryland School of Medicine (UMSOM) Institutional Review Board (IRB) and the project site was obtained before project implementation. Measures to protect the privacy and confidentiality of staff and patients were employed. Data for RNs and CNAs were collected in an aggregated and completely anonymous manner. Patients' identifiers were stored securely in REDCap for audit purposes only and were not included in the aggregated data. The Skin Assessment Notes in the EHR were reviewed, and data were collected privately within the unit. Only the QI project lead (QI-PL) and faculty advisor could access the data. Patient information was not used in data analysis. There was a potential conflict due to the QI-PL's employment at the project site. Before project implementation, the QI-PL completed the Rules for Employees Dual Training Status agreement and Privacy and Mandatory Training.

### **Results**

This QI project aimed to implement PIPB in SICU to enhance staff knowledge and compliance with HAPI prevention strategies and documentation. Before the project's launch on September 4, 2023, all SICU participants were scheduled to receive education and training on

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PIPB and the checklist. During the first week, 81.25% (n=13) of staff received training; by the third week, all 16 staff members were trained (Figure 5). However, some staff members required additional training time, which caused the project to fall short of its goal of 100% staff training by the Go-live date. Project participants received training during work hours, either individually or in groups. The remaining three staff members who missed the first week of training were able to complete the training by the second week.

During the implementation process, it was essential to ensure that adequate supplies were consistently and readily available to support compliance with PIPB intervention and prevent delays in patient care. While some supplies were available in the facility, not all were part of the unit stock. To address this, the unit nurse manager designated a specific area for the supplies several weeks before the project launch. Also, the quantity and inventory of the supplies were coordinated with the Supply Chain Management Department (SCMD). A QR code generated from REDCap was utilized to track the daily inventory of supplies, and the data were aggregated weekly in a run chart. The data revealed fluctuations (Figure 6), with the highest in week ten (100%) and the lowest in week five (75%). After week five, the NGT holder was removed from the inventory due to safety concerns. RNs reported that the NGT holder was not staying in place, and the NGT was getting dislodged quickly. The QI-PL communicated this issue with leadership, WCNS, and SCMD. The SICU was consistently stocked, except for the nasal gel pad. The nasal gel pad is only available for the Respiratory Department and is awaiting approval to be part of SICU's stock. Three runs were observed, with one falling on the lower limit and the latter two on the upper limit. The data suggested increased Periodic Automatic Replacement (PAR) levels or supplies stocked in the unit.

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No trends or shifts observed in the process and outcome data over 14 weeks. Despite this, there was a 29.12% improvement in skin inspection/assessment and documentation. Compliance rates remained consistently high, averaging 96.88% based on the 1028 Skin Inspection/Assessment Notes reviewed (Figure 7). The effectiveness of the project, strategies, and tactics was further demonstrated by the PIPB intervention and bundle checklist, which achieved a compliance rate of 90.05% based on the 543 notes with a Braden score of  $\leq 18$  reviewed. Weeks eight and nine were noted to have the lowest compliance rate (75%) (Figure 8).

Five runs were observed in the process and outcome data, indicating no special cause existed in the PIPB implementation process. Although the run charts had 10 and 12 useful observations (Figure 7 and Figure 8, respectively), these may not provide a complete analysis of the intervention's effectiveness. Additional data is necessary to fully understand the impact of the intervention on RNs' compliance with the PIPB and documentation.

The project had both positive and negative unintended consequences. Leadership support, evidence-based guideline, and staff education were positive factors, while workflow challenges (time constraints and high patient acuity), lack of integration of the PIPB checklist in the EHR, and inconsistent bedside handoff posed hurdles for sustained compliance rates. Individualized feedback highlighted the importance of staff completing the audit tool. Several resources and tools were developed during implementation to facilitate compliance, including the intervention process guide (Figure 9), which was placed in the education binder and staff lounge. Reminder tools were created based on staff feedback. The laminated visual prompts of the PIPB process (Figure 10) were placed on each work computer in the unit. The "HAPI Hour" (Figure 11), a fun and motivating text message reminder for RNs to complete appropriate PIPB interventions and documentation during a specific hour of their shift, was introduced, ensuring the timely

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completion of necessary tasks. Staff were re-educated either individually or during change of shift huddle. The WCNS also provided an in-service for staff on pressure injury and management. Another positive reinforcement was providing staff with recognition and incentives (i.e., penlights, ID badge holders, and snacks). The project did not impose added costs on the unit.

### **Discussion**

The QI project focused on enhancing compliance with pressure injury prevention practices (intervention and documentation) in SICU through the implementation of a Pressure Injury Prevention Bundle. Although the 100% compliance goal was not achieved, the initiative was deemed successful, attributed to the dedication of the staff, strong leadership support, and collaboration with the wound care nurse specialist. This led to improved staff understanding of best practices, increased compliance with pressure injury prevention measures, and enhanced documentation accuracy. The project resulted in improved patient outcomes, a culture of excellence within the SICU, and promotion of practice standardization and professional development. The dissemination of project information through various platforms underscored the project's impact on promoting best practices and accountability within the organization.

To ensure long-term success, the project lead, WCNS, and leadership will continue disseminating the results to the site's nursing councils and executive leadership, providing ongoing education and support to staff, consulting nursing informatics about integrating checklist documentation into EHR and conducting regular audits for continuous improvement. Supplies and logistics will be maintained to ensure the smooth functioning of the project. These efforts aim to sustain the improvements and spread the project's success across other facilities within the network.

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The project results align with findings from previous research studies, indicating that implementing pressure injury prevention strategies, such as the PIPB, can significantly reduce the incidence and severity of pressure injuries in critically ill patients (Alshahrani et al., 2021; Trisnaningtyas et al., 2021; Zhang et al., 2021). Key features of successful PIPBs include risk assessment, ongoing skin assessment, skin hygiene, heel elevation, regular repositioning, and education (Alshahrani et al., 2021; Trisnaningtyas et al., 2021; Zhang et al., 2021). Implementing the PIPB impacts nurses' compliance with pressure injury prevention interventions, leading to decreased pressure injury rates (Tayyib et al., 2016a; Zhang et al., 2021). Multi-component pressure injury prevention programs, incorporating education, audit, feedback, and standardizing documentation, have effectively reduced pressure injuries in critical care units (Lin et al., 2020; Yilmazer & Tuzer, 2022). It is important to note that while the project demonstrated significant improvements in skin inspection/assessment and documentation, the limited scope of the SICU and a smaller number of participants may impact the generalizability of the findings compared to broader studies across various ICUs (Tayyib et al., 2016b; Roberts et al., 2017).

The observed outcomes of the project were influenced by factors such as the short implementation period and simultaneous ongoing initiatives. These factors may have impacted the project's outcomes and limited the ability to assess long-term sustainability. Efforts were made to minimize bias, including understanding root causes, embedding interventions within site operations, ensuring data integrity, and receiving leadership support.

Lessons learned from the QI project implementation emphasize the importance of understanding root causes, integrating interventions effectively, maintaining data integrity, and garnering leadership support for successful project outcomes. Recommendations include

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extending the project duration, expanding the scope to other units, and addressing ongoing initiatives to enhance the project's impact and sustainability.

### **Conclusion**

This QI project supports the feasibility of implementing a standardized PIPB and checklist in the SICU to improve staff compliance with HAPI prevention interventions and documentation practices. The implications for practice highlight the importance of adhering to skin inspection/assessment, bundle interventions, and documentation for early detection and prevention of pressure injuries and related complications. This promotes patient safety, practice standardization, professional development, and accountability.

The project's next steps include monitoring its impact on reducing HAPI incidence and cost savings. Other plans include partnering with logistics and WCNS to incorporate technology into HAPI prevention strategies. This will help continuously evaluate the interventions' effectiveness and provide guidance for further improvements.

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## PRESSURE INJURY PREVENTION BUNDLE

**Table 1***Evidence Review Table*

<p><b>Citation #1:</b> Alshahrani, B., Sim, J., &amp; Middleton, R. (2021). Nursing interventions for pressure injury prevention among critically ill patients: A systematic review. <i>Journal of clinical nursing</i>, 30(15-16), 2151–2168. <a href="https://doi.org/10.1111/jocn.15709">https://doi.org/10.1111/jocn.15709</a></p> <p><b>Level and Quality: II-B</b>          - Based on a comprehensive literature review, this systematic review has good and consistent results and recommendations for practice change.</p>					
Purpose or Hypothesis	Type of Evidence and Research Design	Sample (population, size, setting)	Intervention Procedures	Primary Outcome/Measures	Results Conclusions
To systemically synthesize the evidence on the most effective nursing interventions to prevent pressure injuries among critical care patients.	Systematic review	<p><b>Search Strategy:</b> The search was conducted in four databases: Cumulative Index to Nursing and Allied Health (CINAHL), MEDLINE, Web of Science, and Scopus. The search terms included: nurs* AND “pressure ulcer” (OR) “pressure injury” (OR) “bed sore*” (OR) “decubitus ulcer” (OR) “pressure sore” AND “intensive care” (OR) “critical care” (OR) ICU (OR) “high depend*”. An asterisk (*) wildcard symbol was added to certain search phrases to ensure more</p>	<p><b>Control:</b> Controls varied between studies (assessment, PI bundle interventions, education and staff training)</p> <p><b>Intervention:</b> The interventions used to prevent PIs in included studies have been analyzed and reported by intervention type. Interventions included PI prevention bundles, repositioning, prevention of medical device-related pressure injuries (MDRPis) and the use of nursing expertise to support care practices.</p>	<p><b>Dependent Variable (DV):</b> Incidence of pressure injury</p> <p><b>DV Measure:</b>            1. Primary outcome measurement: Development of pressure injury (PI) through identification and staging of pressure injury            2. Secondary outcome measurement: Risk assessment (multiple risk assessment tools were used in the studies, but Braden scale was the tool most commonly used)</p>	<p><b>Statistical Results:</b> Not all studies provide statistical results</p> <p><b>Conclusions:</b> Nurses are well qualified to lead in the prevention of pressure injuries in critical care units. Every critically ill patient requires interventions to prevent pressure injuries, and the prevention of PIs should be considered a complex intervention. Nurses must plan and implement evidence-based care to prevent all types of pressure injuries, including medical device-related pressure injuries. Education and training programs for nurses on PI prevention can minimize practice variations improves nurses’ compliance with preventive initiatives, and may help determine the standard of practice.</p>

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		<p>comprehensive identification of the relevant studies. The search for sources was completed in February 2020.</p> <p><b>Accepted:</b> 14 studies were included and reviewed based on whether they (a) were primary research conducted in critical care/ICU settings, (b) examined nursing interventions, nursing skills or nurses' knowledge or attitudes, towards PI prevention, (c) measured PI development as the primary outcome.</p> <p><b>Excluded:</b> 2352 studies were excluded due to duplicate studies, not in full text, and full-text articles with the following reasons: only assessed nurses' knowledge, attitude, and skills; PIs were not examined as outcomes; quality improvement projects.</p> <p><b>Controls and intervention groups:</b> Varied in different studies.</p>			
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		<b>Power analysis:</b> Not applicable			
<p><b>Citation #2:</b> Lin, F., Wu, Z., Song, B., Coyer, F., &amp; Chaboyer, W. (2020). The effectiveness of multicomponent pressure injury prevention programs in adult intensive care patients: A systematic review. <i>International journal of nursing studies</i>, 102, 103483. <a href="https://doi.org/10.1016/j.ijnurstu.2019.103483">https://doi.org/10.1016/j.ijnurstu.2019.103483</a></p> <p><b>Level and Quality: III-B</b>        - Based on a comprehensive literature review, this systematic review contains good and consistent results and recommendations for practice change.</p>					
<b>Purpose or Hypothesis</b>	<b>Type of Evidence and Research Design</b>	<b>Sample (population, size, setting)</b>	<b>Intervention Procedures</b>	<b>Primary Outcome/Measures</b>	<b>Results Conclusions</b>
<p>This systematic review evaluated the effectiveness of pressure injury prevention programs in reducing pressure injury prevalence and incidence in the adult intensive care population. It also critically appraised the program components and strategies used to implement these programs.</p>	<p>Systematic review</p>	<p><b>Search Strategy:</b> A search strategy was developed by the author team in consultation with an experienced health librarian. A comprehensive literature search was conducted by searching databases including PubMed (NCBI platform), EMBASE (embase.com), Medical Literature Analysis and Retrieval System Online (MEDLINE) (Ovid), Cumulative Index to Nursing and Allied Health Literature (CINAHL) (EBSCOhost), and Cochrane Library databases for studies published in English from the year of 2000</p>	<p><b>Control:</b> Varied between studies.</p> <p><b>Intervention:</b> Pressure injury programs and components were different, ranging from 2-11 components. Components of pressure injury prevention programs included: clarification of staff roles/introducing new roles dedicated to pressure injury prevention, repositioning/positioning of patients' pressure areas, staff and patient education, support surfaces use, pressure injury risk assessment, skin assessments, nutrition needs assessment, documentation, multi-disciplinary team involvement, and mobilization. Ten QI projects and seven research studies implemented a multicomponent pressure injury prevention program. Two research studies and one QI project implemented a multicomponent education</p>	<p><b>DV:</b> Pressure injury incidence and prevalence, compliance with intervention, patients' hospital and ICU length of stay, and cost of treating pressure injuries.</p> <p><b>DV measures:</b></p> <ol style="list-style-type: none"> <li>1. Patient outcome           <ol style="list-style-type: none"> <li>a. incidence</li> <li>b. prevalence</li> <li>c. pressure injury stages</li> </ol> </li> <li>2. Care process outcome           <ol style="list-style-type: none"> <li>a. compliance to intervention protocol</li> <li>b. staff and patient satisfaction rate and participation rates</li> </ol> </li> <li>3. Organizational outcomes           <ol style="list-style-type: none"> <li>a. patient ICU LOS</li> <li>b. patients' hospital LOS</li> </ol> </li> </ol>	<p><b>Results:</b> Five of the eight research studies and one of the quality improvement projects reported significant decrease in pressure injury prevalence, and/or increase in compliance to pressure injury prevention protocols and strategies. Two quality improvement papers reported cost savings of \$1 million and £2.6 million respectively after the implementation of the programs.</p> <p><b>Conclusions:</b> Positive outcomes and strong theoretical rationales for the components in the programs suggest that they are beneficial.</p>

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		<p>to May 2018. Search terms included “pressure ulcer”, “pressure injury”, “decubitus ulcer”, “bed sore”, “pressure sore”, “prevention”, “program”, “bundle”, “multi-component”, “complex intervention”, “ICU”, “intensive care”, “intensive care unit”, “critical care”, “intensive therapy”, and “adult”. Searches were performed using medical subject headings, key words, and free text words depending on the database. Alternative spelling and synonyms were combined using Boolean “OR” and main terms were combined using Boolean “AND”. Reference lists of included articles were searched for other potential articles.</p> <p><b>Sampling technique:</b> Varied between studies.</p> <p><b>Sample size:</b> Varied in these studies from 78 to 399 patients with a median of 202</p>	<p>program with skin assessment, pressure injury risk assessment, repositioning, and support surfaces as subcomponents. One QI project implemented a multicomponent early mobility program, with pressure injury prevention intervention as its subcomponent.</p>	<p>c. cost to treat pressure injuries</p>	
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		<p><b>Control:</b> Not all studies have control groups</p> <p><b>Intervention:</b> Not all studies have intervention group</p> <p><b>Setting:</b> Research studies were conducted in various types of ICUs including medical, surgical, neurological, trauma, cardiac, or mixed ICUs. Quality improvement projects (n=12) were conducted in United Arab Emirates, Australia, United Kingdom and United States. Other research studies (n=9) were done in Saudi Arabia, Brazil, Turkey, Argentina, US.</p> <p><b>Excluded:</b> Total of 1,479 articles were excluded for this systematic review because of the following reasons: not conducted in the ICU, not a multicomponent intervention, not published in English, conference abstract,</p>			
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## PRESSURE INJURY PREVENTION BUNDLE

		poster presentation and an article review. <b>Accepted:</b> 21 articles (12 quality improvement projects and 9 research studies)			
<p><b>Citation #3:</b> Roberts, S., McInnes, E., Bucknall, T., Wallis, M., Banks, M., &amp; Chaboyer, W. (2017). Process evaluation of a cluster-randomised trial testing a pressure ulcer prevention care bundle: a mixed-methods study. <i>Implementation science : IS</i>, 12(1), 18. <a href="https://doi.org/10.1186/s13012-017-0547-2">https://doi.org/10.1186/s13012-017-0547-2</a></p> <p><b>Level and Quality: III-B</b> -Overall body of evidence has good quality and consistent results.</p>					
Purpose or Hypothesis	Type of Evidence and Research Design	Sample (population, size, setting)	Intervention Procedures	Primary Outcome/Measures	Results Conclusions
The aim of this study was to evaluate the processes underpinning implementation of the pressure ulcer prevention care bundle (PUPCB) and patient and staff perceptions of the bundle in order to give a deeper understanding of the effects of the intervention	Research: Pre-specified mixed-methods process evaluation	<p><b>Sampling technique:</b> Cluster random sampling and convenience sampling</p> <p><b>Sample:</b> Participants included patients and nurses on study wards at intervention sites, but some data (such as recruitment data) was also collected on patients at control sites.</p> <p><b>Setting:</b> 8 Australian hospitals</p>	<p><b>Control:</b> Not applicable</p> <p><b>Intervention:</b> 1. The cluster-level intervention involved information sessions delivered to nursing staff on study wards, who were given education and training around pressure ulcer prevention (PUP), the PUPCB, and partnering with patients in PUP care. Formal in-services lasted 15–30 min and were delivered by the site Chief Investigator or a research assistant at each study site.</p>	<p><b>DV:</b> Patients, nurses, and hospitals willingness to accept and engage with pressure ulcer prevention care bundle</p> <p><b>DV measurement:</b> Quantitative data were collected prior to and during intervention. Qualitative data were collected post-intervention. Intervention delivery to patients (i.e. components of the PUPCB delivered and time spent with patients) were analyzed descriptively. Chi-squared tests and one-way analysis of variance (ANOVA) tests were used to determine any differences in intervention delivery between sites. The effects of intervention dose on main trial findings were also analyzed at the individual patient level using chi-squared tests (i.e. number of intervention components delivered) and one-way ANOVA tests (i.e. time</p>	<p><b>Results:</b> PU occurred in 6.1% of intervention and 10.5% of control patients, and PU incidence was 9.6 and 20.1 per 1000 person-days in the intervention and control groups, respectively (incidence rate ratio 0.48; 95% CI 0.33, 0.69; <math>p &lt; 0.001</math>). Recruitment and reach among clusters and individuals were high, indicating that patients, nurses, and hospitals were willing to engage with a PUPCB. Of 799 intervention patients in the trial, 96.7% received the intervention. Patients and nurses accepted the care bundle, recognizing its benefits and describing how it enabled participation in pressure ulcer prevention care.</p> <p><b>Conclusion:</b> Nurses and patients responded positively to the</p>

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		<p>participated in the Introducing A Care bundle To prevent pressure ulcer (INTACT) trial, and data for the process evaluation was collected across all sites, but focused mainly on the four intervention sites.</p> <p><b>Eligible:</b> 2377 patients</p> <p><b>Included:</b> 1598 patients</p> <p><b>Control:</b> 799 (68.4%) of 1168 eligible patients</p> <p><b>Intervention:</b> 799 (66.1%) of 1209 eligible patients</p> <p><b>Interview participants:</b> 18 nurses and 19 patients across four intervention sites.</p> <p><b>Power analysis:</b> The study was not powered for these</p>	<p>(The intervention was aimed at both the cluster (nurse) and individual (patient) level, focusing on patient participation in care and partnerships between patients and nurses in PUP.)</p>	<p>spent delivering intervention) to describe any associations between intervention delivery and PU development</p> <p>Semi-structured interview data on responses of clusters (i.e. nurses) and individuals (i.e. patients) to the intervention were analyzed qualitatively using thematic analysis to give in-depth insights into patients' and nurses' perceptions of the intervention.</p>	<p>intervention. Nurses recognized the benefits of the PUPCB to patients and nurses, with improved awareness, communication, and participation related to PUP care. The patient interview component of the process evaluation found that, overall, patients responded positively to the PUPCB and described how learning about PUP empowered them to participate in PUP care.</p>
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		exploratory analyses.			
<p><b>Citation #4:</b> Tayyib, N., Coyer, F., &amp; Lewis, P. A. (2016a). Implementing a pressure ulcer prevention bundle in an adult intensive care. <i>Intensive &amp; critical care nursing</i>, 37, 27–36. <a href="https://doi.org/10.1016/j.iccn.2016.04.005">https://doi.org/10.1016/j.iccn.2016.04.005</a></p> <p><b>Level and Quality: II-C</b> - The study has low quality due to insufficient sample size for the study design.</p>					
Purpose or Hypothesis	Type of Evidence and Research Design	Sample (population, size, setting)	Intervention Procedures	Primary Outcome/Measures	Results Conclusions
<p>The aims of this study were to appraise the implementation of a series of high impact intervention care bundle components directed at preventing the development of PUs, within ICU, and to evaluate the effectiveness of strategies used to enhance the implementation compliance.</p>	<p>Research: Observational prospective study design</p>	<p><b>Sampling technique:</b> Snapshot sampling</p> <p><b>Eligible participants:</b> 60 registered nurses (RNs) working in the ICU</p> <p><b>Participated:</b> 11 RNs (participation was voluntary)</p> <p><b>Setting:</b> Conducted in the ICU of a major metropolitan government-funded public Saudi Arabian hospital between December 1, 2013 and February 28, 2014.</p>	<p><b>Control:</b> Not applicable</p> <p><b>Intervention:</b> <b>Intervention fidelity:</b> All ICU RNs learned about the study PU prevention bundle through in-service meetings and one-to-one bedside education, all provided by the researcher. The training and education program consisted of (1) brochures that explained the elements of the PU prevention bundle, presented the evidence that supported the bundle and lastly provided the outcome of the implementation of the bundle in reducing PU incidence in ICU; (2) PowerPoint presentation with handout was used during the in-service; (3) consultation and clarification with the researcher throughout the study. In the first two weeks of the study period, the researcher then</p>	<p><b>DV:</b> Compliance to the PU bundle interventions and hospital-acquired pressure ulcer incidence.</p> <p><b>DV measurement:</b> <b>1. Pressure ulcer (PU) prevention bundle checklist-</b> The instrument included 30 items and covered the six dimensions of the PU prevention bundle: risk assessment, skin assessment, skin care, nutrition, repositioning and care of medical devices. All items were scored on two points (yes = 1, no = 0), an ‘all or nothing’ approach was used. The total score for this instrument was 30, with a higher score</p>	<p><b>Statistical Result:</b> Descriptive statistical and correlation statistical methods were performed using SPSS (version 21; SPSS, Chicago, IL). Study participants demonstrated a high level of compliance towards the PU prevention bundle implementation (78.1%), with 100% participant acceptance. No significant differences were found between participants’ demographic characteristics and the compliance score. There was a significant effect for time in the implementation compliance (Wilks Lambda = 0.29, <math>F(3, 8) = 6.35</math>, <math>p &lt; 0.016</math>), indicating that RNs needed time to become familiar with the bundle and routinely implement it into their practice.</p> <p><b>Conclusion:</b> The implementation strategies used had a positive impact on compliance. Assessing and</p>

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			<p>made personal contact, through letters and face-to-face meetings, with each RN, providing a copy of the study information sheet detailing the overview and purpose of the study. Participation in this study was voluntary. Participants' compliance was audited through observations by the researcher. The researcher followed up with participants to measure the effectiveness of bundle compliance during the implementation and evaluation period through a checklist and self-evaluation at four-time points (see Table 2). All data were de-identified. To monitor PU incidence, a patient skin assessment was performed every second day by the researcher and the RN assigned to care for the patient to calculate new PUs developed after 24 hours of the patient's admission to the ICU. Then, at each of the four-time points, all ICU RNs were provided feedback on overall compliance rates and the incidence of HAPUs, through the ICU communication book.</p>	<p>meaning high compliance to the PU prevention bundle and vice versa.                  2. RN self-evaluation                  3. HAPU cumulative incidence at the time points.</p>	<p>evaluating implementation compliance is vital to achieve a reduction in HAPU incidence. This study's findings also highlighted that while RNs needed time to familiarize themselves with the care bundle elements, their clinical practice was consistent with the bundle elements.</p>
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<p><b>Citation #5:</b> Tayyib, N., Coyer, F., &amp; Lewis, P. A. (2016b). Pressure Injury Prevention in a Saudi Arabian Intensive Care Unit: Registered Nurse Attitudes Toward Prevention Strategies and Perceived Facilitators and Barriers to Evidence Implementation. <i>Journal of Wound, Ostomy &amp; Continence Nursing</i>, 43, 369-374. <a href="https://doi.org/10.1097/WON.0000000000000245">https://doi.org/10.1097/WON.0000000000000245</a></p> <p><b>Level and Quality: III-B</b> - This study has consistent results, definitive conclusion and recommendations.</p>					
Purpose or Hypothesis	Type of Evidence and Research Design	Sample (population, size, setting)	Intervention Procedures	Primary Outcome/Measures	Results Conclusions
<p>The purpose of this study was to examine RNs' attitudes toward pressure injury (PI) prevention strategies. Barriers and facilitators perceived by RNs to potentially impact on the adoption and implementation of PI prevention interventions in the intensive care unit (ICU) were examined.</p>	<p>Research: Descriptive cross-sectional survey</p>	<p><b>Sampling technique:</b> Self-selection sampling</p> <p><b>Eligible participants:</b> 60 RNs practicing in an intensive care unit (ICU)</p> <p><b>Participants:</b> 56 ICU RNs</p> <p><b>Setting:</b> Tertiary hospital, King Abdul-Aziz, Mecca, in Saudi Arabia (data were collected from July 10 to August 16, 2013)</p>	<p><b>Control Protocol:</b> Not applicable</p> <p><b>Intervention:</b> The researcher collaborated with the study site's ICU nurse unit manager, who provided a list of all RNs who worked in the ICU. The researcher then made personal contact with each RN, providing a copy of the study information sheet detailing the overview and purpose of the study.</p>	<p><b>DV:</b> Nurses' attitude towards pressure injury prevention strategies.</p> <p><b>DV measure:</b> Data were collected using a survey with 42 items. This survey was divided into 4 sections: demographic information; potential barriers to optimal skin care; potential facilitators to skin care; and RNs' attitudes toward PI care and prevention in the ICU. The Attitude towards Pressure injury Prevention (APuP) instrument (to measure RNs' attitude towards PI prevention) and the Barriers and Facilitators tool. Also, thematic analysis was undertaken for qualitative data</p>	<p><b>Statistical Result:</b> Most participants demonstrated positive attitudes toward PI prevention (<math>\mu = 38.19/52</math>; 73.44%). No significant differences were found between the demographic characteristics of the participants with the RNs' Attitude subscale and perceived barriers and facilitators associated with implementing PI prevention in the acute care setting. Several barriers influenced the ability of RNs to implement PI prevention strategies, including time demands (<math>\beta = .388</math>; <math>P = .011</math>), limitation of RNs' knowledge (<math>\beta = -.632</math>; <math>P = .022</math>), and current documentation format (<math>\beta = .344</math>; <math>P = .046</math>). Statistically significant facilitating factors that increased respondents' ability to undertake PI prevention were ease of obtaining pressure-reduction surfaces (<math>\beta = -.388</math>; <math>P = .007</math>), collaboration with interdisciplinary teams (<math>\beta = .37</math>; <math>P = .02</math>), and</p>

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					<p>availability of appropriate skin care products (<math>\beta = .44</math>; <math>P = .015</math>). Thematic analysis of open-ended questions emphasized workload as a barrier that impedes the implementation of care specific to PI prevention.</p> <p><b>Conclusion:</b> The ICU RNs have a positive attitude toward PI prevention. Moreover, PI prevention was facilitated by the availability of pressure-relieving support surfaces, appropriate skin care products, and collaboration between the healthcare professional team. However, barriers impeding the implementation of PI prevention strategies were identified as RNs' lack of knowledge on this topic and the demands of a high workload.</p>
<p><b>Citation #6:</b> Trisnaningtyas, W., Retnaningsih, R., &amp; Rochana, N. (2021). Effects and Interventions of Pressure Injury Prevention Bundles of Care in Critically Ill Patients: A Systematic Review. <i>Nurse Media Journal of Nursing</i>, 11(2), 154–176. <a href="https://doi-org.va.proxy.liblynxgateway.com/10.14710/nmjn.v11i2.28881">https://doi-org.va.proxy.liblynxgateway.com/10.14710/nmjn.v11i2.28881</a></p> <p><b>Level and Quality: II-B</b>                  - Based on a comprehensive literature review, this systematic review has good and consistent results and recommendations for practice change.</p>					
Purpose or Hypothesis	Type of Evidence and Research Design	Sample (population, size, setting)	Intervention Procedures	Primary Outcome/Measures	Results Conclusions
This study aims to review the effects of the pressure injury prevention	Systematic Review	<b>Search Strategy:</b> This review conducted a comprehensive search of literature through several databases such as EBSCO, ScienceDirect,	<b>Control Protocol:</b> Not applicable  <b>Intervention:</b> The interventions used to prevent pressure injuries were analyzed and reported by the type of intervention including risk	<b>DV:</b> Incidence of pressure ulcer  <b>DV measure(s):</b>	<b>Results:</b> The pressure injury prevention bundles of care decreased pressure injury incidents by as many as 4.3%- 36.2% in developed countries and 4.16%-25.72% in developing countries. Also, the

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<p>bundles of care on the incidents of pressure injury in critically ill patients and the intervention measures of the care bundles.</p>		<p>PubMed, ProQuest, Google Scholar, and Scopus from 2009 to 2020 using several pre-determined keywords in English and in the Indonesian language. “Adult”, “intensive care”, and “critical care” were used as keywords for the population. “Prevention”, “pressure ulcers/injury/sores”, “skin injuries”, “intervention bundle”, “bundle of care”, and “multi/multiple interventions” were used as keywords for the intervention and comparison. “Reduction” and “incident” were also used as keywords for the outcome. Boolean phrases were used during the searching process using the combination of keywords. Relevant articles from the reference lists of the included literature were also retrieved in order to get more thorough search results.</p> <p><b>Sample size:</b> Total of 7,439 patients Twelve</p>	<p>assessment, skin care, repositioning, nutrition, support surface, education, and medical device maintenance.</p>	<p>1. Primary outcome measurement: Incidence of pressure injury 2. Secondary outcome measurement: Pressure injury prevention strategies that significantly reduced pressure injury.</p>	<p>bundles of care which significantly reduced the incidents of pressure injury consisted of 7 intervention measures, which were pressure injury risk assessment using the Cubbin Jackson scale, skin assessment and care, repositioning, nutrition, education, support surface, and medical device care</p> <p><b>Conclusion:</b> The pressure injury prevention bundles of care in critically ill patients significantly reduced the incidents of pressure injury</p>
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		<p>studies used a large sample size, 3 studies used small samples in an ICU, and 2 studies did not include sample sizes.</p> <p><b>Setting:</b> Conducted in developed countries (i.e., Australia, US, Turkey, and China) and developing countries (i.e., Saudi Arabia, Lebanon, Brazil and Argentina).</p> <p><b>Excluded.</b> 326,090 articles were excluded after duplicates were removed and screened using additional filters (i.e., years, language, study design, title, abstract, intervention, different outcome, other settings, unclear findings, unclear if both groups were comparable undefined measurement, involving other population and intervention).</p> <p><b>Eligible studies:</b> 50</p> <p><b>Accepted:</b> 17 studies were included, consisting of quasi-experimental (n=14),</p>			
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		RCT (n=2) and cohort (n=1) studies.			
<p><b>Citation #7:</b> Yilmazer, T., &amp; Tuzer, H. (2022). Effectiveness of a Pressure Injury Prevention Care Bundle; Prospective Interventional Study in Intensive Care Units. <i>Journal of wound, ostomy, and continence nursing: official publication of The Wound, Ostomy and Continence Nurses Society</i>, 49(3), 226–232. <a href="https://doi.org/10.1097/WON.0000000000000875">https://doi.org/10.1097/WON.0000000000000875</a></p> <p><b>Level and Quality: III-C</b> - Study contains good results and recommendation, however, the study setting was done in a single unit which limits its generalizability. Tool used for knowledge test were not validated.</p>					
Purpose or Hypothesis	Type of Evidence and Research Design	Sample (population, size, setting)	Intervention Procedures	Primary Outcome/Measures	Results Conclusions
The purpose of this study was to assess the effectiveness of a pressure injury prevention care bundle (PIPBC).	Research: Prospective interventional study	<p><b>Sampling technique:</b> Purposive sampling</p> <p><b>Sample and sample size:</b> 13 nurses assigned in ICU and 104 patients (18 years and older) and cared for in the intensive care unit for at least 24 hours</p> <p><b>Setting:</b> Neuro intensive care unit (NICU) in a university-based hospital in Ankara, Turkey.</p>	<p><b>Control Protocol:</b> Not applicable</p> <p><b>Intervention:</b> The bundle comprises 8 interventions: participation in pressure injury education, pressure injury risk assessment, skin assessment, skin care, nutrition management, activity management, moisture management, and support surfaces management. This modified care bundle has a strong content validity (CVI) of 0.99.</p>	<p><b>DV:</b> Incidence of stage 1 pressure injury, nurses' knowledge and compliance with the care bundle.</p> <p><b>DV measure (s)</b> 1. Primary outcome: The pressure injury incidence rates of patients before and after the application of the care bundle were compared using the Fisher exact test; the distribution of pressure injury stage and location was compared using the chi-square test with a .05 significance level. Incidence rates were compared using a no-cost trial version of Stata 14. Other statistical analysis were performed using sing IBM SPSS Statistics 21.0. 2. Secondary outcome measurement: -Knowledge scores of nurses before and after the training were compared using the paired <i>t</i> test.</p>	<p><b>Statistical Results:</b> The incidence of stage 1 pressure injury rate per 1000 patient-days was 15.11 (95% CI, 6.18-24.04) versus 6.79 (95% CI, 2.20-15.86) before and after the introduction of the PIPBC; this difference was not significant (<math>P = 0.138</math>). The mean test score of the pressure injury knowledge form for nurses was 53.46 (SD = 9.22) before the education and 70.77 (SD = 8.62) after the education (<math>t = 6.429</math>, <math>P = .000</math>). Levels of compliance based on direct observation were similar (<math>P = .536</math>; Table 3). The 3-month average of the compliance level in the post-care bundle stage was 78.91 (SD = 7.93). This finding indicates that in 78.91% of observations, nurses were found to comply with the PIPBC.</p>

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		<p><b>Power analysis:</b> The minimum sample size was calculated based on 80% power, 5% margin of error, and <math>d = 0.640</math> effect size; at least 40 samples in total were found to be sufficient (<math>n_1 = 40</math>, <math>n_2 = 40</math>).</p>	<p><b>Stage 1: Pre-bundle</b> -data collection between April 1, 2018 and June 30, 2018 - Pressure injury incidence of the patients was followed by the nurses. -By the end of the third month, the researcher held a 1-day training program for the nurses about the care bundle use to promote correct implementation. -Nurses were given a pre and post knowledge assessment</p> <p><b>Stage 2: Post-bundle</b> - A preliminary implementation of the PIPCB was performed throughout July. - Nurses provided care according to the bundle. -Compliance with the care bundle was assessed. - Pressure injury incidence rates in the pre- and post-care bundle stages were compared.</p>	<p>-Care bundle compliance after training was obtained by dividing the total number of days in the relevant period by the number of days with care bundle compliance for each bed and assessed using repeated-measures analysis of variance test.</p>	<p><b>Conclusion:</b> The PIPCB implemented in the NICU resulted in a decline in stage 1 pressure injuries.</p>
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**Citation #8:** Zhang, X., Wu, Z., Zhao, B., Zhang, Q., & Li, Z. (2021). Implementing a Pressure Injury Care Bundle in Chinese Intensive Care Units. *Risk management and healthcare policy*, 14, 2435–2442. <https://doi.org/10.2147/RMHP.S292579>

**Level and Quality: II-B**

- Contains good quality with consistent results and recommendations for practice change.

Purpose or Hypothesis	Type of Evidence and Research Design	Sample (population, size, setting)	Intervention Procedures	Primary Outcome/Measures	Results Conclusions
<p>The aims of this study were to (1) identify the impact of the care bundle on preventing PI, and (2) identify changes in the compliance rate of nurses to the elements of the care bundle at different time points (before and after intervention).</p>	<p>Research: Quasi-experimental, pre- and post-intervention design</p>	<p><b>Sampling technique:</b> non-probability sampling</p> <p><b>Participants:</b></p> <ul style="list-style-type: none"> <li>- Ninety-seven hospitals participated in data reporting</li> <li>- Before the intervention, 156 ICU nursing units participated in data collection; 163 participated after the intervention.</li> <li>- A total of 2021 ICU patients participated in verification before intervention, and 2329 participated after the intervention.</li> </ul> <p><b>Setting:</b> Critical care units in 26 provinces in China, and all hospitals belonged to the China Nursing Quality Promotion Alliance</p>	<p><b>Control Protocol:</b> Not applicable</p> <p><b>Intervention:</b> Implementation strategies included training, auditing during the use of the care bundle, and measuring outcome indicators in the ICU. Pressure injury prevention bundles include risk identification, skin assessment, patient repositioning, skin care, use of a pressure-reducing device, and nutrition.</p>	<p><b>DV:</b> Incidence of pressure injury and compliance rate of nurses to the elements of care bundle</p> <p><b>DV measure:</b></p> <p>1. Primary outcome measurement: Descriptive statistics (frequency and percentage) was used to summarize the number of patients with PI and hospital-acquired pressure injuries (HAPI), the development of PIs and HAPIs, and the stage of PIs. The Chi-square test was used to compare the difference of PI prevalence and new HAPIs across three time points (before, during, and after the intervention). Poisson regression was used to examine the level of PI</p>	<p><b>Statistical result:</b> ICU staff compliance rate for the PI care bundle increased from 55.15% to 60.15% before and after the intervention, and the difference was statistically significant (<math>\chi^2 = 17.62</math>, <math>P &lt; 0.01</math>). No significant improvement was observed for compliance with the use of pH weak acid/neutral cleaning liquid to clean the skin of patients and provide individualized nutritional guidance.</p> <p><b>Conclusion:</b> A standardized care bundle based on the best evidence reduces the incidence of PIs. Nurses training in the care bundle and the audit during the intervention contributed to an increased compliance rate after the intervention.</p>

PRESSURE INJURY PREVENTION BUNDLE

				<p>prevalence before and after the intervention. 2. Secondary measurement: Care bundle checklist specifically designed by researchers to check the compliance of nurses with the care bundle. The implementation compliance rate was measured at two time points using the compliance checklist.</p>	
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## PRESSURE INJURY PREVENTION BUNDLE

**Table 2***Evidence Synthesis Table*

<b>Project Title:</b> Implementation of Standardized Pressure Injury Prevention Bundle in Intensive Care Units			
<b>PICO:</b> In adult surgical intensive care units, does implementation of a standardized pressure injury prevention bundle (multi-component interventions including risk assessment, skin assessment and care, repositioning and mobility, pressure, friction and shear reduction, nutrition, and education), compared to current practice (one single intervention at a time) increase nurses' compliance with pressure injury prevention intervention?			
<b>JHNEBP Model Level</b>	<b>Total Number of Sources</b>	<b>Author and Quality Rating of each study</b>	<b>Synthesis of Findings</b>
<b>Level I</b> Experimental study · Randomized Controlled Trial (RCT) · Systematic review of RCTs with or without meta-analysis			
<b>Level II</b> Quasi-experimental studies · Systematic review of a combination of RCTs and quasi-experimental studies, or quasi-experimental studies only, with or without meta-analysis	Total Sources:4 (3) Systematic Reviews (1) Observational prospective study design	Alshahrani et al., B Tayyib et al.(2016a), C Trisnaningtyas et al., B Zhang et al., B	<p>The systematic review by Alshahrani et al. (2021) found that pressure injury prevention bundles lead to reductions in the numbers and severity of pressure injuries in critically ill patients. The study identified key core features of the pressure injury prevention bundle, including risk assessment and ongoing skin assessment, skin hygiene, heel elevation, regular repositioning, and nutrition. Other interventions that supported the reduction of pressure injuries were surface support, early mobility, targeted medical device-related pressure injury prevention, and nursing expertise to support clinical practices. Similarly, Trisnaningtyas et al. (2021) findings showed that the pressure injury prevention bundles of care decreased pressure injury incidents by 4.3%-36.2% in developed countries and 4.16%-25.72% in developing countries. The care bundle used in this study consisted of seven intervention measures, including a risk assessment scale for pressure injury, skin assessment and care, repositioning, nutrition, education, support surface, and medical device care. Zhang et al., 2021 also found a reduction in hospital-acquired pressure injury (HAPI) by 29.5% within six months.</p> <p>Tayyib et al. (2021a) and Zhang et al. (2021) conclude that implementing a pressure injury prevention bundle positively impacts participants' compliance. Study participants demonstrated a high level of compliance towards the PU prevention bundle implementation (78.1%), with 100% participant acceptance</p>

## PRESSURE INJURY PREVENTION BUNDLE

			<p>(Tayyib et al., 2021). Also, there was a significant effect for the time in the implementation compliance (Wilks Lambda=0.29, F (3, 8)=6.35, p&lt;0.016), implying that RNs needed time to become familiar with the bundle and routinely implement it into their practice. Moreover, Zhang et al. (2021) showed that the compliance rate of nurses increased significantly from 55.15% to 60.15% before and after the implementation of the care bundle (<math>\chi^2=16.72</math>, P=0.00). These findings were attributed to the care bundle education and training for nurses and the audit during the intervention. Alshahrani et al. (2021) discussed that nurses' knowledge of pressure injury prevention warrants consideration when implementing interventions. Individual nurses' knowledge, decision-making, and access to expertise all play an essential role in preventing pressure injuries in this vulnerable population.</p>
<p><b>Level III</b> 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</p>	<p>Total Sources:4 (1) Systematic Review (1) Prospective interventional study (1) Descriptive cross-sectional survey (1) Pre-specified mixed-methods process evaluation</p>	<p>Lin et al., B Roberts et al., B Tayyib et al.(2016b), B Yilmazer &amp; Tuzer, C</p>	<p>A systematic review of multi-component programs (also known as a bundle) that incorporates evidence-based interventions has demonstrated that pressure injury prevention bundles can effectively reduce pressure injuries in critical care units (Lin et al.,2020). Common components of the programs include clarification of staff roles, the introduction of new roles, staff and patient education, pressure injury risk assessment, skin assessment, support surfaces use, mobilization, repositioning, nutrition needs assessment, documentation, and multidisciplinary team involvement. Implementation strategies commonly used were education, audit and feedback, and standardizing documentation. Positive outcomes and strong theoretical rationales for the components of the programs suggest they are beneficial (Lin et al.,2020).</p> <p>Yilmazer and Tuzer's (2022) study showed that the incidence of stage 1 pressure injury rate per 1000 patient days before and after implementation of the care bundle was 15.11 (95% CI, 6.18-24.04) versus 6.79 (95% CI, 2.20-15.86) but was not statistically significant. Also, Yilmazer and Tuzer (2022) found that the 3-month post-bundle stage was 79.91 (SD=7.93), reflecting that nurses were compliant with the PIPCB.</p> <p>Studies by Tayyib et al. (2016b) and Roberts et al. (2017) examined the nurses' attitudes and acceptance of the pressure injury prevention care bundle. There is high recruitment and reach among nurses and individuals, indicating that participants are willing to engage with the intervention and, in the same way, an effective way to get patients involved in their care and promote evidence-based practice (Roberts et al., 2017). At the same time, Tayyib et al. (2016) study participants demonstrated a high level of compliance towards the pressure injury prevention bundle implementation (78.1%), with 100% participant</p>

PRESSURE INJURY PREVENTION BUNDLE

			acceptance. This study also identified perceived barriers and facilitators that provide essential information identifying context-specific factors that may influence implementing pressure injury prevention interventions in the ICU. Perceived facilitators included the availability of pressure-relieving support surfaces, appropriate skin care products, and collaboration with the healthcare professional team. Perceived barriers included limited pressure injury prevention knowledge of the nurse and nurse workflow (time demands and documentation format).
<b>Level IV</b> Opinion of respected authorities and/or reports of nationally recognized expert committees/consensus panels based on scientific evidence			
<b>Level V</b> Evidence obtained from literature reviews, quality improvement, program evaluation, financial evaluation, or case reports · Opinion of nationally recognized expert(s) based on experiential evidence			
Overall Quality Rating w/rational and Recommendation: B; Good and consistent evidence to support practice change.			

## PRESSURE INJURY PREVENTION BUNDLE

**Table 3***Measurement Plan*

<b>Project Goals</b>	<b>Data Collection Procedures (who, how, when)</b>	<b>Name of Data Collection Tool</b>
<b>Structure Goal:</b> By September 4, 2023, 100% of ICU staff Registered Nurses (RNs) and Certified Nursing Assistants (CNAs) will receive education and training on pressure injury prevention (PIP) bundle interventions and checklist.	The number of participants on every education and training session will be recorded through the QR code from REDCap and will be totaled by September 4, 2023.	Staff Education and Training Attendance
<b>Structure Goal:</b> Starting September 8, 100% of supplies needed for the purpose of pressure injury prevention will be available on a periodic automatic replacement (PAR) level.	Daily inventory report was done by Charge RN or CNA through a generated QR code from REDCap.	Supplies Daily Inventory Report
<b>Process Goal:</b> By December 11, 2023, 100% of RNs will demonstrate compliance with documentation (in EHR) and performance of the Braden scale, comprehensive skin assessment, and placing appropriate consult(s) in all SICU patients on admission, every shift, and with significant in condition.	The DNP student performed weekly data collection. Data will be obtained directly from the EHR's Skin Inspection/Assessment Note.	Skin Inspection/Assessment and Documentation
<b>Outcome Goal:</b> By December 11, 2023, 100% of RNs will demonstrate compliance with pressure injury prevention bundle interventions and checklist in all SICU patients on admission every shift, and with significant in condition.	Data entry on each patient (on admission, every shift and with significant in condition) will be placed by RNs through the generated QR code or URL link from REDCap. The DNP student performed weekly data collection.	Pressure Injury Prevention Bundle Checklist Audit Tool

## PRESSURE INJURY PREVENTION BUNDLE

Table 4

*Standardized Pressure Injury Prevention Protocol 2.0 Checklist*

Unit _____	Standardized Pressure Injury Prevention Protocol Checklist (SPIPP- Adult) 2.0	Date _____
ITEM	Completed Yes/No	COMMENT
<b>Assess risk factors for pressure injury to guide risk-based prevention</b>		
Significant current or anticipated mobility problems		
Use a structured risk assessment approach (e.g., Braden or other validated risk tool) on admission		
Reassess risk q shift and with significant change in condition		
Patient/family informed of PI risk and prevention plan		
Additional risk factors considered: Previous PI __, Localized pain __, Diabetes __, Poor perfusion __, Vasopressors __, Oxygenation deficits __, Increased Temp __, Advanced Age __, Spinal cord injury __, Neuropathy __, Surgery/procedure duration > 2 hrs. __, Critical illness __, Organ Failure __, Sepsis __, Mechanical vent __, Medical devices __, Sedation __, Dark skin tone		
<b>Assess Skin/Tissue for signs of skin damage and pressure injury</b>		
Assess skin (comprehensive, visual, palpation) upon admission and q shift for erythema, discoloration, edema, and temperature		Location(s):
Assess skin under medical devices q shift		Device(s):
Inspect heels q shift		
In people of color: Ensure adequate lighting and moisten/moisturize skin to augment visual inspection		
Consider enhanced skin assessment methods- thermography, SEM, skin color chart		
<b>Preventative Skin Care- Manage moisture/Incontinence</b>		
Cleanse and apply appropriate moisture barriers promptly after each incontinent episode		
Avoid use of alkaline soaps/cleansers		
Consider urinary/fecal management systems for high-risk persons		
Single layer, breathable, high absorbency pads for incontinence		
Consider using low friction textiles		
Apply wicking material to skin folds when appropriate		
<b>Redistribute Pressure</b>		
Turn/reposition q 2-3 hours persons who do not have independent bed mobility and as required by individual needs and risk, unless contraindicated (Braden Activity/Mobility score ≤2)		
Use high specification reactive foam or reactive air mattress/overlay for immobile persons (Braden Activity/Mobility score <2)		
Use positioning aids that minimize friction/shear (pillows, wedges). Use turn/lift equipment if available. Proper side-lying position with upper leg over/in front of lower leg		
Keep head of bed as flat as possible		
Place silicone multilayer foam dressings on areas of high-risk (i.e., sacrum, lower buttocks, or heels) (Braden Activity/Mobility scores <2)		
Elevate heels off bed with pillows, heel devices or boots (Braden Sensory Perception score <3)		
Provide adequate repositioning (30 degree) when side lying. Position upper leg forward and support with pillow.		
Use slow, gradual, frequent, small, body shifts when unstable		
Use pressure redistributing seat cushion for persons who cannot adequately reposition independently		
Reposition seated persons q 1 hour		
Consult Physical Therapy for mobilization program when appropriate (Braden Activity/Mobility scores <2)		
Consider reminder systems, pressure mapping, motion sensors		
Implement early mobilization program		
<b>Nutrition</b>		
Screen for malnutrition using a validated tool on admission		
Consult dietitian for persons with or at risk of malnutrition, decreased nutrient intake, NPO > 48 hours or presence of stage 2 or greater PI (Braden Nutrition Score <2)		
Provide additional calories, protein, fluids, and additional nutrients (i.e. multi-vitamin, arginine, glutamine, HMB) per nutrition plan of care or as appropriate		
Continue to regularly assess goals and consult dietitian as needed		

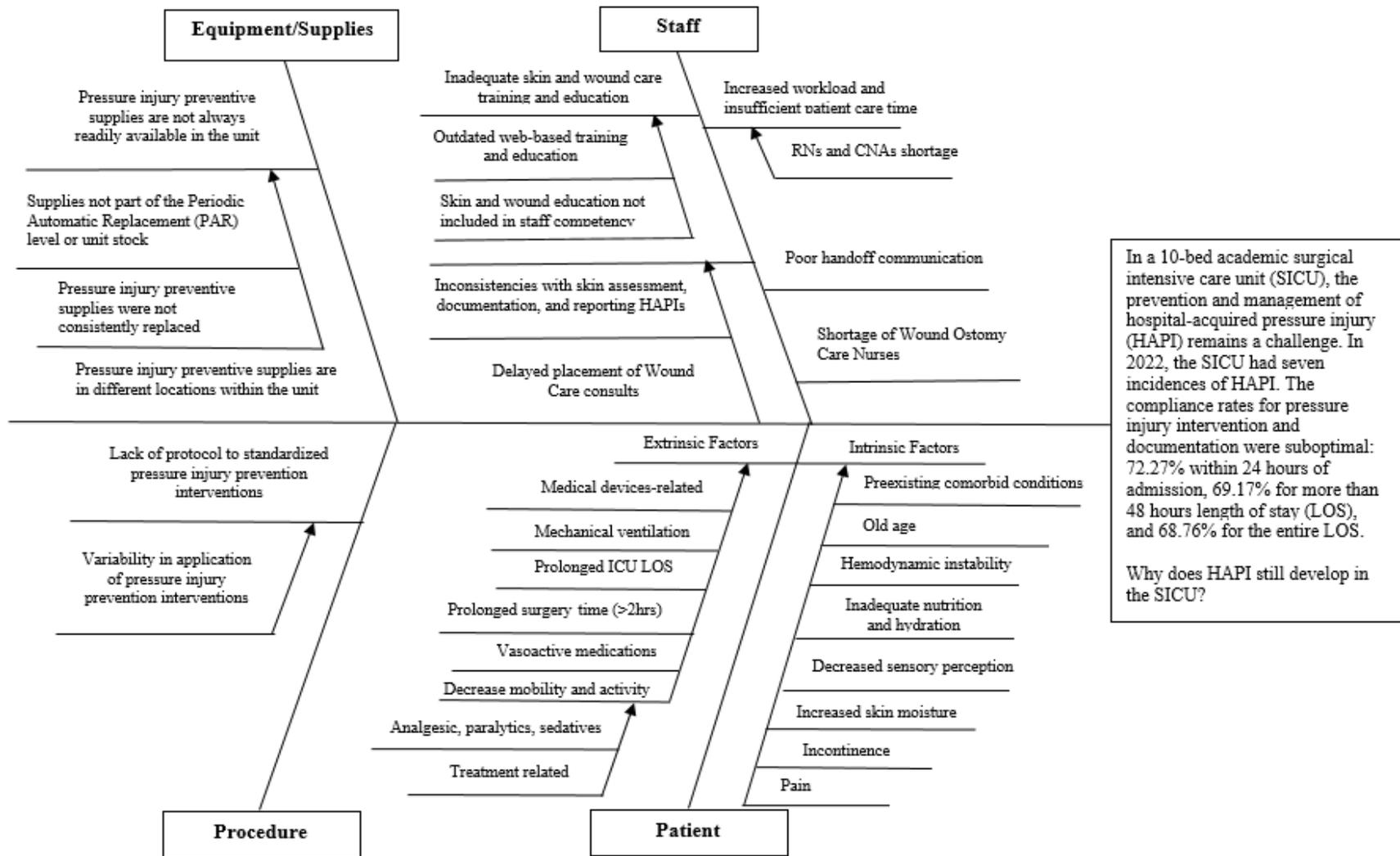
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Note: Adapted from: <https://doi.org/10.1111/jan.15964>

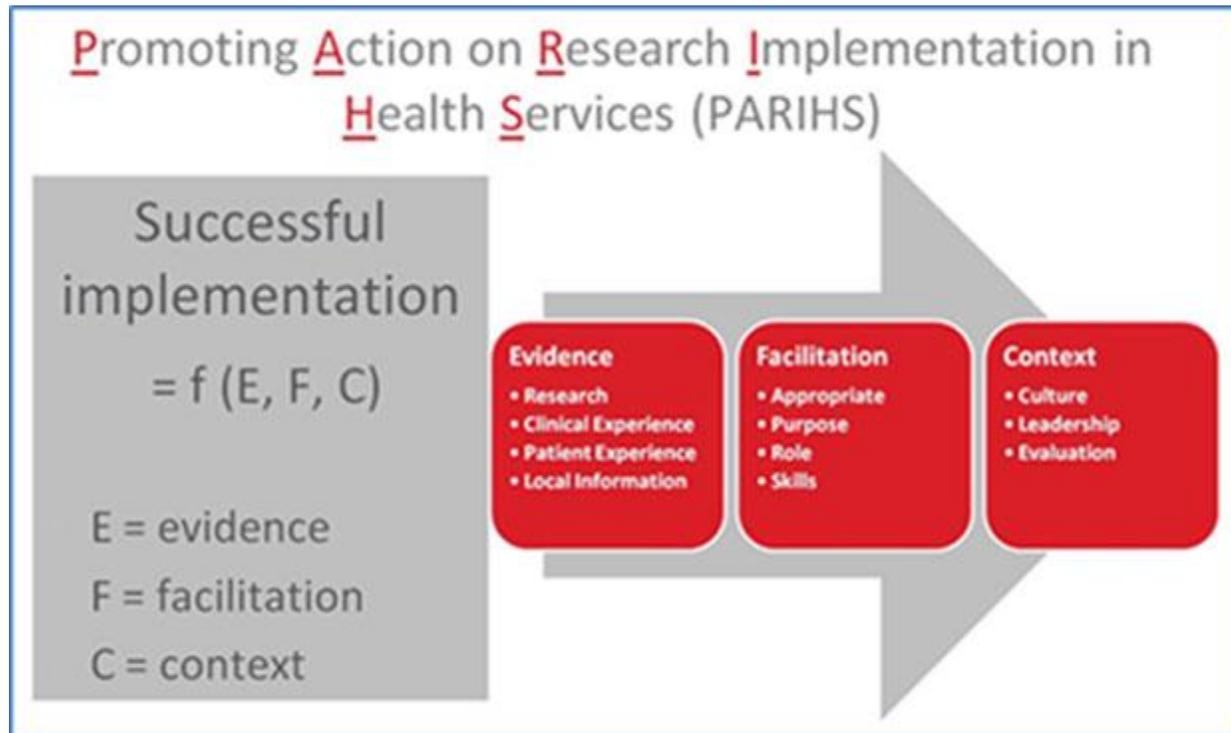
PRESSURE INJURY PREVENTION BUNDLE

Figure 1

Fishbone Diagram



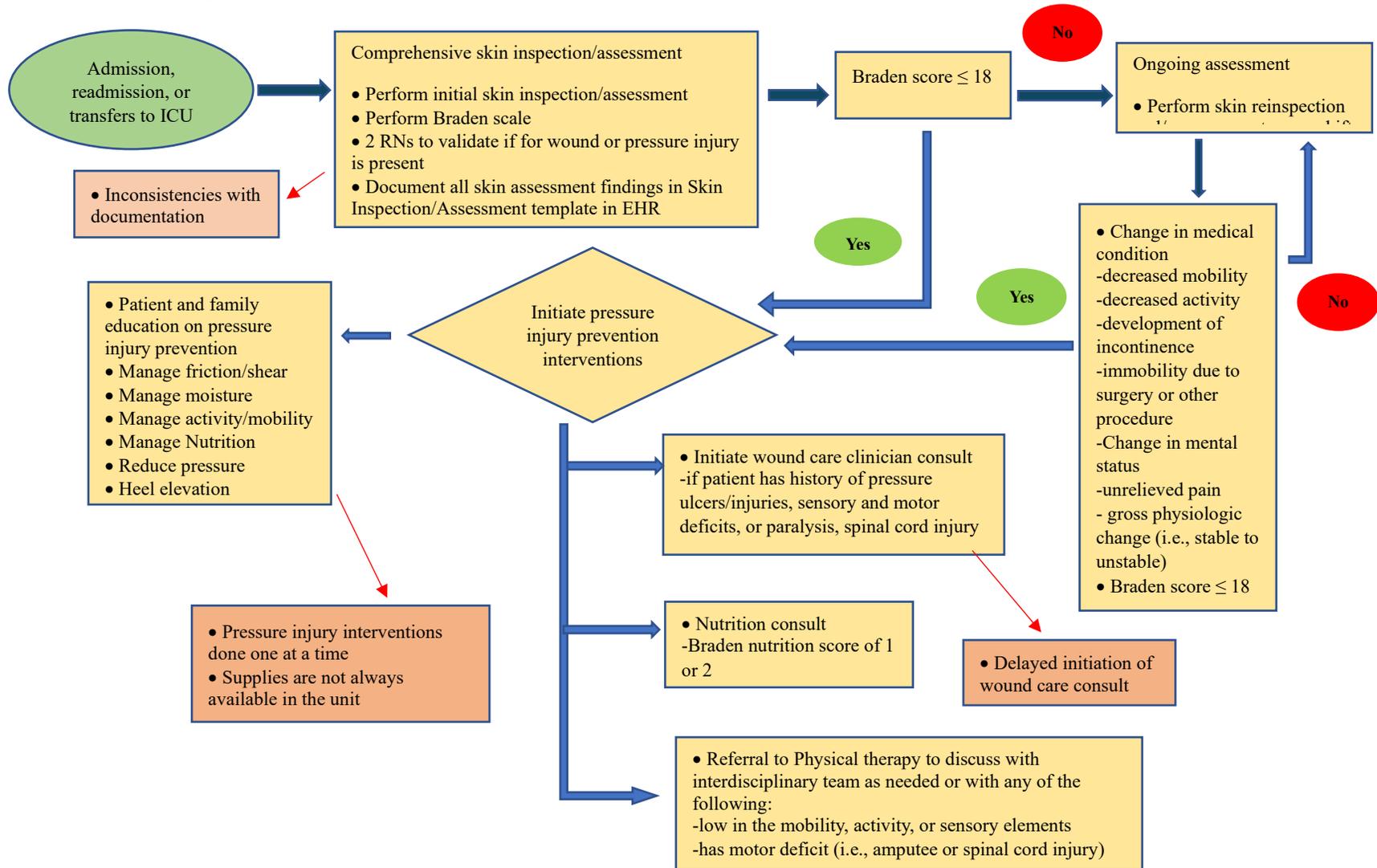
## PRESSURE INJURY PREVENTION BUNDLE

**Figure 2***Promoting Action on Research Implementation in Health Services**Note:* Adapted from Kitson et al. (1998). Enabling the Implementation of Evidence-Based Practice: A Conceptual Framework

PRESSURE INJURY PREVENTION BUNDLE

Figure 3

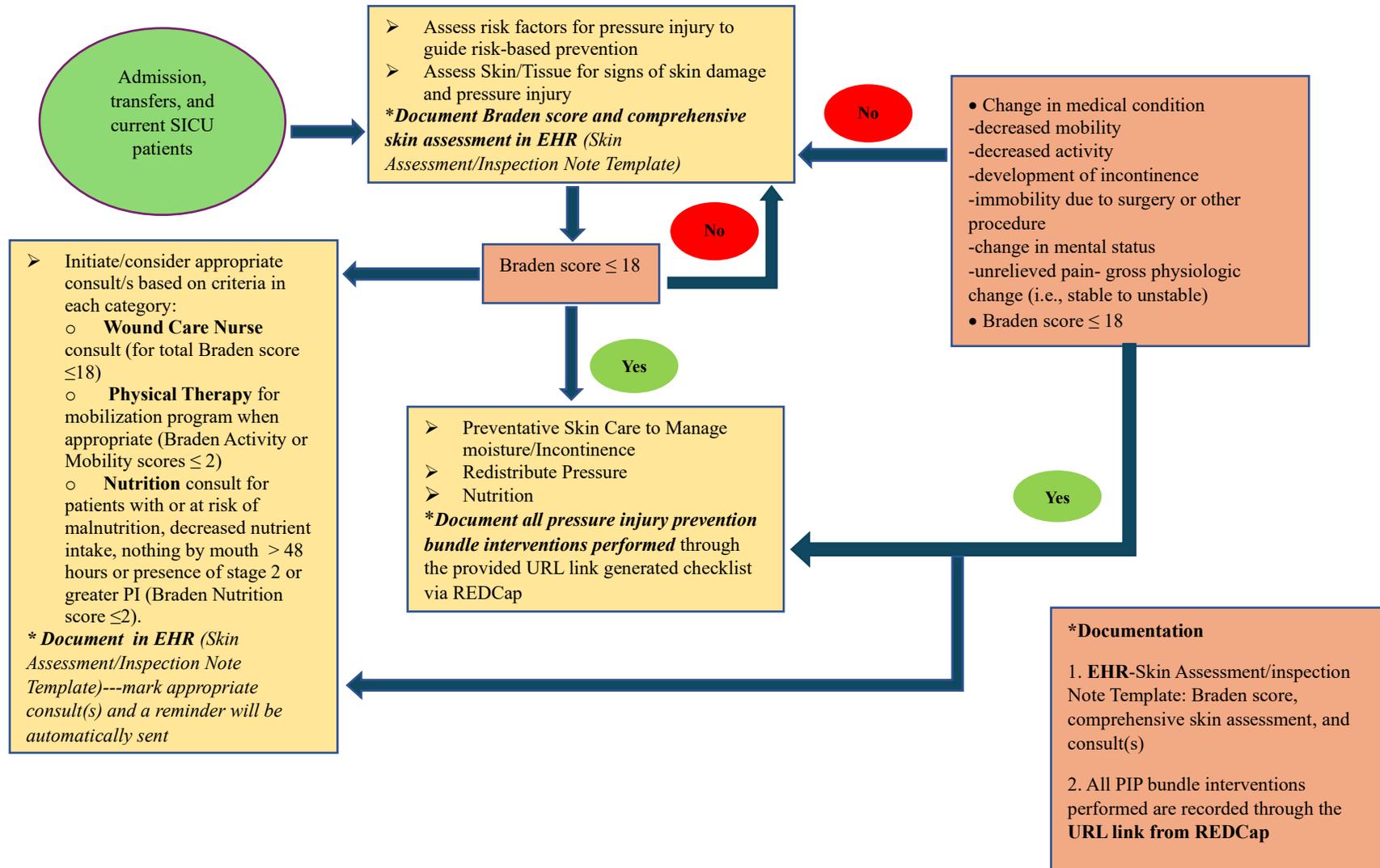
Current Process Map on ICU Pressure Injury Prevention



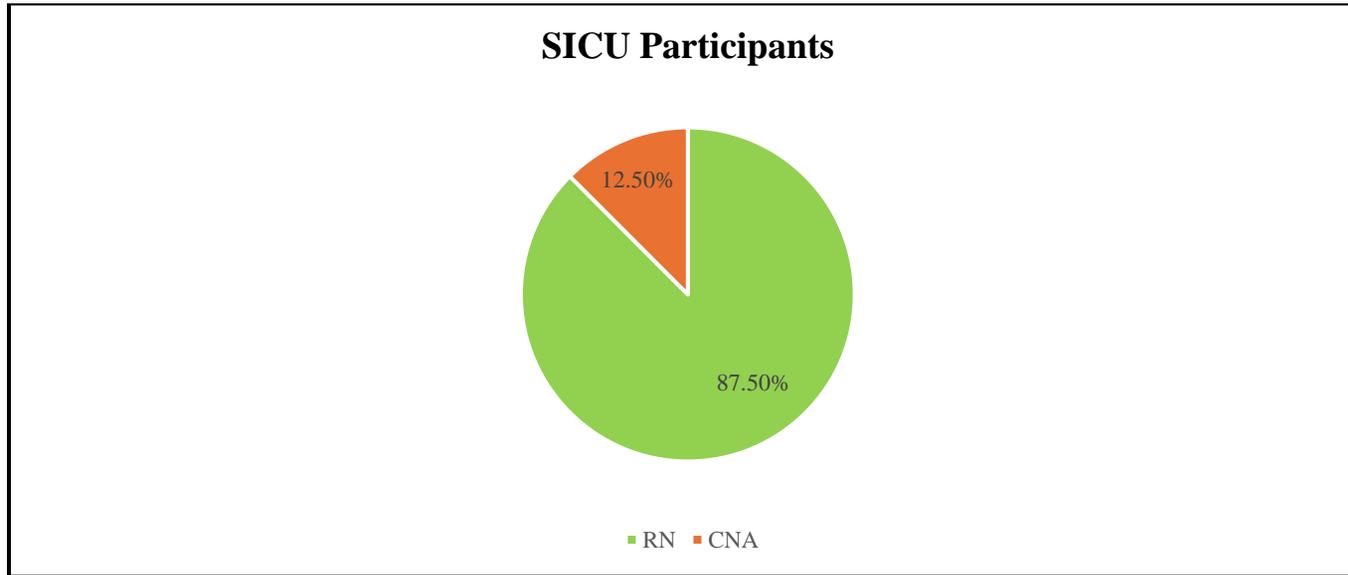
PRESSURE INJURY PREVENTION BUNDLE

Figure 4

Desired Process Map on SICU Pressure Injury Prevention Bundle



## PRESSURE INJURY PREVENTION BUNDLE

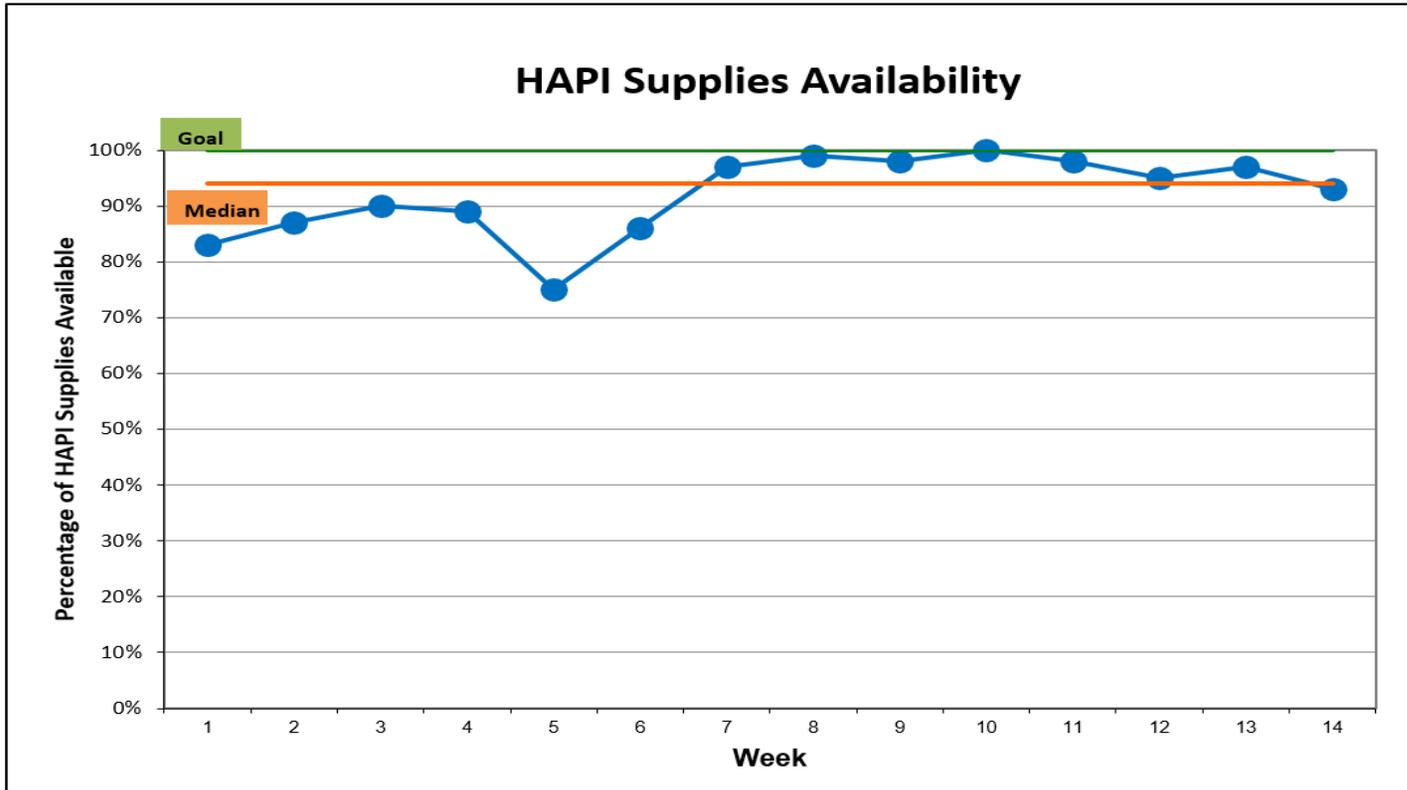
**Figure 5***SICU Staff Education and Training on Pressure Prevention Bundle and Checklist*

**Note:** Counts/frequency: Certified Nursing Assistant (CNA) (2, 12.5%), Registered Nurse (RN) (14, 87.5%)

PRESSURE INJURY PREVENTION BUNDLE

Figure 6

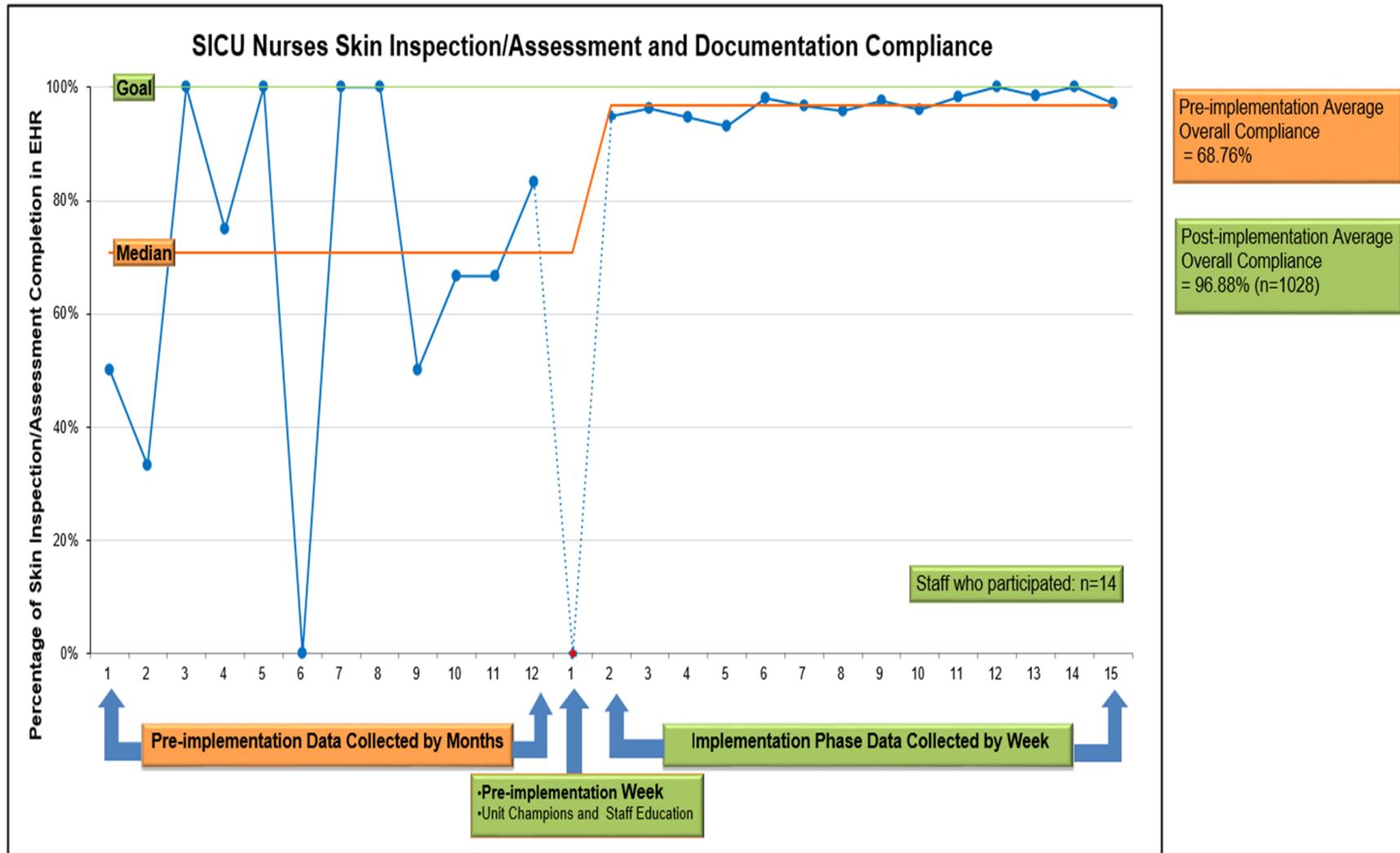
Run Chart of HAPI Supplies Availability



PRESSURE INJURY PREVENTION BUNDLE

Figure 7

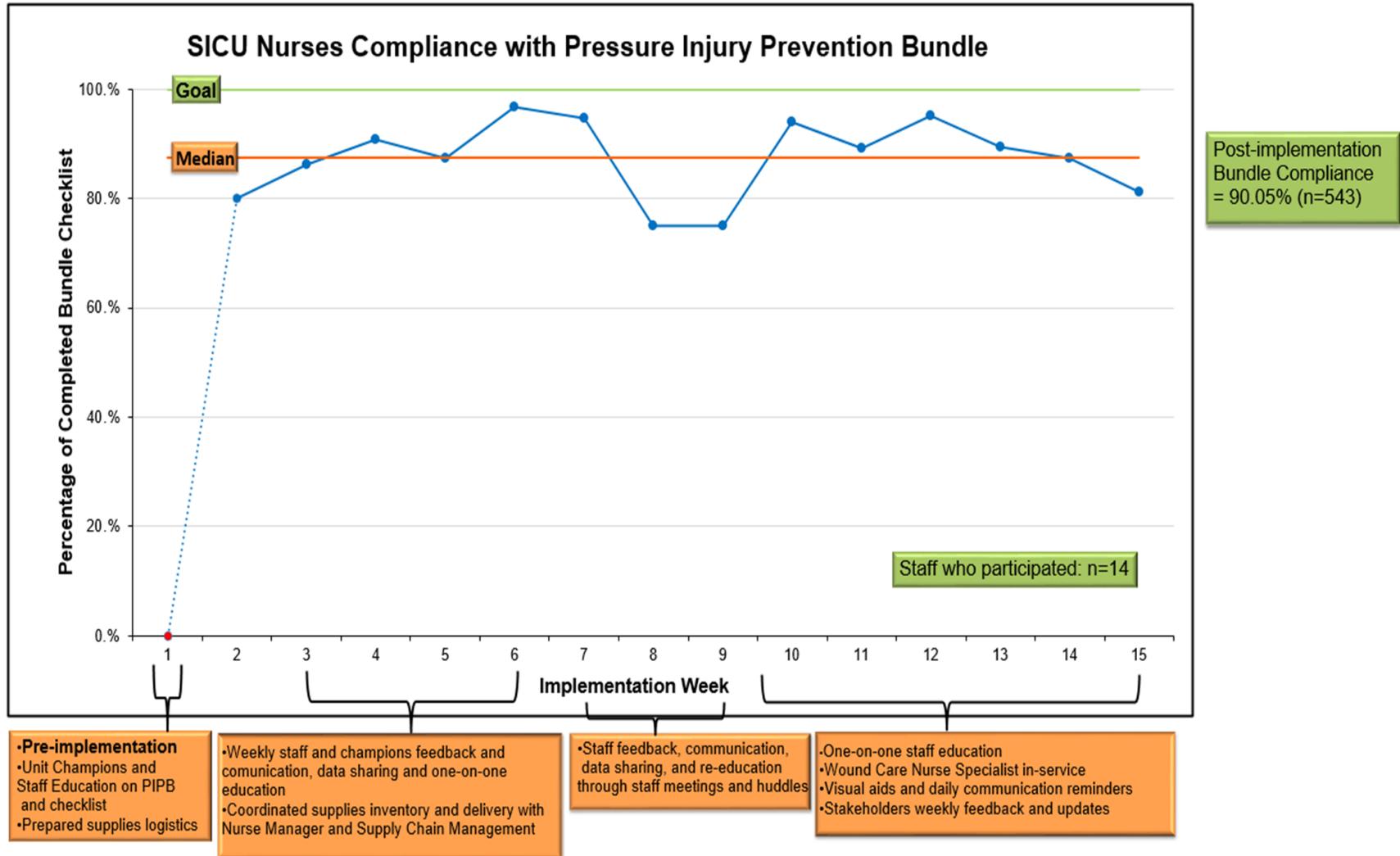
Run Chart of SICU Nurses Skin Inspection/Assessment and Documentation Compliance



PRESSURE INJURY PREVENTION BUNDLE

Figure 8

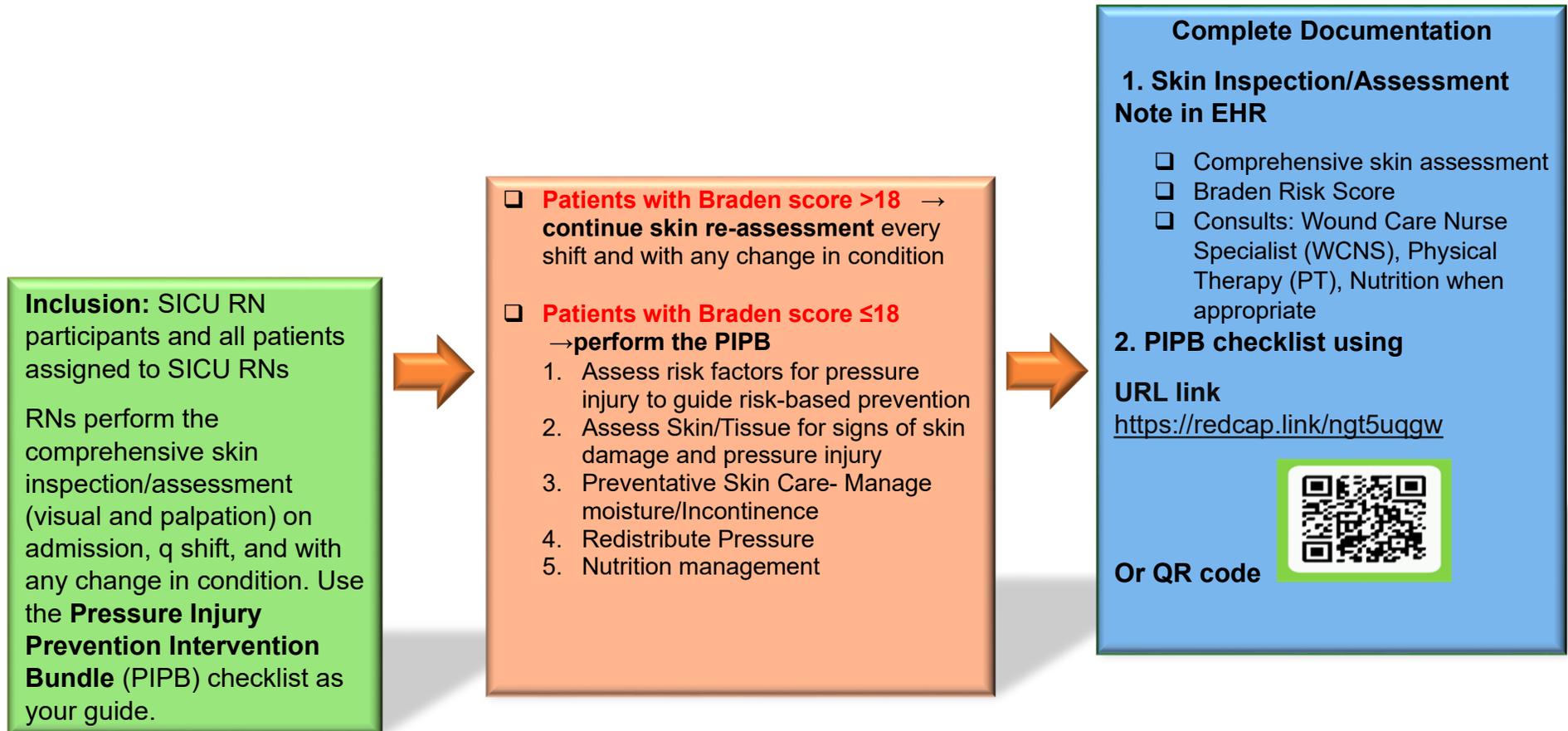
Run Chart of SICU Nurses Compliance with Pressure Injury Prevention Bundle



## PRESSURE INJURY PREVENTION BUNDLE

Figure 9

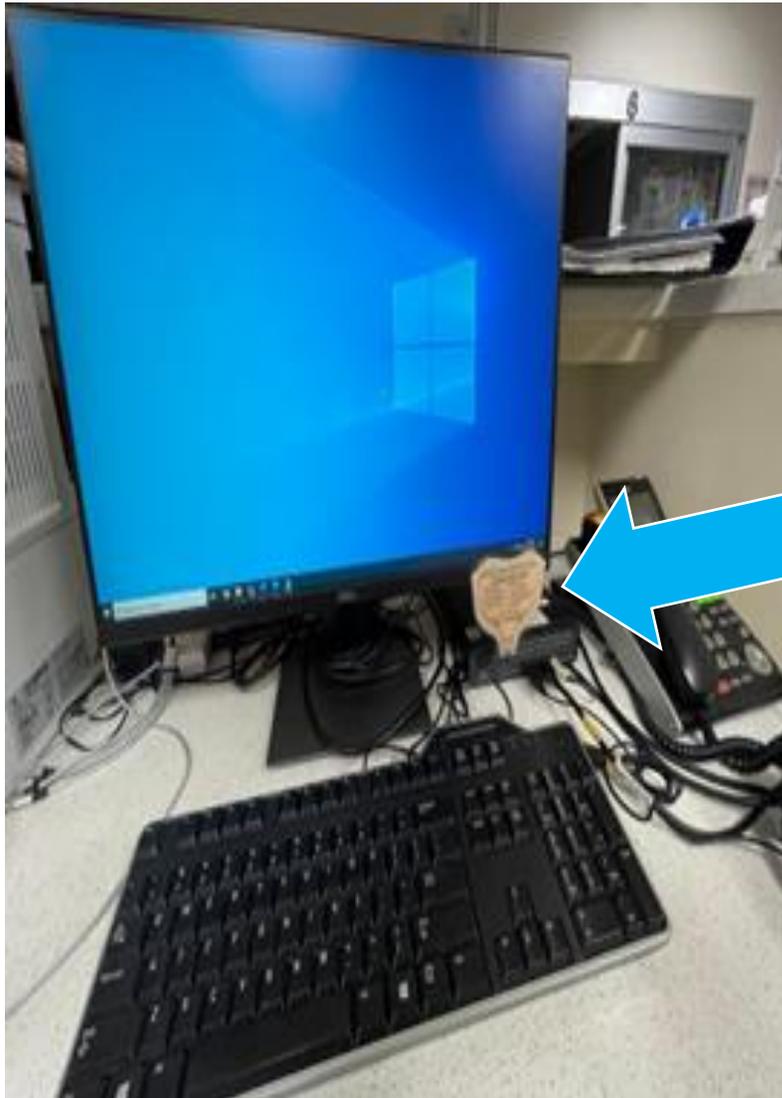
*Pressure Injury Prevention Bundle Intervention and Checklist Process*



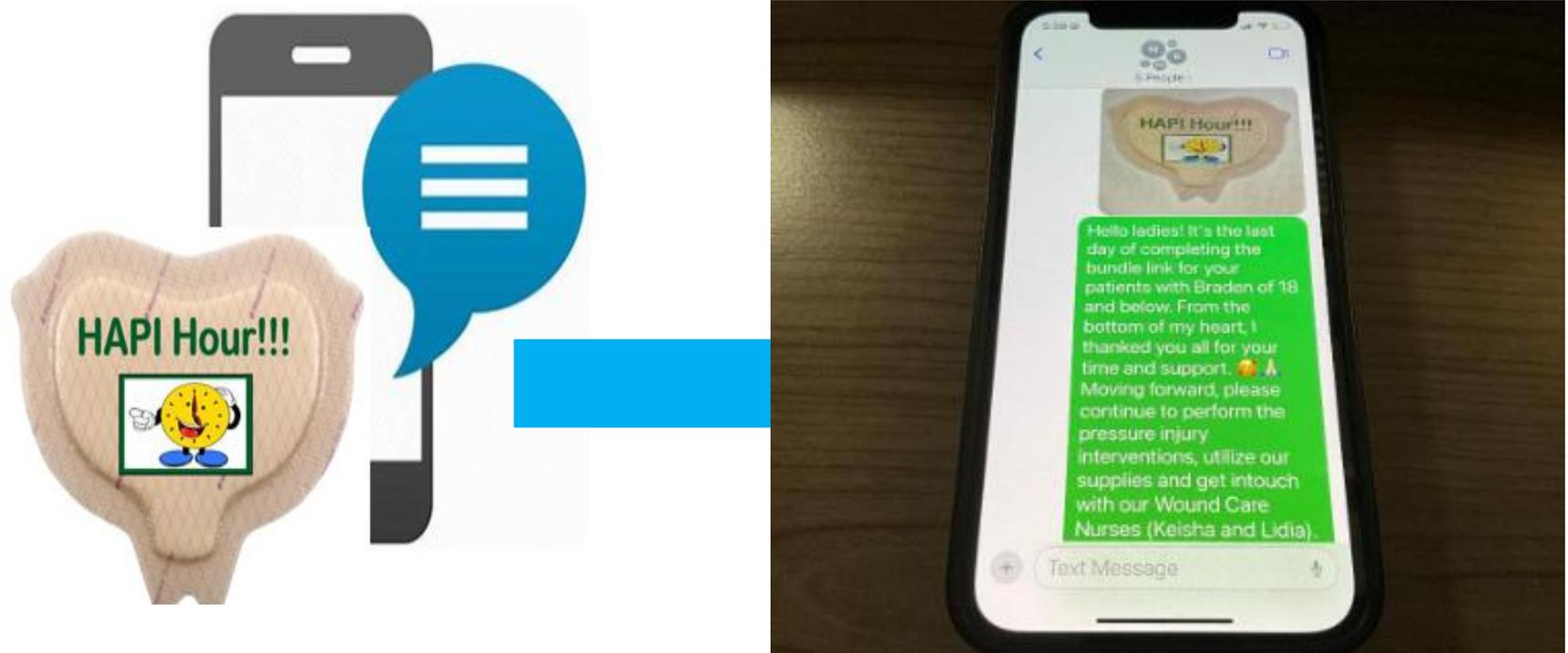
## PRESSURE INJURY PREVENTION BUNDLE

**Figure 10**

*Visual Reminder for the Pressure Injury prevention Bundle Process*



## PRESSURE INJURY PREVENTION BUNDLE

**Figure 11***HAPI Hour Reminder*

*Note:* The HAPI Hour reminder was sent once every shift (between 5 and 6 p.m. and 12 midnight and 1 a.m.).

## PRESSURE INJURY PREVENTION BUNDLE

## Appendix A

*Standardized Pressure Injury Prevention Protocol 2.0 Checklist Author Permission*William Vincent Padula <padula@usc.edu> To:  Quilao, Jacquelyn

Mon 4/10/2023 2:44 PM



Padula\_SPIPP JOCN 2018.pdf

565 KB



**CAUTION:** This message originated from a non-UMB email system. Hover over any links before clicking and use caution opening attachments.

Hi Jacquelyn,

Nice to hear from you. It would be absolutely fine to reference the SPIPP and use it for work on your doctorate. Some points of clarification...

- The SPIPP Checklist is initially referenced in this 2018 JCN paper (attached); this was based on the 2014 guideline from NPIAP/EPUAP/PPPIA
- The NPIAP updated the SPIPP Checklist in fall of 2022, referring to it as "SPIPP Checklist 2.0" which is available to download for free at the NPIAP website: <https://npiap.com/store/viewproduct.aspx?id=21538323>
- SPIPP 2.0 is based on the 2019 guideline from NPIAP/EPUAP/PPPIA – so reflects more currently best practice and a scientifically validated structure for implementation
- The SPIPP checklist 2.0 is currently under review with a peer reviewed journal, and hopefully will be available to reference during the course of your studies.
- We are working on specialized versions of SPIPP for different units (e.g. ICU, surgery, nursing home, LTC, etc.) – so keep an eye out in case some of these products better fit your research and practice needs in the future

Best,  
Bill

## PRESSURE INJURY PREVENTION BUNDLE

## Appendix B

*Pressure Injury Prevention Bundle Checklist Audit Tool*

PLEASE NOTE : DO NOT collect live data if project is in development mode .

Implementation of Pressure Injury Prevention Bundle in Surgical Intensive Care

Record ID 1

**PIP Bundle Checklist Audit Tool**

Record ID

1

Date

\* must provide value

 M-D-Y

First Initial of Last Name and Last 4 of MRN

Date of Admission or Transfer in SICU

 M-D-Y

**Assess risk factors for pressure injury to guide risk-based prevention**

- Significant current or anticipated mobility problems
- Use a structured risk assessment approach (e.g., Braden or other validated risk tool) on admission
- Reassess risk q shift and with significant change in condition
- Patient/family informed of PI risk and prevention plan
- Additional risk factors considered

**Assess Skin/Tissue for signs of skin damage and pressure injury**

- Assess skin (comprehensive, visual, palpation) upon admission and q shift for erythema, discoloration, and temperature
- Assess skin under medical devices q shift
- Inspect heels q shift
- In people of color: Ensure adequate lighting and moisten/moisturize skin to augment visual inspection
- Consider enhanced skin assessment methods- skin color chart

**Assess skin under medical devices q shift**

- Yes
- No

**Preventative Skin Care- Manage moisture/Incontinence**

- Cleanse and apply appropriate moisture barriers promptly after each incontinent episode
- Avoid use of alkaline soaps/cleansers
- Consider urinary/fecal management systems for high-risk persons
- Single layer, breathable, high absorbency pads for incontinence
- Consider using low friction textiles
- Apply wicking material to skin folds when appropriate

## PRESSURE INJURY PREVENTION BUNDLE

**Redistribute Pressure**

- Turn/reposition q 2-3 hours persons who do not have independent bed mobility and as required by individual needs and risk, unless contraindicated (Braden Activity/Mobility score  $\leq 2$ )
- Use high specification reactive foam or reactive air mattress/overlay for immobile persons (Braden Activity/Mobility score  $\leq 2$ )
- Use positioning aids that minimize friction/shear (pillows, wedges). Use turn/lift equipment if available. Proper side-lying position with upper leg over/in front of lower leg
- Keep head of bed as flat as possible
- Place silicone multilayer foam dressings on areas of high-risk (i.e., sacrum, lower buttocks, or heels) (Braden Activity/Mobility scores  $\leq 2$ )
- Elevate heels off bed with pillows, heel devices or boots (Braden Sensory Perception score  $\leq 3$ )
- Provide adequate repositioning (30 degree) when side lying
- Use slow, gradual, frequent, small, body shifts when unstable
- Use pressure redistributing seat cushion for persons who cannot adequately reposition independently
- Reposition seated persons q 1 hour
- Consult Physical Therapy for mobilization program when appropriate (Braden Activity/Mobility scores  $\leq 2$ )
- Consider reminder systems, pressure mapping, motion sensors
- Implement early mobilization program
- Screen for malnutrition using a validated tool on admission
- Consult dietitian for persons with or at risk of malnutrition, decreased nutrient intake, NPO > 48 hours, or presence of stage 2 or greater PI (Braden Nutrition Score  $\leq 2$ )
- Provide additional calories, protein, fluids, and additional nutrients (i.e., multi-vitamin, arginine, glutamine, HMB) per nutrition plan of care or as appropriate
- Continue to regularly assess goals and consult dietitian as needed

**Nutrition****Form Status**

Complete?

Complete 