Individual QI projects from single institutions

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Prevention of Pressure Ulcers in a Pediatric Cardiac Intensive Care Unit

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Abstract

Background: Pressure ulcer (PU) is an injury to skin or underlying tissue as a result of pressure or pressure with shear stress. We classify PUs by the level of tissue injury: stage I–IV, unstageable, suspected deep tissue injury. This quality project was aimed to reduce the incidence of PUs > stage II in the cardiothoracic intensive care unit. **Methods:** We reviewed PUs > stage II from March 2010 to December 2017. Interventions included: PU bundle (April 2010, revised January 2013); multidisciplinary huddles for PUs > stage II (October 2011); multidisciplinary weekly skin rounds (March 2010, revised August 2012); unit specific workgroup (October 2012); caregiver input form (December 2012). The PU bundle included diaper barrier cream, pulse oximeter probe rotation, turning schedule, pressure reduction surfaces, heel pressure release, head of the bed elevation. **Results:** Between 2010 and 2014, PUs decreased from 15.7 events per 1,000 patient days to a new baseline of 2.9 events per 1,000 patient days. We have sustained this rate for 3 years. PUs related to immobility decreased from 35 in 2010–2011 to 4 in 2016–2017. PU related to medical devices decreased from 34 in 2010–2011 to 15 in 2016–2017. **Conclusions:** Institution of PU bundle, multidisciplinary weekly skin rounds, and huddles for PUs > stage II reduced PUs related to immobility, allowed for earlier identification of stage II PUs and reduced stage III PUs. Challenges remain in reducing PUs related to medical devices. Importantly, we sustained this improvement over the past 3 years. *(Pediatr Qual Saf 2019;2:e162; doi: 10.1097/pq9.0000000000000162; Published online April 2, 2019.)*

INTRODUCTION

A pressure injury or ulcer is defined by the National Pressure Ulcer Advisory Panel (NPUAP) as localized damage to the skin and underlying soft tissue usually over a bony prominence or injury related to medical or other devices.[1] The injury occurs as a result of intense and/or prolonged pressure or pressure in combination with shear stress.[1] The NPUAP has defined pressure ulcers based on the level of tissue injury using a staging system with uniform terminology for consistency in reporting.[1] NPUAP defines a stage I injury as nonblanchable erythema of intact skin; stage II is partial-thickness skin loss with exposed dermis; stage III is full-thickness skin loss; stage IV is full-thickness skin and tissue loss; and a deep tissue injury is persistent nonblanchable deep red, maroon, or purple discoloration.[1] NPUAP defines an unstageable as obscured full-thickness skin and tissue loss.[1]

The prevalence of pressure ulcers in critically ill children widely varies and is reported at 0.8% to 27%.[2–4] Schindler et al[2] reported pressure ulcer incidence per 1,000 patient days from 9 pediatric intensive care units ranging from 2.47 to 57.1. Patients at then greatest risk are those requiring mechanical ventilation or inotropic support; those who suffer a cardiac arrest following cardiac surgery; neonates requiring extracorporeal membrane oxygenation; those with nutritional deficits, weight loss, or anasarca; and patients with longer hospital lengths of stay.[4–8] Medical device–associated pressure ulcers are frequent among pediatric patients with reported prevalence rates ranging from 50% to 69%.[2,3,9–21]

This quality project aimed to reduce the incidence of pressure ulcers > stage II in the cardiothoracic intensive care unit (CTICU) and, more importantly, sustain the reduction over time.

METHODS

Ethical Issues

This quasi-experimental quality improvement work involved the development of a process to reduce pressure

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Preliminary data presented at the Pediatric Cardiac Intensive Care Society Meeting in 2012.

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ulcers. No interventions involved a comparison of multiple devices or therapies, and patients were not subject to randomization. Medical records were accessed by healthcare staff and quality improvement team members as part of their normal responsibilities. Per policy, this project does not meet the definition of human subjects' research. Therefore, institutional review board review was not required.

Setting

Nationwide Children's Hospital is an academic, nonprofit, freestanding children's hospital located in Columbus, Ohio. The CTICU is a 20-bed unit with over 600 admissions per year. The top 5 most common admission diagnoses are postoperative ventricular septal defect repair, hybrid palliation stage I, hybrid palliation comprehensive stage II, pulmonary valve replacement, and Fontan procedure. Approximately, 10% of our admissions are newborns, defined as less than 30 days of age. The CTICU staff includes a multidisciplinary team of critical care and cardiology physicians (n = 8), advanced nurse practitioners (n = 10), a dedicated clinical pharmacist (n = 1), registered nurses (n = 61), respiratory therapists (n = 14), cardiology and critical care physicians in fellowship training, clinical dieticians (n = 3), physical and occupational therapists, child life specialist, and social worker.

Planning the Intervention

We recruited a multidisciplinary team to develop and implement standardized surveillance of pressure ulcers in the pediatric CTICU. The team included physicians, advanced nurse practitioners, nursing, respiratory therapists, and quality team representatives. We began by creating a SMART (specific, measurable, achievable, realistic, timely) aim statement and key driver diagram.[21] We identified patient factors, staff and family education, staff accountability, communication, and collaboration among the key stakeholders, standardized guidelines, specific documentation and follow-up, data/compliance analysis, and measurable outcomes as the relevant key drivers.

Interventions

In March 2010, the hospital instituted multidisciplinary weekly skin rounds attended by the bedside nurse, unit specific pressure ulcer nurse champion, respiratory therapist, wound ostomy nurse, and quality improvement representative. Subsequently, hospital leadership implemented a hospital-wide pressure ulcer bundle in April 2010. Pressure ulcers hospital-wide are staged by the wound team. The pressure ulcer bundle included: (1) barrier cream use for diapered patients; (2) pulse oximeter probe rotation every 8 hours; (3) patient turning schedule every 2 hours; (4) use of pressure reduction surfaces; (5) heel pressure relief; (6) elevation of head of the bed; and (7) wound ostomy nurse consult for all pressure ulcers > stage II. A multidisciplinary team reviewed all pressure ulcers > stage II identified during huddles beginning in October 2011. Huddle team members included a representative from each of the following: physician, advanced nurse practitioner, pharmacist, clinical nurse leader, bedside nurse, respiratory therapist, and quality project manager. This group collaborated to review events and suggest interventions in a factual, blameless, nonthreatening environment. It was beneficial to have multiple disciplines involved in the review process, as each discipline looked at the event from their unique perspective. Huddles are organized by the clinical nurse leader with the goal to occur within 2 weeks of the event. The huddle process starts with a chart review of events leading to the pressure ulcer and caregiver input regarding attributable clinical or situational factors. The goal of each huddle was to identify factors that may have contributed to the pressure ulcer and interventions aimed at preventing event recurrence with consensus agreement of the huddle participants. Representatives from the huddle would then communicate and discuss their findings and proposed interventions with the CTICU staff via email and staff meetings. The CTICU quality committee created in spring 2010, with accountability for guiding improvement and quality process education, would assist the staff in the implementation of the interventions as appropriate. Also, the CTICU quality committee periodically updates a bulletin board with actual photographs of pressure ulcers in our patients (with parental approval) in the CTICU staff-only area as a visual tool to raise staff awareness and engagement.

The first Plan-Do-Study-Act Cycle (August 2012) aimed to increase participation in the multidisciplinary weekly skin rounds. The day and time of skin rounds were changed to accommodate the multidisciplinary staff members. A nurse and advanced nurse practitioner champion receive dedicated nonpatient care hours to work on pressure ulcer prevention. Therefore, they are always available to participate in weekly skin rounds and pressure ulcer huddles and represent the unit at the institutional pressure ulcer meetings. They also participate in the creation, education, and monitoring of action plan compliance, and coaching, mentoring, and collaborating with other stakeholders.

The second Plan-Do-Study-Act Cycle (October 2012–December 2012) includes the creation of a multidisciplinary (physician, bedside nurse, advanced nurse practitioner, respiratory therapist, and quality representative) unit specific pressure ulcer work group to discuss leadership involvement, bedside accountability, and develop patient-specific interventions. This group developed the caregiver input form (Fig. 1) that allows all caregivers to provide input on the cause and potential prevention of each pressure ulcer.

After review of our pressure ulcers from 2012, the third Plan-Do-Study-Act Cycle (January 2013) was a revision of the pressure ulcer bundle. Secondary to the increased incidence of medical device–related pressure ulcers, the following interventions were added: (1) a head-to-toe skin assessment every 12 hours; (2) removal of each

Pressure Ulcer Caregiver Input Document

There is a Pressure Ulcer on _____ (patient's name), _____ (medical number) with an identifcation date of _____. You are being contacted because frontline staff often has knowledge on ways to prevent future Pressure Ulcers. Your responses are confidential. **Let our team know about any factors you think could have contributed to this Pressure Ulcer. Please answer the following questions below and include any additional comments. Please return within 3 days to your Nurse Manager or Clinical Leader.**

	Yes	No	NA	Comments
1. Were there patient-specific issues that contributed to the injury? If so, what were those issues?				
2. Were there patient-specific issues that prevented proper turning?				
3. Were there any supply/material/device/environmental issues? (ie. proper bed not available)				
4. Were there problems with resources such as inadequate staffing that contributed to the injury? If yes, please explain.				
5. Can you identify any sources you used to prevent pressure injuries? (ie. Z-flow positioner, mepilex lite)				
6. Did you inspect around all medical devices? Any redness or breakdown noticed?				If Yes CHECK ALL THAT APPLY ____Patient ID bands ____IV/CVL sites ____NG/NJ tubes ____ETT/Trach ____Urinary Catheter ____Pulse Ox ____NCPAP/BIPAP ____Chest Tubes ___ TED hose/SCDs ____ECMO cannula/VAD ____Temp Probe ____Other
7. Do you have any comments on how this Pressure Ulcer may have occurred or how it might have been prevented?				

Caregiver Role				Comments and Additional Insights
RN ___ MD ___ RT ___ APN ___				

Thank you for your valuable time and insight.
Program Manager **Date:**

Fig. 1. Caregiver input form.

respiratory device every 4 hours to monitor for pressure injury or skin breakdown; and (3) skin inspection around each medical device including all lines, tubes, and drains every 12 hours.

Method of Evaluation and Analysis

Random monthly nursing audits tracked pressure ulcer bundle compliance. Each component of the bundle is tracked for appropriate documentation in the electronic medical record.

RESULTS

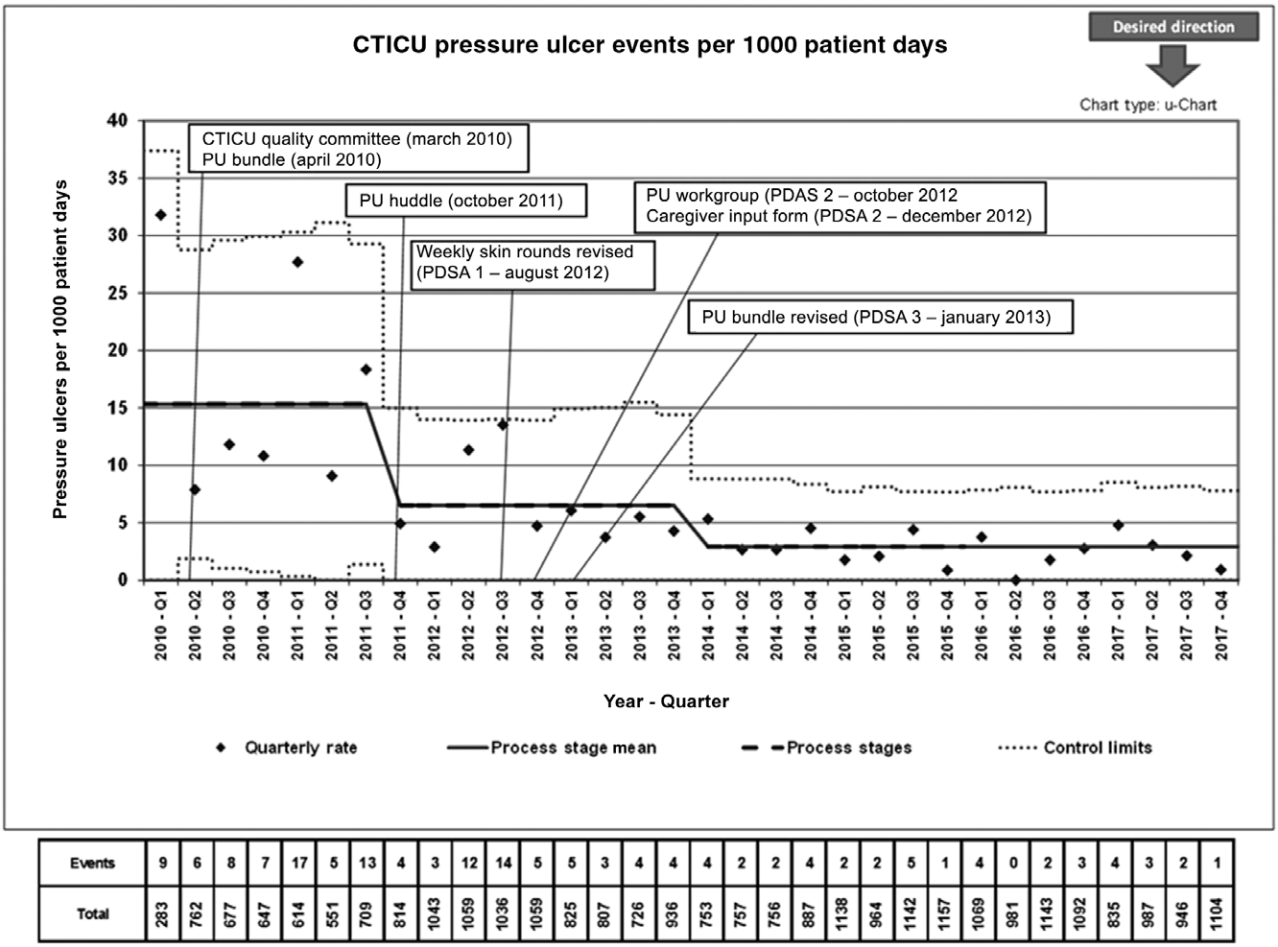
Between 2010 and 2014, pressure ulcers > stage II in the CTICU decreased from 15.7 events per 1,000 patient days to a new baseline of 2.9 events per 1,000 patient days. We sustained this new rate for 3 years (Fig. 2). The severity of pressure injury events also reduced over time with only one stage III pressure ulcer in 3 years (Fig. 3). Pressure ulcers related to immobility decreased. Pressure ulcers related to medical devices also decreased but not as markedly (Fig. 4).

Compliance

Figure 5 depicts the overall compliance with the pressure ulcer bundle elements. Compliance with the following individual components of the pressure ulcer bundle are consistently greater than 90% and near 100% for 2017: wound ostomy nurse consult, skin inspection, pressure reduction surface usage, heel pressure relief, head-to-toe assessment, and barrier cream use. Notably, removal of respiratory devices every 4 hours for pressure-related skin breakdown assessment is the least compliant bundle element followed by scheduled turning and pulse oximeter rotation. These 3 components of the pressure ulcer bundle consistently have suboptimal compliance with only minimal improvement over the years as shown in Figure 6.

DISCUSSION

Using quality methodology we were successful in reducing pressure ulcers > stage II causing patient harm and have sustained the reduction for 3 years. "Zero Hero" is our previously published institutional goal of striving for zero preventable harm events.[22] The philosophy is the belief that system failures require corrective action plans including an "owner," timeline, and a monitoring plan. The hospital leadership valuing quality improvement, transparency, and individual unit accountability was the foundation for this hospital-wide quality initiative. Hospital-wide multidisciplinary quality process education was mandatory for all staff. Hospital-wide behavioral



	2010 - Q1	2010 - Q2	2010 - Q3	2010 - Q4	2011 - Q1	2011 - Q2	2011 - Q3	2011 - Q4	2012 - Q1	2012 - Q2	2012 - Q3	2012 - Q4	2013 - Q1	2013 - Q2	2013 - Q3	2013 - Q4	2014 - Q1	2014 - Q2	2014 - Q3	2014 - Q4	2015 - Q1	2015 - Q2	2015 - Q3	2015 - Q4	2016 - Q1	2016 - Q2	2016 - Q3	2016 - Q4	2017 - Q1	2017 - Q2	2017 - Q3	2017 - Q4
Events	9	6	8	7	17	5	13	4	3	12	14	5	5	3	4	4	4	2	2	4	2	2	5	1	4	0	2	3	4	3	2	1
Total	283	762	677	647	614	551	709	814	1043	1059	1036	1059	825	807	726	936	753	757	756	887	1138	964	1142	1157	1069	981	1143	1092	835	987	946	1104

Fig. 2. Annotated run chart demonstrating an initial reduction in the incidence of pressure ulcers > stage II with a sustained reduction over the past 3 years. PDSA, Plan-Do-Study-Act.

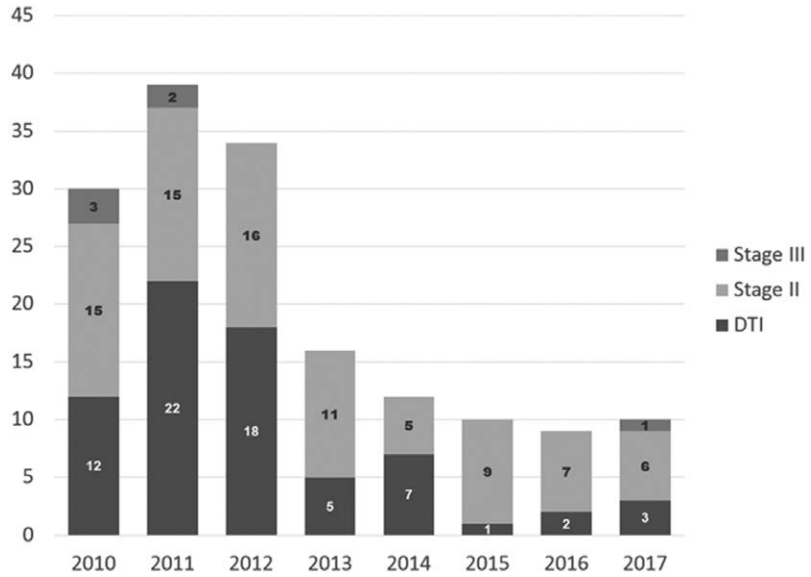


Fig. 3. The severity of pressure ulcer events. DTI, deep tissue injury.

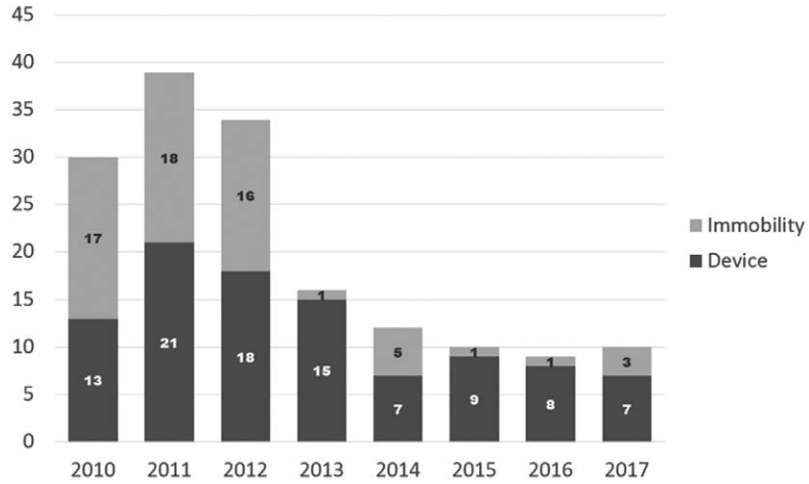
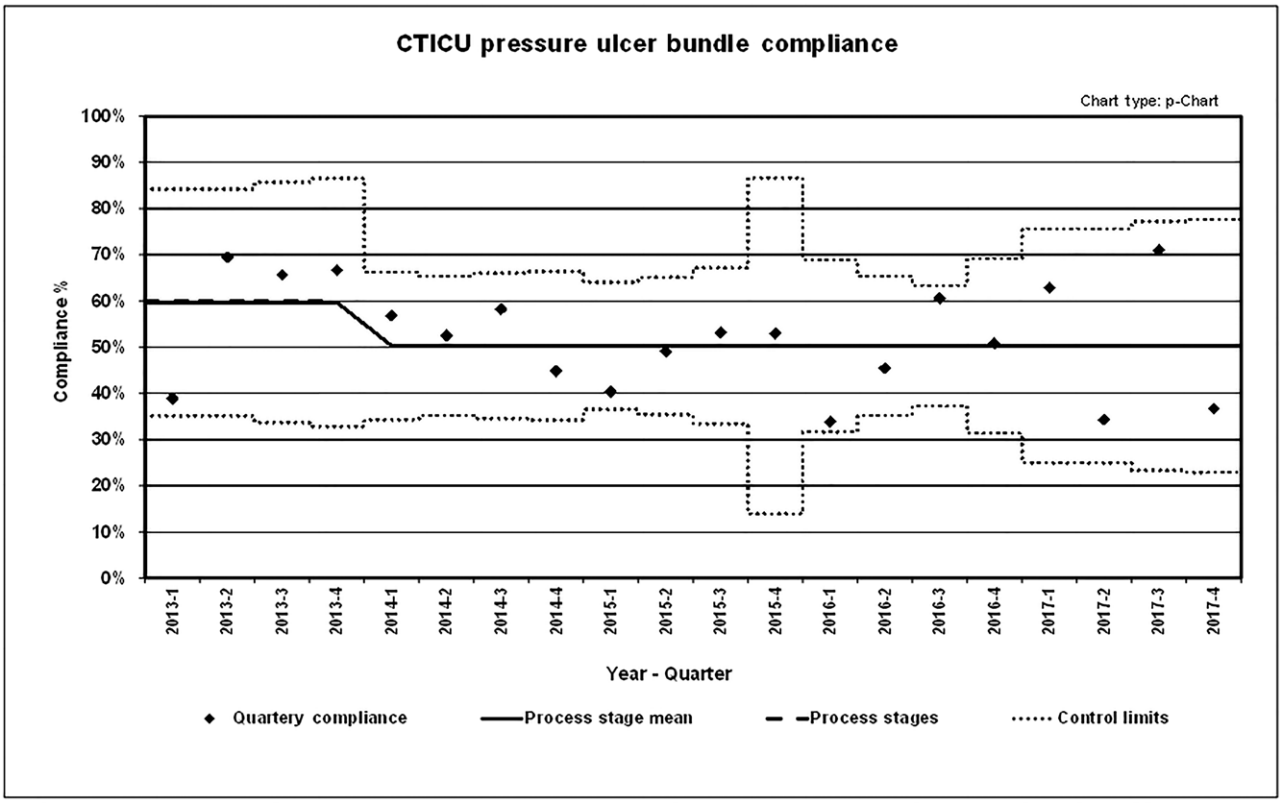


Fig. 4. Pressure ulcers due to immobility and medical devices.



Compliant	14	25	21	20	50	52	53	39	48	50	42	9	22	45	80	32	22	12	22	11
Total	36	36	32	30	88	99	91	87	119	102	79	17	65	99	132	63	35	35	31	30

Fig. 5. Overall compliance with the pressure ulcer bundle.

expectations included making a personal commitment to safety, accountability for clear, complete communication, and supporting a questioning attitude.[22]

The CTICU pressure ulcer bundle complies with the Children's Hospital's Solutions for Patient Safety pressure ulcer prevention bundle recommendations.[23] In addition to the Solutions for Patient Safety bundle elements, the CTICU has unit specific interventions. An early unit specific intervention was the creation of a multidisciplinary CTICU quality committee with unit champions that enabled all CTICU staff members to become accountable and active participants in the quality improvement process. A work group from this committee is responsible for the evaluation and reduction of pressure ulcers resulting

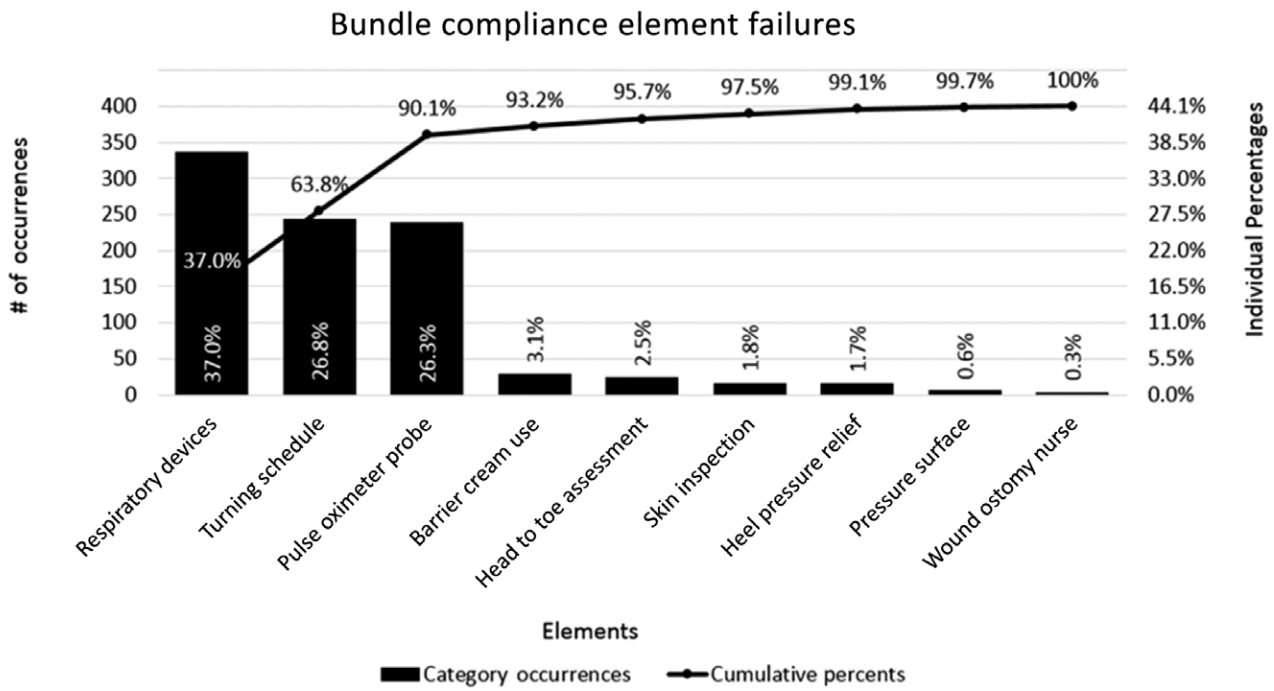


Fig. 6. Pareto chart of the individual bundle element compliance failures. Note: Adjacent bars of the same pattern are statistically equal ($\alpha = 0.01$). Any differences in height should be considered random.

in patient harm in the CTICU. Institutional quality improvement measures posted on the intranet are markers of internal and external transparency. Unit-based quality improvement measures appear on bulletin boards in prominent public places in every unit.

Perpetual education cycles, continual real-time feedback during weekly skin rounds, transparency with quality process measures, and accountability are imperative for sustainable success. The nonpunitive huddle process and the bulletin board with actual photographs of pressure ulcers in our patients as a visual tool are effective in raising staff awareness and engagement. Review of pressure ulcers resulting in patient harm in the first several months following the first set of interventions resulted in robust discussions of the situation surrounding the pressure ulcer, possible confounding factors, and additional potential interventions.

Pressure ulcer bundle compliance for the individual components that were already a part of routine charting (ie, no additional charting was required) was better compared with those elements that require additional charting. The bundle elements part of routine charting included: skin inspection, pressure reduction surface, head-to-toe assessment, and barrier cream use. Heel pressure relief was utilized only in muscle-relaxed patients who comprised only a very small number of patients. The bundle elements that require additional charting include turning schedule, respiratory devices, and pulse oximeter probe rotation. Secondary to the reduction of pressure ulcers in the CTICU, we speculate that compliance with these bundle elements occur more frequently than the audits would suggest. We believe that failure to appropriately chart these elements contributed more to the poor compliance issue rather than bundle element execution.

These interventions were successful in reducing pressure ulcers secondary to immobilization; however, pressure ulcers secondary to medical devices remain challenging. To address this ongoing problem, we recently adopted the practice of utilizing a thin layer of Mepelex (Mölnlycke Health Care, Norcross, Ga.) as a barrier between the respiratory device (CPAP or BiPAP mask) and the patient's skin as well as removing the mask for detailed skin assessment every 4 hours. At this time if there is evidence of pressure injury, the clinical team discusses the utilization of a different mask type.

LIMITATIONS

This work was done using quality improvement methodology, and therefore no control group. Multiple interventions were undertaken simultaneously with no attempt made to ascertain which intervention was most or least effective. This quality initiative performed in a single unit utilizing specific interventions designed to address specific areas of weakness. Therefore, this may not be fully generalizable to other units. However, the quality improvement methodology utilized is valuable to all.

CONCLUSIONS

Education and process improvement strategies directed specifically at reducing pressure ulcers and staff

engagement were successful in reducing pressure ulcers causing patient harm. We sustained the reduction in pressure ulcers for 3 years. Further steps include continued vigilance with reporting of pressure ulcer events, interventions aimed at the reduction of pressure ulcers caused by medical devices and huddles to strive for "Zero" patient harm events.

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DISCLOSURE

The authors have no financial interest to declare in relation to the content of this article.

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