The Turn Team: A Novel Strategy for Reducing Pressure Ulcers in the Surgical Intensive Care Unit

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BACKGROUND: Pressure ulcers cause significant morbidity and mortality in the surgical intensive care unit (SICU). The purpose of this study was to determine if a dedicated team tasked with turning and repositioning all hemodynamically stable SICU patients could decrease the formation of pressure ulcers.

STUDY DESIGN: A total of 507 patients in a 20-bed SICU in a university hospital were assessed for pressure ulcers using a point prevalence strategy, between December 2008 and September 2010, before and after implementation of a team tasked with turning and repositioning all hemodynamically stable patients every 2 hours around the clock.

RESULTS: At baseline, when frequent turning was encouraged but not required, a total of 42 pressure ulcers were identified in 278 patients. After implementation of the turn team, a total of 12 pressure ulcers were identified in 229 patients ($p < 0.0001$). The preintervention group included 34 stage I and II ulcers and 8 higher stage ulcers. After implementation of the turn team, there were 7 stage I and II ulcers and 5 higher stage ulcers. The average Braden score was 16.5 in the preintervention group and 13.4 in the postintervention group ($p = 0.04$), suggesting that pressure ulcers were occurring in higher risk patients after implementation of the turn team.

CONCLUSIONS: A team dedicated to turning SICU patients every 2 hours dramatically decreased the incidence of pressure ulcers. The majority of stage I and stage II ulcers appear to be preventable with an aggressive intervention aimed at pressure ulcer prevention. (J Am Coll Surg 2013; 216:373–379. © 2013 by the American College of Surgeons)

Critically ill patients are at high risk for developing unit-acquired pressure ulcers.[1,2] The increased risk of circulatory impairment from immobility, hemodynamic instability, exposure to vasopressor therapy, altered sensory perception, and organ failure all contribute to this increased risk. Once considered an inevitable consequence of long-term ICU or hospital care, many pressure ulcers are now understood to be avoidable.[3]

More than 2.5 million patients in United States acute care facilities suffer from pressure ulcers, and 60,000 die from pressure ulcer complications each year.[4] Pressure ulcers represent 1 of the 5 most common harms experienced by patients in health care facilities.[5] Pressure ulcers are common in adult ICUs, with rates ranging from 8.8% to 23% depending on ICU type examined.[4,6-8] Based on their severity, pressure ulcers are categorized as stage I to stage IV, deep tissue injury, or unable to stage, according to a system devised by the National Pressure Ulcer Advisory Panel.[9] Of note, in an observational cross-sectional trial of more than 90,000 patients across the United States in 2009, a total of 3.3% of pressure ulcers in ICUs were considered "severe," defined as stage III, stage IV, unable to stage, or deep tissue injury.[4]

Precisely which pressure ulcers are preventable is unclear. The Centers for Medicare and Medicaid Services have declared that stage III and stage IV ulcers represent a "never event," and do not reimburse hospitals for their development.[10] Similarly, the National Quality Forum endorses measurement of the prevalence of stage II or greater pressure ulcers as a performance measure.[11] The Centers for Medicare and Medicaid Services definition

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of avoidable pressure ulcers is specific to long-term care and states that the health care facility fails to evaluate the patient's clinical condition and risk factors, fails to implement interventions consistent with patient's needs and standards of practice, and fails to monitor, evaluate, and revise interventions.[12] Subsequent expert opinion has defined avoidable pressure ulcers as ones in which the provider did not evaluate an individual's clinical condition and risk, define and implement interventions specific to an individual's needs or recognized practice, and monitor and revise interventions if appropriate.[3]

A patient's risk for developing a pressure ulcer can be ascertained by calculating a score on the Braden scale.[13,14] This widely used and validated tool assays patient sensory perception, activity, and mobility to determine intensity and duration of pressure exposure and also assays nutrition, moisture, and friction or shear to determine tissue tolerance for pressure.[15,16] The Braden score ranges from 6 to 23 (lower scores indicate higher risk), with scores less than 18 representing a patient at risk of developing a pressure ulcer.

Although not all pressure ulcers are preventable, a number of strategies have been proposed to decrease their development. Turning and repositioning immobile patients can be beneficial by removing pressure from vulnerable tissue. Although the optimal frequency of turning is unclear,[17,18] a recent consensus statement on pressure ulcer prevention supported turning patients every 2 hours as a guideline; however, this was not supported as a standard of care.[3] Unfortunately, hemodynamic instability can be exacerbated by turning patients, which can lead to increased risk in this patient population,[19,20] as can the presence of medical devices (endotracheal tubes, nasogastric tubes, blood pressure cuffs) in critically ill patients.[21] Other key features that have been shown to decrease risk of pressure ulcers include use of low-pressure mattresses, implementing a standard protocol of care, and increasing staff awareness with feedback of pressure ulcer rates to the staff.[22-26] Following these evidenced practices has led to significant reductions of pressure ulcers in multiple health care settings.[27-30]

This study tested the hypothesis that implementation of a dedicated turn team responsible for turning and repositioning all hemodynamically stable patients every 2 hours would decrease pressure ulcer formation in the SICU.

METHODS

Location

The study took place in a 20-bed SICU contained within Emory University Hospital, a 579-bed academic hospital. The routine patient population in the SICU includes general surgery, solid organ transplant (liver, kidney, pancreas, hand), ENT, and urology patients. The nurse:patient ratio was 2:1 throughout the course of the study, although a minority of the sickest patients received 1:1 staffing. Two patient care assistants (PCAs) staffed the SICU on all shifts.

Baseline data collection

At baseline, the bedside nurse was encouraged to perform frequent turning and repositioning of patients, but there was no standard frequency for this to occur. Between December 2008 and March 2010, audits were performed to measure the incidence of pressure ulcers. A point prevalence approach was used whereby all patients in the SICU on a given day were examined for the presence of pressure ulcers. Initially, audits were performed quarterly but then increased in frequency to biweekly. A total of 15 audits were done. As such, there were 15 different days before the intervention detailed below in which every patient in the SICU was evaluated for the presence of pressure ulcers. At the initial stages of data collection, data were collected once every 3 months, but by the end of data collection, data were collected every other week. Although nurses charted whether or not patients had pressure ulcers as part of their daily assessment between audits, no formal information was collected on the incidence of pressure ulcers outside of the 15 days in which audits were performed. All audits were performed by a clinical nurse specialist (MDS) and were staged according to the National Pressure Ulcer Advisory Panel's staging of ulcer criteria. The anatomic location of all pressure ulcers was also recorded.

Intervention

After determining that pressure ulcer rates were higher than desired based on the above audits, an intervention was designed with the intent of lowering their incidence. First, to ensure consistency in assessment and repositioning, all registered nurses (RNs) and PCAs received online training in pressure ulcer prevention and Braden Scale scoring. Next, all PCAs underwent further training in turn mechanics. After this training, a team of 2 PCAs (the "turn team") were tasked with turning and repositioning all hemodynamically stable patients every 2 hours, around the clock. Hemodynamic stability was defined as systolic blood pressure > 90 mmHg, heart rate with normal sinus or nonlife threatening rhythm, and oxygen saturation by pulse oximeter (SpO_2) $> 88\%$ or recovery to normal range within 2 to 5 minutes. Before turning a patient, the PCAs on the turn team checked with the bedside nurse to determine if the patient was hemodynamically unstable or if there was some other

contraindication to turning the patient. Turns were not done in patients whom the nurse classified as either hemodynamically unstable or having another contraindication to turning, and patients were then reassessed for suitability for turning every 2 hours thereafter.

After development of the turn team, all patients in the SICU were examined for pressure ulcers on a weekly basis for a total of 15 weeks between April 2010 and September 2010 by the same clinical nurse specialist who performed the preintervention audits. As such, there were 15 different days after the intervention in which every patient in the SICU was evaluated for the presence of pressure ulcers. Although data collection was done more frequently after the intervention than before the intervention, an identical number of days were assayed both before and after the implementation of the turn team in which every patient in the SICU was examined for the presence of a pressure ulcer. Similar to the preintervention, although nurses charted whether or not patients had pressure ulcers as part of their daily assessment between audits, no formal information was collected on the incidence of pressure ulcers outside of the 15 days in which audits were performed. In both pre- and postintervention groups, if a patient was present in the SICU for more than a single assessment, the patient was counted only a single time and was assigned the worst outcome of all the assessments (ie, if a patient had a pressure ulcer that progressed between first and second assessment, the higher stage would be recorded). In both the pre- and postintervention groups, every patient in the SICU was assessed for the presence of pressure ulcers on the days when audits were performed, and no patients were excluded from the final analysis.

Throughout the course of the study, the bed a patient was placed on was protocolized. The majority of patients were placed on an AccuMax 9000 pressure relief mattress (Encompass). Specialty beds were used by protocol for specific medical conditions (eg, acute respiratory distress syndrome) or types of patients (eg, bariatric patients). Of note, the protocolized decision tree that determined on which bed a patient was placed was identical in the pre- and postintervention phases of the study. Emory University's institutional review board approved the study and waived the requirement for obtaining written informed consent.

Statistics

Data were analyzed using statistical software program GraphPad Prism 5.0 for Windows, (GraphPad Software). Comparison groups were analyzed using either unpaired *t*-test or Fisher's exact test depending on data type. Welch correction was applied to the *t*-test for the Braden score due to unequal variances in the populations. A p value < 0.05 was considered statistically significant.

RESULTS

Baseline pressure ulcer rates

Before initiation of the turn team, there were a total of 42 pressure ulcers identified in 278 patients. An average of 2.8 pressure ulcers were identified each time the SICU was assessed for ulcer prevalence (range 0 to 7/audit day). Most of these were stage II ulcers (Table 1) and were located on the sacrum or buttocks (Table 2). Of note, a total of 4 patients in this cohort had 2 pressure ulcers.

Effect of turn team on pressure ulcer rates

After initiation of the turn team, there were a total of 12 pressure ulcers identified in 229 patients. An average of 0.87 pressure ulcers were identified each time the SICU was assessed for ulcer prevalence (range 0 to 2/audit day, $p < 0.0001$, Fig. 1). Although the number of advanced pressure ulcers was similar before and after implementation of the turn team, there was a marked decrease in stage I and stage II ulcers after the intervention (Table 1), suggesting that the turn team decreased the formation of earlier stage pressure ulcers. Of note, a single patient in this cohort had a sacral wound and developed a separate heel ulcer 20 days later. The anatomic site of pressure ulcers after implementation of the turn team was generally similar to the preintervention group, with the sacrum and buttocks being the most common location for development of pressure ulcers (Table 2). No significant complications from turning were documented after the implementation of the turn team.

Characteristics of patients with pressure ulcers

The vast majority of patients who developed pressure ulcers required mechanical ventilation and vasopressors (Table 3). Additionally, patients with pressure ulcers had prolonged SICU stays, with the average length of stay nearly 1 month. Patients who developed pressure

Table 1. Prevalence of Pressure Ulcers before and after Implementation of the Turn Team

Stage	Preintervention, n	Postintervention, n
Stage I	7	2
Stage II	27	5
Stage III	1	0
Stage IV	0	1
Deep tissue injury	4	3
Unstageable	3	1
Total	42	12

Table 2. Anatomic Location of Pressure Ulcers

	Preintervention		Postintervention	
Location	**n**	**%**	**n**	**%**
Sacrum	17	41	4	33
Buttocks	11	26	2	17
Heel	4	10	2	17
Tracheostomy site	3	7	0	0
Leg/finger/toe	3	7	2	17
Occiput	2	5	0	0
Ear	1	2	0	0
Lip	1	2	0	0
Nare	0	0	1	8
Penis	0	0	1	8
Total	42		12	

ulcers after the development of the turn team had significantly lower Braden scores than those who developed pressure ulcers before the intervention ($p = 0.04$).

DISCUSSION

This study demonstrates that implementation of a team responsible for turning patients every 2 hours dramatically decreased the incidence of pressure ulcers in a SICU. Notably, there was a marked diminution of stage I and stage II ulcers in lower risk patients.

There are a number of potential implications of this study. First, nearly all pressure ulcers prevented in the study were early stage. Before the intervention, 34 stage I and II ulcers were detected, and 8 severe ulcers (stage III or greater) were detected in 278 patients. In contrast, after implementation of the turn team, 7 stage I and II ulcers were detected, and 5 severe ulcers were detected in 229 patients. This strongly suggests that stage I and II ulcers are preventable with frequent turning, while advanced ulcers may not be preventable. This is counter to the Centers for Medicare and Medicare Services definition of pressure ulcers of stage III or greater as "never events," and suggests that the ulcers being targeted as preventable may be the ones that are unavoidable. We suspect the reason for this is that hemodynamically unstable patients were excluded from being turned in light of concerns that this could acutely worsen their clinical status. This is supported by the fact that 100% of patients who developed pressure ulcers after implementation of the turn team required vasopressor support to keep their mean arterial blood pressure > 65 mmHg, meaning that each of them would have been excluded from turning based on their hemodynamic instability.

The data also show that the average Braden score in patients who developed pressure ulcers was significantly lower after implementation of the turn team, meaning these patients were at higher risk of developing pressure ulcers. This is consistent with the fact that patients who developed pressure ulcers after implementation of the turn team had a higher incidence of vasopressor use and were older.

Between one-half and two-thirds of pressure ulcers in both the pre- and postintervention groups were on the sacrum or buttocks (67% in the pre group, 50% in the post group). This is consistent with previous findings that the sacrum and buttocks are the most common location for ICU-acquired pressure ulcers.[4] Although sacral and buttocks ulcers represented a significant proportion of ulcers both before and after implementation of the turn team, the actual number of sacral or buttocks ulcers

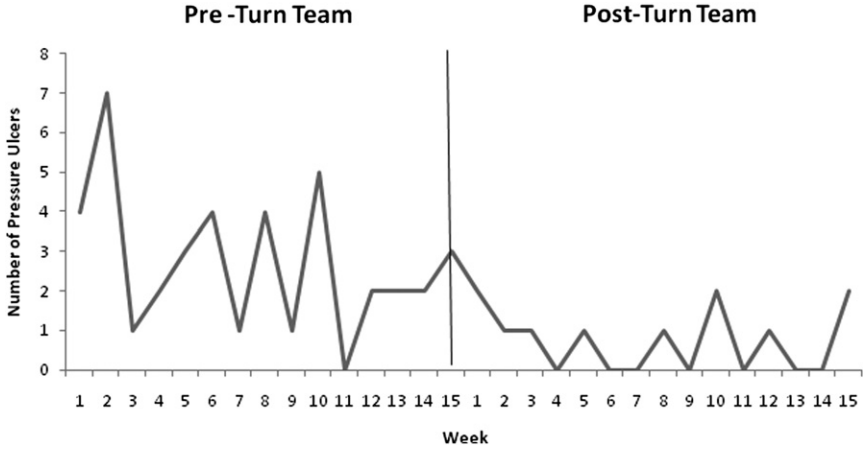

Figure 1. Number of pressure ulcers detected before and after implementation of the turn team. At each of the times audits were performed (15 pre- and 15 postintervention), all patients in the surgical ICU (SICU) were assessed for the presence of pressure ulcers. The y axis depicts the total number of pressure ulcers found across the SICU on each audit day.

Table 3. Demographics of Patients Who Developed Pressure Ulcers

Demographic	Preintervention	Postintervention	p Value
Age, mean, y	57	65	0.03
Length of stay, mean, d	28.4	26.0	0.50
Mechanical ventilation, mean, %	86	83	1.0
Vasopressor use, mean, %	71	100	0.049
Braden score, mean	16.5	13.4	0.04
Serum albumin, mean, g/dL	2.4	2.1	0.28

decreased from 28 before implementation of the turn team to only 6 after its initiation. This is consistent with the theoretical benefit of both turning and repositioning to prevent pressure on fragile skin surfaces. It is also consistent with the observation made in other ICUs[31] that despite best efforts, critical care nurses may not have been routinely turning or repositioning their patients during the baseline period of data collection. Of note, the increased use of supportive devices in the SICU setting (endotracheal tubes, nasogastric tubes, nasal cannulas) can also lead to increased incidence of pressure ulcers in areas subjected to constant pressure from these devices such as the lip or nose. However, device-related ulcers were not found to be a significant source of ulcers either before or after the implementation of the turn team.

Pressure ulcers are costly to patients in terms of pain, body image, and potential prolongation of hospital care.[29] In addition, with increasing attention paid to the cost of health care in the United States,[32] pressure ulcers pose a significant financial burden to the health care system. Although the precise cost of pressure ulcers remains unclear, estimates for the daily cost of care range from $500 to $5,000 depending on the severity of the ulcer.[4] Using the lowest cost estimate of $500/day, prevention of a single ulcer in a patient population with an average length of stay of approximately 28 days (Table 3) would result in cost savings of $14,000. A decrease of 25 pressure ulcers/year (less than that seen in our point prevalence study) would result in cost savings of $350,000 a year. Although this must be balanced against the salary and benefits of the PCAs on the turn team, it suggests that the turn team is a cost-effective strategy to decrease pressure ulcers. In order to operationalize a functioning turn team 24 hours a day, 7 days a week, options include hiring new PCAs dedicated exclusively to turning patients, repurposing existing PCAs by changing their job duties (the strategy we used), or a combination of these two. As such, even if a turn team required hiring an entirely new staff (which it did not), the return on investment would still be significant, and the financial outlay required to prevent pressure ulcers would be justifiable.

In order to more fully understand the challenges and opportunities related to sustaining the turn team effort, it is appropriate to summarize here 2 years worth of extended follow-up after the study's conclusion. The turn team, as outlined throughout the manuscript, was in existence for the 15 weeks of the study. Despite its success in dramatically lowering pressure ulcer rates, it required the resources of the 2 PCAs, whose job became primarily starting at one end of the ICU, turning a patient, moving on to the next bed, turning that patient, etc, until they reached the end of the ICU and then starting over again. Although there are arguments supporting the viability of this strategy both in terms of patient safety and in terms of fiscal outlay, at the end of the 15 weeks of study, a decision was made to alter the composition of the turn team to include a single PCA and the bedside nurse. This freed up 1 PCA to do more work while adding a modest amount of work for the bedside nurses, who were then responsible for turning their 2 patients every 2 hours (rather than a PCA who was responsible for turning up to 20 patients). As such, the turn concept remained, but the turn team was reconfigured to include 1 PCA and 10 to 12 different bedside nurses. Initially, this new variant of the turn team (1 PCA, 1 nurse) was successful, with continued low rates of pressure ulcers. Over time and with a change in the SICU nursing director, there was some "creep" in PCA responsibility as they were given additional tasks, and turning was not the sole priority for any PCA. With this, pressure ulcer rates increased over time. In turn, this led to a formal reinvigoration of the modified turn team (1 PCA and a bedside nurse) in October, 2011, with subsequent drops in rates.

Although weekly audits over the past 2 years support the concept that a variant of the turn team is associated with low pressure ulcers rates, we have chosen not to include the actual data because it would be difficult to compare with information contained in the results for a number of reasons. First, although the turn team, as constituted in the Results section (2 PCAs), was easily measurable, we cannot give a specific date on which the nurses or PCAs began taking on additional tasks. Next, we now keep records of all pressure ulcers on admission to the SICU, so it would be expected that our rates would be different than when we did not record pressure ulcers on admission. Finally, over the timeframe outlined in the Results section, pressure ulcers were recorded by a single individual (MDS). She has now trained a team of 6 registered nurses to assess for pressure ulcers, and although the assumption is that pressure ulcers are being assayed similarly, independent

of who is staging them, the introduction of 5 new providers to stage the ulcers introduces a variable that did not exist during the study. Put together, we can state in broad terms that when a focused variant of the turn team has been in place, our rates have been low and when that focus has been altered somewhat, our rates have been higher, which led to a reinvigoration of the efforts and subsequent improved low rates of pressure ulcers.

This study has a number of limitations. As a pre- and postintervention study, we cannot rule out that other factors unrelated to the implementation of the turn team were responsible for the decrease in pressure ulcer rates. For example, all registered nurses and PCAs received online training in pressure ulcer prevention and Braden scale scoring, so it is possible that the decrease in pressure ulcers was due, at least in part, to increased knowledge and preventive care as opposed to the actual turning and repositioning done by the turn team. We also do not know how many pressure ulcers were present on admission throughout the study, although this is now documented routinely. There is no evidence that our patient population has changed over time as discussed further below, but it is possible that better care in patients being admitted from long-term facilities may have been responsible for some of the decrease in pressure ulcer rates seen over time.

Further, the frequency of assessments differed between the pre and post phases. Baseline assessments were initially performed on a quarterly basis and then increased to biweekly as part of an internal quality improvement initiative by the health care system. Once the problem of persistent elevation in pressure ulcer rates was recognized, the turn team was designed as an intervention, and the decision was made to examine the SICU for pressure ulcers on a weekly basis. Even though an identical number of audits was made both pre- and postintervention, it is theoretically possible that the shorter timeframe examined after the intervention led to evaluation of a different patient population before and after the implementation of the turn team. However, length of stay was similar for all patients admitted to the SICU throughout the course of the study regardless of whether they developed pressure ulcers (data not shown), suggesting the overall acuity of the SICU was not different in the pre- and postintervention phases of the study, although we do not have APACHE II scores, which would have strengthened this conclusion. At the same time, it is important to note that the pre group contained 278 patients while the post group contained 229 patients. This means that the average census in the ICU decreased from 18.5 to 15.3 patients/day in the 30 times that every single patient in the SICU was assessed for the presence of pressure ulcers, and we cannot rule out that a slightly lower census led to increased attention to individual patients (although the nurse:patient ratio did not change), which affected pressure ulcer rates. Because the total number of patients in the post group was 18% lower than the number in the pre group, it would be reasonable to expect a lower number of ulcers in the post group. However, if the prevalence of ulcers was identical before and after implementation of the turn team, there would have been 35 ulcers in the post group, rather than the 12 ulcers that were actually documented.

Next, audits were not performed to determine if patients were actually turned 12 times a day, nor was it documented how many patients were not turned because they were considered too unstable to turn. With increasing attention recently paid to the benefits of mobility in the ICU,[33] it is also unclear whether hemodynamic instability should have been an absolute exclusion criterion when deciding whether to turn patients.[34] Finally, it is unclear how easily our results can be adapted in other SICUs due to logistical concerns because turning patients at scheduled intervals around the clock is physically demanding and requires either hiring new staff or repurposing existing staff, which could lead to other equally important tasks not being completed, an issue we addressed in our extended follow-up.

CONCLUSIONS

Despite these limitations, this study demonstrates that the implementation of a team dedicated to turning all hemodynamically stable SICU patients every 2 hours around the clock nearly eliminated stage I and stage II ulcers. Whether this decrease in pressure ulcers is generalizable to other SICUs is not known, and we believe this should be subject of additional rigorous studies.

Author Contributions

Study conception and design: Still, Cross, Coopersmith
Acquisition of data: Still, Cross, Dunlap, Rencher, Larkins
Analysis and interpretation of data: Still, Cross, Carpenter, Buchman, Coopersmith
Drafting of manuscript: Still, Coopersmith
Critical revision: Cross, Dunlap, Rencher, Larkins, Carpenter, Buchman

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