Retrospective Data Analysis to Support the Use of Small Body Movements as an Intervention for Prevention of Pressure Ulcer Development

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Date of Submission: June 28, 2020
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Abstract

Pressure ulcers cost the healthcare systems millions of dollars every year. The current literature indicates that a multi-modal approach must be used in order to provide the best prevention of pressure ulcers. The use of small body movements is a simple intervention that could be utilized in addition to the regularly used prevention methods. A retrospective data analysis was used to assess the possible need for an additional pressure ulcer prevention intervention and the possible effectiveness it may have had on the intensive care patient population. Data was collected 60 days prior to the implementation of the new intervention in place and the data was assessed to see if pressure ulcers development decreases with an additional intervention. The retrospective data was collected by the clinical nurse specialist from the pressure ulcer prevention team. That data was cleared of any identifying information and then forwarded to the primary investigator. Unfortunately, not enough data was able to be collected in order to indicate if the proposed question was accurate.

**Keywords**: small body movements, pressure ulcer prevention in the intensive care, pressure ulcer prevention, retrospective analysis of pressure ulcer prevention, ICU pressure ulcer prevention
Retrospective Data Analysis to Support the Use of Small Body Movements as an Intervention for Prevention of Pressure Ulcer Development

Pressure ulcers are one of the most common complications a patient can develop during hospitalization. The definition of a pressure ulcer, as defined by The National Pressure Ulcer Advisory Panel, is a localized damage to the skin and/or its underlying tissue due to pressure or in combination with shear and friction from movement (Bauer, Rock, Nazzal, Jones & Qu, 2016). A patient in the intensive care unit is at an even higher risk to develop a pressure ulcer due to decreased mobility from either sedation, ventilation, acuity of illness, or a generalized weakness. After a pressure ulcer occurs, mortality rates rise from 15% to 63% for a patient in the intensive care unit, putting them at even further risk for more complications (He, Tang, Ge, & Zheng, 2016). These complications include increased length of hospitalization, added morbidity, pain, isolation, and increased financial burden, not only on the patient, but the facilities as well.

Pressure ulcers cost millions of dollars every year and with so many methods available for the prevention, the fact that they continue to occur so frequently is reason for further study to be of the highest priority. The purpose of this capstone project was to assess if the utilization of small body movements to shift body weight decreased the rate of pressure ulcer development.

**Overview**

**Background**

Prevention of pressure ulcers has been an uphill battle for many years in regards to methods of prevention and treatments. Mortality rates are increased by 63% when a patient develops a pressure ulcer. Pressure ulcers are also considered a “never event”; insurance companies will not reimburse facilities if a patient develops a pressure ulcer (Mattie & Webster, 2008). Besides lack of reimbursement, there are other consequences, including longer length of
stay in the hospital, increased pain, infection, loss of independence, increased workload for staff, litigation expenses, loss of credibility of facilities, and even social isolation of the patient (Ajami & Khaleghi, 2015; He et al., 2016). The significant impact of these consequences suggest prevention needs to be paramount for patient’s health and safety.

Pressure ulcers cost around $17 billion a year and are most prevalent in adult intensive care units (Peterson, Gravenstein, Schwab, Oostrom & Caruso, 2013). Stakeholders that are affected by the development of a pressure ulcer include the patient and their families, the bedside staff, educators, providers, the administration of a facility, insurance companies, and the facility. When a patient develops a pressure ulcer the morbidity and mortality rates, longer lengths of stay and complications that can arise all contribute to the increasing costs (Peterson et al., 2013). Standard practice calls for the repositioning of patients every 2 hours, however that intervention does not solely prevent pressure ulcers (PU) from developing. It has been suggested that adding pressure redistribution to scheduled turning could lower the incidences of PUs (Tayyib & Coyer, 2016). Unfortunately, there is a lack of research available in regards to this intervention.

Since the movement of dependent and critically ill patients requires manual manipulation by bedside staff, the added stress on staff’s bodies and the effectiveness of their turns may decrease over time. If the intensive care units have a high acuity level, staffing requirements are not met, the patients are obese, or procedures performed limit the turning positions available, the turning and repositioning of patients may become less effective in reducing pressure or altering interface pressure on tissue (Krishnagopalan, Johnson, Low & Kaufman, 2002).

When critically ill patients are turned, the interface pressure on the different pressure points of the body is altered, thus allowing better blood flow to pass the pressure point surface. Previous studies have shown that increased blood flow following a small shift in body weight
can reduce pressure ulcers. This phenomenon is known as reactive hyperemia (Oertwich, Kindschuh & Bergstrom, 1995).

**Problem Statement**

The prevention of pressure ulcers relies on so many different moving parts from body position changes, nutrition management, and use of prophylactic dressings on pressure points, to the effort of bedside staff in repositioning tubes, lines, and the patient’s body. With intensive care patients being at higher risk of developing a pressure ulcer, the utilization of more methods to reduce pressure may help improve patient outcomes with a decrease in pressure ulcer rates. The effort bedside staff are required to use in order to turn patients the standard 30 degrees and at least every two hours, has been shown to increase fatigue in staff and lead to higher prevalence in units that are overwrought with lack of staffing, or high acuity patients where there are not enough resources. This capstone project explored the following question: Did small shifts in body weight performed hourly with every 2 hour 30-degree turns, compared to every 2 hours 30-degree turns only, decrease the incidence of pressure ulcers over a 30-day period in the intensive care unit?

**Purpose Statement**

The purpose of this capstone project was to perform a retrospective data analysis in order to provide supportive data for implementation of a systems change that would require utilization of small body movements as an additional intervention to prevent pressure ulcers from developing on patient in an intensive care unit.

**Outcomes**

It was expected that the retrospective data analysis would find commonalities in pressure ulcer development and would support small shifts in body weight in conjunction with every 2-
hour 30-degree turns as a viable option to prevent pressure ulcers. The overall outcome goal was a decrease in pressure ulcers occurring during the 30 day intervention period. A benchmark of 5% reduction in pressure ulcers pre/post intervention was used as the targeted benchmark.

**Review of the Literature**

**Search Trail**

A review of the literature was completed using Cumulative Index to Nursing and Allied Health Literature (CINHAHL), COCHRANE database of Systemic Reviews and Medline. Using CINHAHL with the phrases *pressure ulcer prevention in the ICU*, and *pressure ulcer prevention in the intensive care unit* along with the terms *turning* and *repositioning*, and *interface pressure* the final selection of included over 1000 journal articles. With the addition of the Boolean “AND” as well as “OR” included *repositioning, turning, small shift of body weight, and interface pressure* (Appendix A). Searching COCHRANE database of Systemic Reviews with the same search terms resulted in 2 articles. Lastly the search of Medline, with the aforementioned search items, resulted in 23 articles. With the addition of limiters which include: narrowing the dates from 2014 to current and excluding research not done in English. Exclusion criteria included research not related to the PICOT question, incorrect age groups and duplicates. Inclusion criteria included adults, full text, pressure ulcer therapy, prevention & control, wound healing. The final selection of included 14 journal articles. One article was excluded for focusing on bed position and reporting its irrelevance to pressure ulcer prevention. Each article was critically appraised and the level of evidence was determined utilizing Melnyk and Fineout-Overholt (2015) (Appendix B). Common themes found amongst the research includes decreased rates of pressure ulcers with additional interventions, the use of small body movements to decrease interface pressure and reduce tissue damage, and overall improved outcomes for patients.
While utilizing multiple options or preventive methods is common practice, there is not a specific set of cares adopted worldwide to be utilized by healthcare providers. Even on different units or floors of the same facility, different healthcare providers or nurses may utilize different methods on a case by case basis. Options of prevention include, but are not limited to: nutrition supplementation, incontinence management, pressure relieving devices, barriers creams, prophylactic dressings, specialty beds and turning systems (Tayyib & Coyer, 2016). Evidence shows all of these methods are effective choices to be used for prevention, however the use of small body movements to alter the interface pressure on different points of the body is not currently a widely practiced choice. According to Oertwich et al. (1995), small body movements and repositioning is enough to alter the interface pressure on a patient’s tissues. Findings suggested that small shifts in body movement relieve pressure and increase blood flow to a patient’s skin (Oertwich et al., 1995).

Overall there is a multimodal approach and many prevention methods are utilized at the same time, due to the fact patients in the intensive care require such invasive and close monitoring to occur. Common findings throughout the literature suggest a key proponent in prevention is turning patients and redistributing pressure on different points of their bodies. This redistribution of what is known as interface pressure, prevents tissue ischemia, which leads to tissue breakdown, and helps prevent pressure ulcers from occurring.

**Current Prevention Methods**

A pressure ulcer is one of the top three complications a patient can develop while in the hospital. A pressure ulcer can cost thousands of dollars to treat and a patient can suffer from increased pain, social isolation, increased rates of infection, and longer lengths of hospitalization. Patient’s in the intensive care unit have an increased risk of developing a pressure ulcer
compared to other units in the hospital. The prevalence rate is about 22% to 49% (Tayyib & Coyer, 2016).

**Preventing Tissue Breakdown**

Studies conducted by Boyko, Longaker and Yang (2018) and Tayyib and Coyer (2016) show that a multi-disciplinary approach is needed to prevent pressure ulcers. Movements utilized to prevent skin breakdown include using a 2-hour repositioning schedule, and reducing turning degrees to less than 30 degrees to reduce and alter interface pressure on pressure points (Gill, 2015; Peterson et al., 2013). Ways to promote skin healing and prevent skin damage include: managing nutrition to improve tissue healing and prevent skin breakdown, repositioning invasive interventions like, nasogastric tubes, indwelling foley catheters, endotracheal tubes, pulse oximetry probes, documenting skin changes by completing skin assessments done every shift and when changes in condition occur, and preventing friction and shear by using repositioning systems to move the patients. Oertwich et al. (1995) further discuss the concern for continued tissue ischemia on certain pressure points including the elbows, shoulders, hips, and coccyx and how small body movement can decrease interface pressure.

These articles were examined closely to gain a better understanding as to how small body movements could impact the development of pressure ulcers. The common themes found throughout these articles include the use of repositioning to prevent tissue ischemia, which leads to pressure ulcers. The research also revealed the importance of a multi-disciplinary approach in order to prevent pressure ulcers, to include important elements such as nutrition and the use of preventive dressings.
Method of Measurement

Continuous body pressure mapping (CBPM) was also being used in multiple studies in order to assess the interface pressure of the different pressure point on a patient’s body. Krishnagopalan et al. (2002) state that turning patients every 2 hours is increasingly important in order to prevent tissue breakdown, especially with patients in the intensive care unit. This monitor, when used in conjunction of current practices, i.e. scheduled turning and repositioning, was able to pinpoint where higher levels of pressure were maintained after a turn and where small shifts in movement would help to alter this increased pressure and prevent tissue ischemia (Oertwich et al., 1995). Several researchers report that the use of these monitors were able to show staff actual visual data to represent the increased interface pressure on pressure points where tissue ischemia occurs. This real time visual feedback helped to improve turns and pressure relief and showed how simple small body movements can be used to alter the pressure and improve the blood flow to that tissue (Ajami & Khaleghi, 2015; Behrendt, Ghaznavi, Mahan, Craft & Siddiqui, 2014).

Summary of Findings

Despite pressure ulcer prevention methods and all of the research to support the use of an additional intervention, pressure ulcers continue to develop and cause complications. Oertwich et al. (1995) endorse the use of small body movements to alter interface pressure and decrease tissue ischemia, leading to pressure injuries. Modifying the current standard of practice to include adding small body movements to shift weight distribution and alter interface pressure, would increase the level of pressure ulcer prevention. Research by Peterson et al. (2013) also demonstrates the need for redistribution of patient’s tissue in order to have more effective prevention of pressure ulcers. The added prevention measures of small body movements are
highly impactful to patients and are low impact on staff who would be implementing these changes, which in turn will lead to better outcomes.

Theoretical Framework

Iowa Model

The Iowa Model utilizes a twelve-step process to developing a new practice and implementing that practice (Iowa Model Collaboration, 2017). These steps include identifying a triggering issue, state a question or purpose, figuring out if this topic is a priority, forming a team, retrieving and appraising evidence, finding out if the evidence is sufficient, design that practice change, implement the practice, evaluation, using that data and deciding if the change is appropriate to practice, integrate and sustain the practice and lastly, disseminating the results (Appendix C).

With the topic being chosen, the PICO was identified due to an increased number of pressure ulcers developing in this intensive care, and this topic was determined a priority. The next step was to form the team, which included the primary investigator, clinical nurse specialist, and the pressure ulcer prevention team. These individuals were responsible collecting and composing the data.

Evidence and research were identified, literature was collected, and a critical appraisal was completed in regards to the pressure ulcer prevention methods and small shifts in body weight previously identified (Appendix A). The anticipated practice change supported with this capstone project, was be to add small shifts in body weight to alter interface pressure of a patient’s pressure points and increasing blood flow to that tissue, thus decreasing tissue ischemia, and preventing tissue damage.

Data was collected by the clinical nurse specialist and compiled to reveal the prevalence
of pressure ulcers prior to small body movement interventions. The project was interrupted by the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) pandemic, limiting available data. The retrospective data obtained was determined insufficient and a statistical analysis was unable to be completed. Due to the lack of available data to be collected, the completion of the Iowa Model halted.

**Organizational Assessment**

A Midwest hospital dedicated to teaching and research was selected for implementation of this capstone project. Stakeholders at this institution recognized the need to explore additional methods to decrease pressure ulcers among ICU patients. Several nurses on the designated unit were active members of the pressure ulcer prevention team. These nurses were eager to identify and implement more effective methods to help prevent the occurrence of pressure ulcers. This organization utilized evidenced-based practice. This project was supported by leadership at both administrative and unit levels. Approval to conduct the capstone project was granted and letter of support was obtained (Appendix D and E).

Readiness to change within the organization was evident by staff support of the project and pre-existing interest in the topic within the organization. An anticipated significant barrier included staff push back, however this did not occur. Education and encouragement were provided to help decrease staff resistance. Project risks and unintended consequences were limited. Evaluating and comparing data of the current trial intervention of adding small body movements as it compares to every 2 hour turns only did not pose any threat to patient safety. The comparison data for the project looked retrospectively at existing data, which did not impact the patient population.
Methodology

In the intensive care unit, the patient population consisted of patients requiring support and care for septic shock, liver and kidney transplants, post cardiac arrests, gastrointestinal bleeds, pulmonary emboli, and the use of vefetri and remodulin for pulmonary hypertension management, and/or any other condition causing a patient to require a higher level of care. Data from prior to the retrospective data collection, and the time period afterwards was not comparable due to the alteration of the patient population related to the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) pandemic.

Setting

This capstone project took place on a 12-bed intensive care unit at the Midwest teaching and research hospital. The critical care medicine team managed all of the patients and the consults to different groups included, but were not limited to: cardiology, nephrology, hepatology, neurology and transplant. The population served was diverse. The institution was a high-profile facility that conducts transplants and other extensive procedures. Transfers from outside facilities and patients served from surrounding regions were common.

Sampling

The characteristics of this population included patients whose ages ranged from 18 years old and older and the demographic included people of all races, genders, ethnicities, religions and creeds. As a state institution, this Midwest hospital had some of the most prolific specialties which allowed the patient population to be the most diverse and critically ill. The intensive care included a population of patients who required life sustaining medications, assistive devices, and extensive assessments and cares, continually being provided by bedside staff. These patients may have required mechanical ventilation, vasopressor medication utilization, been subjects of
substance overdosed, needed pulmonary hypertension management with Veletri or Remodulin, required continuous renal replacement therapy (CRRT), needed more invasive vascular access, or overall had a higher risk of compromise of life due to illness, medical condition or injury. The inclusion criteria for this project included all intensive care patients on the unit during the designated 60-day period identified as at risk for pressure ulcers on admission or due to a change in status. The exclusion criteria were if the patient was able to turn themselves and were not dependent on staff assistance for movement.

**Implementation Procedures**

Retrospective data was requested from patient charts who were hospitalized in this specific intensive care unit during a specific 60-day period of time that included 30 days pre-small body movement intervention. Specific data included, age, gender, admitting diagnosis, Braden scale score, use of prevention methods, stage of pressure ulcer developed, and where the pressure ulcer developed was collected. The clinical nurse specialist was responsible for retrieving the requested data, and removed all identifying health information before the data was placed in to a spreadsheet. This data was forwarded to the primary investigator. Due to severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) pandemic and decreased patient census, there was limited data available to be collected.

This specific intensive care where the retrospective data analysis was being completed, was deemed to be modified to provide care for patients who were being admitted with SARS-CoV-2. This modification required the intensive care to stop admitting patients for a few weeks prior to being closed to all patients. This was done in order to alter the air flow to create the negative air flow required for the SARS-CoV-2 patient population. Since the unit needed to close staff was dispersed throughout the hospital until such time that the population of SARS-CoV-2
patients increased and required the intensive care to reopen. Due to being closed for weeks prior to readmitting patients there was no opportunity for data to be collected in order to be included in this retrospective data analysis.

**Measurement Instrument**

A retrospective analysis included data from a 60-day period in this intensive care unit. Charts were reviewed to assess the incidence rate of pressure ulcer development or worsening of existing pressure ulcers while the standard interventions were in place. A pressure injury deep dive tool was used to gather all the needed information and the pertinent information required for this capstone (Appendix F). This tool was actively utilized by the pressure ulcer prevention team, and would be used when a pressure ulcer would develop in the intensive care. Data they would collect include basic demographic information about each patient, where the pressure ulcers developed, as well as characteristics about the pressure ulcers. They would evaluate whether or not the proper prevention methods were in place when the pressure ulcer developed, and if not, why they were not utilized.

**Data Collection Procedures**

Data was collected by the clinical nurse specialist. Charts were assessed to see if preexisting pressure ulcers worsened during the period of the intervention. Each chart was assessed for the gender, age, admitting diagnosis, Braden scale score, and if all the current interventions were in place, the stage of the pressure ulcer and the location. If the interventions were properly utilized, it was noted on the data collection tool by checking the corresponding box.

**Ethical Considerations/Protection of Human Subjects**
Institutional Review Board (IRB) approval was obtained prior to initiating the capstone project. Data that was collected in regards to this capstone was collected by a Clinical Nurse Specialist and was only reviewed by this investigator. The collected data was stored on a password protected computer and only this same investigator had access to it. When this data was collected, charts were assigned numbers starting from one and increasing in order and were identified further by that assigned number. No personal information other than age and gender were identified. The primary investigator is an employee of this facility, therefore the information was collected by the Clinical Nurse Specialist and given to the investigator without any identifying information to keep it anonymous and prevent any conflict of interest.

The gathering of retrospective data posed no greater than minimal risks to the subjects involved. The population involved in this retrospective data analysis included individuals from different vulnerable populations, however it did not impact the patients directly in any way.

Data Analysis & Results

Due to SARS-CoV-2 pandemic the data available was limited. The data that was collected was insufficient to complete a statistical analysis. The numbers were unable to be compared to determine if pressure ulcers could have had decreased prevalence rates with the use of the additional intervention, due to the fact there was not enough data collected.

<table>
<thead>
<tr>
<th>demographic information</th>
<th>case #1</th>
<th>case #2</th>
<th>case #3</th>
</tr>
</thead>
<tbody>
<tr>
<td>age</td>
<td>67</td>
<td>71</td>
<td>54</td>
</tr>
<tr>
<td>gender</td>
<td>Male</td>
<td>Male</td>
<td>Male</td>
</tr>
<tr>
<td>admitting diagnosis</td>
<td>septic shock</td>
<td>encephalopathy</td>
<td>acute hypoxemic respiratory failure</td>
</tr>
<tr>
<td>braden score</td>
<td>18 or less/16 or less</td>
<td>18 or less/16 or less</td>
<td>18 or less/16 or less</td>
</tr>
<tr>
<td>interventions in place</td>
<td>yes</td>
<td>no</td>
<td>no</td>
</tr>
<tr>
<td>stage of pressure ulcer</td>
<td>deep tissue injury</td>
<td>unstageable</td>
<td>stage 1</td>
</tr>
<tr>
<td>location of pressure ulcer</td>
<td>coccyx</td>
<td>bilateral heels</td>
<td>behind ears</td>
</tr>
</tbody>
</table>

Due to SARS-CoV-2 pandemic the intensive care population this project was focused on, there
was a decreased patient census prior to the intensive care being closed down. This intensive care was transformed into one that specifically cared for patients with SARS-CoV-2, and the usual population was diverted to other intensive care units. When this intensive care reopened it was during the 60-day time frame and the patient population was decreased and did not included the baseline patient population of sepsis, pre-liver transplants, gastrointestinal bleeding, or pulmonary hypertension, which the original intensive care population this capstone was focused on.

**Discussion**

This project did not reveal sufficient data and the statistical information was due to the inability to collect more data. Attempting to complete this project again in the future can provide more data. Using the Iowa Model, the steps up to the point of having sufficient evidence, were complete but had to stop there as there was insufficient data available. The next step, state a question or purpose was completed after a discussion with the pressure ulcer team took place. It was determined that prevalence rates of pressure ulcers had increased in the Midwest teaching hospital. A team was formed between the primary investigator, the clinical nurse specialist and the pressure ulcer prevention team in order to collect the data. The investigator retrieved and appraised the evidence, however there was insufficient evidence or data to support the utilization of small body movements to prevent pressure ulcer development. This project was greatly impacted by SARS-CoV-2 pandemic and decreased patient population, thus causing the limited available data. Due to this fact the primary investigator was unable to move forward with the project as originally intended.

**Plan for Sustainability**
The option to move forward and attempt to complete this retrospective data analysis remains possible. Since the onset of the SARS-CoV-2 pandemic, there has been an alteration in the patient population, resulting in patients who are much sicker and have more invasive treatments being performed to help them survive. These procedures yield higher risks of the patient’s developing pressure ulcers due to prone positioning of the patients. The prone position limits the pressure relief able to be provided because of how the patient must lay for proper oxygenation. All this data could be collected at a later date, and if the time frame could be extended, there would be an opportunity for data availability.

**Implications for Practice**

This retrospective data analysis was unable to show how the implementation of small body movements being added to the regularly planned interventions would be a viable option used to prevent pressure ulcers from occurring and worsening. It was important to recognize that due to time constraints, limited availability of patient data, and the impact that the current pandemic had on patient population, it was the responsible choice to not push this project forward. The clinical nurse specialist, pressure ulcer prevention team, and the faculty investigator we all made aware of the barriers to completing this capstone project. The investigator was greatly supported throughout this process and despite the current pandemic, the clinical nurse specialist and pressure ulcer prevention team made themselves available to collect what data they could.

**Conclusion**

There are a multitude of prevention methods that are used on a daily basis to help prevent pressure ulcers from developing. This capstone was limited due to the SARS-CoV-2 pandemic and the effects it had on the intensive care unit where this capstone project took place.
Reattemptsing this capstone at a later date would be recommended to obtain a larger data set in order to perform a statistical analysis yielding sufficient data to examine the use of small body movements as an intervention for prevention of pressure ulcer development. This analysis could then assist with the determination if policy change would impact pressure ulcer prevalence.
References


Appendix A

Search Trail

**Do small body movements prevent pressure ulcers when used in conjunction with every 2-hour, 30 degree turns, vs only every 2-hour, 30 degree turns over a 30-day period in the intensive care unit (ICU)?**

**Interventions**
Pressure ulcer prevention in the ICU (100)
“AND” Turning (293)
“AND” Repositioning (258)
“AND” Small shift of body weight (2)
“AND” Interface pressure (21)
“OR” Repositioning (42,570)
“OR” Small shift of body weight (200)
“OR” Interface pressure (9,456)
Pressure ulcer prevention in the intensive care unit (204)
“AND” repositioning (82)
“AND” turning (57)
“AND” Small shift of body weight (2)
“AND” Interface pressure (28)
“OR” repositioning (2,800)
“OR” turning (12,085)
“OR” Small shift of body weight (74)
“OR” Interface pressure (703)

**Population**
Pressure ulcer prevention in the ICU (100)

**Population**
Pressure ulcer prevention in the intensive care unit (159)

**Limitations**
time between 2014-present; English (430)

**Exclusion Criteria**
subject matter not related to PICOT question, incorrect age groups, duplicates

**Inclusion Criteria**
adults, full text, pressure ulcer therapy, prevention & control, wound healing

**Finals**
Results = 13
## Appendix B

### Clinical Question

Do small body movements prevent pressure ulcers when used in conjunction with every 2-hour, 30 degree turns, vs only every 2-hour, 30 degree turns over a 30-day period in the intensive care unit (ICU)?

<table>
<thead>
<tr>
<th>Citation/Level of Evidence</th>
<th>Participant/Setting/Sample Size</th>
<th>Purpose/Background</th>
<th>Methods/Design &amp; Limitations</th>
<th>Findings/Summary/Strengths/Weakness</th>
<th>Applicability to Own Research</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Appendix</em>. S., &amp; Khalqm, L. (2015). A review on equipped hospital beds with wireless sensor networks for reducing bedsores. <em>Journal of Research in Medical Science</em>. 20(10), 1067. doi: 10.4103/1309-7990.151797</td>
<td>ICU patients</td>
<td>Bedsores is the third most common disorder after cancer and cardiovascular diseases. In various studies, treatment costs have been estimated to be about $123-411 for grades 1 and 2 of bedsores and $1,400-2,309 for grades 3 and 4 of bedsores. Smart bed and mattress, either alone or in combination with the other technologies, should be capable of providing all of the novel features while still providing the comfort and safety features usually associated with traditional and hospital mattresses. It can eliminate the expense of bedsores in the intensive care unit (ICU) department in the hospital and save much expense there.</td>
<td>This study was a non-systematic review. The literature was searched for WHO to reduce and prevent bedsores with the help of libraries, databases (PubMed, SCOPUS, and EMBASE), and also search engines available at Google Scholar including during 1974-2014 while the inclusion criteria were applied in English and Persian. In our searches, we employed the following keywords and these combinations: &quot;wireless sensor network,&quot; &quot;smart bed,&quot; &quot;smart mattress,&quot; &quot;information technology,&quot; and &quot;bedsores&quot; in the searching areas of the title, keywords, abstract, and full text. In this study, more than 45 articles and reports were collected and 17 of them were selected based on their relevance.</td>
<td>Overall, according to the care method and costs of the care, patient care is very important for caregivers and also for patients and their families. Finding the best and most economic method of patient care has engaged the minds of many experts in various fields of medical services or information technology (IT) and electronic engineering. With the application of smart materials or microsensors in medical equipment and attaching the same to patients as well as physicians, these conditions can be controlled to a great extent and the standard care can be provided for patients.</td>
<td>This use of mattress sensors is not directly related to any case cause, however there is supportive evidence as regards to the cost to the healthcare system when a bed sore does develop, and how systems as a whole, need more options to assist with pressure ulcers prevention.</td>
</tr>
<tr>
<td>Bhowmick, B., Ghosh, A. M., Mahan, M., Craft, B., &amp; Siddiqui, A. (2014). Continuous bedside pressure mapping and rate of hospital-associated pressure ulcers in a medical intensive care unit. <em>American Journal of Critical Care</em>. 23(2), 127-133. doi: 10.4037/ajcc2014192</td>
<td>422 patients in the medical ICU</td>
<td>Critically ill patients are vulnerable to the development of hospital-associated pressure ulcers (HAPUs). Positioning of patients is an essential component of pressure ulcer prevention.</td>
<td>Prospective controlled study, patients were enrolled and assigned to beds equipped with or without a CPAP device. Patients’ skin was assessed daily and weekly to determine the occurrence and significantly fewer pressure ulcers in patients being repositioned every 2 hours and small body movement were made to high-pressure areas to alter surface pressure. 2/23 patients in the test groups developed pressure ulcers</td>
<td>This article supports my research because I am trying to implement the process of small body movements in order to reduce...</td>
<td></td>
</tr>
</tbody>
</table>
PREVENTION OF PRESSURE ULCERS

Randomized, prospective, controlled study, Level 2, (Matsouka & Fineman-Overholt, 2013).

- Alopecia prevention because it off-loads areas of high pressure. A continuous bedside pressure monitoring (CBPM) device can provide real-time feedback of optimal body position through a pressure setting that displays pressure maps at a patient’s bedside, allowing off-loading of high-pressure areas and possibly preventing HAP-related pressure injuries.
- Progress of HAPs: All patients were turned every 2 hours. CBPM patients were questioned to off-load high-pressure points during turning, according to a graph display. The number of newly formed HAPs was the primary outcome measured. A second test was then used to compare the occurrence of HAPs between groups.
- Limitations: Restricted definition of a pressure ulcer; only stage II or higher.
- Lack of blinding the outcome assessment.
- The surface pressure of the patients to prevent pressure ulcers.


- ICU patients: Pressure ulcers are a real and definite problem in our medical system. Regardless of all our new equipment and knowledge, pressure ulcers are not on a downwards trend. Pressure ulcers are growing in incidence, and it is usually the most vulnerable, elderly, and weak of our society who face these complications. Pressure ulcers cause the patient pain, suffering, and are expensive to treat. They can also be a major component in a patient’s mortality rates. High incidences of pressure ulcers in an organization may imply a diminished quality of care.
- The four main areas targeted were: improving staff education and knowledge of pressure ulcer prevention, correct and timely risk assessment of the patient, frequent patient offloading relating pressure, and moisture management. The plan, do, check, act cycle in a four-step management method was used in the facility for the control and continuous improvement of processes.
- Limitations: Being faced with a quality improvement process to our ICU department due to manpower and time constraints. We are planning to initiate and develop this quality improvement process throughout the facility.


- ICU patients: The aim of this study was to determine whether skin barrier factors were associated with the occurrence and complication of pressure ulcers (PUs) in intensive care unit (ICU) patients. It was unclear whether skin barrier factors influenced the development of PUs.
- Demographic variables and the scores for the Arabic, Physical and Chronic Health Evaluation IV were recorded on admission. The Braden Scale Assessment and measurements of the skin barrier factors were performed daily. Standard care for the prevention of PUs was strictly administered, and PUs that developed were evaluated according to the recommendations of the UC National Pressure Ulcer Advisory Panel 2007. (Note: The authors used the 2007 recommendations at the time of their study.)


- Prospective longitudinal observational study, Level V. (Matsouka & Fineman-Overholt, 2013).

- 74 critically ill patients in the intensive care unit. Conversion sample of mixed medical/surgical ICU patients at three tertiary care hospitals in two different cities in the United States. Random sampling of ICU professionals from a directory.

- To determine the prevalence of immunocompromised patients in the intensive care unit (ICU) receive the pervading standard of care in position every 2 hours.

- To determine prevailing attitudes about patient positioning among ICU physicians.

- Prospective longitudinal observational study. E-mail survey of ICU physicians.

- Limitations: The response rate to survey was quite low (66/72 responded). We were unable to mail a semi-structured survey to improve the ease of response for recipients and thereby the response rate. Non-respondents were sent reminders. Despite our efforts, the response rate remained low. It is believed, however, that there is no selection bias of this smaller sample that would preclude drawing conclusions from the data for trends. Other limitations of our study stem primarily from its observational nature. Despite our attempts to blind caregivers.

- In the survey of ICU specialists, 39 surveys were sent by electronic mail, and replies were obtained from 72 people, a response rate of 18.4%. A total of 60 of those replying (31%) agreed that the standard of ICU care was turning the patient every 2 hours (Table 1). To the question of whether this standard may prevent complications, 45 (60%) agreed. As to whether this standard is being achieved by the majority of the time in their ICUs, the respondents were divided. Only 41 (57%) felt that the standard of turning every 2 hours was achieved, the remaining 30 (42%) felt that this standard was not practiced in their ICU.

- A total of 37 patients were observed in three separate ICUs. Table 2 shows the total observation times by site and per patient. Patients were observed for an average of 1.7 hours per day.
PREVENTION OF PRESSURE ULCERS

shifts in body weight on blood flow and interface pressure. Research in Nursing &
Health, 18(5), 481-488. doi:10.1002/nur.477180504
Repeated measures design, Level 4. (Melnyk & Fineout-Overholt, 2015).

A convenience sample of 59 long term care residents from three rural long-
term care facilities. 31 women and 19 men aged ranging from 87 to 97.

The purpose of this study was to evaluate the effect of small shifts in body
weight on blood flow and interface pressure in two different positions (neutral
oblique and supine) in body weight.

A within subject, repeated measures design used to evaluate blood flow and
interface pressure in two different positions (neutral oblique and supine) in
body weight.

Interface pressures decreased beneath dependent body
premises as a result of small shift interventions. Making small shifts in body weight
and repositioning a body's surface area does make an impact on pressure
sugar prevention and is effective in preventing pressure injuries and increase blood flow.

Strengths
Use of monitors for interface pressure measurement can be repeated
Weakness
More research is needed

This article supports my research because it is

directly related to what I am hoping to implement
with patient’s in order to prevent pressure ulcers.

Citation/Level of Evidence
Participants/ Setting/ Sample Size
Purpose/Background
Methods/Design & Limitations
Findings/Summary/Strengths/ Weaknesses
Applicability to Own Research

Monitoring interface pressures at-risk patients. The Journal of Rehabilitation Research and Development, 50(4), 477-
487. doi:10.1682/0278-3612.2012.03040


A convenience sample of 100 participants with a Braden score
less than 18.

Pressure ulcers are a high-risk, high-volume, and high-cost problem
for hospitalized and bedridden patients. Overall, low-pressure ulcer
prevalence rates have been reported at 12.3.

Descriptive, observational study. Bedridden patients undergoing 64hr
repositioning would demonstrate a triple-
potropically area (i.e., triple
potency area is not zero).

To achieve a score of 50

Bedridden patients at risk for pressure ulcer formation exhibit high skin blood interface pressures and specific skin areas that are likely always at risk (i.e., triple
potency) and always at risk areas for the vast majority of the time
patients are in bed during recovery.

This research article does support my
research as I am trying to improve the
pressure relief and interface
resistant patients.

Togashi, N., & Coyer, F. (2016). Effectiveness of bed surface ulcer prevention strategies for adults in intensive care unit: A
systematic review. Worldviews on Evidence-Based Nursing.

This was a study retrieval completed through

The purpose of this study was to synthesize the best available evidence regarding the

Evidence of effectiveness in nutrition, skin care regimens, positioning and repositioning
schedules, support surfaces and

Evidence of effectiveness in nutrition, skin care regimens, positioning and repositioning
schedules, support surfaces and

This article does not support my research as it does not provide...
### Prevention of Pressure Ulcers

**Randomized Controlled Trial**

<table>
<thead>
<tr>
<th>Study</th>
<th>Description</th>
<th>Sample Size</th>
<th>Intervention</th>
<th>Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wong, H., Kneisl, J., Bayley, B., Casto, J.M., Kaplan, D.B., Szleider, H.T., Southern, D., Ghali, W., Ho, C.H. (2015).</td>
<td>Efficacy of a pressure-sensing mattress cover system for reducing interface pressure. Study protocol for a randomized controlled trial.</td>
<td>6/8 patients at an acute care facility. Data on interface pressure collected over 3 days.</td>
<td>A parallel two-group randomized controlled clinical trial will be conducted to study the effect of continuous interface pressure monitoring on reducing interface pressure and on the incidence of pressure ulcers in vulnerable hospital patients. The intervention group will have the Ecorange PPT™ system and the LCD monitor tuned to a particular monitor. The control group will have the Ecorange PPT™ system tuned off.</td>
<td>This research article, depending on the findings of the study, will support my current research. I will be attempting the adjusting nursing and interface pressure to assess for decreased ulcers in pressure ulcer development.</td>
</tr>
</tbody>
</table>
The Iowa Model Revised: Evidence-Based Practice to Promote Excellence in Health Care

1. Identify Triggering Issues / Opportunities
   - Clinical or patient identified issue
   - Organization, state, or national initiative
   - Data / new evidence
   - Accrediting agency requirements / regulations
   - Philosophy of care

2. State the Question or Purpose

3. Is this topic a priority?
   - No: Consider another issue / opportunity
   - Yes: Form a Team

4. Assemble, Appraise and Synthesize Body of Evidence
   - Conduct systematic search
   - Weigh quality, quantity, consistency, and risk

5. Is there sufficient evidence?
   - No: Conduct research
   - Yes: Design and Pilot the Practice Change

6. Design and Pilot the Practice Change
   - Engage patients and verify preferences
   - Consider resources, constraints, and approval
   - Develop localized protocol
   - Create an evaluation plan
   - Collect baseline data
   - Develop an implementation plan
   - Prepare clinicians and materials
   - Promote adoption
   - Collect and report post-pilot data

7. Is change appropriate for adoption in practice?
   - No: Consider alternatives
   - Yes: Integrate and Sustain the Practice Change

8. Integrate and Sustain the Practice Change
   - Identify and engage key personnel
   - Hardwire change into system
   - Monitor key indicators through quality improvement
   - Reinforce as needed

9. Disseminate Results
## Prevention of Pressure Ulcers

### Appendix F

### Pressure Injury Deep Dive

**Complete one Deep Dive per Injury**

1. **Admitting Diagnosis:**
2. **Patient Name:**
3. **Facility Admission Date:**
4. **Facility Admission Time:**
5. **HOSPITAL ACQUIRED PRESSURE INJURY INFORMATION – LDA**
6. **Secondary Diagnosis (If applicable):**
7. **DATE HAPI IDENTIFIED:**
8. **Time HAPI Identified:**
9. **Anatomical Location of HAPI:**
10. **Stage of HAPI:**
   - Stage 1
   - Stage 2
   - Stage 3
   - Stage 4
11. **Department(s) connected to this injury (Mark all that apply for 48 hours PRIOR to date HAPI identified):**
   - ICU
   - CCU
   - PCU
   - PACU
   - OR
   - ICCU
   - NICU
   - Other...
12. **Was Injury related to medical device:**
   - Yes
   - No
   - N/A
   - If applicable, what medical device was determined to have caused the pressure injury?
13. **Was P1 consulted PRIOR TO development of HAPI:**
   - Yes
   - No
   - Date/Time Consulted: ______
14. **Was WO consultation for P1 PRIOR TO development of HAPI:**
   - Yes
   - No
   - Date/Time Consulted: ______
15. **Was OT consulted PRIOR TO development of HAPI:**
   - Yes
   - No
   - Date/Time Consulted: ______
16. **Was WO consultation for OT PRIOR TO development of HAPI:**
   - Yes
   - No
   - Date/Time Consulted: ______
17. **Was WO consulted for Wound Care PRIOR TO development of HAPI:**
   - Yes
   - No
   - Date/Time Consulted: ______
18. **Was WO consultation for Wound Care PRIOR TO development of HAPI:**
   - Yes
   - No
   - Date/Time Consulted: ______
19. **Did patient or family refuse repositioning:**
   - Yes
   - No
20. **If pressure injury related to medical device, were medical devices rotated or repositioned at least once per shift?**
   - Yes
   - No
21. **Was WO flagged on admission profile:**
   - Yes
   - No
22. **Was WO notification on admission profile:**
   - Yes
   - No

### Pressure Injury Prevention Skin Bundle

**Stage 1 or 2 – Look at 24 hours PRIOR to pressure injury identification**

**Stage 3, 4, or Unstageable – Look at 72 hours PRIOR to pressure injury identification**

**DTI – Look at 48 hours PRIOR to pressure injury identification**

<table>
<thead>
<tr>
<th>Question</th>
<th>Yes</th>
<th>No</th>
<th>N/A</th>
</tr>
</thead>
<tbody>
<tr>
<td>Was a 2 RN skin assessment completed within 12 hours of admission?</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Was a 2 RN skin assessment completed on return from a procedural area?</td>
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<tr>
<td>Was a 2 RN skin assessment completed every shift?</td>
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<tr>
<td>Was repositioning schedule assigned per the pressure injury prevention bundle?</td>
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<td></td>
</tr>
<tr>
<td>Did patient or family refuse repositioning?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Was Braden/Braden Q completed within 12 hours of admission?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Was Braden/Braden Q completed every shift?</td>
<td></td>
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<tr>
<td>Were heels elevated?</td>
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<tr>
<td>Was a specialty support surface utilized for bed?</td>
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<tr>
<td>Was a chair cushion or specialty chair surface utilized?</td>
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<tr>
<td>Were orders in place for wound care?</td>
<td></td>
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<tr>
<td>Patient weight on admission</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Patient weight on day HAPI discovered</td>
<td></td>
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