

**A CNS-Led Intervention to Improve Rates of Respiratory Mechanical
Device-Related Pressure Injuries in Critically Ill Patients: A DNP Project**

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Abstract

Background

There is a new focus on medical device-related pressure injuries (MDRPI). Endotracheal tubes (ETT) and their fasteners constitute a portion of these injuries and may lessen the quality of life and function of the critically ill patients who suffer from them.

Local Problem

The purpose of this quality improvement project was to determine if a bundle of interventions in patients with ETT and their fasteners may lessen the rate of mechanical device-related pressure injuries.

Methods/Interventions

The project consisted of pre-and post-intervention surveys of nursing comfort with ETT movement/assessments, implementation of a standardized turn clock to have all ETTs in the same location and moved every 2-3 hours, and job aids related to the assessment and documentation of ETT movement.

Results

The project's pre-implementation survey revealed that some nurses were uncomfortable with manipulating the ETT tube and may prevent them from moving the ETT. The post-implementation survey demonstrated improved comfort with moving the ETT. While nurses felt they regularly assessments, they acknowledge that do not often chart ETT movement. Documentation audits bore out these claims – most charts did not include ETT movement or peri-oral/mucosal tissue assessments. Of note, in the three months before the project, there were 3 ETT-related pressure injuries, and none during the implementation.

Conclusions

This project sought to determine whether a bundle of interventions might lessen the rate of MDRPI associated with ETT and their fasteners. This bundle of interventions may be useful to other healthcare organizations struggling with this subset of pressure injury.

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A CNS-Led Intervention to Improve Rates of Respiratory Mechanical Device-Related Pressure Injuries in Critically Ill Patients: DNP Project

Introduction

As long as clinicians have utilized tubes, devices, and braces to aid in healing interventions, those appliances have caused skin and soft tissue breakdown. However, for many years, these specialized injuries were merely added to the summation of overall pressure injuries and clinically treated similarly (Edsberg et al., 2016). Only in the past few decades has there been a focus on mechanical device-related pressure injuries (MDRPI) and how they differ from traditional pressure injuries (Edsberg et al., 2016; Pittman and Gillespie, 2020). As technological and biomedical advances continue to provide more appliances and machines to maintain and heal patients, these devices also serve as new vectors for skin breakdown. This project aims to determine if a CNS-led intervention associated with respiratory MDRPI in critically ill patients could lower the incidence rate of these avoidable injuries.

Background and Significance

It is essential to understand what constitutes an MDRPI for this project. Gefen (2021) provided a comprehensive explanation of the etiology of skin breakdown associated with mechanical devices, explaining that the tissue deformation caused by these devices (which often apply force, such as with respiratory face masks and endotracheal tube fasteners) leads to cell damage, which initiates an edematous inflammatory response, culminating in tissue ischemia and possible tissue death. Thus, over the past two decades, there has been an increasing focus on the subspecialty of MDRPI and the appropriate interventions necessary to prevent them.

It was not until 2016 that the National Pressure Injury Advisory Panel (NPIAP) updated its definitions to include MDRPI (Edsberg et al., 2016). According to Pittman and Gillespie

(2020), it was in 2017 that the National Database of Nursing Quality Indicators (NDNQI) added operational definitions for MDRPI to their pressure injury prevalence data collection guidelines.

In 2020, the first international group of experts from the medical, nursing, and bioengineering communities gathered to develop a comprehensive consensus statement regarding MDRPI (Gefen et al., 2020). This statement highlighted their growing concern as more and more devices are utilized on patients and served as a call to action for continued research and a better understanding of this subset of pressure injuries. Additionally, the group validated the assumption that most MDRPIs are associated with respiratory appliances. Finally, and most pertinent to this discussion, the expert panel emphasized that several factors lead patients in the ICU to experience more MDRPI, including an inability to shift position independently, long device use time, medical or neurological incapacity that impedes their ability to sense tissue changes, and the care team's fear of unintentional device dislodgment, which leads to tight or forceful placement.

To ascertain the prevalence of MDRPI, Kayser et al. (2018) analyzed the results of the 2016 International Pressure Ulcer Prevalence Study. They highlighted some significant findings, including common anatomic locations (ears and feet), standard devices (various oxygen delivery devices and splints), and the noteworthy conclusion that MDRPI forms a full three days faster than other pressure injuries. This last point is particularly relevant, emphasizing the need for frequent assessment and early detection. A meta-analysis by Jackson et al. (2019) evaluated 29 studies, including over 125,000 patients. The study found an overall MDRPI incidence of 12 % and a prevalence of 10 %. Comprehensively, the inquiry also identified respiratory devices, catheters, and immobilization devices as common sources. While the focus was on long-term acute care facilities (LTAC) instead of the inpatient setting, a study

by Arnold-Long et al. (2017) of over 300 patients found a strikingly high incidence of MDRPI, occurring in 47 % of the patients, perhaps highlighting the assumption that the longer the patient requires the appliance or device, the higher the chance of an MDRPI. Furthermore, Arnold and Long striated MDRPI into common culprits, including respiratory devices, tubing, and splints.

Although it is challenging at this point in research to determine the specific demographics, as well as the magnitude of overall morbidity, mortality, and cost of MDRPI, it is important to note the consequences of pressure injuries. In 2014, the Agency for Healthcare Research and Quality (AHRQ) observed that pressure injuries affect 2.5 million patients yearly, costing between \$9.1-\$11.6 billion (AHRQ, 2014). It is challenging to parse out the specific cost of an MDRPI, as most cost analyses focus on pressure injuries. That said, AHRQ offers a few possibilities for costliness. In 2017, AHRQ released a meta-analysis on cost and mortality associated with several hospital-acquired conditions, including pressure injuries. Their inquiry included four studies and summarized that pressure injuries cost between \$8,573 and \$21,075 per patient (AHRQ, 2017).

For this project, a large Mid-Atlantic urban teaching hospital's pressure injury data was evaluated. This hospital has a current HAPI rate of 0.94 injuries per 1000 patient days as of February 24, 2023 (MedStar Health, 2023). The 2023 fiscal year goal is a rate of 0.81. Data obtained on March 23, 2023 (last modified Feb 24, 2023) revealed 18 MDRPI since April 1, 2022. Based on AHRQ's findings, these MDRPIs are estimated to cost the hospital between \$154,000 to \$379,350 so far in the fiscal year. Additionally, since pressure injuries are often included in hospital and nursing quality metrics, elevated rates may affect the hospital's bottom line via reputation, status, and potential quality designations.

As the Centers for Medicare and Medicaid Services (CMS) continue to hone their reimbursement metrics related to their quality star ratings (CMS, n.d.), preventing pressure injuries will be a vital concern. Pressure injuries are included in the safety scoring of the organization's Patient Safety Indicator (PSI) 90 score, a composite of several patient safety indicators (CMS, 2019). The organization states that hospitals' PSI-90 scores are promoted and highlighted because "it may inform how patients select care options, providers allocate resources, and payers evaluate performance" (CMS, 2019, p. 1).

Organizational Assessment

This intervention occurred at a 912-bed academic and research medical center, which is the largest hospital in the Washington, DC region, and provides over 400,000 patient visits each year. The hospital trains roughly 350 medical residents and 40 fellows in 40 residency and fellowship programs. The center holds high rankings with U.S. News & World Report and was the first in the region to receive The Joint Commission's Comprehensive Stroke Center of Excellence. The hospital's nursing division achieved and has maintained the American Nurses Credentialing Center's (ANCC) Pathway to Excellence® Designation since 2017 and is currently completing an application for ANCC's Magnet® designation (MedStar Washington Hospital Center, 2023).

This rich history and institutional excellence are indications that the hospital is already performing evidence-based practice at the bedside. The hospital's system division of nursing utilizes the Iowa Model of Evidence-Based Practice (Iowa Model Collaborative, 2017). The hospital's desire to obtain Magnet® status, which relies on nursing-sensitive indicators such as pressure injury rates, places the organization on a track to focus on increased quality metrics and rate reduction.

Strengths, Weaknesses, Opportunities, and Threats

Strengths

The hospital system has many strengths related to quality improvement associated with MRDPI (See Appendix E: SWOT Analysis). There is a Wound, Ostomy, and Continence nursing division with a dedicated staff of 10 registered nurses providing care. A clinical nurse specialist (CNS) is also devoted to pressure injury prevention and data analysis. A robust “Skin Champions” cohort on each of the 28 in-patient nursing units is involved in the hospital’s monthly pressure injury prevalence survey and participatory in Hill-Rom's yearly International Pressure Ulcer/Injury Prevalence (IPUP) Survey each March.

Current nursing practice at the hospital includes a collaborative unit nursing leadership and staff review for every pressure injury that is a mucosal injury, deep tissue injury, unstageable injury, or Stage III/IV injury, to include all elements of documentation, discussion of skin injury prevention in daily rounds, as well as specific interventions related to the patient. These are then presented to unit medical and nursing staff and the wound-focused clinical nurse specialist to determine any gaps in practice and discuss any quality improvement opportunities.

The hospital maintains a rich library of protected patient data, with access to Tableau, a data visualization software system that provides clinicians with an analytics platform to explore their data and compare it to organizational benchmarks and goals over specific timeframes (What is Tableau, n.d.) The databases are broken down into specific hospital-acquired conditions, and reports can be obtained on the desktop of any institutional leader. Pressure injuries, including MDRPI, are tracked and can be drilled to the patient level.

Weaknesses

The hospital does face weaknesses concerning MDRPI. An article by Sheehan and Geyn (2021) for the DC Policy Center found that healthcare needs and demands had risen in the area

around the hospital since 2015. They state that healthcare needs are calculated using the patient's age, sex, and health status, and healthcare demands are predictions that consider both socioeconomic and psychosocial barriers (Sheehan & Geyn, 2021). They also noted racial disparities that led to a greater proportional healthcare need for Black and Latinx communities, many of which are in the hospital's catchment area (Sheehan & Geyn, 2021).

Assuming many of these people are unable to access preventative care means they will be seen in the hospital much further along their disease state trajectory, with a potential for comorbidities that could worsen their chance of developing a pressure injury. A study of over 13,000 ICU patients found that comorbidities, organ support modalities such as mechanical ventilation and hemodialysis, and a low to low-middle socioeconomic status led to a higher pressure injury rate (Labeau et al., 2021).

All this data means that this hospital's patient population is incredibly fragile and often lacks adequate health insurance and other funding sources. This leaves the organization with a thin operating margin and a stretched budget to care for this vulnerable population. Therefore, the hospital must judiciously manage its resources and utilize quality and process improvement processes to advance care.

Opportunities

The hospital has several current and future external opportunities to assist in pressure injury prevention. The division of nursing's current application process for Magnet® Designation requires a strong focus on nursing-sensitive indicators, including pressure injuries. A 2015 observational study by Ma and Park found that patients in Magnet®-designated hospitals had 20 % lower odds of developing a pressure injury than in non-designated hospitals. Additional opportunities exist related to the hospital's participation in the yearly IPUP survey,

with feedback and data available to help determine practice gaps to encourage and initiate quality improvement projects.

Threats

Regarding future threats, many of the hospital's patient population is insured via Medicare and Medicaid. A literature review by the Kaiser Family Foundation in 2020 found that the reimbursement rates of private insurers are nearly double that of Medicare alone, much less Medicaid (Lopez et al., 2020). Additionally, there are two well-known competitors in the region, both of whom have a substantially more prevalent private insurer/payer mix to potentially siphon away patients with higher reimbursement rates to bolster their income.

According to Leapfrog ratings associated with pressure injuries, competitors in the region fare better than this hospital. Leapfrog's current data is sourced from the Centers for Medicare and Medicaid Services (CMS) and covers the time frame from July 1, 2018, to December 31, 2019. One hospital competitor's rate is 0.46 Stage III/IV pressure injuries per 1000 patients, while the other competitor's rate is 0.20. This hospital's rate is 1.27, which is significantly higher (Leapfrog Hospital Safety Grade, Fall 2022).

Organizational Mission, Vision, and Values

The hospital's mission is "to serve our patients, those who care for them, and our communities." Its vision is "to be the trusted leader in caring for people and advancing health." The hospital's values are referred to as the SPIRIT Values, which stand for Service, Patient First, Integrity, Respect, Innovation, and Teamwork (MedStar Health, 2023). These values, particularly regarding Patient First, Innovation, and Teamwork, are utilized to prioritize the continuous quality improvement of patient care, providing technological advances in a fiscally

responsible manner, in a multidisciplinary format to engage the collective voice of the staff to make positive change.

Gap Analysis

Gaps associated with the formation of MDRPI at this hospital may be broken down into four major categories: 1) patient-associated factors, 2) RN workforce-associated factors, 3) device-associated factors, and 4) physician-associated factors (See Appendix F: Fishbone Diagram). As previously mentioned, many patients arrive at the facility with multiple comorbidities and a high disease severity, placing them at high risk for developing pressure injuries. The nursing workforce is becoming less experienced, as evidenced by recent surveys of nurses across the country. In one such survey of nurses' intent to leave the profession amid the COVID-19 pandemic, an unprecedented number voiced that intent (Raso et al., 2021). This may leave less experienced nurses vulnerable and less capable of noticing the subtle changes that can warn of or precipitate tissue breakdown. As technological advances continue to create more devices to maintain patients, there will continue to be more vectors for potential skin breakdown in these vulnerable patients. Finally, observations during interdisciplinary rounds and repeated documentation reviews highlight a lack of focus on potential and existing pressure injury concerns from physicians and provider colleagues.

Evidence-Based Practice Framework

As previously stated, the hospital's system division of nursing utilizes the Iowa Model of Evidence-Based Practice. Therefore, it is a known and understood framework for most individuals in the hospital, making it a wise decision to employ it as a strategy for this quality improvement process. In considering MDRPI, it is evident that there is a problem (18 MDRPI in FY23), and the hospital considers reducing all pressure injuries a priority.

PICO Question

To determine how to uncover the best possible interventions associated with the prevention of MDRPI, the following Population, Intervention, Comparison, and Outcome (PICO) question was developed: In patients with respiratory mechanical devices, such as endotracheal tubes and their fasteners, how does a bundle of interventions associated with their devices, compared with interventions that are not bundled, affect the rate of mechanical device-related pressure injuries?

Synthesis of the Evidence

Search Strategy

Pressure injuries and their prevention are a widely studied phenomenon. However, it was only in 2016 that the National Pressure Injury Advisory Panel's definitions delineated MDRPI, furthering the capacity to quantify their true incidence and prevalence (Edsberg et al., 2016). A literature search was performed on April 22, 2023, in PubMed and the Cumulated Index to Nursing and Allied Health Literature (CINAHL). The search criteria were limited to the timeframe of 2017-2023 and included the search terms (mech* device OR MDRPI) AND (pressure injury OR pressure ulcer). Inclusion criteria comprised the adult and gerontological patient population with medical devices used in an inpatient setting. Exclusion criteria included pediatric patients, the outpatient setting, and one noted area of study focused on patients who utilize wheelchairs, where the chair is considered a mechanical device. The databases included PubMed (595 results) and CINAHL (41 results), for a total of 636 results, inclusive of duplicates. After duplicate removal and review for inclusion/exclusion criteria, 53 articles remained. Ultimately, 10 studies were reviewed for inclusion.

Articles were analyzed by strengths, weaknesses, and their level of evidence (Appendix C), utilizing the Johns Hopkins Nursing Evidence-Based Practice Framework (Dang et al., 2021). Analysis of the literature demonstrated a predisposition to focus on the prevalence and location of the injury, as well as nursing knowledge, perception, and available interventions. Additionally, articles not included in the evidence synthesis focused on prevention bundles that may prove beneficial to lowering risk.

Results

A total of 10 studies were included in the synthesis of the evidence. One of those was a Level of Evidence (LOE) IA randomized controlled trial. The remaining nine were either LOE IIA (four studies) or LOE IIB (five studies). See the Quality Improvement/EBP Project Evidence Critique Table (Appendix C). The themes identified were prevalence and location, endotracheal tube stabilization, nursing knowledge and perception, and quality improvement.

Prevalence and Location

Since that 2016 demarcation, there have been several prospective and retrospective studies to observe the prevalence and anatomic location of pressure injuries associated with medical devices. In these studies, many found a large number to be associated with respiratory devices such as endotracheal tubes and their fasteners, tracheostomy tubes, non-invasive positive pressure ventilation masks (BiPAP & CPAP), as well as simple oxygen appliances such as nasal cannulas (Celik et al., 2022; Coyer et al., 2022; Dang et al., 2021; Kayser et al., 2018). The study by Kayser et al. (2018) analyzed the results of the 2016 International Pressure Ulcer Prevalence (IPUP) survey of 102,865 patients in hospitals, nursing homes, long-term care facilities, hospice, and rehabilitation centers, with a prevalence of 604 MDRPI (0.6%) and most frequent locations being on the face, ears, and nose, associated with oxygen delivery device. While the various patient locations provide a better understanding of the myriad healthcare sites where a patient

may suffer an MDRPI, for this review, including some facilities may skew data away from the true number of MDRPI in critically ill patients.

Many authors provided data from large cross-sections of populations, though only Kayser focused on patients in the United States. The remaining prevalence studies were conducted in China (Dang et al., 2021), Turkey (Celik et al., 2022), as well as New Zealand and Australia (Coyer et al.) This may mean further study is necessary, as the data from other countries may not be replicated in the United States. The country is fortunate to have large data sets from the National Database of Nursing Quality Indicators (NDNQI) and the yearly International Pressure Injury Prevalence study each March, where data from US hospitals may be reviewed.

Endotracheal Tube Stabilization

For many years, endotracheal tubes were stabilized with adhesive tape that was changed when wet or soiled. While all clinicians believe that the risk of extubation is both real and dangerous, a concern also developed regarding how those endotracheal tubes were stabilized over time. Various fasteners and fixation devices were developed to help secure ETTs while also being hopeful that these devices would help lower the incidence of pressure and mucosal injuries caused by the ETT itself. Landsperger's random control trial (RCT) and Kuniavsky et al.'s prospective comparative study comprising 453 patients sought to compare complications, including pressure injuries, associated with adhesive tape versus an endotracheal tube fastener. Both found that endotracheal tubes stabilized with adhesive tape carried a significantly higher risk of causing an MDRPI (Kuniavsky et al., 2020; Landsperger et al., 2019).

Nursing Knowledge and Perception

Another specific area discovered during the literature review and evidence synthesis focused on baseline knowledge and perception of MDRPI. A weakness of all these studies is that the questionnaire utilized was self-created and not yet validated. However, as a first step,

this questionnaire provides a strong inception point for future research and study validation. The strength of these studies in total is in providing control, or starting point, regarding nursing knowledge of MDRPI. Nurses were able to provide basic knowledge of this specialized pressure injury. However, they fell short in the ability to stage, conceptualize, and, in some instances, even believe that a medical device might cause a pressure injury (Erbay et al., 2021; Fu et al., 2022; Karadag et al., 2017). Further research is necessary to determine additional areas of education for nurses regarding MDRPI prevention and treatment.

Quality Improvement and Interventions

While the body of research regarding MDRPI abounds with small quality improvement examples of a singular intervention, such as nursing education or highlighted focus on the issue, there is little available regarding a bundle of interventions to prevent them. Tayyib et al. (2021) assembled a group of interventions denoted as the SKINCARE bundle versus the standard of care in 223 patients in Saudi Arabia. The team successfully lowered their MDRPI rate from 13.5% to 0.89% over three months. The article revealed strong educational practices regarding device positioning and assessment. However, the sustainability of the success may be in question if study investigators do not continue their focus on communication and education regarding the needed interventions.

Of note, in 2020, the Journal of Wound Care released an International Consensus Statement titled “Device-related pressure ulcers: SECURE prevention,” which provided background, anatomical locations of concern, devices at highest risk, patient risk assessment tools, as well as the most well-received practice approaches to help prevent MDRPI (Gefen et al., 2020). The statement also voiced a call to the medical device manufacturing industry to collaborate with healthcare providers to ensure designs are considering the risk of MDRPI.

Methods

This evidence-based practice and quality improvement project compares standard skincare and wound prevention for patients with endotracheal tubes and a bundle of interventions designed to reduce MDRPI in this population. Rates of ETT-associated MDRPI were measured before and after intervention. Additionally, nursing comfort with tube manipulation and ETT fastener padding was assessed before and after the pilot and is included in the evaluation.

Patient Selection

Patients included in this project are those with endotracheal tubes in five intensive care units (ICUs) in a large, urban teaching hospital in the Mid-Atlantic region. Patients with facial trauma and facial gunshot wounds and those with facial burn wounds that may require specific ETT location placement are excluded, as well as patients who are nasally intubated. Additionally, those who are on comfort care awaiting compassionate extubation or a donor patient being optimized for organ procurement are excluded from this protocol. Finally, any patient being placed in a prone position for medical therapy is also excluded.

Process and Workflow Mapping of ETT Movement

In a meeting with the hospital's respiratory therapy (RT) clinical specialist, it was determined that the RTs working in the intensive care units have a standard assessment schedule for intubated patients, timed every six hours at 0200, 0800, 1400, and 2000. During that assessment, the RT's tasks include a mucosal and skin assessment around the ETT fastener and manipulation of the tube to move it to a different area of the oral cavity. According to the RT clinical specialist, there is an assumption that the patient's nurse also evaluates the skin and moves the ETT during their regular assessments. However, this is not currently part of the nurse's standard work. The RT clinical specialist aptly said: "It is a task that is considered to be everyone's responsibility, which makes it no one's responsibility" (personal communication,

June 3, 2023). It should be noted that a pre-pilot chart audit found that both RT and RN documentation of tube movement was infrequent and sporadic.

Given that the RT staff has a standard workflow related to ETT assessment, and the nursing staff does not, it seems plausible to build a nursing guideline and procedure around their existing schedule of activities. Additionally, the standardization of ETT locations may provide a visual cue to both RT and RN staff that the tube has been recently assessed and moved. Therefore, a protocolized schedule was developed to align with the existing RT workflow and added times when the RN is likely already completing a patient task to make it a more straightforward responsibility. This schedule is available in Appendix G.

The schedule begins with the respiratory therapist's 0200 assessment and tube location movement. Over the next 24 hours, the assessment and movement alternate between disciplines at set times. Additionally, for included patients, all parties can quickly determine that the assessment has been completed, as all patients will have their tubes at the same location during that time. Finally, when a patient is intubated, their tube will be placed in the location of all other patients' tubes and moved and assessed at the following designated time.

The existing ETT fastener utilized by the hospital has padding for the upper lip; however, patients still suffer from pressure injuries at that very location. Therefore, an additional quality improvement component will be to place a foam-bordered dressing under the padding at that anatomic location. This will be added upon intubation and changed when the site is assessed.

This project utilizes the nursing process as its change theory. It is highlighted in the planning process to bring together necessary stakeholders, such as the respiratory therapy department, and in determining pain points, such as the lack of an institutional protocol for nursing involvement in ETT skin assessments and standardized tube movement (Wagner, 2018).

Staff Education

Currently, there are roughly 300 RNs who work in the five intensive care units involved in the pilot. The hospital's nursing practice and professional development division suggests reaching 80 % of the involved staff before the rollout of a new process. Therefore, roughly 240 nurses will need education before this practice changes. This will be accomplished during existing staff huddles, rounding on the units with just-in-time training, and job aide creation. Anecdotal information received from several staff members reiterated that many RNs are apprehensive about moving the ETT on their patients due to fear of dislodgement. Therefore, an instructional mannequin head was made available, and a modified endotracheal tube and ETT fastener were placed so that nurses could practice moving the tube. This kinesthetic learning is vital for some individuals to feel comfortable performing a task. A job aide was developed to include the location clock/responsibilities and screenshots of documentation best practices.

Education will also be necessary for RT staff regarding nurse involvement, initial placement during intubation, skin assessment and padding placement, and a reinvigoration of documentation practices. This was completed via a job aide with the location clock, responsibilities, and documentation screenshots. It is also available in Appendix H.

Here, the use of the nursing process as change theory is vital. As noted above, overcoming the apprehension of some nurses regarding the manipulation of the ETT and its fastener is an important component in the success of this project. Communications with nursing staff should focus on the implementation element of the nursing process to quell uneasiness. Additionally, The CNS student must negotiate with those who might not be ready for a change, like that which is accomplished with a nurse-and-patient relationship, to achieve the goals of this project.

Data Collection

Both process and outcome data points will be collected before and at the end of the pilot. Process data will include a pre- and post-pilot survey of nurse comfort related to tube movement. Specifically, nurses will be asked the following questions in the pre-implementation survey:

- How confident are you in safely manipulating a patient's ETT to change its position in a patient's mouth? Yes/No
- If you answered no, does this safety concern prevent you from moving or manipulating a patient's ETT? Yes/No.

Additional process data will include chart audits of documentation to evaluate compliance and determine whether RT and RN staff members validate the patient record of their assessment and interventions. Finally, outcome data will focus on ETT-associated MRDPI and whether the quality improvement project was successful.

Cost Benefit Analysis

This paper states that HAPIs are costly for hospitals and may result in decreased reimbursement from CMS and private insurers. The actual cost of an MDRPI has not yet been quantified in the literature. This project's costs will be minimal as it is focused on improving existing practices and processes. A small cost will be associated with increased usage of foam-bordered dressings to be placed under the ETT fastener on the patient's upper lip.

Ethical Considerations

This is an evidence-based quality improvement process and, thus, part of the hospital's ongoing practice of continuous improvement. It was approved by the hospital's nurse scientist to implement current best practices and research. Additionally, nursing leadership sought and received approval from each unit to share and gather information and data. It is the hospital's practice to deem that internal Institutional Review Board (IRB) approval is unnecessary if the project is for implementation of evidence-based practice and research and allows the project to

be managed by the student's university IRB. Before the start of the project, it was submitted to Michigan State University's Institutional Review Board and deemed non-human subject research. No patient identification was needed or necessary for the project. No additional consent was needed beyond the patient's consent for treatment at the hospital.

Barriers

An obvious barrier to this project is RT and RN time in moments of high patient acuity. Preventative measures often become a lower priority when a patient is being actively resuscitated or on multiple therapies with frequent necessary interventions. Additionally, continued unease by nurses about moving the ETT would mean the project would be unsuccessful. Another barrier to success is documentation compliance. As mentioned, RT and RN documentation of tube location movement is sporadic. If staff continue not documenting tube movement, it will be difficult to determine if any improvements are associated with the project's goals.

Evaluation

To discover whether the suggested interventions reduce the frequency of ETT- and fastener-related pressure injuries, it will be important to collect data prior to the intervention and then repeat that data collection after a pre-determined amount of time. Three specific data points will be gathered, including the suggested survey of nursing comfort associated with manipulation of the ETT and its fastener, both nursing and respiratory therapist documentation audits related to tube positioning and skin/tissue assessment, and whether the number of ETT- and fastener-related pressure injuries lessen after the interventions are undertaken.

Results

A pre-implementation survey was made available to bedside nurses in the hospital's seven ICUs. There were 76 responses to this survey, revealing that 16 % (12 nurses) did not feel

comfortable manipulating or moving their patient's ETT and that these safety concerns prevented them from moving it. A total of 38 of these respondents (50 %) had two years or less experience as a critical care nurse.

The post-implementation survey was only made available to the two units where the interventions occurred. These interventions included frequent rounding with job aids related to ETT movement, assessment suggestions, and the turn clock. In addition to the three original questions, the following were added to this survey:

- Do you regularly chart skin and tissue assessments associated with ET tubes?
- Do you regularly chart ET tube movement?
- If you do not regularly chart assessments or movements, why?
 - I don't know where to chart it.
 - I don't normally utilize this EHR section.
 - The respiratory therapist does it.

Thirty-one nurses responded to the post-implementation survey. A full 30 of them (97 %) answered that they feel comfortable to safely move and manipulate the ETT. Additionally, 27 nurses (87 %) believe they regularly chart skin and tissue assessments related to these devices. While these nurses claim they do chart that assessment, they admitted that they do not often chart the movement of this tube, with their rationales being split between the provided answers, essentially that there is still an expectation that the respiratory therapist completes this documentation, or that they do not know where or how to chart it.

Documentation audits bore out this finding related to the movement of ETTs. A review of 81 patient charts throughout the intervention revealed substantial noncompliance with assessment documentation. Sixty-two charts (77 %) did not include ETT movement, and 77 (95

%) did not have peri-oral or mucosal tissue assessments. It is important to note that the EHR location where ETT movement is located is in a section where the nurses do not normally chart assessments, as the respiratory therapists maintain it. Therefore, the nurse must remember to navigate to this chart section and document one assessment point.

Most importantly, during the intervention time frame (October 2023 to January 2024) there were no ETT- or fastener-related pressure injuries in the critical care division, while three such injuries occurred during the three months before the intervention. While it cannot be determined whether this intervention made a difference in these results, it is still a notable finding.

Implications and Limitations

A pre-implementation survey found that some nurses did not feel comfortable with their ability to manipulate and move a patient's ETT safely and that this discomfort prevented them from completing that task. This inaction could result in skin and tissue breakdown related to the ETT and its fastener and the delayed discovery of any skin or mucosal tissue breakdown related to the pressure exerted by the appliance. According to the post-implementation survey results after this three-month quality improvement project, nursing comfort seems to have improved.

While the nurses confessed comfort with movement and assessment during the post-implementation survey, documentation of these tasks remained a barrier. Of note is that the EHR documentation locations for these various tasks are scattered throughout the interface, without one specific location. However, the only location to chart ETT movement is in an area of the EHR normally utilized by respiratory therapists. A skin assessment section is present in this area of the chart, with the options of "red," intact," "not intact," and "other" as potential documentation options. These are not complete nursing documentation of any skin abnormality

and thus fall short of the necessary assessment details. Additionally, the follow-up section may lead the nurse to believe this is not a nursing documentation location, as one of the options to document is “nurse notified.”

While nurses stated that they believed they completed documentation of skin assessments and tube movement, documentation audits did not bear this out. This could mean that, despite the anonymity of the survey, nurses did not feel comfortable admitting they did not complete a task they knew they should do. Additionally, there is no prompt from the EHR to remind nurses to document tube movement. The hospital standard is to document skin abnormalities by exception, potentially negating any preventative assessment documentation with no abnormal findings.

While the turn clock with locations was considered an innovative option to ensure ETT movement, it depended on a 24/7 champion to ensure the task was completed. As this was a quality improvement project, no changes were made to existing orders, documentation standards, and clinical prompts in the EHR. That meant it was dependent upon a champion to initiate the process every 2-3 hours daily.

Further discussions with the nursing director of the wound, ostomy, and continence department have led to a future state project where all patients are turned every two hours and their ETT placed on the side of that turn, barring any complications that would prevent it. That would essentially mean if the patient were lying on their left, the ETT would be in the left of their mouth; when the patient is supine, it would be in the middle of the mouth, and so forth. However, this intervention would remove the task from the RT’s domain, so further interdisciplinary discussions will be necessary to confirm a practice change.

This discussion of removing the task from the RT's domain raises another salient point. Current practice is that ETT movement and assessment are shared tasks, meaning that the respiratory therapist and the nurse dually own them. This can lead to frustration amongst the interdisciplinary team due to task duplication and confusion over who would complete the task at which timeframes. There was an attempt to build the nurse-led movement times around existing respiratory therapist documentation standards: assess the tube and move it every six hours at 0200, 0800, 1400, and 2000. However, given that no clinical prompts could be added to the EHR and those documentation locations were unfamiliar to the RN, this task fell short.

Finally, there has been considerable pushback from nursing practice regarding adding a new task and the related documentation to an already overwhelmed and data-saturated nursing team. However, this writer believes that skin assessments are the purview and responsibility of the nurse; therefore, any associated interventions should be documented. It is incumbent upon nursing practice and informatics to make that task as simple as possible for bedside nursing workflow, thus making the activity more accessible to complete and document.

Discussion

Medical-device-related pressure injuries have grown to be a debilitating subset of pressure injuries affecting critically ill patients. If the patient survives their illness, they may be left scarred and with potential deficits. This is especially true regarding respiratory device-related injuries, which may cause permanent damage to a patient's face and mouth, potentially lessening their quality of life and confidence. Additionally, mucosal injuries in the mouth may lead to complications with swallowing and speech. These potential sequelae convey the importance of vigilant assessment and prevention tactics associated with using these devices.

While these injuries are not a substantial portion of the overall problem of hospital-acquired pressure injuries, the ones that do occur have the potential to cause life-changing disfigurement and harm. However, these injuries often develop because of actions taken to provide a patient with life-sustaining treatment, leading some in healthcare to deem them an inevitable cost of saving a patient. Countering this theory can be both difficult and time-consuming. Additional barriers include competing patient priorities, documentation inconsistencies, and staff turnover that will require constant reiteration of standard practices. Staff turnover and competing priorities may also be barriers to sustainability without a strong facilitator to keep the project at the forefront of people's minds. The project does have promise as one that could be generalized across other critical care settings in the health system's hospitals and could even serve as an interdisciplinary best practice for nurse and respiratory therapy collaboration.

More research is necessary to lessen the force application associated with respiratory device-related injuries, especially the ETT fastener, which is utilized for patient safety against potential unintended extubation but may cause injury. Future projects could focus on the tissue damage associated with non-invasive respiratory device-related pressure injuries, such as BiPAP and CPAP masks and high-flow nasal cannula devices.

Conclusion

The frequency of ETT- and fastener-related pressure injuries may be lessened by a bundle of interventions associated with nursing safety confidence improvement, frequent tube location changes, and frequent skin assessment and prevention interventions. While not a huge portion of pressure injuries, their existence can lead to debilitating injuries and a potential loss of function. The international healthcare community has come together with a clarion call to increase

surveillance and focus on medical-device-related pressure injuries. It is imploring the healthcare community to develop strategies to prevent their formation. Critical care nurses are at the front lines of establishing these interventions and play a vital role in the solutions that will prevent these injuries.

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Appendix A: Quality Improvement/EBP Project Evidence Critique Table

Author Citation	Design/Purpose	Results	LOE & Quality: Strengths and Weaknesses	Relevance to the Problem
Dang et al. (2021)	Cross-sectional study of prevalence and risk factors in 694 patients	Overall prevalence of 13.1% in 98 locations, with CPAP/BiPAP masks being highest culprit (25%)	LOE: Level IIA Strengths: large geographic and socioeconomic cross-section of China Weaknesses: not generalizable	Highlights common devices and anatomical locations of MDRPI
Celik et al. (2022)	Observational prospective study of 302 ICU patients in Turkey	MDRPI in 27.2% of patients, with nose and mouth being most common	LOE: Level IIA Strengths: large population over the course of full year Weakness: one ICU, evaluation every other day	Data on common locations and appliances
Coyer et al. (2022)	Cross-sectional prospective observational study of 627 patients in 44 ICUs as part of a point prevalence program	27 patients with 35 MDRPI (4.3%), with common locations being mouth, ear, and neck and devices being ETTs and respiratory assist devices	LOE: Level IIA Strengths: large cross-section of binational population Weaknesses: first AUS/NZ study to report MDRPI; cross-sectional and point-prevalence of one day	Calls for further research and recommendations on clinical practice guidelines for the care of patients with medical devices

Kayser et al. (2018)	Retrospective analysis of 2016 IPUP survey	102,865 patients, prevalence of 604 MDRPI (0.6%) with most frequent locations on face, head, ears, and nose, associated with oxygen delivery devices	LOE: Level IIA Strengths: large cross-section of USA/Canada Weaknesses: self-reported, total numbers include long-term care facilities, hospice, rehabilitation, and long-term acute care facilities, which may skew away from true number in critically ill patients	Highlights common devices and anatomical locations of MDRPI
Karadag et al. (2017)	Prospective descriptive study of nursing perceptions of & interventions related to MDRPI	606 nurses surveyed and found 20% did not believe a medical device could cause injury	LOE: Level IIB Strengths: large sample of RNs Weaknesses: based on RN statements and not observation of care	Provides working questionnaire to survey nurses on perceptions and interventions
Fu et al. (2022)	Cross-sectional survey of nurses' knowledge level regarding MDRPI	261 nurses completed questionnaire with an average accuracy of 60.5%, with the ability to stage and the conceptualization of MDRPI being the lowest score at 28%	LOE: Level IIB Strengths: provides baseline of nursing knowledge for future research Weaknesses: self-designed questionnaire without validation	Provides working questionnaire to survey nurses on knowledge

Erbay Dalli and Girgin (2021)	Cross-sectional survey on knowledge, perception, and prevention of MDRPI	142 nurses completed questionnaire with average knowledge of 68%	LOE: Level IIB Strengths: provides baseline of nursing knowledge for future research Weaknesses: self-designed questionnaire without validation	Demonstrates need for more education and knowledge on MDRPI
Kuniavsky et al. (2020)	Prospective comparative study of two groups of intubated patients (cloth tape vs Anchorfast Hollister tube fixator device)	155 patients with significant differences in pressure injury development favoring the use of AnchorFast	LOE: Level IIB Strengths: shows strong connection with adhesive tape and increased injury Weaknesses: no randomization of patients and does not say how they were placed in groups; relatively small sample size	Highlights need to utilize tube fastener over tape for patients intubated longer than 24 hours
Landsperger et al. (2019)	Randomized control trial of patients to adhesive tape or tube fastener	153 patients with tube fastener and 145 with adhesive tape, with lip ulcers having a much higher incidence in the tape group	LOE: Level IA Strengths: first large, randomized trial focused on complications Weaknesses: adhesive tape vs. Single brand of fastener; did not study repositioning timing but left that to existing ICU protocol	Demonstrates that the use of an endotracheal tube fastener may be associated with few complications than adhesive tape, including MDRPI

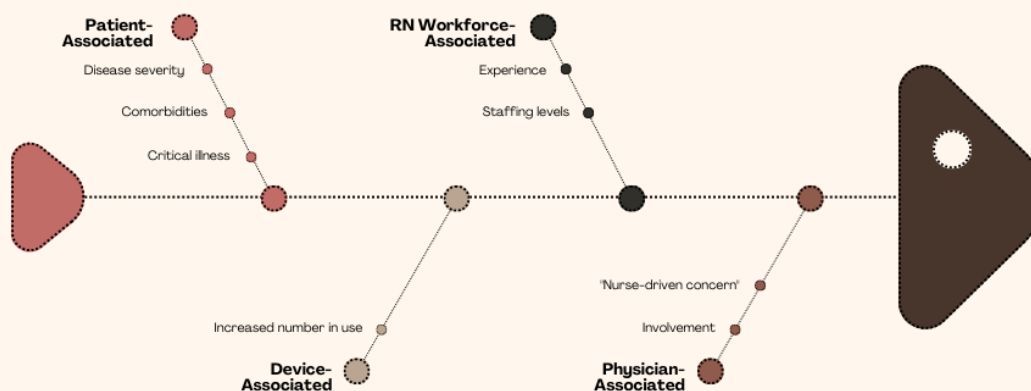
Tayyib et al. (2021)	Prospective study of a MDRPI skincare bundle of 223 patients in three ICUs in one hospital	90% reduction (from 13.5% to 0.89%) patient population MDRPI over a 3-month period	LOE: Level IIIB Strengths: Reveals strong educational practices regarding device positioning and assessment Weaknesses: concerns about sustainability and generalizability	Provides bundle of interventions that provided success during the intervention period
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Appendix B: SWOT Analysis

<u>Strengths</u>	<u>Weaknesses</u>
• Wound, Ostomy, and Continence Nurse Department with 15 RNs • Active “Skin Champions” on each of the 28 in-patient nursing units • Monthly pressure injury prevalence day • Yearly participation in the International Pressure Injury Prevalence Survey each March • Robust review of each mucosal, DTI, unstageable, Stage III/IV injury • Extensive patient data available to all via Tableau Software	• District of Columbia – high healthcare needs and demands • Patients with multiple comorbidities • Patients with less access to preventative care
<u>Opportunities</u>	<u>Threats</u>
• Magnet® application and readiness – designation is associated with lower pressure injury rates • Utilization of Hill-Rom’s IPUP data	• High number of Medicaid/Medicare in payer mix • Two competitors with more private insurance in payer mix • Competitors current serious HAPI are significantly lower

Appendix C: Fishbone Diagram

Institutional Factors Contributing To Mechanical-Device-Related Pressure Injuries (MDRPI)



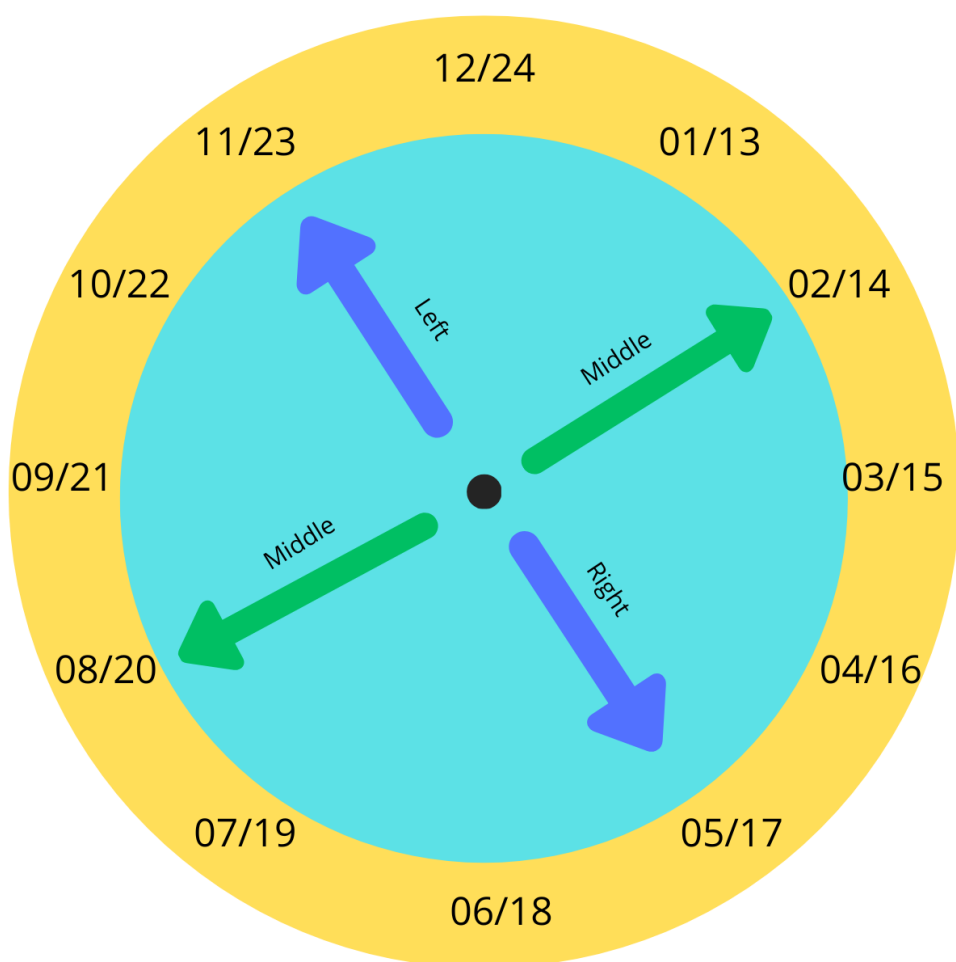
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Appendix D: ETT Assessment Times, Location, and Responsibilities

0200	Left	Respiratory Therapist
Between 0500-0600	Middle	Registered Nurse
0800	Right	Respiratory Therapist
Between 1100-1200	Middle	Registered Nurse
1400	Left	Respiratory Therapist
Between 1700-1800	Middle	Registered Nurse
2000	Right	Respiratory Therapist
Between 2300-2400	Middle	Registered Nurse

Appendix E: Turn Clock

24-Hour Turn Clock



Nursing

Respiratory
Therapist

Appendix F: Nursing Job Aids

Endotracheal Tube & Tube Fastener Related Pressure Injuries

The photographed injury occurred due to prolonged pressure of the ETT tube on the patient's tongue.

Injuries may also occur on:

- The upper inner lip (mucosal tissue) and upper outer lip (skin tissue), related to the pressure of the ET tube fastener.
- The lower inner lip (mucosal tissue) and lower outer lip (skin tissue), related to the prolonged pressure of the ET tube.

Frequent intervention is necessary to prevent these injuries, which may cause permanent scarring and decrease quality of life, and even issues with speaking and swallowing!

Nurses can and should move the patient's ET tube to the middle, right, and left side of the patient's mouth throughout their shift, while assessing the skin and mucosal tissue for any injury.



Appendix F (continued): Nursing Job Aids

MedConnect: Regular Skin Assessments and Movement

Documentation of ETT movements and skin assessments is in *Ivview* under Adult ICU Advanced Respiratory.

- Options for "Oral Position" are: Left, Middle, Right
- Skin Inspection: Lips

NOTE: due to MedConnect current state, assessment of any tongue abnormalities should be documented in the Skin Abnormalities section of the Adult ICU Systems Assessment band.

Adult ICU Quick View	
Adult ICU Quick View	
Intake And Output	
CAPO CRT SCUP	
Adult ICU Systems Assessment	
Adult ICU Advanced Respiratory	
Airway Management	
Cough/Suction	
Chest Physiotherapy	
Incentive Spirometry	
Endotracheal Tube	
Tracheostomy	
Laryngectomy	
Pharyngeal Airway	
Nursing Mechanical Ventilation	
CPAP/BiPAP	
Skin Inspection	
Pronation	

Endotracheal Tube	
Cuffed 7.5cm Oral	
Insertion Distance:	cm
Landmark:	
Oral Position:	
Position Confirmation:	
Cuff Pressure:	cmH2O
Cuff Pressure Method:	
Tube Status/Securement:	
Tube Care:	
Oral Care Type:	
Activity:	
Unexpected Event:	
Comment:	

Adult ICU Advanced Respiratory	
Airway Management	
Cough/Suction	
Chest Physiotherapy	
Incentive Spirometry	
Endotracheal Tube	
Tracheostomy	
Laryngectomy	
Pharyngeal Airway	
Nursing Mechanical Ventilation	
CPAP/BiPAP	
Skin Inspection	
Pronation	

Skin Inspection	
Forehead	
Bridge of Nose	
Nasal Septum	
Nares	
Lips	
Chin	
Ear, left	
Ear, right	
Cheek, left	
Cheek, right	
Skin Inspection Follow-up Completed	

MedConnect: Regular Skin Assessments and Movement

Documentation of ETT movements and skin assessments is in *Ivview* under Adult ICU Advanced Respiratory.

- Options for "Oral Position" are: Left, Middle, Right
- Skin Inspection: Lips

NOTE: due to MedConnect current state, assessment of any tongue abnormalities should be documented in the Skin Abnormalities section of the Adult ICU Systems Assessment band.

Adult ICU Quick View	
Adult ICU Quick View	
Intake And Output	
CAPO CRT SCUP	
Adult ICU Systems Assessment	
Adult ICU Advanced Respiratory	
Airway Management	
Cough/Suction	
Chest Physiotherapy	
Incentive Spirometry	
Endotracheal Tube	
Tracheostomy	
Laryngectomy	
Pharyngeal Airway	
Nursing Mechanical Ventilation	
CPAP/BiPAP	
Skin Inspection	
Pronation	

Endotracheal Tube	
Cuffed 7.5cm Oral	
Insertion Distance:	cm
Landmark:	
Oral Position:	
Position Confirmation:	
Cuff Pressure:	cmH2O
Cuff Pressure Method:	
Tube Status/Securement:	
Tube Care:	
Oral Care Type:	
Activity:	
Unexpected Event:	
Comment:	

Skin Inspection	
Forehead	
Bridge of Nose	
Nasal Septum	
Nares	
Lips	
Chin	
Ear, left	
Ear, right	
Cheek, left	
Cheek, right	
Skin Inspection Follow-up Completed	