Medical device-related pressure injury prevention related to fixation of nutritional and derivative probes: a best practice implementation project

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ABSTRACT

Objectives: The main objective was to improve the provision of clinical care in pressure injury prevention related to the use of medical devices focused on nasogastric probes.

Introduction: The insertion of nasogastric probes could lead to the formation of medical device-related pressure injuries (MDRPI). The risk increases with the length of the probe insertion and is higher in patients in intensive care. MDRPI prevention is mostly based on appropriate skin and mucosa membrane and tissue monitoring and positioning of the medical devices.

Methods: The project has been conducted based on JBI Implementation approach for promoting change in healthcare practice. A baseline audit on MDRPI prevention was undertaken and involved 21 nurses and 12 patients using a questionnaire for nurses and a record sheet for patient's monitoring. The intervention included education, clinical practice training, consultation, and other strategies. A follow-up audit was undertaken, including all original participants. Results data on changes in compliance were measured using descriptive statistics embedded in JBI-PACES in the form of percentage changes from baseline.

Results: There were significantly improved outcomes across all best practice criteria. The level of knowledge of nurses increased. Skin barrier creams and mass-supplied fixation are now used to prevent skin injuries on the nose. The new monitoring and documentation is more accurate and in line with evidence-based practice.

Conclusion: Overall, the project achieved an improvement in evidence-based practice in the prevention of MDRPI in patients with nasogastric probes based on nurses' increased level of knowledge and usage of appropriate preventative measures.

Key words: clinical audit, implementation project, medical device-related pressure injury, nasogastric probe, prevention

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What is known about the topic?
- The nasogastric probe can cause medical device-related pressure ulcers.
- The length of the insertion of the nasogastric probe increases the risk of MDRPI formation.
- The skin injury related to the nasogastric probe insertion is mostly on the nose dorsum area and mucosa injury in the nose cavity.

What does this article add?
- The commercially available device (fasteners or holders) is still not commonly used and needs to be promoted in clinical practice in the Czech Republic.
- The use of potentially harming skin products (e.g. hydrogen peroxide) is still in place in the clinical practice in the Czech Republic, and an effective education plan could reduce usage and the incidence of the MDRPI.
- On the basis of the implementation project activities, the internal guidance has been changed, and the use of harmful products has been highlighted.

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Introduction

Pressure injury (PU) remains a common complication of health care despite intensive prevention strategies and growing strategic interest. It is known that a significant proportion of pressure injuries (PUs) in critically ill or immobile patients are related to the use of medical devices, such as endotracheal tubes or oxygen masks.[1] Other devices, such as urinary catheters, cervical collars, tracheostomy tubes/ties, compression stockings, and nasogastric tubes, to name a few, are found across care settings.[2]

Pressure injury formation in unusual regions is frequently caused by the use of diagnostic and therapeutic medical devices called medical device-related injuries (MDRI). The definition of MDRI was included in the NPUAP update in 2016, defined MDRPI as arising `from the use of devices designed and applied for diagnostic or therapeutic purposes. The resultant pressure injury generally conforms to the pattern or shape of the device'.[3] MDRPIs develop the same configuration as the device mentioned above and can result from a variety of factors including the materials the device is constructed from, securement method, prolonged pressure in the same place and local oedema.[4]

This implementation project is focused on the prevention of pressure injury when using a nasogastric probe. MDRPIs originating connection with a nasogastric probe make up 8% of the total number of MDRPIs and are often neglected in clinical practice.[5]

The occurrence of MDRPI in patients with an established nasogastric probe is conditioned by a combination of risk factors. The predisposing factor for pressure injuries is the time for which the nasogastric probe is introduced. Other risk factors include decreased sensory perception, impaired circulation and subsequent oxygenation of the skin and mucous membranes, in combination with too tight a device, the presence of moisture and heat that develops between the skin and the nasogastric probe. In addition to the damage to the skin by pressure in the nasal cavity, there is a risk of damage to the skin on the surface of the nose because of insufficient skincare and the use of unsuitable fixing materials.[1] Mucosal injury could potentially cause stenosis of the nostril/vestibule, nasal septum perforations, and nasal synechia in addition to scarring that could lead to nasal deformity.[6]

The underestimation of the seriousness of the problem of MDRPI is widespread in clinical practice; a small ulcer in a critical patient is not considered a serious clinical problem. But even such injuries may cause a poor aesthetic result and functional chronic nasal airflow obstruction.[7] In addition to the financial burden on the healthcare system and the extension of the length of hospitalization, the patient's quality of life is also significantly affected.[8]

Objective(s)

The objective of this evidence implementation project was to improve the provision of clinical care in the field of pressure injury prevention related to the use of medical devices focused on nasogastric probes.

The specific objectives of the project were:

(1) To conduct an audit of nursing clinical handover and determine current compliance with the best practice recommendations for preventions of MDRPI when using nasogastric probe.
(2) To increase nursing knowledge of MDRPI prevention in a patient with nasogastric probe.
(3) To formalize local nursing practices in the prevention of the MDRPI in a patient with nasogastric probe.
(4) To evaluate changes in compliance with the evidence-based practice recommendations following the implementation of strategies to address identified barriers and enhance identified facilitators in preventing MDRPI when using nasogastric probe.

Methods

The project used the JBI's Practical Application of Clinical Evidence System (JBI-PACES),[9] an online tool for health researchers to collect and compare data for the purposes of pre–post implementation audits and the Getting Research into Practice (GRiP)[10] frameworks to promote change in healthcare practice. Additional analyses were performed in Microsoft Excel and allowed comparison of seven defined monitored parameters and criteria in the baseline and follow-up phase (e.g. use of correct size of medical devices, proper skin care and changes in position of medical devices).

The project involved seven steps divided into three phases as follows.

The first phase, `Stakeholder engagement or team establishment and baseline audit', consisted of four steps:

(1) identification of practice area for change – long-term ICU in a private hospital, building the project team and collaborating nurses, patients and lay carers, power analyses of the sample size.
(2) engaging change agents – managerial level – the head nurse at the unit, bedside staff at the unit and patients as well as lay carers, market analyses – available product for the prevention of skin injuries related to nasogastric probe/tube

(3) assessment of context and readiness to change (i.e. situational analysis) – analyses of the frequency of nasogastric probes/tubes insertions
(4) review of practice (i.e. baseline audit) against evidence-based audit criteria – analyses of the actual practices, availability of the guidance at the unit and availability of preventative measures and protective agents

The second phase, `Design and implementation of strategies to improve practice' based on the GRiP framework consisted of implementation of changes to practice based on a basic audit analysis, definition of barriers, and determination of changes strategies.

The third phase, `Follow-up audit and post-implementation of change strategy', contained re-assessment of practice using a follow-up audit and consideration of the sustainability of practice changes. This study was carried out from January 2020 to March 2021.

Ethics

The project was registered as a quality improvement activity within the participating hospital, and therefore, did not require ethical approval.

Phase 1: stakeholder engagement (or team establishment) and baseline audit

A project team consisted of the head nurse of the long-term ICU, general nurses ($n = 21$) working as bedside healthcare personnel and senior nursing consultant in PUs prevention, one wound consultant from the private hospital, and one independent industry representative. The project started in January 2020 with the baseline audit performed from 15 February to 2 April 2020. There were six meetings in total (because of the COVID-19 pandemic, three meetings were virtual) held at different stages of the project. During the first phase, one face to face meeting and one virtual meeting was organized. During the first meeting, the project's main goals and project description were presented. For the second virtual meeting, a discussion forum in a form of Question and Answers (Q&A) session was carried out – to clarify the roles and responsibilities of the project members.

The rationale for the sample size and characteristics: at the particular long-term ICU are hospitalized patients with endangered vital signs and impaired consciousness, problem with oral food intake, and need for supplementary feeding. There are 20 beds for patients and 25 general nurses in total [22 of them were employed as full-time employees (FTE) including the head nurse, 3 nurses worked part-time]. The FTE nurses ($n = 21$) were all involved in the study. As there was not always 100% of beds occupied, the number of patients involved differed; 60% ($n = 12$) of patients were involved in the baseline audit, 80% ($n = 16$) were included in the follow-up audit. We had planned to involve more units but because of the COVID-19 pandemic situation, it was not possible.

The roles of the project members varied during the project; the head nurse and industry representative were involved mainly as supervisors. Despite the fact that the materials for educational activities were offered by the industry and industry partners worked as consultants, there was neither direct influence on running the implementation project nor on the results. Involvement of the project team members varied in capacities of support, data collection, data entry and/or participation and contribution to the evaluation.

The audit criteria have been defined based on the JBI Implementation model for promoting change in healthcare practice (Table 1).[10]

Phase 2: design and implementation of strategies to improve practice (Getting Research into Practice)

The project team analyzed the results of the baseline audit. On the basis of the results of the baseline audit, the barriers to compliance with best practice recommendations were identified and discussed, and strategies to address the barriers were developed and implemented. The strategies primarily included the dissemination of evidence-based information in care plans for the prevention of MDRPI. In the timeframe from 15 February to 2 April 2020.

Phase 3: follow-up audit postimplementation of change strategy

The postimplementation audit was carried out from 20 January to 25 March 2021. The follow-up audit used the same evidence-based audit criteria as the baseline audit and involved 21 nurses and 16 patients.

The project leader was responsible for entering the data into the online JBI-PACES program.

Analysis

Results data on changes in compliance were measured using descriptive analyses embedded in JBI-PACES in the form of percentage changes from baseline.

Results

Samples' demographics

In total, 16 patients were assessed in the implementation project. The vast majority were women (60%) with a mean age of 48 years (minimum 30, maximum 68) for

Table 1. Audit criteria and the method to measure compliance

Audit criterion	Sample	Method
Healthcare professionals are provided with clinically based education on the prevention of MDPRI.	Baseline: 21 nurses Follow-up: 21 nurses	Review of organizational safety instructions and instructions for continuous healthcare professional's education (we have analyzed retrospective content analysis and participative observation). Review of educational materials for lay carrying and patients (through the document content analyses). Interview and questionnaire – nursing staff were asked if they had previously received any training (answer yes) on the prevention of medical device-related injury in general.
Medical devices are correctly sized and fitted according to the manufacturer's specifications.	Baseline: 12 patients Follow-up: 16 patients	Observation – nurses from the project team assess the size and application of commercially available devices (probe/tube and its fixation).
The skin under and around the medical device is inspected at least twice daily for signs of skin injury.	Baseline: 12 patients Follow-up: 16 patients	Observation – the nursing records were checked. Recording – the nurses from the project team (working in the shifts) checked the nursing record and shared the knowledge about the care coordination and symptomatology needed to inspect concerning the skin condition.
The skin under the medical device is kept clean and dry.	Baseline: 12 patients Follow-up: 16 patients	Observation – the nurses from the project team (working in the shifts) observed patients' skin and mucosal tissue in the risk area.
The medical device or the patient is regularly rotated or repositioned if practical.	Baseline: 12 patients Follow-up: 16 patients	Observation – the nurses from the project team (working in the shifts) observed patients' skin and mucosal tissue in the risk area and checked the skin and mucosal lesions symptoms. Observation – the nurses from the project team (working in the shifts) checked the nasogastric probe/tube position and deformation of the skin and mucosal tissue in the risk area.
Commercially available device fasteners or holders with demonstrated efficacy, rather than adhesive tape, are used if available.	Baseline: 12 patients Follow-up: 16 patients	Observation – the nurses from the project team (working in the shifts) checked the use of commercially available devices (fixations, skin protectors and barrier creams).
Prophylactic dressings cut to the correct size are used between the skin and the device wherever appropriate.	Baseline: 12 patients Follow-up: 16 patients	Observation – the nurses from the project team (working in the shifts) checked the use of prophylactic dressings cut to the correct size between the skin and the device (nasogastric probe/tube) wherever appropriate.

women and 56 years (mininimum 44, maximum 76) for men. The mean BMI of women was 22 and men 28 (kg/m^2). All patients were polymorbid. The most common principal diagnosis (more than 75%) were cardiovascular diseases (ischemic heart disease, hypertension and chronic heart failure). The most common associated (secondary) diagnoses were diabetes, ischemic disease of the lower limbs and infectious diseases of the gastrointestinal system. In all the patients, the nasogastric probe has been inserted.

Phase 1: baseline audit

An initial project team meeting was held to present the project's main goal and project description and discuss the audit criteria and data collection methods before the baseline audit. For the baseline audit, we created two tools of our own design. The first was a short questionnaire for nurses (bedside workers). The second was a record sheet, where team members recorded the monitored parameters in patients or from documentation (nursing records). A questionnaire survey was used to investigate whether nurses were trained in MDRPI prevention, and if so, what was the content. The record sheet contained six items, of which five items had to be observed directly and determined whether MDRPI was monitored and prevented.

Evidence-based audit criteria targeting behaviour modification of healthcare professionals were used to

reduce the incidence of pressure injury (MDRPI) related to the nasogastric probe. The team members reviewed the project background and determined an implementation plan for MDRPI prevention in patients with a nasogastric probe.

The baseline audit found that healthcare professionals are not provided with clinically based education on prevention of MDRPI in general and related to nasogastric probe insertion (0%), and prevention of MDRPI related to the nasogastric probe is not monitored and sufficiently prevented.

Phase 2: strategies for Getting Research into Practice

On the basis of the audit criteria and audit guide, the team implemented the evidence-based interventions to prevent MDRPI related to the nasogastric probe. During phase 2, we identified several barriers listed below for best practice implementation, both on the managerial and individual levels and influenced by the low level of knowledge and economics.

In total, three main barriers were identified, and strategies designed to overcome them. These are described in detail, and summarized in Table 2 for the GRiP matrix.

The first identified barrier represented the traditional approach of nurses based on the lack of knowledge about the appropriate preventative measures and also lack of awareness of the risk of MDRPI in a patient with nasogastric probe. The first strategy to overcome that barrier was to develop a short online course devoted to monitoring the skin and mucosal membrane and tissue condition. Further information related to the appropriate usage of commercially available device fasteners or holders with demonstrated efficacy and prophylactic dressings, which could be used between the skin and the device wherever appropriate. The second strategy was to create regular ward arounds to inspect the patient skin with a special focus on the MDRPI risk areas and provide case studies analyses. Strategies, which targeted all nursing staff, were delivered by the project team.

The second recognized barrier signifies lack of equipment for MDRPI prevention. Three strategies to bridge that obstacle were set. One was aimed at the staff level, the other two at the management level. All targeted audiences participated in online courses. Two of three strategies necessitated collaboration with industry, which, unfortunately, because of the pandemic, was limited to a few short meetings with selected members of the hospital management. For the implementation phase, the industrial company offered special tape, scientifically proven barrier creams, and sprays with different agents to protect the skin. Strategies were brought by project manager and head nurse.

The last barrier implies the underestimation of the seriousness of the issue of MDRPI prevention by physicians and other members of the multidisciplinary team. The strategies to mitigate such a problem was to increase awareness of this issue through their participation in advised activities. Strategies were aimed at particular healthcare professionals and were delivered by the project team.

Phase 3: follow-up audit

The follow-up audit used the same evidence-based audit criteria as the baseline audit and involved 21 nurses and 16 patients. Figure 1 shows that there has been a positive change in all the monitored parameters. In the baseline, only three interventions were implemented and even these only in a small percentage (skin inspection twice a day – 8.5%, proper skin care – 25%, regular rotation of medical device – 33.5%). In the follow-up phase, it was verified that regular skin inspection was implemented in 100% of cases, proper skin care was implemented in 80% of cases and regular rotation of medical device was implemented in 87.5% of cases. Use of prophylactic dressing was initiated and applied in 50% of cases. And completely new interventions contributing to quality of care were introduced: use of commercially available device fasteners or holders to fix medical devices (from 0 to 100%) and use of appropriate sizes of medical devices (from 0 to 100%). Education was provided to all staff in the department after the implementation project.

Discussion

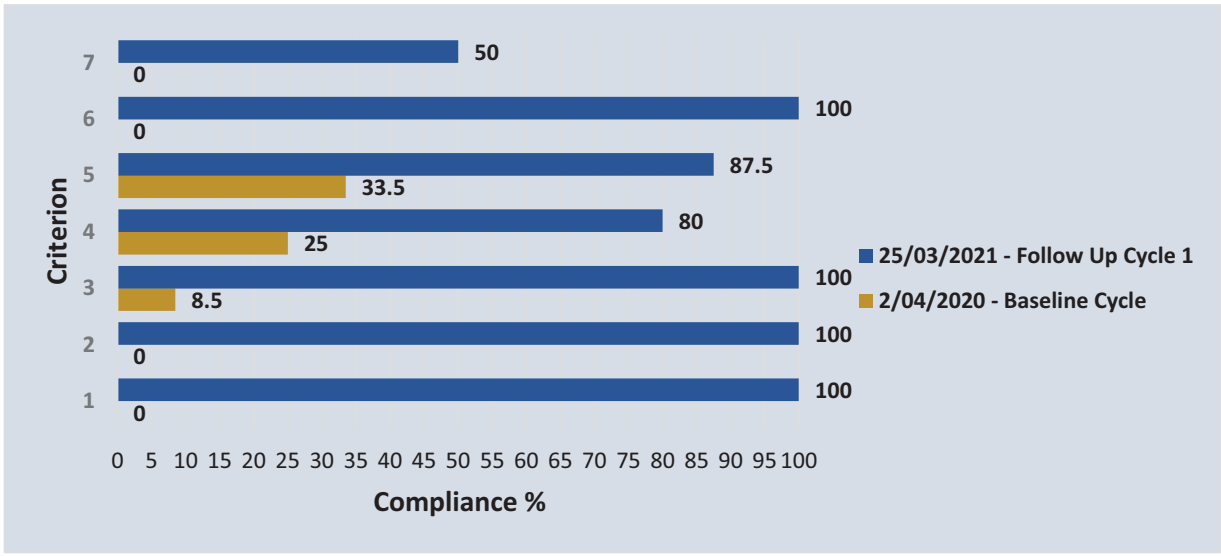
The objectives of this evidence implementation project were to improve the provision of clinical care (increase knowledge and formalize nursing prevention procedures) in the field of pressure injury prevention related to the use and insertion of nasogastric probes as medical devices. The project used the JBI's Practical Application of Clinical Evidence System (JBI-PACES) and Getting Research into Practice (GRiP) audit tool to promote healthcare practice change. A baseline audit on Medical Device-Related Injuries prevention was undertaken and involved 21 nurses and 12 patients. An intervention included clinical practice training, consultation, and following strategies and was followed by a postimplementation audit. The follow-up audit involved 21 nurses and 16 patients. Results data on changes in compliance were measured using descriptive statistics embedded in JBI-PACES in the form of percentage changes from baseline.

Table 2. Getting Research into Practice: barriers and corresponding strategies

Barrier	Strategy	Resources	Outcomes
1 The reluctance to leave traditional approaches in nursing interventions.	1.1 Education seminars and sharing knowledge in the team (because of the COVID-19 pandemic switched to the online course and virtual meetings). 1.2 Regular ward rounds and case studies analyses.	1.1 Face to face meetings (before the epidemic restrictions). 1.2 Personal involvement of the nursing staff (case studies).	1.1 Development and completion of the online education course covering the prevention and treatment of MDPRI with an emphasis on nasogastric probe. All nursing staff attended online education lessons. The level of knowledge was evaluated at the end with an online test (cut-off point of 90% achieved by all respondents). Nursing staff improved their level of knowledge of prevention of MDRPI in patients with nasogastric probe/tube. Focus group was organized virtually to share knowledge and discuss the experiences. 1.2 Regular nursing ward rounds were established to inspect the patient skin with a special focus on the MDRPI risk areas.
2 Lack of equipment for the MDRPI prevention.	2.1 Staff level – education related to the equipment needed for proper prevention. 2.2 Management level – prevalence analyses of the efficacy when using the proper preventative measures. 2.3 Management level – rent (loan) and afterwards purchase of a prevention equipment and the aids described in the text.	2.1 Collaboration with industry. 2.2 Local facility resources. 2.3 Collaboration with industry – loan of aids.	2.1, 2.2. and 2.3: The online course was organized – see the outcome no. 1.1. Face to face meetings with head nurse and selected members of the management.
3 The underestimation of the seriousness of MDRPI prevention by physicians and other members of the multidisciplinary team.	3.1 Staff level – the involvement of physicians and multidisciplinary team members in educational and training activities. 3.2 Organizational and managerial level – consultations with a nutritionist and wound consultant nurse.	3.1 Local facility resources and collaboration with industry partners. 3.2 Local facility resources and collaboration with industry partners. Collaboration with the insurance company – negotiation for the payment for preventative measures.	3.1 The commercial industry negotiated the lower price for preventative skin creams and barriers and offered it to the unit. 3.2 Physicians' involvement in the educational activities was very low.

MDRPI, medical device-related pressure injuries.

Currently, the feeding of polymorbid patients with signs of malnutrition is considered to be the most effective intervention. Enteral nutritional support plays a very significant part in the management of patients with poor oral intake, chronic dysphagia, or intestinal failure, and in the critically ill. Enteral feeding is not only more physiological than parenteral nutrition but has also been shown to improve patient outcomes, decrease



Criteria Legend

1. Healthcare professionals are provided with clinically based education on prevention medical device related pressure injuries.
2. Medical devices are correctly sized and fitted according to manufacturer's specifications.
3. The skin under and around the medical device is inspected at least twice daily for signs of skin injury.
4. The skin under the medical device is kept clear and dry.
5. The medical device or the patient is regularly rotated or repositioned if practical
6. Commercially available device fasteners or holders with demonstrated efficacy, rather than adhesive tape, are used if available.
7. Prophylactic dressings cut to the correct size are used between the skin and the device where appropriate.

Figure 1. Follow-up audit compliance rates (%).

costs, and reduce septic complications in comparison to parenteral nutrition. In a meta-analysis of 82 randomized controlled trials (RCTs), parenteral nutrition was associated with a significantly increased risk of infectious complications, especially in patients receiving therapy for malignancy.[11]

Early enteral nutrition support with the use of nasogastric probe provides the necessary energy and nutrients for patients but is related with the risk of negative local impact on the skin and soft tissue. Moreover, nasogastric are uncomfortable and associated with odynophagia, epistaxis, and respiratory tract infections. Pressure ulcers to the nostrils related to nasogastric use after surgery have seldom been reported in the medical literature. Nevertheless, it is estimated that more than one-third of hospital-acquired pressure ulcers are medical device-related, and that the nasogastric is responsible for significant and permanent lesions in 5–8% of patients.[12] We have not focused on patients postsurgery in our implementation project, we have assessed patients in long-term care, but we assume similar problems related to the nasogastric probe insertion exist with other patient groups.

Lack of resources, such as study materials and financial resources were identified at the collaborating clinical site. There were no organizational safety instructions and guidelines for continuous education of healthcare professionals. Shortcomings in the knowledge of health professionals were identified and insufficient preventive interventions of the MDRPI. It could be one of the reasons that also patients and their families have a low degree of cooperation for enteral nutrition. This could increase the risk of MDRPI in patients with nasogastric probe.[13]

Despite all these barriers, we have increased the knowledge of healthcare professionals in MDRPI prevention through the educational activities of the implementation project. All nurses are informed about MDRPI prevention (0–100%). We have improved monitoring and documentation of skin changes related to the nasogastric probe insertion and MDRPIs and improved care in MDRPI prevention in nasogastric probe patients.

The basic intervention in the prevention of skin damage is the appropriate choice of fixation and its location. The adhesive properties of the fixing material should be flexible, breathable, adaptable, and, most

importantly, it should fix the device well, and thus prevent its unwanted extraction.[14] Our basic audit also detected the use of common tape, which respondents most often used to fix the nasogastric probe and did not meet the properties mentioned above. This finding is associated with ignorance of recommended procedures or aids and underestimation of risks in the care of patients with nasogastric probes. After educating the nursing staff and management in selecting and using the correct fixation materials, changes were achieved, and the cooperating workplace began to use the recommended fixation according to professional sources (0–100%).

Further, necessary intervention in the prevention of MDRPI is proper care of the patient's skin, which includes its control, keeping the skin clean and dry, using skin protection products and regular repositioning of the probe. All educational activities of the implementation project increased the compliance of nursing staff in the care of patients with a nasogastric probe. Medical devices were correctly sized and fitted according to the manufacturer's specifications (0–100%). The skin under and around the medical device was inspected at least twice daily for signs of skin injury (8.5–100%).

Setting the proper care and education of the nursing staff is essential for the effective prevention of MDRPI.[12] Another implementation project[15] also focused on the prevention of MDRPI in patients with nasogastric probes, specifically on the fixation and stabilization of the probe, evaluation of the area near the probe, relief of probe pressure, and recording in nursing documentation. The aim was to create guidelines based on the study of professional resources and implementation into clinical practice. Individual steps of proper care and nursing staff education helped reduce the incidence of MDRPI in connection with the established nasogastric probe. This process improvement project proves culture, leadership, and process improvement focused on safety can attain a goal of zero injuries to patients and can support an organization's quest to become highly reliable.[15]

Local protocols for risk assessment and the use of medical devices are necessary for the management of care for patients with a nasogastric tube to prevent MDRPI.[16] This was demonstrated in a prospective study focused on the impact of a nursing intervention protocol on critically ill patients with a nasogastric probe `Nursing intervention protocol' proved highly effective in reducing the occurrence of selected MDRPI in critically ill patients. The incidence of nasogastric probes pressure injuries fell from 77.8 to 13.1% ($P = 0.012$).[17] it can be assumed that proper care for nasogastric probe led not only to the prevention of the local complications (e.g. PUs in site of insertion) but also to the prevention of the underfeeding of patients with the nasogastric probe and contribute to their recovery process.[18,19]

Strategies for improving sustainability should include continuous audits focused on the level of knowledge, patient records and incidence of MDRPI monitoring as an adverse event – as a part of quality improvement. Support for knowledge and experience sharing in a multidisciplinary team is also essential.

Conclusion

The implementation project aimed to increase compliance for nurses in the care of patients with a nasogastric tube and MDRPI prevention with evidence-based practice recommendations and improvement in safety care.

The project succeeded in achieving the objectives as significant improvements in the best practice criteria. The level of knowledge in nurses has increased, the monitoring process and documentation has become more accurate and in line with the EBP (new entries in patient records, regular check-ups) and nurses use appropriate equipment to prevent skin injuries. All achieved results are simply transferable at different types of inpatient facilities caring for patients with nasogastric probes.

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Conflicts of interest

There are no conflicts of interest.

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