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# Impact of a multifaceted and multidisciplinary intervention on pain, agitation and delirium management in an intensive care unit: an experience of a Canadian community hospital in conducting a quality improvement project

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## ABSTRACT

**Background** Clinical guidelines suggest that routine assessment, treatment, and prevention of pain, agitation, and delirium (PAD) is essential to improving patient outcomes as delirium is associated with increased mortality and morbidity. Despite the well-established improvements on patient outcomes, adherence to PAD guidelines is poor in community intensive care units (ICU). This quality improvement (QI) project aims to evaluate the impact of a multifaceted and multidisciplinary intervention on PAD management in a Canadian community ICU and to describe the experience of a Canadian community hospital in conducting a QI project.

**Methods** A ten-member PAD advisory committee was formed to develop and implement the intervention. The intervention consisted of a multidisciplinary rounds script, poster, interviews, visual reminders, educational modules, pamphlet and video. The 4-week intervention targeted nurses, family members, physicians, and the multidisciplinary team. An uncontrolled, before-and-after study methodology was used. Adherence to PAD assessment guidelines by nurses was measured over a 6-week pre-intervention and over a 6-week post-intervention periods.

**Results** Data on 430 and 406 patient-days (PD) were available for analysis during the pre- and post-intervention periods, respectively. The intervention did not improve the proportion of PD with guideline compliance to the assessment of pain (23.4% vs. 22.4%, p=0.80), agitation (42.9% vs. 38.9%, p=0.28), nor delirium (35.2% vs. 29.6%, p=0.10) by nurses.

**Discussion** The implementation of a multifaceted and multidisciplinary intervention on PAD assessment did not result in significant improvements in guideline adherence in a community ICU. Barriers to knowledge translation are apparent at multiple levels including the personal level (low completion rates on educational modules), interventional level (under-collection of data), and organisational level (coinciding with hospital accreditation education). Our next steps include reintroduction of education modules using organisation approved platforms, updating existing ICU policy, updating admission order sets, and conducting audit and feedback.

## INTRODUCTION

Most patients admitted to the intensive care unit (ICU) experience pain even at rest, which can stem from surgery, trauma, burns, cancer and procedures.[1] The incidence of pain is high in both surgical–trauma patients (52%) as well as medical patients (50%) in the ICU.[2] Not only does pain affect patients for their duration in the ICU, the memory of unrelieved pain persists post-ICU discharge for many years and can be distressing. In addition, at least 71% of patients develop agitation in the ICU determined by bedside clinical judgement.[3] Disease-induced and iatrogenic delirium can affect 32%–80% of critically ill patients in the ICU.[4] This in turn is an important independent negative predictor for several outcomes, including a threefold increase in 6-month mortality, extra days on mechanical ventilation, increased hospital length of stay,[5] and long-term cognitive impairment consistent with a dementia-like state.[4 6 7]

In response to addressing pain, agitation and delirium (PAD) experienced by patients in the ICU, the Society of Critical Care Medicine published clinical practice guidelines for the assessment, management, and prevention of PAD for adult patients.[8 9] The PAD guidelines focus on the importance of using validated tools to monitor PAD in patients. Interventions to improve the management of PAD in ICUs are associated with improvements in patient outcomes. The implementation of bundles such as the awakening and breathing coordination, delirium prevention and monitoring, and early mobility and exercise (ABCDE) saw a 3-day decrease (24 vs 21 days, p=0.04) in mechanical ventilation status,

decrease in delirium (OR=0.55, p=0.04) and increase in odds of mobilising out of beds in academic medical or surgical ICUs (OR=2.11, p=0.003).[10 11] Similarly, the implementation of educational and clinical interventions for elements of PAD bundles involving the interdisciplinary team improved the accuracy of PAD assessments through standardised patient assessments and improved adherence to clinical practice guidelines in an academic medical ICU.[12] Additionally, the introduction of online education modules resulted in a clinically relevant improvement in patient safety and was valued by nurses treating critically ill, mechanically ventilated patients.[13]

Despite their recognised importance, the implementation and compliance to PAD guidelines is poor, especially in community hospitals.[14] To assess our centre's adherence, we developed a phase I study on PAD, which engaged nurses from our community centre's adult medical-surgical ICU in a survey and focus groups that identified a care gap in PAD assessment in critically ill adult patients. The survey revealed that only 88%, 85% and 41% of nurses were comfortable with assessing PAD, respectively.[15] Additionally, only 47% and 42% of nurses were satisfied or strongly satisfied with PAD management in general provided by other nurses and by intensivists, respectively.[15] Qualitative data from this group showed divergent opinions on optimal sedation level of critically ill patients.[16]

Current evidence on implementation of clinical guidelines demonstrate that effective guideline implementation strategies often have multiple components.[17] Additionally, environmental characteristics, including support from peers and superiors, can affect guideline implementation.[17] Multiple studies have investigated interventions to improve the management of PAD.[11–14] These studies, however, have been largely conducted in academic settings, highlighting the gap in the understanding of the generalisability to community-based hospital settings. Using this information, we designed a multifaceted and multidisciplinary intervention involving nurses, family members and physicians in a community adult ICU to improve compliance with PAD guidelines.[18]

## METHODS

We used the quality improvement model using an uncontrolled before-and-after design. The intervention was developed over September 2017 to August 2018 using the Model for Improvement Plan–Do–Study–Act (PDSA) cycles.[19] The PDSA cycle is a rapid and iterative approach to deliver and modify interventions for the desired improvement.[19] For this project, the PDSA cycle approach was used to develop, test and refine the intervention components before wide scale implementation. A PAD Advisory Committee (PADAC) was formed for the development of the intervention. The PADAC included the ICU manager, five nurses, two physicians (intensivists), an ICU pharmacist and the ICU research coordinator. Patients and the public were not involved in the design of the study nor the choice of outcome measures. Although the public and patients were not involved in the PADAC, family members and patients provided feedback in the development of some components of our intervention. We followed the recommendations set by the Standards for Quality Improvement Reporting Excellence V.2.0 guidelines.[20] The protocol of this quality improvement study was published.[18] The goal of this study is to improve compliance to PAD assessment guidelines among nurses using a multifaceted and multidisciplinary intervention on the assessment of PAD by ICU staff in a Canadian community hospital.

This study was conducted in the ICU of St. Catharines Site, Niagara Health, a community hospital in a medium-sized city in Ontario, Canada. The site has one closed level III medical–surgical ICU with 14 beds. Approximately 10 physicians and 100 registered nurses provide ICU care. The ICU setting is described further in the study protocol.[18] The intervention targeted all nursing staff, family members and physicians in the ICU. The duration of the intervention was 4 weeks. The nurse-focused components included four educational modules developed using the 2013 PAD guidelines and visual reminders in the form of cue cards from validated assessment tools including the Critical Care Pain Observation Tool (CPOT) for pain, the Richmond Agitation–Sedation Scale (RASS) for agitation and Confusion Assessment Method for the ICU (CAM-ICU) for delirium.[8] The family member-focused components involved educational pamphlet regarding delirium, educational video on a dedicated computer on delirium and volunteer conducted in-person interviews of the newly admitted patients' family members. The physician-focused component included a script to remind intensivists to encourage assessment and treatment of PAD during rounds. The multidisciplinary-focused component included a poster to remind nursing staff, physicians and family members on the assessment of delirium. Descriptions of the multifaceted and multidisciplinary intervention are outlined in table 1. The specific components where possible are included in the online supplemental materials. A logic model of the multifaceted and multidisciplinary intervention is shown in online supplemental materials 6.

### Eligibility criteria and sample size calculation

All adult patients defined as ages 18 and above admitted to the ICU for more than 24 hours were included in the study. Based on a previously conducted nurse-focused quality improvement study, improvements in the proportion of patient-days with PAD assessment in pain by 8.2%, agitation by 14.4% and delirium by 14.8% are expected.[21] The sample size was calculated using 95% CI and power of 80% (Z beta=0.20). The minimum sample size of 277 unique patients was required.

### Study of the intervention

The effects of the PAD intervention were studied using an uncontrolled before-and-after design. The outcomes of

Table 1 Description of multifaceted and multidisciplinary intervention for pain, agitation, and delirium

| Component | Description | Refer to |
|---|---|---|
| Nurse-focused components | | |
| Educational modules | 4 online educational modules:<br>1. PAD research programme, post-intensive care syndrome, basic pharmacology, pharmacokinetic properties of common ICU drugs<br>2. Pain module: CPOT<br>3. Agitation: RASS<br>4. Delirium: CAM-ICU<br>Followed up with weekly email reminders and demonstration of modules | |
| Visual reminders | Validated tools including the CPOT, RASS and CAM-ICU cue cards by bedside | Online supplemental materials 1 |
| Family-focused components | | |
| Interviews | Volunteer (undergraduate students) conducted in-person interviews with family members of newly admitted patients within 48–72 hours of admission<br>Intended to empower family members to participate in PAD care by providing information on baseline cognitive function, mobility and use of visual and hearing aids | Online supplemental materials 2 |
| Educational pamphlet | Provided in waiting rooms to educate family members regarding delirium | Online supplemental materials 3 |
| Educational video | Video on dedicated computer on delirium (licensed from Osmosis.org) | |
| Physician-focused component | | |
| Multidisciplinary round script | Script to remind intensivists to order target RASS Score, to discuss PAD assessment and treatment and to encourage nurses to achieve adequate pain control and light sedation | Online supplemental materials 4 |
| Multidisciplinary-focused component | | |
| Poster | Reminder on the unit to assess and treat PAD | Online supplemental materials 5 |

CAM-ICU, Confusion Assessment Method for the ICU; CPOT, Critical Care Pain Observation Tool; ICU, intensive care unit; PAD, pain, agitation and delirium; RASS, Richmond Agitation–Sedation Scale.

interest were selected based on recommendations from the 2013 PAD guidelines. To study the effects of the intervention, preintervention data were collected daily for 6 weeks prior to the start of the intervention. Following the 4-week implementation period, postintervention data were collected daily for 6 weeks. Data collection was completed by a dedicated research coordinator (MCP). Data were collected using a dedicated PAD Programme daily collection form.

The primary outcomes of this study were: (1) the proportion of patient-days with pain assessment by nurses using the Numeric Pain Rating Scale (NPRS) or the CPOT at least four times per 12-hour shift, (2) the proportion of patient-days with agitation assessment by nurses using the RASS at least four times per 12-hour shift and (3) the proportion of patient-days with delirium assessment by nurses using the CAM-ICU at least once per 12-hour shift. The secondary outcomes of this study were: (1) proportion of patient-days with significant pain defined as NPRS scores≥4, or CPOT scores≥3, (2) proportion of patient-days with optimal sedation levels defined by RASS scores between −2 and 0, or at target RASS Score at least 50% of the time per day, (3) proportion of patient-days with oversedation defined by RASS score of less than −2 at least 50% of the time, (4) proportion of patient-days with agitation defined by RASS Score of greater than 0 at least 50% of the time, and proportion of patient-days with positive delirium screening using the CAM-ICU.

### Analysis

Descriptive and analytical statistics was used to analyse quantitative data, and SPSS V.26.0 was used. McNemar's test was used to detect differences on dichotomous variables between preintervention and postintervention. The level of significance was set at $p<0.05$.

## RESULTS

The intervention was designed and developed over a 12-month period using the Model for Improvement's PDSA test cycles. The key improvement areas and specific components of the intervention are outlined in table 2. The details of each PDSA cycle are outlined in online supplemental material 7.

Overall, 430 patient-days from 69 unique patients and 406 patient-days from 64 unique patients were included

Table 2 Initial results and development of the intervention

| Component | Key improvements | PDSA cycles |
|---|---|---|
| Nurse-focused components | | |
| Educational modules | In-person nursing engagement intervention turned to development of e-modules | 4 |
| Visual reminders | Reviewed by MD and nurses. Feedback was collected on design and content | 2 |
| Family-focused components | | |
| Interviews | Volunteer conducted in-person interviews with family members of newly admitted patients, content revised | 10 |
| Educational pamphlet | Education pamphlet developed with feedback from family and with permission from www.icudelirium.org | 4 |
| Educational video | Purchased from Osmosis.org | 3 |
| Physician-focused component | | |
| Multidisciplinary round script | Script to remind intensivists to order target RASS scores, to discuss PAD assessment and treatment and to encourage nurses to achieve adequate pain control and light sedation<br>Rephrased by physicians | 5 |
| Multidisciplinary-focused component | | |
| Poster | Reviewed by MDs and RNs | 8 |

MD, Intensivists; PAD, Pain, agitation, and delirium; RASS, Richmond Agitation–Sedation Scale; RN, registered nurse.

during the preintervention and postintervention periods, respectively, for this quality improvement project. The intervention did not improve the proportion of patient-days with guideline compliance to the assessment of pain (23.4% vs 22.4%, p=0.80), agitation (42.9% vs 38.9%, p=0.28), nor delirium (35.2% vs 29.6%, p=0.10). Of patient-days with PAD assessments, there was no significant difference in patient-days with significant pain, optimal sedation, oversedation, agitation, nor delirium (table 3).

### Barriers to implementation

Barriers to the implementation of our quality improvement intervention occurred on many levels. This included documentation deficiencies where nurses were documenting PAD assessment in the incorrect section of patients' charts, which may have led to the undercollection of data. There was a high rate of nursing turnover at the time of the intervention, where not all of the nurses were aware of the PAD training modules. The implementation period also coincided with hospital accreditation, which had a significant time and learning burden for ICU staff. In our setting, this reflected in poor completion rates (14%–24%) of our online educational modules. Additionally, the hospital policy lacked clarity on PAD assessment frequency that conflicted with the agitation assessment recommendation from the PAD guidelines.[8] Personal attributes could have also been a factor as our previous nursing survey found that only 88%, 85% and 41% of nurses were either comfortable or very comfortable with the assessment of PAD, respectively, and had differing opinions on optimal sedation.[15 16]

## DISCUSSION

Despite the development of guidelines for the assessment and management of PAD in the ICU, compliance to these guidelines is poor in community ICU settings.[18] This study evaluated a multifaceted and multidisciplinary intervention on PAD assessment in a Canadian community ICU. The intervention involving nurses, physicians and patient families resulted in no significant changes in adherence to the PAD assessment guidelines. Post intervention, the proportion of patient-days with guideline adherence remains low for pain (22.4%), agitation (38.9%) and delirium (29.6%) assessments by nurses.

There is an average 17-year gap between research and clinical practice.[22] Barriers to implementation in healthcare arise

Table 3 Preintervention and postintervention proportion of patient days with significant pain, optimal sedation, oversedation, agitation and delirium

| | Preintervention | Postintervention | P value |
|---|---|---|---|
| Proportion of patient-days with significant pain | 7.7% | 4.9% | P=0.210 |
| Proportion of patient-days with optimal sedation | 86.1% | 81.1% | P=0.081 |
| Proportion of patient-days with oversedation | 13.6% | 18.9% | P=0.059 |
| Proportion of patient-days with agitation | 5.3% | 4.3% | P=0.618 |
| Proportion of patient-days with significant delirium | 17.5% | 15.0% | P=1.000 |

from many levels. In 2009, Damschroder *et al* established the Consolidated Framework for Implementation Research (CFIR) to guide the implementation of health services, which comprises five domains: intervention, inner settings, outer settings, individuals involved and process by which implementation is accomplished.[23] Specific to the ICU setting, Costa *et al* applied the CFIR framework in a systematic review on the implementation of the ABCDE to identify barriers to ABCDE delivery and have found barriers to implementation in all but the process category.[24] In our study, the CFIR framework can be applied to identify barriers to the implementation of our PAD assessment intervention. Barriers in the intervention domain included the documentation deficiencies. Barriers in the inner setting domain included high nursing turnover, the coincidence with hospital accreditation, as well as lack of clarity in existing hospital policy. We also experienced barriers in the characteristics of individuals domain, where nurses had differing comfort levels in PAD assessment and differing opinions on optimal sedation.[15 16] Other literature has identified barriers to delirium assessment by nurses including that it is challenging to assess in intubated patients, complexity of delirium assessment tools and that it can be time-consuming.[25 26]

This is one of the first studies to target not only nurses and physicians, but also patients and family members in the management of PAD in a community ICU. The formation of the PADAC ensured that ICU administrator, nursing staff and physicians were onboard and had input on the intervention, which could promote the uptake of the intervention.[27] This study included all patients admitted to the ICU for more than 24 hours regardless of mechanical ventilation status adding to the external validity of the intervention. The uncontrolled before-and-after design represents a pragmatic approach to investigating interventions in a resource-limited setting.

Limitations of the study include the uncontrolled before-and-after design. The study's results lacked comparisons to a control group, which implies that the intervention cannot be compared with practice changes that occur in ICU settings at baseline. The analysis of our results was completed using patient-days, and we were unable to reach our sample size due to the short study period. Due to resource limitations in community ICU settings, information on patients including baseline risk factors associated with delirium (eg, demographics, severity of illness, age, history of dementia, history of hypertension, history of delirium and substance use) was not collected to adjust for potential confounders.[8] Data collection was limited to patient flow sheets, while some nurses documented PAD in narrative interdisciplinary notes and were missed in data collection. The doses of medications such as sedatives, neuromuscular blockers, analgesics and antipsychotic medications were not recorded in this study. Patients were also not stratified based on mechanical ventilation status. However, our primary outcomes, that is, proportion of patient-days with guideline-recommended PAD assessments by nurses, are not influenced by the above. Other process measures including exposure to the QI interventions that could have elucidated the effectiveness of specific components of the multifaceted and multidisciplinary intervention were not measured, and variation in physician uptake of the intervention was not assessed. This intervention focused on the compliance to PAD assessment guidelines, but did not measure the accuracy of the assessment, adherence to treatment or prevention recommendations from PAD guidelines, nor patient-outcomes.[8]

The current study illustrates that the implementation of a multifaceted and multidisciplinary PAD intervention did not improve adherence to PAD assessment guidelines by nurses in a Canadian community ICU. The rate of PAD assessment remains low postintervention. PAD experienced in the ICU has important implications on patient outcomes, including patient mortality. Therefore, the reliable detection and diagnosis of PAD is essential for PAD treatment and ongoing interventions are necessary to improve guideline adherence. Components of the intervention are still in place, including educational modules for nurses to complete, as well as the multidisciplinary poster. Our quality improvement intervention identified barriers specific to our ICU that need to be addressed in future iterations. This includes inner setting, intervention, and individuals involved domains such as: (1) including the education modules in the orientation of new nurses and reintroduction of mandatory nurse education modules using organisation approved platforms to assist completion, (2) updating the ICU policy to include the frequency of PAD assessment and its inclusion of PAD assessment in ICU admission order sets, (3) including PAD assessment frequency and target RASS scores in pre-printed ICU admission order sets, (4) conducting an audit to evaluate whether continuation of intervention would improve outcomes, (5) surveying nurses on perceptions on the intervention to potentially simplifying the intervention to increase buy-in and (6) carrying the study on to the quality improvement division of the hospital to improve buy-in. Future implementation of PAD guidelines should assess their own units' specific barriers to PAD implementation and design specific interventions tailored to overcome these barriers with consideration of the context, team and capacity for implementation.

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**Contributors** ZM analysed the data, drafted and revised the manuscript. MC implemented the intervention including modifying the intervention based on feedback from staff. MC collected data from the unit. ML contributed to the

intervention design, implementation using quality improvement methodology and revisions of the manuscript. DJ contributed to the statistical design and analysis of the results. H-OC contributed to the implementation of the intervention and revision of the manuscript. JNHL contributed to the revision of the manuscript. JLYT is the guarantor of the project and contributed to the conception and design of the study, implementation of the interventions, and writing and revisions of the manuscript.

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