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Research paper

Implementation of the Critical Care Pain Observation Tool increases the frequency of pain assessment for noncommunicative ICU patients

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ABSTRACT

Background: Pain is a common stressor for ICU patients, necessitating routine assessment. For patients who are unable to communicate, self-report tools are unsuitable, and the use of an observational tool is required to assess pain appropriately. The Critical Care Pain Observation Tool (CPOT) is the most reliable tool currently available to assess pain in these patients. We investigated whether the implementation of the CPOT in one Australian ICU could increase frequency of appropriate pain assessments, and if this would affect the administration of analgesia and sedation.

Methods: In this before and after study, we first performed a retrospective chart audit on 441 adult ICU patient charts, over 49 days. Data collected included frequency and type of pain assessments, sedation and analgesia administered, communication and CAM-ICU status, and bedside nurse-perceived pain. During the implementation phase, new policy and guideline documents were released, and ICU charts were redesigned to incorporate the CPOT. All nursing staff attended an education session on pain assessment and correct use of the CPOT. The chart audit was repeated, capturing 344 charts over 43 days.

Results: Mean total assessments in 24 hours increased from 7.2 to 7.9 for communicative, 3.0 to 8.9 for non-communicative, and 5.1 to 9.1 for transitioning patients. For non-communicative patients there was a significant increase in observational assessments including the CPOT (1.7 to 8.3), and a decrease in inappropriate use of self-report tools (1.3 to 0.2). We also observed significant increases in administration of paracetamol, opiates, propofol, patient-controlled analgesia, modified-release opiates, and neuropathic pain agents.

Conclusions: Implementation of the CPOT using standardised education and resources led to increased frequency of pain assessment, particularly for non-communicative patients. Appropriate observational assessments were also more frequently used for these patients. Analgesic administration generally increased, as did the use of propofol.

1. Background

Pain is a common and traumatic experience for ICU patients, both at rest[1] and during routine procedures.[2–4] It precipitates a cascade of harmful physiological and psychological sequelae, which can hamper and complicate recovery from critical illness.[5] It is associated with adverse outcomes, such as anxiety, sleep, and post-traumatic stress disorders, and chronic pain.[5–7] Additionally, many patients are unable to communicate, complicating pain assessment in the ICU.[8,9]

Ethically, pain management is considered a basic human right and an important responsibility in both medicine and nursing.[10,11] Furthermore, the formal pain assessment of critically ill patients is associated with more favourable outcomes such as reduced pain intensity, shorter duration of mechanical ventilation and length of

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ICU stay, and reduced complications.[12,13] It is, therefore, stipulated in clinical practice guidelines that all critically ill patients should be routinely assessed for pain, using an appropriate tool.[5,10]

Some ICU patients can communicate either verbally, by writing, using communication boards, or gestures such as nodding and shaking the head. They are, therefore, able to self-report their pain, using tools such as the Numeric Rating Scale, describing their symptoms or indicating the presence of pain via yes/no answers.[11] However, for patients who are unable to communicate, clinicians are limited to the observation of pain behaviours. Because pain is a subjective experience, this can never approach the accuracy of a self-report;[11,14] however, the use of a valid and reliable observational pain scale is the best possible surrogate.[9,11,15] Without such a tool available to nursing staff, pain in these patients may be inadequately assessed and treated,[11,16] and self-report tools may be used inappropriately.

The Behavioural Pain Scale (BPS) and the Critical Care Pain Observation Tool (CPOT) are both valid in critically ill patients and recommended in expert consensus clinical practice guidelines.[15] The BPS, first validated in 2001,[17] consists of a score of 1–4 in each of the following three domains: facial expression, upper limb movements, and ventilator compliance.

The CPOT, first validated in 2006,[18] builds on the BPS.[19] Each domain is instead scored 0–2 with clear operational definitions, and a fourth domain, muscle tension, is added. In addition, for noncommunicative patients who are extubated, a vocalisation domain is used instead of ventilator compliance. A total CPOT score of >2 indicates presence of pain.[19,20] These changes have resulted in greater interrater reliability,[21–23] discriminant validity,[24] and extended applicability of the CPOT compared with the BPS.[9] However, until recently, neither tool had been validated in delirious patients,[25] because of the complex interplay among pain, agitation, and delirium.[26] Because agitation can result in points scored in domains of either tool for a nonpain reason, early validation studies excluded delirious patients.[17,18,27] Delirium incidence as identified by the Confusion Assessment Method for ICU (CAM-ICU) varies from 26 to 87%, depending on the ICU type.[28,29] Delirium is recognised as a ubiquitous condition in ICUs with serious consequences.[15] Furthermore, either uncontrolled pain or excessive opiate administration may precipitate delirium,[15] which in turn contributes to the noncommunicative status in ICU.[9] It is, therefore, necessary that delirious patients are assessable with an observational tool, to treat both their pain and delirium appropriately. This issue was addressed by Kanji et al., in 2016, who demonstrated validity and reliability of the CPOT in a small sample of delirious patients in two Canadian ICUs.[25]

After implementation of the CPOT in one Canadian ICU in 2011, a significant increase in the frequency of pain assessment was observed.[21] This result was replicated in a larger study across two Canadian ICUs in 2013.[30] Interestingly, the former study observed a decrease in use of sedatives and analgesics after CPOT implementation.[21] The other study also observed significant decreases in these drugs in the cardiac surgical ICU studied; however, in the mixed ICU, an increase in opioids was observed, with no change to sedation administered.[30]

2. Objectives

We were interested to ascertain if the results of these Canadian studies would be generalisable to our remote Australian ICU. Before this study, the common practice in this ICU was informal observational assessment of noncommunicative patients, which was inconsistent with international guidelines. Therefore, we decided to implement the CPOT in our routine ICU practice and evaluate the effects on pain assessment and management.

The primary outcome of this study was the observed difference in pain assessment frequency (the number of documented pain assessments per 24-h period) between audit periods, by the communication status. Secondary outcomes included differences in the type of assessments used for noncommunicative patients (observational being appropriate and self-report being inappropriate), proportions of charts on which analgesic drugs were given, and quantities of analgesics and sedatives administered. We also wanted to examine variations in pain assessment and management of delirious (CAM-ICU positive) patients compared with nondelirious (CAM-ICU negative) patients.

3. Methods

3.1. Design and patients

The study was conducted in the Royal Darwin Hospital Intensive Care Unit, which is a remote, 18-bed, mixed tertiary unit. We used a before-and-after design, using a repeated 24-h period prevalence chart audit, before and after implementation of the CPOT. On audit days, every patient older than 18 years in the unit had their chart audited retrospectively at 1400hrs, the end of the chart period. Data collected included the number of hours on the chart, the frequency and type of pain assessments performed, the sedative and analgesic drugs administered, the communication and CAM-ICU status, and the bedside nurse's perception of whether the patient was experiencing pain. Patients were considered communicative if they could self-report their pain, which meant at a minimum they could consistently answer yes/no questions. They were considered noncommunicative if they could not do this and transitioning if they spent part of the chart period in each state. An audit guide was produced to facilitate the consistency of data collection among the three auditors.

Sample size calculations were determined based on an estimated average of six pain assessments per day with a conservative standard deviation of four. With a minimum of 337 charts per period, this study had a 90% power to detect a difference of one pain assessment per day with a two-sided p-value of 0.05. A difference of this magnitude was perceived to be of clinical importance. We conservatively predicted that each audit day would capture eight charts; therefore, the duration of collection would be approximately 43 days per period.

This project was approved by the Human Research Ethics Committee of the Northern Territory Department of Health and Menzies School of Health Research (HREC 2015–2470).

3.2. Preimplementation

During the preimplementation phase, audits were conducted on 49 days over a 65-day period, during September to November 2015. This audit captured 441 patient charts.

3.3. Implementation

Our implementation strategy was based on that of Gelinas et al.[21] and the education principles of “develop materials”, “educate”, and “educate through peers” as described by Powell et al..[31] The nursing guidelines folders and ICU flow charts were redesigned to incorporate the CPOT, and a pain assessment of adults in ICU guideline document was uploaded to the hospital intranet, establishing the CPOT as the standard pain assessment tool for noncommunicative ICU patients. These were made available immediately before the implementation phase. The CAM-ICU was also included in the redesign of the ICU flow charts.

Table 1
Admission characteristics during audit periods.

Variable	2015 (n = 441)	2016 (n = 344)	P-value
Age	49.5 (16.3)	52.2 (17.4)	0.11
Apache III score	60.5 (26.9)	60.3 (27.6)	0.94
Apache III risk of death	11% [5%–32%]	9% [3%–21%]	0.13
Male	59% (115)	57% (118)	0.69
Nonindigenous	46.2% (90)	55.6% (115)	0.06
Medical admission	56.9% (111)	47.8% (99)	0.07
Diagnosis			0.19
Cardiovascular	16.4% (32)	14.5% (30)	
Gastrointestinal	8.2% (16)	14.5% (30)	
Metabolic	4.6% (9)	4.8% (10)	
Musculoskeletal	2.6% (5)	3.9% (8)	
Neurological	9.7% (19)	5.3% (11)	
Renal	4.1% (8)	5.3% (11)	
Respiratory	26.7% (52)	18.8% (39)	
Sepsis	8.2% (16)	12.1% (25)	
Trauma	15.4% (30)	14.5% (30)	
Other	4.1% (8)	6.3% (13)	

SD, standard deviation; IQR, interquartile range.
Table shows mean (SD) age and APACHE III, median (IQR) APACHE III risk of death, and proportions (n) of men, nonindigenous, medical admissions, and diagnoses.

Education sessions were run three times a week, over a 28-day period in February 2016, which 63 of 70 staff nurses and eight doctors attended. Postcourse questionnaires were sent to nursing staff to ensure understanding of the material and correct use of the CPOT. This identified problems such as staff misinterpreting the CPOT as an intensity scale and guided ongoing education. Six nurses were given additional training to become "CPOT champions". They assisted with bedside education and the correct use of the CPOT.

3.4. Postimplementation

After a 6-week run-in period during which no additional education was conducted, the postimplementation audit commenced, conducted by a single auditor and using the same audit forms. Every adult patient chart was again audited, on 43 days during a 76-day period between April and June 2016. This audit captured 344 charts.

3.5. Statistical analysis

Continuous variables were visually assessed for normality. Group comparisons were performed using chi-square tests for equal proportion, student t-tests for normally distributed data, and Wilcoxon rank-sum (Mann–Whitney *U*) tests otherwise, with results reported as proportions (n) or means (standard deviations). All analysis was performed using SAS, version 9.4, (SAS Institute Inc., Cary, NC, USA), and a two-sided p-value of 0.05 was used to indicate statistical significance.

4. Results

4.1. Patient characteristics

Admissions during both audit periods were well matched for age, gender, severity, and diagnosis, with no significant baseline differences between groups (Table 1). The proportion of noncommunicative patients was 20.6% (91) in the preimplementation audit and 20.3% (70) in the postimplementation audit (p = 0.9).

4.2. Frequency of pain assessment

Mean total assessments in 24 h significantly increased from 7.2 to 7.9 for communicative patients, 3.0 to 8.9 for noncommunicative patients, and 5.1 to 9.1 for patients transitioning between these states (Fig. 1a). For noncommunicative patients, we observed a significant increase in observational assessments including the CPOT (1.7–8.3) and a decrease in inappropriate use of self-report tools (1.3–0.2) (Fig. 1b).

4.3. Pain management

There was no statistically significant difference in the proportion of patients in pain reported by nurses (31% [104] before implementation vs 34% [134] after implementation, p = 0.37). However, nurses' uncertainty regarding whether their patients were experiencing pain decreased from 11% (48) to 2% (8), p < 0.001.

Regarding analgesia, there were significant increases in the proportion of patients receiving paracetamol, fentanyl, and oxycodone and a decrease in those receiving morphine (Fig. 2a). The mean quantities of analgesic drugs administered in 24 h were also significantly increased (Fig. 2b). Of note, oxycodone increased from a mean of 5 mg to 15 mg per 24 h. Additionally, we observed significant increases in pain management interventions such as patient-controlled analgesia pumps, modified-release opiates, and neuropathic pain agents (Fig. 3).

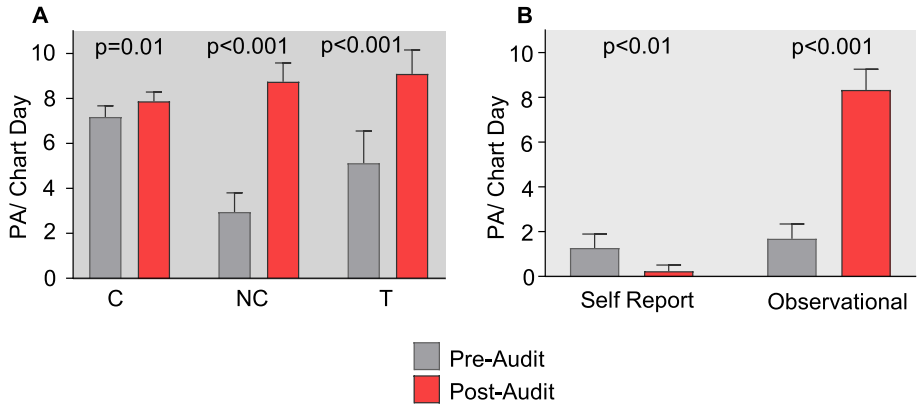

Fig. 1. Pain assessments in a 24-h period. **A:** Number of pain assessments (PA) per communicative (C), noncommunicative (NC), or transitioning (T) patient chart in a 24-h period before and after CPOT implementation. Graph shows mean ± SD, using Student t-tests. n=310 pre-audit, n=230 post-audit (C); n=91 pre-audit, n=70 post-audit (NC); n=40 pre-audit, n=44 post-audit (T). **B:** Number of self-report or observational pain assessments per noncommunicative patient chart in a 24-h period pre and post CPOT implementation. Graph shows mean ± SD, using a Wilcoxon rank-sum test. n=91 pre-audit, n=70 postaudit. SD, standard deviation.

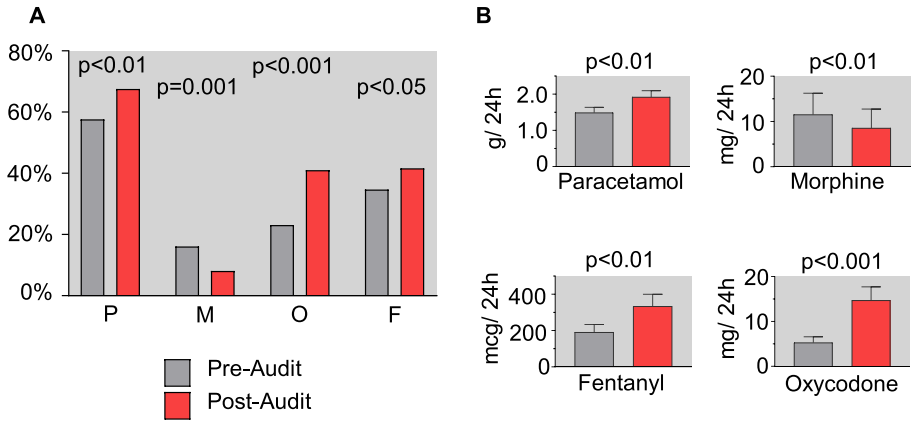

Fig. 2. Analgesia administered. A: Proportion of charts on which analgesics paracetamol (P), morphine (M), oxycodone (O), and fentanyl (F) were administered, pre and post CPOT implementation. Graph shows percentages, calculated with chi-square tests. n = 441 pre-audit, n=344 post-audit. **B:** Mean quantities of analgesics administered in a 24-h period, before and after CPOT implementation. Graphs show means ± SD, calculated with Wilcoxon rank sum tests. n = 441 pre-audit, n=344 post-audit. SD, standard deviation.

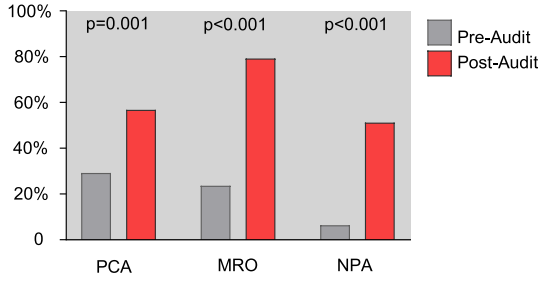

Fig. 3. Pain management interventions. Proportion of charts on which patient-controlled intravenous opiate pumps (PCA), enteral modified-release opiates (MRO), and enteral neuropathic pain agents (NPA) were used, before and after CPOT implementation. Graph shows percentages, calculated with chi-square tests. n=441 pre-audit, 344 post-audit.

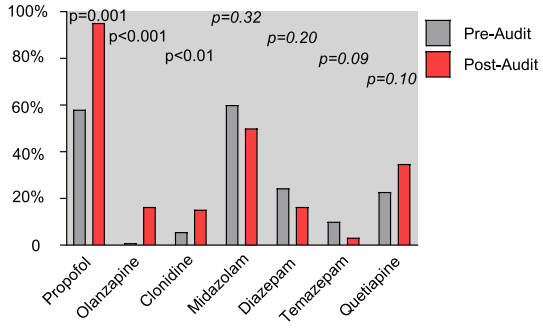

Fig. 4. Sedation administered. Proportion of charts on which sedatives propofol, olanzapine, clonidine, midazolam, diazepam, temazepam, and quetiapine were administered, before and after CPOT implementation. Graph shows percentages, calculated with chi-square tests. Nonsignificant p-values italicised. n=441 pre-audit, 344 post-audit.

4.4. Sedation

There were statistically significant increases in the use of propofol, olanzapine, and clonidine. Propofol was given on 15% of charts pre-CPOT and on 24% after implementation (Fig. 4). There were also nonsignificant decreases in use of midazolam, diazepam, and temazepam and a slight increase in quetiapine use.

4.5. Confusion Assessment Method for ICU

Interestingly, compliance with use of the CAM-ICU at least once per chart improved from 19% to 89% between the audit periods

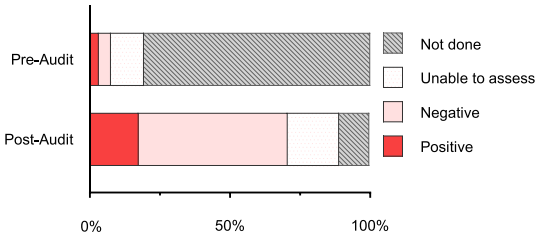

Fig. 5. CAM-ICU compliance. Proportion of charts with a CAM-ICU recorded before and after chart redesign to include CPOT and CAM-ICU. Graph shows percentages, calculated with chi-square tests. n=441 pre-audit, 344 post-audit.CAM-ICU, Confusion Assessment Method for ICU.

(Fig. 5). The low CAM-ICU compliance in the preimplementation audit likely resulted in underreporting of delirium; thus, we are unable to make any comparative inferences with regard to pain management of delirious patients.

5. Discussion

5.1. Interpretation of the results

The primary outcome of the study was the frequency of pain assessment, and we observed a nearly threefold increase in pain assessments per 24-h period for noncommunicative patients. This is the same factor of improvement noted by Gelinas et al.[21] For transitioning patients, the effect was less pronounced, presumably because these patients are assessable by self-report tools for some of the chart period. For communicative patients, however, the increase in mean pain assessment frequency was minimal, as the baseline was relatively high at 7.2 assessments in 24 h. These results indicate that a significant barrier to pain assessment in this ICU was the lack of a suitable tool for noncommunicative patients. When provided with such a tool, nurses assessed pain more frequently and appropriately, as seen in the Canadian studies. However, as noted by Rose et al., compliance still fell short of the policy recommendation of 2-hourly assessments.[30]

We observed statistically significant increases in the use of paracetamol, opiates, and neuropathic pain agents. This contrasts with the results of Gelinas et al. who found a decrease in analgesia administered after CPOT implementation.[21] However, there were fewer trauma patients in their second cohort, which could account for the observed decrease in analgesia use. Rose et al. observed a decrease in opiate use in the cardiac surgical ICU and a significant

increase in the mixed ICU.[30] The latter is more representative of our unit and generated a similar result. It is probable that patient demographics influence whether pain is undertreated or overtreated before implementation and that the CPOT does enhance nurses' abilities to discriminate pain from other symptoms, as suggested by Gelinas et al.[21] We conclude that in our study, the increases in analgesics used are most likely due to pain being more frequently detected and treated.

It seems reasonable to expect that more comfortable patients would require less sedation, as observed by Gelinas et al. and in the cardiac surgical ICU studied by Rose et al..[21,30] We, however, saw increased use of sedatives. The increase in propofol use may be explained in part by the nonsignificant decreases in use of midazolam, diazepam, and temazepam. There were no changes to local sedation policies during the study; however, on a review of pharmacy orders, we noted a steady decline in the amount of midazolam ordered over the previous 2 years. We suggest that the shorter acting drug propofol may, at times, be being used in place of benzodiazepines as lighter sedation is now recommended practice.[15]

The trend towards increased use of the atypical antipsychotics olanzapine and quetiapine, may be explained by the substantial increase in CAM-ICU compliance, which would translate to more delirium identified, and therefore treated. This increase in compliance was an unexpected finding. There was no additional education around delirium or CAM-ICU conducted during this study, so it appears that simply adding it to the ICU flow charts has prompted an increase in use.

5.2. Limitations and challenges

As patient-identifying information was not collected, we are unable to account for repeated measures in analysis. However, large data sets were collected to compensate for this, and because every patient in the unit was captured on any given audit day, selection bias was eliminated.

During the study, one patient with Guillain-Barre syndrome was present in the unit. This condition is known to require significant analgesia and lengthy ICU admissions,[32] factors which could introduce bias. This patient received high doses of gabapentin but was present for part of the first audit period only. As the use of neuropathic pain agents including gabapentin increased during the second audit period, this did not affect the results. There were no other patients with similar conditions identified during the study.

Owing to the variety of pain assessment tools used and the absence of an assessment tool for noncommunicative patients in the first audit, it was not possible to directly compare patients' actual pain levels between audits. The opinion of bedside nursing staff was chosen as a surrogate indicator suitable for all patients.

We did not examine interrater reliability of the CPOT; however, this has been demonstrated in other studies. In one study of patients in a burns unit, the investigators reported poor interrater reliability for the CPOT, and other observational tools, after brief education on the tools.[33] This result is in contrast to that of Gelinas et al.,[21] where interrater agreement reached 86–100% after implementation using a standardised education programme and the use of CPOT trainers, similar to our implementation strategy. Provision of accessible resources and effective education is vital to achieve the correct use and interpretation of the tool. The CPOT is commonly misinterpreted as being an intensity scale, as seen in our posteducation questionnaire and in some published academic literature.[34] However, no observational pain assessment tool can achieve this.[35]

During the 6-week run-in period, seven nurses resigned or ended contracts, and 10 new staff commenced. Despite this staff turnover, the information and resources provided were accessible and clear enough for new staff to apply. Anecdotally, nurses trained in use of the CPOT found it clear, easy to use and teach, and clinically useful, which is consistent with feasibility studies.[36] We have since incorporated CPOT education into our orientation training for new staff, to sustain these gains in appropriate pain management.

5.3. Generalisability

As our results are similar to the Canadian studies with regard the primary outcome, this study provides further evidence to support the suggestion that a CPOT implementation strategy can increase the frequency of pain assessment for noncommunicative ICU patients. We agree with Rose et al.[30] that randomised trials would be the ideal evaluative measure; however, this may become increasingly difficult as adoption of the CPOT and BPS become more widespread. Further research in observational pain assessment is warranted for ICU patients with delirium, chronic pain, and neuromuscular dysfunction, for whom minimal validation testing of such tools has been conducted.

6. Conclusion

The implementation of the CPOT in this ICU, using standardised education and integrated documents, led to more frequent pain assessments, particularly for noncommunicative patients. Additionally, it led to an increase in observational assessments including the CPOT for noncommunicative patients and a corresponding decrease in the inappropriate use of self-report tools. Nurses were also more confidently able to discriminate whether their patients were experiencing pain. This was accompanied by an increase in the proportion of patients who received analgesics and adjunctive pain management interventions and the amounts of analgesics administered across all patient groups. These findings are likely to signify improved patient comfort and mitigation of the adverse effects of pain in this ICU. This study provides further evidence for a CPOT implementation strategy to increase the frequency of pain assessment for noncommunicative ICU patients, suggesting generalisability to Australian ICUs.

Author statement

Ethical approval

This project was approved by the Human Research Ethics Committee of the Northern Territory Department of Health and Menzies School of Health Research (2015–2470).

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Author contribution

M.L.P. designed the study protocol, developed the charts and resource documents, conducted staff training sessions, completed audits, and wrote the manuscript. V.K. assisted with the study design and planning, completed audits, proofread the manuscript, and approved the final version. M.B. conducted the statistical analysis, assisted with the manuscript, and approved the final version.

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