

BMJ Open Quality **Improving timely analgesia administration for musculoskeletal pain in the emergency department**

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ABSTRACT

Delays to adequate analgesia result in worse patient care, decreased patient and provider satisfaction and increased patient complaints. The leading presenting symptom to emergency departments (EDs) is pain, with approximately 34 000 such patients per year in our academic hospital ED and 3300 visits specific for musculoskeletal (MSK) injuries. Our aim was to reduce the time-to-analgesia (TTA; time from patient triage to receipt of analgesia) for patients with MSK pain in our ED by 55% (to under 60 min) in 9 months' time (May 2018). Our outcome measures included mean TTA and ED length of stay (LOS). Process measures included rates of analgesia administration and of use of medical directives. We obtained weekly data capture for Statistical Process Control (SPC) charts, as well as Mann-Whitney U tests for before-and-after evaluation. We performed wide stakeholder engagement, root cause analyses and created a Pareto Diagram to inform Plan-Do-Study-Act (PDSA) cycles, which included: (1) nurse-initiated analgesia at triage; (2) a new triage documentation aid for medication administration; (3) a quick reference medical directive badge for nurses; and (4) weekly targeted feedback of the project's progress at clinical team huddle. TTA decreased from 129 min (n=153) to 100 min (22.5%; n=87, p<0.05). Special cause variation was identified on the ED LOS SPC chart with nine values below the midline after the first PDSA. The number of patients that received any analgesia increased from 42% (n=372) to 47% (n=192; p=0.13) and those that received them via medical directives increased from 22% (n=154) to 44% (n=87; p<0.001). We achieved a significant reduction of TTA and an increased use of medical directives through front-line focused improvements.

PROBLEM

Pain is the most common presenting complaint for patients accessing emergency departments (EDs).¹⁻⁴ Despite this, ED providers often do a suboptimal job in treating pain in a way that is timely and satisfactory to patients.⁴⁻⁶ Our ED is an urban, quaternary care, adult-only academic medical centre with a long-standing history of tackling quality and safety issues for improved patient care, and our team has previously published reports in this journal.^{7,8} We see approximately 53 000 ED visits per year, with approximately 70% for pain-related concerns (excluding chest

pain). Approximately 3300 of these pain-related visits are for musculoskeletal (MSK) injuries, which include upper extremities, lower extremities and back pain (traumatic and atraumatic). Many patients with MSK injuries are triaged to a lower acuity category and as a result wait for extended periods of time before being seen by a provider and having their pain treated. Due to inconsistent practices between nurses and physicians, the point when the patient receives analgesia (or not) varies tremendously along their care journey through our ED.

To better understand our local practices, a 4-month chart audit was conducted for the MSK pain-related visits to our ED. A total of 372 charts were audited selecting every seventh chart. This chart audit demonstrated 42% (150/372) of patients who presented to our ED with MSK pain received analgesia. Of those that received analgesia, only 22% (31/150) had it administered through the nursing medical directives. Medical directives allow nurses to initiate specific analgesic medications such as paracetamol/acetaminophen, ibuprofen and ketorolac under agreed-upon protocols prior to assessment of the patient by the most responsible provider (MRP) (physician or a nurse practitioner). In our audit, the patients who received analgesia waited an average of 129 min. Eighty-nine per cent of this subgroup had a documented pain score at triage, and the median pain score was 7 on an 11-point numeric rating scale (0-10). The British Association of Accident and Emergency Medicine introduced guidelines in 2006 (updated in 2014) that state that patients with a pain score of 7-10 should have analgesia administered within 20 min of arrival to the ED or at triage.⁹ Those patients with pain score of between 4 and 6 should have analgesia offered at triage.⁹

The aim of our quality improvement (QI) project was to decrease the time from triage to analgesia (TTA) by 55% (to under 60 min)



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for patients presenting with MSK pain at the Toronto General Hospital ED, within 9 months (May 2018).

BACKGROUND

Pain is the leading symptom for ED visits across the globe and has been studied extensively since Wilson and Pendleton first described in 1989 the effects of 'oligoanalgesia', or the undertreatment of pain.⁵ Despite the extensive study of oligoanalgesia, pain is still poorly treated in EDs.^{2 10} Extended delays in the initial assessment and treatment of pain is common in many EDs.⁴⁻⁶ Time to analgesia administration is now being used in many countries as a quality indicator.^{2 6} Oligoanalgesia has been associated with increased ED length of stay (LOS), decreased patient satisfaction and decreased healthcare provider satisfaction.¹¹ The causes of poor pain management in the ED have been associated with multiple factors, such as incomplete or missing triage-based pain scores, lack of knowledge and perceived obstacles by healthcare providers.^{6 12} Moreover, when the EDs are busier, there is less attention focused on pain relief and analgesia administration as the nurses may be more focused on task completion.⁶

Due to overcrowding in many EDs, patients often wait a significant amount of time before being assessed by an MRP, which often translates into extended periods of time before any treatment (including analgesia) is initiated.^{1 4 6} On average, patients wait 1.6 hours before being assessed by an MRP in our province of Ontario, Canada.¹³ Our local centre data are an average wait time of 2.0 hours before MRP assessment.¹³ Recommendations have been made to develop nurse-initiated analgesia (NIA) protocols to help expedite the treatment of acute pain in the ED.⁶ NIA is defined as medications administered by a nurse without a direct MRP order, based on a predefined set of criteria that is agreed on with the responsible medical leadership.¹⁴ NIA and pain protocols have been used in the ED with positive effects such as expedited analgesia administration and more timely reduction in pain score and with minimal negative effects such as adverse medication reactions such as nausea, vomiting, dizziness and/or change in vital signs.¹⁵

Studies that used NIA reduced the time to the first dose of analgesia and increased the proportion of patients receiving any analgesia.^{10 14 16} In one study, TTA was reduced from 76 min to 40 min with NIA at triage.^{10 14} Another example where NIA was used, first dose of analgesia was administered in less than 30 min versus 131 min when not used.^{10 14} Cabilan and Boyde¹⁵ conducted a systematic review of the impact of NIA in the ED based on the six domains of quality of care. This study showed that it was more beneficial to patients than non-NIA practice in five of six of them (safety, timeliness, effectiveness, equitability and patient-centeredness), with no negative impact on the remaining one (efficiency).¹⁵ Of note, the TTA in that study was found to be significantly lower in the NIA group, at less than 30 min.¹⁵

A 2017 randomised control trial compared the effectiveness of four oral analgesic regimens in the ED for patients with acute extremity pain: ibuprofen and paracetamol/acetaminophen, oxycodone and paracetamol/acetaminophen, hydrocodone and paracetamol/acetaminophen and codeine and paracetamol/acetaminophen.¹⁷ The authors found that there was no clinically significant difference in pain reduction between each of the four drug regimens.¹⁷ This study provides evidence that non-opioid analgesia, such as paracetamol/acetaminophen and ibuprofen, can have an equivalent impact on pain reduction.¹⁷

MEASUREMENT

This project was developed using the Model for Improvement, and it was analysed using Statistical Process Control (SPC) methodology.^{18 19} Measures were abstracted via weekly chart audits, with our Decision Support team providing data of relevant charts starting in November 2017 for our baseline measure, continuing throughout the project duration until June 2018 and ongoing for 1 year to evaluate sustainability. A total of 372 charts were audited during baseline data collection and for all metrics, over the course of 20 weeks.

Outcome measures

Our primary outcome measure was TTA in minutes, defined as the time between a patient's triage and their initial dose of analgesia as documented in the chart. The average baseline TTA was 129 min (n=372, range 78–193 min). Our secondary outcome measure was the ED LOS, defined as the time from patient triage to discharge from the ED. The mean baseline ED LOS was 580 min (n=372, range 91–2443 min).

Process measures

Our process measures included: (1) the rate of medication administered, defined as the percentage of patients who received any analgesia during their ED visit, (2) the percentage of medical directive use for those who received analgesia, defined as analgesia administration documented prior to MRP assessment and (3) the percentage of patients with a documented pain score at triage. Baseline process measures were as follows: analgesia administration was a weekly average of 42% (n=372, range 20%–73%), medical directive use was a weekly average of 22% (n=372, range 0%–100%) and triage pain score assessment was a weekly average of 89% (n=372, range 76%–100%).

Balancing measures

Balancing measures included the percentage of adverse events (AEs), captured via our existing institution-wide incident reporting system. We selected adverse medication events as they are an important patient-centred safety event. During the baseline period, no AEs were identified. A second balancing measure was the time spent performing the triage assessment by the triage nurses,

captured via electronic health record time stamps of initiation and completion of triage. Baseline time spent triaging was a mean of 5 min (n=25, range 3–8 min). The sample size is smaller as it was a retrospective and labour intensive value to abstract. We abstracted approximately the same number of preintervention charts as there were postintervention for those who received medication at triage (n=17).

DESIGN

With many patients waiting greater than 2 hours to receive any analgesia, we saw an opportunity to improve the patient experience by earlier analgesia administration. Stakeholder engagement revealed a discrepancy: 91% (41/45) of nurses surveyed felt that they were providing analgesia both early in the patient visit as well as often times via the pre-existing medical directives, but our baseline data did not support this perception. An interprofessional team was formed composed of key stakeholders, including three nurse champions, a physician, two nurse practitioners, as well as our ED's nurse educator, and patient care coordinator. The group sought input from other important stakeholders within the ED including medical and nursing leadership and our ED's pharmacist. The team worked together to complete a process map to better understand the problem and map where in the patients journey that analgesia was being administered.

Our core QI team developed process changes to improve the delivery of analgesia within our ED. These processes were then tested, improved and implemented in serial Plan–Do–Study–Act (PDSA) cycles. A quick reference badge tag was developed to allow for easy access to medical directive criteria. The triage nurse would use a newly developed adhesive label to document the administration of the medication. The label also functions as a flag for other health care providers (HCPs) indicating that medications had been provided.

Weekly data collection was used to inform twice weekly updates on the initiative's progress to our ED staff during morning huddles. The QI project team met once a month during the project's implementation phases to ensure the project was progressing.

Nine months after the project's implementation, we conducted a 1-month chart audit (n=48) to evaluate the sustainability of this project.

STRATEGY

The SMART aim of this initiative was to decrease the time-to-analgesia (TTA; time from patient triage to receipt of analgesia) by 55% (under 60 min) in 9 months' time (May 2018). We used the Model for Improvement and PDSA cycles to iteratively change and monitor the smaller parts of this project to achieve our primary outcome.¹⁸

PDSA 1: triage-based analgesia administration

Our process mapping identified that triage was the earliest point of contact with a healthcare provider that would be

amenable to administering analgesia to patients. Nurses at triage can assess patients' suitability for medical directive inclusion criteria to provide analgesia. This was the most significant change idea of our initiative and involved multiple smaller PDSA cycles (ie, documentation process, medical directive reference and secure medication storage with lockbox to comply with organisational policies) within it to make it function as intended in our setting. Medications administered at triage included only paracetamol/acetaminophen and ibuprofen. These were selected because they do not require close monitoring or frequent reassessment so as to not increase their workload. Seventy-seven per cent (432/560) of all patients included in this project were moved into a 'fast track' area after triage, where ongoing monitoring and observation was performed.

PDSA 2: documentation of analgesia provided

Our new practice of providing medications at triage created a need for a new medication documentation practice. In our ED, paper charts (used for all documentation, including medications) are created by the registration clerks after triage nurses have assessed a patient and printed remotely from the triage area. As such, triage nurses cannot document the administration of medications provided at triage without significant hindrance to their workflow. Our QI team therefore developed an adhesive label that could be completed by the triage nurse prior to chart creation and applied to the front of the chart by the registration clerk as they printed the chart (online supplementary appendix A). This label was a conspicuous bright neon flag for other HCPs to be aware that medications were provided at triage. Our other ideas, which were abandoned as they did not fit within our flow and logistical constraints, included a preprinted medication order sheet (concerns that it would be lost as it was an extra page to be added to the chart), keeping the chart at triage for documentation later on (triage nurses were too busy to not document in real time) and an ink stamp that could be applied to the chart (found to be not conspicuous enough).

PDSA 3: quick reference badge tag

An area of need identified via our nursing survey was the nurses' lack of comfort with using the medical directives. These include select blood work, X-rays and nine medications that can all be initiated by an ED nurse prior to an MRP assessment. Each item has strict inclusion and exclusion criteria. A quick reference badge tag to be worn on ID lanyards was developed through iterative design improvement and stakeholder feedback. We used both heuristic analysis and human factors methods to develop and improve it (online supplementary appendix B). One side of the badge is an algorithm for managing pain based on the patient's pain score. The reverse contains the remaining six medications which, although not the focus of this project, were included to be all encompassing for the department's benefit.

A 5 min medical directive review was presented twice weekly at department huddles for 4 weeks to ensure that all nurses were educated, as well as integrating this into education for new hires in the future. Once a nurse had attended this review, they were provided with a badge tag to carry on them; this proved to be an effective nudge for the nurses to attend this educational session.

PDSA 4: directed feedback

The final intervention was directed feedback at safety huddle on a weekly basis. The project lead (VW) would talk daily with the triage nurses to get their feedback on the initiative, which was then presented back to the department at daily huddle. Feedback included tips on what was working well or not well for individual triage nurses. It also served as an open forum to discuss concerns and challenges (eg, when to offer medication during the triage process) and to celebrate successes. Additional data presented to the group at weekly huddles included TTA, medical directive use, analgesia administration and time spent triaging.

RESULTS

Analysis of the outcome and process measures was performed using SPC methodology.¹⁸ XBarS charts were selected for TTA and LOS because the type of data collected (time, which is continuous) had more than one data value per point and the number of weekly charts audited varied as volumes fluctuated within the ED.¹⁸ P charts were selected for medication administered via medical directives and the total analgesia administered because the data are considered classification data (ie, either the patient received medication or not), with varied subgroups due to varied patient volumes.¹⁸ Balancing measures were captured before, during and after the interventions, and they are reported as such. Mean was used throughout the study for internal consistency as SPC charts use mean. As a result, Mann-Whitney U test was used for our before-and-after evaluation of the data.

Outcome measures

Our primary outcome measure, TTA, had a baseline mean of 129 min (n=153) that decreased to 100 min (n=87, $p<0.05$), a 22% reduction. This data set included those patients who received analgesia, thus these sample sizes are smaller than the overall sample size. Special cause variation was not identified via SPC rules for our primary outcome measure. However, we noted a downward trend coinciding with the introduction of select triage nurses providing analgesia via medical directives and 12 out of the last 13 points were below the midline of the SPC chart (figure 1).¹⁸ At the time of full project implementation (week of April 2–8), we indicated a process change on the SPC chart that is shown as a change in the level of the control line indicating a change in the mean.

Our secondary outcome measure, LOS, was recorded at a mean of 580 min (n=361) prior to our project and 519 min throughout the project implementation (n=187, $p=0.77$). Special cause variation was identified in our SPC chart as the LOS has a run of nine points below the centerline after the broad implementation of medication administration at triage (figure 2).¹⁸ Due to data including the entire LOS in the ED (which included the time spent admitted but boarded in our ED and not just the ED-specific LOS) and our data set being relatively small on a week-to-week basis, some weeks resulted in abnormally high LOS.

Process measures

Overall analgesia medication administration for the targeted population was recorded at a baseline mean of 42% (n=361) and at 47% (n=187, $p=0.13$) through and after our intervention. No special cause variation was identified.¹⁸

Medical directive utilisation increased from a baseline mean of 22% (n=150) to 44% (n=87, $p<0.001$) through and after our initiative. We also observed special cause variation with greater than eight points above the control line (figure 3) for the SPC chart.¹⁸ An astronomical point is noted at the start of the SPC chart, which may be due to a random occurrence or a limitation of auditing only 15% of an occasionally small number of charts.

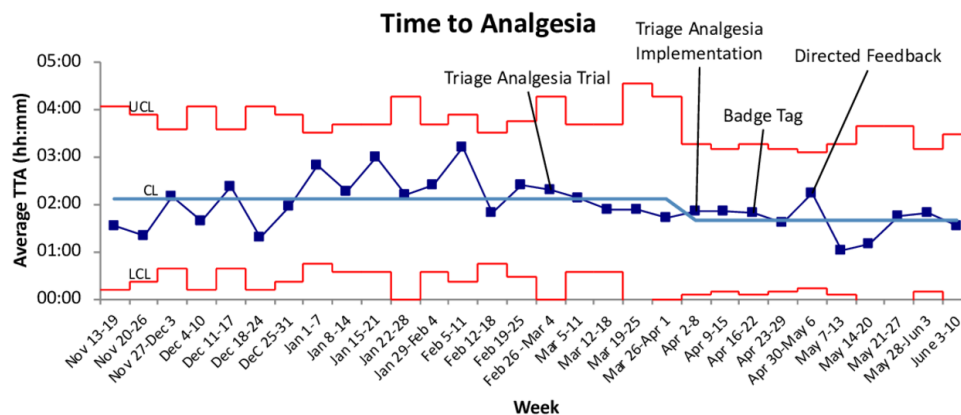


Figure 1 Time-to-analgesia, upper control limit (UCL), control line (CL) and lower control limit (LCL).

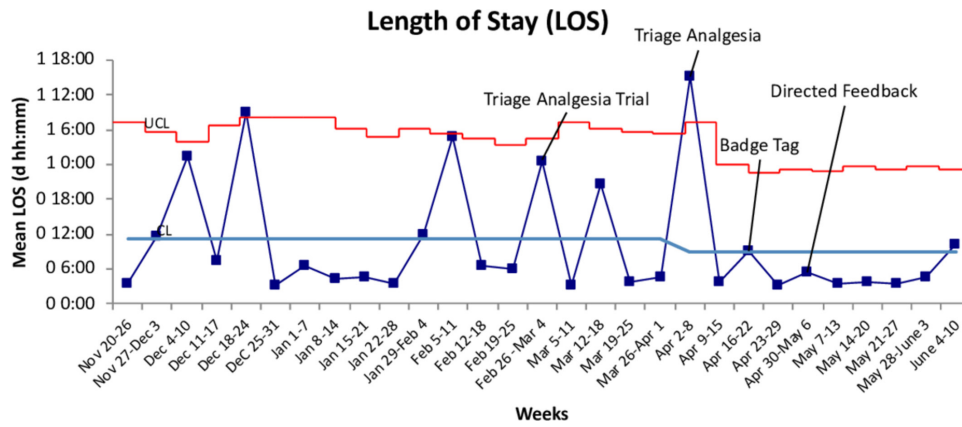


Figure 2 Length of Stay (LOS), upper control limit (UCL) and control line (CL).

Balancing measures

AEs to medications infrequently occur in our ED. There were zero such instances prior to our initiative. During our initiative, one AE was reported when both ketorolac and ibuprofen (two non-steroidal anti-inflammatory drugs) were concurrently administered via the medical directives. This issue was discussed at safety huddle and one on one with the individual provider.

We also examined time spent triaging, as there were concern that there would be an increase in nursing workload. Time spend triaging was a mean of 5 min both before (n=25) and after (n=17) the initiative. Of the patients that received analgesia after project initiation (n=87), only a small portion received analgesia at triage (n=17), resulting in a small sample size. The majority of patients, 80%, that received analgesia received it by the primary nurse.

Sustainability

A 9-month postinitiative follow-up was completed to assess for sustained and ongoing improvement, with a chart audit of 48 patients. We found a sustained reduction in

TTA at 82 min (from 100 min at project end), a similar rate of medication administration (50% from 47%) and a reduction in the use of medical directives to 38% (from 44%, but still up from our preproject rate of 22%).

LESSONS AND LIMITATIONS

Overall, this project was successful in making changes to improve the duration patients wait for analgesia. There was a significant reduction in the TTA by 22% (129 min to 100 min) as a result of the interventions implemented with this project. A significant increase in the medical directive use from 22% to 44% occurred with this front line focused and grass roots developed project. Stakeholder engagement throughout the project helped to gain buy in and encouraged staff participation in the project. The nurse champions were the driving force behind the implementation and helped keep the project on track. We are encouraged by the increased adherence to medical directive use, but we realise this is still a relatively low adherence. As we were unable to reliably capture data on patient who were offered but declined

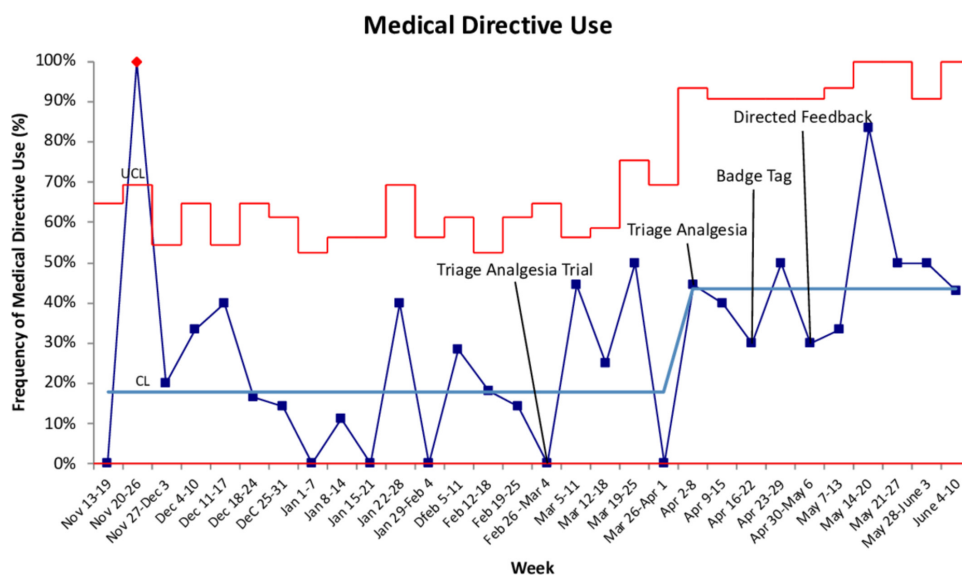


Figure 3 Medical directive use, upper control limit (UCL) and control line (CL).

analgesia or subsequently accepted from the MRP, we suspect that a greater percentage of patients may have actually been offered analgesia (and possibly earlier on) than our data suggest. We also know, based on feedback from our nursing team, that they often skipped analgesia administration at triage during times of surge for fear of 'falling behind' (despite our data showing the lack of significantly increased time spent), which would also have impacted our adherence to medication administration.

By keeping the initiative's focus on a small patient population (ie, MSK pain), we were able to create a project that felt manageable for our project team and department. This helped with buy-in from our nursing team; instead of asking nurses to give medication to 70% of the patients they triaged (ie, those who have pain), we instead asked for only 8% of them (ie, MSK pain, which represented approximately two patients/hour). As a result of this initiative, the nurses use the medical directives more frequently and feel comfortable using them more for other appropriate pain-related complaints that meet the medical directives' inclusion criteria.

We were able to use our organisation's heuristics and the human factors lab to trial the badge tag that was created for this project. This resulted in a much more refined end-user tool compared with what had been prototyped initially, allowing for problems with the tool to be identified, modified and retested prior to going live. We have had positive anecdotal feedback regarding this tool from the staff nurses that use it daily.

Our project involved creating a workaround for the current electronic health record (EHR) system, the documentation of medications administered at triage. We are currently awaiting a change to a new EHR system, and with that change, we will be integrating a field into the new e-triage system for medications administered at triage. This change will create a more seamless workflow for the triage nurses and registration clerks as well as minimising any potential for error with the current workaround.

The aforementioned workaround compounded with the challenge of changing individual healthcare providers' practices negatively impacted our ability to provide excellent and timely care. Although we saw a decrease in our TTA throughout the initiative, we did not see as large a reduction as we had aimed for. Our triage nurses indicated that during times of surge, they often skipped analgesia administration at triage in an effort to assess incoming patients more quickly. This is reflected in the literature: when there are high volumes in the ED, providers are likely to be less attentive to patients' complaints of pain, and in periods of overcrowding, there is worse pain management.²⁰

We were unable to capture the data on accepted or declined non-medication analgesia interventions (eg, slings, splints and ice packs), which may have provided more insight into our project. This information may have affected the data if we decided to 'stop the clock' on those patients provided with non-medication analgesia.

During data analysis, we realised that the LOS had multiple astronomical points. These outliers were due to counting the full LOS, including for those admitted. In hindsight, we would have either 'stopped the clock' at the time of referral or omitted admitted patients from the data all together.

We intend to spread this initiative to other sites within our institution, and we have already received interest from others when this project was disseminated to nearby organisations. Further sustainability would be improved with an EHR solution for documentation of medications for all patient encounters, including triage.

CONCLUSION

Our project aimed to reduce the TTA for patients with MSK injury/pain to below 60 min within a 9-month time frame. Although we did not meet our stated aim, we made significant improvements of 22% that were sustained and actually improved 9 months after the project's end. We also saw a reduction in our LOS with special cause variation identified on our SPC chart. This initiative also increased the appropriate utilisation of medical directives from 22% to 44% by using human factors testing and heuristic analysis. We have noted a sustained reduction with of the TTA at 82 min 9 months postproject implementation. We endeavour to work towards our goal of a TTA of less than 60 min and are encouraged by the sustained results.

This front-line driven project highlighted the success in using medical directives and NIA in an appropriate patient population to improve the timeliness of analgesia. An interprofessional QI team and early stakeholder engagement led to a widely accepted project within our ED. The nurse champions have kept our project's momentum going and contributed greatly our continued success.

Other institutions seeking to adopt similar practices may consider developing medical directives or analgesia medication algorithms to help support their staff and possibly to focus on triage-based interventions if appropriate to their setting. We were lucky to already benefit from medical directives being in place, and we capitalised on promoting their use instead to achieve our results.

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Contributors VW designed the quality improvement (QI) strategy, and methods, monitored data collection for the whole project, cleaned and analysed data and drafted and revised and edited the paper. RA, HL and KB designed the QI strategy and methods and edited and revised the paper. JD monitored data collection during the whole project and cleaned and analysed the data. LBC designed the QI strategy and methods, analysed the data and edited and revised the paper.

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