University of Cincinnati

Date: 7/19/2016

I, Emily C. Sterrett M.D., hereby submit this original work as part of the requirements for the degree of Master of Science in Clinical and Translational Research.

It is entitled:
Are quality improvement outcomes sustainable within a dynamic clinical environment?

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Are Quality Improvement Outcomes Sustainable within a Dynamic Clinical Environment?

A thesis submitted to the Graduate School of the University of Cincinnati in partial fulfillment of the requirements for the degree of Master of Science in Clinical & Translational Research in the Department of Environmental Health Division of Epidemiology & Biostatistics of the College of Medicine

July, 2016

by

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ABSTRACT

Objectives
To determine the long-term sustainability and unintended consequences of a QI intervention to improve the timeliness of IV opioid administration to patients with long-bone extremity fractures within the changing microenvironment of a pediatric emergency department.

Methods
A retrospective study of patients with long-bone extremity fractures using electronic medical record data from 2007 to 2014. The primary outcome was the proportion of patients receiving timely IV opioids. Control charts and time series models were used to determine if changes in the clinical microenvironment were associated with changes in the outcome measure. Long-term unintended consequences included patients receiving potentially unnecessary IVs and the process being applied to patients without long-bone extremity fractures.

Results
Improved timeliness of IV opioids was sustained. The type of physician who staffed the process and faculty physician staffing hours were associated with a 9.6% decrease, and 11.8% increase in timely IV opioids. Implementation of the IV opioid process was not associated with an increase in potentially unnecessary IV placement. Of patients receiving the IV opioid process, 22% did not have a long-bone extremity fracture, of whom 91% were diagnosed with another painful injury.

Conclusion
Improving IV opioid timeliness was robust despite changes in the clinical microenvironment. Changes in physician staffing and responsibilities in a PED may be especially important to consider when planning future improvement initiatives. Our findings support the importance of higher reliability interventions, such as identification and utilization of existing patterns of behavior, as being particularly high-yield for improvement teams striving to achieve sustained outcomes.
ACKNOWLEDGMENTS

Sincerest thanks to my Thesis Committee members and co-authors of this work. Terri Byczkowski, PhD provided senior mentorship, quality improvement expertise, biostatistical support, and manuscript contribution and review. Eileen Murtagh Kurowski, MD provided mentorship, pediatric emergency medicine and quality improvement expertise, and manuscript contribution and review. Thank you to Richard Ruddy, MD for mentorship while planning this study.

Thank you also to the original improvement team members - Srikant Iyer MD, Charles Schubert MD, Scott Reeves MD, and Jenny Oehler BSN.
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BACKGROUND
The keys to long-term sustainability of improved processes and outcomes resulting from quality improvement (QI) work are not well understood, with the majority of QI publications tracking process measures and/or outcomes for only one year following the initial work.\textsuperscript{1,2} Also, there is a paucity of literature on unintended consequences that can result from the implementation of new processes resulting from QI work.\textsuperscript{3-9}

To address these gaps, we conducted a retrospective study of a QI project to improve the timeliness of pain medication for patients with clinically apparent long-bone extremity fractures in our pediatric emergency department (PED).\textsuperscript{10} The resulting process, implemented in October 2007, continues to be the standard of care in our practice setting. Given that there have been many changes in our clinical microenvironment, this provided an ideal opportunity to measure the sustainability of the original outcome and examine potential unintended consequences resulting from implementing and sustaining this process. Studies such as this are a first step to exploring and understanding the robustness of improvement work within an ever changing clinical environment.

Process for Timely Pain Medication
In 2007, Iyer et al began QI work using Model for Improvement\textsuperscript{11} methodology to improve the timeliness of intravenous (IV) opioids for patients with clinically apparent long-bone extremity fractures.\textsuperscript{10} The IV opioid process, as it exists today, was implemented in October 2007 (Figure 1). The primary outcome measure was the proportion of patients with a long-bone extremity fracture who received their first dose of IV opioid within 45 minutes of arrival. Special cause variation indicated improvement in this outcome measure within the first 60 days after implementation. The results were monitored for an additional 20 months showing that the initial improvements were sustained. This IV opioid process persists as the standard of care for patients with clinically apparent long-bone extremity fractures in our PED despite numerous changes in the clinical microenvironment (Table 1).
Study Objectives

The objective of this study was to explore the long-term sustainability and unintended consequences of a QI intervention within a dynamic PED microenvironment. This study had two specific aims. First, we explored the impact of system-level microenvironment changes on the sustainability of successful QI work to improve the timeliness of IV opioids for patients with long-bone extremity fractures. Identifying and quantifying the effects of microenvironment changes may inform plans for sustainability by helping QI teams better understand the impact these changes can have on processes and outcomes resulting from improvement work. We hypothesized that the proportion of patients receiving IV opioids in less than 45 minutes had not changed since 2007 despite numerous changes in the clinical microenvironment.

Second, we sought to explore unintended consequences of this QI implementation in our specific care environment. Providers working in our PED hypothesized unintended consequences were likely resulting from this implementation, and specifically, that this implementation was a source of increased resource utilization. To that end, we hypothesized that the proportion of patients with long-bone extremity fractures receiving IV access for a single dose of IV opioid, but not requiring procedural sedation has increased. Additionally, we hypothesized that the population of patients to whom the IV opioid process is applied has broadened to include those with other painful injuries besides long-bone extremity fractures.

METHODS

This was a retrospective observational study using data from the electronic medical record (EMR) for patient visits from January 1, 2007 to June 30, 2014. The setting for this study was a large, urban, tertiary, academic PED and level-one pediatric trauma center with approximately 66,000 annual visits.
Study Population

Patients were included if diagnosed with a long-bone extremity fracture specified by ICD-9 code prefixes 812, 813, 820, 821, 823, and/or 824. Patients were excluded if they presented with critical illness as indicated by receipt of resuscitation medications or paralytics. To determine if the population of patients receiving the IV opioid process included those without long-bone extremity fractures, we included all patients who had an IV opioid process triage designation in the EMR. It should be noted, however, that this triage designation was not captured in the EMR until November 2012.

Measures

Timely IV Opioids

We calculated the monthly proportion of patients who received timely IV opioids. The denominator was the number of patients with long-bone extremity fractures who received at least one dose of IV opioid. The numerator was the number of patients who received their first dose of IV opioid within 45 minutes of arrival in the PED. This definition matched that of Iyer et al.\textsuperscript{10}

Unintended consequences

We measured the monthly proportion of patients who experienced potentially unnecessary IV catheter placement. IV placement was considered potentially not necessary if it was placed for a single dose of IV opioid and no other medication was administered through the IV catheter. The denominator was the number of patients with a long-bone extremity fracture who received at least one dose of IV opioid. The numerator was the number of patients who received only one dose of IV opioid and no other intravenous medications.

Finally, we examined the proportion of patients who were triaged to the IV opioid process, but were not diagnosed with a long-bone extremity fracture. Diagnosis codes were collected and summarized for all patients with a triage designation for the IV opioid process from November 2012 to June 2014, which is when this triage designation was available in the EMR.
Analysis

Annotated monthly p-charts were used to display the proportion of patients who received timely IV opioids and the proportion who received potentially unnecessary IV catheterization. Data leading up to implementation of the initial IV opioid process was used to calculate the baseline centerline and control limits. Significant shifts in the measures (i.e., special cause variation) were identified using traditionally accepted rules for statistical process control.\(^\text{12}\)

Time series models were developed to determine which, if any, of the microenvironment changes (Table 1) were associated with changes in the proportion of patients receiving IV opioids within 45 minutes.\(^\text{13}\) First, we developed a time series model for each individual microenvironment change that occurred after implementation of the IV opioid process. The dependent variable in each model was the monthly proportion of patients receiving an IV opioid within 45 minutes. The independent variables included an indicator variable denoting the microenvironment change. To account for temporal trends, we included a time variable for which the months were coded zero up to the microenvironment change, and then numbered consecutively after the microenvironment change. Similarly, we accounted for an overall secular trend by including a variable that consecutively numbered the months for the duration of the study period beginning with the first month. We used an indicator variable in each model to control for the initial IV opioid process implementation. Finally, we controlled for the monthly proportion of patients in our population who received intranasal fentanyl. Fentanyl is an opioid medication that can be delivered via a spray in the nose without IV access. We controlled for intranasal fentanyl because a patient’s time to first IV opioid may be delayed if their pain was adequately controlled using the intranasal route. Intranasal fentanyl has shown equivalent efficacy to IV opioids in children with fractures and we clinically do not consider administration of intranasal fentanyl a failure of the IV opioid process.\(^\text{14}\) The proportion of patients in our study population who received intranasal fentanyl appeared to exhibit a slight curvilinear pattern over time (Figure 2). As a result, we included both a linear and quadratic term for intranasal fentanyl in the time series models.
A final time series model was developed by including all microenvironment changes that were significant, controlling for the implementation of the initial IV opioid process and the use of intranasal fentanyl. SAS PROC AUTOREG (SAS v9.3, SAS Institute, Inc., Cary, NC) was used to analyze the data in order to account for autocorrelation.

RESULTS

Study Population Demographic Characteristics

Table 2 shows the demographics of patients diagnosed with long-bone extremity fractures during the course of this study. The mean age, sex, and racial distribution of the study population remained similar throughout the course of the study.

Sustainability of Timely IV Opioids

Figure 3 is a p-chart that depicts the variation in the primary outcome during the study period. The center line was recalculated when special cause variation was indicated, in this case eight consecutive points above or below the center line. The annotations indicate when the implementation of the initial IV opioid process occurred followed by each microenvironment change. Overall, it shows the gains of the original improvement team were largely sustained. There were, however, two instances of special cause variation during the post-implementation period: a negative shift beginning in September 2009 and a positive shift beginning in November 2012.

Table 3 summarizes the results of the time series models for each microenvironment change. It shows that the microenvironment change in which the physician for the IV opioid process changed from an independent staff physician to a resident-faculty pair was significant (p-value = 0.01) after controlling for the IV opioid process implementation and intranasal fentanyl use. Similarly, the implementation of a change in the distribution of faculty physician staffing hours was significant (p-value = 0.02).
Table 4 shows the results of the final time series model, which included the two significant microenvironment changes (Table 3), while controlling for the initial implementation of the IV opioid process and the use of intranasal fentanyl. It shows that the initial implementation of the IV opioid process was associated with an increase of 28% in the proportion of patients receiving timely opioids (p-value < 0.01). Changing the type of physician who responded to the IV opioid process from clinical staff to a faculty/resident pair was associated with a decrease of 9.5% (p-value = 0.04). Changes to the distribution of faculty physician staffing hours was associated with an increase of 11.8% in the proportion of patients receiving IV opioids within 45 minutes (p-value < 0.01). Finally, the use of intranasal fentanyl had a small but significant negative association with the proportion of patients receiving IV opioid within 45 minutes.

With one exception, these results align with the p-chart in Figure 3. The final time series model showed that changing the type physician who responded in the IV opioid process, which was implemented in January 2009, had a significant negative association with the timeliness of IV opioids. The control chart, however, did not indicate special cause variation until October 2009. This is likely due to the more conservative criteria of declaring special cause variation when 8 consecutive points are above or below the centerline, compared to using p-value < 0.05 in the time series analysis model. Finally, the magnitude of the change noted on the control chart was aligned with the regression coefficient resulting from the time series analysis, which indicated a decrease of 9.6 percentage points.

Unintended consequences

The introduction of the IV opioid process was not associated with special cause variation in the proportion of patients receiving an IV for a single dose of IV opioid (Figure 4). There was, however, a large negative shift in this measure beginning in September 2010. At this time in our PED, an order was created in the EMR which allowed our nursing staff to administer a second “as needed” dose of IV morphine without
physician consultation. We hypothesize that the negative shift observed in September 2010 was due to increased administration of a second dose of IV opioid.

To address our hypothesis concerning the population to which the IV opioid process is applied, we obtained data for the patients who were designated in the EMR as having been triaged to the IV opioid process. This designation was put in place in November 2012. Of the 944 patients who were designated in the EMR as having received the IV opioid process, 733 patients (77.6%) had a diagnosis of a long-bone extremity fracture at discharge, and 211 patients (22.4%) did not have a long-bone extremity fracture diagnosis. Table 5 shows the distribution of diagnoses applied to patients without long-bone extremity fractures. Of those, 91% were diagnosed with an injury (11% had some other fracture) and 8% of patients were diagnosed with non-injury related pain.

**DISCUSSION**

This study demonstrates the long-standing sustainability of an improvement process over seven years following implementation. The proportion of patients receiving timely analgesia remained above the pre-implementation baseline despite numerous changes in the clinical microenvironment. Additionally, time series analysis showed that the timeliness of analgesia was associated with the type of physician responsible for pain medication decision-making and changes to the distribution of faculty physician staffing hours.

Broad categories of factors contributing to sustainability include context, culture, adaptability, resources and funding, but limited quantitative research has measured the influence or interaction of such factors. Additionally, a systematic review identified numerous gaps in the healthcare literature which limit our understanding of sustained improvement outcomes. One specific gap includes the lack of a standard definition of sustainability, specifically related to time. Enhanced sustainability, however, has been described as incorporating a process into an organization’s operations such that process outcomes are mitigated over time with changes in the microenvironment. Figure 3 demonstrates enhanced sustainability
of the IV opioid process in our PED. The overall improvement gains were sustained and the deflection of
the center line due to changing the physician provider to the faculty/resident pair was mitigated when the
faculty staffing was optimized several months later.

Sustainability also depends on the level of reliability of the interventions in play. High reliability
interventions are more likely to consistently produce intended outcomes, despite inconsistencies in human
behavior.17 Levels of reliability are defined in healthcare systems from $10^{-1}$ to $10^{-3}$ representing 1/10 to
1/1,000 failures per opportunity. While processes with lower levels of reliability may be initially successful
(e.g., checklists or education modules), the outcomes can be difficult to sustain.18 Sustainability requires
attention to process design and incorporation of the process into the operations of the global system.18 The
IV opioid process was designed as a level of reliability $10^{-2}$ intervention as it took advantage of existing
behaviors, in this case, emergently responding to pages (Figure 1). Furthermore, the IV opioid process
mimicked our existing trauma and medical resuscitation alert systems which use the same paging process
and were already ingrained in the workflow of our PED.

Improvement methodologies suggest sustainability should be measured as persistence of the process
without variation.18 A successful and long-standing process, however, needs to accommodate advances in
healthcare while maintaining its core structure15 to avoid entrenchment in outdated medical practices. The
strength of the IV opioid process is the persistence of its core structure to identify patients with obvious
painful injuries and rapidly gather a team to provide pain medication. Even though a sufficient team was
gathered for IV catheter placement, the exact means of analgesia was not prescribed or mandated by the
process. Bedside providers maintained the freedom to tailor pain medication orders to the needs of the
patient. This specific feature of the IV opioid process allowed for the use of intranasal fentanyl in the years
following implementation without changing the core structure of the process (Figure 2).
Since the IV opioid process was directed at expediting IV pain medication, we speculated this may bias providers toward placing IV catheters when alternative pain medication routes may be appropriate. This study shows that the number of IVs placed for only one dose of IV opioid medication did not increase among patients with long-bone extremity fractures. In fact, providers capitalized on the IV opioid process as a point in time to place additional “as needed” medication orders and increase the provision of opioid medications during PED visits. As seen in Figure 4, substantially fewer patients received only one dose of IV opioid medication after the “as needed” orders were implemented.

We also hypothesized the IV opioid process was being used for patients without clinically apparent long-bone extremity fractures, potentially causing undue process burden on our PED system. We found almost all patients subject to the IV opioid process had painful injuries warranting timely analgesia including the 22% of patients without long-bone extremity fracture diagnoses.

**Limitations**

Because this study was conducted retrospectively using data from the EMR, we used diagnosis codes to identify eligible patients. As a result, we could not discern whether or not patients we included had a “clinically apparent” long-bone extremity fracture, the population of patients to whom the initial IV opioid process was intended. So, while the inclusion of children with non-clinically apparent fractures could bias our results, we are confident that any bias was consistent during the study period. Also, like most single-center publications of QI projects, the work done by the initial improvement team and sustainability of its outcomes may not be readily generalizable. For example, we recognize that our physician staffing model may not be present or feasible at other institutions. Similar success, however, may be achieved by utilizing physician-extending providers (e.g., advanced practice nurses, physician assistants) or restructuring provider-patient ratios to optimize the physicians’ capacities. For this reason, we provided a description of each microenvironment change (Table 1) such that organizations can take into account contextual factors when interpreting our results.
CONCLUSION

This study is a first step in understanding long-term sustainability of our quality improvement work. Specifically, we found our initial improvement gains were robust despite multiple changes in the clinical microenvironment and that changes in physician staffing and physician responsibilities in a PED may be especially important to consider when planning future improvement initiatives. Our findings support the importance of higher reliability interventions, such as identification and utilization of existing patterns of behavior as being particularly high-yield for improvement teams striving to achieve sustained outcomes. Future research should focus on the long-term sustainability of outcomes resulting from improvement work taking into account the organizational characteristics and processes that both enhance and inhibit sustainability, such as those outlined by the Institute for Healthcare Improvement. Understanding sustainability and its drivers is key to transforming the quality of care we provide to patients and families.
APPENDIX

Figure 1. Process map for IV Opioid Process

1. Triage nurse recognizes clinically apparent fracture
2. Patient transported to dedicated space with IV equipment
3. Telecommunication page sent to PED care providers
4. PED care providers gather to assess injury & pain
5. IV catheter placed & IV opioid delivered
Figure 2: Proportion of patients with long-bone extremity fractures who received intranasal fentanyl
Figure 3. Proportion of patients with long-bone extremity fractures who received their first dose of IV opioid within 45 minutes of arrival (p-chart)
Figure 4. Proportion of patients with long-bone extremity fractures who received IV access for one dose of opioid (p-chart)
Table 1. Changes in the clinical microenvironment

<table>
<thead>
<tr>
<th>Microenvironment Change</th>
<th>Start date</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IV Opioid Process Implementation</td>
<td>October 2007</td>
<td>The original intervention (Iyer et al).\textsuperscript{10}</td>
</tr>
<tr>
<td><strong>Subsequent IV Opioid Process Changes</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Physician Change</td>
<td>January 2009</td>
<td>Physician provider changed from an independent provider to resident-faculty physician pairs.</td>
</tr>
<tr>
<td>Location Change</td>
<td>May 2013</td>
<td>Changed from the shock-trauma suite to a triage room.</td>
</tr>
<tr>
<td><strong>ED Fast Track Implementation</strong></td>
<td>May 2011</td>
<td>A section of the main PED was dedicated to the care of lower acuity injuries and illnesses.</td>
</tr>
<tr>
<td>Faculty Staffing Change</td>
<td>September 2012</td>
<td>Additional faculty-level staffing was implemented with staggered start times in an effort to expedite patient flow through the major care section of the PED.</td>
</tr>
<tr>
<td><strong>Rapid Intervention Pager QI Project</strong></td>
<td>February 2013</td>
<td>QI intervention to initiate goal-oriented care for status asthmaticus, migraine headache, sickle cell vaso-occlusive pain, testicular pain and gastrostomy tube replacement.</td>
</tr>
<tr>
<td>Sepsis Triage QI Project</td>
<td>June 2013</td>
<td>QI project designed to rapidly triage and bring physician-level providers to the bedside of potentially septic high-risk patients.</td>
</tr>
<tr>
<td><strong>Urgent Care Opening</strong></td>
<td>July 2013</td>
<td>The ED Fast Track was replaced by an urgent care facility located on the same campus as the PED, but in a separate location.</td>
</tr>
</tbody>
</table>
Table 2. Demographics of patients with long-bone extremity fractures in the study population by year

<table>
<thead>
<tr>
<th></th>
<th>2007 (n=610)</th>
<th>2008 (n=656)</th>
<th>2009 (n=532)</th>
<th>2010 (n=712)</th>
<th>2011 (n=629)</th>
<th>2012 (n=715)</th>
<th>2013 (n=712)</th>
<th>2014* (n=335)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean age, year (SD)</td>
<td>8.6 (± 4.2)</td>
<td>8.4 (± 4.3)</td>
<td>8.5 (± 4.5)</td>
<td>9.0 (± 4.2)</td>
<td>9.1 (± 4.4)</td>
<td>9.1 (± 4.4)</td>
<td>9.0 (± 4.3)</td>
<td></td>
</tr>
<tr>
<td>Sex, % male</td>
<td>66</td>
<td>64</td>
<td>65</td>
<td>65</td>
<td>70</td>
<td>66</td>
<td>68</td>
<td>67</td>
</tr>
<tr>
<td>Race, %</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>79</td>
<td>75</td>
<td>73</td>
<td>81</td>
<td>77</td>
<td>74</td>
<td>77</td>
<td>78</td>
</tr>
<tr>
<td>Black</td>
<td>15</td>
<td>16</td>
<td>18</td>
<td>14</td>
<td>16</td>
<td>15</td>
<td>14</td>
<td>14</td>
</tr>
<tr>
<td>Other</td>
<td>7</td>
<td>10</td>
<td>9</td>
<td>5</td>
<td>7</td>
<td>10</td>
<td>9</td>
<td>9</td>
</tr>
</tbody>
</table>

*Only data from January 1 to June 30, 2014 are included.

Table 3. The independent association of each microenvironment change with the proportion of patients receiving IV opioids within 45 minutes

<table>
<thead>
<tr>
<th>Microenvironment change</th>
<th>Indicator Variable Denoting Implementation</th>
<th>Linear Trend Variable Post-implementation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Regression Coefficient*</td>
<td>p-value</td>
</tr>
<tr>
<td>IV Opioid Process: Location Change</td>
<td>6.10</td>
<td>0.24</td>
</tr>
<tr>
<td>IV Opioid Process: Physician Change</td>
<td>-11.90</td>
<td>0.01</td>
</tr>
<tr>
<td>ED Fast Track Implementation</td>
<td>-3.76</td>
<td>0.32</td>
</tr>
<tr>
<td>Urgent Care / Sepsis Triage**</td>
<td>6.17</td>
<td>0.27</td>
</tr>
<tr>
<td>Rapid Intervention Pager</td>
<td>2.50</td>
<td>0.60</td>
</tr>
<tr>
<td>Faculty Staffing Change</td>
<td>10.30</td>
<td>0.02</td>
</tr>
</tbody>
</table>

* Each model contained a variable denoting the number of months since the study start and variables to control for the initial implementation of the IV opioid process and intranasal fentanyl use

**These two microenvironment changes were implemented during the same month.
Table 4. Final model describing microenvironment changes associated with the proportion of patients receiving IV opioids within 45 minutes

<table>
<thead>
<tr>
<th>Variable</th>
<th>Regression Coefficient</th>
<th>95% Confidence Interval</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall trend: Months since study start</td>
<td>0.5</td>
<td>-1.4, 2.4</td>
<td>0.62</td>
</tr>
<tr>
<td>Initial IV Opioid Process Implementation by Iyer et al(^{10})</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Implementation Indicator</td>
<td>28.1</td>
<td>15.8, 40.5</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Post-implementation Trend</td>
<td>1.2</td>
<td>-1.0, 3.3</td>
<td>0.29</td>
</tr>
<tr>
<td>IV Opioid Process Physician Change</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Implementation Indicator</td>
<td>-9.6</td>
<td>-18.4, -0.7</td>
<td>0.04</td>
</tr>
<tr>
<td>Post-implementation Trend</td>
<td>-1.7</td>
<td>-2.5, -0.6</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Faculty Staffing Change</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Implementation Indicator</td>
<td>11.8</td>
<td>3.8, 19.9</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Post-implementation Trend</td>
<td>-0.3</td>
<td>-0.8, 0.3</td>
<td>0.37</td>
</tr>
<tr>
<td>% Patients Receiving Intranasal Fentanyl</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Linear term</td>
<td>-1.8</td>
<td>-3.0, -0.5</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Quadratic term</td>
<td>0.1</td>
<td>0.02, 0.14</td>
<td>&lt;0.01</td>
</tr>
</tbody>
</table>

Table 5. Diagnoses of patients without acute long-bone extremity fractures who were triaged to the IV opioid process

<table>
<thead>
<tr>
<th>Diagnosis</th>
<th>Percent of Patients (N=211)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Joint dislocation, effusion, or sprain</td>
<td>37 %</td>
</tr>
<tr>
<td>Non-specific injury code</td>
<td>20 %</td>
</tr>
<tr>
<td>Soft tissue injury</td>
<td>12 %</td>
</tr>
<tr>
<td>Phalanx injury</td>
<td>11 %</td>
</tr>
<tr>
<td>Other fractures</td>
<td>11 %</td>
</tr>
<tr>
<td>Pain diagnosis</td>
<td>8 %</td>
</tr>
<tr>
<td>Non-pain, Non-injury codes</td>
<td>1 %</td>
</tr>
</tbody>
</table>
REFERENCES


