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Intravenous Pump Guardrail Usage Optimization at a Tribal Health Facility

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ABSTRACT

Introduction: Most medication errors can be prevented through safe medication practices; however, some errors are caused by a combination of human and technical risk factors. Smart infusion pumps combine technology and drug libraries to limit errors.

Objective: The purpose of this study is to optimize guardrail usage following the best practice standards set by the Institute for Safe Medication Practices.

Methods: This is a single-center, retrospective, quality improvement project conducted at Tuba City Regional Health Care Corporation. Data was obtained using an analytics program from April 1, 2023, to September 30, 2023, and guardrail changes were made using a quality improvement software.

Results: After assessing the number of infusions run with and without guardrails, it was determined that only 20% of the hospital units evaluated were at or above goal. The drug library is overridden for about 10% of infusions each month. The infusion pumps were reprogrammed an average of 44 times per month. There were 25 total good catches, with decimal point error being the most common. A survey was emailed to nursing staff to assess barriers to the use of guardrails and the results revealed that guardrails never or less than 25% prevent running the medication at the prescribed rate, 60% never override the drug library, and 70% have either received inadequate training or no training at all.

Conclusion: Optimizing guardrail usage by updating the drug library frequently, providing continuous education to staff, and asking for feedback regularly will increase compliance, reduce medication errors, and improve patient safety.

Keywords: Medication Safety, Quality Improvement, Information Technology, Smart Infusion Pump, Drug Library

Introduction

Tuba City Regional Health Care Corporation (TCRHCC) is a 73-bed regional hospital with 2 satellite outpatient clinics in Flagstaff, AZ and LeChee, AZ. TCRHCC provides services to a 6,000 square mile area of the Navajo, Hopi, and Paiute Reservations. TCRHCC is an acute care facility, an outpatient clinic, and since 2016 has been the only Level III Trauma Center serving Native Americans outside of Anchorage, Alaska. TCRHCC provides numerous medical services, such as family medicine, internal medicine, dermatology, pediatrics, ophthalmology, orthopedics, OB/GYN, dentistry, physical therapy, public health nursing services, urology, primary care, behavioral health, ancillary services, and oncology. Specialists in Nephrology and Rheumatology conduct clinics onsite. There is also a 24-hour emergency room, as well as surgical services.

Most medication errors can be prevented through safe medication practices; however, some errors are caused by a combination of human and technical risk factors such as fatigue, distraction, drug library overrides, deficiencies, or misuse. Smart infusion pumps combine technology and drug libraries to limit errors. A 2016 study found that 10% of medication errors were related to smart pump non-compliance, which included overriding the pump and bypassing the drug library.

The purpose of this study is to optimize guardrail usage following the best practice standards set by the Institute for Safe Medication Practices (ISMP). The goal is to maximize guardrail compliance to 95% or greater for the administration of medication infusions.

Methods

This is a single-center, retrospective, quality improvement project conducted at Tuba City Regional Health Care Corporation. This study was IRB exempt. Data was obtained through the use of an analytics program from April 1, 2023, to September 30, 2023, and guardrail changes were made using a quality improvement software. Specialty Care Clinic medications, including hematology and oncology medications, were excluded. Metrics were used to report guardrail appropriateness, infusions run with and without utilization of guardrails, drug library overrides, and medication errors. Guardrail appropriateness is defined as soft and hard limits that were correct versus incorrect. Good catches and reprograms were used as an indicator for a potential medication error. Good catches are infusions that have been reprogrammed due to a decimal point, double digit, high-rate, rate dose, or zero decimal point error alert. Reprogram is defined as an infusion that was reprogrammed upon receiving a soft or hard minimum or maximum alert before being administered. Through an interdisciplinary approach, pharmacy and nursing determined solutions to identified barriers from a survey sent to nursing staff. The survey assessed how often the guardrails prevent them from running the medication at the prescribed rate, how often they override the drug library, which drug prevents them from running the medication at the prescribed rate or which drug they override the most, how adequate the training was they received on using guardrails, and general feedback on how to improve the drug library.

Results

There is a total of 162 non-hazardous and 7 hazardous medications in the current drug library. Originally, the plan was to update the entire drug library. The facility is currently in the process of switching smart infusion pumps, therefore, 12 drugs were identified and updated in the current drug library. The drugs were identified using feedback from the survey sent to nursing staff as well as feedback from quarterly reports that showed the top 5 drugs that were overridden the most and why. The drugs that were identified and updated include ampicillin, dexmedetomidine, fentanyl, nitroglycerin, norepinephrine, penicillin G, phenylephrine, piperacillin/tazobactam, propofol, remifentanil, thiamine, and vasopressin. Remifentanil was removed from the drug library as it's no longer on formulary nor is the drug in house. Out of the 11 other drugs, 10 drugs required updates. Updates included changing the drug name as well as increasing or decreasing the hard and soft minimum and maximum for the dose limits, bolus dose limits, concentration limits, and administration rate limits. Guardrails were within the limits suggested by literature but were too narrow for the facility's practice was a trend noted while reviewing the drug library.

After assessing the number of infusions run with and without guardrails, it was determined that only 20% of the hospital units evaluated were at or above goal between April 1, 2023, to September 30, 2023. The monthly average compliance rate in the Adult Care Unit (ACU) was 80%. The monthly average compliance rate in the Intensive Care Unit (ICU) was 70%. The monthly average compliance rate is the Pediatric Care Unit (PCU) was 78%. The monthly average compliance rate in the Nursey was 95%. The monthly average compliance rate in the Obstetrics (OB) Unit was 63%.

The drug library is overridden for about 10% of infusions each month. In April 2023, there were 2,702 total guardrail infusions run with 362 (13.4%) infusions overridden. In May 2023, there were 2,932 total guardrail infusions run with 366 (12.5%) infusions overridden. In June 2023, there were 2,989 total guardrail infusions run with 300 (10%) infusions overridden. In July 2023, there were 3,262 total guardrail infusions run with 352 (10.8%) infusions overridden. In August 2023, there were 2,953 total guardrail infusions run with 295 (10%) infusions overridden. In September 2023, there were 2,937 total guardrail infusions run with 353 (12%) infusions overridden.

Reprograms and good catches were used as indicators for a potential medication error. The infusion pumps were reprogrammed for a total of 261 times between April 1, 2023, to September 30, 2023, with the pump being reprogrammed an average of 44 times per month. There were 25 total good catches, with an average of 4 per month. Decimal point error was the most common good catch.

A 7-question survey was emailed to frontline nursing staff to assess the barriers to the use of guardrails and the results are as follows: 40% of respondents work in the Emergency Department, followed by 30% in the PCU, and 30% in the ACU, guardrails never or less than 25% prevent nursing from running the medication at the prescribed rate, 60% never override the drug library, and 70% have either received inadequate guardrail training or no training at all. Additional feedback received included provide education on entering pediatric doses and rates into the smart pump as well as review and update the drug library annually.

Discussion

The purpose of this quality improvement project was to optimize guardrail usage following the best practice standards set by the ISMP. Per ISMP, the guardrail compliance goal is 95%. The results of this study revealed that only 20% of the units evaluated were at or above goal between April 1, 2023, to September 30, 2023, with the biggest barrier being that nursing staff has either received inadequate guardrail training or no training at all. The results from this study suggest that a continuous education plan is needed to increase awareness and adherence to using guardrails while infusing intravenous (IV) medications. Additionally, there should be a plan in place to review and update the guardrails annually. The next steps of this project include deployment of guardrails to our current smart infusion pumps, updating and building the drug library for the smart infusion pumps the facility is switching too, and providing education to staff. Once completed, the survey should be resent to nursing staff to reassess the barriers to use of guardrails using the new smart infusion pumps. Study limitations include analytics program, time, and small sample size.

Conclusion

Most medication errors can be prevented through safe medication practices. Optimizing guardrail usage by updating the drug library frequently, providing continuous education to staff, and asking for feedback regularly will increase compliance, reduce medication errors, and improve patient safety.

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Appendix A: Barriers to Guardrails Survey

1. Please select which unit you most often work in.

- ACU North
- ACU/ICU South
- Emergency Department
- OB
- OR
- PACU/Same Day Surgery
- PCU

2. How often do guardrails prevent you from running the medication at the prescribed rate?

- Greater than 75%
- 50% to 75%
- 25% to 50%
- Less than 25%
- Never

Please list which drug prevents you from running the medication at the prescribed rate the most: _____

3. How often do you override the drug library?

- Greater than 75%
- 50% to 75%
- 25% to 50%
- Less than 25%
- Never

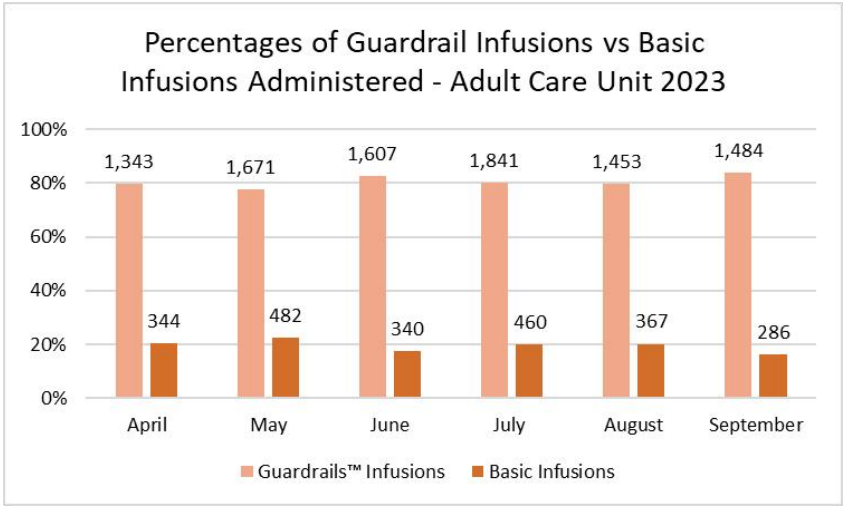
Please list which drug you override most often: _____

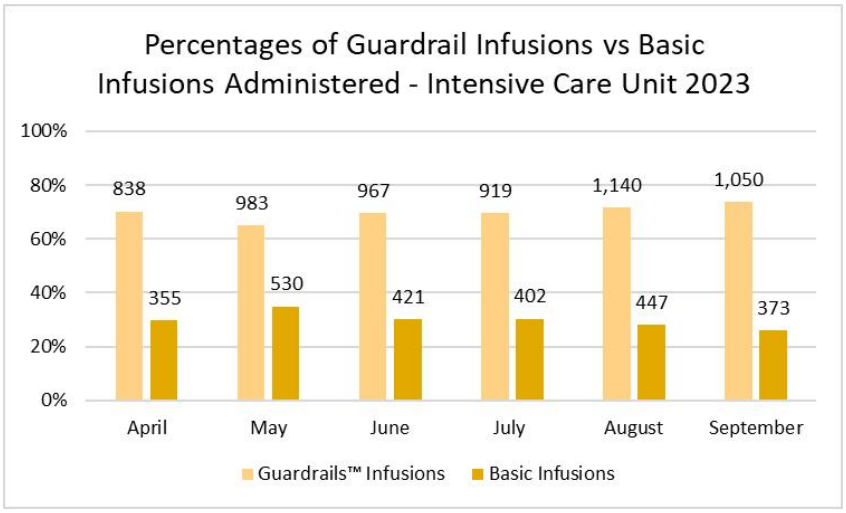
4. The training or education I received on using guardrails was:

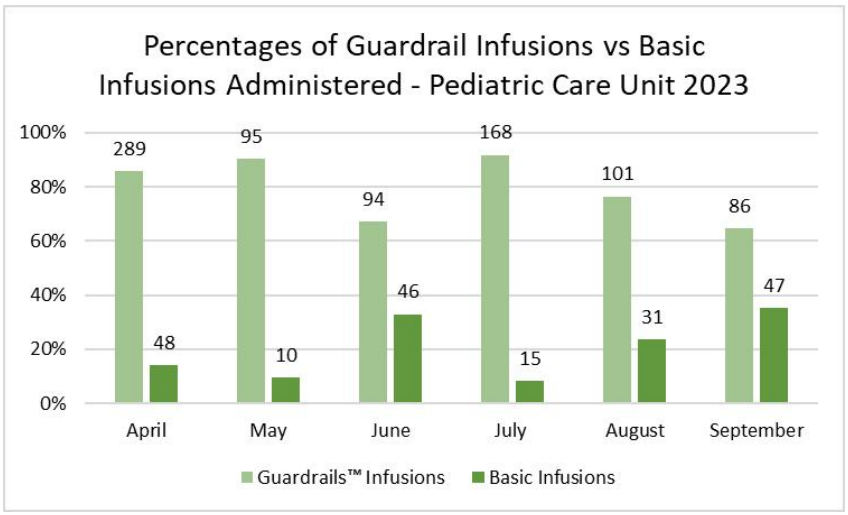
- Adequate
- Not Adequate
- I didn't receive training or education

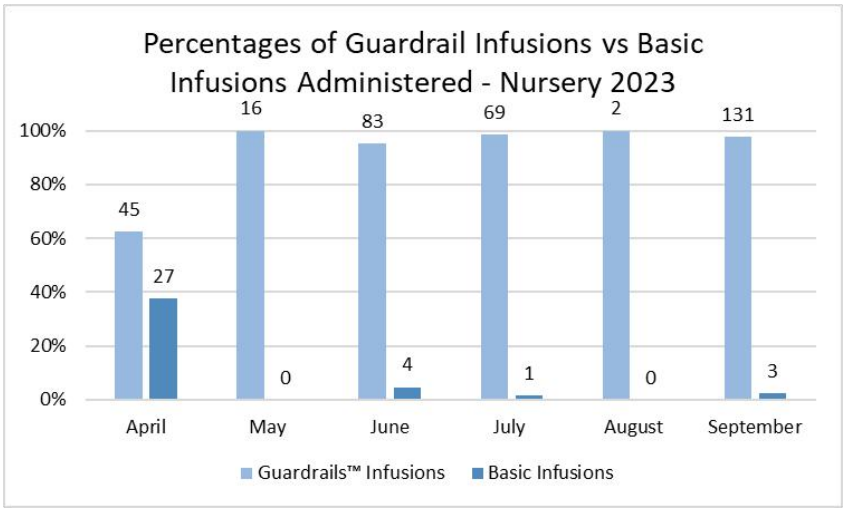
5. We are working to include all missing drugs and concentrations in the library. We are also working to make sure all guardrail alerts are appropriate and meaningful. Please provide any feedback below on the current library.

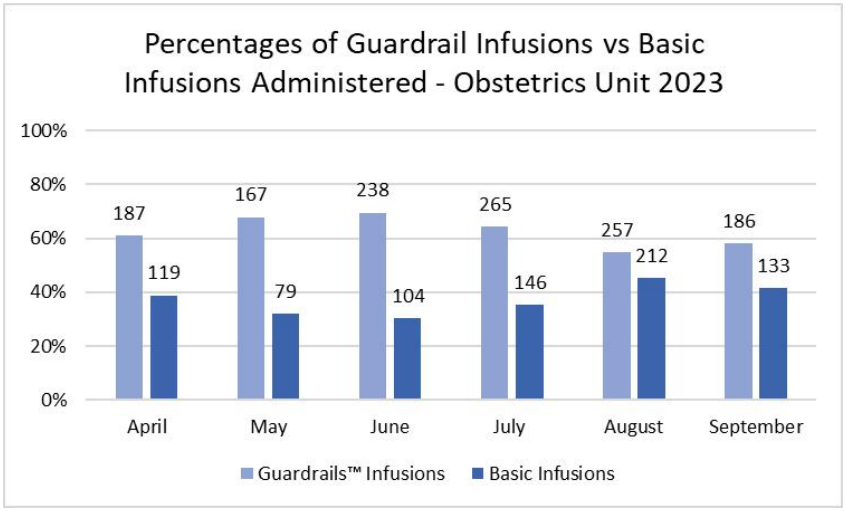
Appendix B: Guardrail Infusions vs Basic Infusions



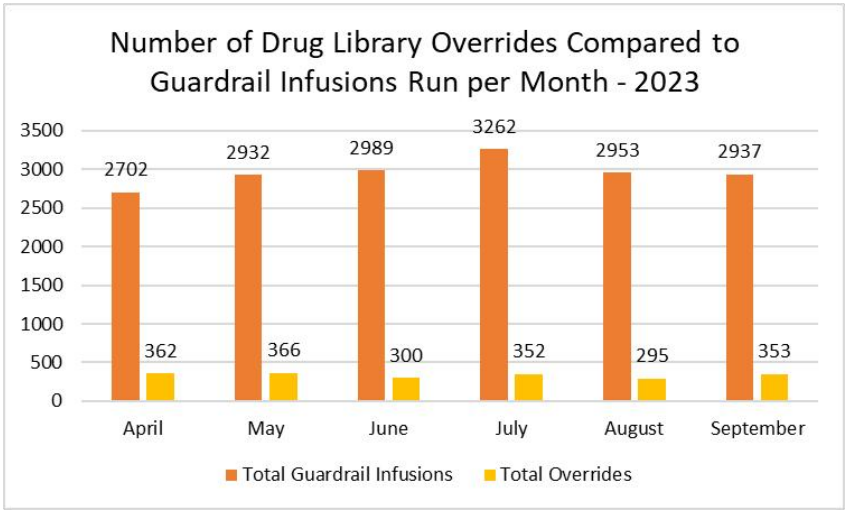




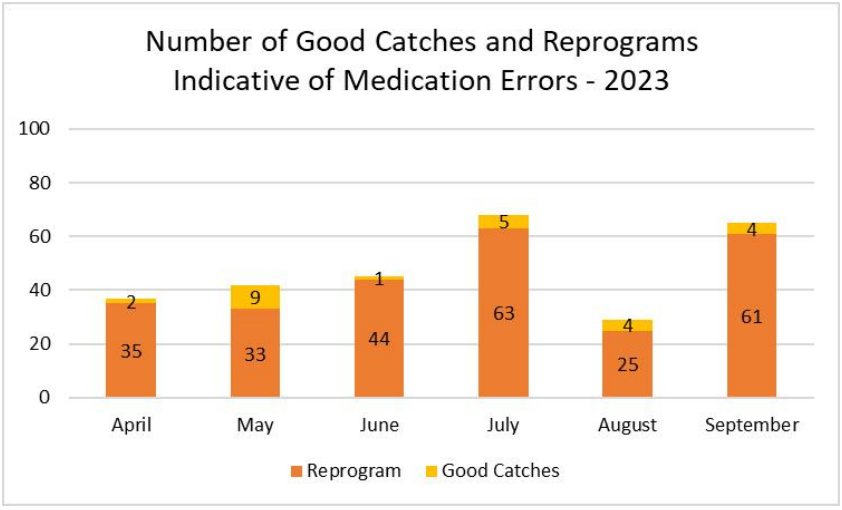




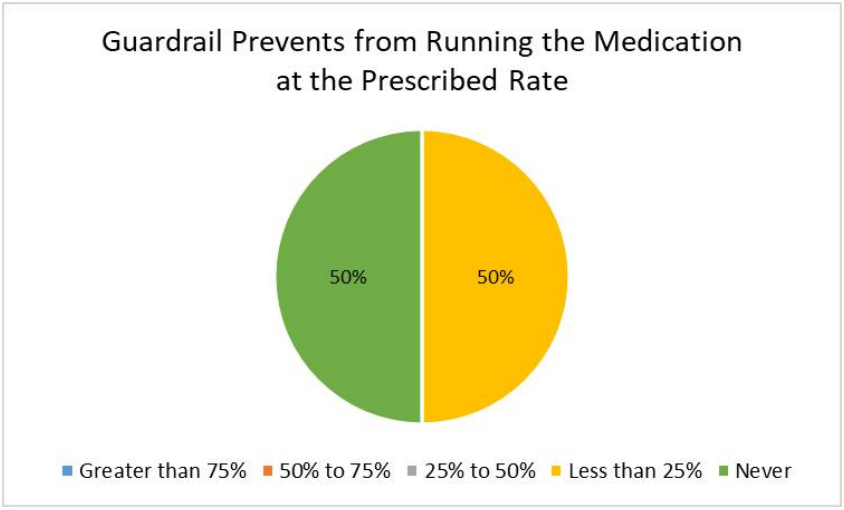
Appendix C: Drug Library Overrides

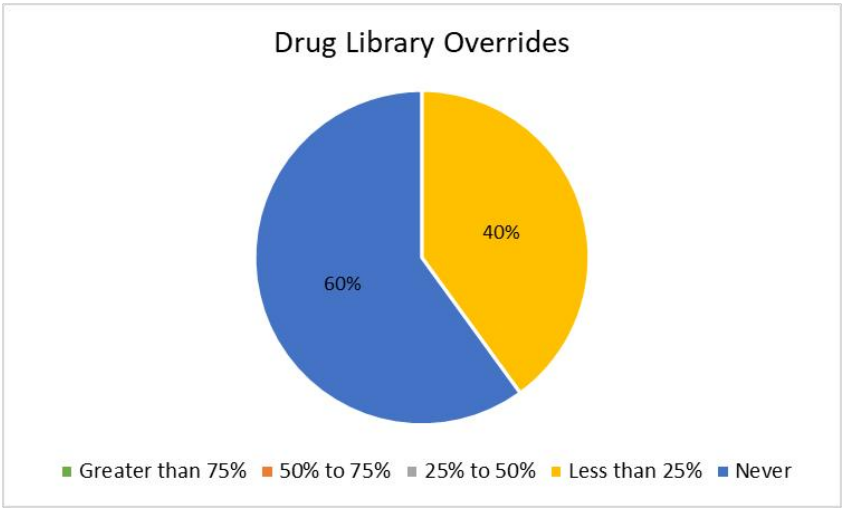


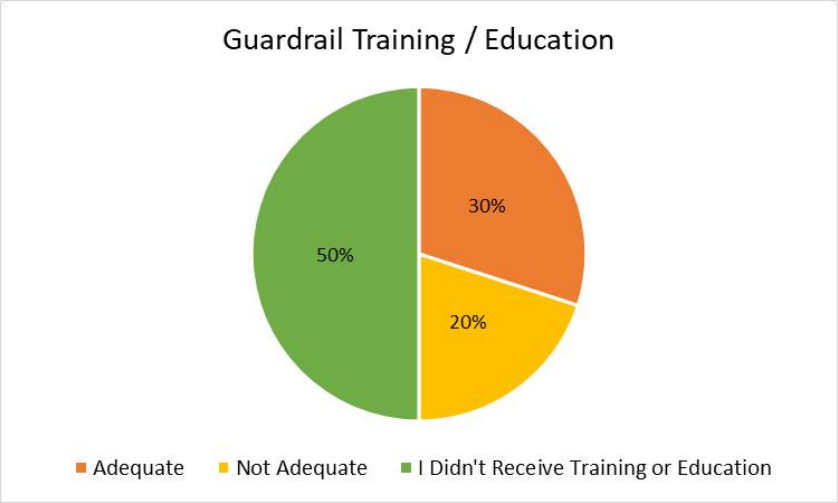
Appendix D: Reprograms and Good Catches



Appendix E: Barriers to Guardrails Survey Results






Guardrail Training / Education
30%
20%
50%
Adequate
Not Adequate
I Didn't Receive Training or Education