Educating Pediatric Registered Nurses on the Administration of Prolonged Intravenous Antibiotics

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Educating Pediatric Registered Nurses on the Administration of Prolonged Intravenous Antibiotics

Kasandra Rezler

School of Nursing and Health Professions, University of San Francisco

NURS 670: RN-CNL Internship

Dr. Nicole Beamish, DNP, PHN, FNP-BC, CNL, BC-ADM

April 28, 2024
Abstract

Problem  According to Children’s Hospital A's incident reporting system, 50% of problems related to prolonged intravenous antibiotics were classified as administration issues. When mistakes are made in this process, the antibiotic is then delivered at the wrong rate or the wrong time, which is problematic. Additionally, findings from a needs assessment survey highlight a critical need for targeted interventions, such as an educational video, to reduce administration errors associated with prolonged IV antibiotics. Context  Within Children’s Hospital A, the microsystems targeted by this quality improvement project consist of inpatient pediatric patient care units (PCU) 300, 360, and 400. Children’s Hospital A is a 361-bed hospital located in the San Francisco Bay Area.

Interventions  On April 11, 2024, 91 nurses and nurse managers gathered for an in-person staff meeting, where the quality improvement project was presented. The presentation defined prolonged IV antibiotics and their rationale. A 5-minute and 40-second video demonstrating the correct setup of prolonged IV antibiotics was shown, filmed in Children Hospital A’s simulation lab. Measures  A pre-video quiz assessed attendees’ baseline knowledge. A post-video quiz evaluated the impact of the educational video on attendees’ knowledge. Results  86.95% of nurses answered the pre-video quiz questions correctly, while 95.45% answered the post-video quiz questions correctly, indicating an 8.5% increase in knowledge. Conclusions  This quality improvement project comprehensively evaluated the microsystem, identified the issue, conducted root-cause analysis and needs assessment, analyzed data, developed an educational tool, and seamlessly implemented it, resulting in increased knowledge among staff. The educational tool is cost-effective, time-efficient, easily accessible, and adaptable, ensuring sustainability. Ongoing
evaluation using iCares data will assess long-term impacts and ensure the video's continued effectiveness through biannual reviews.

Children’s Hospital A defines extended infusion (or prolonged infusion) as medication administration over three to four hours as opposed to standard infusions which may be intermittent (over 30-60 minute administration time) or continuous (over 24 hours). The reasoning behind using prolonged intravenous (IV) antibiotics is to increase the effectiveness of beta-lactam antibiotics by allowing the antibiotics to remain in the patient’s system longer, enhancing antibiotic activity and improving patient outcomes. These medications are administered differently than intermittent antibiotics. When administering prolonged IV antibiotics, a new straight-set tubing without ports must be used and primed. The total volume of the medication is then programmed into the IV pump. The rationale behind priming the straight set is that the medication is run over at such a slow rate that if the medication is not primed into the tubing it would take a long time for the medication to reach the patient. Then, the RN should flush the rest of the medication that is in the line. These instructions are written out on Children’s Hospital A’s “tipsheets” (see Appendix A).

When mistakes are made in this process, the antibiotic is then delivered at the wrong rate or the wrong time, which is problematic. For example, beta-lactam antibiotics operate on time-dependent pharmacodynamics. It's essential to maintain consistent antibiotic levels, prioritizing steadiness over high peak concentrations, to effectively combat infections caused by susceptible bacteria. As an alternative to conventional intermittent dosing, continuous administration has been proposed to better optimize the pharmacokinetic/pharmacodynamic characteristics of beta-lactams (Mohd et al., 2012). In other words, prolonged infusions can improve clinical outcomes, if given correctly.
When antibiotics are not given or taken as ordered, consequences occur. One of the most significant concerns is the occurrence of antibiotic resistance. The Centers for Disease Control and Prevention (CDC) (2022) reports that when antibiotics are not used properly, bacteria can adapt and become resistant to the drugs meant to kill them. This can lead to infections that are more difficult, or even impossible to treat, which is a serious threat to public health. In fact, each year, the United States experiences over 2.8 million infections that are resistant to antimicrobial treatments, leading to the deaths of more than 35,000 individuals (CDC, 2022). Another consequence of improper antibiotic administration is the onset of severe adverse effects, affecting approximately 20% of hospitalized patients who are prescribed them (Tamma et al., 2017). Although prompt administration of antibiotics is crucial for treating infections and preventing complications like sepsis, research indicates that in U.S. acute care hospitals, around 30% of all antibiotics prescribed may be avoidable or not optimally prescribed (Fridkin et al., 2014). The misuse of antibiotics can extend its negative impact beyond individual patients, contributing to the spread of resistant organisms and conditions like Clostridium difficile infection, even among patients who haven't directly received antibiotics (Brown et al., 2015). It is crucial to ensure the correct administration of prolonged IV antibiotics to prevent these adverse consequences from occurring.

**Problem description**

Children’s Hospital A is a 361-bed hospital located in the San Francisco Bay Area. Within Children’s Hospital A, the microsystem targeted by this quality improvement project consists of inpatient pediatric patient care units (PCU) 300, 360, and 400. PCU 300’s patient population typically consists of postoperative organ transplants, gastrointestinal issues, and renal issues. PCU 400 typically cares for neurology, orthopedic, respiratory, general surgery, or
endocrine patients. PCU 360 provides care for stable patients across these specialties. Together, these units accommodate approximately 60-70 pediatric patients at a time. These acute care units utilize prolonged IV antibiotics and the registered nurses working on these units are expected to know how to properly administer these medications. However, there have been reported errors with the setup and administration of prolonged IV antibiotics.

According to Children’s Hospital A incident reporting system or “iCares” data obtained from November 2021 to February 2024, 36.4% of the reports regarding prolonged IV antibiotics came from PCU 300, 31.8% of reports came from PCU 400, and 18.2% came from PCU 360. The remainder 4.5% came from in-patient pharmacy. When classifying the reports, 50% of the problems were classified as administration issues, 31.8% were classified under IV access issues, 9.1% of problems were adverse drug reactions, and 9.1% were dispensing/pharmacy issues. These iCares reports were consistent with the observations reported by the clinical practice quality specialist (CPQS) at Children’s Hospital A.

Additionally, an anonymous survey was conducted as a needs assessment and to evaluate the baseline knowledge of prolonged IV antibiotics among registered nurses on PCU 300, 360, and 400 (see Appendix B). A total of 55 responses were collected, with 56.4% of respondents having less than 5 years of RN experience. Among the respondents, 45.5% were from PCU 400, 30.9% from PCU 300, 16.4% from PCU 360, and 7.3% from a float pool. Approximately half of the respondents worked day shifts, while the other half worked night shifts, with a few rotating between the two. 38.2% of respondents strongly agreed with the statement, “I feel confident in setting up and administering prolonged IV antibiotics.” The remaining 47.3% agreed, 12.7% felt neutral, and 1.8% disagreed with the statement. In terms of training, 52.7% received hands-on in-person training, 38.2% used the M.E.O.W. or tip sheet, and 9.1% reported receiving no training.
Additionally, 41.8% had reported that they had never seen the tipsheet. When asked about preferred educational tools to reduce errors related to prolonged IV antibiotics, 34.5% favored educational videos, 29.1% preferred educational videos with a checklist, 20% wanted a step-by-step poster board, and 16.4% desired an updated tip sheet. The findings indicate the critical need for targeted interventions, such as an educational video to reduce administration errors linked to prolonged IV antibiotics.

Available knowledge

PICOT Question

A Population, Intervention, Comparison, Outcome, and Time frame (PICOT) question was formed to lead the process of searching through available literature on prolonged intravenous antibiotics. The following PICOT question was developed: In inpatient pediatric registered nurses (P), how does nurse education (I) affect the number of medication errors related to the setup and administration of prolonged IV antibiotics (O) over four months (T)?

Search Methodology:

Using PubMed and CINAHL databases, a review of existing literature was done from January to February 2024. To initiate the search for evidence, the following keywords were used: pediatric, intravenous antibiotics, IV prolonged antibiotics, extended infusion of antibiotics, continuous infusion of antibiotics, nursing education video, nursing, β-lactam antibiotics intravenous, and intravenous medication errors. Additional exclusion criteria were applied, specifying "within the past 10 years," although the oldest article included in this review was from 2018. Priority was given if the articles included a pediatric patient population, however, there were very few articles that exclusively discussed pediatric patients on prolonged antibiotics. This search strategy revealed peer-reviewed articles that directly address the PICOT question by
connecting the appropriate population, interventions, and outcomes. Abstracts were read, and ten relevant articles were selected. Using the Johns Hopkins Nursing Evidence-Based Practice methodology, the articles were critically appraised (see Appendix C)(Dang et al., 2022). A key strength in synthesizing literature lies in the incorporation of a diverse range of studies, ranging from case studies to both qualitative and quantitative research. This comprehensive method allows for a detailed analysis of the identified topic (Dang et al., 2022). Among the ten articles selected for final integration in this review, two were systematic reviews (Level I), three were quasi-experimental studies (Level II), three categorized as Level III (non-experimental, mixed-method non-experimental, and qualitative,); two classified as Level V (case studies and integrative reviews).

**Literature Review**

This discussion encompasses various journal articles related to prolonged IV antibiotics, medication administration errors, knowledge assessment surveys, and educational videos, summarizing the available knowledge on these topics. The evidence supports the use of prolonged IV antibiotics in pediatrics, especially in critically ill patients. However, for the antibiotics to work properly, they need to be given properly. Issues with IV access, antibiotic compatibility, antibiotic stabilization, dose calculations, and lack of familiarity with the medications can contribute to medication administration errors. The use of an educational video has been successful in improving clinical skills and it is a flexible option. A video educating RNs on the purpose of prolonged antibiotics and how to correctly administer prolonged antibiotics will benefit the patients and their health outcomes.

**Research Supporting the Use of Prolonged IV Antibiotics in Pediatric Patients**
Both Budai et al. (2023) and Imburgia et al. (2022) conducted reviews of pediatric medical literature on extended or continuous infusions of β-lactam antibiotics, highlighting their safety and efficacy in pediatric patients. They found that extended infusions were associated with decreased mortality rates and increased microbiological eradication, emphasizing the importance of proper administration techniques such as ensuring adequate IV access and antibiotic stability. The studies also emphasized the significance of extended infusions in achieving pharmacokinetic-pharmacodynamic targets and improving clinical outcomes, particularly in infections with elevated minimum inhibitory concentrations (MICs). The findings from both studies support the rationale that prolonged infusions are crucial for evidence-based practice (EBP) in pediatric care, highlighting the necessity for proper administration. This technical understanding, coupled with implementation considerations outlined in the studies, can be directly applied to Children’s Hospital A, ensuring effective utilization of prolonged antibiotics for critically ill pediatric patients.

**Research Supporting the Use of Prolonged IV Antibiotics in Critically Ill Patients**

Kondo et al. (2020) produced a meta-analysis and systematic review and meta-analysis demonstrating prolonged β-lactam antibiotic infusion concluded in enhanced cure rates without an increase in adverse events. Li et al. (2021) similarly concluded that prolonged intravenous antibiotics significantly reduced mortality and improved clinical outcomes in septic patients. Luo et al. (2019) emphasized the clinical advantages of continued antibiotic administration over an extended period, particularly in critically ill patients. Wu et al. (2021) associated continuous/extended infusions with improved patient outcomes, especially in critical septic shock cases, while Yu et al. (2018) recommended prolonged infusion for severe infections due to its higher clinical success rate and lower mortality. These findings emphasize the importance of
proper administration practices, including temperature control and loading dose utilization, which should be incorporated into education initiatives and clinical protocols at Children’s Hospital A to optimize patient care.

**Education Need**

The cross-sectional study conducted by Fawaz et al. (2020) revealed that while nurses possess adequate knowledge and confidence regarding prolonged infusion antibiotics, there's still an indicated need for additional education, especially in areas such as preparation and administration. Additionally, Coyne et al. (2018) found through an integrative review that blended learning, including concise video-assisted online resources, effectively enhances knowledge and offers flexibility. Therefore, integrating video demonstrations into nursing education can address knowledge gaps and enhance skills, ultimately contributing to safer and more effective patient care at Children’s Hospital A.

**Medication Errors in Hospitals**

Kuitunen et al. (2021) performed a systematic review encompassing 11 studies with the aim of investigating systemic factors contributing to intravenous medication errors within hospital settings. Their findings highlighted primary causes of IV medication errors, including inadequate measures to ensure the safe use of that are classified as high-alert, lack of familiarity with medications, errors in calculations, lapses in double-checking procedures, and making mistakes in medications that share similar appearances or names. Understanding these factors can inform preventive actions to mitigate systemic medication errors at Children’s Hospital A. Notably, this study did not include randomized controlled trials and the reliance on self-reporting for error detection raises concerns about potential underreporting of errors (Kuitunen et al., 2021).
Rationale

Lippitt’s Change Theory can guide quality improvement for prolonged antibiotic setup and administration at Children’s Hospital A. This theory, commonly used by nurses, provides a framework for implementing evidence-based changes in microsystems to enhance processes. A strength of this change theory is its alignment with the four stages of the nursing process: assessment, planning, implementation, and evaluation (Mitchell, 2013). The students and CPQS at Children’s Hospital A will follow the seven steps to assess the microsystem, diagnose the problem, synthesize a plan to implement change into the microsystem, pilot the change, and evaluate if the change is successful and can efficiently operate in the microsystem.

Lippitt’s Change Theory consists of seven steps: The first phase is evaluating and then diagnosing the problem at hand. The second is determining the motivation and ability for change, evaluating the resources available for change, and developing a relationship between the system and the change agent. During this phase, it's essential to establish a collaborative relationship between the system and the change agent, who could be internal personnel like nurse managers or external consultants (Mitchell, 2013). In this case, the change agents would be internal and external personnel as nurses from Children’s Hospital A and students from the University of San Francisco will be working together to implement change at Children’s Hospital A. Moving forward, the third phase involves assessing the change agent’s motivation, materials, experience, and dedication (Swanson & Andresen, 2023). The fourth step is planning out the change, setting goals, creating timelines, assigning roles, and developing strategies. The next step is testing the change which can be done with a pilot program in a smaller setting and then reassessing and gathering feedback and data. The sixth step is making appropriate adjustments and then
implementing the change into the microsystem. The last is ensuring that the change is stable in the microsystem without the change agent present (Swanson & Andresen, 2023).

**Ethical Considerations**

This project adheres to the criteria for an evidence-based quality improvement initiative. As no research was conducted, IRB review was deemed unnecessary. To validate this quality improvement endeavor, a Statement of Non-Research Determination (SONRD) form was completed, as detailed in Appendix D. Additionally, the project received review and approval from the clinical staff at the University of San Francisco School of Nursing and Health Professions. No external funding was obtained for this project, and all project group members stated no conflicts of interest.

This quality improvement project aligns with provision three of the American Nurses Association Code of Ethics for Nurses, as it seeks to enhance the safety and quality of care. This provision emphasizes the nurse's role in promoting, advocating, and safeguarding the rights, health, and safety of the patient (American Association of Colleges of Nursing, 2013). In this case, the quality improvement team worked to promote the education of the nurses to prevent medication administration errors from occurring, ensuring safety and better outcomes for the patient. This project also complements the University of San Francisco’s Jesuit values. More specifically, community-engaged learning, as this project is being implemented in a real hospital located within the University of San Francisco’s community.

**Project AIM**

By April 2024, of pediatric registered nurses who administer prolonged IV antibiotics in Children’s Hospital A’s acute care units, there will be an overall 5% increase in self-reported knowledge of the correct setup and administration of prolonged IV antibiotics following the
receipt and intervention of a comprehensive educational video demonstration, ultimately decreasing length of stay and improved patient outcomes.

Methods

Context

The project ran from January to April 2024, with a Gantt chart serving as a timeline and task organizer (see Appendix E). The quality improvement project focused on inpatient care units (PCUs) 300, 360, and 400 at Children’s Hospital A. Children’s Hospital A is a 361-bed hospital located in the San Francisco Bay Area. This microsystem underwent assessment using the five P's (purpose, patients, professionals, process, and patterns) assessment tool (see Appendix F). These units serve pediatric patients and their families, accommodating approximately 60-70 patients collectively. A multidisciplinary team collaborates within the microsystem, addressing variances in processes and patterns, including decisions on prolonged antibiotic use and administration. Shift huddles promote communication and coordination among healthcare professionals, enhancing overall care delivery.

Fishbone RCA

The root cause analysis (RCA) using a fishbone diagram identified key factors contributing to errors in prolonged IV antibiotic setup and administration (see Appendix G). Causes were identified through unit observations, discussions with pediatric nurses and the CPQS, and a needs assessment survey. Findings include limited nurse training due to lack of resource access and hands-on training; discrepancies across units impacting practice consistency; decreased familiarity in units with lower patient volumes; inaccessible and outdated nurse tip sheets; methodological inconsistencies in preparation and administration; and equipment challenges.
Strengths, Weaknesses, Opportunities, and Threats (SWOT) Analysis

A SWOT analysis identifies internal strengths and weaknesses and external opportunities and threats of a project (see Appendix H). Children's Hospital A's strengths include access to tip sheets, comprehensive training programs, strong support structure, commitment to patient safety, and adequate staffing. Weaknesses include limited hands-on training, inconsistencies across units, and a lack of training for float and travel RNs. External opportunities include refining protocols, utilizing teaching hospital resources, and leveraging incident report tools. Being a Magnet hospital and commitment to evidence-based research are advantages. Threats include time constraints, staff survey fatigue, and resistance to policy adherence.

Cost-Benefit Analysis (CBA)

A cost-benefit analysis (CBA) is a tool used to weigh the potential expenses of implementing a change intervention against the anticipated benefits or savings it is expected to generate for the hospital. The cost to implement this project is $61,126.65 (see Appendix I). This amount was calculated based on the time spent by the Clinical Nurse Leader to plan and implement the intervention, totaling approximately 200 hours. According to data from Children’s Hospital A, the average nurse earns $117 per hour, plus an additional 35% in benefits, totaling $157.95 per hour. This results in a total cost of $31,590 for the Clinical Nurse Leader's time. Additionally, with 187 nurses in acute care requiring one hour each to watch the video, complete a post-video assessment, and practice/ask questions, the cost is $29,536.65. When combined, the total cost is $61,126.65.

The cost avoidance is calculated as $133,563.10. According to hospital data, the average length of stay is seven days, costing $6,071.05 per day. Based on a review by da Silva & Krishnamurthy (2016), medication errors typically add an extra 1-4 days to the hospital stay. For
this project, an average of two additional days was used. With eleven medication administration errors reported related to prolonged IV antibiotics, patients required an additional two days in the hospital. The current state costs $601,033.95 (11 patients x 9 days x $6,071.05), while the improved state aims for 7 days, costing $467,470.85 (11 patients x 7 days x $6,071.05). Therefore, the cost avoidance is $133,563.10, minus the implementation cost ($61,126.65), resulting in a cost saving of $72,436.45.

**Intervention**

On April 11, 2024, 91 nurses and nurse managers met for an in-person staff meeting, during which this quality improvement project was presented. The presentation defined prolonged antibiotics and explained the rationale behind their usage. Additionally, a four-question, pre-video quiz was administered to assess the baseline knowledge of the attendees (see Appendix J). Following this, a 5-minute and 40-second video demonstrating the suggested correct setup of prolonged IV antibiotics was shown. See Appendix K for the steps that were recommended and demonstrated in the video. The video was filmed in Children Hospital A’s simulation lab under the guidance of the clinical practice quality specialist and another experienced nurse. Finally, a post-video quiz consisting of seven questions was utilized to assess and gauge the impact of the educational video on the participants’ knowledge (see Appendix L).

**Study of the Intervention**

In this project, a Plan-Do-Study-Act (PDSA) cycle was utilized to plan, implement, and evaluate the educational intervention at Children’s Hospital A (see Appendix M). Initially, collaborative efforts with the microsystem’s leadership team aided in the formulation of a PICOT question and an aim statement, which served as guides for collecting research and data, making goals, and developing a plan. Utilizing the iCare data and conducting a needs assessment
through a survey utilizing QR codes allowed for a comprehensive analysis of current practices and identification of knowledge gaps. Afterward, an educational video was developed to address the gaps in the process of setting up and administering prolonged IV antibiotics. Prior to its presentation, registered nurses underwent a pre-video knowledge assessment quiz to establish a baseline understanding. Following the educational session, a post-video quiz was administered to assess any changes in knowledge. Through analysis of pre and post-video quiz results, the effectiveness of the intervention was evaluated, and compared to the established aim statement. Fortunately, the study yielded positive outcomes, affirming the intervention's success in improving registered nurses' knowledge. As a result, Children’s Hospital A will upload the educational video onto Sharepoint for all nurses to easily access. The video will also be used in nurse training orientations. Continued use of iCares data will assess the long-term impacts of the education while evaluating the video every six months ensuring its ongoing effectiveness.

**Outcome Measures**

The project's outcome measures relied on quiz responses from the microsystem’s registered nurses to evaluate the change in knowledge regarding the setup and administration of prolonged IV antibiotics. Initially, the pre-intervention quiz gathered quantitative data through closed-ended questions that required binary responses. Following the implementation of the intervention, which included showcasing an educational video illustrating the correct process alongside a PowerPoint presentation, a post-intervention survey was administered. This survey also collected quantitative data through closed-ended questions with binary responses. Additionally, two of the post-intervention quiz questions were the same as the needs assessment quiz. The results of the two questions were compared and there was a remarkable improvement
in the later quiz responses. Ongoing evaluation using iCares data will assess long-term impacts and ensure the video's continued effectiveness through biannual reviews.

**Results**

The survey conducted before and after the video demonstration aimed to assess nurses' understanding of administering prolonged IV antibiotics. Initially, 68.1% of nurses correctly answered that prolonged IV antibiotics cannot be mixed with another compatible antibiotic. However, after watching the video, this understanding significantly increased to 93.9%, reflecting a notable 25.8% improvement. Before the video, only 94.2% of nurses correctly identified primary (straight set) tubing without ports as suitable for infusing prolonged IV antibiotics. This understanding improved to 100% after the video, indicating a 5.8% increase in knowledge. Similarly, there was a slight improvement in knowledge regarding the next steps when the medication bag is near empty, with 95.5% of nurses correctly identifying the action as flushing with the bag, a 1.3% increase. Additionally, there was a 1% increase in understanding the timing of medication bag checks, with 92.4% of nurses now correctly identifying that checks should be conducted every hour during peripheral IV assessments. Overall, 86.95% of nurses answered the pre-video quiz questions correctly, while 95.45% answered the post-video quiz questions correctly, indicating an 8.5% increase in knowledge overall.

In the post-survey, three additional questions were posed to assess nurses' perceptions and confidence following the video demonstration. Among the respondents, 31.8% indicated that they found the video to be “absolutely essential” for their practice, while a larger portion, accounting for 48.5%, deemed it “helpful.” 53% of nurses strongly agreed and 47% agreed with the statement, “I understand the rationale behind the use of prolonged IV antibiotics”. 
Furthermore, a significant 66.7% of nurses strongly agreed that they felt confident in setting up and administering prolonged IV antibiotics.

**Discussion**

**Summary**

These results demonstrate the positive impact of the video demonstration in enhancing nurses' knowledge and understanding of administering prolonged IV antibiotics at Children’s Hospital A. With an overall increase of 8.5% in knowledge, this meets the aim statement’s goal of 5%. Comparing responses from over a month earlier to the present, there has been a notable shift in nurses’ perceptions regarding their understanding of the rationale behind the use of prolonged IV antibiotics. Initially, 35% strongly agreed and 42% agreed with the statement, “I understand the rationale behind the use of prolonged IV antibiotics”, while 18% felt neutral and 4% disagreed. However, after the intervention, there has been a considerable increase in confidence, with 53% strongly agreeing and 47% agreeing with the statement. This suggests a positive impact of the intervention on nurses’ comprehension and confidence in this aspect of their practice. The results regarding nurses’ confidence in setting up and administering prolonged IV antibiotics show a similar trend, indicating the success of the intervention.

**Limitations**

Several project limitations should be acknowledged. The primary limitations include the low survey response rate and the time constraint of three months. Despite having 187 nurses in acute care, the needs assessment survey only received 51 responses. This could be attributed to several factors, including the survey's limited availability (just over a week), challenges in reaching everyone due to varying schedules, and potential survey fatigue among nurses who may choose not to participate. Moreover, the review of iCares data was constrained by limited time,
with approximately three hours available to analyze three years' worth of data, and data were received late into the project. Due to time constraints, there was also no opportunity for a retrospective chart review. Additionally, not every nurse could attend the educational meeting, with only 91 out of 187 nurses able to participate in the pre-and post-video assessments. Another noteworthy aspect is the limited availability of literature specifically addressing the setup and administration procedures of prolonged IV antibiotics. Instead, research focused on medication errors in a more general sense. Additionally, there was a scarcity of data regarding specific monetary amounts when creating the budget, necessitating the use of averages and general medication error data.

Conclusion

This successful quality improvement project comprehensively evaluated the microsystem, identified the issue, conducted root-cause analysis and needs assessment, analyzed data, developed an educational tool, and seamlessly implemented it, resulting in increased knowledge among staff. The educational tool is cost-effective, time-efficient, easily accessible, and adaptable, ensuring sustainability. Children’s Hospital A plans to upload the educational video to Sharepoint for easy access by all nurses and incorporate it into nurse training orientations. Ongoing evaluation using iCares data will assess long-term impacts and ensure the video's continued effectiveness through biannual reviews.

References


Swanson, C., & Andresen, K. (2023). *Leading Change in Health Systems Strategies for RNBSN Students*. 5.1 theoretical approach to change [Link](https://pressbooks.uwf.edu/nursingleadership/chapter/4-3-implementing-change/)


https://doi.org/10.1371/journal.pone.0201667
Appendix A

Current Tip/M.E.O.W. Sheet

Extended Infusion of Antibiotics

Audience: Inpatient RNs who administer antibiotics via extended infusion

Objective(s)

Inpatient RNs will implement the administration of antibiotics via extended infusion as ordered.

Overview Statement

The Antimicrobial Stewardship Program is aimed at the careful use of antimicrobials to reduce potentially life-threatening Hospital Acquired Infections and prevent antibiotic-associated toxicity. Extended infusion of Beta-Lactam antibiotics increases their effectiveness by allowing the antibiotics to remain in the patient’s system longer, enhancing antibiotic activity and improving patient outcomes.

Definitions

Extended Infusion (aka prolonged infusion): medication administration over 3-4 hours

Standard infusion: may be intermittent (administration over 30-60 minutes) or continuous (administration over 24 hours)

Key Educational Points

- Starting the first extended dose 3-4 hours after loading dose or when switching from a standard infusion to an extended infusion helps to maintain the antibiotic concentration within the “kill zone.”
- Access and/or compatibility issues: discuss with provider any issues to weigh the benefits of extended infusion vs risks of starting a new line
- Access issues related to flush volumes should be evaluated on a case by case basis

Scenario #1: A new order for extended infusion of Cefepime requires starting the initial extended infusion at half the dosing interval:

Order: Cefepime 665mg IV q1h over 30 min, THEN Cefepime 665mg IV q 8hrs (infuse over 4 hrs)

Scenario #2: Changing a standard infusion to an extended infusion requires starting the initial extended infusion at half the dosing interval:

Order: Piperacillin/Tazobactam 4gm IV q 6hrs (infuse over 3 hrs)

November 2023

M.E.O.W

(Medication Education and Outreach Workgroup)

*Extended & Continuous Antibiotic Infusions*

**Extended Antibiotics (Infused over multiple hours)**

**Tidbits:**

- Prolonged Antibiotic infusions are indicated for many conditions, but especially CF.
- Order states how long infusion should be run over.
- There is a loading dose given over standard infusion time.
- Orders for loading and prolonged infusion dose are linked, but always follow the 7 rights of medication administration to make sure the right dose is given at the right time.

**Process:**

- Use new straight set tubing without ports (blue occlusion ball preferred) with each dose. Program total volume of med into pump as per order.
- Prime tubing with antibiotic.
  - **Rationale for Priming:** Extended Infusion Antibiotics are run over a SLOW rate. If Medication is not primed into tubing, it would take a long time for medication to reach patient.
- Pump will beep off when med bag is empty/dry and the occlusion ball reaches the empty chamber.
- Spike 50ml NS bag. (No need to change programmed volume in pump). Remaining volume will be the amount needed to “flush” the rest of the medication in the line/what is left of your total medication volume.

**Continuous Antibiotics (Infused over 24 hours)**

- Follow above procedure for priming and infusing antibiotic.
- May need a chaser fluid running concurrently if medication rate is below 10mls/hour and it is a central line.

November 2023 MEOW_Med Administration
M.E.O.W.

(Medication Education & Outreach Workgroup)

TOPIC: Extended Antibiotic Infusions (Over 3-4 hours) Date: 4/11/2023

Supplies: IV Antibiotic, Primary Tubing w/ blue ball without ports, and sterile drape, sterile gloves, gauze and filter (if infused through a central line) If IV antibiotic is infused through a PIV sterile technique is not required

1.) Spike Antibiotic bag with primary tubing and prime Antibiotic to end of the line (sterile prime and use a filter if being infused through a central line)
2.) Bring Antibiotic primed line into room, scan patient and medication
3.) On Alaris Pump, Click “Channel Select” → “Guardrail Drugs” and Program according to order (Antibiotic name, dosage, volume, and time infused)
4.) Connect primary line directly to patient’s PIV or Central Line. Press start and check for your drip
5.) After RN observes a drip confirming that the line is unclamped, press PAUSE
6.) Change volume on pump to NEW VOLUME (New Volume=Ordered Volume-25 ml)
7.) Press START, recheck for drip
8.) Pump will beep once NEW VOLUME (ordered volume- 25ml) is completed.
9.) Once pump beeps, the medication bag should be empty and your volume left should be zero. Spike a 50 ml NS bag and add 25 ml to your volume of zero. If there is still medication left in Antibiotic bag, squeeze remaining medication into tubing chamber, Press “restart”
10.) After the 25ml is complete, pump will beep off “Infusion Complete”. At this point, patient has received full dose of medication. Tubing can be disconnected and thrown in sharps. New tubing is required for each dose.

RATIONAL FOR PRIMING: Extended Antibiotics are typically ran over a SLOW rate. If they were ran as IVPP’s then it would take a long time before medication reached patient’s line.

RATIONAL FOR NEW VOLUME: 25ml is the approximate length of primary tubing. When the pump beeps off as “infusion complete” and a volume of zero, the IV Antibiotic fluid bag should be empty and the primary tubing should be filled with 25ml of medication.

April 2023 MEOW: Medication Administration

Learn More:
- File an Occurrence Report: file all ICare related to Medication Administration - please use SBAR format
- Speak to your SubCommittee Leads & Members
- Check out the Acute Care Sharepoint on our Intranet
### Appendix B

#### Needs Assessment Survey Questions

<table>
<thead>
<tr>
<th>Question</th>
<th>Options</th>
</tr>
</thead>
<tbody>
<tr>
<td>How many total years of experience do you have as an RN?</td>
<td>0-5 years, 6-10 years, 11-15 years, 16+ years</td>
</tr>
<tr>
<td>I understand the rationale behind the use of prolonged IV antibiotics</td>
<td>Strongly disagree, Disagree, Neutral, Agree, Strongly agree</td>
</tr>
<tr>
<td>I feel confident in setting up and administering prolonged IV antibiotics</td>
<td>Strongly disagree, Disagree, Neutral, Agree, Strongly agree</td>
</tr>
<tr>
<td>Which shift do you work?</td>
<td>AM, PM, Other</td>
</tr>
<tr>
<td>How often do you utilize tip sheets in your practice?</td>
<td>Always, Usually, About half the time, Seldom, Never</td>
</tr>
<tr>
<td>Do you find tip sheets helpful in your practice?</td>
<td>Not helpful at all, A little helpful, Neutral, Very helpful, Absolutely essential</td>
</tr>
<tr>
<td>Have you ever used the Extended Infusion of Antibiotics Tip Sheet?</td>
<td>Yes, No, I have not seen this before</td>
</tr>
<tr>
<td>Have you ever used the Extended Infusion Antibiotics M.E.O.W. sheet?</td>
<td>Yes, No, I have not seen this before</td>
</tr>
<tr>
<td>What would you like to see as an educational tool to help reduce errors related to the setup and administration of prolonged IV antibiotics?</td>
<td>Educational video, Educational video with checklist, Step-by-step poster board, Updated Tip Sheet</td>
</tr>
<tr>
<td>What do you think is the biggest contributor to incorrect setup and administration of prolonged IV antibiotics?</td>
<td>Dishonest data, Other</td>
</tr>
</tbody>
</table>

---

![Image of the Extended Infusion of Antibiotics Tip Sheet](image-url)

![Image of the M.E.O.W. sheet](image-url)
## Appendix C

### Johns Hopkins Evidence Appraisal Table

<table>
<thead>
<tr>
<th>Journal #</th>
<th>Citation</th>
<th>Evidence Type</th>
<th>Sample, Sample Size, Setting</th>
<th>How Does Article Address Problem?</th>
<th>Quality of Evidence</th>
<th>Other Highlights from Article (consider including limitations &amp; outcomes)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Budai, K. A., Tímár, Á. E., Obeidat, M., Máté, V., Nagy, R., Harnos, A., Kiss-Dala, S., Hegyi, P., Garami, M., Hankó, B., &amp; Lódi, C. (2023). Extended infusion of β-lactams significantly reduces mortality and enhances microbiological eradication in paediatric patients: a systematic review and meta-analysis. <em>EClinicalMedicine</em>, 65, 102293. <a href="https://doi.org/10.1016/j.eclinm.2023.102293">https://doi.org/10.1016/j.eclinm.2023.102293</a></td>
<td>Systematic review and meta-analysis of RCT and non-RCTs</td>
<td>Budapest, Hungary 19 studies were included out of the 19,980 articles were screened. N= 4,195 patients aged less than 21 years</td>
<td>Investigated the effectiveness and safety of extended infusion or continuous infusion vs. short, intermittent infusion of antibiotics.</td>
<td>Level II-High Quality</td>
<td>Limitations: A heightened risk of bias due to limited sample sizes and clinically comparable sample populations. As well as the absence of pathogen confirmation through culture. Outcome: The study findings indicate that extended β-lactam infusion correlates with reduced mortality and improved microbiological eradication, deemed safe compared to intermittent infusion. Critically sick children may face challenges with inadequate antibiotic levels because of altered pharmacokinetic properties. Technical considerations like IV access, compatibility, and antibiotic stability are crucial.</td>
</tr>
<tr>
<td>2</td>
<td>Coyne, E., Rands, H., Frommolt, V., Kain, V., Plugge,</td>
<td>Integrative Review</td>
<td>Multiple-country studies comprised 4</td>
<td>To guide future educational approaches, this study aims to</td>
<td>Level V-High Quality</td>
<td>Limitations of the study were identified through MMAT scores, revealing</td>
</tr>
<tr>
<td>Source</td>
<td>Methodology</td>
<td>Research Focus</td>
<td>Findings</td>
<td>Limitations</td>
<td></td>
<td></td>
</tr>
<tr>
<td>--------</td>
<td>-------------</td>
<td>----------------</td>
<td>----------</td>
<td>-------------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>M., &amp; Mitchell, M. (2018). <em>Investigation of blended learning video resources to teach health students clinical skills: An integrative review.</em> <em>Nurse Education Today, 63</em>, 101–107. <a href="https://doi.org/10.1016/j.nedt.2018.01.021">https://doi.org/10.1016/j.nedt.2018.01.021</a></td>
<td>With 10 articles mixed-methods, 3 quasi-experimental, 1 randomized controlled trial, 1 qualitative, and 1 quantitative descriptive study.</td>
<td>Analyze research on blended learning resources, with a particular emphasis on simulation videos employed for teaching clinical skills to healthcare students.</td>
<td>Predominant outcome measures included knowledge, satisfaction, and clinical skill performance.</td>
<td>Methodological shortcomings such as selection bias, utilization of non-validated tools, and absence of a comparison group. Additionally, reliance on student self-assessment as the primary evaluation method in most studies poses inherent limitations due to potential bias. Outcome: Blended learning, including video-assisted online resources, proves effective for health students’ clinical skill acquisition, offering flexibility and enhancing knowledge. Quality assessment of such resources is crucial, emphasizing concise, authentic videos with contextual support. Further research is needed to optimize integration and conduct unbiased evaluations.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**mix of open- and closed-ended questions.**

SGH, the survey included a diverse sample from three ICU wards, ensuring representation.

**Outcome:** The data indicated that nurses possess sufficient knowledge and confidence regarding prolonged/continuous infusion antibiotics, as well as effective communication skills on the subject. However, the findings suggest a requirement for additional education, particularly in the preparation and administration of such infusions and dose calculations. Despite this need, nurses generally endorse the broader adoption of prolonged/continuous infusion treatment in critical care settings, reflecting promising outcomes.

| 4 | Imburgia, T. A., & Kussin, M. L. (2022). A review of extended and continuous infusion beta-lactams in pediatric patients. *The Journal of Pediatric Pharmacology and Therapeutics* | Review | The studies covered various research designs like pharmacodynamic models, case series, retrospective and prospective | This review provides a summary of the pediatric medical literature concerning the administration of beta-lactam antibiotics via extended infusions lasting | Level V-Good Quality | Outcomes: Further research is required to validate prospective clinical outcomes. However, existing evidence indicates that extended and continuous infusions of beta-lactam antibiotics are successful in pediatric patients. They enhance |
analyses. They explored extended and continuous antibiotic infusion in diverse pediatric patient groups. Additionally, high-risk patients like neonates, critically ill individuals, those with febrile neutropenia, and cystic fibrosis patients were also examined. A minimum of 3 hours. This approach is explored due to its association with enhanced achievement of pharmacodynamic targets and improved patient outcomes, as observed in the adult literature.

**Implementation considerations:** Drug stability is crucial and dependent on concentration, diluent, storage temperature, and infusion delivery device. While these factors pertain to all IV preparations, temperature necessitates evaluation when extending infusions. Ensuring uninterrupted IV access during prolonged infusions is also essential.

<p>| 5 | Kondo, Y., Ota, K., Imura, H., Hara, N., &amp; Shime, N. (2020). Prolonged versus intermittent β-lactam antibiotics intravenous infusion strategy in sepsis or septic shock patients: a systematic review with meta-analysis and trial sequential analysis of 13 RCT studies | To assess the effectiveness of prolonged versus intermittent β-lactam antibiotic infusion in patients with sepsis/septic shock. This investigation was prompted by uncertainties regarding the efficacy of this approach. | Level I-High Quality Limitations: A limited number of RCTs were available. In some RCTs, participants were aware of group assignments, potentiating performance bias. The definition of intermittent and prolonged infusion times may affect results, despite including only continuous infusion. Outcome: Extended infusion of β-lactam |</p>
<table>
<thead>
<tr>
<th>6</th>
<th>Kuitunen, S., Niittynen, I., Airaksinen, M., &amp; Holmström, A. R. (2021). Systemic causes of in-hospital intravenous medication errors: a systematic review. <em>Journal of Patient Safety, 17</em>(8), e1660–e1668. <a href="https://doi.org/10.1097/PTS.000000000000632">https://doi.org/10.1097/PTS.000000000000632</a></th>
<th>Systematic Review</th>
<th>11 observation al studies from six countries. 3 took place in a neonatal setting and 3 took place in an adult oncology unit. This study aimed to investigate the systemic factors contributing to intravenous medication errors occurring within hospitals.</th>
<th>Level III Good quality Small sample size, no RCTs</th>
<th>Limitations: None of the studies were RCT. Concern for self-reporting. Outcomes: This study concentrates on medication safety activities associated with the administration, prescribing, and preparation of IV medications.</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>Li, X., Long, Y., Wu, G., Li, R., Zhou, M., He, A., &amp; Jiang, Z. (2023). Prolonged vs intermittent intravenous infusion of β-lactam antibiotics for patients with sepsis: a systematic review of randomized clinical trials with meta-analysis and trial sequential analysis. <em>Annals of Intensive Care</em></td>
<td>Systematic Review with meta-analysis and trial sequential analysis</td>
<td>Total of 9 studies with 1762 patients were included Compared the effects of prolonged versus intermittent intravenous infusion of antibiotics in those with sepsis.</td>
<td>Level I-High Quality Small study size</td>
<td>Limitations: Small number of studies. The quality of the evidence was also considered lower because the definition of sepsis was not consistent throughout the studies. Outcomes: The findings showed that prolonged IV antibiotics significantly decreased mortality in patients with sepsis. It also suggests that it relates to lower ICU mortality and better patient outcomes.</td>
</tr>
<tr>
<td>8</td>
<td>Luo, J., Liao, J., Cai, R., Liu, J., Huang, Z., Cheng, Y., Yang, Z., &amp; Liu, Z. (2019).</td>
<td>Systematic Review with meta-analysis</td>
<td>43 studies which included 30 RCTs, 5 prospective observational studies, and 8 retrospective observational studies. It included 3,610 patients between 1977 and 2018. Done in China.</td>
<td>Aimed to investigate the correlation between prolonged infusion, compared to intermittent infusion, and its impact on mortality and clinical outcomes.</td>
<td>Level II-High Quality</td>
</tr>
<tr>
<td>9</td>
<td>Wu, C., Su, Y., Wu, K., Wu, T., &amp; Yang, C. (2021).</td>
<td>Systematic review with meta-analysis and meta-regression analysis</td>
<td>Included 18 RCTs and 13 non-RCTs</td>
<td>Compared the efficacy of continuous/extended beta-lactam infusions versus intermittent administration.</td>
<td>Level II-High Quality</td>
</tr>
<tr>
<td>10</td>
<td>Yu, Z., Pang, X., Wu, X., Shan, C., &amp; Jiang, S. (2018). Clinical outcomes of prolonged infusion (extended infusion or continuous infusion) versus intermittent bolus of meropenem in severe infection: A meta-analysis. <em>PLOS ONE</em>, 13(7), e0201667. <a href="https://doi.org/10.1371/journal.pone.0201667">https://doi.org/10.1371/journal.pone.0201667</a></td>
<td>Systematic review with meta-analysis</td>
<td>Included 6 RCTs and 4 observational studies.</td>
<td>Level III-High Quality Small study size</td>
<td>Limitations: Small sample sizes. The type and site of infection were not reported. A main limitation is that it was not clear if other antibiotics were used. Outcomes: The prolonged infusion group exhibited a higher success rate and lower mortality compared to the intermittent group. These results indicate that prolonged infusion is recommended to those with severe infections.</td>
</tr>
</tbody>
</table>
Appendix D

Statement of Non-Research Determination
STUDENT NAME (Please print):

Kassandra Rezler

Signature of Student:

Kassandra Rezler

DATE 03/05/2024

SUPERVISING FACULTY MEMBER NAME (Please print):

Dr. Nicole Beamish, DNP, PHN, FNP-BC, CNL, BC-ADM

Signature of Supervising Faculty Member

Dr. Nicole Beamish

DATE: 3/12/24

Appendix E

GANTT Chart
## GANTT CHART

<table>
<thead>
<tr>
<th>TASK NAME</th>
<th>START DATE</th>
<th>END DATE</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Project Conception</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Determination of Change Theory</td>
<td>1/23</td>
<td>1/28</td>
</tr>
<tr>
<td>Define Project/PICOT Question</td>
<td>1/28</td>
<td>2/7</td>
</tr>
<tr>
<td>Microsystem assessment/P's</td>
<td>2/4</td>
<td>2/11</td>
</tr>
<tr>
<td>Develop AIM statement</td>
<td>2/4</td>
<td>2/11</td>
</tr>
<tr>
<td>Literature Review</td>
<td>1/28</td>
<td>2/26</td>
</tr>
<tr>
<td>Meeting with medication administration</td>
<td>2/21</td>
<td>2/21</td>
</tr>
<tr>
<td><strong>Project Planning</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Develop needs assessment survey</td>
<td>2/13</td>
<td>2/29</td>
</tr>
<tr>
<td>Deploy needs assessment survey</td>
<td>2/29</td>
<td>3/7</td>
</tr>
<tr>
<td>Analyze needs assessment survey</td>
<td>3/7</td>
<td>3/14</td>
</tr>
<tr>
<td>Draft 1 due</td>
<td>3/24</td>
<td></td>
</tr>
<tr>
<td>Create pre- and post-intervention survey</td>
<td>4/1</td>
<td>4/11</td>
</tr>
<tr>
<td>Create educational video &amp; presentation</td>
<td>4/1</td>
<td>4/11</td>
</tr>
<tr>
<td><strong>Project Implementation</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Present video &amp; presentation to nurses</td>
<td>4/11</td>
<td>4/11</td>
</tr>
<tr>
<td>Deploy pre- and post-intervention survey</td>
<td>4/11</td>
<td>4/11</td>
</tr>
<tr>
<td><strong>Project Evaluation and Synthesis</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Data Analysis</td>
<td>4/12</td>
<td>4/14</td>
</tr>
<tr>
<td>Draft 2 due</td>
<td>4/14</td>
<td></td>
</tr>
<tr>
<td>Evidence-based poster creation</td>
<td>4/14</td>
<td>4/24</td>
</tr>
<tr>
<td>Paper due</td>
<td>4/28</td>
<td></td>
</tr>
<tr>
<td>In-class project presentation</td>
<td>4/30</td>
<td></td>
</tr>
<tr>
<td>Submission to USF Scholarship Repository</td>
<td>5/13</td>
<td></td>
</tr>
</tbody>
</table>

### Appendix F
5 P's Assessment Tool

The purpose of these pediatric acute care units is to enhance the health and well-being of children, aligning with the hospital's overarching vision of healing humanity through science and compassion, one child and family at a time.

The patients served by the microsystem include pediatric patients admitted to these units, along with their families and caregivers. PCU 300 primarily cares for postoperative organ transplants, gastrointestinal, and renal patients, while PCU 400 serves neurology, orthopedic, respiratory, general surgery, and endocrine patients. PCU 360 provides care for stable patients across these specialties, collectively accommodating approximately 60-70 pediatric patients at a time.

The professionals who work together in the microsystem include registered nurses, doctors (at various levels), nurse practitioners, physician assistants, respiratory therapists, phlebotomists, unit secretaries, social workers, child life specialists, therapists, sitters, nurse managers, pharmacists, environmental workers, nursing assistants, nurse educators and leaders, students, informational technologists (IT), and patient transporters.

Within the microsystem, caregiving and support processes encompass various initiatives such as quality improvement meetings, ethics committees, and volunteer programs. Additionally, there are notable variances in processes and patterns, including decisions regarding prolonged versus regular antibiotic use for specific conditions, as well as the setup, administration, and accurate charting of prolonged antibiotics. Variations also extend to the types of tubing and lines utilized for prolonged antibiotic therapy. Shift huddles play a crucial role in fostering communication and coordination among healthcare professionals, significantly influencing the overall delivery of care within the microsystem.
Appendix G

Fishbone Analysis

- Pediatric HCP using wrong wording on EMR, prolonged IV antibiotic order.
- Pediatric RNs are not properly trained due to lack of awareness of and easy access to educational resources.
- Nurse educators are not providing requested individual hands-on training to the RNs.
- Tip sheets are not easily accessible for the RNs - not updated and not succinct.
- iCares data is not easily accessible.

Errors with prolonged IV antibiotic setup and administration

People
- The microsystem consists of three units with different training, applications of policies, materials inventory, and processes.
- Each unit has a different patient population. Some of these acute care units do not always have patients who need prolonged IV antibiotics, therefore, some RNs have less practice.

Environment
- When a mistake is made, the process for reporting and fixing these errors is unclear.
- Straight set IV tubing with blue occlusion ball is inconsistent throughout units.

Methods
- Inconsistencies between physical preparation and administration steps of antibiotics.
- Inconsistency between antibiotic syringe vs. bag.
- Inconsistency with antibiotic flush volume.

Equipment
Appendix H

SWOT Analysis

**Strengths**
- Ability to access tipsheets
- Training program
- Support: resource RNs, flex RNs, team leaders, CNAs, and sitters available
- Commitment to patient safety and quality care
- Adequate staffing

**Weaknesses**
- Management not providing extra hands-on training for RNs
- Three different units that have different resources, materials, procedures, and trainings
- Various trainings, or lack of, for float nurses and travel nurses

**Opportunities**
- Continually striving to improve existing protocols
- Ability to provide high acuity care to patients
- Teaching hospital
- Incident report tool
- Magnet-recognized hospital
- Values evidence-based research

**Threats**
- Time constraints to educate nurses
- Staff survey fatigue due to large academic facility
- Staff resistance to policy adherence
# Appendix I

## Budget Analysis

### Educating RNs on Prolonged IV Antibiotics to Reduce Medication Errors

**Aim Statement:** By April 29th, 2024, of pediatric registered nurses who administer prolonged IV antibiotics in the hospital’s acute care units, there will be an overall 5% increase in self-reported knowledge of the correct setup and administration of prolonged IV antibiotics following the receipt and intervention of a comprehensive educational video demonstration, ultimately decreasing length of stay.

<table>
<thead>
<tr>
<th>Current State</th>
<th>Patients on Prolonged IV Antibiotics</th>
<th>Length of Stay</th>
<th>Cost of 1 day in the hospital</th>
<th>Annual cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Length of Stay + 2 additional days due to medication errors</td>
<td>11</td>
<td>9 days</td>
<td>$6,071.05</td>
<td>$601,033.95</td>
</tr>
<tr>
<td>Improved State</td>
<td>Patients on Prolonged IV Antibiotics</td>
<td>Average Length of Stay</td>
<td>Cost of 1 day in the hospital</td>
<td>Annual cost</td>
</tr>
<tr>
<td>Reduce length of stay</td>
<td>11</td>
<td>7 days</td>
<td>$6,071.05</td>
<td>$467,470.85</td>
</tr>
<tr>
<td><strong>Cost Avoidance</strong></td>
<td></td>
<td></td>
<td></td>
<td><strong>$133,563.10</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Implementation Cost</th>
<th>Hourly rate ($) + 0.35% benefit</th>
<th>Number of hours needed</th>
<th>Number of nurses</th>
<th>Annual cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>CNL conducts video and implements project</td>
<td>117+$40.95</td>
<td>200</td>
<td>1</td>
<td>$31,590.00</td>
</tr>
<tr>
<td>RN receives education</td>
<td>117+$40.95</td>
<td>1</td>
<td>187</td>
<td>$29,536.65</td>
</tr>
<tr>
<td><strong>Total Cost to Hospital</strong></td>
<td></td>
<td></td>
<td></td>
<td><strong>$61,126.65</strong></td>
</tr>
<tr>
<td><strong>Project Savings</strong></td>
<td></td>
<td></td>
<td></td>
<td><strong>$72,436.45</strong></td>
</tr>
</tbody>
</table>
Appendix J

Pre-Video Quiz

Pre-Video Quiz for RNs

Before watching the educational video regarding prolonged IV antibiotics, we would like to understand your current knowledge regarding the setup and administration of these medications.
*No personal information/identifiers will be collected*

Can prolonged IV antibiotics be "Yed" with another compatible antibiotic? *

- Yes
- It depends
- No

When infusing prolonged IV antibiotics through a PIV, which tubing is appropriate to use? *

- Primary (straight set) tubing without ports
- Secondary (VPB) tubing
- Tubing of personal preference

When the medication bag is near empty, what are the next steps? *

- Flush with a saline syringe
- Connect it back to the maintenance fluids
- Flush with a bag

When is it appropriate to check the medication bag? *

- When the pump beeps off
- Every hour during PIV assessments
- When the bag, drip chamber, and line are empty/run dry
Appendix K

Recommended Process of Prolonged IV Antibiotic Setup and Administration

Recommended process of prolonged IV antibiotic setup and administration

1. Obtain a new straight set tubing without ports for each dose.
2. Verify the 7 rights of medication.
3. Clamp tubing. Spike antibiotic bag with primary tubing, squeeze drip chamber and prime tubing with antibiotic all the way to the end of the line, leaving no air bubbles. If infusing through a central line, sterile prime.
4. Bring primed antibiotic line to room. Scan patient and medication, and re-verify the 7 rights of medication.
5. Click Channel Select on Alaris Pump, then Guardrail Drugs. Program total volume of medication into pump as per HCP's order → (Antibiotic name, dosage, volume, & infusion time).
6. Connect primary line to hub of PIV or Central Line closest to patient. Unclamp, press Start, and assess for dripping in drip chamber to confirm the line is unclamped.
7. If there is medication still present in the antibiotic bag, squeeze the remaining medication into the drip chamber. Spike a flush bag.
8. At this point, the remaining medication is in the tubing. Tubing is approximately 25 mL. Patient must get full medication dose.
9. Re-program the pump to infuse the remaining 25 mL.
10. After the 25 mL is infused, pump will beep Infusion Complete. Patient has now received full dose of medication.
11. Disconnect tubing and discard in sharps container.
12. Document infusion complete in the MAR.
Appendix L

Post-Video Quiz
Appendix M

PDSA Worksheet

Post-Video Quiz/Survey for RNs

After watching the educational video regarding prolonged IV antibiotics, we would like to understand your level of gained knowledge pertaining to the information and demonstration presented in the video.

*No personal information/identifiers will be collected*

<table>
<thead>
<tr>
<th>Question</th>
<th>Rating Options</th>
</tr>
</thead>
<tbody>
<tr>
<td>How helpful did you find the video demonstration to be for your practice?</td>
<td>Not at all helpful, Somewhat helpful, Neutral, Helpful, Absolutely helpful</td>
</tr>
<tr>
<td>I understand the rationale behind the use of prolonged IV antibiotics:</td>
<td>Strongly disagree, Disagree, Neutral, Agree, Strongly agree</td>
</tr>
<tr>
<td>I feel confident in setting up and administering prolonged IV antibiotics:</td>
<td>Strongly disagree, Disagree, Neutral, Agree, Strongly agree</td>
</tr>
<tr>
<td>Can prolonged IV antibiotics be &quot;Yed&quot; with another compatible antibiotic?</td>
<td>Yes, It depends, No</td>
</tr>
</tbody>
</table>

When infusing prolonged IV antibiotics through a PIV, which tubing is appropriate to use? 
- Primary (straight set) tubing without ports
- Secondary (YH) tubing
- Tubing of personal preference

When the medication bag is near empty, what are the next steps?
- Flush with a saline syringe
- Connect it back to the maintenance fluids
- Flush with a bag

When is it appropriate to check the medication bag?
- When the pump beeps off
- Every hour during PIV assessments
- When the bag, drip chamber, and line are empty/run dry
PDSA Cycle

Act
- RNs will adapt and the educational video will be integrated into all RN training orientations.
- Evaluate intervention every six months and make changes as needed.

Plan
- Collaborate with hospital’s leadership team.
- Synthesize PICOT question and AIM statement.
- Analyze current practice through iCares data
- Conduct needs assessment/gap analysis with RN surveys via QR codes.

Study
- Analyze pre and post-video quiz results.
- Compare results to AIM statement.

Do
- Create an educational video.
- Prior to showing the video to RNs, the RNs will take a knowledge assessment quiz. They will take the same quiz before and after video education to assess increases in knowledge.