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Kiara Hayden
University of San Francisco, hayden.kiara@yahoo.com

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Educating inpatient pediatric registered nurses on the setup and administration of prolonged intravenous antibiotics and the reduction of medication errors

Kiara Hayden, RN, CNL

School of Nursing and Health Professions, University of San Francisco

NURS-670: ME-MSN Internship

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

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Abstract

**Problem** The acute care unit microsystem of a California children’s hospital encounters issues involving the incorrect set up and administration of prolonged intravenous (IV) antibiotics and medication errors, such as delivery at the wrong rate or time. These problems can result in negative patient health outcomes, delayed healing, antibiotic resistance, and increased length of hospital stay and costs. **Context** A collaborative quality improvement (QI) project was launched to target the pediatric population of this particular microsystem. The aim of this project was to standardize prolonged IV antibiotic practices, disseminate knowledge while using evidence-based practice (EBP), and improve patient outcomes. **Interventions** The QI team performed an intervention of nurse education. Registered nurses (RNs) were educated on the recommended process of prolonged IV antibiotic setup and administration via a comprehensive educational video demonstration and supplemental PowerPoint presentation. **Measures** The outcome measurements are increased percentage of inpatient pediatric RN self-reported knowledge and a reduction in medication errors. Self-reported knowledge was measured via a pre- and post-video quiz. **Results** There were increases in RN participation, self-reported knowledge, and confidence level. The results’ effect on improvement of the microsystem’s units, patients, and staff could not be analyzed due to the limited timeframe of this project. **Conclusions** The QI team surpassed the specific aim and expectation of increasing RN self-reported knowledge from 5% to 8.5%. Although increases in knowledge and confidence level were observed, the effectiveness of the intervention and RN performance should be continuously evaluated, reflecting accurate, up-to-date information.
Educating inpatient pediatric registered nurses on the setup and administration of prolonged intravenous antibiotics and the reduction of medication errors

During the Spring of 2024, a QI team of University of San Francisco clinical nurse leader nursing students and a Clinical Practice Quality Specialist (CPQS) initiated a QI project on the acute care units of a children’s hospital in California. The nursing students agreed to take on the high-priority problem and project of setting up and administering prolonged IV antibiotics while observing the impact on patients and implementing changes. Prolonged IV antibiotics are administered among these units for prophylactic, flare-up, and work-up reasons as well as for chronic conditions like Cystic Fibrosis. The incorrect setup and administration of prolonged IV antibiotics can result in negative patient health outcomes, delayed healing, antibiotic resistance, medication errors, and increased length of hospital stay and costs. The goal for the QI team was to standardize prolonged IV antibiotic practices for the hospital’s acute care microsystem while disseminating knowledge and EBP.

The QI team was able to review 170 incident reports dating back from November 2021 to February 2024. Of the 170 incident reports examined, only 22 were included in this review due to their relevance for this specific QI project. Incident reports were acquired from RNs, providers, pharmacists, educators, and managers. The 170 incident reports were narrowed down to 22 due to exclusionary criteria such as, patient-reported data and complaints, non-prolonged IV antibiotic drugs, and irrelevant situations. No patient or staff identifiers or protected health information were obtained.

Problem Description

The acute care units of this hospital encounters issues involving conflicting information of what the hospital’s standard practice of prolonged IV antibiotics is, inconsistencies in the
materials and processes of prolonged IV antibiotic setup and administration, lack of awareness of and easily accessible educational resources, lack of hands-on training and knowledge, and incorrect healthcare provider (HCP) orders in Epic. Unfortunately, these problems result in medication errors, such as delivery at the wrong rate or time and prolong the IV antibiotic administration process for patients. The QI team recognized that 50% of incident report data were administration issues. The intervention of nurse education is a critical need for providing role clarity, improving the number of correct and consistent performances, and minimizing and preventing medication errors concerning prolonged IV antibiotics.

A needs assessment survey was designed to gauge current RN performance, establish benchmark data, and attain the first set of quantitative data. Four of the survey questions results can be seen in Appendix A. Nurse participation was recruited via nursing huddles, personal communication, and quick response codes posted throughout the units (including break rooms and restrooms). Of the 55 total responses, 56.4% of RNs reported having zero to five years of total experience as an RN which translates to a large number of inexperienced staff. The factors that likely affect the current number of inexperienced staff are new graduates, new hires, float nurses, and travel nurses. These elements can certainly impact the number of errors related to the incorrect setup and administration of prolonged IV antibiotics.

Between the three acute care units, the unit and shift participation can be influenced by the QI team member(s) efforts to distribute the survey and can depend on the day, unit, and shift the team member(s) was assigned to be on-site. Of the survey respondents, 52.7% acknowledged that they received in-person hands-on training on the setup and administration of prolonged IV antibiotics. The other type of training that 38.2% of RNs noted receiving was from the hospital’s Extended Infusion of Antibiotics Tip Sheet or the Extended Antibiotic Infusions Medication
Education & Outreach Workgroup sheet. The remaining 9.1% expressed that they did not receive training which is especially concerning if some RNs are practicing a skill that they did not receive training for and can unknowingly be contributing to the problem.

To collect qualitative data, when provided the opportunity to give short answer, open-ended feedback pertaining to personal opinions of the largest contributor to the incorrect setup and administration of prolonged IV antibiotics, some answers were different ways people have learned, priming the line with normal saline, forgetting extended infusion can’t be given via piggyback, inconsistent practice, lack of knowledge and training, out of date tip sheets and protocols, not deducting the tubing volume for infusing, and not enough physical hard stops to prevent incorrect administration. Given these results, it is necessary for the QI team to learn the existing knowledge gaps and discrepancies while establishing an intervention and plan to close them. As the most favorable answer option for RN feedback of what they would like to see as an educational tool was a video, a video is the intervention that the QI team will be implementing.

Available Knowledge

PICOT Question

For this QI project’s literature review and evidence appraisal table (see Appendix B), a question was framed using the site’s microsystem-specific issues with the following components: Population, Intervention/Issue, Comparison, Outcome, Timeframe (PICOT). The following QI project’s question did not include a comparison: In inpatient pediatric RNs (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

Extensive research was conducted via CINAHL Ultimate, a medical database, to obtain
and analyze data for the PICOT question. Compared to other databases such as PubMed, CINAHL Ultimate was discovered to be the most resourceful and relevant to this QI project and PICOT question. Key phrases used to search the database were *inpatient pediatric registered nurse education, prolonged IV antibiotics, extended antibiotic infusions, medication error reduction, and antimicrobial stewardship*. Literature was reviewed and critically appraised using the Johns Hopkins Evidence Appraisal Tools and was synthesized via the evidence appraisal table in Appendix B (Dang & Dearholt, 2018). After a critical appraisal of the literature, a sample of 10 journal articles with levels I, III, and V were included. The sample contains numerous types of comprehensive research: quantitative study (1), qualitative studies (4), quality improvement studies and projects (2), and systematic reviews and meta-analyses with randomized controlled trials (3). Given the diverse spectrum of information integrated in this review, it embodies a compelling overview of research surrounding inpatient pediatric registered nurse education and its effect on the number of medication errors related to the setup and administration of prolonged IV antibiotics.

The process for selection of the 10 final articles was based on an analysis of each article’s relevance, background, methods, results, type of study design, and the level and quality of supportive evidence. The articles included in this literature review illustrate appropriateness, data collection, and transparency pertaining to acute care units and prolonged IV antibiotics data. Other articles were not chosen for reasons such as the content was unfit for the PICOT question and a connection between the article and QI project could not be easily identified which led to their exclusion. Additional factors that contributed to the exclusion criteria were non-acute care units and irrelevant circumstances.
Literature Review

Beginning with the subject of nurse engagement, Abbas et al. (2019) accentuate that in acute care units across the United States, approximately 20%-40% of antibiotic use and the engagement of nurses in antimicrobial stewardship programs (ASPs) is less than optimal. The authors support the major claim of the need for nurses’ role identification and clarification in antimicrobial stewardship (AS) with the purpose of nurse education and participation in order to address knowledge gaps, prevent the development of multi-drug resistant organisms (MDROs), and disseminate key concepts of microbiology and pharmacology pertaining to AS (Abbas et al., 2019). Online educational tools, cell phone apps, and nursing huddles are a few opportunities to help disseminate information about ASPs to nursing staff (Abbas et al., 2019). This would be helpful for the QI project site as UpToDate, online tip sheets, and nursing huddles are valuable educational tools and shared practices among the acute care units. These results are relevant to this QI project as they emphasize the significance of optimal antibiotic use and nurse education in the microsystem.

In the analysis of therapeutic drug monitoring (TDM) and extended infusions (EIs), Budai et al. (2023) assert that pediatric patients are frequently affected by antibiotic misuse, subtherapeutic levels, treatment failure, and inappropriate doses. Treatment failure can increase the risk of antibiotic resistance and in order to prevent this, TDM is crucial (Budai et al., 2023). The authors suggest the use of a time-dependent antibiotic (e.g., beta-lactams) for EI to help combat this issue. The QI site can benefit from EI of beta-lactams and TDM by decreasing length of hospital stay and delayed healing. These findings are applicable to this QI project as they highlight the effects of antibiotic misuse and inappropriate TDM which can lead to negative patient health outcomes.
Similar to both Abbas et al. (2019) and Budai et al. (2023), Chant et al. (2013) explicate the importance of antimicrobial use and the connection to antibiotic resistance. Patients with severe illnesses are at an increased risk for antibiotic resistance, and pharmacodynamics-based dosing can improve their outcomes (Chant et al., 2013). Antibiotic resistance can prolong healing and illness recovery, making it more challenging for patients to combat and overcome future infections. This study relates to the QI project with its purpose of a pharmacodynamics-based dosing intervention to help increase clinical outcomes when EI of antibiotics is primarily used (Chant et al., 2013).

Considering patient-centered care and areas of improvement, Dzintars et al. (2021) developed a custom AS module with the help of Epic information technology to distribute best practice alerts (BPAs) with the purpose of improving antibiotic-related health outcomes, workflow, and reducing length of stay and costs. The BPAs will notify providers of potential prescribing issues and advocate for patients when they can benefit from a medical intervention (Dzintars et al., 2021). Some areas requiring medical intervention include antibiotic bug-drug mismatch, antibiotic de-escalation, drug interactions, duplicate antibiotics, and excess therapy (Dzintars et al., 2021). This supports the QI project as it pertains to antibiotic-related health outcomes, patient safety, and changes in HCP Epic orders which can reduce medication errors. Orders made by HCPs at the QI site can utilize BPAs as a tool to help prevent potential medication errors from occurring.

Focusing on the correct IV administration per manufacturer guidelines for accurate medication flow, Giuliano et al. (2021) identify a significant lack of knowledge among acute care pharmacists and nurses pertaining to primary and secondary infusions. Although antibiotics are the most common medications administered via secondary infusions, research has inferred that
infusions via secondary lines are prone to error due to the complexity of the IV smart pump systems, setup, diverse types, and delay in failure detection which can lead to delays in antibiotic delivery (Giuliano et al., 2021). These factors can contribute to antibiotic resistance and sub-therapeutic levels which are also issues discussed by Budai et al. (2023) and Chant et al. (2013). Furthermore, these factors, as well as inadequate knowledge, may be related to MDROs which is a matter that Abbas et al. (2019) acknowledged. The purpose is to enhance healthcare professional education to improve the safety and operation of IV smart pumps as they are the most commonly used infusion devices in acute care hospitals across the United States (Abbas et al., 2019). This literature correlates to the QI project with the mutual goal of improving the setup, operation, and administration of IV antibiotics in the acute care microsystem. The incorrect setup is a major contributing factor to the cause of medication errors at the QI site, therefore, the information provided in this article can be an education tool for nurses and pharmacists.

In addition to the subject of engagement in ASPs by Abbas et al. (2019), Monsees et al. (2020) also indicate the value of nurses’ roles in AS in order to standardize antibiotic processes. Monsees et al. (2020) determined that the lack of standardization stems from knowledge gaps and sparse education. Standardization is important for the QI site to accomplish as each of the acute care units report inconsistencies in the materials and processes of prolonged IV antibiotic setup and administration. In the same way that excess therapy requires medical intervention (Dzintars et al., 2021), polypharmacy can also add to confusion and lack of clarity concerning antibiotic care plans, indications, and duration (Monsees et al., 2020). The primary objective of this study was to address areas of antibiotic optimization during care transitions via the implementation of a nurse driven, antibiotic engagement tool (Monsees et al., 2020). This is
consistent with the QI project’s necessity of nurse education and the standardized setup and administration of IV antibiotic processes.

Regarding errors in HCP orders, Newby et al. (2021) initiated a QI project to change the wording of a physician’s antibiotic duration order. Sometimes incorrect word usages can result in patients receiving excess doses of antibiotics (Newby et al., 2021). Excess antibiotic doses and therapy is a common theme among several studies in this literature review. Dzintars et al. (2021) and Monsees et al. (2020) maintain this connection between excess therapy, polypharmacy, and the need for an intervention. Along with the wording change, the introduction of a hard-stop for antibiotic orders could help reduce antibiotic administration errors (Newby et al., 2021). This QI initiative is associated with the QI project of this literature review as they both have a shared goal of reducing errors related to antibiotics and HCP orders. A hard stop can be a useful tool for the QI site as it will help oversee the patient’s medication administration record and require an incorrect order to be changed by the prescriber to reflect the site’s standard policies and processes.

Another common theme reflected in the articles throughout this literature review is antimicrobial resistance (AMR) and ASPs. Budai et al. (2023), Chant et al. (2013), and Giuliano et al. (2021) all validate that AMR can lead to negative patient health outcomes. Abbas et al. (2019) and Monsees et al. (2020) justify the need for nurse engagement in ASPs and their role in antibiotic use and patient health outcomes. Wong et al. (2020) note the concerns of inappropriate antibiotic use, AMR, and minimal efforts to engage nurses in hospital ASPs and provide role clarity. Continuing nursing education (e.g., in person and online training) with a focus on antibiotics, updates, and treatments can provide nurses with the knowledge and skills to enhance their role in AS (Wong et al., 2020). This aligns with the QI project in that inappropriate
antibiotic use, AMR, and lack of nurse involvement in ASPs can negatively impact patients and decrease patient health outcomes. With the efforts to close knowledge gaps and facilitate ongoing training, medication errors at the QI site can be minimized.

Along with Budai et al. (2023) and Chant et al. (2013), Wu et al. (2020) reinforce the requirement of adequate antibiotic dosing and precise timing as well as the efficacy of beta-lactams and pharmacodynamics. It is imperative for RNs at the QI site to adopt these practices to promote positive patient health outcomes. Beta-lactams (e.g., carbapenem and piperacillin/tazobactam) administered via continuous infusion or EI are linked to decreased mortality and length of stay of severely ill patients (Wu et al., 2020). Continuous extended infusions with loading doses demonstrated a significant improvement in clinical cure benefits after adjustments were made based on the type of beta-lactam (Wu et al., 2020). It is recommended that continuous extended infusions of carbapenem are used with loading doses in order to enhance clinical outcomes of severely ill patients (Wu et al., 2020). The information the authors presented is appropriate for this QI project as it helps draws attention to what is considered the most favorable type of antibiotic to administer for EIs and can be shared with the QI site.

In the final analysis, and similar to the QI project launched by Newby et al. (2021), Yalamanchi et al. (2021) also organized a QI study to address antibiotic administration performance and safety gaps due to inconsistencies between indications, interpretations, appropriate timing, and adherence to institutional standards. To improve standardization in prescribing and incorporate guidelines into provider workflow, a hard stop for antibiotic orders was established and integrated into the electronic health record (Yalamanchi et al., 2021). The intervention of a hard stop was also recognized by Newby et al. (2021) with the purpose of
reducing potential medication errors which ultimately increases patient-centered health outcomes and is therefore, suitable for the QI project of this literature review. As hard stops and BPAs can somewhat coincide with one another, these can be valuable electronic tools for the QI site’s acute care microsystem to use in prioritizing patient safety and patient-centered care.

**Rationale**

The change theory used to guide this QI project is William Bridges’ Theory into Transition which entails “three phases of physiological readjustment and reorientation to change” (Hawkes & Hendricks-Jackson, 2017). In the first phase, indication of change should be present so transitioning can begin. When applied to this QI project, a need for change was first indicated via the needs assessment survey and incident report data collection. The second phase is the midway point in which old ways no longer exist, but new ways are not yet completely adapted to. The next step of the QI project which will cover the second phase of William Bridges’ Theory into Transition is to provide RN education by demonstrating the correct setup and administration of prolonged IV antibiotics via a comprehensive educational video. This is where information gaps will be acknowledged and EBP will be shared to establish standard prolonged IV antibiotic practices that are correct, consistent, and not left up to one’s own interpretation. The third and final phase is the adaptation to change. For the QI project, RNs will begin to adapt to the correct protocol and remain compliant to help reduce errors and improve patient health outcomes. The hospital will support the RNs, fulfilling their needs (e.g., more hands-on training) to ensure they are successful in their transition and adaptation. William Bridges’ Theory into Transition will be beneficial for this QI project as it provides a smooth transition to change and adaptation, guiding the QI team in improving the quality of prolonged IV antibiotic-related patient care.
Ethical Considerations

The American Nurses Association Code of Ethics (2015), Provision 3.4: *Professional Responsibility in Promoting a Culture of Safety*, coincides with this QI project because adhering to policies, reducing errors, correcting errors, and addressing system-wide contributing factors are all important for maintaining patient safety. The University of San Francisco Jesuit value to *nurture the whole person (mind, body, spirit)* is associated with this project in that nurses share a responsibility in not only committing to patient safety, but also engaging in every aspect of patient care (University of San Francisco, 2024). Even with the efforts to standardize prolonged IV antibiotic practices, nurses must remember and consider how each patient’s mind, body, and spirit will be affected before, during, and after care. This project meets the guidelines for an EBP QI project and did not require a review by the institutional review board. A statement of non-research determination form was completed to verify this QI initiative (see Appendix C), following an evaluation and approval by University of San Francisco School of Nursing and Health Professions clinical faculty. This project did not acquire any funding and the QI team members proclaim no conflict of interest for this project.

Project AIM

The aim of this QI project is to increase the percentage of pediatric RNs who will self-report increased knowledge of the correct setup and administration of prolonged IV antibiotics in the hospital’s acute care units. The specific aim of this project is *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.* The desired change in
practice is standardized policy, utilization of the educational video, and improved RN performance. The QI team can suggest that the video also be shown in all RN orientations for new graduates, new hires, float nurses, and travel nurses. This can address one particular issue in which one survey respondent wrote “I’m a new grad and have not had any training on this.” Upon watching the video, the RNs should be provided limitless opportunities to practice the correct setup and administration of prolonged IV antibiotics until they are confident and competent enough to perform the skill on the floor.

Methods

Context

The QI team considered the 5P’s (Purpose, Patients, Professionals, Processes, Patterns) while assessing the current state of the microsystem. The purpose of the pediatric acute care unit clinical microsystem is to improve the health and overall wellbeing of the children in support of the hospital’s vision. The people who are served by the microsystem embody the following: acute care unit pediatric patients, their families, and caregivers. The professionals who collaborate within the microsystem encompass doctors (interns, residents, fellows, attendings), nurses (clinical, resource, managers, practitioners, educators, team leads), quality managers, antibiotic stewardship managers, pharmacists, nurse assistants, unit secretaries, respiratory therapists, phlebotomists, sitters, patient transport, child life specialists, social workers, environmental staff, information technology, engineers, and security. The caregiving and support processes the microsystem uses to provide care and services consist of two-nurse health assessments, two-nurse verification of high-alert medications, ethics committees, volunteer programs, support groups and classes, continuing education opportunities, and the continuous strive to improve existing protocols. The patterns that characterize microsystem functioning are
nurse handoff reports, shift huddles (morning and night), interdisciplinary team rounds, incident report documentation, and various monthly, bimonthly, and semiannual staff meetings. Some meetings focus on incident report data and QI. Depending on patient acuity level, a nurse-to-patient ratio can be anywhere from 1:1 to 1:4.

A Gantt Chart, presented in Appendix D, timeline was utilized by the QI team to effectively organize the project’s tasks and optimize time to meet specific deadlines throughout the Spring of 2024. The timeline was designed with the aim statement in mind. This timeline incorporated informative meetings with stakeholders, such as the CPQS, nurse educators, and nurses where needs were assessed and communicated, and a corresponding plan was orchestrated. A fishbone analysis, depicted in Appendix E, was used to assist in discovering areas and processes to improve relative to the site’s microsystem’s identified problems (Institute for Healthcare Improvement, 2017). The fishbone analysis is a diagram in which the layout provides a visual aid in presenting causes that contribute to effects or outcomes (Institute for Healthcare Improvement, 2017). A SWOT (Strengths, Weaknesses, Opportunities, Threats) analysis (see Appendix F) was created to inform the intervention while comparing the site’s internal strengths and weaknesses to its external opportunities and threats. These tools were helpful in coordinating the QI team’s intervention of nurse education. Each of these resources were effective during different stages of the QI project’s implementation process. These resources guided the EBP research and literature synthesis, microsystem analysis, gaps in practice assessment, and data collection.

A cost-benefit analysis, outlined in Appendix G, was drafted to identify and compare costs of the current financial state (problem) with the improved financial state (without problem) of the QI site’s microsystem. In an attempt to reduce length of stay by two days, a vast difference
of $133,563.10 (cost avoidance) in annual costs was calculated when comparing the expenses of increased length of stay (with errors) vs. average length of stay (without errors). With the annual cost of training by a clinical nurse leader and the annual cost of educating each RN across the three acute care units, an amount of $61,126.65 (at the hospital’s expense) was generated. The hour of education that each RN will be receiving is comprised of a presentation, video demonstration, and hands-on training. With this one-time training and annual review/updates, a total of $72,436.45 was introduced as the potential project’s savings for the site’s microsystem.

**Intervention**

The QI team performed an intervention of nurse education. On April 11, 2024, the nursing students educated inpatient pediatric acute care unit RNs on the recommended process of prolonged IV antibiotic setup and administration and the reduction of medication errors via a comprehensive educational video demonstration and supplemental PowerPoint presentation. The video was less than six minutes, and the overall presentation was approximately 15 minutes. The video was guided and approved by the CPQS, and a senior RN based on accuracy of existing policies, standards, and rationales. The accumulation of information was gathered to reach simplification and standardization. The presentation covered background information such as, definitions, rationales, and supplies needed for prolonged IV antibiotics. The PowerPoint presentation was also approved by the CPQS and is to be made available online for RNs and new doctors to view as a teaching tool.

**Study of the Intervention**

The study of the intervention is the PDSA (Plan, Do, Study, Act) cycle (see Appendix H) which is a continuous improvement model that is useful in testing, documenting, evaluating, and adapting to change (Institute for Healthcare Improvement, 2017). The change to test is increased
knowledge to improve RN performance. The plan involved data collection via stakeholder feedback and the incident reporting system as well as observing RNs setup and administer prolonged IV antibiotic on each acute care unit. The test was carried out via a needs assessment survey and pre- and post-video (intervention) quizzes upon the implementation of the comprehensive educational video demonstration. Results of the survey and quizzes were compared and studied by the QI team. Upon (potentially) integrating the video throughout RN orientations, staff meetings, and the employee website’s homepage, the plan of action is for the RNs to adapt. The next step of the cycle is to evaluate the effectiveness of the intervention semiannually, making the appropriate changes where necessary.

Outcome Measures

The outcome measurements are increased percentage of inpatient pediatric RN self-reported knowledge and a reduction in medication errors. Self-reported knowledge was measured via a pre- and post-video (intervention) quiz whose results are illustrated in Appendix I and Appendix J, respectively. The pre-video quiz was to assess RN baseline knowledge. The post-video quiz was to evaluate the effectiveness of the RN education intervention by comparing the results of the pre- and post-video quizzes. These quizzes were distributed via quick response codes at a joint staff acute care meeting with over 90 RN attendees. The pre-video quiz attained 69 responses and the post-video quiz obtained 66 responses. Compared to the initial needs assessment survey, the pre- and post-video quizzes gained an additional 11+ responses. Between the four identical knowledge assessment questions posed on both quizzes, there was an average 8.5% increase in RN self-reported knowledge immediately following the intervention.
Results

With the increased RN participation from the initial needs assessment survey (55 responses) to the post-video survey (66 responses), there was also an increase in level of confidence. In the needs assessment survey results, the percentages from the respondents who strongly agreed to both statements seen in Appendix K were 34.5% and 38.2%, respectively. In the post-video survey results, the percentages from the respondents who strongly agreed to both statements seen in Appendix L were 53% and 66.7%, respectively. The QI team received positive feedback regarding their intervention and collaborative efforts. The video and presentation were well-received with gratitude. Some staff members voiced their appreciation for the QI team initiating this project. The QI team was grateful for the high volume of active RN participation in the initial needs assessment survey and quizzes. Unfortunately, the results’ effect on improvement of the microsystem’s units, patients, and staff could not be analyzed due to the limited three-month timeframe of this QI project.

Discussion

Summary

This QI project’s key findings signify that stakeholder buy-in and RN education can positively impact the intervention and quiz results. The QI team surpassed the specific aim and expectation of increasing RN self-reported knowledge from 5% to 8.5%. Although it was not feasible for the QI team to collect post-intervention data, this percentage has the potential to rise if this QI project continues to be maintained. One strength that contributed to the successful change of this project is that the QI team chose a project that not only consisted of conflicting information and common practices that lacked standardization between three units, but also obtained stakeholder buy-in throughout the implementation process. Another strength is that the
QI team had a simulation room, faux patient, and appropriate supplies made available to them while executing the video demonstration. Moreover, the video and presentation were free of cost and will potentially be accessible online at any time for RNs and new doctors to view.

**Limitations**

With the limitation of this QI project’s three-month timeframe, a comprehensive retrospective chart review could not be conducted. Additionally, improved RN performance, reduction in medication errors, and decreased length of stay could not be measured. If this project were to be replicated in the future, it would be ideal for the QI team to have ample time to launch the project and witness the results. Moreover, the data collected from the incident reports is subjective and may not accurately reflect all acute care unit prolonged IV antibiotic errors as some errors may not be discovered, reported, or documented.

**Conclusion**

The QI team chose a useful and sustainable project being that among the three acute care units, standardization and education of prolonged IV antibiotic practices was a prevalent issue needing a change. To assist the QI team’s efforts in organizing and launching this QI project, it is with hope that going forward, the nurse educators and quality managers of the acute care microsystem will maintain this project and RN education via orientations, staff meetings, and the employee website’s homepage. The sustainability of this project, knowledge, and training has the potential to improve RN performance, reduce medication errors, and decrease length of stay and costs upon ongoing data collection and monitoring. The implications for practice are to advocate for equitable patient care, spread knowledge using EBP, and improve patient outcomes. Although increases in knowledge and level of confidence were observed, it is recommended for
the effectiveness of the intervention and RN performance to be evaluated semiannually, at minimum, reflecting accurate, up-to-date information.
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Appendix A

Needs Assessment Survey Results (non-exhaustive)

How often do you utilize tip sheets in your practice?

Have you ever used the Extended Infusion of Antibiotics Tip Sheet?
55 responses

Have you ever used the Extended Antibiotic Infusions M.E.O.W sheet?
55 responses

What would you like to see as an educational tool to help reduce errors related to the setup and administration of prolonged IV antibiotics?
55 responses
## Appendix B

Johns Hopkins Evidence Appraisal Table

Evidence Table for Literature Review
N660B / N670

<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>Abbas, S., Lee, K., Pakay, A., Markley, D., Cooper, K., Yanheegor, G., Doll, M., Bearman, G., &amp; Stevens, M. P. (2019). Knowledge, attitudes, and practices of bedside nursing staff regarding antibiotic stewardship: A cross-sectional study. <em>American Journal of Infection Control</em>, 47(3), 230–233. <a href="https://doi.org/10.1016/j.ajic.2018.09.088">https://doi.org/10.1016/j.ajic.2018.09.088</a></td>
<td>Quantitative, Cross-Sectional Study</td>
<td>This study was conducted at Virginia Commonwealth University Health System in Richmond, Virginia. In this 866-bed tertiary care academic center, ASPs have existed for 20 years. A 12-question online survey, analyzing the knowledge, attitudes, and practices of bedside nurses was given to nursing staff via REDCap. There were 159 total responses which incorporated identification of barriers relative to nurse participation in ASPs. The study population consisted of all nurses employed at VCUJHS, despite age, gender, education, experience, and areas of practice throughout the hospital (n = 3,485). Participant responses were anonymous, confidential, and voluntary.</td>
<td>In acute care units across the United States, approximately 20%–40% of antibiotic use and the engagement of nurses in ASPs is less than optimal. Most states do not have nursing staff represented in ASPs or national AS meetings. Additionally, nursing education programs typically do not involve AS training. This leads to nurse unfamiliarity or insecurity of AS concepts and core principles. There is a need for role identification and clarity for nurses in AS which can be provided by the CDC and Joint Commission. This problem can be addressed by educating nurses about specific ASP goals, including them in stewardship rounds, and establishing programs to disseminate key concepts of microbiology and pharmacology pertaining to AS.</td>
<td>Level III-B</td>
<td>Good quality due to fairly definitive conclusions and reasonably consistent recommendations.</td>
</tr>
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<tr>
<td>Systematic Review and Meta-Analysis with Randomized Controlled Trials</td>
<td>A systematic review and meta-analysis of RCTs was performed via the following four online medical databases: Central, Embase, Scopus and Medline (via PubMed). A total of 19,980 articles were analyzed. Overall, 25 studies were incorporated into the systematic review. 19 studies were involved in the final meta-analysis. The 19 studies were composed of 4,195 patients from the United States (7), Angola (2), China (2), Mexico (2), Thailand (2), Egypt (1), Estonia (1), France (1), and Switzerland (1).</td>
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<tr>
<td>Pediatric patients are frequently affected by antibiotic misuse, subtherapeutic levels, treatment failure, and inappropriate doses. Treatment failure can increase the risk of antibiotic resistance; therefore, TDM is crucial. Antibiotic resistance can be prevented with the maintenance of appropriate plasma concentrations in the target range. Beta-lactams are antibiotics that are dependent on time. This study includes data that demonstrates EIs of beta-lactams significantly reduces pediatric mortalities with quicker elimination of microbes than short-term infusions. Short, intermittent infusions are defined as ≤50 minutes and CIs or ELs are defined as ≥3 hours. EI of beta-lactams should be contemplated, especially for children who are critically ill.</td>
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<tr>
<td>Level I-A</td>
<td>High quality due to consistent recommendations based on scientific evidence, data transparency, and insightful data interpretation.</td>
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<tr>
<td>Limitations: A low number of cases were involved in some outcomes. RCTs and observational cohorts were examined together. A broad range of patients were enrolled according to their age and comorbidities. Doses varied depending on whether or not a bolus was administered prior to the first prolonged infusion. In some cases, the microorganism was either unconfirmed or culture data was not accessible. A total of 10 studies either used concomitant antibiotics or did not get reported. Data was missing regarding TDM, target attainment, and microbe elimination. Publication bias could not be properly evaluated due to the low number of studies. Mortalities are affected by comorbidities, immunodeficiencies, and the need for respiratory or inotropic therapy. Outcomes: Cases of critically ill children who were treated with CI of beta-lactams indicated a 76.2% achievement rate of optimal target range. The duration of symptomatic remission was smaller in EIs.</td>
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</tr>
<tr>
<td>Systematic Review and Meta-Analysis with Randomized Controlled Trials</td>
<td>This study’s team systematically reviewed Cinahl, Embase, HealthStar. With increasing antibiotic resistance, it is vital for antimicrobials to be used.</td>
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<tr>
<td>Medline, Cochrane Clinical, and Trials Registry databases. A total of 26 studies were incorporated in this meta-analysis. 13 RCTs and 13 cohort studies were included in this study. Only RCTs were involved in the primary analysis. One of the 13 RCTs had the participants blinded to the interventions of the study. The other RCTs revealed concealment or intention to treat. The RCTs sample size ranged from 16 to 240 patients and the cohort studies ranged from 32 to 503. Most studies entailed one antibiotic (n = 22), usually with beta-lactam (n = 13), carbapenem (n = 6), or both (n = 4). Most studies utilized a continuous (n = 16) or extended (n = 8) infusion. optimally. Patients with severe illnesses have an increased risk for antibiotic resistance and related infections. This patient population is most likely to benefit from this study as the mention of PDD and its potential to improve patient-centered outcomes is something that is frequently discussed.</td>
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<tr>
<td>Level I-B</td>
<td>Good quality due to reasonably consistent results and fairly definitive conclusions.</td>
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<tr>
<td>Limitations: The number of enrolled patients in the studies was low. Most of the RCTs were not blinded. Given that most of the studies were not blinded and infections were caused by different microorganisms, this can potentiate bias, especially in reference to clinical cure. The majority of the studies in this review authorized the use of concomitant antibiotics and the remaining studies did not acknowledge whether or not their use was allowed. Concomitant antibiotics could have played a role in reduced outcomes. This analysis did not consider antibiotic dosing routine differences or severity of illness for patients. Severity of illness is a level of patient data that would have been difficult to obtain. Outcomes: Results from RCTs indicate that PDD decreases rates of clinical failure and ICU length of stay in severely ill patients when CI or EI of antibiotics is primarily used as opposed to traditional dosing methods. ICU patient mortality rate decline was observed with CI or EI of only Piperacillin/tazobactam and carbapenems. Piperacillin/tazobactam was not only discovered to be the most researched antibiotic, but also the only one to accompany an obvious decline in mortality.</td>
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<tr>
<td>4</td>
<td>Danier, K., Fabre, V. M., Attie, E., Smith, J., Adams-Sommer, V., Townsend, J., &amp; Inkh</td>
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<tr>
<td>Qualitative Study with Randomized Controlled Trials</td>
<td>The Johns Hopkins Hospital designed a custom A/E module within Epic to improve antibiotic-related health outcomes and When patients can benefit from a medical intervention, this module can help identify areas of improvement by sending out alerts according to the needs of Level III-A</td>
<td></td>
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<tr>
<td>High quality due to transparency of purpose and justified decisions, diligence</td>
<td></td>
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</tr>
</tbody>
</table>
| Limitation: The display of data is a limitation as it is challenging to establish reports that analyze trends over time and review them by unit, service, and antibiotic.
<table>
<thead>
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<tbody>
<tr>
<td>workflow as well as reduce cost and length of stay. The AS team collaborated with Epic IT via weekly hour-long telephone calls. the health system. Some areas of improvement are antibiotic bug-drug mismatch, antibiotic de-escalation, drug interactions, duplicate antibiotics, and excess therapy. One significant feature of the Epic AS is BPAs which notifies providers of potential prescribing issues. A point-value, patient scoring system was developed to help establish rules for customized notifications and scores for prioritizing patients, needs, and interventions that require sooner attention. of data collection, and insightful data interpretation. This may be a more prevalent finding in larger hospitals or facilities with more specialized units. Outcomes: Antibiotic de-escalation time (changing to a less broad-spectrum antibiotic) was reduced from ~29 hours to ~5 hours.</td>
</tr>
<tr>
<td>Non-Experimental Qualitative Study</td>
</tr>
<tr>
<td>Data was collected via an anonymous electronic survey from an existing database of pre-recruited pharmacists and nurses. The survey was coordinated by a third-party research organization. An email was sent to 173 pharmacists and 960 nurses. 58% of pharmacists and 52% of nurses responded. After excluding respondents who were not providers of direct care and who did not utilize a head height differential IV infusion system, the final sample for analysis was 25 pharmacists and 186 nurses (n = 11). The sample was comprised of various United States hospital types, sizes, and geographical locations. The sample contained 64% of male-identifying pharmacists and 77% of female-identifying nurses. Pharmacists ages ranged from 31-72 and their years of experience ranged from 6-49. Nurses ages ranged from 32-72 and their years of experience ranged from 6-44. Although there is not a strong connection between secondary infusion practices and antibiotic resistance, these findings suggest that current knowledge is inadequate which may be a factor in MDRs. Enhanced healthcare professional education and new, advanced technology are needed to improve the safety and operation of IV smart pumps. This is even more of a necessity since large volume IV smart pumps are the most commonly used infusion devices in acute care hospitals across the United States due to their capability in administering both medications and fluids. Limitation: The utilization of secondary data gathered from a third-party organization is a limitation. Outcomes: Less than half of survey respondents (40%) had knowledge of available manufacturer recommendations regarding positioning of the primary infusion bag and infusion pump. 49.5% of survey respondents had knowledge of the necessary head height differentials concerning secondary infusions. Only 12% of survey respondents acknowledged that infusion pumps are to be positioned at the level of the patient’s heart or insertion site for accurate fluid flow. The results indicated that the BD/Alaris IV smart pump is the most commonly used (57%).</td>
</tr>
<tr>
<td>Level III-A</td>
</tr>
<tr>
<td>High quality due to consistent recommendations based on thoughtful reference to scientific evidence, verification of methodological coherence, and insightful interpretation.</td>
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<tr>
<td>Experimental, Qualitative Study</td>
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<tr>
<td>Quality Improvement Study</td>
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<td>8</td>
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<tr>
<td>9</td>
</tr>
</tbody>
</table>
| Quality Improvement Project | This quality improvement study was conducted at a 255-bed tertiary care center, C.S. Mott Children’s Hospital. This hospital is located in Ann Arbor, Michigan and is a part of the greater Michigan Medicine health system. This study involved 32,912 (71%) of eligible pediatric surgical cases. All patients & stay and an improvement in clinical cure rates (only in loading-dose groups) of patients with severe sepsis or septic shock beyond a specific threshold. It was discovered that CEIs with loading doses were more beneficial in comparison with IA of beta-lactams. For CEI of piperacillin/tazobactam and increasing blood concentrations for accelerated target attainment, administering loading doses may be required.

EI may decrease nursing labor costs and the need for medical resources. CI may not be helpful if the infusion rate is set too low.

The antibiotic type and its target are equally important.

CEIs with loading doses demonstrated a significant improvement in clinical cure benefits after adjustments were made based on the type of beta-lactam. It is recommended that CEIs of carbapenem are used with loading doses to enhance clinical outcomes of severely ill patients.

| antibiotic prophylaxis delivery for pediatric surgical procedures. *Pediatrics*, 140(2), 1-8. https://doi.org/10.1542/peds.2020-001469 | 17 years of age who would undergo a surgical procedure from July 2015 to December 2019 were eligible for this study.

An interdisciplinary quality surgical team utilized the plan-do-study-act as part of their initiative. A timely manner as they can decrease the risk of SSIs after surgical procedures. Numerous safety gaps in antibiotic orders and delivery led to a lack of standardization in prescribing and administration of surgical antibiotic prophylaxis.

To incorporate guidelines into provider workflow, a hard stop for appropriate antibiotic orders was established and integrated into the EHR. advance to confirm the preparation of appropriate doses, deliveries, and availabilities at the bedside before patient transportation to the OR. Additionally, allergies and medication interactions were assessed. A specific antibiotic icon was added to the EHR to the preoperative medication column.

The rate of timely antibiotic prophylaxis administration per month at baseline increased from 38.0% to 94%. Timely antibiotic prophylaxis administration is based on the institution’s guidelines for what is defined as an appropriate timeframe.

This study’s implementation of a standardized EHR process offers numerous patient safety benefits with the potential to reduce medication errors. The interdisciplinary team engages in ongoing bi-monthly meetings to identify gaps and provide reconciliation. Team members also share data, optimization strategies, and learned experiences pertaining to timely antibiotic prophylactic administration. | Level V-A | High quality due to transparent limitations, self-reflection and self-critique regarding internal staff behaviors, and insightful interpretation. Limitations: There was no rate reduction of SSIs in this study. Staff behaviors exceeding interventions at this particular institution may be a contributing factor in improved antibiotic delivery time. Outcomes: Hospital staff (including nursing and pharmacy) were engaged in the daily process of verifying and reviewing patients with antibiotic orders in
Abbreviations: AET = Antibiotic Engagement Tool, AMR = Antimicrobial Resistance, AS = Antimicrobial Stewardship, ASP = Antimicrobial Stewardship Program, BD = Becton, Dickinson, BPAs = Best Practice Alerts, CDC = Centers for Disease Control and Prevention, CEI = Continuous Extended Infusions, CI = Continuous Infusion, EHR = Electronic Health Record, EI = Extended Infusion, FGD = Focus Group Discussion, IA = Intermittent Administration, ICU = Intensive Care Unit, IT = Information Technology, IV = Intravenous, LPN = Licensed Practical Nurse, MDROs = Multidrug-Resistant Organisms, NICU = Neonatal Intensive Care Unit, PD = Pharmacodynamics, PDD = Pharmacodynamics-based Dosing, PK = Pharmacokinetics, RCT = Randomized Control Trial, REDCap = Research Electronic Data Capture, RN = Registered Nurse, SSI = Surgical Site Infection, TDM = Therapeutic Drug Monitoring, VCUHS = Virginia Commonwealth University Health System
Appendix C

Statement of Non-Research Determination

Project: Statement of Determination and Non-Research Determination

Form

Student Name: Kiara Hayden, RN, CNI

Title of Project: Educating inpatient pediatric registered nurses on the setup and administration of prolonged intravenous (IV) antibiotics and the reduction of medication errors.

Brief Description of Project: During the Spring of 2024, a quality improvement team of University of San Francisco clinical nurse leader nursing students and a clinical practice specialist initiated a quality improvement project on the acute care units of a children’s hospital in California. The acute care units of this hospital encounter issues involving conflicting information of what the hospital’s standard practice of prolonged intravenous (IV) antibiotics is, inconsistencies in the materials and processes of prolonged IV antibiotic setup and administration, lack of awareness of and timely accessible educational resources, lack of hands-on training and knowledge, and incorrect healthcare provider orders in Epic. Unfortunately, these problems can result in negative patient health outcomes, delayed healing, antibiotic resistance, medication errors, and increased length of hospital stay and costs. By April 29th, 2024, of pediatric registered nurses (RNs) 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. The desired change in practice is standardized policy, utilization of the educational video, and improved RN performance. The outcome measurements are increased percentage of inpatient pediatric RN self-reported knowledge and a reduction in medication errors.

To qualify as an Evidence-based Change in Practice Project, rather than a Research Project, the criteria outlined in federal guidelines will be used:
(http://answers.hhs.gov/ohrp/categories/1569)

☐ This project meets the guidelines for an Evidence-based Change in Practice Project as outlined in the Project Checklist (attached). Student may proceed with implementation.

☐ This project involves research with human subjects and must be submitted for IRB approval before project activity can commence.

Comments: EVIDENCE-BASED CHANGE OF PRACTICE PROJECT CHECKLIST *

Instructions: Answer YES or NO to each of the following statements:

<table>
<thead>
<tr>
<th>Project Title: Educating inpatient Pediatric RNs on the setup and administration of prolonged IV antibiotics and the reduction of medication errors</th>
<th>YES</th>
<th>NO</th>
</tr>
</thead>
<tbody>
<tr>
<td>The aim of the project is to improve the process or delivery of care with established accepted standards, or to implement evidence-based change. There is no intention of using the data for research purposes.</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>The specific aim is to improve performance on a specific service or program and is a part of usual care. ALL participants will receive standard of care.</td>
<td>X</td>
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</tr>
<tr>
<td>The project is NOT designed to follow a research design, e.g., hypothesis testing or group comparison, randomization, control groups, prospective comparison groups, cross-sectional, case control. The project does NOT follow a protocol that overrides clinical decision-making.</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>The project involves implementation of established and tested quality standards and/or systematic monitoring, assessment or evaluation of the organization to ensure that existing quality standards are being met. The project does NOT develop paradigms or untested methods or new untested standards.</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>The project involves implementation of care practices and interventions that are consensus-based or evidence-based. The project does NOT seek to test an intervention that is beyond current science and experience.</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>The project is conducted by staff where the project will take place and involves staff who are working at an agency that has an agreement with USF SONHP.</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>The project has NO funding from federal agencies or research-focused organizations and is not receiving funding for implementation research.</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>The agency or clinical practice unit agrees that this is a project that will be implemented to improve the process or delivery of care, i.e., not a personal research project that is dependent upon the voluntary participation of colleagues, students and/or patients.</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>If there is an intent to, or possibility of publishing your work, you and supervising faculty and the agency oversight committee are comfortable with the following statement in your methods section: “This project was undertaken as an Evidence-based change of practice project at X hospital or agency and as such was not formally supervised by the Institutional Review Board.”</td>
<td>X</td>
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</tr>
</tbody>
</table>

ANSWER KEY: If the answer to ALL of these items is yes, the project can be considered an Evidence-based activity that does NOT meet the definition of research. IRB review is NOT required. Keep a copy of this checklist in your files. If the answer to ANY of these questions is NO, you must submit for IRB approval.

*Adapted with permission of Elizabeth L. Hohmann, MD, Director and Chair, Partners Human Research Committee, Partners Health System, Boston, MA.

STUDENT NAME (Please print): Kiara Hayden

Signature of Student: Kiara Hayden DATE: 3/06/24

SUPERVISING FACULTY MEMBER NAME (Please print): Dr. Nicole Beamish

Signature of Supervising Faculty Member: Dr. Nicole Beamish. DATE: 3/12/24
# Appendix D

GANTT Chart

## GANTT Chart

<table>
<thead>
<tr>
<th>TASK NAME</th>
<th>START DATE</th>
<th>END DATE</th>
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</thead>
<tbody>
<tr>
<td>Project Conception</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/PICO/T Question</td>
<td>1/28</td>
<td>2/7</td>
</tr>
<tr>
<td>Microsystem assessment/S 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>2/6</td>
</tr>
<tr>
<td>Meeting with medication administration</td>
<td>2/21</td>
<td>2/21</td>
</tr>
<tr>
<td>Project Planning</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>Project Implementation</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>Project Evaluation and Synthesis</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>

*Weeks 1-4 for January, February, March, April, May.*
Appendix E

Fishbone Analysis
Appendix F

SWOT Analysis

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

**Weaknesses**
- Nurse educators not providing requested individual hands-on training for RNs
- Three acute care units with different trainings, applications of policies, materials, and processes
- Various trainings, or lack of, for float RNs and travel RNs

**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 G

Cost-Benefit Analysis

**Educating Pediatric 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>$9,071.05</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>$9,071.05</td>
<td>$467,470.85</td>
</tr>
</tbody>
</table>

| Cost Avoidance               |                                      |                |                             | $133,563.10 |

<table>
<thead>
<tr>
<th>Implementation Cost</th>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Hourly rate ($) + 0.33% benefit</td>
<td>Number of hours needed</td>
<td>Number of nurses</td>
<td>Annual cost</td>
<td></td>
</tr>
<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>187</td>
<td>$29,536.85</td>
<td></td>
</tr>
</tbody>
</table>

Total Cost to Hospital $61,126.85

Project Savings $72,436.45
Appendix H

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.
Appendix I

Pre-Video Quiz, Knowledge Assessment Results

Can prolonged IV antibiotics be "Y'ed" with another compatible antibiotic?
69 responses

- Yes: 68.1%
- It depends: 13%
- No: 18.8%

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

- Primary (straight set) tubing without ports: 94.2%
- Secondary (IVPB) tubing: 1.3%
- Tubing of personal preference: 4.5%

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

- Flush with a saline syringe: 94.2%
- Connect it back to the maintenance fluids: 5.8%
- Flush with a bag: 1.3%

When is it appropriate to check the medication bag?
69 responses

- When the pump beeps off: 91.3%
- Every hour during PIV assessments: 8.6%
- When the bag, drip chamber, and line are empty/hun dry: 0.1%
Appendix J

Post-Video Quiz, Knowledge Assessment Results

Can prolonged IV antibiotics be "Yield" with another compatible antibiotic?

- Yes: 2 (3%)
- It depends: 2 (3%)
- No: 62 (93.9%)

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

- Primary (straight set) tubing without ports: 66 (100%)
- Secondary (IVPB) tubing: 0 (0%)
- Tubing of personal preference: 0 (0%)

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

- Flush with a saline syringe: 2 (3%)
- Connect it back to the maintenance fluids: 1 (1.5%)
- Flush with a bag: 63 (95.5%)

When is it appropriate to check the medication bag?

- When the pump beeps off: 2 (3%)
- Every hour during PIV assessments: 61 (92.4%)
- When the bag, drip chamber, and line are empty or dry: 3 (4.5%)
Appendix K

Needs Assessment Survey, Level of Confidence Results

I understand the rationale behind the use of prolonged IV antibiotics.

Please indicate your level of agreement with this statement

I feel confident in setting up and administering prolonged IV antibiotics.

Please indicate your level of agreement with this statement
Appendix L

Post-Video Quiz, Level of Confidence Results

I understand the rationale behind the use of prolonged IV antibiotics.

Please indicate your level of agreement with this statement.

I feel confident in setting up and administering prolonged IV antibiotics.

Please indicate your level of agreement with this statement.