Southern California CSU DNP Consortium

California State University, Fullerton
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# ENHANCING ANTIMICROBIAL STEWARDSHIP PROGRAMS WITH NURSE-LED INTERDISCIPLINARY ROUNDS

A DOCTORAL PROJECT

Submitted in Partial Fulfillment of the Requirements

For the degree of

DOCTOR OF NURSING PRACTICE

By

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ABSTRACT

Every year, millions of people in the United States are diagnosed with a multi-drug resistant organism (MDRO), increasing costs and mortality rates. The overuse and misuse of antimicrobial therapies contribute to the rise in MDROs which causes antimicrobial resistance (AMR). Antimicrobial Stewardship Programs (ASPs) can help decrease AMR in healthcare settings. The purpose of this project was to develop, implement, and evaluate a nurse-led interdisciplinary ASP within the acute care setting. Bedside nurses completed an online descriptive survey before and after implementing interdisciplinary stewardship rounds. Education on antimicrobial stewardship was provided to the bedside nurses using a web-based educational module, guided script for rounds, and just-in-time training. Shewhart charts were used to determine special and common cause variations related to hospital-onset Clostridium *difficile* rates, central line-associated bloodstream infections per catheter days, and catheter-associated urinary tract infections per catheter days. Engaging nurses and integrating nursing practice into ASPs led to increased utilization of nurse-driven catheter removal protocols and the rationalization of necessary treatments. The acceptance rates for discontinuing unnecessary antibiotic therapy and removing indwelling urinary catheters were 92% and 85%, respectively. Additionally, bedside nurses gained more knowledge regarding ASPs and their pivotal role in making a difference in AMR. Nurse-led interdisciplinary rounds are an effective strategy to implement and strengthen ASPs in acute care. Connecting the role of the bedside nurse to the difference they can make in AMR reveals that nurses who are educated and trained in antimicrobial stewardship can result in better patient outcomes.

*Keywords*: nursing, antimicrobial resistance, multi-drug resistant organisms, antimicrobial stewardship, interdisciplinary rounds, antibiotics, education, central line acquired bloodstream infection, catheter-associated urinary tract infection, telemetry

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## Background

Antimicrobial resistance (AMR) occurs due to the overuse and misuse of antimicrobial therapies causing multi-drug resistant organisms (MDRO). According to the Centers for Disease Control and Prevention [CDC, 2021), more than 2.8 million people are diagnosed with an MDRO every year in the United States. Moreover, a recent study revealed that estimated antibiotic resistance costs in the United States exceed $4.6 billion annually (CDC, 2021). The World Health Organization [WHO] (2021) agrees that antimicrobial resistance is a problem that calls for a global fight to prevent multi-drug resistance. The more resistant these organisms become, the fewer therapies clinicians have to treat patients. In the United States, about 30% of prescribed antibiotics within acute care settings were inappropriate (CDC, 2019). The most recent recorded death rate in the United States due to MDROs was an estimated 35,000 people (CDC, 2019). According to WHO (2021), if no action is taken, the death rate could be 10 million worldwide by 2050.

In 2017, The Joint Commission issued the Medication Management standard, MM.09.01.01, which requires antimicrobial stewardship programs (ASP) throughout healthcare settings to decrease AMR and promote the proper use of antimicrobials. Antimicrobial stewardship (AMS) is a form of clinical rounding for patients to optimize the use of antimicrobials, thereby reducing the risk of adverse events to patients, such as increased length of stay, acquisition of superinfections, and increased healthcare costs. Traditional ASPs have consisted of Infectious Disease (ID) physicians and pharmacists. However, including other disciplines allows for an expanded impact of stewardship. The involvement of multidisciplinary providers, including bedside nurses and infection preventionists, has improved patient outcomes and hospital-wide practices (Shah et al., 2017). The nurses' role in antimicrobial stewardship as

key advocates can help improve patient safety and quality of care and, as such, should be standard team members in ASPs (Carter et al., 2019; Olans et al., 2017; Monsees et al., 2018).

## Setting the Stage

### Statement of the Problem

In March 2022, the infection prevention department for a Magnet-designated community hospital in the greater Los Angeles area released its 2021 epidemiological surveillance reports. The reports revealed that a 24-bed, step-down trauma telemetry unit incurred six hospital-onset *Clostridium difficile* (HO-CDI), a multi-drug resistant organism. Each HO-CDI costs the organization $10,000 or more (D. Lira, personal communication, March 7, 2022). HO-CDI rates could be attributed to prolonged antimicrobial use and, in some cases, prevented by early assessment and timely collection of a stool sample.

Early removal of invasive lines to prevent new infections and monitoring antibiotic treatment is also a focus of stewardship efforts. The telemetry unit of interest acquired a central line-associated bloodstream infection (CLABSI), which accounted for an estimated $45,000 in further costs (D. Lira, personal communication, March 7, 2022). According to the Agency for Healthcare Research and Quality [AHRQ] (2017), a single CLABSI could cost anywhere from $13,000 to $48,000. Treating MDROs and hospital-acquired infections increases costs and extends the patient's length of stay due to additional complications. The organization has introduced interdisciplinary antimicrobial stewardship rounds within other telemetry units in the past. However, the nurses still lack a true understanding of and proper training in ASP. Standardized procedures exist to automatically stop antimicrobial therapies and prompt bedside nurses to discontinue invasive lines. In addition, there is a tool used to guide nurses on when to collect stool for suspected *C. difficile* infection. The proper utilization of these procedures within

the trauma step-down telemetry unit is unknown. While many efforts to address multi-drug resistance have been implemented within the hospital, there are no formal interdisciplinary stewardship rounds in the unit of interest to help guide consistent practice.

## Purpose

The purpose of this project was to develop, implement, and evaluate a nurse-led interdisciplinary antimicrobial stewardship program in a trauma step-down telemetry unit. The specific aims of this project were to a) increase bedside nurse knowledge of stewardship processes, b) evaluate nurses' attitudes towards ASP, c) increase proper utilization of nurse-driven catheter removal protocols and d) decrease hospital-onset Clostridium *difficile* infection (HO-CDI) rates per patient days, central line-associated bloodstream infections (CLABSIs) per catheter days, and catheter-associated urinary tract infections (CAUTIs) per catheter days.

## Supporting Framework – Iowa Model of Evidence-Based Practice

The Iowa Model of Evidence-Based Practice was the supporting framework used for this project to help guide and implement the process and intervention (Buckwalter et al., 2017). The model was first developed and utilized by the University of Iowa Hospitals and Clinics to guide evidence-based practice implementation for nurses in research (Titler et al., 2001). The Iowa Model has shown to be an effective framework for executing changes in various healthcare settings, especially since the revised model was released (Buckwalter et al., 2017). The model consists of seven steps and provides three decision points that are easy to follow. Testing the interventions through smaller, pilot studies before implementing the project throughout the entire organization is highlighted in this model (Titler et al., 2001).

Permission to use the model for this DNP evidence-based practice project was obtained from the University of Iowa Hospitals and Clinics (Appendix A).

**First Step – Identify Issues**

The first step in the Iowa Model was to identify an area of improvement needed in the organization. According to Titler et al. (2001), an organization will usually align with projects that have a high-cost factor. As previously described in the background, MDROs are a huge burden to the patient and cost the organization thousands of dollars. This project has clinical, organizational, national, and regulatory body implications. Clinically, improvement was warranted based on the epidemiological surveillance reports and patient outcomes. As an organizational goal, it is important to strive for excellence and provide holistic care. Nationally, efforts to reduce MDROs are a priority in healthcare. Finally, The Joint Commission helps regulate and recommend best practices for ASP.

**Second Step – State the Purpose**

The purpose of this project was to implement interdisciplinary stewardship rounds with bedside nurses in a step-down trauma telemetry unit to achieve better patient outcomes. This included developing an educational program for bedside nurses and creating a sustainable effort for nurses to make stewardship decisions daily. Specific aims were developed based on the priorities and need for improvement within the unit.

**Decision Point – Priority for the Organization**

This first decision point required the approval of ASP implementation from all stakeholders of the various disciplines, including the telemetry unit's leadership team. This author met with the telemetry leadership (including the director and manager), pharmacy manager, and infection prevention members to discuss the importance and feasibility of ASP rounds. The full support of the overarching leadership in the organization led to the third step. Approval was also necessary from this author's DNP Consortium team leader and team

members, Dr. Rachel McClanahan and Dr. Penny Weismuller, respectfully. These members were pivotal in assisting with the project and framework moving forward.

**Third Step – Form a Team**

Forming a team and establishing each team member's role was an important step in an EBP project. For this project, the multidisciplinary team consisted of representatives from nursing, pharmacy, infectious disease, infection prevention, and information technology (IT). Nursing representation consisted of the manager, director, and telemetry champion of the intervention unit. Pharmacy was represented through the manager and infectious disease-trained pharmacists who are experts in antimicrobial therapy. The infection preventionists were part of the team for their expertise in hospital-acquired conditions (HACs). An IT expert specializing in creating reports for the electronic medical record system and extracting data was also included. Finally, the support of the medical director for infectious disease was sought to enhance the support for stewardship rounds.

**Fourth Step – Assemble, Appraise, and Synthesize Body of Evidence**

The next step was to gather evidence supporting robust stewardship programs and the value nurses can contribute when directly involving them. Conducting a literature review, creating a table of evidence, and synthesizing the evidence was a critical step in the process. This fourth step was iterative, which helped pinpoint gaps and identify key strategies to optimize components of the intervention (Iowa Model Collaborative, 2017).

**Decision Point- Sufficient Evidence?**

At this point, a decision was made if there was compelling evidence to support the proposed practice changes. Enhancing an antimicrobial stewardship program with nurses could

lead to better outcomes for patient-centered care. A proposed interventional program for implementing nurse-driven interdisciplinary telemetry rounds was made.

**Fifth Step – Design and Pilot the Practice Change**

Many factors were included within this step to strategize the implementation of nursing ASP rounds. When designing the practice change, an important factor was considering how it will be patient-centered. Integrating patients and their families leads to stronger engagement and improved outcomes (Buckwalter et al., 2017). Meeting with key stakeholders, creating tools for clinicians, developing an educational plan, and deciding on the data collection system are all components that were needed to design the pilot study. Education specific to the telemetry nurses' needs provided meaningful engagement when the practice change started. A solid design was essential to the project's execution.

**Decision Point- Appropriate for practice?**

The implementation of this project was feasible, proposed outcomes were mostly met, and widely accepted by the interdisciplinary unit. A sustainable effort to keep nurse-driven stewardship rounds incurred. This final decision point determined if the change remained a standard in the unit.

**Sixth Step – Integrate and Sustain the Practice Change**

After the decision to continue the practice was made, the nurses adopted ASP as standard practice within the telemetry unit of interest. This success of practice change can help to further expand and implement this program house-wide. The ultimate goal was for nurses to be confident and perform stewardship for their patients even when there are no formal rounds.

**Seventh Step – Disseminate Results**

This final step occurred once the project has been completed and this author has compiled the findings and made conclusions. Dissemination of this project is scheduled to occur in April 2023. Disseminating the results of an evidence-based project can add value to nursing practice, especially when change leads to improvement within the organization (Titler et al., 2001). Sharing successful outcomes can encourage other organizations to implement the same practice change.

## Review of Literature

The purpose of this project was to develop, implement, and evaluate a nurse-led interdisciplinary antimicrobial stewardship program in a trauma step-down telemetry unit. The specific aims for this project were to a) increase bedside nurse knowledge of stewardship processes, b) evaluate nurses' attitudes towards ASP, c) increase proper utilization of nurse-driven catheter removal protocols, and d) decrease HO-CDI rates per patient days, central line-associated bloodstream infections per catheter days, and catheter-associated urinary tract infections per catheter days.

Antimicrobial stewardship, previously known as drug utilization review in 2005, was limited to a physician's responsibility. Over the past ten years, AMS activities have evolved, and the involvement of multidisciplinary teams is now standard practice. Based on the current state of the knowledge, ASPs have only started expanding and formally involving bedside nurses since 2016. A review of the current literature was conducted to answer the following questions: what is the role of bedside nurses in ASPs?, what are the barriers to implementing ASPs?, what are best practices for ASPs that help achieve outcomes?, what can help create nurse involvement in ASP?, do nurses know what ASP is?, and what creates interdisciplinary sustainability?

Relevant literature was searched with the assistance of a research librarian from CSUF Pollak Library. Databases used for the search included CINAHL, EBSCO, PubMed, Cochrane Library, and Google Scholar. The following key major subject headings and MeSH terms were utilized to perform the search: "antimicrobial stewardship," "nurses," and "nursing." The initial search yielded 1,303 articles dating back to 2016. Then, the following exclusions were applied: "nursing home or nursing homes," which resulted in 98 articles. For this project, only studies in acute care settings were included to support the step-down telemetry unit of interest. Articles

included in the review were written in English, peer-reviewed, using various methodologies, and published within the past five years (2017-2022). When inclusion criteria were applied, 91 studies remained. Additionally, the reference lists of a literature review and systematic reviews were hand-searched and yielded one white paper. Abstracts, poster presentations, duplicates, continuing education articles, non-acute care settings, and studies not involving multidisciplinary involvement were excluded. After further exclusion, 32 studies remained.

The final table of evidence included 12 studies which contained four qualitative studies, one quasi-experimental study, six observational studies, and one white paper.

## Operational Definitions

### Antimicrobial Stewardship

Antimicrobial stewardship seeks to optimize antimicrobial use and infection control practices to prevent antimicrobial resistance and unnecessary harm (CDC & ANA, 2017). Many terms for AMS are widely used interchangeably in the literature, such as antibiotic stewardship, antimicrobial stewardship, stewardship, stewardship rounds, stewards, and drug utilization review. For the purposes of this project, antimicrobial stewardship will be the term used to describe this practice.

### Antimicrobial Stewardship Program Goals and Aims

Antimicrobial stewardship programs are continually expanding their efforts and objectives. The CDC has listed core elements of hospital antibiotic stewardship programs as Hospital Leadership Commitment, Accountability, Pharmacy Expertise, Action, Tracking, Reporting, and Education (CDC, 2019). Due to the focus on nursing, this project will expand on the AMS practices that bedside nurses can influence.

## Body of Literature

The following topics are covered in this review based on the table of evidence developed for this project: (a) Nurses in Antimicrobial Stewardship, (b) Multidisciplinary Involvement, (c) Outcomes of ASP, (d) Challenges with Bedside Nurse-Led ASP, and (e) Sustainability and Engagement.

## Nurses in Antimicrobial Stewardship

Bedside nurses, as the direct link between the patient and physician, can utilize their expertise to improve ASPs and impact patient outcomes (Ha et al., 2019). Bedside nurses report key assessments and make early recommendations crucial in making stewardship decisions. Integrating nurses in ASP is a recent development that has improved patient safety and delivered quality patient care (Ha et al., 2019, Monsees et al., 2018).

### Role of the Bedside Nurse in ASP

While the role of bedside nurses has become more recognized in recent years, they are underutilized and integrated as core members of ASP only 54% of the time (Carter et al., 2019). The nurses' role in ASPs includes appropriately obtaining samples for culture analysis, timely antibiotic initiation, correctly documenting allergies, accurately reporting abnormal assessments like diarrhea, isolation practices, communicating sensitivity reports for antimicrobial adjustment and de-escalation, transitioning from IV to PO medications, and identifying end dates of antimicrobial therapy (Carter et al., 2019; CDC & ANA, 2017; Fisher et al., 2018; Monsees et al., 2018; Olans et al., 2017).

Most importantly, bedside nurses have a continuous connection to patients, which allows them to educate them on antibiotics and infection control practices that prevent AMR (Monsees

et al., 2018; Olans et al., 2017). Many of the bedside nurse's daily responsibilities are related to AMS efforts (Olans et al., 2017).

### Bedside Nurse ASP Knowledge

Bedside nurses need to understand the rationale behind their patients' therapies to prevent unnecessary administration of antibiotics. Some studies suggest that bedside nurses with baccalaureate or higher degrees admit to administering inappropriate antimicrobial therapy (Monsees, Lee, et al., 2020). Education and guides should include basic antibiotic therapy and duration, basic microbiology, allergy history training, and true infection versus colonization (CDC & ANA, 2017; Monsees et al., 2018). Carter et al. (2019) indicated that 97% of nurses collected urine cultures due to the misconception that cloudy urine was a symptom of possible urinary tract infection, which led to inappropriate antibiotic therapy.

Antimicrobial stewardship education for nurses should begin pre-licensure and continue during independent practice (CDC & ANA, 2017; Fitzpatrick et al., 2021; Jeffs et al., 2018). Increasing a nurse's knowledge and confidence in a patient's plan of care can strengthen the ability of the nurse to advocate for patients effectively (Carter et al., 2019; Fisher et al., 2018; Monsees, Goldman, et al., 2020). Bedside nurses require formal education and training regarding AMS to integrate into daily practice.

## Multidisciplinary Involvement

A comprehensive team consisting of an ID pharmacist and infection preventionist can help nurses initiate conversations with the attending physician regarding ASP (Ha et al., 2019). Infection preventionists are in constant dialogue with nurses and provide infection control practices regarding resistant organisms (Carter et al., 2019; Monsees, Goldman, et al., 2020).

Nurses have the support of the interdisciplinary group to justify the recommendations made during the rounds process when they speak to the physician, thereby increasing trust and confidence (Fisher et al., 2018; Ha et al., 2019; Monsees, Goldman, et al., 2020). Pharmacist involvement is necessary for their expertise in therapy guidelines but can also help facilitate conversations with physicians (Shah et al., 2017; Kirby et al., 2020). Finally, the clinical informaticist's involvement in developing data collection and ASP rounds tools can help facilitate real-time interventions (Kapadia et al., 2018). Antimicrobial stewardship programs require a team effort from various disciplines to address the multi-layered complexities of antimicrobial resistance (Jeffs et al., 2018; Kirby et al., 2020).

## Outcomes of ASP

This project must address the clinical outcomes that ASP can have and its implications on quality care. After implementing multidisciplinary ASPs, statistical significance for antimicrobial utilization averaged with an overall reduction (Ha et al., 2019; Shah et al., 2017). When involving nurses in ASP, inappropriate usage of various treatments related to AMS was identified (Ha et al., 2019; Shah et al., 2017). For example, specific treatments for asymptomatic bacteriuria were found to be unnecessary 45 to 65% of the time (Shah et al., 2017).

Clinical outcomes examined were CLABSI, CAUTI, and HO-CDI rates but were limited to findings by Ha et al. (2019). In one study, interdisciplinary efforts often recommended de-escalation of antimicrobials and stop-date referrals (Shah et al., 2017). The literature revealed little knowledge of the outcomes of physician consultation after therapy was recommended as inappropriate.

Existing policy and procedure, standardized protocols, and ongoing performance improvement projects are extrinsic factors that may have affected specificity. Overall, after ASP inception, the studies that measured patient outcomes were improved but lacked homogeneity.

## Challenges with Bedside Nurse-Led ASP

An organization's culture and environment are integral in fostering new ideas and change. Bedside nurses have reported hospital culture as a barrier to integrating themselves into ASP (Monsees et al., 2018). Most ASP studies either took place in a Magnet facility or had preemptive buy-in, which may imply explicit bias to do well and affect generalizability (Fitzpatrick et al., 2021). Physician resistance remains an obstacle when treatment recommendations are suggested by bedside nurses (Fisher et al., 2018; Fitzpatrick et al., 2021; Kirby et al., 2020). A physician's perception of questioning orders can be considered intimidating and outside of a nurse's scope (Monsees, Goldman, et al., 2020; Monsees et al., 2018). However, initiating the conversation about the appropriateness of therapies can at least bring the matter to the attention of the physician and pharmacist for further follow-up (Fisher et al., 2018; Monsees, Goldman, et al., 2020; Monsees, Lee, et al., 2020). Integrating an effective process in the electronic medical record is needed to provide real-time data, guide clinicians in decision-making, and create one system with interoperability for data follow-up by all disciplines (Ha et al., 2019; Kapadia et al., 2018). Limitations regarding information technology include users' data input errors, lack of infrastructure, and lack of data analysis (Kapadia et al., 2018; Shah et al., 2017).

The literature revealed that physician disagreement, unsupportive hospital culture, lack of information technology support, and limited multidisciplinary involvement are all challenges that acute care settings can encounter.

## Sustainability and Engagement

While there may be challenges incorporating nurses in ASPs, there are also many key strategies to promote and sustain this practice within healthcare settings. The literature revealed the following approaches to successful ASPs with nurses: conversational tools, leadership involvement, and meaningful education.

### Conversational Tools

Various aspects to ASP can keep nurses engaged and stay committed to AMS practices. Making therapy recommendations to a physician can be daunting for a nurse. Confidence in new practice can be facilitated by tools such as scripts that serve as conversation examples to follow. Utilizing scripts can help engage AMS practice, easily start open-minded conversations with physicians, and naturally become part of the routine (Jeffs et al., 2018; Monsees, Lee, et al., 2020).

### Leadership Involvement

High engagement from ASP champions and organizational leadership, such as nurse managers and directors, is also essential in successful stewardship rounds for support and sustainability (Ha et al., 2019; Jeffs et al., 2018; Monsees, Goldman, et al., 2020). Leaders can create a culture for nurse involvement in ASP and its importance to the organization. Leadership support and involvement may differ from one organization to the next, affecting transferability (Kirby et al., 2020). Collectively, the literature agrees that leadership is a key element in fostering the idea and actual involvement of nurses in ASP.

### Education

A sustainable ASP also requires incentives such as continuing education credits and reinforcement for ongoing education (Fitzpatrick et al., 2021; Jeffs et al., 2018; Monsees et al.,

2018). Adding another task to a nurse's daily routine requires a meaningful purpose, and by educating nurses, that purpose can be achieved. ASP can not only help patients, but it can also ease the daily tasks of the bedside nurse. Interestingly, AMS practices such as de-escalation from IV to PO increased nursing efficiency and confidence in the purpose of their medication administration (Fisher et al., 2018). This can also help nurses to help correctly educate their patients on their medication regimens.

Gaps in knowledge regarding engagement include an inaccurate representation of the nursing population. More studies are required in various units within the acute care setting to increase generalizability and reliability (Monsees et al., 2018). Most studies on engagement were conducted with voluntary involvement or small sample sizes, which may only correspond to nurses with ASP interest (Fitzpatrick et al., 2021; Jeffs et al., 2018; Monsees, Lee, et al., 2020).

Bedside nurse engagement and ASP sustainability are increased when there is support from upper management, clear ASP understanding, nursing practice benefits, and established frameworks to help guide nurses while participating in AMS (Carter et al., 2019; Jeffs et al., 2018; Monsees, Goldman, et al., 2020).

## Summary

This literature review provides convincing evidence of the integral roles that bedside nurses have in antimicrobial stewardship. Nurses are stewards. There is a need for more studies related to the nursing ASP functions proposed by the CDC and ANA White Paper (2017). Considering the evidence that nurse-led interdisciplinary ASP improves outcomes in the acute care setting, the approach to how best to engage and formalize the process is limited. However, the literature recommends that sustained ASP bedside nurse practice must involve nursing

leadership support, a change-oriented environment, mutual respect with physicians, and continued education for bedside nurses.

## Methods

The purpose of this project was to develop, implement, and evaluate a nurse-led interdisciplinary antimicrobial stewardship program in a trauma step-down telemetry unit. The specific aims for this project were to a) increase bedside nurse knowledge of stewardship processes, b) evaluate nurses' attitudes towards ASP, c) increase proper utilization of nurse-driven catheter removal protocols, and d) decrease HO-CDI rates per patient days, central line-associated bloodstream infections per catheter days, and catheter-associated urinary tract infections per catheter days.

Stakeholders included representatives from nursing, pharmacy, infectious disease, infection prevention, and information technology (IT). Nursing representation consisted of the manager, director, and telemetry champion of the intervention unit. A letter of support from the Nursing Director of Clinical Operations (Appendix B) was obtained by this author to complete this project and access data necessary to evaluate outcomes. Pharmacy was represented through the manager, infectious disease pharmacist, and infectious disease-trained pharmacists. The infection preventionists provided surveillance and insight surrounding infection control practices. A clinical informaticist analyst from the IT Department assisted in creating the rounds criteria report, electronic data collection form, and helped with obtaining data pre- and post-implementation of the ASP on the telemetry unit of interest. The project proposal was presented at the hospital's antimicrobial stewardship committee in March 2022. The support of the medical director for infectious disease was granted for this project and continuous implementation of nursing stewardship rounds.

## Project Design

This EBP project utilized descriptive data and program development, implementation, and evaluation design. Pre-implementation baseline data from 24-months prior to implementation of the change was collected related to the specific aims. Data was collected pre-implementation utilizing infection prevention and pharmacy databases specific to the telemetry unit. Six months of post-implementation data was extracted using the electronic medical record from the electronic rounds' documentation tool and the departments that provided pre-implementation data. An electronic survey was conducted pre- and post-intervention regarding ASP knowledge and nurse attitudes towards ASP.

## Participants

A convenience sample was used for patient encounters to be rounded on, bedside nurses participating in rounds, and nurses participating in pre-and post-survey. Patients being rounded on were based on the round's criteria report tool (Appendix F). The primary nurses of the patients being rounded on participated in ASP. Licensed vocational nurses, nurses who do not receive ASP education, temporary-contract nurses, nurses on leave of absence during the implementation phase, and nurses who do not perform direct patient care as their primary role were excluded. Participants were included regardless of degree and years of professional experience.

## Setting

This project was implemented in a 24-bed, trauma step-down telemetry unit in a 412-bed, not-for-profit, Magnet-designated community hospital in the greater Los Angeles area of Southern California. The unit was staffed by 47 nurses with a rotating group of 15 hospitalists. An infectious disease pharmacist and infection preventionist was assigned to participate in ASP

rounds. A dedicated infectious disease medical director and the infectious disease pharmacist later reviewed complex cases identified during ASP rounds.

**Ethical Considerations**

The Institutional Review Board approval was obtained at both university and organizational levels. No anticipated risk of harm was foreseen for participants. The bedside registered nurses from the telemetry unit signed a digital consent before the survey and project implementation per IRB requirements. Participants' identities remained anonymous, utilizing confidentiality. All identifiers will be removed to ensure that demographic data will not be traceable back to survey data. Participation is voluntary, and participants will be able to withdraw from the project at any time. Patients' data from the electronic rounds tool via the electronic medical record will be de-identified. Data will be reported in aggregates to ensure confidentiality.

**Measures**

The pharmacy department provided the scope and cost of antimicrobial therapy use. Infection Prevention will trend safety, cost, and scope via HO-CDI rates per patient days, CLABSIs per catheter days, CAUTIs per catheter days, and actual patient days. Quality was measured using acceptance rates by prescribers related to recommendations made during ASP rounds utilizing the electronic rounds tool. A 15-question, pre- and post-online descriptive survey developed by Katreena Merrill, PhD, RN, was used to evaluate bedside nurse attitudes toward ASP. Permission to use the survey in this project was granted.

**Pre- and Post- Intervention Electronic Survey**

The fifteen-question survey was delivered via organizational electronic mail and utilized Survey Monkey, a secure online survey system, where participants will remain confidential. The

survey collected data relating to antimicrobial stewardship knowledge and perceptions towards ASP.

**Process Intervention**

An ASP nurse rounds coordinator and a pharmacist would pre-round to prepare the patient list. This ASP rounds report is the patient list that will target the patients who meet specific criteria necessary for stewardship. Criteria included patients who have antimicrobials ordered greater than 48 hours, have a central line catheter inserted, an indwelling urinary catheter in place, and/or patients with an order to collect stool for C. *difficile*. The ASP nurse rounds coordinator is a nurse champion from the telemetry unit who voluntarily committed to this project to advance her clinical level. The ASP rounds report developed with IT is utilized by the nurse champion and coordinates the workflow of rounds. The primary bedside nurse of the patient provides a brief presentation on the patient utilizing the ASP rounds script. If the therapy is unnecessary and does not meet clinical criteria per interdisciplinary expertise, the bedside nurse will follow up with the ordering physician to discuss the recommendation made by the team (e.g., recommend discontinuing a foley catheter with no order for clinical indication). An electronic ASP rounds documentation tool (Appendix A, Figure 4) is completed by the nurse rounds coordinator and pharmacist to track recommendations made during rounds to confirm if they were accepted or not accepted by the physician.

**Education for Bedside Nurses**

An educational plan was developed with the telemetry champion that consists of visual boards in the unit, ASP rounds script, and the antimicrobial stewardship educational module developed for nurses. The visual boards displayed facts about antimicrobial resistance, ASPs, and ASP nurse involvement. The ASP rounds script is a tool that nurses follow to report on their

patients regarding the ASP rounds' report criteria and to assist in conversations when making recommendations to discontinue therapies with the attending physician. The antimicrobial stewardship educational module was used to educate bedside nurses with obtained permission and use. The educational module is a three-part, interactive web-based module that introduces bedside nurses to the basics of ASP, laboratory, and pharmacy concepts. This tool was developed by Mary Catanzaro, RN, CIC, with the Hospital and Health System of Pennsylvania. Education specific to the telemetry nurses' needs will provide meaningful engagement when the practice change starts.

**Interdisciplinary Rounds Criteria Development**

Patients rounded on included any patient who met any of the following criteria: on antimicrobial therapy greater than 48 hours, have a central line catheter in place, an indwelling urinary catheter in place, have a stool specimen collection for *C.difficle* order pending, and/or are having active diarrhea. These criteria are based on the antibiotic 48-hour time-out standard, central line and urinary catheter surveillance, and diagnostic criteria for *C.difficile*.

**Interdisciplinary Rounds Team Development**

Several meetings were conducted with pharmacists, the telemetry champion, and the clinical informaticist to develop ASP structure. An implementation plan and standardized workflow were formulated. The interdisciplinary team decided when to meet for ASP rounds at a most convenient and productive time for bedside nurses to participate. The interdisciplinary rounds team agreed to: gather during the set time, listen to the bedside nurse's presentation of the patient, and give recommendations regarding the rounds criteria (Appendix A, Figure 2).

**Data Collection Methods and Analysis**

A clinical informaticist's expertise helped to create the rounds criteria report, electronic data collection form, and extract data pre-and post-implementation of the ASP rounds on the telemetry unit of interest. Pre-implementation data was retrieved from the hospital's surveillance and epidemiological reports. This author obtained the data reports three months post-implementation. Pre- and post-implementation data were analyzed via control charts on QI Macros that trended antimicrobial therapy use, HO-CDI rates per patient days, central line days per catheter days, and urinary catheter days per catheter days. The electronic survey platform automatically received surveys as they were completed. Responses from the electronic survey were collected and reported using bar graphs. Demographic data was collected via the electronic survey. The electronic ASP rounds documentation tool tracked the number of accepted recommendations made by the ASP team to the physician. Acceptance rates regarding antibiotics, central line catheters, and urinary catheters were analyzed based on the number of accepted discontinued therapy (numerator) divided by the number recommended to discontinue during rounds (denominator). All data collected was stored in the organization's secure network, on a password-protected computer, in a locked office, and destroyed upon project completion.

**Evaluation**

Pre- and post-implementation data were evaluated for any special variations utilizing control charts trending HO-CDI rates per patient days, central line days per catheter day, and urinary catheter days per catheter day. All antibiotic use was tracked quarterly per 1000 patient days. Acceptance rates by prescribers related to recommendations made during ASP will be revealed. Survey responses regarding bedside nurse attitudes will be evaluated to gain insight and integrate any changes if necessary. After project aims have been evaluated, the team will

determine the feasibility and acceptability of a nurse-led interdisciplinary ASP as a practice change. The generalizability of the ASP script and reliability of the rounds tool will be assessed. The process intervention's sustainability will depend on continued education, leadership support, and infrastructure. Integrating constant feedback from stakeholders and team members is necessary. This project was part of a poster presentation hosted by California State University, Fullerton’s College of Health and Human Development for dissemination.

## Results

The pre-implementation phase included the formation of the interdisciplinary team, educational tool development, nursing committee and IRB approval, electronic medical record integration, and logistics. Prior to the interventional period, education was done with the nursing staff of the telemetry unit with the help of the unit champion. The online educational modules were provided to all the registered nurses via a weblink but were not mandatory to complete. The pre-interventional survey information was emailed to each registered nurse of the telemetry unit. A flyer was also given to the nurse manager and unit champion to encourage participation.

### Pre- and Post-Implementation Survey

The survey was initially launched on October 21, 2022, for three weeks, which yielded 14 respondents. The post-implementation survey was open for two weeks, and 13 of the 14 participants completed it, with one respondent who skipped all of the questions. Results of the survey are found in Appendices D and E. The demographics of the survey respondents are displayed in Appendix C.

### Intervention Phase

The total number of nurse-led antimicrobial stewardship rounds completed from November 24, 2022, to February 21, 2023, was 12. The interdisciplinary rounds team met once a week on Thursdays at 10:30 am. Some weeks did not have rounds due to observed holidays. The total number of patient encounters completed during this period was 125.

### Antimicrobial Therapy

The total number of patient encounters on antibiotics was 108. The total number of patient encounters the team recommended for antibiotics to be discontinued was 25. The total

number of antibiotics accepted for discontinuation by the physician was 23. This resulted in an acceptance rate of 92%.

**Invasive Catheter Lines and HO-CDI**

The total number of patients identified with urinary catheters was 37, and 20 were evaluated as unnecessary per hospital standards. Of the 20 urinary catheters deemed unnecessary, 17 were discontinued, with an acceptance rate of 85%. Regarding urinary catheters, zero CAUTIs were reported for November to December 2022 and January 2023. There was a 22.72% decrease in urinary catheter days from October 2022 to November 2022. Moreover, central line catheter days decreased in January 2023 compared to November and December 2022. The telemetry unit also reported a CLABSI in January 2023.

The specific aims regarding central line-associated bloodstream infections per catheter days, catheter-associated urinary tract infections per catheter days, and HO-CDI rates per patient days are all shown in Appendix F, Figures 1-4. The data reflected is until January 2023 since the study was completed before the end of February 2023. In October to December 2022, the telemetry unit had zero cases of HO-CDI; however, in January 2023, the unit did incur one case of HO-CDI.

## Discussion

The purpose of this project was to develop, implement, and evaluate a nurse-led interdisciplinary antimicrobial stewardship program in a trauma step-down telemetry unit. The specific aims for this project were to a) increase bedside nurse knowledge of stewardship processes, b) evaluate nurses' attitudes towards ASP, c) increase proper utilization of nurse-driven catheter removal protocols, and d) decrease HO-CDI rates per patient days, central line-associated bloodstream infections per catheter days, and catheter-associated urinary tract infections per catheter days.

## Key Findings

The key findings of this DNP project suggest that nurse-led interdisciplinary rounds can help increase bedside nurse knowledge of antimicrobial stewardship, positively affect clinical outcomes, and strengthen the literature on nursing's role in antimicrobial stewardship. A key finding of this project indicates that bedside nurses are willing to be involved and educated on antimicrobial stewardship. Survey results indicate an interest among bedside nurses to learn more and be supported. In addition, acceptance rates greater than 80% for the removal of unnecessary indwelling urinary catheters indicate that weekly stewardship rounds are an effective method to increase nurse-driven catheter removal protocols. This project's contribution to the literature helps to strengthen sustainability factors, multidisciplinary involvement, and the difference that nurses can make in supporting stewardship processes.

### Survey on Bedside Nurses' Knowledge and Attitudes

Pre- and post-survey engagement was difficult to attain in general. This may be due to the existing learning modules and surveys that needed completion simultaneously within the

organization. In addition, some of the participants left for vacation and could not complete the post-survey until their return. Obtaining the responses would not have been possible without the manager's support. Overall, the aim of increasing bedside nurse knowledge of stewardship processes was achieved as post-survey results suggest (See Appendix D, Figures 1-3).

Although the sample size was limited, it is important to note that the new graduate nurse responded to the pre-survey as not having any knowledge of antimicrobial stewardship, which supports the need for nurses to attain such knowledge (CDC & ANA, 2017; Monsees et al., 2018). About 61% of nurses surveyed strongly agree that it is their responsibility to ensure proper antibiotic usage (Appendix D, Figure 14). Bedside nurses are considered the end-users who administer the medications. Interestingly, Q10 (Appendix D, Figure 7) asked if nurses should be involved in interventions aimed at improving antibiotic use which was 100% pre-survey but went slightly down to 83% post-survey. The principal investigator anticipated that nurses would feel more comfortable rather than not after stewardship started. However, about 69% stated they felt comfortable questioning an antibiotic post-survey compared to 92% pre-survey (Appendix D, Figure 7). This result suggests that nurses may be out of their comfort zone when conversing with physicians and recommending antimicrobial therapies.

Overall, survey responses showed increased positive attitudes and knowledge when comparing pre- and post-results. The survey participants revealed increased familiarity, increased knowledge, and feelings of ASPs being extremely important within the healthcare setting after implementing ASP rounds.

**Clinical Outcomes**

The outcomes of this project indicate that implementing nurse-led interdisciplinary antimicrobial stewardship rounds can increase stewardship efforts and decrease unnecessary antibiotic and invasive catheter use over time. Three Shewhart Charts (u-charts) were created to distinguish common and special variations of HO-CDI rates per patient days, central line days per catheter day, and urinary catheter days per catheter day. Prior to the implementation of ASP Rounds, the HO-CDI rates per patient day had an average control limit of 0.0005, which was lowered due to a possible process change. The start of a statistically significant decrease in the C. *difficile* rate may have been due to the re-education of the proper stool collection (including timing and appropriateness), which could explain the special cause variation after November 2021 (see Appendix F, Figure 1).

The average control limit for the CLABSI per catheter days chart was .0012 (Appendix F, Figure 2). The average control limit for CAUTIs per catheter day was 0.0007 (Appendix F, Figure 3). The upper control limits change monthly for Appendix F, Figures 2 and 3 due to variations in catheter days. Additional data points (at least 20) are required to reveal any special cause variations. Any positive CLABSI, CAUTIs, or HO-CDIs reported will appear as special causes since the goal is zero; however, the Shewhart chart can help determine the process stability and capability of ASP Rounds over time. Surprisingly, the reported CLABSI in January of 2023 may have been avoidable should ASP rounds have occurred, and the necessity, charting, and infection control practices could have been assessed by the interdisciplinary team. ASP rounds were not completed for two weeks due to the holidays.

Acceptance rates by prescribers related to recommendations to remove indwelling urinary catheters were 83%, which helped prove an increase in nurse-led catheter removal and led to a

reduction in catheter days. This study contributes to the current body of literature by revealing recommendations made by bedside nurses and the outcomes of physician consultation, which were not previously found in the literature review.

All antibiotic utilization and duration of treatment was tracked quarterly per 1000 patient days (Appendix F, Figure 4). The general utilization of antibiotic therapy was steady; however, more quarterly data is necessary to account for special cause or statistical significance. More importantly, the acceptance rate of 92% for discontinuing inappropriate antibiotics reveals savings in unnecessary administration, costs (not having to charge the patients additional therapy during their hospital stay), and possible risk of acquiring secondary infection. Additional stewardship practices, such as de-escalation of antibiotics from IV to PO and verifying start and stop dates on antibiotics, were also practiced similarly to what Shah et al. (2017) discovered in their study.

## Nursing Implications for Practice

Integrating nurses into formal roles of antimicrobial stewardship programs has much potential. New graduate residency programs or pre-licensure programs can benefit from introducing antimicrobial stewardship concepts and practices. These concepts can be threaded throughout the program, especially where pharmacology and microbiology are prevalent (American Nurses Association & Centers for Disease Control and Prevention, 2017). This can bring new graduate nurses an introduction to the current practices within acute care settings. Like Olans et al. (2017), this project suggests that as bedside nurses gain more knowledge regarding ASPs, they realize their potential and their pivotal role in making a difference in AMR. Creating learning modules with a continuing education credit option at the end could incentivize nurses to complete the training and go towards certification or licensure renewal, as supported by studies

by Fitzpatrick et al. (2021), Jeffs et al. (2018), and Monsees et al. (2018). This reiterates the need for meaningful engagement when implementing a new process.

The survey reveals an interest in learning more about antimicrobial stewardship through various modalities. More organizations can invest in ASP education by giving nurses simple tools, thereby supporting the sustainability and generalizability of ASP Rounds. As aforementioned, leadership support and champions are key to creating successful and sustainable programs that integrate nursing staff. While The Joint Commission requires ASPs within the acute care setting, the involvement of nurses is not clearly stated; however, nurses can help enhance such programs to satisfy program requirements with their existing daily responsibilities.

The bedside nurses' role is vital in obtaining specimens timely, administering antibiotics, and reporting clinical assessment changes to the medical team. ASP Rounds allow nurses to collaborate with pharmacy and infection control and ask questions regarding the plan of care. It also gives nurses evidence and confidence to bring the recommendations by the interdisciplinary team to the attending physicians. When there are more difficult cases/complicated diagnoses, the ID pharmacist can round with the ID physician and review those cases more closely. It empowers nurses to be confident in the therapies their patients are receiving, and patients have better outcomes (Monsees et al., 2018; Olans et al., 2017).

## Limitations

The limitations of this DNP project revolved around timing. From the beginning, there was a limitation due to the small sample size for the survey. A larger sample size could reveal a more accurate depiction of the unit's knowledge and attitudes toward antimicrobial stewardship. Initial completion of the survey could only be completed at work for some bedside nurses due to

not having access to email from home. Although more time was given to the nurses, there may have been competing priorities and possible survey fatigue.

During the initial phase of this project, the ID pharmacist that contributed to creating the ASP Rounds Script and the ASP Rounds Documentation Tool left the organization. However, a few months prior to the survey launch, the organization hired a new ID pharmacist but was quickly onboarded and fully supported the project. The interdisciplinary rounds team was not always available to commit to weekly rounds, depending on schedule and availability. Organizational structure, resources, and champions may vary, affecting the ability to have a complete interdisciplinary team.

Approval from nursing administration, pharmacy, and infection control was almost immediate, but IRB approval did take several months. The IRB department was going through a restructuring phase when this project's IRB submission was completed. Another unavoidable timing factor was that organizations are constantly changing.

The pre-implementation survey proved to be the most time-consuming relating to recruiting participants. Perhaps the timing of initiating the survey simultaneously with several learning modules to be completed may have deterred participation. In addition, participation was truly voluntary with no incentive. The initial go-live date was postponed by two weeks to allow more nurses to respond to the pre-interventional survey.

## Strengths

The strengths of this project included staff engagement, workflow of the rounds process, and solid infrastructure. Prior to the interventional period, the interdisciplinary team was ready to implement ASP nurse-led rounds at any time. In addition to the several months of education leading up to the actual date of rounds, a script was provided to the nurses to help guide the

workflow of rounds. This helped the team to focus based on the specific diagnosis and treatments of the patient.

Within the first month, during the pre-rounding phase, when a bedside nurse was identified to participate in ASP rounds for the first time, just-in-time education would be provided, and the ASP script was provided in the unit as a guide. Just-in-time education was often completed one on one as a reminder of what the goals of ASP rounds were since it would be the first time for the nurses to participate. As the same nurses completed rounds, the more comfortable they were with participation, and they anticipated the recommendations. The bedside nurses also continued to learn and ask questions during ASP rounds. Conversation tools such as the ASP Script proved to be helpful, which was comparable to what Monsees, Lee, et al. (2020) found as well.

The nurse-led ASP rounds model (See Appendix A, Figure 2) was replicated and adopted in the telemetry unit. The unit nurse champion was trained to coordinate rounds and follow up with the recommendations. Pharmacists aided in the follow-up of whether recommendations were accepted or not accepted. The documentation tool within the EMR helped to facilitate communication and follow-up. Infection preventionists provided guidance on proper infection control policies and emphasized infection control practices with patients with invasive lines. This highly suggests that this model is effective and can remain sustainable with the support of the nursing leadership and various disciplines involved.

Each week ASP rounds were completed, key takeaways were observed among the nurses and verbalized by the pharmacists, nurse coordinator, and infection preventionists. The first week of rounds resulted in the removal of a central line catheter that had been initially placed almost a month ago before being identified as unnecessary by the ASP rounds team. Many

bedside nurses were actively promoting unnecessary invasive catheter removal even before rounds. Many successes such as these continued with every week of rounds.

## Future Research

Moving forward with this project, plans for continued expansion of nurse-led interdisciplinary rounds will increase generalizability if successful implementation is achieved. Data will continue to be collected related to catheter days, HO-CDIs, and acceptance rates of unnecessary treatment during rounds. A separate study could focus on nurses' attitudes and knowledge of ASP, and the survey participants can be expanded to nurses throughout the hospital to obtain results with possible statistical significance. Finally, continued partnership with the Education department to embed the learning modules into the Learning Management System and revise competencies for new graduate nurses to include ASP is prospective.

## Recommendations: Sustainability

Nurse-led ASP Rounds' sustainability depends on continued education, leadership support, and infrastructure. Providing various modalities for nurse engagement and learning was a key finding in the literature review. The nursing educational module can be modified to include continuing education credits for California registered nurses to encourage the completion of modules, as supported by studies from Fitzpatrick et al. (2021), Jeffs et al. (2018), and Monsees et al. (2018).

The need for formal and informal leadership support is key to continuing weekly rounds, which is highlighted by studies from Ha et al. (2019), Jeffs et al. (2018), and Monsees, Goldman, et al. (2020). Integrating nurse-led ASP Rounds requires bedside nurses willing to make a change and see the value in ASPs. A dedicated champion or position for antimicrobial stewardship that can work as the daily antimicrobial stewardship nurse coordinator can be effective. If no

dedicated coordinator can be integrated, then more than one unit champion may be required to serve as an alternate to coordinate ASP rounds. Training charge nurses can also be an alternative, depending on the organization's resources.

Integrating constant feedback from the multidisciplinary team members is necessary to improve workflow and create program sustainability. The tool within the EMR system enabled the unit pharmacists to follow up on recommendations, which helped with compliance for closing each round. IT's support to help facilitate the integration of various reports and documentation tools is necessary.

## Conclusions

This project strengthens not only the need for the active role bedside nurses have in ASPs as leaders but also the value of understanding that role. The feasibility and acceptability of a nurse-led interdisciplinary ASP as a practice change is possible, as evidenced by this project. Connecting the role of the bedside nurse to the difference they can make in AMR reveals that nurses who are educated and trained in antimicrobial stewardship can result in better patient outcomes. It is truly a multidisciplinary effort but can be enhanced with nursing expertise and the value of caring for patients at the bedside.

## References

Agency for Healthcare Research and Quality. (2017). Estimating the additional hospital inpatient cost and mortality associated with selected hospital-acquired conditions. https://www.ahrq.gov/hai/pfp/haccost2017-results.html#:~:text=Central%20Line%2DAssociated%20Bloodstream%20Infections,-Based%20on%20seven&text=Individual%20studies%20produced%20a%20broad,%2418%2C000%20to%20more%20than%20%2490%2C000

American Nurses Association & Centers for Disease Control and Prevention. (2017). Redefining the antibiotic stewardship team: Recommendations from the American Nurses Association/Centers for Disease Control and Prevention workgroup on the role of registered nurses in hospital antibiotic stewardship practices. https://www.cdc.gov/antibiotic-use/healthcare/pdfs/ANA-CDC-whitepaper.pdf

Buckwalter, K. C., Cullen, L., Hanrahan, K., Kleiber, C., McCarthy, A. M., Rakel, B., Steelman, V., Tripp-Reimer, T., & Tucker, S. (2017). Iowa model of evidence-based practice: Revisions and validation. *Worldviews on Evidence-Based Nursing*, *14*(3), 175–182. https://doi.org/10.1111/wvn.12223

Carter, E., Manning, M. L., & Pogorzelska-Maziarz, M. (2019). Clinical nurse preparation and partnership in antibiotic stewardship programs. *Journal of Nursing Administration*, *49*(12), 591–595. https://doi.org/10.1097/NNA.0000000000000821

Centers for Disease Control and Prevention (2019). Core elements of hospital antibiotic stewardship programs. https://www.cdc.gov/antibiotic-use/healthcare/pdfs/hospital-core-elements-H.pdf

Centers for Disease Control and Prevention. (2020). Antibiotic/antimicrobial resistance. https://www.cdc.gov/drugresistance/index.html

Centers for Disease Control and Prevention (2021). CDC partners estimate healthcare cost of antibiotic-resistant infection. https://www.cdc.gov/drugresistance/solutions-initiative/stories/partnership-estimates-healthcare-cost.html

Centers for Disease Control and Prevention & The American Nurses Association. (2017). Redefining the antibiotic stewardship team: Recommendations from the American Nurses Association/Centers for Disease Control and Prevention workgroup on the role of registered nurses in hospital antibiotic stewardship practices. https://www.cdc.gov/antibiotic-use/healthcare/ pdfs/ANA-CDC-whitepaper.pdf

Fisher, C., Cox, V. C., Gorman, S. K., Lesko, N., Holdsworth, K., Delaney, N., & McKenna, C. (2018). A theory-informed assessment of the barriers and facilitators to nurse-driven antimicrobial stewardship. *American Journal of Infection Control, 46*(12), 1365–1369. https://doi.org/10.1016/j.ajic.2018.05.020

Fitzpatrick, E. R., Pogorzelska-Maziarz, M., Manning, M., & Gleason, V. M. (2021). The effect of an educational program on nursing knowledge and empowerment in antimicrobial stewardship in a surgical intensive care unit. *Dimensions of Critical Care Nursing*, *40*(1), 21-28. https://doi:10.1097/DCC.0000000000000450

Ha, D. R., Forte, M., Olans, R.D., OYong, K., Olans, R.N., Gluckstein, D., Kullar, R., Desai, M., Catipon, N., Ancheta, V., Lira, D., Khattak, Y., Legge, J., Nguyen, K., Chan, S, Mourani, J., & McKinnell, J. (2019). A multidisciplinary approach to incorporate bedside nurses into antimicrobial stewardship and infection prevention. *The Joint Commission Journal on Quality and Patient Safety*, *45*(9), 600-605. https://doi.org/10/1016/j.jcjq.2019.03.003

Jeffs, L., Law, M. P., Zahradnik, M., Steinberg, M., Maione, M., Jorgoni, L., Bell, C. M., & Morris, A. M. (2018). Engaging nurses in optimizing antimicrobial use in ICUs. *Journal of Nursing Care Quality, 33*(2), 173-179. https://doi:10.1097/NCQ.0000000000000281

The Joint Commission. (2017). Antimicrobial stewardship: Understanding the facts. Updated 2021. https://www.jointcommission.org/standards/standard-faqs/nursing-care-center/medication-management-mm/000002045/

Kapadia, S., Abramson, E., Carter, E., Loo, A., Kaushal, R., Calfee, D., & Simon, M. (2018). The expanding role of antimicrobial stewardship programs in hospitals in the United States: Lesson learned from a multisite qualitative study. *The Joint Commission Journal on Quality and Patient Safety*, *44*(2):68-74. https://doi.org/10.1016/j.jcjq.2017.07.007

Kirby, E., Broom, A., Overton, K., Kenny, K., Post, J., & Broom, J. (2020). Reconsidering the nursing role in antimicrobial stewardship: A multisite qualitative interview study. *British Medical Journal*, *10*(10), 1-9. http://dx.doi.org/10.1136/bmjopen-2020-042321

Monsees, E., Goldman, J., Vogelsmeier, A., & Popejoy, L. (2020). Nurses as antimicrobial stewards: Recognition, confidence, and organizational factors across nine hospitals. *American Journal of Infection Control, 48*(3), 239–245. https://doi.org/10.1016/j.ajic.2019.12.002

Monsees, E., Lee, B., Wirtz, A., & Goldman, J. (2020). Implementation of a nurse-driven antibiotic engagement tool in 3 hospitals. *American Journal of Infection Control, 48*(12), 1415–1421. https://doi.org/10.1016/j.ajic.2020.07.002

Monsees, E., Popejoy, L., Jackson, M., Lee, B. & Goldman, J. (2018). Integrating staff nurses in antibiotic stewardship: Opportunities and barriers. *American Journal of Infection Control, 46*(7), 737-742. https://doi:10.1016/j.ajic.2018.03.028

Olans, R. D., Olans, R. N., & Witt, D. J. (2017). Good nursing is good antibiotic stewardship. *American Journal of Nursing*, *117*(8), 58-63. https://doi:10.1097/01.NAJ.0000521974.76835.e0

Shah, P., Faulkner-Fennell, C., Odom, J., Schrank, J., Meredith, J., & Wu, J. (2017). Impact of an antimicrobial stewardship-driven initiative to assess appropriateness of asymptomatic bacteriuria or funguria treatment. *Greenville Health System, 1*(2), 26-31. https://hsc.ghs.org/wp-content/uploads/2016/11/GHS-Proc-Asymptomatic-Bacteriuria-And-Stewardship.pdf

Titler, M. G., Kleiber, C., Steelman, V. J., Rakel, B. A., Budreau, G., Everett, L. Q., Buckwalter, K. C., Tripp-Reimer, T., & Goode, C. J. (2001). The Iowa model of evidence-based practice to promote quality care. *Critical Care Nursing Clinics of North America*, *13*(4), 497–509. https://doi.org/10.1016/S0899-5885(18)30017-0

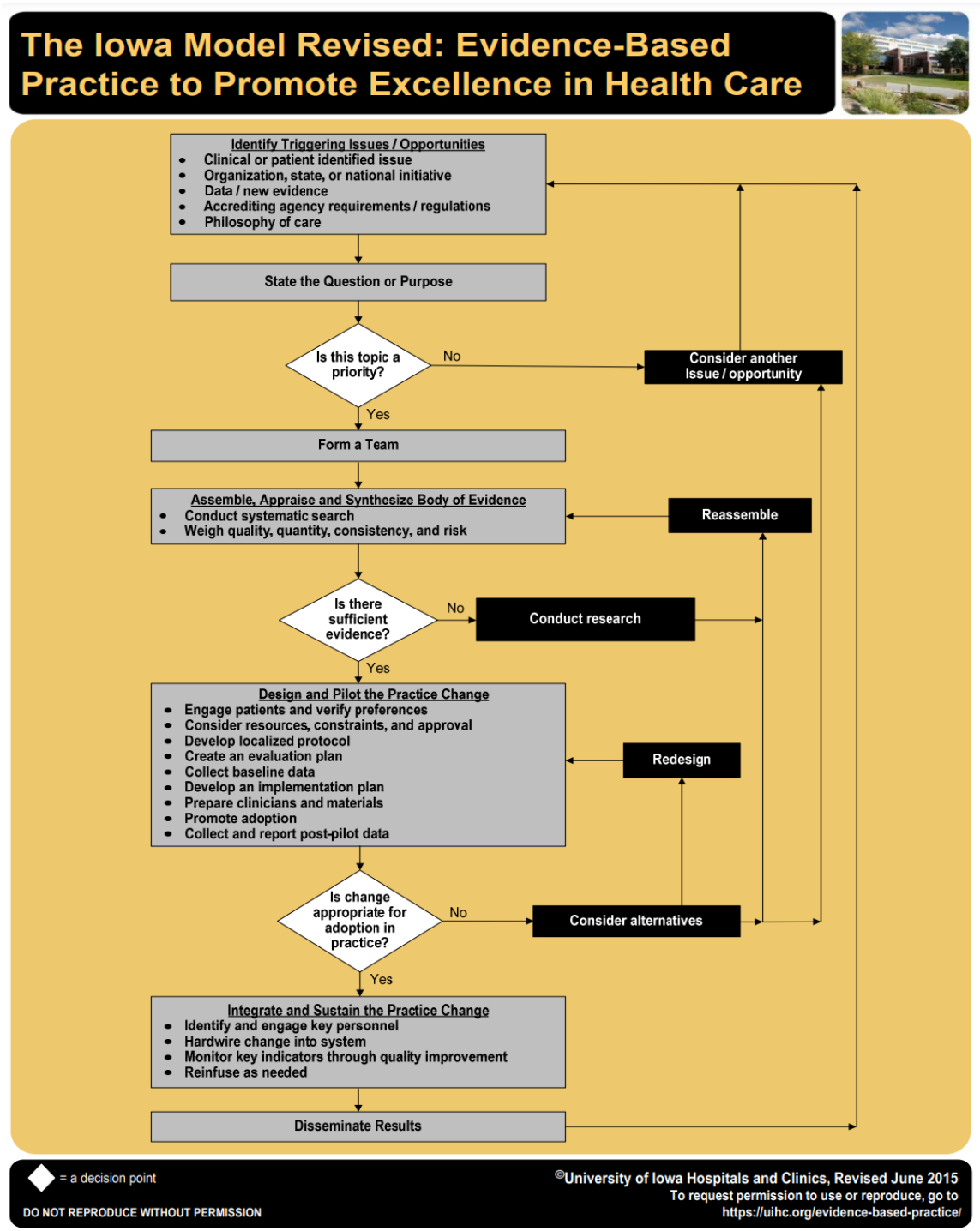
World Health Organization. (2021). Antimicrobial resistance. https://www.who.int/news-room/fact-sheets/detail/antimicrobial-resistance

# Appendix A

## Framework and ASP Rounding Tools

**Figure 1**

*The Iowa Model of Evidence-Based Practice*



EMAIL: Kimberly Jordan - University of Iowa Hospitals and Clinics survey-bounce@survey.uiowa.edu

Friday, February 25, 2022

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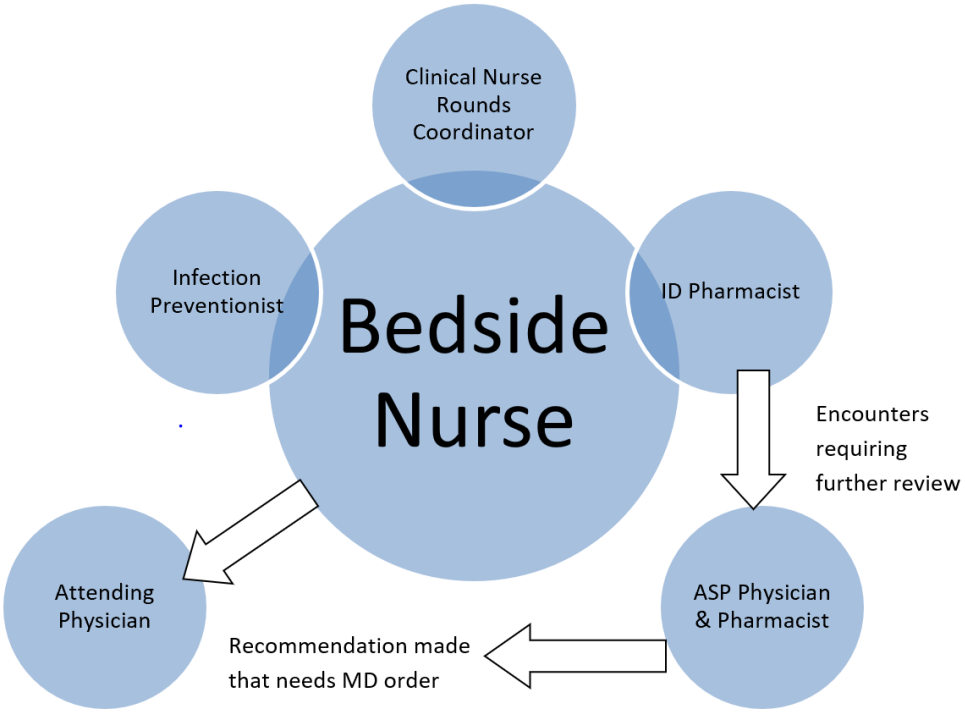
**Figure 2**

*Interdisciplinary Rounds Team Diagram*




*Note:* This model depicts the bedside nurse as the key member in communicating the recommendations made by the interdisciplinary team to the attending physician. The ID pharmacist has the opportunity to review more complicated cases with the ASP Physician during their own daily rounds and is communicated physician to physician.

**Figure 3**

*Interdisciplinary ASP Rounds Script Tool for Bedside Nurses*

## Antibiotics

Pre-round: ***rounding pharmacist and primary RN*** has looked up documented indication, planned duration, pending/resulted cultures/imaging/procedures.

Rounding **pharmacist** should also have looked up antibiotic history for the entire hospitalization, not just days of therapy of current antibiotic

**RN** will also provide dietary/PO status

*Bloodstream Infections*

Microbiological diagnosis

*Urinary Tract Infection*

**Nurse**: *relevant* symptoms of dysuria, urgency, frequency, costovertebral angle tenderness (2019 IDSA Asymptomatic Bacteriuria Guidelines), pending procedure (stenting, lithotripsy, etc.)

**Pharmacist:** recommend discontinuation, culture, antibiotic choice/route, and/or recommended duration

*Respiratory and CNS Infection*

**Nurse**: symptoms and pending procedure (lumbar puncture, shunt tap/removal, etc.)

**Pharmacist:** recommend discontinuation, diagnostic/culture (i.e. procalcitonin, BNP, respiratory culture), antibiotic choice/route, and/or recommended duration or ID consult

*Intra-abdominal Infection, Skin & Soft Tissue Infections*

**Nurse**: relevant symptoms, surgical/imaging/re-exploration plans, whether wound has been closed/wound vac in place, and wound assessment

**Pharmacist**: recommend diagnostic/culture (i.e. wound culture), antibiotic choice/route, and/or recommended duration after source control procedure or if no procedure is planned, as well for post-op surgical site infections and/or ID consult

## Urinary Catheter

**Nurse:** present on admission or insertion date, indication, type, any wounds present

**Pharmacist:** any medications to treat benign prostate hyperplasia on MAR

**Rounds Coordinator/Infection Preventionist:** recommend discontinuation or change, urology consult

## Central Venous Catheter

**Nurse:** line type, present on admission or insertion date, indication, flag femoral lines

**Rounds Coordinator/Infection Preventionist:** recommend discontinuation or change

## Gastrointestinal Assessment

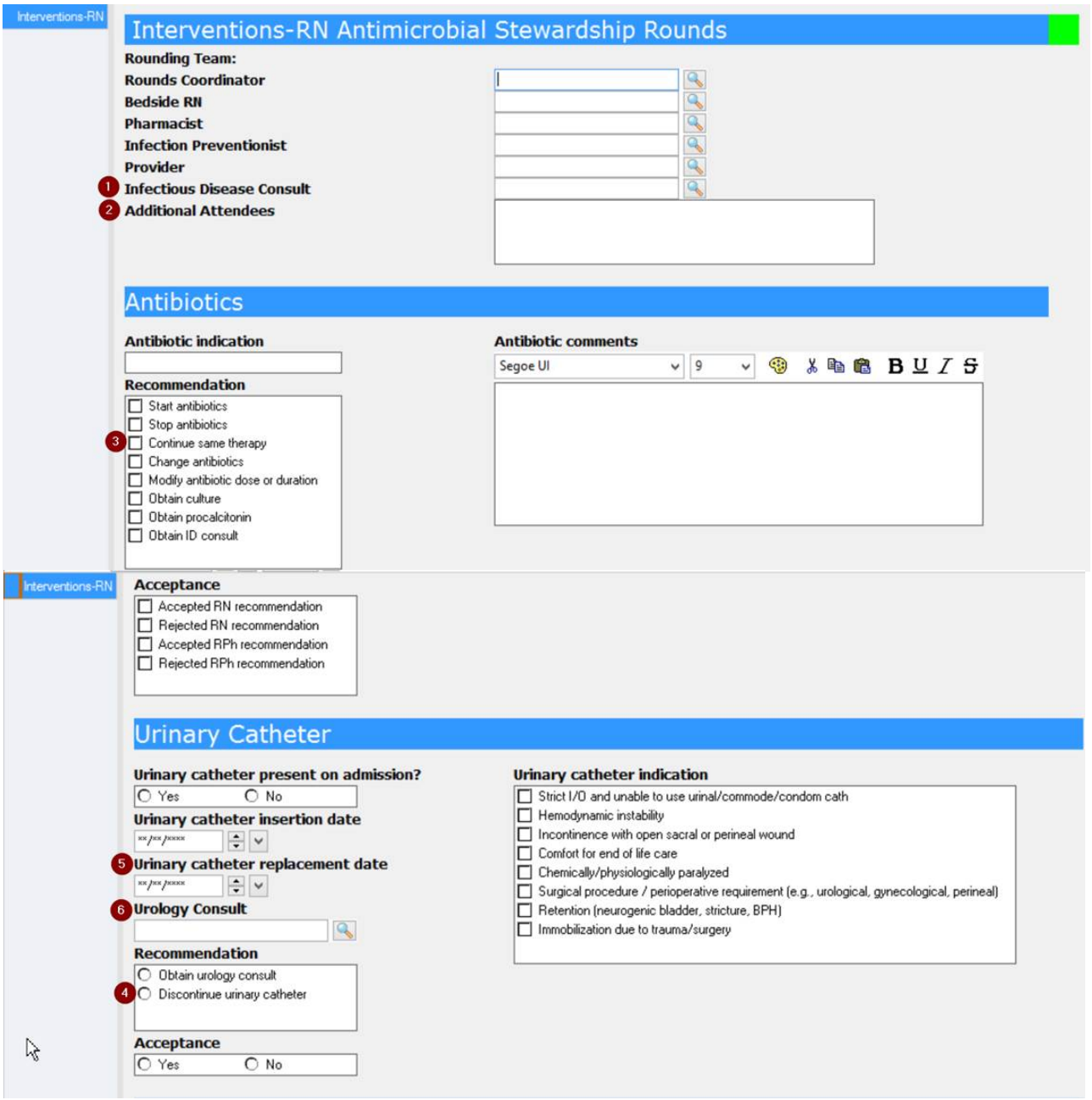
**Nurse:** diarrhea present on admission, whether acute and active, other attributable sources of diarrhea

**Rounds Coordinator/Infection Preventionist:** recommend C.diff test if diarrhea not chronic, has no clear attributable source, no test result within past 7 days especially if risk factors are present, follow time-out huddle sheet

ASP RN Rounds Script 2022 ; Esther Zhang, PharmD, BCPS, BCIDP & Mary Bette Forte, MSN, RN-C

**Figure 4**

*Interdisciplinary Electronic ASP Rounds Documentation Tool*



## Appendix B

## Survey for Nurse-Led Interdisciplinary Rounds

This is the Pre- and Post-Interventional Survey on Bedside Nurses' Knowledge and Attitudes Towards ASP with Digital Consent.

The survey on antimicrobial stewardship on staff nurse knowledge and attitudes was used with permission by, Katreena Merrill, PhD, RN, CIC, FAPIC. The survey monkey platform was used. The digital consent was obtained by accepting the following terms and conditions:

"I, Mary Bette Forte, will be conducting an evidence-based practice DNP project. The purpose of this project is to develop, implement, and evaluate a nurse-led interdisciplinary antimicrobial stewardship program (ASP) in a trauma step-down telemetry unit. The specific aims for this project are to a) provide bedside nurse knowledge of stewardship processes, b) evaluate nurses' attitudes towards ASP, c) increase proper utilization of nurse-driven catheter removal protocols and c) decrease hospital-onset HO-CDI rates, central line days per 1,000 catheter days, urinary catheter days per 1,000 catheter days. The project will consist of a pre-post survey which will be anonymous and is completely voluntary. Withdrawal from the study will not affect employment status at any time. The survey is a tool that was developed by Katreena Merrill, Ph.D, RN, CIC, FAPIC and is titled Antibiotic Stewardship: Nursing. The survey consists of 15 questions regarding antimicrobial stewardship. Education on antimicrobial stewardship will be given prior to starting nurse-driven interdisciplinary antimicrobial stewardship rounds on the unit. By checking this box, I agree to voluntarily participate in this DNP project, which includes taking a pre-post implementation survey. The survey will take 5-10 minutes. Any questions regarding participation, withdrawal, the survey, or education please contact Mary Bette Forte 909-865-9957 or marybette.forte@pvhmc.org."

The following are the questions items:

Q1 How familiar are you with the term “antibiotic stewardship”?

Q2 In your own words, provide a definition of antibiotic stewardship

Q3 How would you rate your knowledge of antibiotic stewardship on a 0-10 scale

Q4 To what extent do you think it is important to have an antibiotic stewardship program in your health care setting?

Q5 When giving a patient an antibiotic, what percent of the time do you know WHY he or she is receiving the antibiotic?

Q6 If you have a question about the antibiotic being given, who do you ask?

Q7 In the past 30 days, have you questioned a treating provider about any of the following?
- The choice of an antibiotic for a patient
- The dose of an antibiotic for a patient
- The route of an antibiotic for a patient
- The duration of an antibiotic for a patient

Q8 The following questions refer to nursing interventions with antibiotics
- Do you think nurses should be involved in interventions aimed to improve antibiotic use?
- Would you feel comfortable raising concerns to the treatment team about the antibiotic(s) a patient is getting?
- Have you ever given an antibiotic that you thought was inappropriate?

Q9 The following statements are about antibiotic use. Please indicate the extent you agree or disagree with the following statements.
- The use of antibiotics can cause harm
- Antibiotics are over-used nationally
- Strong knowledge of antibiotics is important in my job
- I would like more education on the appropriate use of antibiotics
- Appropriate use of antibiotics can cause antibiotic resistance
- Antibiotics are over-used at my health care setting
- It is my responsibility to ensure appropriate antibiotic use in my health care setting
- I am interested in the current status of antibiotic use in my health care setting

Q10 The following statements are about antibiotic resistance. Please indicate the extent you agree or disagree with the following statements.
- Inappropriate use of antibiotics causes resistance
- Prescribing broad-spectrum antibiotics when equally effective narrower spectrum antibiotics are available increases antibiotic resistance
- The incidence of antibiotic-resistant organisms can be reduced by changing antibiotic prescribing patterns

Spread of antibiotic resistance can be reduced by changing infection control practices
Appropriate use of antibiotics can cause resistance
The development of new antibiotics will help to combat current resistance trends
Antibiotic resistance is a significant problem in my health care setting
Antibiotic resistance is a significant problem nationally
I am interested in the current status of antibiotic resistance in my health care setting
Assessment and documentation of allergies are important to ensure appropriate antibiotic use

Q11 Does your health care setting have access to an infectious diseases specialist available in the following ways?

Available onsite
Available by phone
Available by TeleHealth

Q12 The following statements are about infectious disease specialists. Please indicate the extent you agree or disagree with the following statements.

Having an infectious disease specialist on site would improve care
Having an infectious disease specialist available by phone would improve care
Having an infectious disease specialist available by telehealth would improve care

Q13 In the past month, about how many times has an infectious diseases specialist consulted on a patient you've cared for?

Q14 To what extent do you rely on the following sources of information about the care of patients with infectious diseases?

Ask a colleague
Ask an ID specialist
PubMed
Up-to-Date
Clinical textbooks
Personal clinical experience
Ask Infection Control
Ask a pharmacist
Internet Search/Google
Other (Please Describe)

Q15 What interventions do you think would be most helpful in improving the appropriate use of antibiotics in your facility? (check all that apply)

Antibiotic restrictions
Auditing of charts
Pharmacy interventions
Evaluating antibiotics after 48 hour of therapy
Online education modules
Lectures
Knowledge of accurate allergy reporting

Other (please describe)

Demographic Questions

Q16 How many years have you been a registered nurse?

Q17 How old are you?

Q18 What is your gender?

Q19 What is your ethnicity?

Q20 Please indicate your highest degree.

## Appendix C

## Demographic Data of Survey Respondents

**Table 1**

*Demographic Data of Survey Respondents*

| | Pre-Survey (N = 14) | Post-Survey (N = 13*) |
|---|---|---|
| Number of Years as a Registered Nurse | Average = 6 | Average = 6 |
| Age | Average = 35 years | Average = 37 years |
| Gender | Female = 12<br>Male = 2<br>Other = 0 | Female = 11<br>Male = 2<br>Other = 0 |
| Ethnicity | White = 4 (28.57%)<br>Asian = 8 (57.14%)<br>Hispanic = 2 (14.29%) | White = 6 (46.15%)<br>Asian = 6 (46.15%)<br>Hispanic = 1 (7.69%) |
| Degree | Associates = 3 (21.43%)<br>Bachelors = 9 (64.29%)<br>Masters or higher = 2 (14.29%) | Associates = 4 (30.77%)<br>Bachelors = 9 (69.23%) |

*Note.* *There is one less respondent for the pre-survey because the respondent opted in to take the survey but skipped each question.

# Appendix D

## Pre- and Post- Survey Data

**Figure 1**

*Pre- and Post-Survey Results of Item Q3*

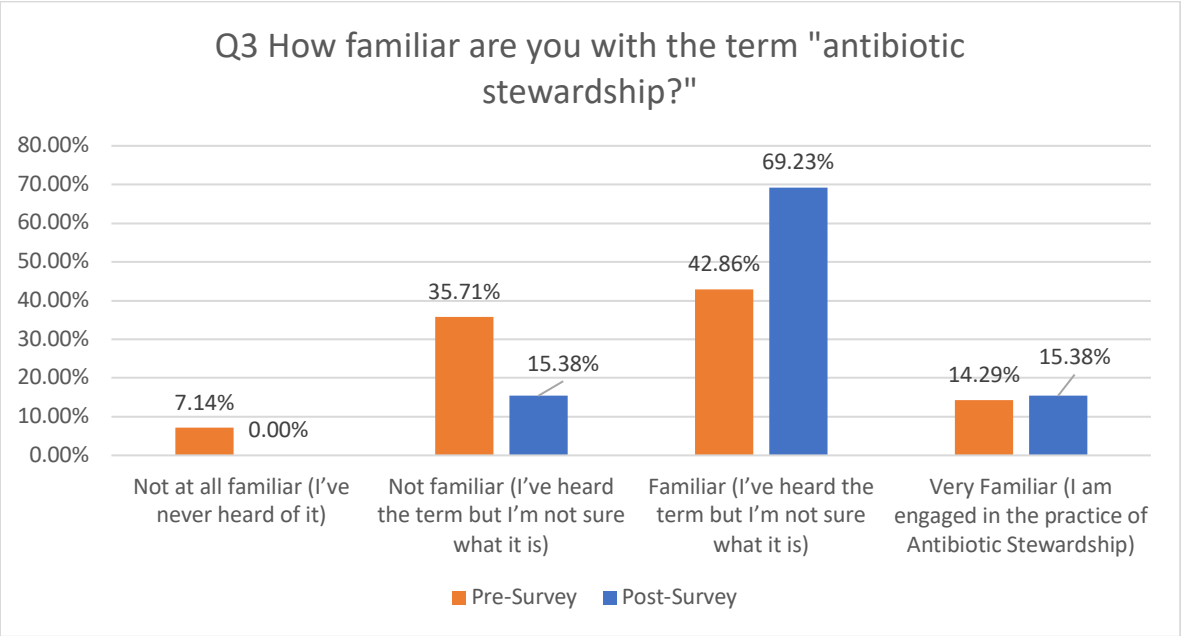



**Figure 2**

*Pre- and Post-Survey Results of Item Q5*

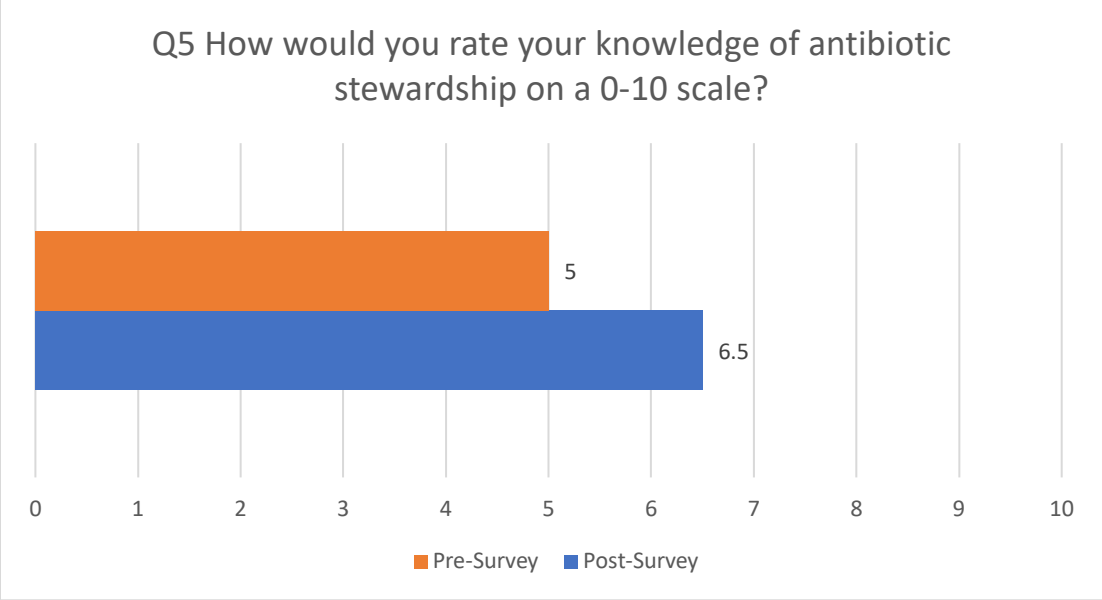


**Figure 3**

*Pre- and Post-Survey Results of Item Q6*

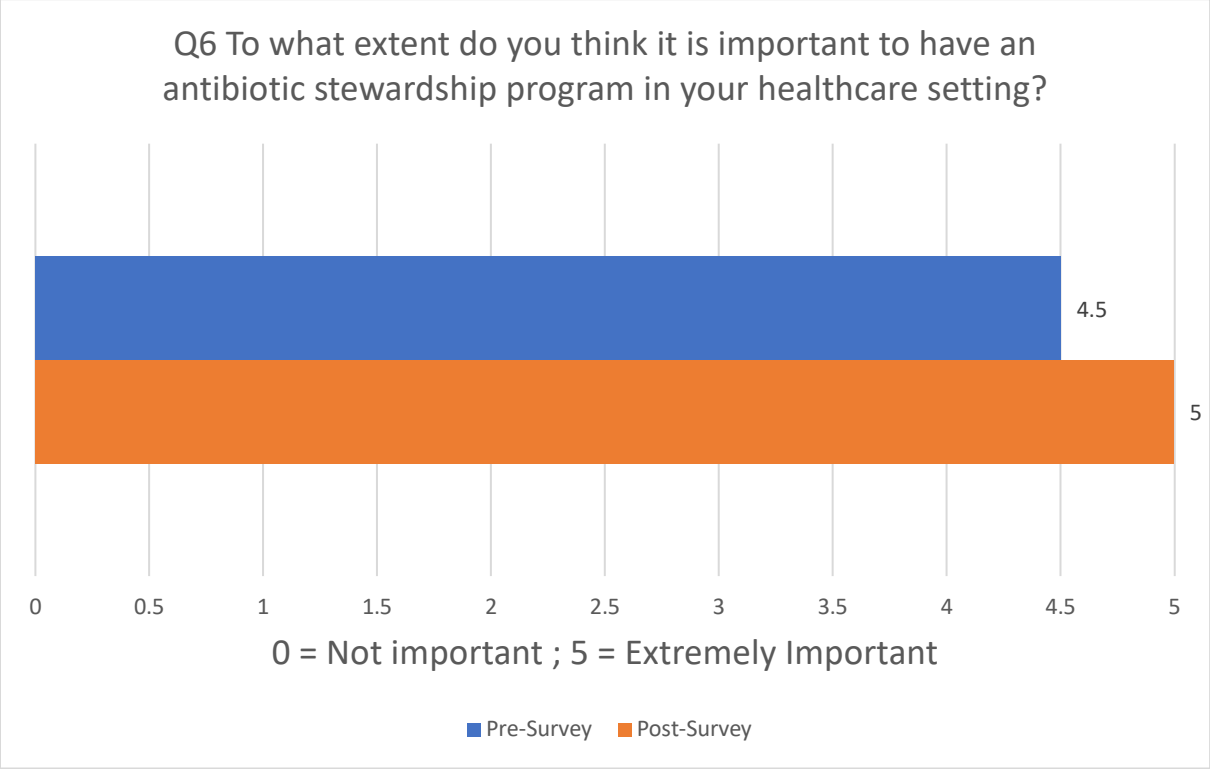


**Figure 4**

*Pre- and Post-Survey Results of Item Q7*

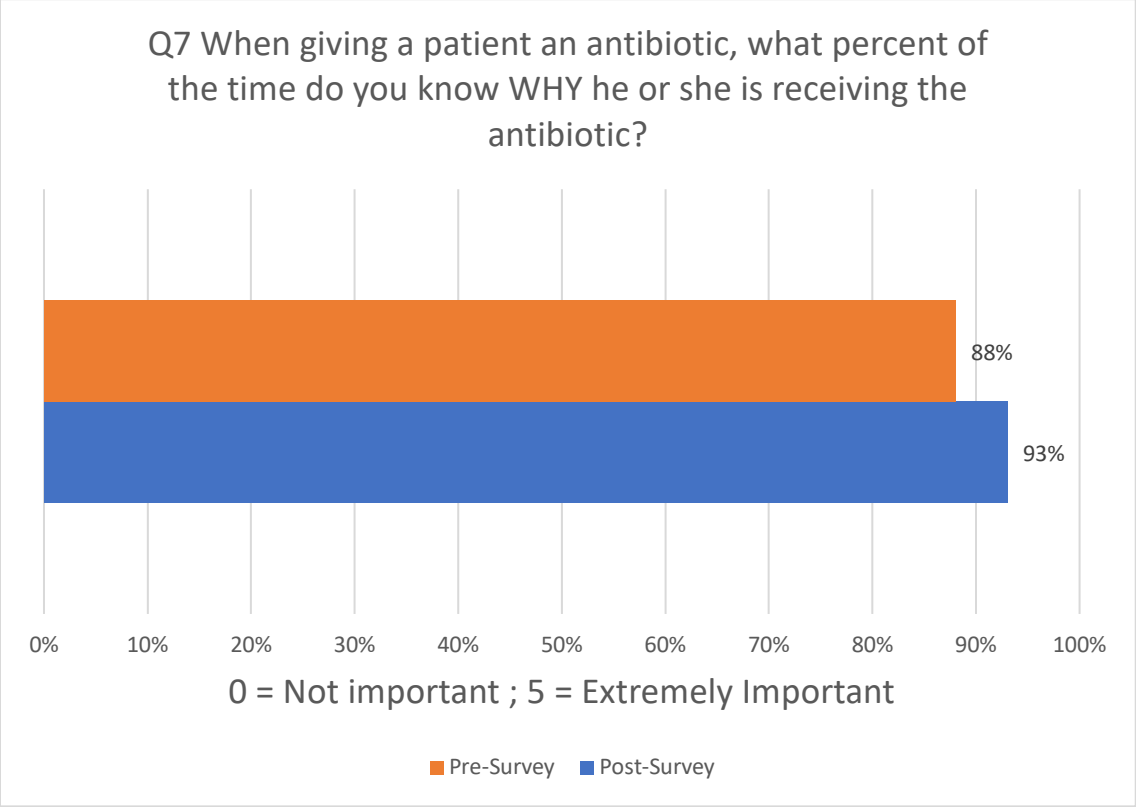


**Figure 5**

*Pre- and Post-Survey Results of Item Q8*

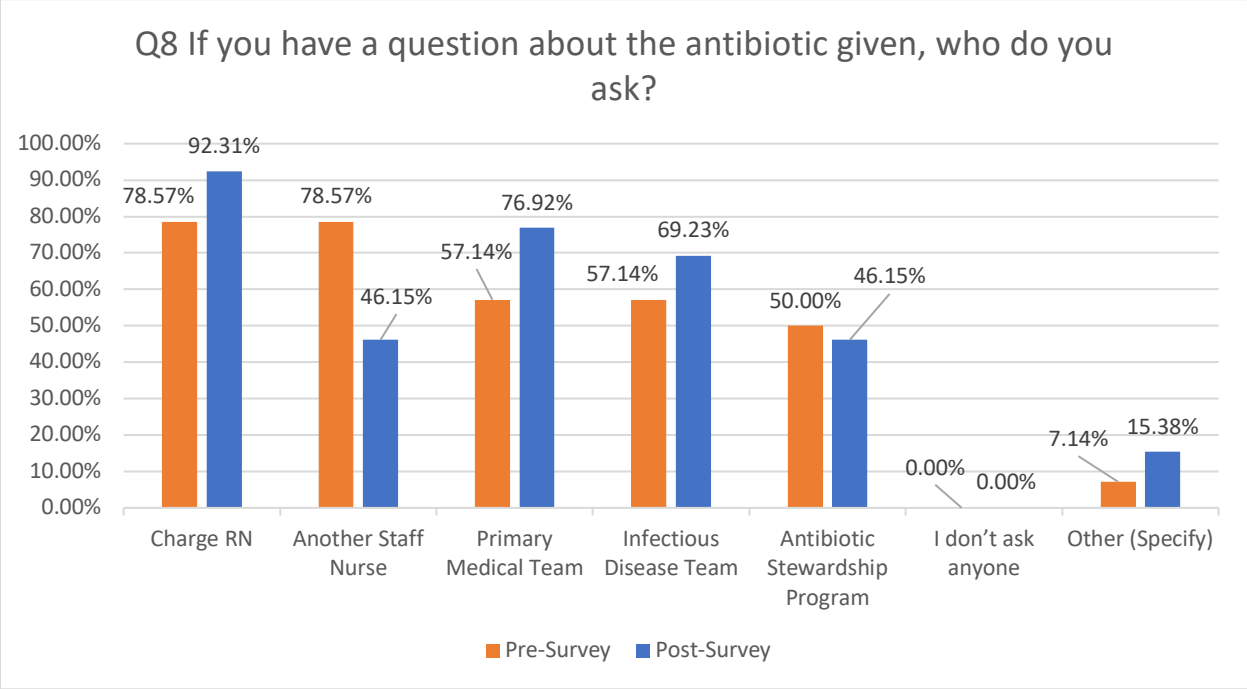


**Figure 6**

*Pre- and Post-Survey Results of Item Q9*

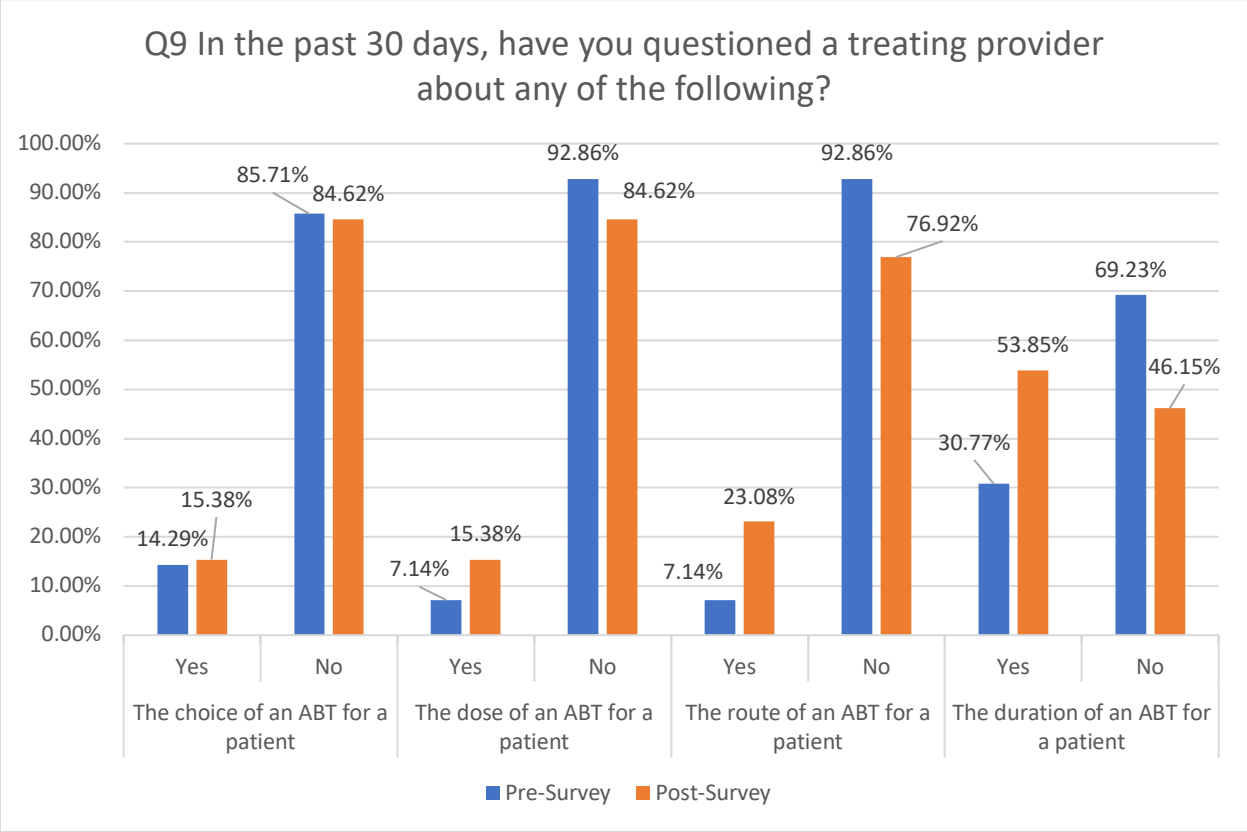
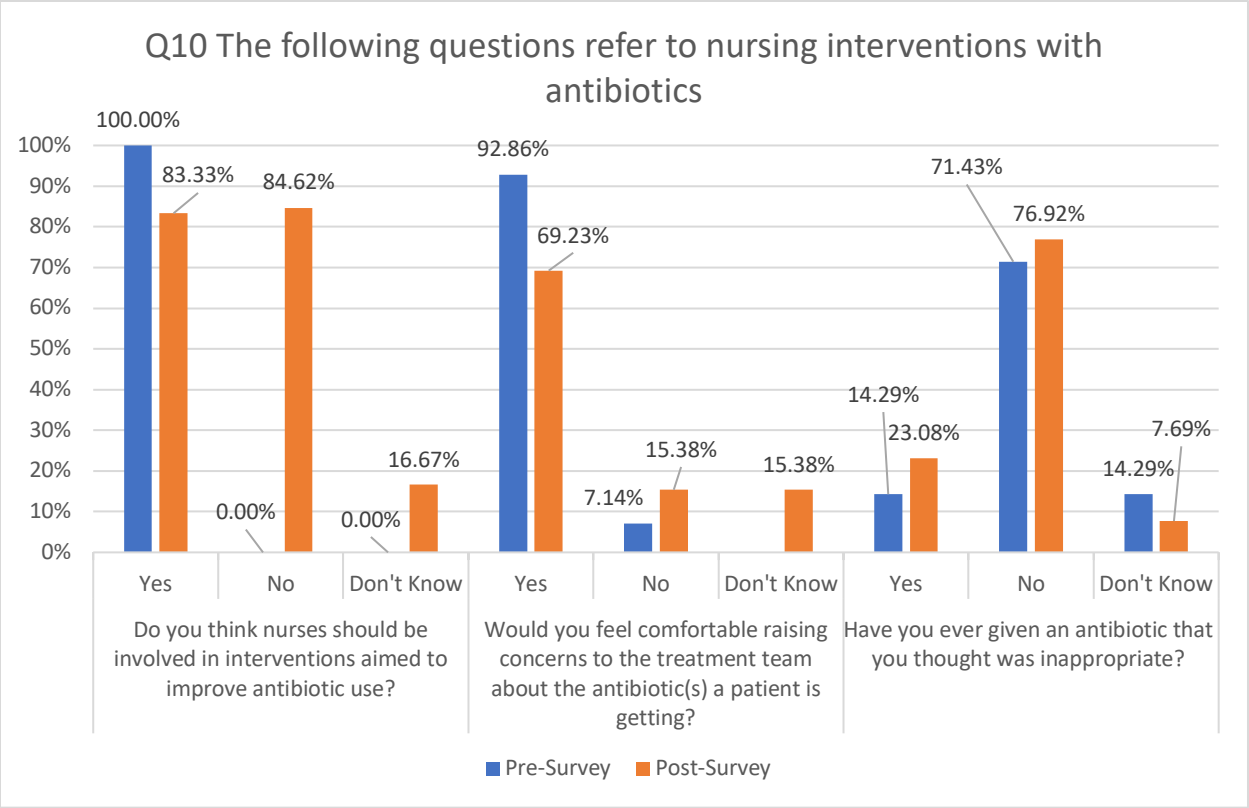


**Figure 7**

*Pre- and Post-Survey Results of Item Q10*



**Figures 8 to 15**

*Pre- and Post-Survey Results of Item Q11*

*Q11*: *The following statements refer to antibiotic use:*

**Figure 8**

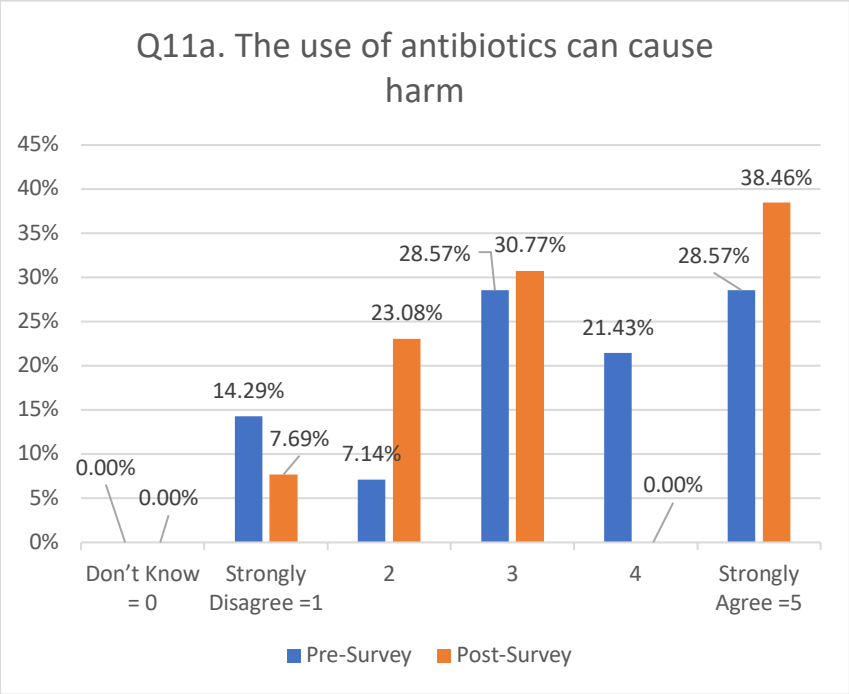



**Figure 9**

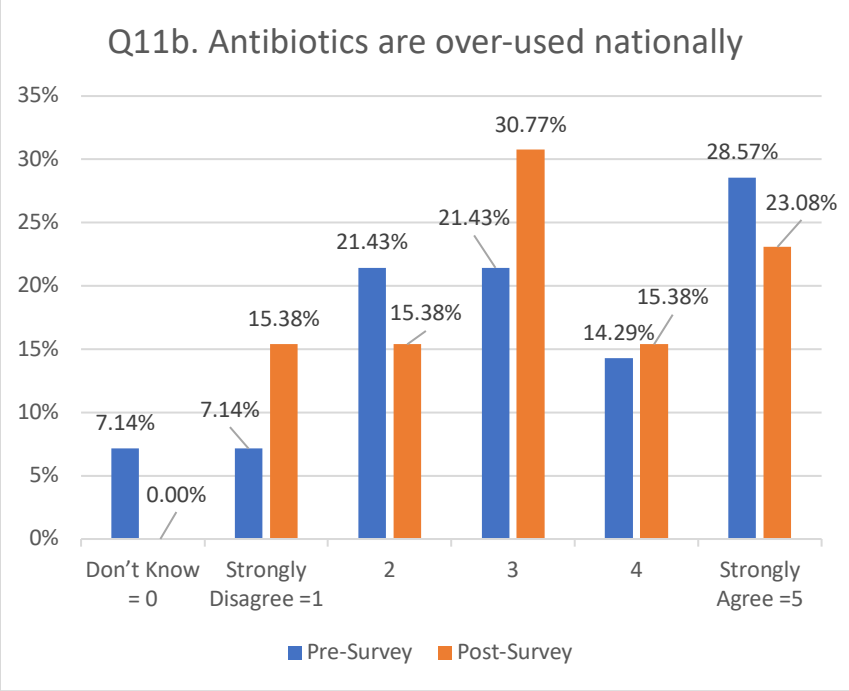


**Figure 10**

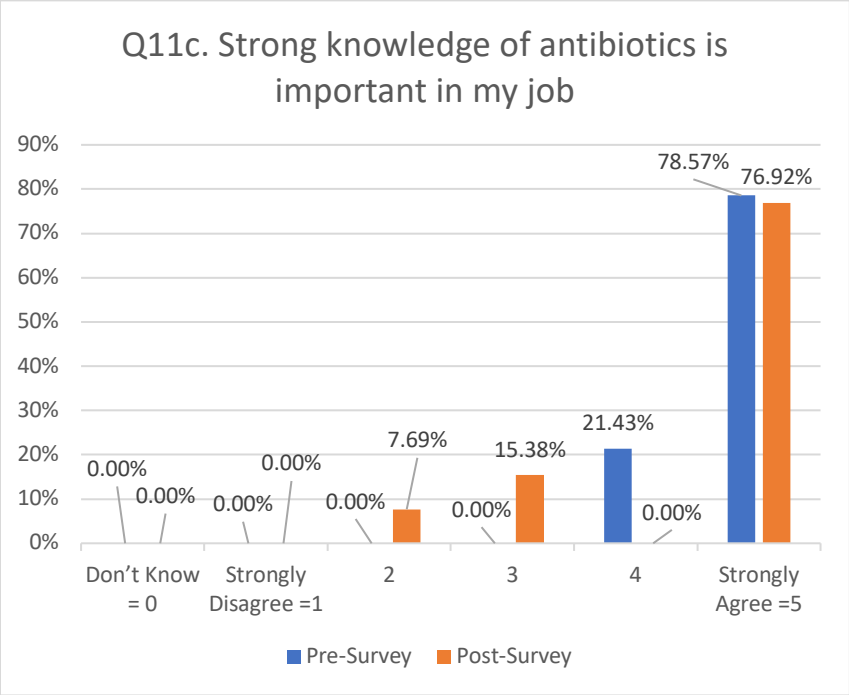



**Figure 11**

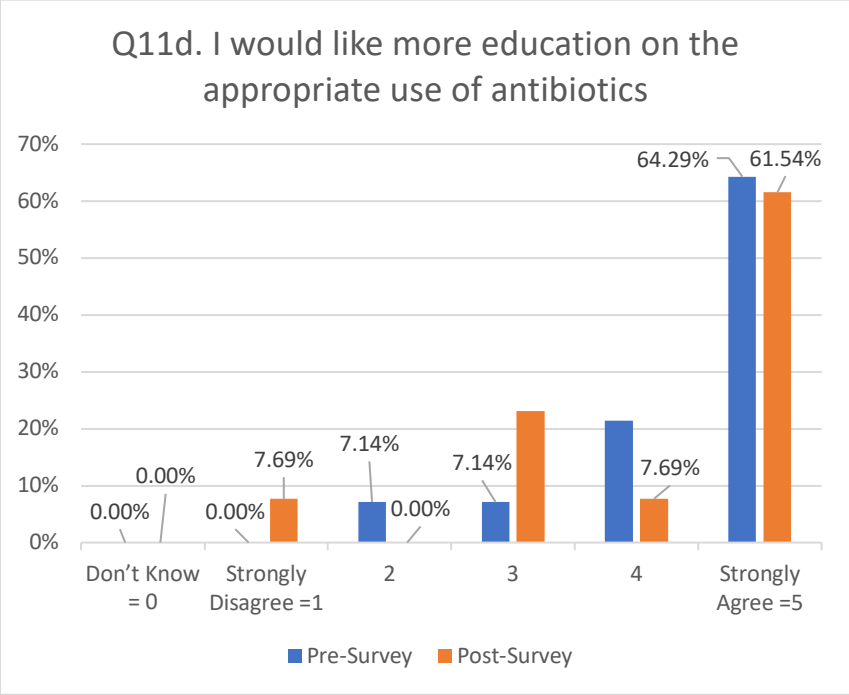


**Figure 12**

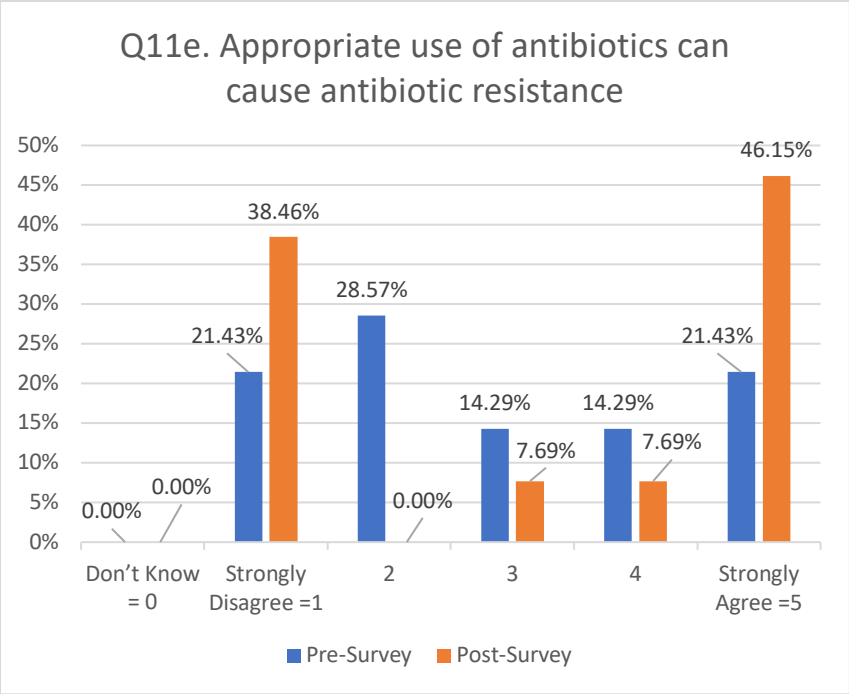



**Figure 13**

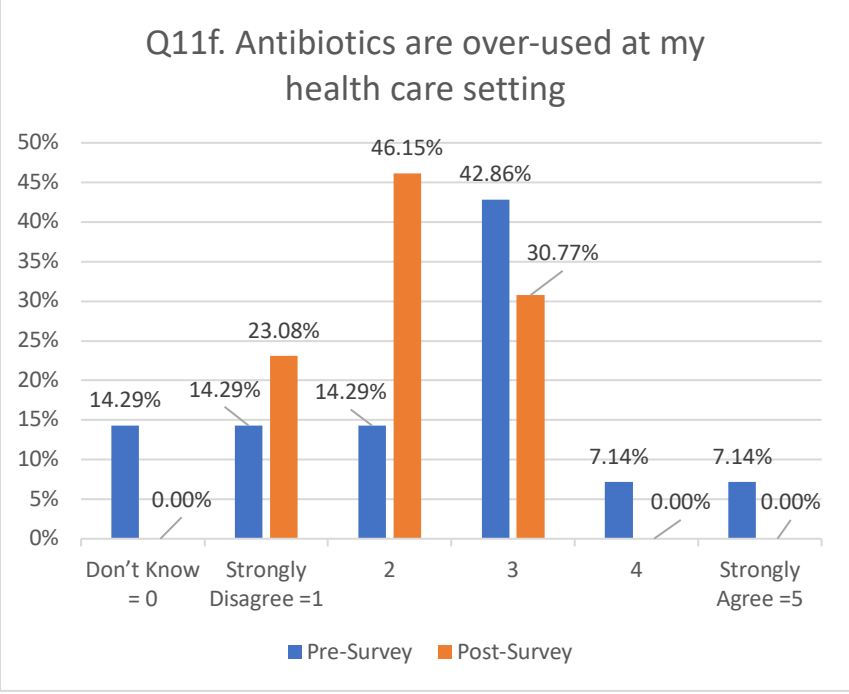


**Figure 14**

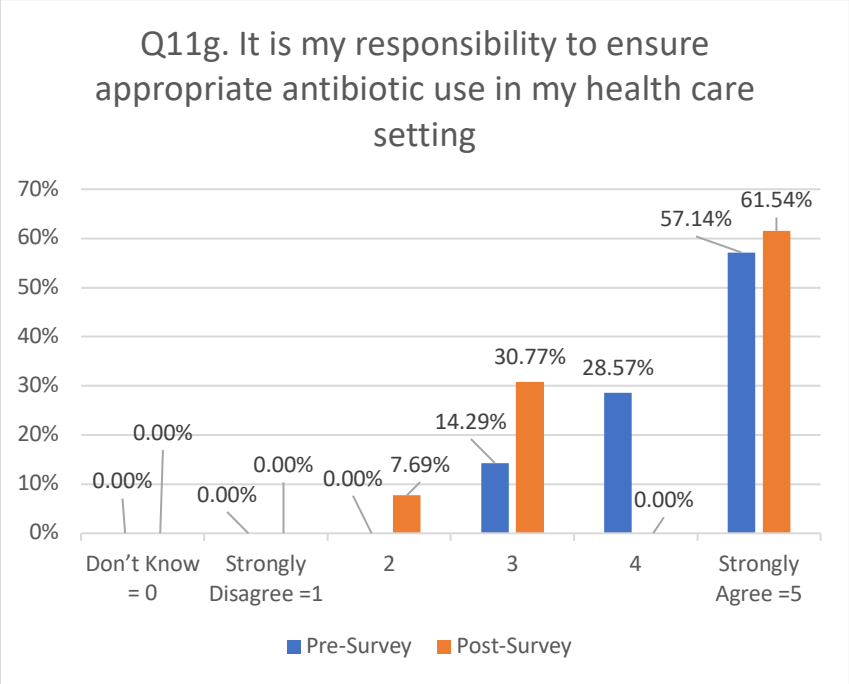
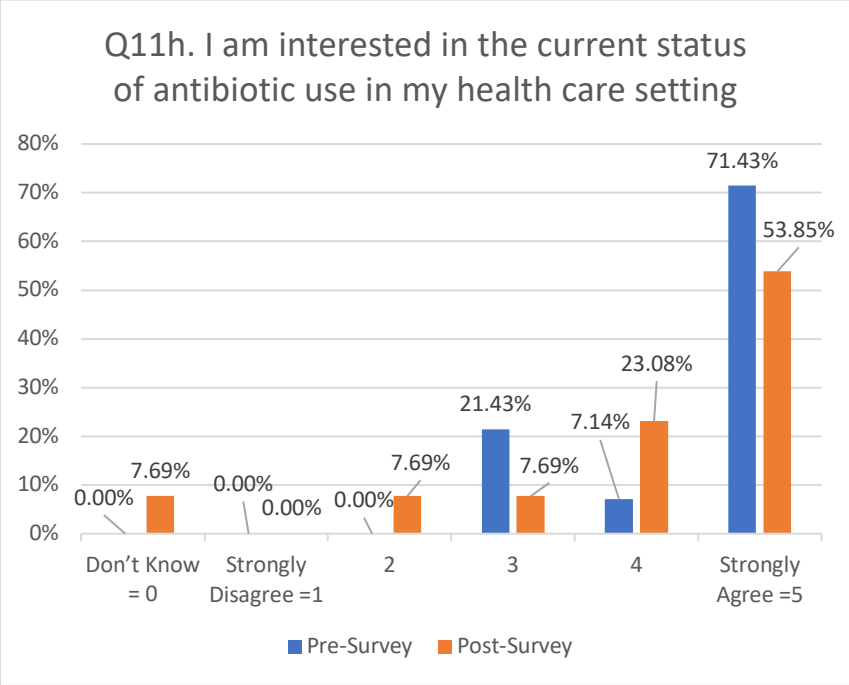



**Figure 15**



**Figures 16 to 25**

*Pre- and Post-Survey Results of Item Q12*

*Q12: The following statements are about antibiotic resistance:*

**Figure 16**

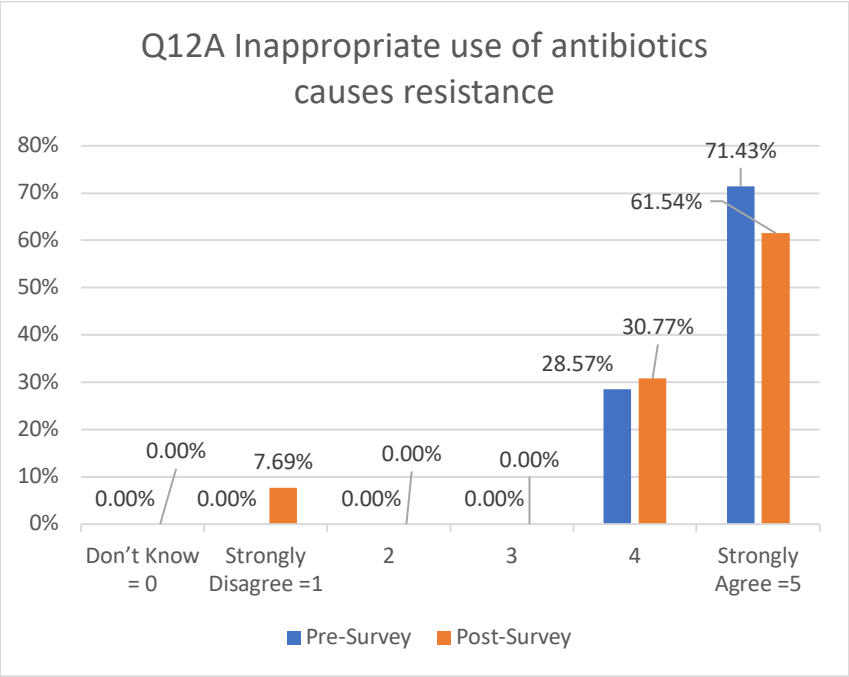



**Figure 17**

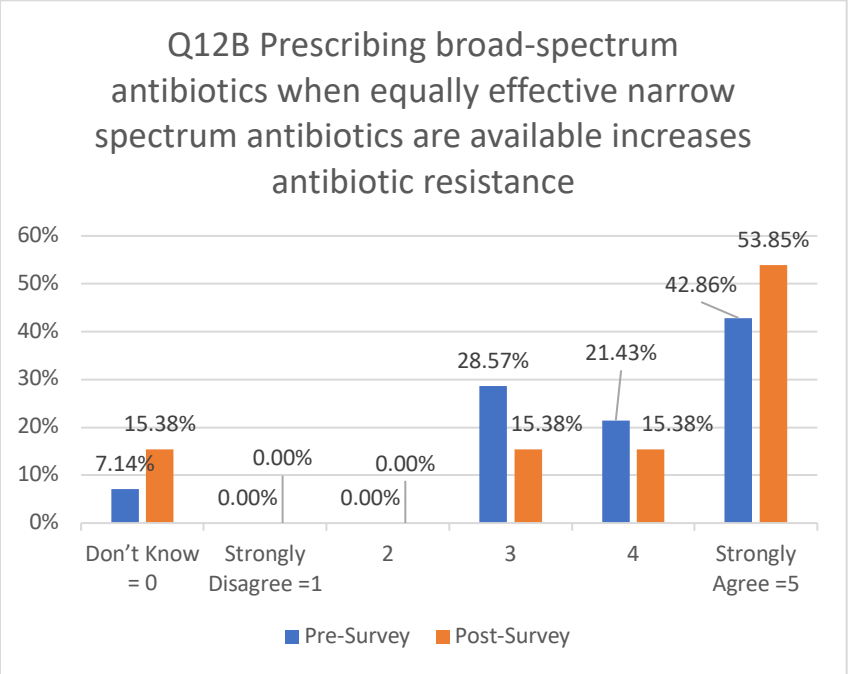


**Figure 18**

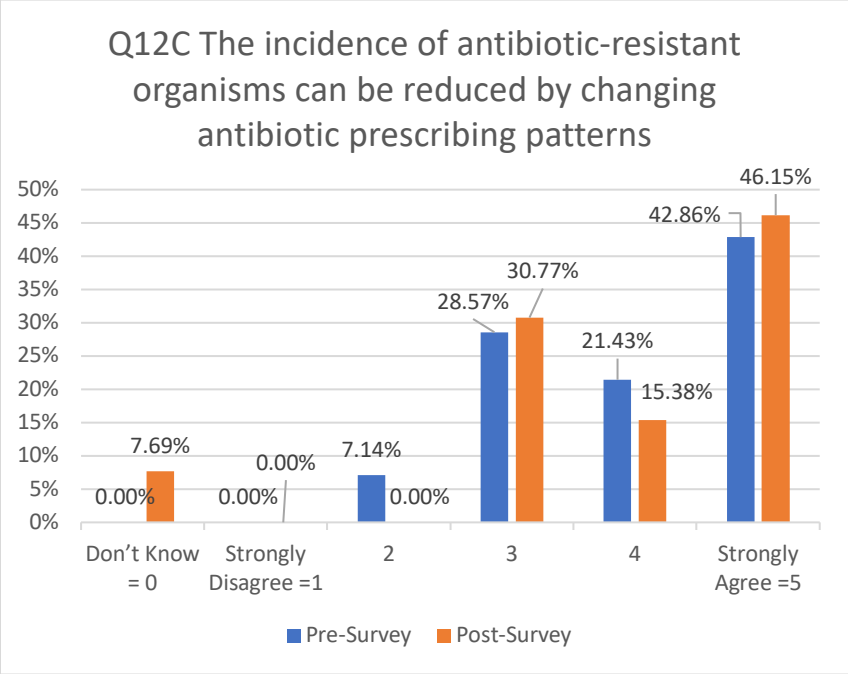
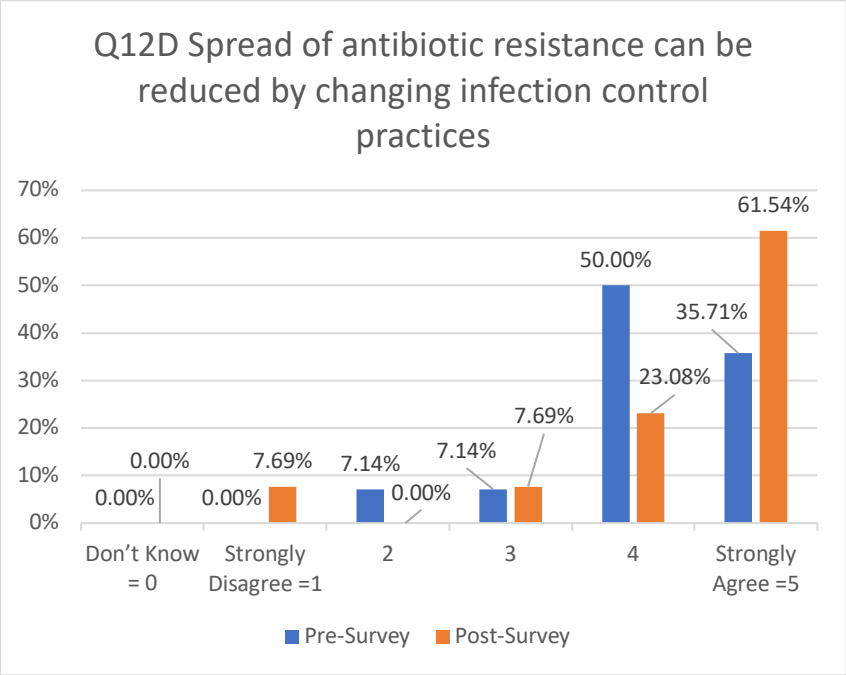



**Figure 19**



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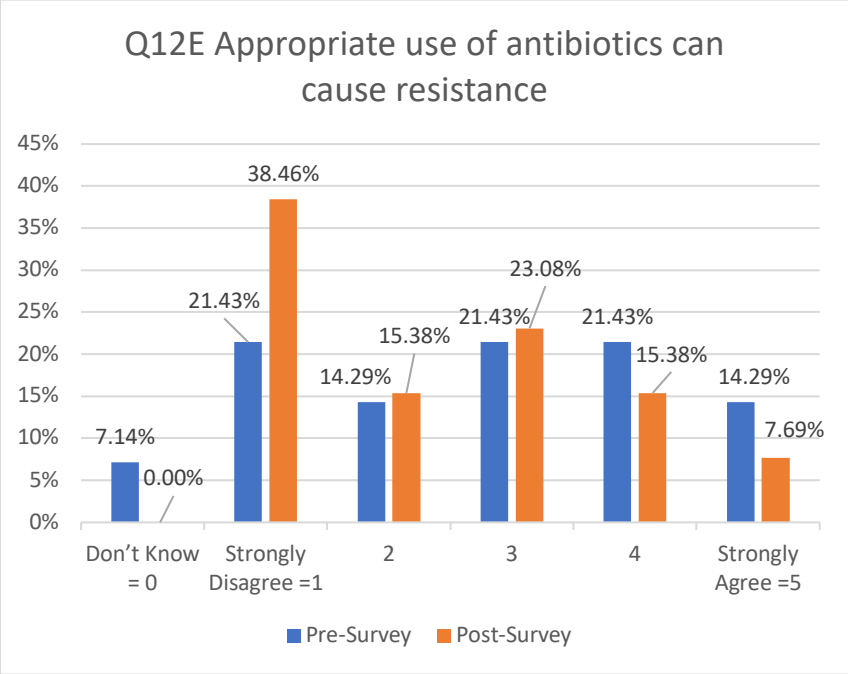


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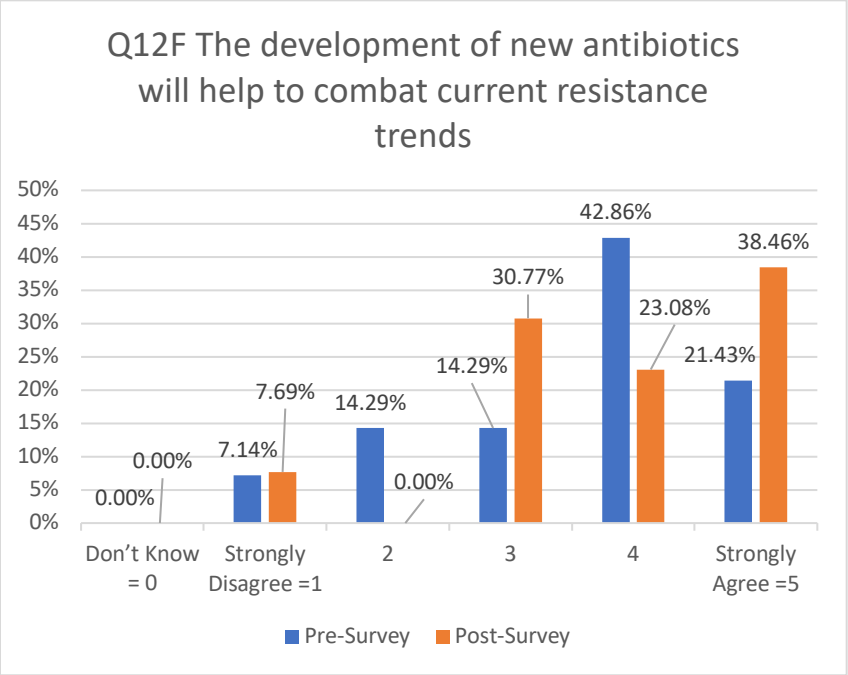


**Figure 22**

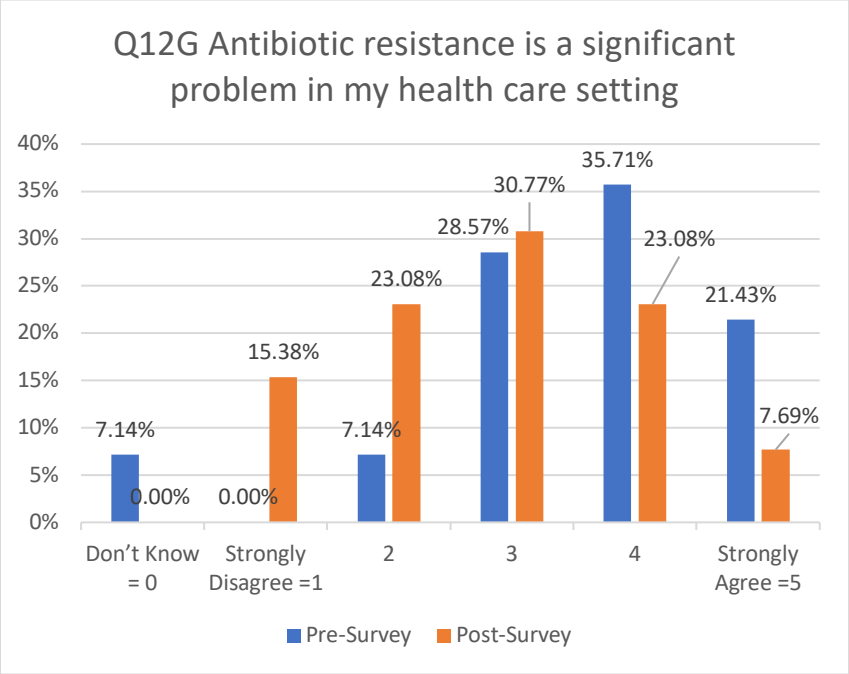



**Figure 23**

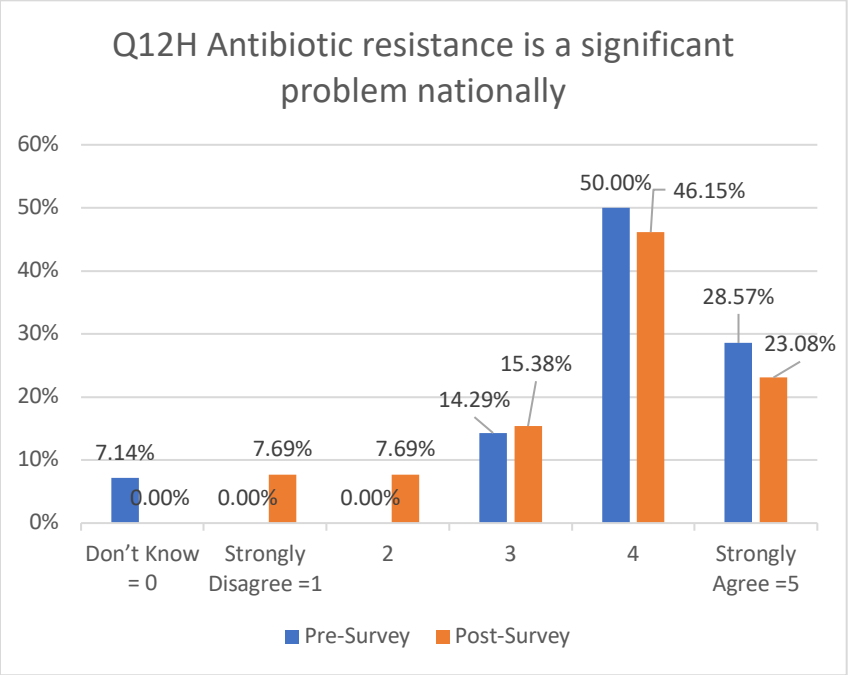


**Figure 24**

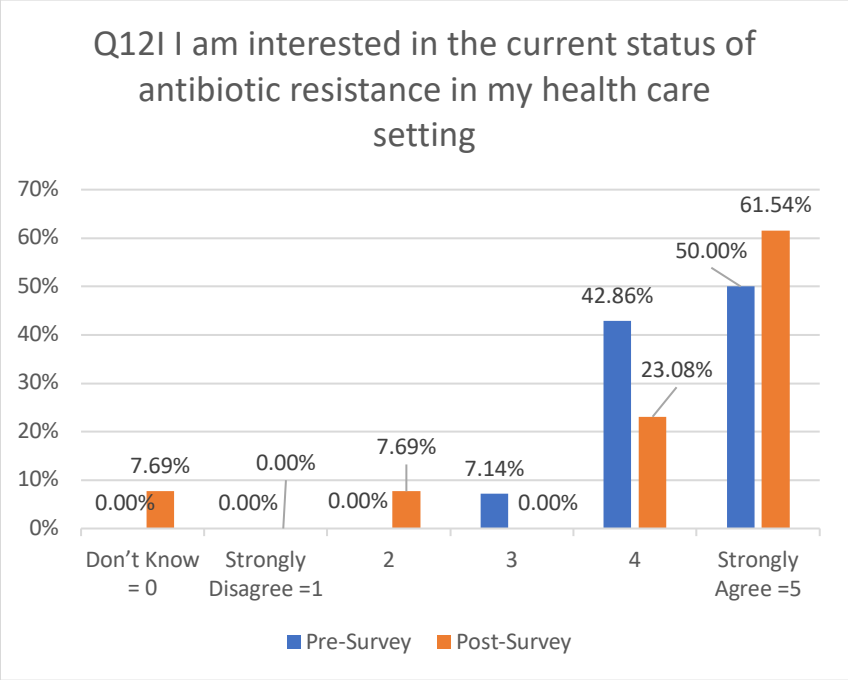



**Figure 25**

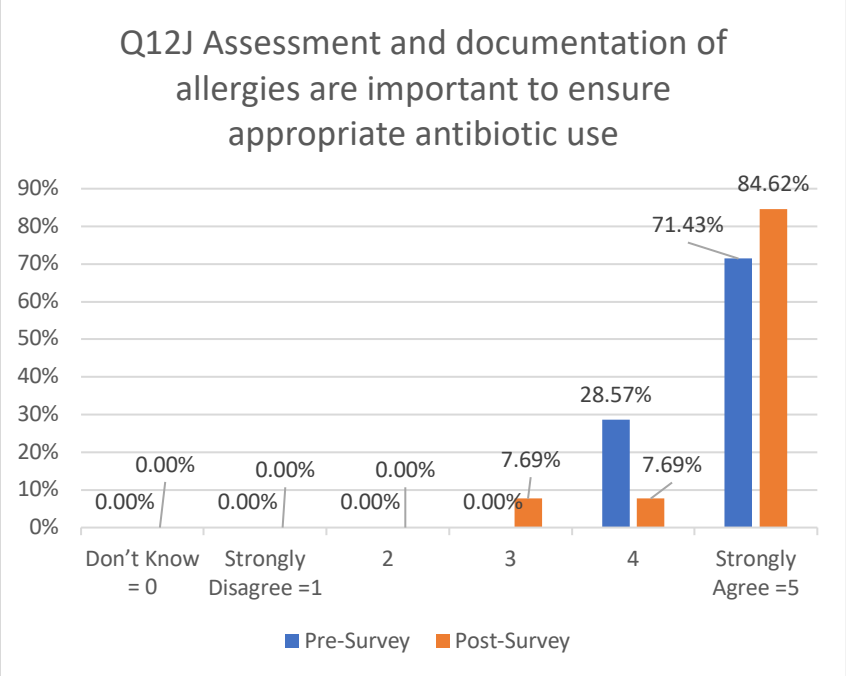


**Figure 26**

*Pre- and Post-Survey Results of Item Q13*

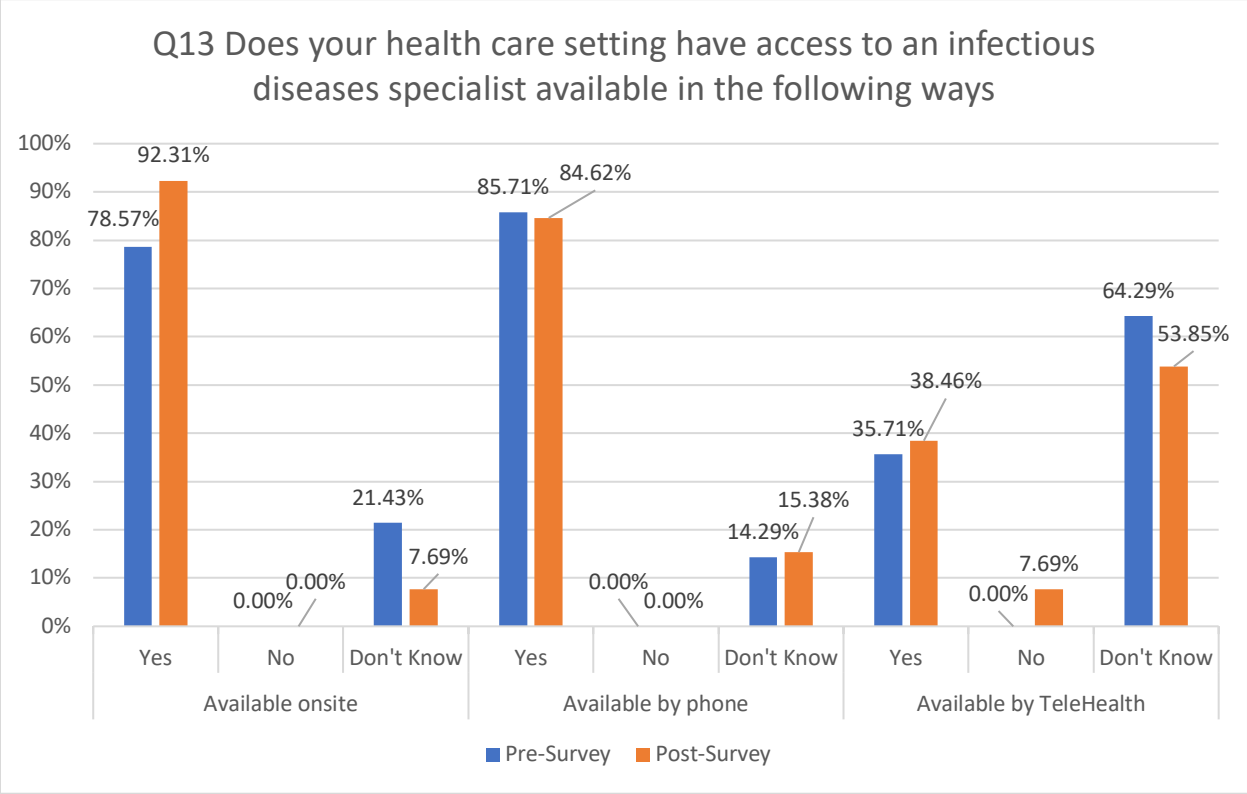


**Figure 27**

*Pre- and Post-Survey Results of Item Q14*

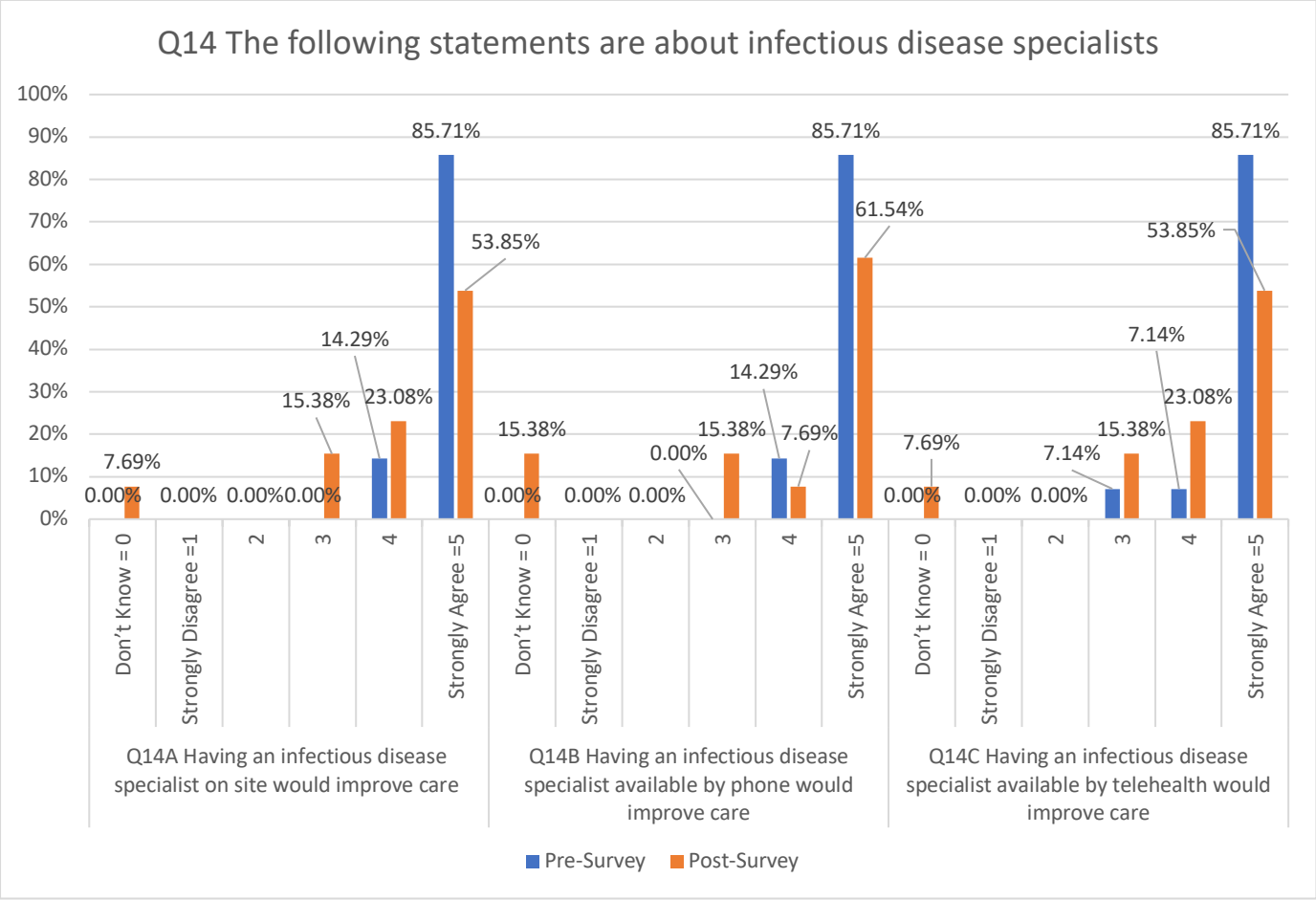


**Figure 28**

*Pre- and Post-Survey Results of Item Q15*

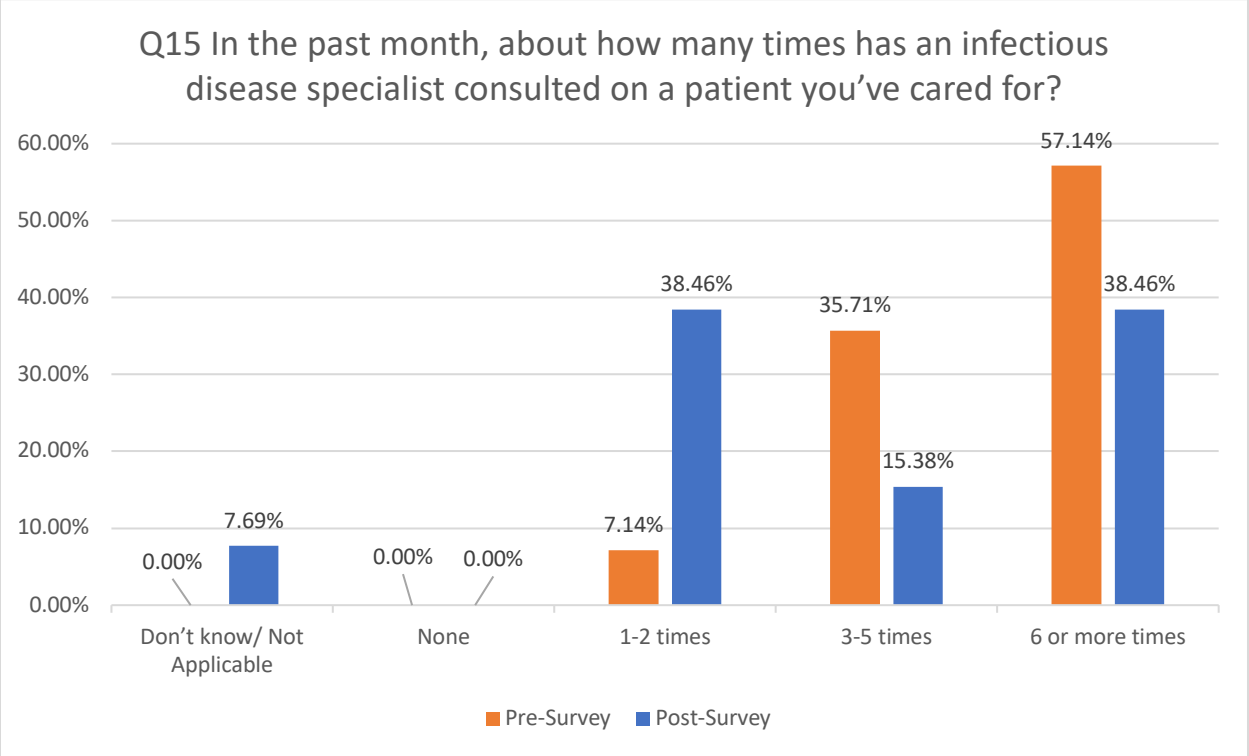
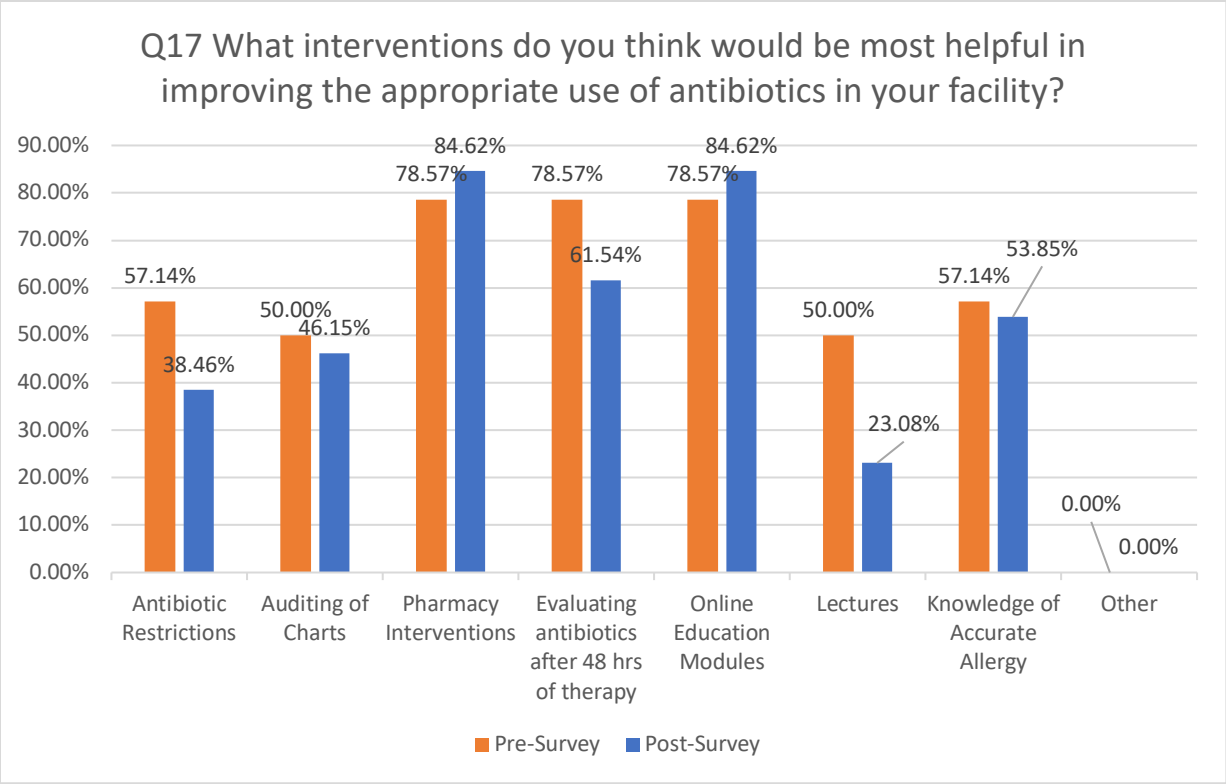


**Figure 29**

*Pre- and Post-Survey Results of Item Q17*



## Appendix E

## Breakout Tables for Survey Items

**Table 1**

*Pre-Survey Free Text Response to Item Q4*

| Q4 In your own words, provide a definition of antibiotic stewardship | Free Text Responses |
|---|---|
| | "effort to measure and improve antibiotic use" |
| | "It entails taking on the commitment to assess the appropriate use of antibiotics and preventing secondary infections due to invasive line use (ie. Foley central line)" |
| | "right antibiotic for specific infection" |
| | "it is a coordinated program that promotes the appropriate use of antimicrobials (including antibiotics), improves pt outcomes, reduces microbial resistance, and decrease spread of infections caused by multidrug-resistant organisms" |
| | "Prevent infection and increase the infection of the patient to provide better quality of care" |
| | "To promote optimal diagnosis of infectious disease and utilize appropriate antibiotics to improve patient safety and outcomes and try to reduce multi drug resistance" |
| | "evidence-based guidelines for antibiotic use to improve clinical outcomes" |
| | "identify use of antibiotic" |
| | "the guardian of the antibiotic to use it wisely" |
| | "A program to reduce unnecessary use of antibiotics" |
| | "complete compliance of antibiotic treatment" |
| | "Measure antibiotic effectiveness" |

| | |
|---|---|
| | "not sure" |
| | "antibiotics working faster and better" |

**Table 2**

*Post-Survey Free Text Response to Item Q4*

| Q4 In your own words, provide a definition of antibiotic stewardship | Free Text Responses |
|---|---|
| | "It is efforts to measure & improve how antibiotics are prescribed by clinicians and used by pts" |
| | "The need for antibiotics" |
| | "Group of people analyzing treatment and possible improvements to make" |
| | "A means to discuss why patients are on specific antibiotics and to discuss the plan of care" |
| | "Prevent the spread of infection" |
| | "Monitoring Patients with Antibiotic and evaluate if that Patient still need an antibiotic" |
| | "Improve pt out outcome" |
| | "Improve appropriate antibiotic use, reduce antibiotics resistance disease" |
| | "A group of people who enforce, analyze and improve protocols of antibiotic administration" |
| | "Antibiotic need & purpose" |
| | "System to assess the use of prescribed antibiotics" |
| | "The effort to measure and improve how antibiotics are prescribed by clinicians and used by patients" |
| | "Used to improve the use of antibiotics and reduce the overuse and inappropriate use of antibiotics" |

**Table 3**

*Respondents' Top Choice for Each Source of Information*

| Method | Pre-Survey (N = 14) | Post-Survey (N = 13*) |
|---|---|---|
| Ask a Colleague | Often | Often |
| Ask an ID Specialist | Sometimes | Often |
| PubMed | Often | Never |
| Up-to-Date | Sometimes | Never |
| Clinical Textbooks | Sometimes | Rarely |
| Personal Clinical Experience | Often | Sometimes |
| Ask Infection Control | Often | Always |
| Ask a Pharmacist | Often | Often |
| Internet Search/Google | Often | Often |
| Other | Occasionally | Never |

*Note*: This is in reference to item number 16 (Q16) from the antimicrobial stewardship survey. The question asked was "To what extent do you rely on the following sources of information about the care of patients with infectious diseases?"

# Appendix F

## Clinical Outcomes Data

**Figure 1**

*Hospital Onset Clostridium difficile Rate per Patient Days*

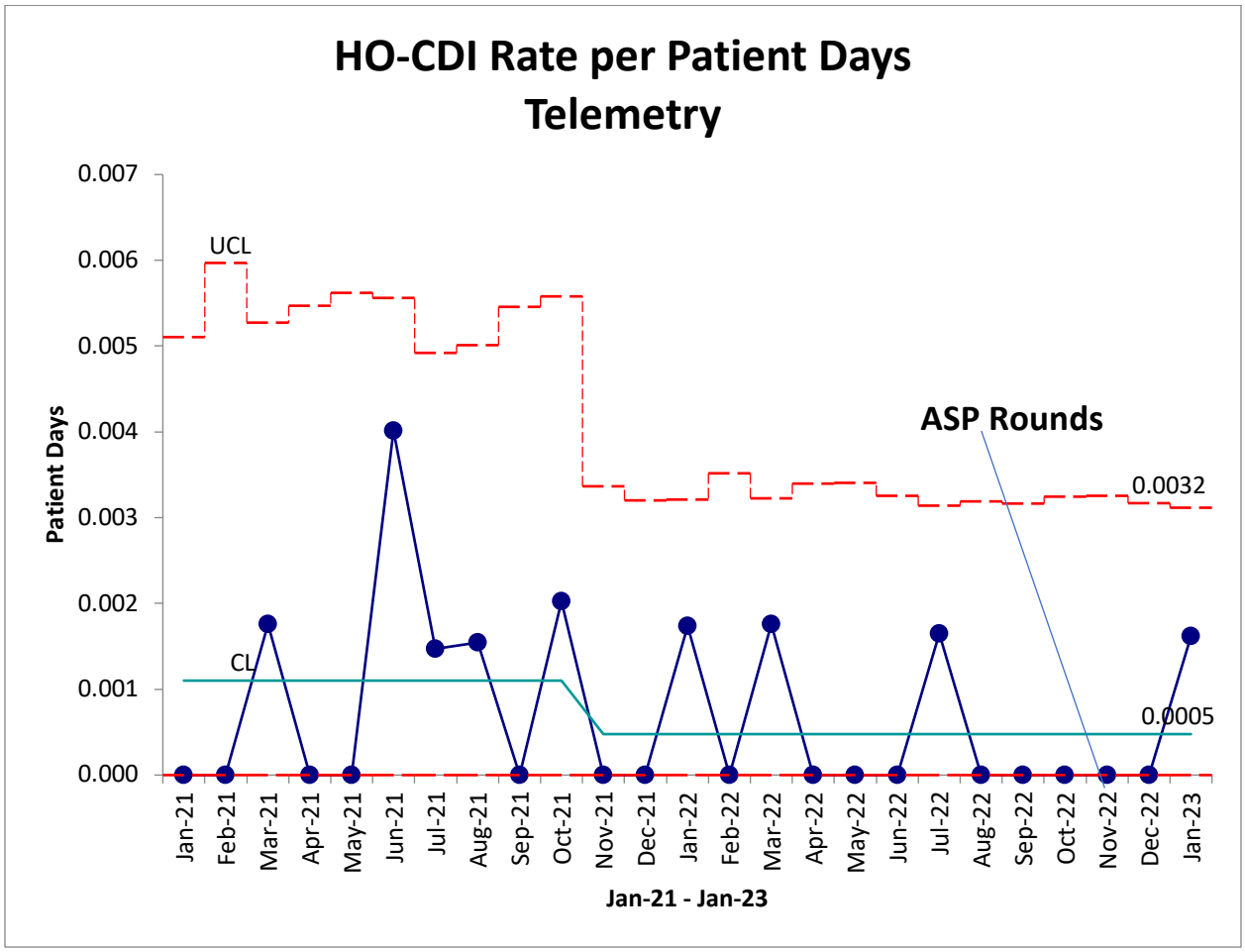


**Figure 2**

*Central Line Acquired Bloodstream Infection Rate per Catheter Days*

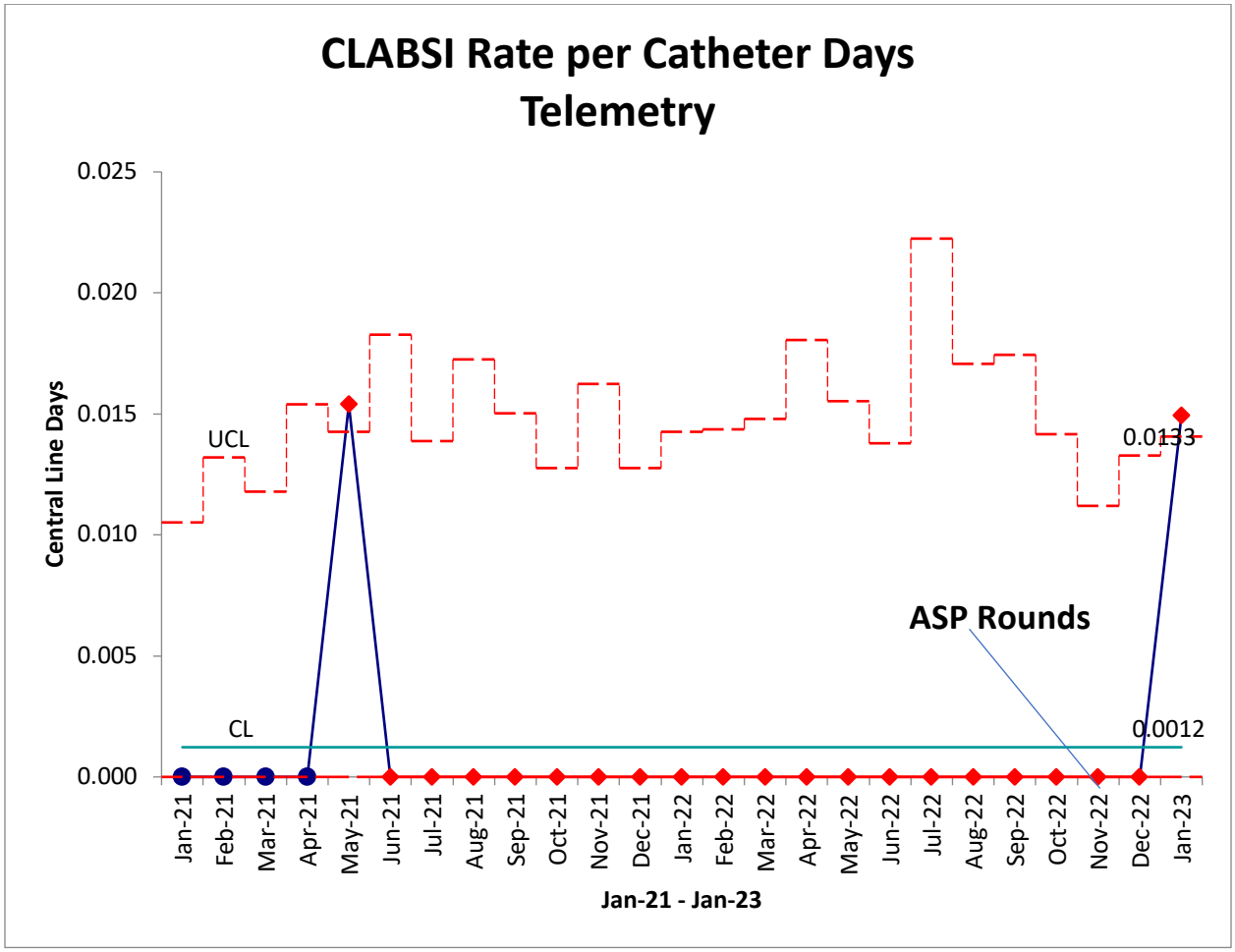


**Figure 3**

*Catheter Acquired Urinary Tract Infection Rates per Catheter Days*

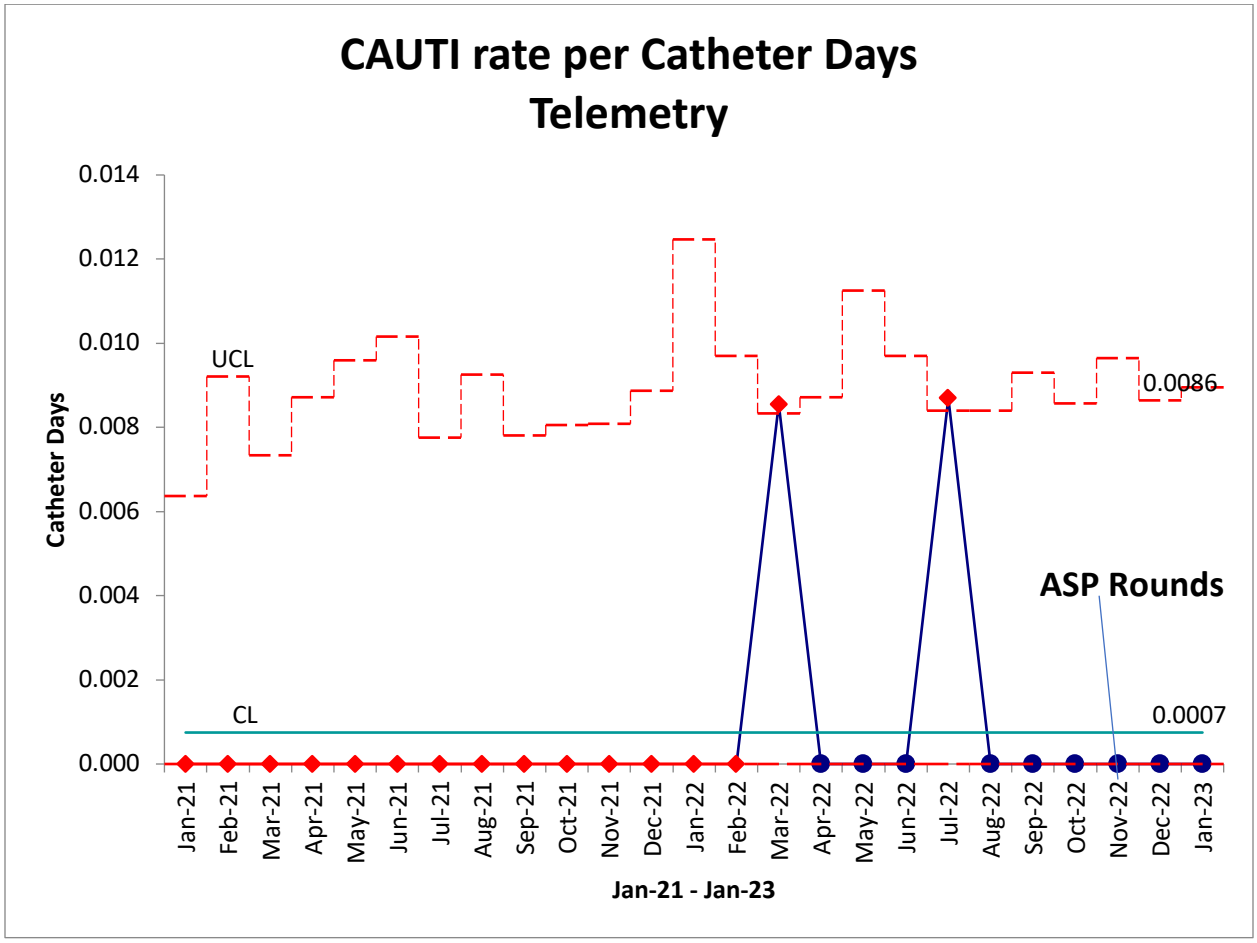
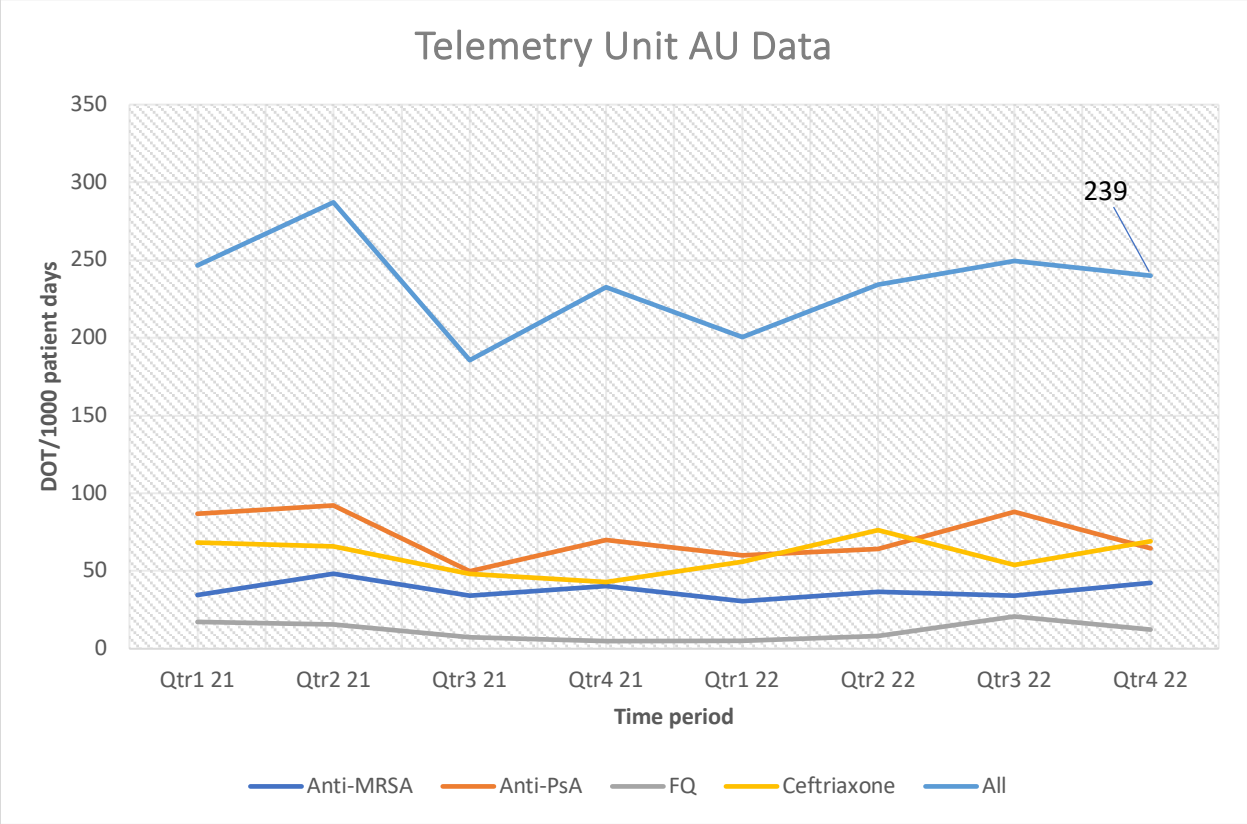


**Figure 4**

*Antibiotic Utilization – Duration of Treatment per 1000 patient days*




*Note*: Comparison data is done with other Telemetry units within the organization.