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# Utilizing Tracer Methodology to Evaluate the Effectiveness of a Hospital Antimicrobial Stewardship Program

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## Executive Summary

Antimicrobial resistant organisms are a growing threat in the United States and globally. It has become the expectation that healthcare institutions, including hospitals, contribute resources to create and maintain antimicrobial stewardship programs to decrease antimicrobial resistance, improve patient outcomes, and decrease the spread of multi-drug resistant organisms. The methods utilized to evaluate antimicrobial stewardship at hospitals often only evaluate outcome measures and fail to capture knowledge of the hospital antimicrobial stewardship program among prescribers, clinical pharmacists, and nurses, as well potential barriers to antimicrobial stewardship among healthcare providers. The purpose of this Doctor of Nursing project is to implement and evaluate the use of tracer methodology to evaluate both implementation and outcomes of a hospital antimicrobial stewardship program. For this project, a tracer was designed by a multidisciplinary team to evaluate treatment of community acquired pneumonia at a local 130-bed regional trauma center affiliated with a large regional not-for-profit health system. The hospital was motivated to conduct the evaluation in response to a suggestion from a state government agency active in promoting hospital ASPs. The results of this evaluation suggest that successful implementation of a tracer is reliant on the quality of questions, the abilities of the surveyor, response from participants, and recognition that antimicrobial stewardship is multifaceted. Further, the interpretation of tracer questions is not always straightforward and tracer results should be interpreted as such. When possible, tracer questions should be specific enough to produce results that are detailed and actionable.

# Utilizing Tracer Methodology to Evaluate the Effectiveness of a Hospital Antimicrobial Stewardship Program

## Introduction

Antimicrobial resistance of microorganisms, including bacteria and fungi, is a growing threat globally and in the United States (Centers for Disease Control [CDC], 2020; World Health Organization [WHO], 2018). In 2013 the CDC estimated at least 23,000 people die each year from antibiotic-resistant infections and more than two million people are infected with antibiotic-resistant organisms (CDC, 2013). The data released by the CDC in 2013 held the caveat that the available numbers were likely underestimated due to limitations in data collection (CDC, 2013). The CDC revised the estimates from 2013 using updated methodologies and data resources and these revised estimates indicated that when the 2013 report was published, more than 2.6 million antibiotic-resistant infections and 44,000 deaths occurred (CDC, 2019a). The most recent data released in 2019 reports more than 2.8 million antibiotic-resistant infections occur each year in the United States and more than 35,000 people die from such infections (CDC, 2019a). However, when comparing the newly recalculated data from 2013 to the newest available data in 2019, the CDC found that deaths from antibiotic-resistant infections had decreased by 18 percent thanks to actions implemented through the National Action Plan for Combating Antibiotic-Resistant Bacteria (CARB) (CDC, 2019a). A decrease in deaths is encouraging, however, antibiotic resistance remains a threat due to the ability of microorganisms to constantly adapt and develop mechanisms of resistance to antibiotics (WHO, 2018).

The development of resistance to antibiotics by microorganisms is evolutionarily inevitable, however, when antibiotics are frequently present in the environment or a host, the development of resistance is accelerated (CDC, 2020; WHO 2018). Inappropriate use of antibiotics includes administration of antibiotics that are not necessary, not the optimal antibiotic,

or the incorrect dose and duration of an antibiotic (CDC, 2019b). The CDC has concluded that 20-50% of antibiotics prescribed in acute care hospitals are unnecessary or inappropriate. Furthermore, researchers at the CDC found that the rate at which healthcare providers prescribe antibiotics varies widely among hospitals, with some providers prescribing three times as many antibiotics when compared to providers in similar departments of other hospitals (CDC, 2019c). Also of note, Baggs, Fridkin, and Pollack (2016) found that while the overall rate of antibiotic use in hospitals did not change from 2006 to 2012, changes were noted in the types of antibiotics being prescribed. The researchers found that the use of carbapenems increased by 37 percent and the use of vancomycin increased by 32 percent. Thus, decreases in the use of fluroquinolones and first- and second- generation cephalosporins were offset by the significant increases in vancomycin and agents with broad-spectrum activity against gram-negative bacteria.

Antimicrobial stewardship programs (ASPs) are coordinated efforts which promote the appropriate use of antimicrobials within various settings. The goals of ASPs are to improve patient outcomes, decrease antimicrobial resistance, and decrease the spread of infections caused by multi-drug resistant organisms (MDROs) (Association for Professionals in Infection Control and Epidemiology [APIC], n.d.). Hospital-based ASPs have been shown to effectively reduce inappropriate use of antibiotics, thereby reducing rates of *Clostridium difficile*, antibiotic resistance, and side effects related to antibiotics (CDC, 2019c). In 2014 the CDC released the *Core Elements of Hospital Antibiotic Stewardship Programs* providing the basis for hospitals to establish and improve stewardship programs. The seven core elements: (a) Leadership Commitment, (b) Accountability, (c) Pharmacy Expertise, (d) Action, (e) Tracking, (f) Reporting, and (g) Education are meant to serve as a framework for hospitals by supplying the structural and procedural components necessary for a stewardship program. Five years later, the

CDC has released an updated version of the *Core Elements of Hospital Antibiotic Stewardship Programs* that is based on new evidence pertaining to antibiotic stewardship and information gathered since 2014. The seven core elements remain the same though each includes updates to incorporate new evidence from the field of antibiotic stewardship and lessons learned from the past five years. The structure of ASPs remain the decision of each individual hospital or healthcare system based on the size, type, and available resources, but programs are expected to integrate components from all seven core elements (CDC, 2019d).

The Joint Commission (TJC) and the Det Norske Veritas-Germanischer Lloyd (DNV-GL) use the Core Elements as the basis for accreditation standards (DNV-GL, 2019). Additionally, the 2019 revision of the hospital conditions of participation from the Centers for Medicare and Medicaid Services (CMS) created a federal regulation for hospital ASPs and references the Core Elements (Centers for Medicare and Medicaid Services [CMS], 2019). As of 2018, 85% of acute care hospitals in the United States report implementing all seven CDC Core Elements (CDC, 2019d). On January 1, 2017 TJC released a new antimicrobial stewardship standard applicable to hospitals and critical access hospitals (TJC, 2016; TJC, 2017). One method utilized by TJC to assess compliance with accreditation standards is tracer methodology, however, such a method has not yet been utilized to assess hospital ASPs. Tracers can provide organizations with useful feedback by either validating practices or identifying knowledge gaps or deviations from evidence-based practices and guidelines. This project applied tracer methodology with the goal of evaluating the success of a hospital ASP, identifying potential gaps in knowledge or deviations from evidence-based practices, and verifying the fulfillment of accreditation requirements.

## Problem Description

A 130-bed regional trauma center affiliated with a large regional not-for-profit health system required evaluation of an active ASP (see Appendix A for Letter of Support from Agency). Once hospitals implement an ASP, ongoing assessment is necessary to ensure interventions are effective and to provide hospital leadership and healthcare providers with feedback. Assessing ASPs provides program leaders with the opportunity to identify potential gaps or deviations from evidence-based practices and the obstacles related to antibiotic stewardship healthcare providers encounter. Previous interventions implemented by the hospital stewardship team included the following: (a) audit and feedback; (b) provision of a hospital antibiogram to clinicians, (c) educational presentations regarding clinical guidelines and antibiotic prescribing, (d) encouragement to conduct antibiotic "timeouts", (e) formulary restrictions, and (f) implementation of specific diagnostic testing for patients being treated with specific antibiotics for certain diagnoses.

Tracking and reporting antibiotic prescribing and outcomes such as C. *difficile* and resistance patterns provides valuable feedback, however, understanding the ways in which providers prescribe antibiotics and the factors that influence their actions helps program leaders to design and modify programs that support providers in their stewardship practices. Past evaluation methods at the hospital did not attempt to specifically identify processes and barriers related to antimicrobial prescribing. Determining the feasibility of applying tracer methodology to evaluate a hospital ASP came to focus when an ASP physician lead proposed the intervention, and a state government agency proposed using tracer methodology to evaluate hospital ASPs.

The hospital employs 42 hospitalists on staff who provide care coverage for six different units during twelve-hour shifts. When patients are admitted through the emergency department (ED), orders are initiated by the ED physician who provides a handoff report to the internal medicine hospitalist. The hospitalist reviews the orders placed for the patient and makes changes as necessary. Each unit of the hospital is assigned a clinical pharmacist during the day who reviews patient medications. Rounds on select patients are led each morning by the hospitalist and are attended by the clinical pharmacist, nurses, and case managers. During rounds the status of the patient is discussed with regards to plan of care, including nursing care, medications, and preparations necessary for discharge.

The ASP team had nine members: (a) an antimicrobial stewardship physician lead; (b) an antimicrobial stewardship pharmacist lead; (c) an infectious disease specialist; (d) the microbiology lab director; (e) the hospital lab director; (f) the pharmacy director; (g) a hospitalist; (h) and infection preventionist; (i) and an administrator. To evaluate current prescribing practices and identify potential barriers to antimicrobial stewardship, the antimicrobial stewardship physician lead team proposed implementing tracer methodology to specifically evaluate treatment of community acquired pneumonia (CAP) and general knowledge of antibiotic stewardship among physicians, clinical pharmacists, and nurses.

## Available Knowledge

### PICOT

With the intent of creating and implementing a tracer to evaluate a hospital ASP and the impact of the program on the knowledge and practices of staff, a review of the literature was conducted to search for evidence supporting best practices. A PICOT question guided the search.

The components of a PICOT question are: patient population, intervention, comparison, outcome, and time (University of North Carolina, 2019).

Is conducting a tracer in an acute care hospital, from February 2020 to July 2020, an effective method for evaluating a hospital-based ASP with regards to the treatment of CAP when compared to only using process measures?

## Search Methodology

A systematic review of the literature was conducted in the PUBMED and CINHAL databases between December 2019 and April 2020. The search criteria included full text, peer reviewed articles in English from 2010 to 2020 using the following search terms in various forms: *tracer method**, *antibiotic*, and *antimicrobial*. The search yielded a total of 454 articles, including duplicates. Articles were selected if tracer methodology was proposed or implemented to evaluate a program addressing a clinical need within an acute care or outpatient setting. Articles were appraised using the John Hopkins *Research Evidence Appraisal Tool* (see Appendix B) (Johns Hopkins Hospital, 2017).

## Literature Review

**ASP evaluation methods.** Previous methods utilized to assess ASPs include interventional, retrospective, and ecological studies to evaluate economic outcomes, clinical outcomes, microbial and resistance outcomes, and process measures (Aldeyab et al., 2012; McGregor & Furuno, 2014). Clinical outcomes include hospital length of stay (LOS), mortality, clinical cure or failure, readmission rates, and adverse events associated with antimicrobial therapy. Assessing microbial or resistance outcomes involves measuring the incidence or prevalence of colonization or infection by an organism at the individual or population level. Process measures data include antimicrobial days of therapy, however, such measures should be

validated in order to establish an association with clinical outcomes (McGregor & Furuno, 2014). To assess progress and barriers to ASPs, surveys, and questionnaires have been administered (Van Limburg, Sinha, Lo-Ten-Foe, & Gemert-Pijnen, 2014). In a review of the literature, Hulscher and Prins (2017) concluded that antimicrobial stewardship teams face the challenge of selecting change interventions based on assessment of barriers, facilitators, and determinants of change interventions, especially since large differences in improvement were noted between studies that tested similar change interventions.

**Description of tracers.** Three types of tracer methods exist; individual tracers, systems tracers, and accreditation program-specific tracers (TJC, 2018). Individual tracers examine patient care experiences while at an organization by evaluating the provision of care and treatment within an institution. In individual tracers, patients are the framework used to determine compliance with set standards. Systems tracers aid in evaluating an entire system or process, including the way related processes are incorporated and the way different departments and disciplines coordinate and communicate within the system or process. Systems tracers are used to evaluate data management, infection control, and medication management. Accreditation program-specific tracers help to identify risks and safety concerns at different levels of care, treatment, and services, especially regarding issues specific to the organization (TJC, 2018).

When TJC conducts a tracer, it generally involves speaking with multiple staff members, patients, and family to learn details about each healthcare experience. Surveyors are collecting information to evaluate compliance with National Patient Safety Goals; adherence to policies and procedures; staff competency; communication within and between departments, programs, and services; and the physical environment as it relates to safety. Commonly, tracers start at the point of sample collection, critical results, transfusions, point of care testing, or frozen sections.

Surveyors review items such as orders, policies and procedures, employee competency, blood utilization review, process improvement, patient medical records, and instrument maintenance records. They also observe staff and conduct staff interviews (Olea, Paiano, & Olson, n.d.).

A search of the literature revealed studies in which tracer methodology was applied to novel applications, however, the application of tracer methodology to evaluate ASPs was not among these applications. Tracer methodology has been suggested or applied to assess a variety of other clinical and patient care practices including surgical site infections, pain reassessment standards, infection control standards, outpatient mental health services, and end-of-life care (Bailey et al., 2015; Bookbinder et al., 2015; Padgette & Wood, 2018; Ross, Feider, Nahm, & Staggers, 2017; Wisdom et al., 2012). Padgette and Wood (2018) recognize tracer methodology can be adapted and applied to all areas of inpatient and ambulatory healthcare at the individual or system level. Additionally, Bookbinder et al. (2018) suggest tracer methodology may be adapted to routine quality improvement activities when implemented in different settings, proposing the integration of the tracer into the normal work of a unit with a simple audit tool to guide information gathering.

A mock tracer is a simulation of an actual tracer. Developing a mock tracer requires four primary steps: planning, conducting, analyzing, and applying (TJC, 2011). To develop and implement a tracer, TJC recommends a series of steps and methods within the steps. The studies that utilized tracer methodology all had similar implementation approaches which closely followed the steps and methods recommended by TJC. An integrative discussion of the literature review will be discussed according to the steps proposed by TJC.

**Planning for tracer methodology.** According to TJC (2011) the planning stage involves establishing a schedule, determining the scope of the tracer, identifying surveyors, and training

the surveyors. Padgette and Wood (2018) highlight the importance of involving a multidisciplinary team in the planning phase as each member can offer insight and has an interest in the practice being traced. For example, to plan for a tracer evaluating the quality of end-of-life care, Bookbinder et al. (2015) generated a large pool of questions related to processes and outcomes of quality of end-of-life care. The authors then collected the questions into three separate instruments to use in a prospective survey of care provided to patients who died in the hospital. A committee of members from hospital administration, medicine, nursing, social work, ethics, chaplaincy, and education was established to write questions. Questions were based on literature describing the best practices in palliative care, and the process was described as iterative. Similarly, to assess mental health services, Wisdom et al. (2012) worked with clinicians and administrators to create 31 measurable criteria and examples from standards of care to design a licensing instrument. Ross et al. (2017) also created a multidisciplinary team from different departments and specialties, including primary care, nursing, quality management, and information technology to evaluate pain reassessment processes in a primary care clinic. The process included a review of the electronic medical record (EMR), observation of clinic workflow, and evaluation of clinic documentation and workflow.

**Conducting a mock tracer.** To conduct a mock tracer, TJC (2011) suggests teams consider several options when assigning the role of surveyor. Teams can consider a surveyor who is an expert in an area similar to the department, program, or service being assessed, but caution teams not to assign surveyors to the same area they work, in order to ensure objectivity. Alternatively, a team can choose to assign a surveyor with no experience in the area, but then must be sure to provide enough time for the surveyor to prepare and become familiar with the requirements. Pairing surveyors is another option as it allows surveyors to learn from each other.

Prior to conducting the tracer, the department, program, or service within the organization should be notified of the possibility of the mock tracer. When the tracer is commenced surveyors will collect data by taking notes of observations, conversations, and review of documents. Surveyors should be methodical and detail oriented, remind interviewees of the purpose of the tracer, maintain focus, but also remain flexible and productive. It is also advised that the surveyor is prepared to address any problems with the tracer that may be identified during the survey, including logistical issues, staff cooperation, and time involved. Once each tracer is completed, especially the first few tracers, it is recommended the team meets to debrief about the tracer process by allowing each team member to share and discuss issues they encounter.

To assess end-of-life care, Bookbinder et al. (2015) conducted a survey that included a review of the medical record and interviews with physicians, nurses, social workers, and chaplains who provided care in the 48 hours prior to the patient's death. The data was then analyzed to determine which questions could be used in a smaller survey, but still capture the more detailed information obtained when the three instruments were used. Next, a field test was conducted to determine if a clinician-led tracer could effectively be used to assess end-of-life care. Prior to the field-test, the nurse manager of a palliative care unit was trained by the survey creators in tracer methodology, specifically regarding obtaining information from front-line clinicians and the chart used to rate survey items.

In an assessment of mental health services, Wisdom et al. (2012) implemented a toolkit which included documents associated with the licensing process, video presentations related to standards of care and implementing best practices, a question and answer page to address topics raised by providers and other stakeholders, and an email address for questions, suggestions,

issues, and comments. Protocols were in place to select tracer cases, and field tests were conducted by central office and field office staff.

To evaluate pain reassessment processes, Ross et al. (2017) reviewed the EMR of patients who received Toradol, then utilized tracer methodology to track patients' process through clinic workflow and noted compliance for the same pain reassessment requirements as was reviewed in the EMR. A workflow questionnaire was also administered to capture the pain reassessment process and clinic procedures for clinic staff. With regards to patient selection, authors Padgette and Wood (2018) state that selections of patients can be random or targeted based on the tracer goal, but note it is important to ensure the number and type of patients observed allow for adequate validation of the practices or processes being evaluated. However, in the study conducted by Ross et al. (2017) the tracer sample size was purposely small in order to allow comprehensive evaluation of pain reassessment practices during observations. Though the authors acknowledge, the small sample size limits the generalizability of the findings.

**Analyzing tracer data.** Organizing and analyzing the data collected from the mock tracer is important in order to review, rank, and prioritize the problems and issues uncovered. TJC recommends several methods for organizing data, including developing a method to categorize the completed forms, previewing the data to check for recording errors and to highlight areas of concern, and ranking problems based on the data analysis. Once the data is analyzed, the results should be reported, but not presented in a way that may be perceived as punitive or that portrays the mock tracer as an inspection. All identifying information should be removed. TJC suggests several ways to report results, including formal reports, conference calls to share results, or posting feedback on an internal organization site or room and asking for feedback. Also important is presenting information in a timely manner, specifically, within one

month after completion and highlighting positive outcomes in order to encourage future positive interactions with mock tracers.

The methods used to analyze data can remain the discretion of the organization. Bookbinder et al. (2015) utilized factor analysis, canonical correlation, and group comparisons to determine if correlations could be made between instrument items and latent variables. Ultimately, the data was analyzed to determine if a clinician tracer guided by a small number of items could effectively be used as an audit tool. The items used on the field test were chosen based on the results of the preliminary analysis of the pilot and survey proper. Wisdom et al. (2012) do not discuss the process used to analyze data, but the authors share the field tests helped to identify strengths and weaknesses of the instrument as a licensing tool. Additionally, the field tests helped to establish the feasibility of using tracer methodology, identify the strength of the scoring protocol, and enable the staff to work together to ensure the survey was conducted consistently. Likewise, Ross et al. (2017) do not discuss the use of statistical analysis to analyze results, but workflow processes were identified, and workflow analyses revealed the roles performed by staff nurses, which was then used to guide clinic policy.

**Applying results.** The final step of conducting a mock tracer is to develop and implement improvement plans. Suggested approaches to implementing plans include handing off corrective actions to relevant managers, working with the organization's performance improvement program, sharing plans with the entire organization, monitoring plans as they are implemented by appropriate departments, and preparing for future mock tracers (TJC, 2011).

The tracer conducted by Ross et al. (2017) revealed the absence of standardized procedures in the clinic for pain reassessment. Therefore, the project improvement team recommended workflow be reviewed and modified and recommendations for improvement were

provided. The authors also acknowledge the importance of including primary care staff, EMR trainers, and clinical workflow analysts in the review and evaluation of possible solutions. Bookbinder et al. (2018) created a tracer tool based on staff feedback and the results of the field test. The authors concluded that findings revealed using the tracer tool would not be definitive, but instead would suggest the need for more detailed evaluation, practice change, or staff training. Similarly, Wisdom et al. (2012) concluded tracer methodology provided a more accurate assessment and follow-up of clinical issues compared to the process that emphasized policies and procedures, meeting minutes, and adherence to medical record documentation. Staff also revealed the process was more collaborative, affirming, and clinically relevant and ended with more agreement and clarity on clinic functioning. Overall, the implementation of interventions utilizing tracer methodology result in positive and valuable outcomes, however, the application of tracer methodology is not without challenges.

**Summary of evidence.** Several studies note the importance of cooperation from staff and leadership. Wisdom et al. (2012) found mental health service providers were reluctant to share information about service users and other providers. Ross et al. attribute success to having leadership support and recognize conducting a stakeholder analysis helped to identify and engage appropriate staff members. Bookbinder et al. (2018) also acknowledge the cooperation and capabilities of the professionals in their study may not be applicable to other settings. Furthermore, the authors recognize that some tests conducted by staff in their own unit may be subject to bias, indicating the need for future studies to assess for rater bias. With regards to the sustainability of implementing tracer methodology for program evaluation, Wisdom et al. (2012) note the challenges in continuously incorporating feedback from clients and providers and ensuring consistency among the survey team. Likewise, Bookbinder et al. (2015) recognize that

the tracer tool utilized in their study requires validation in new samples, and the tracer should be tested and retested to evaluate the reliability and sensitivity to change. The authors comment that the results of the tracer are not definitive, but indicate a need for further assessment, change, or education.

Overall, the reviewed studies suggest tracer methodology can be used not only to audit an organization's policies and procedures, but as a means to evaluate system programs and staff performance. Information gathered from a tracer can aid organizations in creating new programs or improving existing programs by helping to identify deviations or deficits. Furthermore, by measuring more than process outcome measures, tracers also have to potential to provide reasons for certain patterns or deviations. Ensuring multidisciplinary input when creating a tracer appears paramount, as does ensuring surveyors are not prone to biases when conducting the survey. Additionally, allowing adequate time for surveyors to become comfortable in their role is important as the success of the survey relies strongly on the abilities of the surveyor. None of the studies reviewed discussed evaluating the consistency of tracers conducted by multiple surveyors, however, given the reliance of tracers on surveyors, if more than one surveyor is assigned, consideration should be given to inter-rater reliability.

**Conceptual Framework**

The integrated promoting action on research implementation in health services (i-PARIHS) is the framework that guided the implementation of the tracer in the acute care setting (Kitson & Harvey, 2016). Kitson and Harvey (2016) examine knowledge translation (KT), also known as evidence-based practice. KT is the process of developing knowledge into practical applications for clinical practice and patient care. The authors note that historical models of KT are based on linear models of translation with the assumption that knowledge producers and

knowledge users are two separate entities. However, Kitson and Harvey (2016) cite evidence that multifaceted or complex interventions are more effective than simple interventions and suggest the use of the i-PARIHS framework to introduce KT principles into practice. Furthermore, the authors cite evidence that facilitation is a key component of KT, and is effective in primary care, community development, and acute and sub-acute care settings.

According to the original PARIHS framework, successful implementation of evidence-based practices relies on the quality and type of evidence, the characteristics of the setting or context, and the methods used to introduce or facilitate the uptake of the evidence. The core constructs of the i-PARIHS framework are facilitation, innovation, recipients, and context. Facilitation, the process of supporting individuals, groups, or teams to collectively work to achieve a common goal, is highlighted as being the active component in assessing, aligning, and integrating the other constructs (Kitson & Harvey, 2016; Schwarz, 2002). In order to effectively utilize a tracer as a means to evaluate a hospital ASP, facilitators were important to encourage the integration of tracer methodology (innovation) into the assessment practices of the hospital and ASP team in the acute care hospital (recipients and context) . A Doctor of Nursing Practice (DNP) student was designated as the novice facilitator, an administrative nursing director and a regional clinical coordinator pharmacist served as the experienced facilitators, and the medical director of pharmacy and infection control served as the expert facilitator.

**Specific Aims**

The goal of the project was to utilize tracer methodology to assess the effectiveness of a San Francisco Bay Area community hospital's antimicrobial stewardship interventions through the evaluation of healthcare providers' awareness of antimicrobial stewardship within their

institution, knowledge regarding antimicrobial stewardship components, and approach to prescribing antibiotics and ordering diagnostics for patients with CAP by August 2020.

## Methods

### Context

Implementing an antimicrobial stewardship tracer in a hospital setting required participation and cooperation from several key stakeholders. The Medical Director of Pharmacy and Infection Control was aware of the need to explore tracer methodology to evaluate the ASP, and buy-in from the ASP team members and hospital leaders, including the antimicrobial stewardship pharmacist lead, the hospitalist lead, the pharmacy director, a nursing administrative director, and nurse managers, were necessary in order to convey the importance of the tracer to other staff members and leaders within the hospital. Additional key stakeholders included the internal medicine physicians, clinical pharmacists, and nurses, all of whom were interviewed during the tracer process.

Care of patients in the hospital is multifaceted and involves input from numerous individuals, disciplines, and specialties. Capturing information from one component of patient care is challenging as the care team and treatment team is constantly changing and evolving. Understanding the process in which patients are assessed and admitted to the hospital was important in order to create a tracer that would best capture stewardship practices and potentially elicit obstacles or outside influences of different actions, attitudes, or behaviors.

### Intervention

The purpose of the intervention was to implement tracer methodology to assess the hospital ASP. Tracer methodology follows patients through the health care delivery system collecting information related to treatment or services to evaluate care provided. Tracer surveys

enable assessors to identify potential issues regarding performance issues within processes, or with interfaces between processes (TJC, 2018).

**Gap analysis.** The current and past ASP evaluation methods of the hospital included audit and feedback, rates of usage of specific antibiotics, and prescribing rates of individual prescribers. In planning, developing, and conducting a tracer, then analyzing and sharing the data, the objective of the intervention was to create a tool to determine current antimicrobial prescribing practices when treating CAP, identify barriers to stewardship, and evaluate the knowledge of healthcare providers regarding antimicrobial stewardship (see Gap Analysis, Appendix C).

The tracer in and of itself helped to identify gaps within the hospital ASP. At the individual patient level, the tracer assessed patient care regarding diagnostic criteria, ordered tests, and prescribed antibiotics. At the system level the tracer assessed if the hospital ASP has been effective in distributing education regarding antimicrobial stewardship and is a distinguishing resource for clinicians. The results of the interview portion of the tracer were compared to the information collected from the patient chart to determine if an association exists between antimicrobial prescribing practices and confidence regarding antimicrobial stewardship. Gaps in patient care were identified based on information collected during the tracer.

**Work breakdown structure and Gantt chart.** Implementation of the tracer involved four components: planning, conducting, analyzing, and sharing (see Work Breakdown Structure, Appendix D). The process of creating and implementing the tracer for antibiotic stewardship began with creating a multidisciplinary team with representatives from infectious disease, pharmacy, and nursing. In the planning phase, the team met multiple times to determine the scope of the tracer and establish a schedule for creating and conducting the tracer. (see Gantt

Chart, Appendix E). It was important to designate who would be performing the survey in order to begin preparing the surveyor by establishing access to the EMR, providing education about ASP guidelines and standards, and offering methods for conducting the tracer.

The DNP student assumed the role of surveyor, and while the tracer was being developed, the process of introducing the surveyor to clinical staff began. An introductory letter was sent from the experienced and expert facilitators to clinical staff to introduce the surveyor and the project. Additionally, the surveyor attended patient rounds for several weeks leading up to the tracer to meet as many hospitalists, clinical pharmacists, and nurses in person as possible, and, as time permitted, was introduced to nursing managers and clinical pharmacy directors and staff by the experienced and expert facilitators. The surveyor was also granted access to the electronic medical record and provided with contact information for prescribers and clinical pharmacists, all of which was facilitated by one of the experienced facilitators.

To choose components that would be best reflect the overall impact of the ASP through meeting compliance standards, it was necessary for all team members to review the CDC's Core Elements of Hospital Antibiotic Stewardship Programs: 2019 (CDC, 2019c), TJC's New Antimicrobial Stewardship Standards (TJC, 2016), and the American Thoracic Society's (ATS) guidelines for diagnosing and treating adults with CAP (Metlay et al., 2019). The multidisciplinary team met multiple times to determine the overall goals of conducting the tracer, including which questions and metrics would provide the most useful feedback for the stewardship program. It was important to ensure that tracer questions reflected components of the Core Elements. After deciding the tracer would focus on patients being treated for CAP, the team worked to integrate components of the ATS guidelines into the tracer. Additionally, the

team created interview questions for healthcare practitioners, with the goal of obtaining current practices and self-perceived knowledge.

Once the tracer was created by the Medical Director of Pharmacy and Infection Control, the Clinical Coordinator Pharmacist, and the DNP student who comprised the multidisciplinary team tasked with creating the tracer (see Appendix F), the surveyor (also the DNP student) conducted several chart reviews with the tracer to identify any preliminary issues with questions or the tracer format. The surveyor then presented the findings to the rest of the multidisciplinary team and modifications were made as necessary. Once the tracer was finalized, the surveyor began conducting the tracer with staff interviews.

Patient charts were selected to be surveyed if the patient had an admitting diagnosis of CAP; pneumonia due to infectious organism; or multifocal pneumonia. When a chart was identified, it was reviewed by the surveyor and used to answer questions in the 'Infection Specific Questions' and 'All Pneumonia' sections of the tracer which identified various components of care, including diagnostic criteria, laboratory and radiology testing, and ordered antibiotics. The admitting physician was notified and attempts were made to contact him/her for the interview portion of the tracer which included questions related to their knowledge of antimicrobial stewardship and the hospital ASP, and specifically the clinical approach to the patient. If more than five days had passed from the time the patient was admitted, the physician was not contacted. Additionally, an attempt was made to interview a nurse taking care of the patient on the day the tracer was conducted, as well as the clinical pharmacist responsible for reviewing the patient's medications for the day, to ask questions related to their general knowledge of antimicrobial stewardship, the hospital ASP, and the care of the selected patient. Patient charts were excluded if pneumonia was suspected but antibiotics were not ordered; the

patient was diagnosed with COVID-19; the patient met the criteria for healthcare associated pneumonia; the patient was originally admitted to the intensive care unit; the patient was ventilated or had a tracheostomy.

The first tracers conducted in February 2020 were conducted in-person whenever possible. The surveyor conducted tracers twice a week until the onset of the COVID-19 pandemic, at which point, tracers were halted. Tracers resumed in May 2020 but were conducted remotely, with the interview portion of the tracer conducted via telephone. The tracers were conducted twice a week, however, conducting the interview portion by phone allowed more flexibility as to the days the surveyor could attempt to contact providers. As the tracers progressed, the surveyor met with at least one member of the multidisciplinary team every two to four weeks to review challenges encountered with implementing the tracer and discuss any issues or observations made regarding the tracer tool or methodology.

It was important for the surveyor to remain flexible while conducting the survey to meet the needs of the patient care team. The ability to conduct face to face interviews was helpful in establishing a connection with the staff member being interviewed, however, it had the potential to limit the available timeframes the surveyor could reach staff. In fact, even when in-person interviews were conducted, there were still times the surveyor conducted an interview via phone due to the availability and preference of staff. After the onset of the COVID-19 pandemic, all tracers were conducted remotely. The ability to conduct tracers remotely potentially provided the surveyor with more flexibility with regards to days and time spent dedicated to conducting the tracer and interviews. Unfortunately, conducting the tracer remotely may have contributed to staff being unfamiliar with the mock tracer and, therefore, more apprehensive to share information.

Once tracers were completed, the last step of the implementation was consolidating the data and organizing it in a meaningful way for provision to the multidisciplinary team. Results and lessons learned throughout the process were also presented to the systems regional Antimicrobial Stewardship Team. Additionally, a toolkit (Appendix G) was created to guide hospitals in the plan, design, and implementation of future ASP tracers.

**Responsibility/communication plan.** The i-PARIHS framework guided the implementation of the tracer, and as such, guided communication and assignment of tasks amongst facilitators and from facilitators to recipients. According to the constructs of the i-PARIHS framework, the novice facilitator was selected to lead the project with support from the experienced and expert facilitators (Kitson & Harvey, 2016) (See Responsibility/Communication Plan, Appendix H). The novice facilitator worked to apply evidence in healthcare to innovations in practice. In order to successfully link evidence to innovation, the novice facilitator learned how to assess the quality of evidence and engage colleagues in discussion about current practices and areas for improvement (Kitson & Harvey, 2016). The DNP student served as the novice facilitator and conducted a review of tracer methodology, including past applications, and reviewed antimicrobial stewardship guidelines to establish an understanding of ASP requirements from TJC and CMS and present the findings to the established multidisciplinary tracer team.

The DNP student worked to understand the organizational structure of the hospital, with a specific focus on learning organizational priorities in order to garner support from hospital leadership and senior management. As the novice facilitator, the DNP student was supported by an administrative nursing director and regional clinical coordinator pharmacist serving as experienced facilitators. The nursing administrative director helped to orient the novice

facilitator to the hospital by familiarizing the novice to the setting, introducing the novice to appropriate leaders and managers, facilitating access to the electronic medical record, and facilitating remote access as necessary. Additionally, as an internal member of the organization, the nursing director was able to positively promote the innovation to stakeholders.

The regional clinical coordinator pharmacist provided guidance by helping the DNP student understand different ASP interventions and processes related to antimicrobial prescribing in the hospital. Understanding how to implement new evidence into routine practices enabled the experienced facilitators to support the novice facilitator with issues related to recipients and context. The medical director of pharmacy and infection control fulfilled the role of the expert facilitator by supervising the project and providing guidance to the DNP student. An expert facilitator is able to work across academic, service, and other organizational boundaries to actively incorporate evidence-based practices (Kitson and Harvey, 2016). In the implementation of the tracer, the expert facilitator aided in troubleshooting various strategies and provided insight into the potential strengths and weaknesses of implementing such methodology.

**SWOT analysis.** In conducting a SWOT analysis (see Appendix I for SWOT chart), potential strengths of utilizing tracer methodology for ASP evaluation included: (a) the ability to assess the knowledge of individual prescribers, pharmacists, and nurses regarding antibiotic prescribing, (b) the ability to establish resources available to clinicians, and (c) the potential to elicit the rationale regarding prescribing habits. Furthermore, tracer methodology enabled the assessor to gather information directly from the EMR to evaluate the impact of system wide interventions of education, antibiotic formularies, patient rounding, and diagnostic testing. While interviews and chart reviews can be conducted on site, the nature of the tracer allowed for information to be collected by phone or remotely, which helped to ensure efficiency for both

staff and the assessor. The development of the tracer by a multidisciplinary team provided the unique perspective of each profession. Additionally, the tracer focused on care provided for one specific infection, allowing for a more focused assessment, and the chosen infection of pneumonia has established treatment guidelines. Lastly, completion of the tracer by an outside assessor provided the potential of less risk of bias.

Potential weaknesses included the time involved to conduct the tracer, as well as coordinating prescriber and pharmacist schedules with the day the tracer was conducted. For the purposes of this tracer, the practices of the admitting physician were evaluated, however, questions pertaining to specimen collection and antibiotic timing and review required the patient to receive care for more than the initial first day. The admitting hospitalist may not have been available on day three of the patient's hospital stay. Additionally, the clinical pharmacist responsible for reviewing antibiotics on day three may not have been available every day. The perception of prescribers, pharmacists, and nurses, and their willingness to cooperate and participate also influenced the success of the tracer. The assessor had additional challenge of earning buy-in from stakeholders who were unfamiliar with them. Also, the accuracy of the tracer is dependent on the surveyor's knowledge of the charting system and ability to find information. Moreover, the tracer does not account for legitimate deviations from standard antibiotic therapy.

Potential opportunities include the fact that tracer methodology is evidence-based and utilized by accrediting agencies to evaluate various aspects of patient care and system processes. In the instance of ASPs, a state government agency responsible for promoting hospital ASPs has proposed the utilization of tracer methodology to evaluate the effectiveness of hospital ASPs as TJC and the DNV-GL now use the Core Elements as a basis for accreditation standards.

Additionally, the questions posed to staff have the potential to become an indirect way of providing antibiotic stewardship education and impress the importance of ASPs within the hospital.

Potential threats to implementing tracer methodology for the evaluation of ASPs within hospitals include the financial investment to implement and sustain the program and the amount of time involved to conduct the tracer. While the review of the electronic health record and interview can be streamlined, infections such as pneumonia are multifaceted, therefore, the approach to treating pneumonia can vary based on the patient. Such variation has the potential to confound data if questions lack direction or the surveyor is inexperienced or unfamiliar with the process. The tracer as a source of information is only as valuable as the surveyor is conscientious in data collection.

**Budget and break-even analysis.** The proposed budget considered the number of hours required by the employees with the largest contributions of time when developing and implementing the tracer. Hours for the medical director of pharmacy and infection control and the regional clinical coordinator pharmacist were related to the creation of the tracer and provision of guidance and feedback as needed. The DNP hours were accrued based on time spent creating and implementing the tracer.

The incremental cost to treat an antibiotic resistant infection is: $1,383 per patient (Thorpe, Joski, & Johnston 2018). Therefore, if the total cost to develop and implement the tracer is $16067, to break even, antimicrobial resistant infections need to be prevented in 12 people (see Appendix J for Budget and Break-Even Analysis).

**Study of the interventions.** Data was collected using the proposed tracer (see Appendix F). The face validity of the tracer was determined during the creation of the tracer. The first draft

of the tracer was distributed to all members of the survey team to review. The tracer was revised according to comments and suggestions received, then distributed to members again for final approval. Content validity was assessed once the survey was complete and data was analyzed and discussed. During the course of the survey, the surveyor determined that certain questions were not effective as the intervention was difficult to assess from a review of the chart, or the question implied the intervention was being implemented and practiced, when, in fact, it was not. Additionally, the surveyor noted questions found to be non-specific, therefore making the answers more susceptible to being misinterpreted.

**Measures**

The main goals of the tracer (see Appendix F) were to evaluate antimicrobial stewardship awareness and knowledge of physicians, clinical pharmacists, and nurses working at the hospital. The outcome measures were related to questions assessing clinician knowledge and awareness during the interview portion, and treatment approaches collected during the EMR tracer. Outcome measures included: Physician knowledge of hospital ASP; nurse knowledge of hospital ASP; clinical pharmacist knowledge of hospital ASP; physician self-reported confidence regarding pneumonia treatment; and compliance with ATS treatment guidelines for CAP.

Specifically, the tracer was expected to capture the percentage of interviewed providers aware of the ASP and using appropriate antimicrobial prescribing protocols. Data collected through interviews was compared to data collected from the EMR, with the intent of identifying strengths or weaknesses in antimicrobial stewardship practices as they related to the self-reported knowledge and confidence surrounding stewardship by the healthcare providers. Qualitatively, observations made by the surveyor regarding the attitudes of providers toward being interviewed and toward specific questions were also noted.

## Analysis

The surveyor deidentified information from the charts and interviews and filed the forms electronically as the tracers were being completed. Once all the tracers were completed, the surveyor reviewed the data to ensure all information was recorded and coded correctly. The yes/no questions and answers were tabulated using an Excel spreadsheet. The answers to the questions which allowed open answers were coded according to identified categories and themes.

To analyze the collected information, answers were organized into tables and charts from Excel, and then data from the interview portion of the tracer was compared to the data collected from the patient chart. The intention of comparing data from the two parts of the tracer was to determine if an association existed between antimicrobial prescribing practices, confidence regarding antimicrobial stewardship, and self-reported knowledge regarding antimicrobial stewardship.

The small number of patient charts reviewed, and smaller number of clinicians interviewed, created a limitation when interpreting the results. However, as there are a set number of staff within the hospital, and repeat interviews within the same tracer cycle are not desirable, an increased number of chart reviews would perhaps only aid in a better understanding of the processes taking place. Data collected on the proposed outcome measures could still be analyzed, but attention was shifted to also include knowledge garnered through observations regarding methodologies applied during the tracer. Such observations can help to guide future tracers and provide insight into the stewardship knowledge and practices of healthcare providers within the hospital.

## Ethical Considerations

This project was evaluated and approved as a quality improvement project through the University of San Francisco School of Nursing and Health Professionals (see Appendix K for Statement of Non-Research Determination)**.** The project was undertaken as an evidence-based change of practice project and as such, did not need to be supervised by the Institutional Review Board. Priority was given to confidentiality and privacy by blinding data retrieved from the EMR. Ensuring patient privacy during chart audits was essential, as was maintaining confidentiality of prescribers, clinical pharmacists, and nurses during interviews. To protect the identity of patients and healthcare personnel, a coding system was implemented to de-identify the hospital, interviewee, and patient.

Collecting information and data regarding antimicrobial prescribing practices and barriers to antimicrobial stewardship was done with the ultimate goal of improving patient care and preserving antimicrobials for future use. The purpose of this project was in accordance with the Jesuit values and the American Nurses Association (ANA) Code of Ethics. The implementation and outcomes served to fulfill a social responsibility of creating, communicating, and applying knowledge that will assist with responsible utilization of healthcare resources (University of San Francisco, n.d.). Furthermore, according to Provision 6 of the ANA Code of Ethics, in order to encourage safe, quality healthcare, the nurse is expected to establish, maintain, and improve the ethical environment of the work setting (American Nurses Association, 2015). Implementing tracer methodology to evaluate a hospital ASP seeks to create a new assessment method to improve and encourage antimicrobial stewardship which supports nurses and other health professionals in the fulfillment of their ethical obligations.

## Results

In total 15 tracers were completed from February 2020 to July 2020, with a pause in conducting tracers from the beginning of March to the end of May due to COVID-19. Within the 15 tracers, seven physician interviews, nine nurse interviews, and five clinical pharmacist interviews were conducted. The focus of the tracer was on the admitting physician, nurse caring for the patient on the day of the tracer, and the clinical pharmacist caring for the patient on the day of the tracer. The data being collected, however, was often generated over several days and in the days preceding the tracer.

### Tracer Results

All raw data was provided to the hospital medical director of pharmacy and infection control and the regional clinical coordinator pharmacist, however, as the onus of antimicrobial stewardship in the hospital falls to physicians, results from the physician interviews and EMR review were highlighted in the presentation to the regional System Antimicrobial Stewardship committee (see Appendix L and Appendix M). Specifically, with regard to general knowledge of the hospital ASP, it was noted that of the seven physicians interviewed, six stated they were aware of the hospital ASP prior to being interviewed, five recognized the hospital had specific guidelines for common infections, and all seven stated the hospital implemented specific antimicrobial stewardship interventions. However, when asked to specify interventions, answers varied widely. Answers included the following responses: (a) someone calling to review prescribing, (b) receiving a prescribing report with the overall percentage of antibiotics prescribed for select antibiotics, (c) patient rounding, (d) antibiotic specific education, (e) order sets, and (f) receiving input from the pharmacy. Only education, patient rounding, and prescribing reports were cited by more than one physician. With regards to self-reported

knowledge, all physicians interviewed stated they had adequate knowledge of the treatment of pneumonia to choose empiric antibiotic therapy. Of the EMRs reviewed, all patients were appropriately prescribed standard empiric therapy.

Factors influencing treatment revealed some inconsistencies with chart documentation and following guidelines. Physicians reported the following multiple resources used to determine a definitive antimicrobial regimen: (a) clinical guidelines, (b) clinical condition of patient, (c) procalcitonin level, (d) minimum therapy of three days for treatment, (e) culture and sensitivity results, (f) infectious disease consult, (g) UptoDate, (h) type of infection, and (i) clinical improvement of the patient. Only clinical guidelines, clinical condition, and infectious disease consult were cited by more that one physician.

The EMR review sought to detect diagnostic criteria identified by the ATS/IDSA clinical practice guidelines for the treatment of CAP. Of the 15 patient charts reviewed five patients were tested for influenza, nine patients were not tested, and one patient chart was missed. The guidelines state patients should be tested when influenza was circulating in the community (Metlay et al., 2019). It was noted that this result is somewhat difficult to interpret as the tracer was halted from March to June, but it may have been easier to interpret if results were collected from charts in winter and early spring when influenza is more prominent. Other diagnostics reviewed included urine tests for Legionella and pneumococcal antigens. The recommendation is to not routinely check for these antigens except in patients with severe CAP (Metlay et al., 2019). Only three of the patient charts reviewed met IDSA/ATS criteria for severe CAP, yet seven patients were tested for the Legionella antigen and four were tested for the pneumococcal antigen. The discrepancy in Legionella and pneumococcal antigen testing is interesting, as is the divergence in the number of patients tested for Legionella and pneumococcal antigens compared

to the number of patients meeting the diagnostic criteria for severe pneumonia. Lastly, procalcitonin is not recommended to determine need for initial antibiotic therapy, but it is acknowledged it may be helpful to monitor (Metlay et al., 2019). Of the patient charts reviewed, nine patients had a serum procalcitonin level ordered prior to the initiation of antibiotics or prior to the second dose of antibiotics, but six did not.

Of the questions related to factors influencing treatment of MRSA, P. *aeruginosa*, and other MDROs, physicians cited multiple criteria to determine risk for such organisms. The intent of the questions regarding MDROs was to evaluate knowledge regarding risk factors and treatment. The answers were found to be varied and inconsistent. Criteria cited included: (a) prior isolation of P. *aeruginosa*, (b) prior isolation of MRSA, (c) recent hospitalization and exposure to parenteral antibiotics, (d) arrival from facility with known MDROs, and (e) an 'other' category. The EMR review revealed vancomycin was ordered for three of the 15 patients, however, a MRSA PCR was only ordered for one of the three patients. A pretreatment gram stain and culture of lower respiratory secretions was ordered for three patients, but the three patients for which the gram stain were ordered differed from the patients for whom vancomycin was ordered and the patients did not meet the criteria for severe-CAP according to the documentation. The guidelines recommend obtaining a pretreatment gram stain and culture of respiratory secretions in adults being treated for CAP in the hospital who are classified as severe CAP, or are being empirically treated for MRSA or P. *aeruginosa*, or who were previously infected with MRSA or P. *aeruginosa*, or who were hospitalized and received parenteral antibiotics in the last 90 days (Metlay et al., 2019).

**Data presentations.** The final step of the tracer was presenting the results of the tracer and lessons learned about applying the methodology to ASP assessment to the hospital medical

director of pharmacy and infection control and the regional clinical coordinator pharmacist (see Appendix L). Additionally, some results and the lessons learned regarding methodology were presented to the regional System Antimicrobial Stewardship committee of which the medical director of pharmacy and infection control and the regional clinical coordinator pharmacist are members. Results were communicated in a written report which presented data collected for each question on the tracer. Qualitative data was provided from interview questions, and annotations were added to questions found to need clarification or revision. A PowerPoint presentation was also created for the regional System Antimicrobial Stewardship committee and presented virtually during a regularly scheduled meeting (see Appendix M).

**Tracer observations/recommendations.** Collecting data retrospectively provided insight into the approach to caring for patients with a diagnosis of CAP and highlighted that caring for such patients is a team approach. The surveyor observed that often when the admitting physician admits the patient, the initial orders do not necessarily include all recommended diagnostic tests, but the tests may eventually be ordered by consulted specialists or hospitalists on subsequent days. Thus, with regards to lessons learned in applying tracer methodology for ASP evaluation, it was concluded future tracers must carefully consider the presentation of questions and designate medications, tests, and processes by specialty or department to help establish progression of treatment and propensity of providers.

With regards to staff participation, including attitudes toward the tracer, it was noted that willingness to participate and enthusiasm varied by discipline. Regardless of discipline, willingness to participate was greatly influenced by current workload. Amongst physicians, attitudes toward participation also seemed to be influenced by past experiences with feedback related to their antimicrobial prescribing practices.

Incidentally, the surveyor also found some uncertainty existed regarding the classification of the severity of patients' pneumonia complicating some aspects of the tracer. Aside from reviewing the chart for criteria from a validated definition, there is no standardized designation in the patient chart to distinguish CAP from Severe-CAP. The clinical practice guidelines approved by the American Thoracic Society (ATS) and Infectious Disease Society of American (IDSA) in 2019 provide criteria for defining severe-CAP and use the distinction to indicate which diagnostics are recommended. Future tracers should further evaluate the sensitivity and specificity of the criteria as it pertains to patients admitted to the hospital for CAP. No physicians cited the ATS and IDSA guidelines and several physicians listed criteria not included when determining the course of treatment for patients.

The results of the tracer can be used as an educational opportunity for participants, though, ultimately, the ASP team is responsible for reviewing the results and planning future interventions. Additionally, as knowledge and insight evolved regarding the creation and implementation of an ASP tracer, a toolkit was developed to guide future efforts. The implementation toolkit (see Appendix G) includes guidance regarding selection of team members, recommendations for strategies to create the tracer tool, and offers considerations to be made when deciding metrics to be investigated.

## Discussion

### Summary

Antimicrobial stewardship will remain an important part of providing safe, quality healthcare, therefore, healthcare facilities must find ways to efficiently and effectively evaluate programs. Utilizing a method that evaluates process measures while simultaneously assessing barriers to appropriate antibiotic prescribing has the potential to provide valuable feedback and

empower involved stakeholders to meaningfully contribute to quality improvement projects within their institutions. The completed tracers provided insight into the effectiveness of the ASP program and helped to identify trends with regards to resources used, efficacy of currently utilized feedback methods, and potential knowledge gaps. The ability of a tracer to provide valuable information relies heavily on the quality of questions and the ability of the surveyor to understand and identify questions that may provide imprecise answers. Often, survey questions aspire to have definitive answers, however, answers may not always be interpreted definitively in the context of the multifaceted nature of patient care in an inpatient setting, under the circumstances of an evolving infection, and during transfer of care between providers and departments.

Future application of tracer methodology to evaluate antimicrobial stewardship must be sensitive to the multiple providers and departments involved in caring for patients receiving antimicrobials. Future tracers should remain sensitive to the time required of staff to participate in the tracer, including considering the use of e-surveys to obtain information for follow-up (North et al., 2009). Some information may best be collected in the form of a survey or interview, but the value of requesting staff to demonstrate the location of items in the chart, for example, an order set, versus questioning knowledge of an item should not be underestimated. Such a technique allows more accurate assessment and potentially decreases the provider's perception that their judgement or knowledge is being tested.

If a tracer can successfully be created and implemented to evaluate a hospital ASP, then applying the method to evaluate ASPs in outpatient and long-term care facilities should also be considered, as antimicrobial stewardship recommendations exist for these institutions which are

also subject to review from TJC and CMS (CDC, 2015; CMS, 2016; Sanchez et al., 2016; TJC, 2019).

**Interpretation**

As was demonstrated in other projects in which a tracer was developed and implemented, the establishment of a multidisciplinary team was an important component in the development of the ASP tracer (Bookbinder et al., 2015; Padgette & Wood, 2018; Ross et al., 2017; Wood et al., 2012). Just as Wisdom et al. (2012) noted providers were reluctant to share information about service users and other providers, the ASP tracer found that providers were not only sometimes reluctant to answer questions, but also suspicious as to why the information was being collected. While leadership provided support for the project and facilitated its implementation, increasing the visibility of the project in future tracers and involving more stakeholders may lessen such reluctance. Moreover, the importance of choosing appropriate methods to introduce the project and the role of facilitation in implementing a new practice in the hospital was evident in the reluctance displayed by many staff members. Understandably, many resources were directed toward the COVID-19 pandemic, but future tracers must be prioritized by experienced and expert facilitators to integrate tracer methodology as an assessment method within the hospital (Kitson & Harvey, 2016).

Assigning a surveyor from outside the hospital potentially limited bias but may also have contributed to reluctance to participate. In fact, future endeavors may wish to involve hospital clinical pharmacists more, as stewardship pharmacists are likely key in ensuring trust amongst other providers with respect to the tracer. With regards to specifically implementing the tracer, Bookbinder et al. (2015) highlighted the importance of training the surveyor in tracer methodology and obtaining information from front-line clinicians. Indeed, the ability of the

surveyor to effectively obtain information from staff during the ASP tracer hinged on knowledge of tracer methodology, familiarity with the tracer questions, and the ability to make observations, while collecting data. If data is collected by hospital staff, assessing for rater bias will be necessary (Bookbinder et al., 2018). Furthermore, if a tracer is conducted by more than one surveyor, testing inter-rater reliability will also be important.

Padgette and Wood (2018) noted it is important to ensure the number and type of patients observed allow for adequate validation of the practices and processes being evaluated. While the sample size in the ASP tracer was small, focusing on patients with CAP provided a more focused outcome, which was helpful when reviewing a process as multifaceted as antimicrobial prescribing and stewardship. Unfortunately, the small sample size also makes the results less generalizable.

Ross et al. (2017) identified workflow processes and roles of staff with a tracer and applied the knowledge to guide clinic policy, the observations and lessons learned in the ASP tracer with regards to staff receptiveness, intention of questions, and focus of questions can be applied to future assessments and education topics. Just as Wisdom et al. (2012) concluded that tracer methodology provided a more accurate assessment and follow-up of clinical issues as opposed to processes emphasizing policies and procedures, likewise, the ASP tracer revealed the steps involved in prescribing antibiotics are not straightforward and are influenced by variables not only related to the patient, but also to the provider, the specialty, the department, or even the day.

Nevertheless, the various components involved in antimicrobial stewardship that make utilizing tracer methodology an appealing assessment technique also contribute to the challenges of implementing future tracers in a sustainable manner. Wisdom et al. (2012) note the challenges

in continuously incorporating feedback and ensuring consistency among the survey team, and Bookbinder et al. (2015) observe that tracers continuously require testing and validity to evaluate reliability and sensitivity to change. Maintaining a tracer that is current and relevant to the practices within the hospital, and ensuring surveyors are consistently and uniformly educated requires a commitment and investment from hospital administrators. Yet, an ASP tracer has the potential to fulfill the required core elements of tracking, reporting, and education as the tracer is capable of collecting data related to antimicrobial prescribing practices and indirectly educating staff on antimicrobial stewardship. Moreover, results can not only be shared with staff, but can also be used to guide further evaluation, influence policies, and inform educational interventions (Bookbinder et al., 2018; Wisdom et al., 2012).

**Limitations**

The project was to be initiated early 2020 with the first tracers to be conducted in February which seemed advantageous when attempting to survey as many cases of CAP as possible based on the usual seasonal trend of increased CAP admissions in the winter and spring seasons (Murdoch, et al., 2014). However, arguably the biggest limitation in conducting this particular tracer was the occurrence of COVID-19. Surveys had to be halted at the beginning of March, then resumed at the end of May and continued until the middle of July, though the number of cases able to be captured on days the surveyor was able to conduct tracers decreased over time. The small number of patient charts reviewed, and smaller number of clinicians interviewed created a limitation when interpreting the results.

The first tracers conducted in February were conducted in-person whenever possible. The ability to conduct face to face interviews was helpful in establishing a connection with the staff member being interviewed, however, it had the potential to limit the available timeframes the

surveyor could reach staff. In fact, even when in-person interviews were conducted, there were still times the surveyor conducted an interview via phone due to the availability and preference of staff. After the onset of the COVID-19 pandemic, all tracers were conducted remotely. The ability to conduct tracers remotely potentially provides the surveyor with more flexibility with regards to days and time spent dedicated to conducting the tracer and interviews. Unfortunately, conducting the tracer remotely may have contributed to staff being unfamiliar with the tracer and, therefore, more apprehensive to share information. Furthermore, as the tracer focus is on the diagnosis of CAP, the outbreak of COVID-19 presents a unique challenge as it has the potential to cause viral pneumonia. Consideration must be given to the potential for the pandemic to alter the approach of healthcare providers when caring for patients with pneumonia. Remote access and phone interviews helped to minimize unnecessary exposure to non-essential individuals.

Challenges were also encountered with regards to the willingness and ability of staff members to participate in the interview. Physicians often cited being too busy as a reason to not be able to answer questions. One physician did not have access to the electronic medical record at the time of the interview and could not remember the patient in question. In several instances the physician did not return messages requesting a return call in order to conduct the interview. With regards to nursing staff, a major challenge was trying to find times the nurses were able to answer questions. Often, nurses were called multiple times in an attempt to accommodate their schedules. Additionally, when tracers were resumed in May, several nurses refused to answer patient specific questions citing patient privacy. Staff seemed unfamiliar with the project despite an introductory letter being sent to units at the beginning of the project. The clinical pharmacists were often the easiest staff to contact for interviews. In only one instance did the clinical

pharmacist state she did not have time, though she did return the surveyor's call, but the surveyor was unable to conduct the interview at the time.

In addition to challenges related to finding acceptable times to speak with staff, the receptiveness and openness of staff varied amongst disciplines. The success of the interview portion of the tracer hinged on the willingness of staff to answer candidly and honestly. Staff members were continually reassured their responses were anonymous, however, it was not uncommon for physicians to appear apprehensive, as evidence by questions such as, "Why did you choose me?" or "What did I do wrong?" The attitude amongst nursing staff varied with some nurses appearing eager or enthusiastic, as evidenced by the details shared in their answers, while others appeared rushed as evidenced by the need to end interviews early and answers that were vague. The clinical pharmacists appeared the most open and eager to participate and share their knowledge, observations, and thoughts.

Unfamiliarity with the surveyor also seemed to generate a certain level of reluctance. Certainly, during a tracer conducted for accreditation, the surveyor is unfamiliar to staff, however, during a process improvement project, the importance of establishing trust was underscored. Care must also be taken to ensure questions are perceived as assessing the process or program and not the provider. The intent of the tracer is to evaluate the ASP program, therefore, staff should not be made to feel as though their knowledge or the quality of care they provide is being questioned.

The greatest potential barrier to completion of tracers is the time required to complete a tracer for the surveyor and those being interviewed. The tracer needed to be conducted on the third day of patient care as required by questions regarding review of antibiotics. This requirement presented a challenge with regards to scheduling. The surveyor may not be able to

conduct tracers on site daily and the prescriber may not be available several days later. However, this challenge can potentially be mitigated if the surveyor is able to access the patient chart remotely, thus, providing the opportunity to review the chart off site. Additionally, while not ideal, interviews with prescribers, nurses, and clinical pharmacists can be conducted via telephone. The ability to conduct phone interviews provides flexibility to both the surveyor and the healthcare professional being interviewed.

While the interview portion of the tracer offers valuable insight into the general knowledge of antimicrobial stewardship and the ASP program at the hospital, it may be more efficient to obtain the information in a questionnaire or survey and save only select questions, particularly those that require demonstrations for the in-person interview. North et al. (2009) discuss the value of utilizing an e-survey to address areas identified in a tracer that require follow-up. The authors state that an e-survey can either assess the extent of a particular standard knowledge gap or provide information about a gap area. E-surveys are able to complement tracer methodology by expanding the range of assessment of standard knowledge, much like the intention of the interview portion of the tracer that was implemented (North et al., 2009). Given the limited time staff members have to answer questions, completing the interview portion at a time separate from the tracer questions may decrease the burden on staff. Additionally, the ability to reach staff in multiple departments may help to increase the scope of the tracer and increase understanding of stewardship practices within different departments of the hospital. For example, many, if not all, patients admitted with CAP start in the Emergency Department which is often where they receive their first dose of antibiotics. The surveyor noted that Emergency Department physicians seemed to have a preference for which empiric therapy they prescribed

which differed from hospitalists' preferences, however, the tracer was not equipped to capture such a difference.

Administering an anonymous e-survey may encourage staff to provide more thoughtful, candid answers, however encouraging participation may be difficult and the ability to correlate individual answers to practice would be forfeited. North et al. (2009) also note e-surveys are able to determine baseline knowledge and then assess and quantify improvement in knowledge over time. Since tracers can be used as an opportunity for education, the ASP team may find it interesting to assess any changes in knowledge and practice related to modifications or additions to the hospital ASP.

**Conclusions**

Ultimately the question remains whether tracer methodology can be implemented to assess a hospital ASP. Hospital ASPs are multifaceted as they must incorporate numerous components including staff education, interventions to improve antibiotic use, pharmacy expertise, and tracking and reporting (CDC, 2019d) and target multiple disciplines. However, much of the onus falls to the physicians or other advanced practice providers (APPs) responsible for assessing and determining the appropriate treatment plan for patients. A successful tracer demonstrates whether certain actions are occurring, but it may be difficult to apply tracer methodology to educe the reasons why certain actions are or are not occurring. The goal of many ASP interventions regarding education and feedback, is to influence the internal processes of providers and enhance the quality of patient care. In the instance of CAP, assessing the type of empiric antibiotic therapy ordered upon initial diagnosis is straightforward, however, the internal processes used by the practitioner, such as reasons for ordering certain diagnostics or determining the severity of a patient's condition, are more difficult to capture objectively.

The implemented tracer provided insight into the progression of patient care upon admission from the ED to the hospital and revealed the complex manner in which patient care progresses after the initial admission. Tracer methodology can be applied to assessing various components of an ASP, but it must be understood that an interpretation of the results is not necessarily straightforward. Tracer questions should be specific to ensure clarity in the results, however, specific questions may prompt providers, therefore jeopardizing organic answers. If used by an accrediting body to evaluate an ASP, care must be taken that results are not interpreted too narrowly, unless questions have been tested and found to elicit answers with no other explanation.

The implementation of a tracer to evaluate a hospital ASP has the potential to provide constructive feedback to the ASP team regarding successful interventions, as well as identify potential gaps or deviations from evidence-based practices. The portion of the tracer that seeks to ascertain the knowledge of clinicians regarding general antibiotic stewardship and the ASP within the hospital will provide valuable information when compared to information collected from the patient chart related to antimicrobial prescribing practices. The purpose of this ASP tracer was not to be punitive in any way. Therefore, regardless of the results, sharing the results with hospital leadership and employees can provide valuable education, especially if presented with transparency. Requesting feedback from all stakeholders will aid in the development and implementation of new interventions aimed at addressing the issues uncovered.

Once the tracer has been successfully implemented, future tracers can be conducted to evaluate whether the initial tracer had an impact on clinicians with regards to antimicrobial prescribing. However, future tracers will require updates to account for interventions implemented as a result of previous tracers. The same process implemented to create and

conduct the original tracer can be utilized. Additional research may be needed if new standards or guidelines are available, and new questions should be added to account for interventions implemented as a result of information gathered from the first tracer. Also, the potential for accrediting agencies to implement tracers to evaluate ASPs remains a possibility, thus, future tracers can also be modified to better reflect feedback received from such institutions.

If a tracer can successfully be created and implemented to evaluate a hospital ASP, then applying the method to evaluate ASPs in outpatient and long-term care facilities should also be considered, as antimicrobial stewardship recommendations exist for these institutions which are also subject to review from TJC and CMS (CDC, 2015; CMS, 2016; Sanchez et al., 2016; TJC, 2019). According to the CDC, approximately half of antibiotics prescribed in the outpatient setting are inappropriate (Sanchez, et al., 2016). Ross et al. (2017) and Wisdom et al. (2012) demonstrate that tracer methodology can successfully be applied to the outpatient setting. Thus, it would be reasonable to apply tracer methodology to evaluate fulfillment of the core elements of outpatient antibiotic stewardship and the core elements of nursing home antibiotic stewardship.

The ability of tracers to help hospitals not only identify potential deficiencies, but the reasons contributing to deviations from evidence-based practices provides healthcare settings with a potentially invaluable evaluation tool. The existence of such explanatory evaluation tools is important when designing and creating education and interventions aimed at helping healthcare professionals provide quality, evidence-based patient care.

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Appendix A
Letter of Support from Agency

2200 River Plaza Drive

Sacramento, CA 95833

June 22, 2020

To Whom It May Concern,

This is a letter of support for Christine Smyth to implement her DNP Comprehensive Project: Utilizing Tracer Methodology to Evaluate the Effectiveness of a Hospital Antimicrobial Stewardship Program within the [redacted] System, conducted primarily at [redacted].

I will be acting as a co-mentor providing Christine with antimicrobial stewardship and pharmacological therapies guidance related to this project.

Sincerely,

**Lisa Hammer Rieg, PharmD, FCSHP, FASHP**

Clinical Coordinator, Drug Use Management and Infectious Diseases Clinical Programs

[redacted] Office of System Enterprise, Pharmacy

[redacted]

[redacted]

Cell: (916) 210-9546

# Appendix B

## Non-Research Evidence Appraisal Tool

| Citation | Conceptual Framework | Design/ Method | Sample/ Setting | Variables Studied and Their Definitions | Measurement | Data Analysis | Findings | Appraisal: Worth to Practice |
|---|---|---|---|---|---|---|---|---|
| Bailey, C., Kay, R., Starling, P., Walsh, K., Samuel, V., . . .Murray, K. (2015). A health system's approach to successful accreditation utilizing joint commission's infection control tracer methodology. Poster Abstracts. *American Journal of Infection Control, 43*, S18-73. | Not specified | - Utilization of the Joint Commission Tracer methodology to improve ongoing readiness and compliance with national standards for each Joint Commission Chapter<br>-Utilized a Joint Commission Resource Consultant to train staff to conduct Infection Control tracers | Health system: five acute care facilities, multiple outpatient facilities and clinics | -Readiness and compliance with national standards<br>-system processes | Tracers and audits utilizing Joint Commission Tracer methodology | Not specified | -Employees improved navigation of electronic medical record based on use of tracer methodology<br>-Increased staff confidence led to:<br>-improved quality of information presented to surveyors<br>-improved compliance to key infection control standards<br>-development of system-wide consistency | ***Level V, A**<br><br>**Strengths**: Leadership devoted resources and specific time for staff to focus on compliance standards (e.g. "no-meeting Wednesdays"<br><br>**Limitations**: Project based on input from consultant; implementation described as "challenging" |

*Johns Hopkins Hospital/The Johns Hopkins University (2017). Appendix F: Non-Research evidence appraisal tool. Retrieved from https://www.hopkinsmedicine.org/evidence-based-practice/_docs/appendix_f_nonresearch_evidence_appraisal_tool.pdf

| Citation | Conceptual Framework | Design/ Method | Sample/ Setting | Variables Studied and Their Definitions | Measurement | Data Analysis | Findings | Appraisal: Worth to Practice |
|---|---|---|---|---|---|---|---|---|
| Bookbinder, M. Hugodot, A., Freeman, K., Homel, P., Santiago, E., Riggs, A., . . .Portenoy, R. K. (2018). Development and field test of an audit tool and tracer methodology for clinician assessment of quality in end-of-life care. *Journal of Pain and Symptom Management, 55*(2), 207-216. | Not specified | -tracer methodology<br>-large pool of questions collected into three instruments used in prospective survey of care<br>-survey included reviews of medical record and interviews with physicians, nurses, social workers, or chaplain who provided care during 48 hrs preceding patient death | -Prospective survey conducted at Beth Israel Medical Center (urban teaching hospital), 145 deaths evaluated from inpatient palliative care unit, medical intensive care unit, or one of seven medical units<br>-Field test: 127 dying patients during 48 hours prior to death | -Overall family<br>-Overall patient<br>-After death<br>-Last hours<br>-Psychosocial<br>-Religion<br>-Tradition<br>-Decision making<br>-Communication<br>-Symptom control | -Professional Caregiver Interview Tool: 155 items<br>-Global Assessment Tool for Physicians: 32 items<br>Chart Audit Tool: 51 items | -Factor analysis<br>-canonical correlation<br>-group comparisons | -Small number of items could be used to validly capture items | ***Level V, A**<br><br>**Strengths**: provider cooperation; acceptable administration burden; nonthreatening to staff; able to identify and broadly characterize quality concerns in individual groups of patients<br><br>**Limitations**: -sample size, too much missing data to include in factor analyses; physician data too imcomplete; family and patient assessments not included; symptom control excluded from canonical correlation; data not normally distributed; |

*Johns Hopkins Hospital/The Johns Hopkins University (2017). Appendix F: Non-Research evidence appraisal tool. Retrieved from https://www.hopkinsmedicine.org/evidence-based-practice/_docs/appendix_f_nonresearch_evidence_appraisal_tool.pdf

| Citation | Conceptual Framework | Design/ Method | Sample/ Setting | Variables Studied and Their Definitions | Measurement | Data Analysis | Findings | Appraisal: Worth to Practice |
|---|---|---|---|---|---|---|---|---|
| Ross, A., Feider, L., Nahm, E-S., & Staggers, N. (2017). An outpatient improvement project: A baseline assessment of adherence to pain reassessment standards. *Military Medicine, 182(5/6)*, e1688-1695. | Situation Awareness framework | -Electronic Medical Record query<br>-observation of clinic workflow using tracer methodology<br>-evaluation of clinic documentation<br>- | -Large military outpatient clinic<br>- patients who received Toradol between Feb 1-May30, 2013<br>-for observation: convenience sample of 12 patients | -pain reassessment compliance rates (pain intensity scale, met time requirement, location of pain, side effects of med, patient education, overall)<br>-associated documentation<br>-clinic workflow | -workflow questionnaire<br>-workflow observation | Workflow analysis | --clinic staff impacted by lack of standardized procedures and heavy reliance on staff memory<br>-three distinct workflow processes identified: exam room, treatment room, examination room to treatment room<br>-staff nurses perform one of three roles: triage nurse, nurse assigned to a provider or exam room, nurse assigned to the treatment room<br>-nurses administering medications had to continually assess patients in multiple locations while also rotating patients through exam rooms<br>-documentation could occur with computers in multiple rooms<br>-nurse administering medication had several steps to complete<br>-workflow did not allow or allowed only limited information exchange about patients moving from exam to treatment room. No formalized handoff procedure. | ***Level V, A**<br><br>**Strengths**:<br>-small tracer sample size allowed thorough evaluations of pain reassessment practices<br>-strong leadership support<br>-team members identified early in project<br><br>**Limitations**:<br>-only one large primary care clinic<br>-Military's current EMR may not be generalizable to other populations and settings<br>-small tracer sample size limits generalizaof findings<br>-clinic relocated in middle of project, thus changing workflows |

*Johns Hopkins Hospital/The Johns Hopkins University (2017). Appendix F: Non-Research evidence appraisal tool. Retrieved from https://www.hopkinsmedicine.org/evidence-based-practice/_docs/appendix_f_nonresearch_evidence_appraisal_tool.pdf

| Citation | Conceptual Framework | Design/ Method | Sample/ Setting | Variables Studied and Their Definitions | Measurement | Data Analysis | Findings | Appraisal: Worth to Practice |
|---|---|---|---|---|---|---|---|---|
| Wisdom, J. P., Knapik, S., Holley, M. W., Van Bramer, J., Sederer, L. I., & Essock, S. M. (2012). New York's outpatient mental health clinic licensing reform: Using tracer methodology to improve service quality. *Psychiatric Services*, *63*(5), 418-420. | Not specified | -tracer methodology<br>-licensing instrument<br>-interviews | -11 clinics (2-3 clinics from each region of New York, mix of non-for-profit, county, hospital-based, and state operated clinics serving adults, children and adolescents, and adults and children) | -current clinic functioning<br>-systems providing care<br>-experience of services for people with serious mental illness and their families | Not specified | percentage | - five of 11 clinics received operating license with new process for fewer months than previous licensing process<br>-providers found to be reluctant to share information about service users with other providers<br>-new process more focused | ***Level V, A**<br><br>**Strengths**: key collaborations contributed to success of tracer development; positive perception of technique as OMH survey team and clinic staff reported a more positive licensing process<br><br>**Limitations**: challenge to continuously incorporate feedback from clients and providers; ensuring consistency among OMH surveyors; process will require continued updating |

*Johns Hopkins Hospital/The Johns Hopkins University (2017). Appendix F: Non-Research evidence appraisal tool. Retrieved from https://www.hopkinsmedicine.org/evidence-based-practice/_docs/appendix_f_nonresearch_evidence_appraisal_tool.pdf

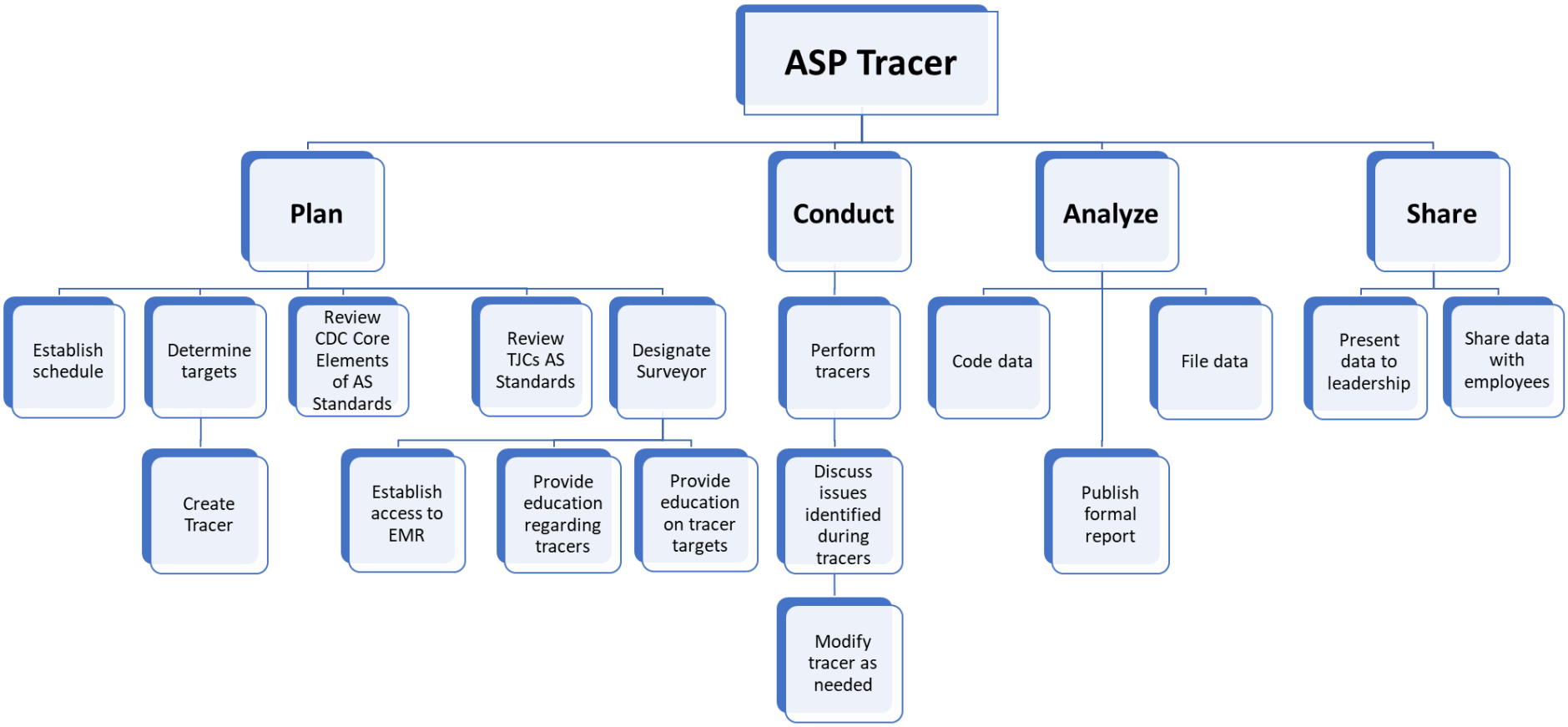
# Appendix C

## Gap Analysis

| Current State | Desired State |
|---|---|
| • Existing ASP<br>• Evaluation of stewardship practices include: audit and feedback, rates of usage of specific antibiotics, prescribing rates of individual prescribers | • Tracer to determine current antimicrobial prescribing practices when treating CAP and identify barriers to AS |
| **Gap** | **Action Plan** |
| • Tracer to evaluate antimicrobial prescribing practices and barriers to AS does not exist | Plan<br>• Establish multidisciplinary team to develop tracer<br>• Designate surveyors to conduct tracer, provide training/education<br>• Create tracer based on CDC's Core Elements of Hospital Antibiotic Stewardship Programs, TJC's New Antimicrobial Stewardship Standards, and the American Thoracic Society's guidelines for diagnosing and treating adults with CAP<br>Conduct<br>• Surveyor to begin conducting tracer<br>Analyze<br>• Data to be analyzed<br>• Qualitative results to be compared to quantitative data relating to antimicrobial prescribing practices<br>Share<br>• Results to be shared with hospital leadership, ASP team, and survey participants |

# Appendix D

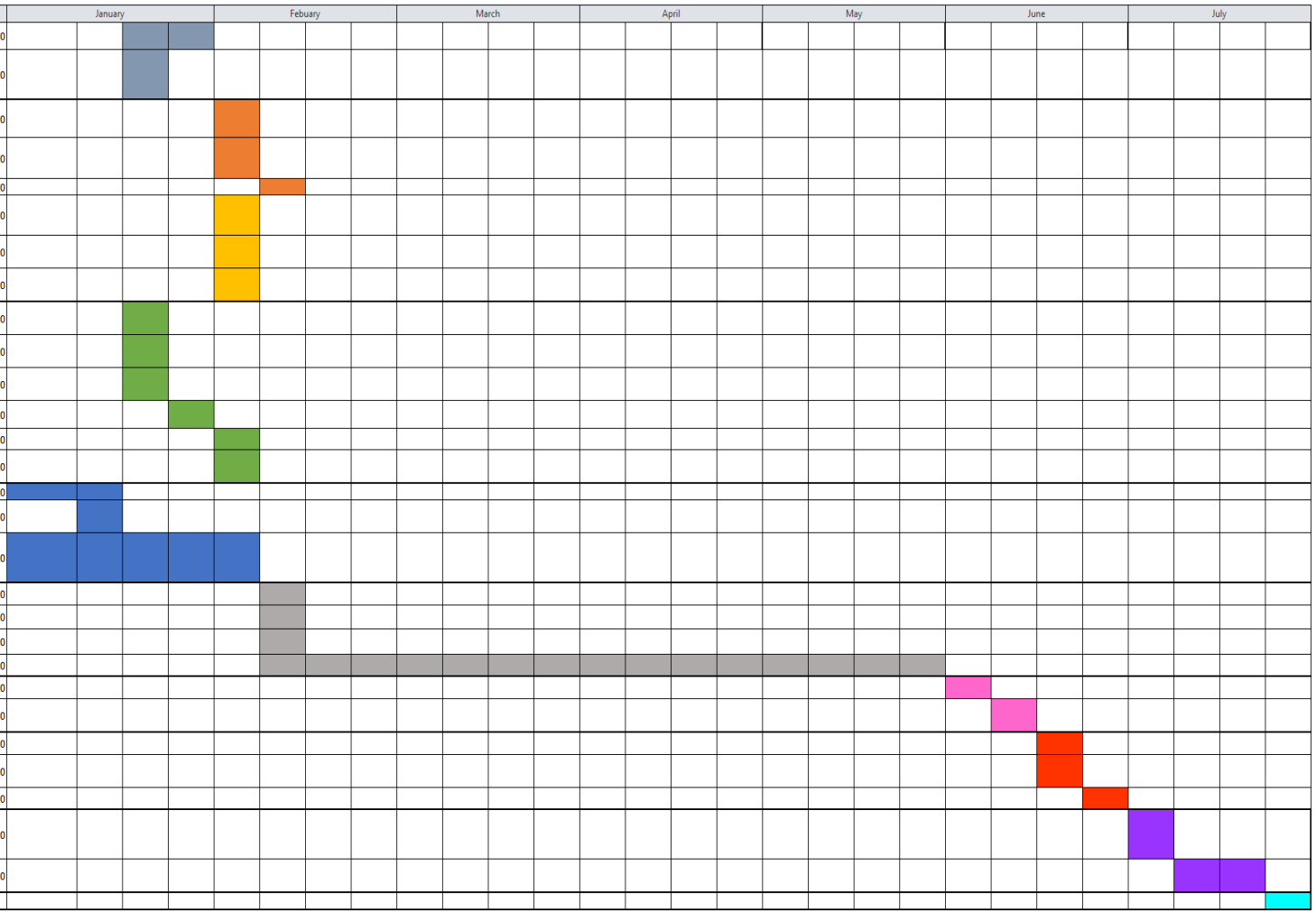
## Work Breakdown Structure



# Appendix E

## Gantt Chart

| Task Name | Task Name | Start | Finish |
|---|---|---|---|
| **Introduce Tracer Methodology to Hospital** | Establish Multidisciplinary Team | 1/15/2020 | 1/30/2020 |
| | Identify Team Members Responsible for Administering Survey | 1/15/2020 | 1/22/2020 |
| **Prepare Team Member Administering Survey** | Onboard team surveyor(s) if necessary | 2/1/2020 | 2/6/2020 |
| | Establish electronic medical record access for survyeor(s) if necessary | 2/1/2020 | 2/6/2020 |
| | Familiarize surveyor(s) with EMR if necessary | 2/6/2020 | 2/13/2020 |
| | Provide surveyor(s) with education regarding survey conduction | 2/1/2020 | 2/6/2020 |
| | Provide surveyor with education regarding ASP standards | 2/1/2020 | 2/6/2020 |
| | Provide surveyor(s) with education regarding cinical guidelines | 2/1/2020 | 2/6/2020 |
| **Create Tracer** | Gather information of current antibiotic stewardship program | 1/15/2020 | 1/22/2020 |
| | Identify treatment guidelines to be utilized in tracer | 1/15/2020 | 1/22/2020 |
| | Learn Joint Commission standards regarding ASP | 1/15/2020 | 1/22/2020 |
| | Submit first draft of tracer for team to review | 1/22/2020 | 1/27/2020 |
| | Make revision to tracer | 2/1/2020 | 2/4/2020 |
| | Submit final draft of tracer for team to review | 2/4/2020 | 2/7/2020 |
| **Inform Staff of Upcoming Tracer** | Introduce surveyor(s) to department leaders | 1/6/2020 | 1/10/2020 |
| | Draft and send email to hospital staff with introduction and explanation of mock tracer | 1/10/2020 | 1/10/2020 |
| | Surveyor(s) attend inpatient rounds to introduce self to prescribers, nurses, and pharmacists | 1/6/2020 | 2/6/2020 |
| **Implement/Conduct Pilot Tracer** | Conduct practice tracers | 2/7/2020 | 2/14/2020 |
| | Review identified issues with tracer team | 2/14/2020 | 2/14/2020 |
| | Finalize tracer | 2/17/2020 | 2/17/2020 |
| | Conduct tracers | 2/17/2020 | 5/30/2020 |
| **Analyze Data from Tracers** | Rank and prioritize problems identified | 6/1/2020 | 6/8/2020 |
| | Present and discuss data with multidisciplinary team | 6/8/2020 | 6/13/2020 |
| **Share Data** | Publish formal report | 6/13/2020 | 6/19/2020 |
| | Submit copy of report to hospital and ASP leadership | 6/19/2020 | 6/19/2020 |
| | Share results with tracer participants | 6/19/2020 | 6/26/2020 |
| **Develop Improvement Plans** | Hand off corrective measures to relevant managers, ASP team, and project improvement program | 6/26/2020 | 6/26/2020 |
| | Inform entire organization of proposed corrective actions as result of tracer | 7/6/2020 | 7/17/2020 |
| | **Prepare for next round of tracer** | | |



Appendix F

Tracer Tool

## Antimicrobial Stewardship Program Tracer

**Purpose:** Assess and/or validate organizational Antimicrobial Stewardship Program (ASP); identify potential gaps or deviations from evidence-based practices and internal/external guidelines; identify obstacles to Antimicrobial Stewardship (AMS); educate/inform physicians, advanced practice providers (APPs), and nurses regarding appropriate antibiotic prescribing practices
**Interviewee:** Hospitalist, APP, attending of record for patient admitted to the hospital, nurses, pharmacists

### For Physicians and APPs:

**Factors influencing prescribing (Action): patient specific**

1) Prior to today, were you aware of your hospital having an antimicrobial stewardship program (ASP)? ☐ yes ☐ no ☐ unsure

2) If YES to #2, do you know who the ASP leaders are at your hospital/institution?
☐ yes ☐ no

3) Do you think you have adequate knowledge on the treatment of pneumonia to choose empiric antibiotic therapy?
☐ yes ☐ no
4) What resources do you use when needed when choosing empiric antimicrobial therapy? (*Examples could include: institution specific clinical guidelines, institution specific order sets, national guidelines, utilize the hospital antibiogram, UpToDate, etc.)*

    - If hospital-specific guidelines or an antibiogram, ask provider to demonstrate how the information is accessed *(e.g. pocket cards, online, etc.)*

    - When was the last time provider accessed guidelines or received education regarding antimicrobial therapy?

        - How was the education delivered?

*5)* How do you determine a definitive antimicrobial regimen (including duration) for your patients diagnosed with a microbiologically confirmed infection?
(*Examples could include: institution specific clinical guidelines, national guidelines, UpToDate, etc., duration' response may be based on clinical improvement)*

6) [If not addressed above] Does your hospital have hospital-specific guidelines for any common infections? ☐ yes ☐ no
   a. If YES, can you please demonstrate where to find them?

*7)* Does your hospital implement any specific antimicrobial stewardship (AS) interventions? *(preauthorization, prospective audit and feedback? Infection-specific order sets? Diagnostic stewardship)* ☐ yes ☐ no
   a. Can you specify interventions or give examples of previous interventions?

*8)* Who do you contact to ask questions regarding antimicrobial prescribing? (*Examples could include floor pharmacists, ASP, colleagues.)*
   a. How would you contact these individuals?

9) Do you find the resources available to you adequate? ☐ yes ☐ no

**Education:**

10) Do you receive education from your hospital regarding antimicrobial stewardship and the optimization of antibiotics? ☐ yes ☐ no

11) If answer to #10 is YES, how is education delivered? *(Examples: prospective audit and feedback? Handshake stewardship? Rounding? Newsletters? One on one consult with ASP team or with stewardship pharmacist or ID physician? Lectures? Electronic chart updates?)*

12) What education do you provide the patient when starting them/discharging them on an antimicrobial? *(Examples: adverse reactions, antibiotic resistance, optimal prescribing; verbal education, handouts, posters; assessment of patient understanding?)*

**Tracking and Reporting:**

13) Do you receive data regarding antimicrobial prescribing at your hospital? ☐ yes ☐ no
*14)* If answer to #13 is YES, what type of data? *(Examples: antibiotic utilization, duration of antibiotic therapy; outcomes measurements- e.g. resistance patterns, C. difficile infection rates impact of AMS interventions)*

How is data delivered and in what format? *(provider specific, service-line specific, hospital-wide)*

**Infection Specific Questions- Pneumonia**

**Dx:**

Patient tracer (medical record):

1) Orders placed from order set? ☐ yes ☐ no
2) How did you determine patient's severity of pneumonia?
3) Is the following documented in the patient chart?

- Diagnostic criteria documented?

**One or more major criterion OR ≥ three minor criterion**

Major criteria

☐ Septic shock with need for vasopressors

☐ Respiratory failure requiring mechanical ventilation

Minor criteria

☐ Respiratory rate ≥ 30 breaths/min

☐ PaO2/FIO2 ratio ≤ 250

☐ Multilobar infiltrates

☐ Confusion/disorientation

☐ Uremia (blood urea nitrogen level ≥ 20mg/dl)

☐ Leukopenia (r/t infection alone) (white blood cell count < 4,000 cells/μl)

☐ Thrombocytopenia (platelet count < 100,000/ μl)

☐ Hypothermia (core temp < 36°C)

☐ Hypotension requiring aggressive fluid resuscitation

Classified as Severe Pneumonia ☐

Classified as Non-severe Pneumonia ☐

*4)* Did you decide or verify if the patient has risk factors for MRSA, *P. aeruginosa, or other MDROs?*

☐ yes ☐ no

If YES, how?

☐ prior isolation of *P. aeruginosa*

☐ prior isolation of MRSA

☐ recent hospitalization and exposure to parenteral antibiotics

☐ arrived from facility with known MDROs

5) Pretreatment gram stain and culture of lower respiratory secretions ordered?

☐ yes ☐ no

If YES, how did you determine if sputum culture should be ordered?

☐ classified as severe CAP (especially if intubated)
☐ being empirically treated for MRSA or *P. aeruginosa*
☐ previous infection with MRSA or *P. aeruginosa* (especially prior respiratory infection)
☐ hospitalized and received parenteral antibiotics (during hospitalization or not) in last 90 days
☐ arrived from facility with known MDROs

**Non-Severe Pneumonia**

1) How did you decide on your treatment for non-severe CAP?

2) Standard empiric treatment for non-severe CAP used? ☐ yes ☐ no

If YES, antibiotic therapy prescribed:

For non-severe CAP **without MRSA or *P. aeruginosa* risk factors**:

☐ Combination therapy with β-Lactam (ceftriaxone 1 -2g daily) and a macrolide (azithromycin 500 mg daily)
☐ Monotherapy with a respiratory fluoroquinolone (levofloxacin 750 mg daily) (less preferred due to FQN safety issues; use if beta-lactam to be avoided)
☐ β-Lactam (see above) and doxycycline 100 mg twice
☐ none

For non-severe CAP **with MRSA or *P. aeruginosa* risk factors**:

☐ Empiric therapy for MRSA: vancomycin 15mg/kg q 12 hours **and** β-Lactam (ceftriaxone 1-2g daily) **and** macrolide (azithromycin 500 mg daily) **or** doxycycline 100mg bid
☐ Empiric therapy for *P. aeruginosa*: piperacillin-tazobactam 4.5g q 6 **or** q 8 hours **or** cefepime 2g q 8 hours **or** aztreonam 2g q 8 hours (only for severe β-Lactam allergies), **or** meropenem 1g q 8 hours **and** macrolide (azithromycin 500 mg daily); **or** doxycycline 100 mg q12 hours
☐ none of the above

3) Is Vancomycin to be administered? ☐ yes ☐ no
   a. If YES, was MRSA PCR ordered? ☐ yes ☐ no
   b. If YES, was MRSA PCR collected prior to Vancomycin administration or within 24 hours of first dose? ☐ yes ☐ no
4) If PCR negative, was Vancomycin discontinued? ☐ yes ☐ no
   If NO, why?

5) If PCR positive, Vancomycin continued? ☐ yes ☐ no
   If YES, why?
6) If patient being treated for *P. aeruginosa*, was sputum culture ordered? ☐ yes ☐ no
   a. If YES, was sputum culture collected prior to antibiotic initiation? ☐ yes ☐ no

7) Did provider adjust antibiotics based on culture results? ☐ yes ☐ no

**Severe Pneumonia**

1) How did you decide on your treatment for severe CAP?

2) Standard empiric treatment for severe CAP used? ☐ yes ☐ no
   If YES, antibiotic therapy prescribed:
   For severe CAP **without MRSA or *P. aeruginosa* risk factors**:
   ☐ Combination therapy with β-Lactam (ceftriaxone 1 -2g daily) and a macrolide (azithromycin 500 mg daily)
   ☐ β-Lactam/fluoroquinolone
   ☐ β-Lactam (see above) and doxycycline 100 mg twice daily
   ☐ none of the above
   For severe CAP **with MRSA or *P. aeruginosa* risk factors**:
   ☐ Empiric therapy for MRSA: vancomycin 15mg/kg q 12 hours **and** β-Lactam (ceftriaxone 1-2g daily) **and** macrolide (azithromycin 500 mg daily)
   ☐ Empiric therapy for *P. aeruginosa*: piperacillin-tazobactam 4.5g q 6 **or** q 8 hours **or** cefepime 2g q 8 hours **or** aztreonam 2g q 8 hours (only for severe β-Lactam allergies), **or** meropenem 1g q 8 hours **and** macrolide (azithromycin 500 mg daily) **or** doxycycline 100 mg q12 hours
   ☐ none of the above

6) Is Vancomycin to be administered? ☐ yes ☐ no
   a. If YES, was MRSA PCR ordered? ☐ yes ☐ no
   b. If YES, was MRSA PCR collected prior to Vancomycin administration or within 24 hours of first dose? ☐ yes ☐ no
7) If PCR negative, was Vancomycin discontinued? ☐ yes ☐ no
   If NO, why?

8) If PCR positive, Vancomycin continued? ☐ yes ☐ no
   If YES, why?

9) If patient being treated for *P. aeruginosa*, was sputum culture ordered? ☐ yes ☐ no
   a. If YES, was sputum culture collected prior to antibiotic initiation? ☐ yes ☐ no

10) Did provider adjust antibiotics based on culture results? ☐ yes ☐ no

**All Pneumonia**

1) Patient tested for influenza? ☐ yes ☐ no
2) Patient urine tested for Legionella antigen? ☐ yes ☐ no
3) Patient urine tested for pneumococcal antigen? ☐ yes ☐ no
4) Serum procalcitonin level ordered prior to initiation of antibiotics or prior to second dose of antibiotics? ☐ yes ☐ no
5) Aspiration pneumonia? ☐ yes ☐ no
    a. If YES, additional anaerobic coverage beyond standard empiric treatment for CAP? ☐ yes ☐ no
    a. If YES, is a lung abscess or empyema suspected? ☐ yes ☐ no

Note: Metronidazole is most commonly used for anaerobic coverage. Meropenem and piperacillin-tazobactam also have anaerobic coverage.

6) Does antibiotic order include:
    ☐ indication
    ☐ expected duration

7) Documentation for antibiotic timeout (if done at this institution, remember terminology is hospital specific, what terminology is used? Handshake stewardship? Rounds?)
    ☐ Will infection respond to antibiotics?
    ☐ Have proper cultures and diagnostic tests been performed? (sputum culture, blood culture; possible diagnostic tests: pneumococcal urinary antigen, legionella urinary antigen, influenza during season, MRSA screen by PCR)
    ☐ Can antibiotics be stopped or improved by narrowing spectrum or changing from IV to oral? (de-escalation)
    ☐ Duration of therapy (hospital stay + post-discharge therapy)
    ☐Was there an intervention by ASP team?

**For nurses:**

**Action:**

1) Prior to today were aware that your hospital has an antimicrobial stewardship program (ASP)?
   ☐ yes ☐ no ☐ unsure
2) If YES to #1, do you know who the ASP leaders are at your hospital/institution?
   ☐ yes ☐ no
3) Are you provided with education regarding appropriate indications to obtain cultures?
   ☐ yes ☐ no
4) Are you provided with education regarding proper specimen collection techniques to reduce contamination? ☐ yes ☐ no
5) Are you provided with education regarding antibiotic resistance and adverse reactions from antibiotics? ☐ yes ☐ no
6) Are you comfortable initiating discussions with patients' care teams regarding the transition from IV to oral antibiotics when the patient is able to tolerate oral medication?
   ☐ yes ☐ no
7) Are you comfortable prompting antibiotic reviews with patients' care teams?
   ☐ yes ☐ no
   If YES, when is it appropriate to initiate such reviews?

8) Does your facility have specific interventions to ensure optimal use of antibiotics for treating the most common infections in hospitals? *(e.g. ensuring correct discharge duration of therapy?)* ☐ yes ☐ no
9) If answer to #6 is YES, can you provide examples?

**Education**

10) Do you receive education from your hospital regarding antimicrobial stewardship and the optimization of antibiotics? ☐ yes ☐ no
*11)* If answer to #10 is YES, how is education delivered? *(Newsletters? Lectures? Electronic chart updates?)*

12) What education do you provide the patient when starting them/discharging them on an antimicrobial? *(adverse reactions, antibiotic resistance, optimal prescribing; verbal education, handouts; posters; assessment of patient understanding?)*

13) Are nurses involved in creating educational materials at your hospital?
   ☐ yes ☐ no ☐ unsure

**Tracking and Reporting:**

14) Do you receive data regarding antimicrobial prescribing at your hospital? ☐ yes ☐ no

*15)* If answer to #14 is YES, what type of data? *(antibiotic prescribing utilization; outcomes measurements- e.g. resistance patterns, C. difficile; impact of ASP interventions)*

*a.* How is data delivered and in what format? *(provider specific, service-line specific, hospital-wide)*

**Patient Specific Questions:**

16) Are you aware of risk factors for MRSA? ☐ yes ☐ no

a. If YES, is this patient at risk for MRSA? ☐ yes ☐ no ☐ don't know
b. If YES, was a nasal PCR collected? ☐ yes ☐ no
c. If YES, has the final result been reviewed? ☐ yes ☐ no ☐ not available

17) Are you aware of risk factors for *P. aeruginosa*? ☐ yes ☐ no

a. If YES, do you know if this patient is at risk for *P. aeruginosa* ☐ yes ☐ no ☐ don't know
b. If YES, was a sputum sample collected? ☐ yes ☐ no
   If YES, has the final result been reviewed? ☐ yes ☐ no ☐ not available

**For clinical pharmacists:**

**Action:**

1) Do you think you have adequate knowledge of the treatment of pneumonia to evaluate empiric antibiotic therapy?
   ☐ yes ☐ no
2) What resources do you use when evaluating whether a chosen antimicrobial therapy is appropriate?

3) Do you have specific experience with antibiotic stewardships?
   ☐ yes ☐ no

4) Does your hospital have a pharmacist(s) responsible for leading implementation efforts to improve antibiotic use?
   ☐ yes ☐ no

5) Does your hospital pharmacy have a process in place to review antibiotics prescribed?
   ☐ yes ☐ no
6) If answer to #5 is YES, is this done/documented within 48-72 hours of initiation of antibiotic therapy?
   Does the process include the following?
   ☐ Review for dose adjustments as needed? (e.g. in cases of organ dysfunction or therapeutic drug monitoring)
   ☐ Review for dose optimization (e.g. in cases of extended-infusion administration of beta-lactams in critically-ill patients and those infected with drug-resistant organisms)
   ☐ Alerts for duplicative therapies (e.g. simultaneous use of multiple agents with overlapping spectra)
   ☐ Automatic changes from intravenous to oral antibiotic therapy
   ☐ Time-sensitive automatic stop orders
   ☐ Detection and prevention of antibiotic-related drug-drug interactions

**Education:**

7) Do you receive specific education/training regarding antibiotic stewardship at your hospital? ☐ yes ☐ no
8) IF answer to #7 is YES, how is education/training delivered*? (posters, formal training, certificate program?)*
9) Do you receive data regarding antimicrobial prescribing at your hospital? ☐ yes ☐ no
10) If answer to #9 is YES, what type of data is shared? *(rate of antibiotic prescribing; outcomes measurements- e.g. resistance patterns, C. difficile; impact of ASP interventions)*

    a. How is data delivered and in what format? *(provider specific, service-line specific, hospital-wide)*

**Patient Specific:**

11) Did you decide or verify if the patient has risk factors for MRSA, *P. aeruginosa, or other MDROs?*
☐ yes ☐ no

If YES, what criteria did you use?
☐ prior isolation of *P. aeruginosa*
☐ prior isolation of MRSA
☐ recent hospitalization and exposure to parenteral antibiotics
☐ arrived from facility with known MDROs

12) Is Vancomycin to be administered? ☐ yes ☐ no
   a. If YES, was MRSA PCR ordered? ☐ yes ☐ no
   b. If YES, was MRSA PCR collected prior to Vancomycin administration or within 24 hours of first dose? ☐ yes ☐ no
   c. If YES, has the final result been reviewed? ☐ yes ☐ no ☐ not available
   d. If PCR negative, was Vancomycin discontinued? ☐ yes ☐ no
      If NO, why?

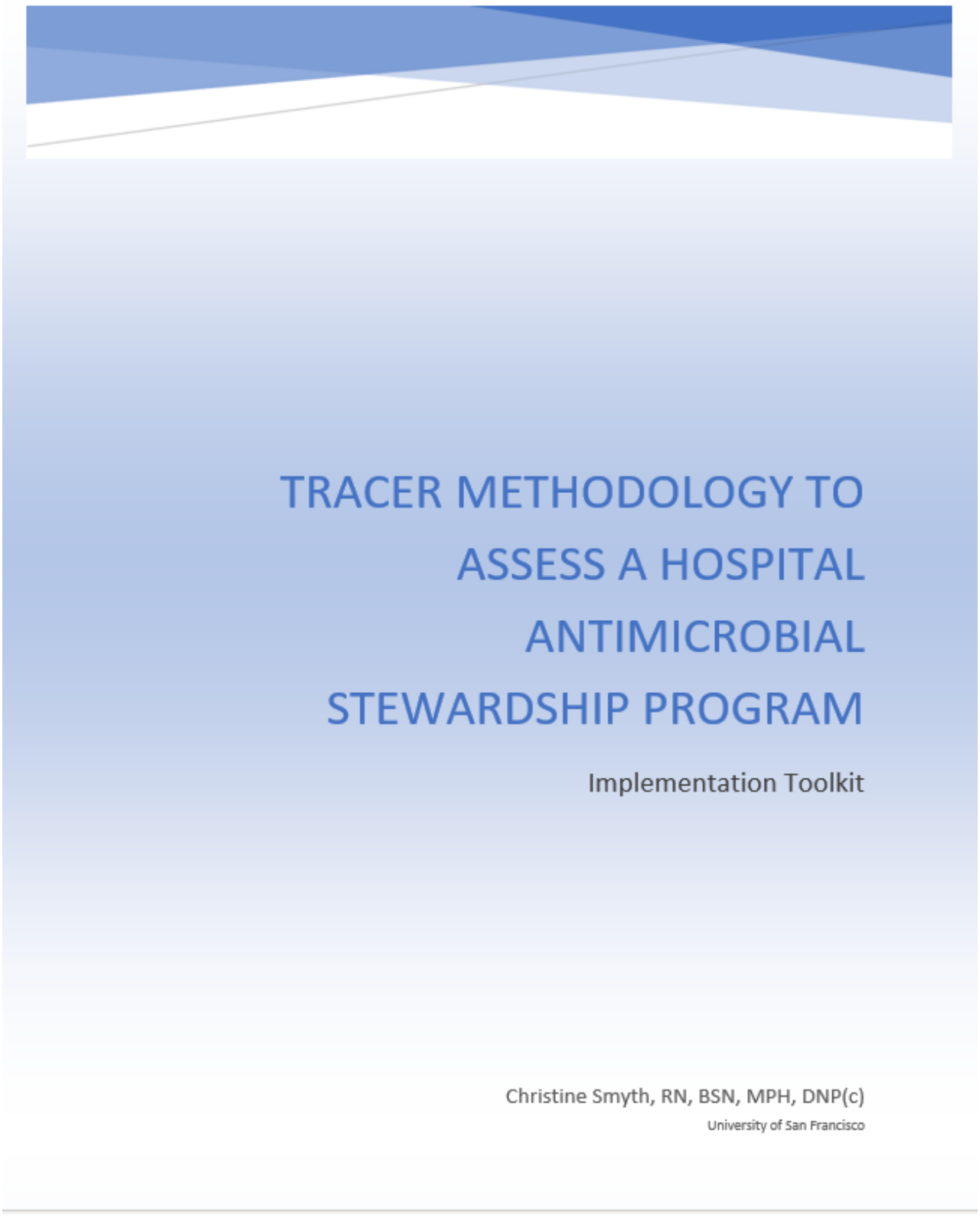
   e. If PCR positive, Vancomycin continued? ☐ yes ☐ no
      Is YES, why?

13) Is patient being treated for *P. aeruginosa*? ☐ yes ☐ no
   a. If YES, was sputum culture ordered? ☐ yes ☐ no
   b. If YES, was sputum culture collected prior to antibiotic initiation? ☐ yes ☐ no
   c. If YES, has the final result been reviewed? ☐ yes ☐ no ☐ not available

14) On calendar day three, was antibiotic therapy discussed? ☐ yes ☐ no
15) Was a decision made to change antibiotics? ☐ yes ☐ no

Appendix G

Tracer Toolkit



# Introduction

The purpose of this toolkit is to help hospitals plan, design, and implement a mock tracer to evaluate hospital antimicrobial stewardship programs (ASPs). Assessment of the hospital ASP is necessary to identify potential gaps or deviations from evidence-based practices and the obstacles related to antimicrobial stewardship. Ongoing assessment is necessary to ensure interventions are effective, to provide hospital leadership and healthcare providers with feedback, and to ensure quality evidence-based care.

The Joint Commission (TJC) released a new Antimicrobial Stewardship Standard in 2017 applicable to hospitals and critical access hospitals (TJC, 2016, 2017). Additionally, in 2019 the Centers for Medicare and Medicaid Services (CMS) created federal regulations for hospital ASPs as part of the revision of the hospital conditions of participation (CMS, 2019). In 2019 the Center for Disease Control (CDC) updated the original Core Elements of Hospital Antibiotic Stewardship Programs, which serves as a template for TJC and CMS for minimum and advanced standards of a successful program.

**The toolkit provides guidance regarding selection of team members, recommendations for strategies to create the tracer tool, and offers considerations to be made when deciding the metrics to be investigated.**

# Tracer Information

## Types of Tracers

| Individual Tracers | Systems Tracers | Accreditation Program-specific Tracers |
|---|---|---|
| -examine patient care experiences while at an organization by evaluating the provision of care and treatment within an institution<br>-Patients are framework used to determine compliance with set standards clarity. | -Used to evaluate an entire system or process, including how related processes are incorporated and how different departments and disciplines coordinate and communicate within the system or process<br>-Used to evaluate data management, infection control, and medication management | - Helps identify risks and safety concerns at different levels of care, treatment, and services, especially regarding issues specific to the organization |

- Tracers can be hybrid of tracer types.
- Tracers commonly start or are used at point of sample collection, critical results, transfusions, point of care testing, treatment interventions, or frozen sections.
- Examples of items reviewed by regulatory surveyors: orders, policies and procedures, employee competency, blood utilization review, process improvement, patient medical records, instrument maintenance records.
- Tracers can also involve observing staff and speaking with multiple staff members, patients, and family to learn details about their experience.

# Implementing an ASP Tracer

## Step One: Planning for the Tracer

1. Assemble multidisciplinary team to plan and create tracer
    a. Identify and involve stakeholders (e.g. hospitalists, infectious disease physicians, pharmacists, nurses)
    b. Consider applying the integrated promoting action on research implementation in health services (j-PARIHS) framework. Core constructs include: facilitation, innovation, recipients, and context (see Responsibility and Communication Plan Example).
    c. Identify novice, experienced, and expert facilitators to initiate team meetings, establish relationships with stakeholders, positively promote tracer to stakeholders, create tracer, assist with communication between team and leadership/management, evaluate tracer outcomes, and facilitate the integration of tracer method into future evaluation processes
2. Establish timeframe in which to conduct tracer and share data, and a schedule for conducting tracers
3. Develop understanding of Core Elements of Hospital Antibiotic Stewardship Programs
4. Determine scope of tracer
    a. Identify guidelines, process, or protocol to be assessed/used (e.g. diagnostic criteria used based on guidelines [Diagnosis and Treatment of Adults with Community-acquired Pneumonia. An Official Practice Guidelines of the American Thoracic Society and Infectious Disease Society of America], discharge protocols)
    b. Identify metrics to be assessed based on Core Elements of Hospital Antibiotic Stewardship Programs (see below for examples)
    c. Consider focusing on one infection, antibiotic, or process (e.g. pneumonia, UTI, cellulitis, vancomycin, using procalcitonin as guide to prescribing antibiotics, adhering to guidelines, complying with specific hospital protocol))
5. Create tracer
    a. Ensure tracer questions are easy to measure
    b. Determine selection criteria for patients and interviewees
    c. Establish system or program to record data to ensure streamlined process for data analysis
6. Identify surveyors or tracer staff
    a. Assign surveyor who is expert in area similar to department, program, or service being assessed

b. DO NOT assign surveyors to the same area they work, in order to ensure objectivity

**OR**

c. Assign surveyor with no experience in area, but be sure to provide enough time for surveyor to prepare and become familiar with requirements

**OR**

d. Pair surveyors to allow them to learn from each other

7. Prepare surveyors
   a. Ensure surveyors have access to records and departments as needed
   b. Ensure surveyors have supplies and tools necessary to collect data (taking notes of observations, conversations, and review of documents)
   c. Educate surveyors to be methodical, detail oriented
   d. Prepare surveyors to be flexible, but productive, when collecting data and conducting interviews
   e. Prepare surveyors to address problems encountered during survey, including logistical issues, time involved, and staff cooperation

8. Notify department, program, or service within organization of the possibility of the mock tracer

## Step Two: Conducting the Tracer

1. Consider field-test. Once first few tracers are complete, have surveyors meet with team to debrief about process by sharing and discussing issues encountered
2. Be prepared to modify tracer or process if issues are encountered

## Step Three: Analyzing Data

1. Develop method to categorize the completed forms
2. Preview data to check for recording errors and highlight areas of concern
3. Remove all identifying information
4. If possible, rank problems based on the data analysis
5. Report data
   a. Share data in a timely manner based on facility standards, planning team's recommendation, or more frequently if undesirable or unexpected trends result
   b. Ensure report is presented in a way that in non-punitive, lacks identifying information, or portrays mock tracer as an inspection
   c. Highlight positive outcomes to encourage future positive interactions with mock tracers

d. Consider sharing results in formal report, conference call or meeting to share results, or posting results on internal organization site or room
e. Ask for feedback

### Step 4: Applying Results

1. Develop improvement plans. Approaches can include:
    a. Handing off corrective actions to relevant managers
    b. Working with the organization's performance improvement program
    c. Sharing plans with the entire organization
    d. Monitoring plans as they are implemented by appropriate departments
    e. Prepare for future mock tracer

## POINTS TO CONSIDER

- Ensure all staff are informed of tracer to encourage participation.
- If possible, have ASP leaders introduce surveyors to staff during patient rounds or staff meetings to familiarize staff.
- When choosing a starting point for the tracer, be cognizant of patient flow and staff schedules. Some shifts, times, or services may facilitate compliance better than others.
- If part of the tracer entails questions for staff members to assess general knowledge and understanding, consider administering the questionnaire via email or in staff meetings in order to shorten the time necessary for the survey and gather more data.

## ITEMS TO CONSIDER FOR INCLUSION IN A TRACER:

**Elements from the CDC's Core Elements of Hospital Antimicrobial Stewardship Program should be considered as potential topics for a mock tracer. The topics of focus and the number of items assessed through the survey will be contingent upon the scope of the tracer and may involve any combination of the following examples.**

### LEADERSHIP COMMITMENT

- Are there budget plans in place to support stewardship?
- Are there infection prevention plans?
- Are there performance improvement plans?
- Are there formal statements of support to improve and monitor antimicrobial use?
- What (if any) strategic plans are in place to support and implement stewardship?
- Is and electronic health record being used to collect antimicrobial stewardship data?

### ACCOUNTABILITY

- Is there a leader or are there co-leaders responsible for program management and outcomes?
- Are regular "stewardship rounds" completed by the program leads?
- Is there an antimicrobial stewardship multidisciplinary team in place with the following members: infectious disease physician, infection preventionist, pharmacist(s), practitioner?

### PHARMACY EXPERTISE

- Are pharmacist part of implementation efforts to improve antimicrobial use?
- Are there ASP pharmacy leaders with specific training and/or experience with antibiotic stewardship?

**ACTION**

- Is staff aware of the ASP program and/or who the ASP leaders are at the hospital?
- What is the perceived knowledge of healthcare providers regarding empiric therapy of infections (e.g. CAP, urinary tract infections [UTIs], skin and skin structure infections [SSIs])?
- Are resources available to aid in selection of empiric antimicrobial therapy? (e.g. order sets, antibiogram, references, facility guidelines)
- Are there hospital-specific guidelines for common infections? Examples:
  - CAP focus: improving diagnostic accuracy, tailoring therapy to culture results, optimizing duration of treatment to ensure compliance with guidelines
  - UTI focus: avoidance of unnecessary urine cultures, avoiding treatment of asymptomatic patients (unless specific reason to treat), ensure appropriate therapy based on local susceptibilities and for recommended duration
  - SSI focus: ensure patients with uncomplicated infections do not receive antibiotics with overly broad spectra, ensure treatment prescribed is correct route, dosage, and duration
- Are organization approved multi-disciplinary protocols in place? Examples:
  - Antibiotic formulary restrictions
  - Assessment of appropriateness of antibiotics for CAP, UTIs, SSIs
  - Preauthorization requirements for certain antimicrobials
- Are there organizational disease or drug-disease specific guidelines in place?
- What antimicrobial stewardship interventions are in place? Examples:
  - Provider-based interventions: antibiotic "timeouts"

- Pharmacy-based interventions: documentation of indications for antibiotics, automatic changes from intravenous to oral therapy, dose adjustments when needed
- Microbiology-based interventions: selective reporting of antimicrobial susceptibility testing results, comments in microbiology reports
- Nursing based interventions: optimizing microbiology cultures, initiating discussions on switching from intravenous to oral transitions, prompting antibiotic reviews or "timeouts"

**TRACKING**

- Is a system in place to monitor antimicrobial prescribing?
- What outcomes are tracked? (e.g. resistance patterns, C. *difficile* infections)
- Is a system in place to measure the impact of interventions?

**REPORTING**

- Is information on antimicrobial use and resistance reported to staff (including prescribers, pharmacists, nurses, and leadership) regularly or at intervals agreed upon by tracer planning team?
- What type of data is shared with staff?
- In what format is data delivered?

**EDUCATION**

- Do staff receive education regarding antimicrobial stewardship and the optimization of antimicrobials?
- Do staff receive education regarding adverse reactions from antimicrobials, antimicrobial resistance?
- What is the frequency of staff education?
- What modes of delivery are used to educate staff?
- What education is provided to patients when starting/discharging them on antimicrobial?
- What modes of delivery are used to educate patients?

## EXAMPLE OF A RESPONSIBILITY AND COMMUNICATION PLAN USING THE I-PARIHS FRAMEWORK:

| Facilitation | Innovation | Recipients | Context |
|---|---|---|---|
| **Novice** | -Problem Identification: ASP evaluation<br>-Review/appraisal of evidence<br>-Develop tracer<br>-Present process of implementing tracer<br>-Provide guidelines to implement and sustain tracer within system | -Initiate tracer team meetings via face to face meetings and Skype<br>-Create tracer with input feedback from stakeholders<br>-Establish relationships with key stakeholders<br>-Introduce tracer project to staff via email and/or attendance at staff meetings<br>-Explain reason for tracer to leadership and clinical staff as needed during rounds or tracer<br>-Conduct tracer interviews with hospitalists, pharmacists, nurses in person and via telephone<br>-Present tracer findings to ASP team, hospital leadership, and staff | -Establish understanding of organizational priorities<br>-Establish understanding of accreditation requirements<br>-Establish understanding of influence and requirements of California Department of Public Health |
| **Experienced** | -Help novice establish access to EMR and contact with clinical staff<br>-Orient/onboard novice | -Facilitate communication between novice facilitator and leadership/management via face to face meetings and email | -Positively promote the innovation to stakeholders<br>-Provide formal and informal leadership support of project by aiding novice facilitator |
| **Expert** | -Provide feedback/mentoring to novice during tracer development<br>-Review final draft of tracer prior to implementation<br>-Aid in refining and improving tracer as needed<br>-Evaluate final outcome of tracer<br>-Facilitate integration of tracer methodology into future evaluation process | -Facilitate communication between novice facilitator and leadership/management via face to face meetings and email | -Introduce innovation to hospital leadership<br>-Positively promote the innovation to stakeholders<br>-Integrate innovation into ASP<br>-Facilitate the communication of results to leadership and staff |

## EXAMPLES OF OTHER TRACER PROJECTS:

| References | Summary |
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| Bookbinder, M., Hugodot, A., Freeman, K., Homel, P., Santiago, E., Riggs, A., . . .Portenoy, R. K. (2018). Development and field test of an audit tool and tracer methodology for clinician assessment of quality in end-of-life care. *Journal of Pain and Symptom Management, 55*(2), 207- 216. doi: 10.1016/j.jpainsymman.2017.08.017 | Developed brief audit tool to guide assessment and rate care in a clinician tracer to evaluate quality of end-of-life care |
| Padgette, P. & Wood, B. (2018). Conducting a surgical site infection prevention tracer. *AORN Journal, 107*(5), 580-590. doi: http://doi.org/10.1002/aorn.12121 | Applied tracer methodology to assess and validate organizational processes aimed preventing surgical site infections |
| Ross, A., Feider, L., Nahm, E-S., & Staggers, N. (2017). An outpatient performance improvement project: A baseline assessment of adherence to pain reassessment standards. *Military Medicine, 182* (5/6), e1688-e1695. doi: https://doi.org/10.7205/MILMED-D-16-00104 | Performance improvement project using tracer methodology to observe clinic workflow when evaluating pain reassessment workflow and policies |
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Wisdom, J. P., Knapik, S., Holley, M. W., Van Bramer, J., Sederer, L. I., & Essock, S. M. (2012). New York's outpatient mental health clinic licensing reform: Using tracer methodology to improve service quality. *Psychiatric Services, 63*(5), 418-420.

# Appendix H

## Responsibility/Communication Plan

| **Facilitation** | **Innovation** | **Recipients** | **Context** |
|---|---|---|---|
| **Novice-**DNP student | -Problem Identification: ASP evaluation<br>-Review/appraisal of evidence<br>-Develop tracer<br>-Present process of implementing tracer<br>-Provide guidelines to implement and sustain tracer within system | -Initiate tracer team meetings via face to face meetings and Skype<br>-Create tracer with input feedback from stakeholders<br>-Establish relationships with key stakeholders<br>-Introduce tracer project to staff via email<br>-Explain reason for tracer to leadership and clinical staff as needed during rounds or tracer<br>-Conduct tracer interviews with hospitalists, pharmacists, nurses in person and via telephone<br>-Present tracer findings to ASP team, hospital leadership, and staff | -Establish understanding of organizational priorities<br>-Establish understanding of accreditation requirements<br>-Establish understanding of influence and requirements of California Department of Public Health |
| **Experienced-** administrative nursing director and a regional clinical coordinator pharmacist | -Help novice establish access to EMR and contact with clinical staff to implement tracer<br>-Orient/onboard novice | -Facilitate communication between novice facilitator and leadership/management via face to face meetings and email | -Positively promote the innovation to stakeholders<br>-Provide formal and informal leadership support of project by aiding novice facilitator |
| **Expert-** medical director of pharmacy and infection control | -Provide feedback/mentoring to novice during tracer development<br>-Review final draft of tracer prior to implementation<br>-Aid in refining and improving tracer as needed<br>-Evaluate final outcome of tracer<br>-Facilitate integration of tracer methodology into future evaluation process | -Facilitate communication between novice facilitator and leadership/management via face to face meetings and email | -Introduce innovation to hospital leadership<br>-Integrate innovation into ASP<br>-Facilitate the communication of results to leadership and staff |

Appendix I

SWOT Analysis

## Strengths

- Ability to assess knowledge of individual prescribers, pharmacists, and nurses
- Ability to assess knowledge regarding antibiotic prescribing, including available resources
- Potential to elicit rationale regarding prescribing habits
- Tracer can be conducted remotely
- Developed by multidisciplinary team
- Infection specific focus
- Established guidelines for antibiotics for infection
- Internal support from ID physician, AS pharmacist
- Outside assessor may provide opportunity for staff to be more honest and candid

## Weaknesses

- Tracer accuracy dependent on performer's knowledge of charting system/ability to find information
- Assessor from outside hospital has challenge of earning buy-in from stakeholders
- Tracer does not allow for legitimate deviations from standard abx therapy
- Perception of more work/time away from patient care by physicians, nurses, pharmacists when being interviewed; some participants may be reluctant
- Conducting tracer requires time investment by surveyor; surveyor must be willing and able to start and stop interview portion of tracer when convenient for interviewee
- Surveyor must spend time coordinating admitting prescriber and pharmacist schedules with the day the survey is conducted and the number of days patient has received care

## Opportunities

- Desire of providers to improve antibiotic prescribing
- Desire of providers to increase knowledge regarding antibiotic prescribing
- ASPs required by CMS and JACHO, therefore, evaluation methods necessary
- Tracer methodology evidence-based and accrediting agencies (e.g. JACHO for other audit items)
- Collaboration with CDPH AS program
- Tracer questions have potential to become indirect way of providing AS education

## Threats

- Time required to conduct tracer
- Lack of provider buy-in
- Financial investment to implement and sustain program
- Treatment approach for infections such as pneumonia are multifaceted leading to potential confounders if surveyor inexperienced

# Appendix J

## Budget and Break-Even Analysis

Year One

| Position | Number of FTE | Number of Hours Required | Annual Salary | Hourly Rate | Total Cost |
|---|---|---|---|---|---|
| Medical Director of Pharmacy and Infectious Disease | NA | 20 | $210,000 | $101 | $2,019 |
| Clinical Coordinator Pharmacist, Formulary Management and Clinical Practice | NA | 20 | $136,000 | $65 | $1,308 |
| DNP student if paid | 0.13 | NA | $98,000 | $47 | $12,740 |
| | | | | Total Cost | $16,067 |
| | | | | # of patients to break even | 12 |

Appendix K

Statement of Non-Research Determination

UNIVERSITY OF SAN FRANCISCO | School of Nursing and Health Professions

# Doctor of Nursing Practice
# Statement of Non-Research Determination (SOD) Form

*The SOD should be completed in NURS 7005 and NURS 791E/P or NURS 749/A/E*

## General Information

| | | | |
|---|---|---|---|
| **Last Name:** | Smyth | **First Name:** | Christine |
| **CWID Number:** | | **Semester/Year:** | Spring 2020 |
| **Course Name & Number:** | NURS 749B | | |
| **Chairperson Name:** | | **Advisor Name:** | Dr. Wanda Borges |

## Project Description

### *1. Title of Project*

Utilizing Tracer Methodology to Evaluate the Effectiveness of a Hospital Antimicrobial Stewardship Program

### *2. Brief Description of Project*

Clearly state the purpose of the project and the problem statement in 250 words or less.

The purpose of the project is to evaluate the success of a hospital antibiotic stewardship program, identify potential gaps in knowledge or deviations from evidence-based practices, and verify the fulfillment of accreditation requirements utilizing tracer methodology.

**3. AIM Statement: What are you trying to accomplish?**

The goal of this project is to utilize tracer methodology to assess the effectiveness of a hospital antibiotic stewardship interventions by August 2020, through the evaluation of healthcare providers' awareness of antibiotic stewardship within their institution, knowledge regarding antimicrobial stewardship components, and approach to treating patients with community acquired pneumonia (CAP).

**4 Brief Description of Intervention (150 words).**

The intervention begins with developing a tracer based on the CDC's Core Elements of Hospital Antibiotic Stewardship Programs: 2019, TJC's New Antimicrobial Stewardship Standards, and the American Thoracic Society's guidelines for diagnosing and treating adults with CAP. The tracer will then be conducted in a hospital setting by reviewing the charts of at least 30 patients diagnosed with CAP and interviewing physicians, APPs, clinical pharmacists, and nurses involved in the patient's care. The results of the tracer will be analyzed and reported to the hospital antimicrobial stewardship program for the

**4a. How will this intervention be implemented?**

- Where will you implement the project?
- Attach a letter from the agency with approval of your project.
- Who is the focus of the intervention?
- How will you inform stakeholders/participants about the project and the intervention?

The tracer will be conducted at [redacted]. The focus of the intervention is to evaluate the hospital Antibiotic Stewardship Program by interviewing hospitalists, APPs, clinical pharmacists, and nurse practitioners caring for patients with CAP and reviewing the EMR of patients being treated for CAP.

Stakeholders of the project intervention will be informed via email and face to face meetings (attending patient rounds, ASP meetings)

**5. Outcome measurements: How will you know that a change is an improvement?**

- Measurement over time is essential to QI. Measures can be outcome, process, or balancing measures. Baseline or benchmark data are needed to show improvement.
- Align your measure with your problem statement and aim.
- Try to define your measure as a numerator/denominator.
    - What is the reliability and validity of the measure? Provide any tools that you will use as appendices.
    - Describe how you will protect participant confidentiality.

Using the developed tracer, the outcome measures will include physician and APP knowledge of hospital ASP; nurse knowledge of hospital ASP; clinical pharmacist knowledge of hospital ASP; physician and APP self-reported confidence regarding pneumonia treatment; and compliance with ATS treatment guidelines for CAP

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# DNP Statement of Determination
# Evidence-Based Change of Practice Project Checklist*

*The SOD should be completed in NURS 7005 and NURS 791E/P or NURS 749/A/E*

**Project Title:**

Utilizing Tracer Methodology to Evaluate the Effectiveness of a Hospital Antibiotic Stewardship Program

| **Mark an "X" under "Yes" or "No" for each of the following statements:** | **Yes** | **No** |
|---|---|---|
| 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. | X | |
| 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. | X | |
| 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. | X | |
| 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. | X | |
| 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. | X | |
| 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. | X | |
| The project has **no** funding from federal agencies or research-focused organizations and is not receiving funding for implementation research. | X | |
| 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. | X | |
| 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."* | X | |

**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.

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

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# DNP Statement of Determination
## Evidence-Based Change of Practice Project Checklist Outcome

*The SOD should be completed in NURS 7005 and NURS 791E/P or NURS 749/A/E*

**Project Title:**

Utilizing Tracer Methodology to Evaluate the Effectiveness of a Hospital Antibiotic Stewardship Program

**X** 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:**

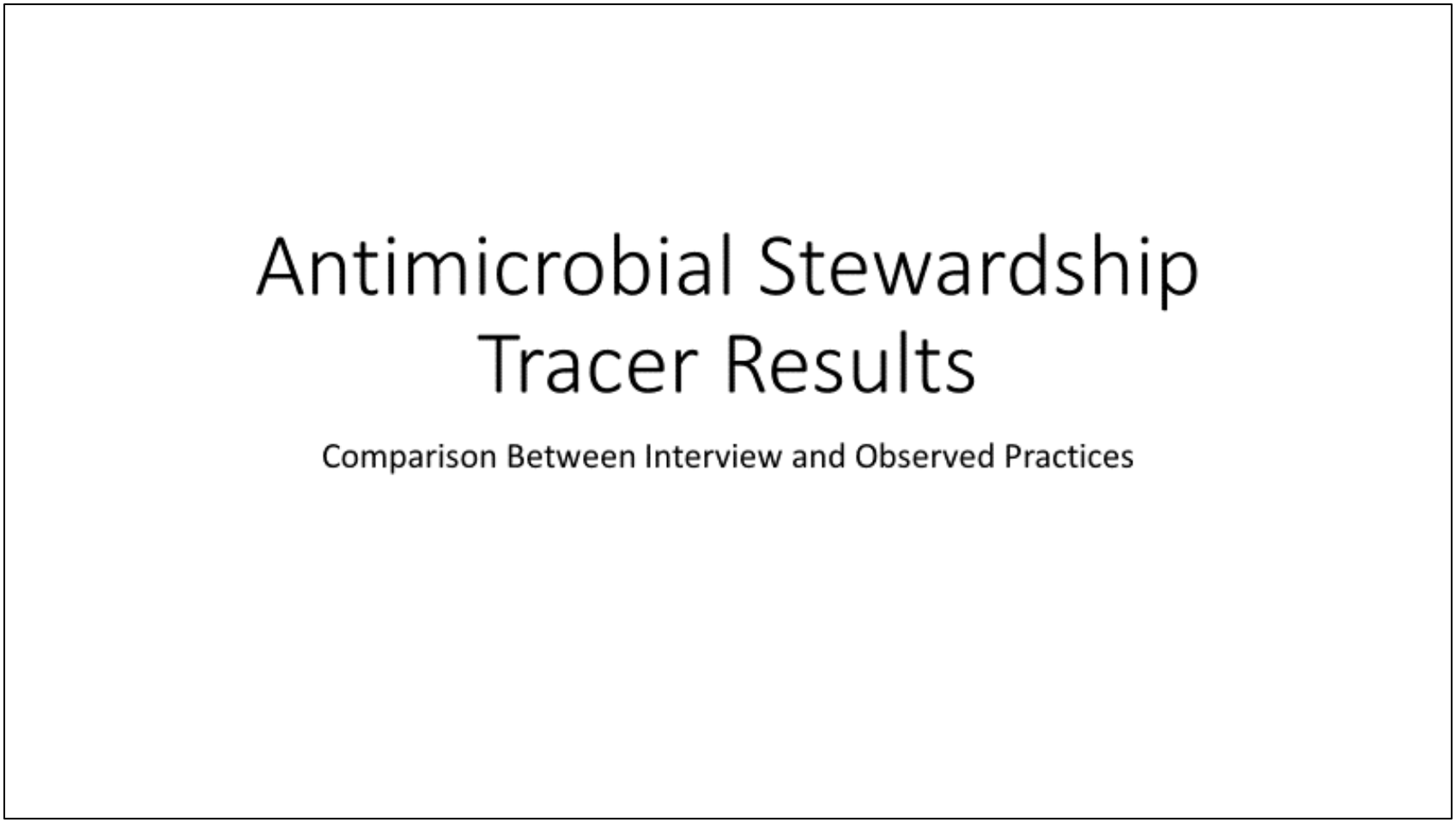
| | | | |
|---|---|---|---|
| **Student Last Name:** | Smyth | **Student First Name:** | Christine |
| **CWID Number:** | 20374628 | **Semester/ Year:** | Spring 2020 |
| **Student Signature:** | Christine Smyth | **Date:** | 5/3/2020 |
| **Chairperson Name:** | Wanda Borges | | |
| **Chairperson Signature:** | | **Date:** | 5/6/2020 |
| **DNP SOD Review Committee Member Name:** | Francine Serafin-Dickson | | |
| **DNP SOD Review Committee Member Signature:** | | **Date:** | |

Appendix L

Results

Presented to Medical Director of Pharmacy and Infection Control and Clinical Coordinator Pharmacist (members of tracer development team)

Shared 9/10/2020



# Knowledge of ASP Interventions

Prior to today were you aware of your hospital having an antimicrobial stewardship program?

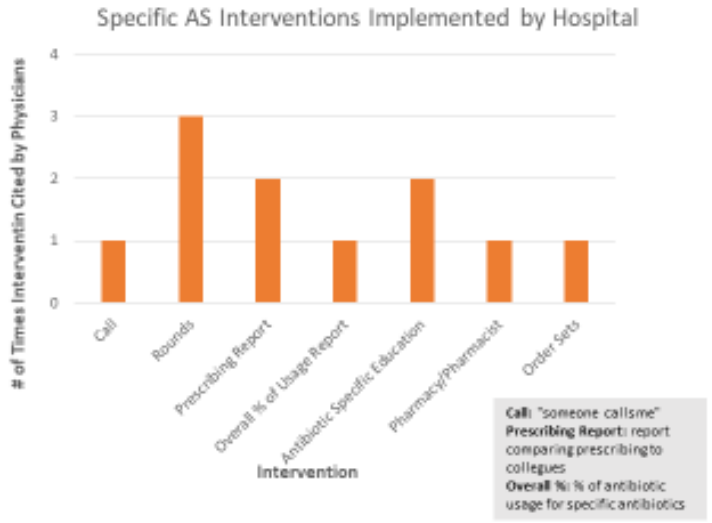
| Yes | No |
|---|---|
| 6 | 1 |

Does your hospital have hospital specific guidelines for any common infections?

| Yes | No |
|---|---|
| 5 | 2 |

Does your hospital implement any specific antimicrobial stewardship interventions?

| Yes | No |
|---|---|
| 7 | 0 |



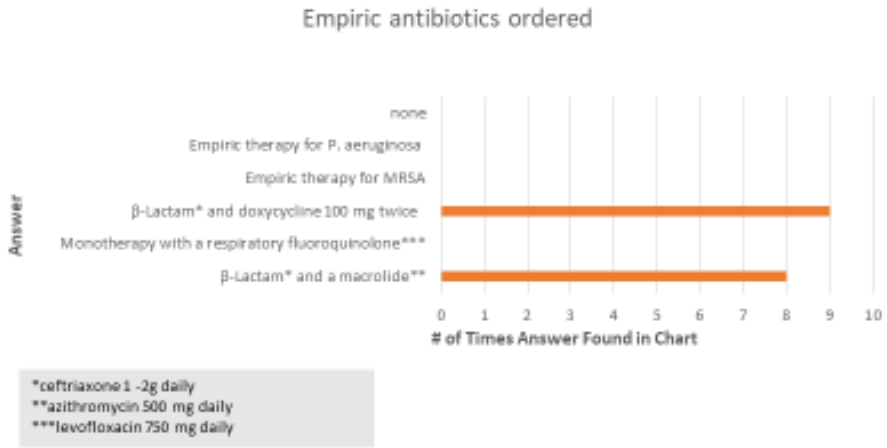
# Knowledge and Practice Regarding Empiric Antibiotic Therapy for Community-Acquired Pneumonia

**Do you think you have adequate knowledge of the treatment of pneumonia to choose empiric antibiotic therapy?**

| Yes | No |
|---|---|
| 7 | 0 |

**Standard empiric treatment CAP used?**

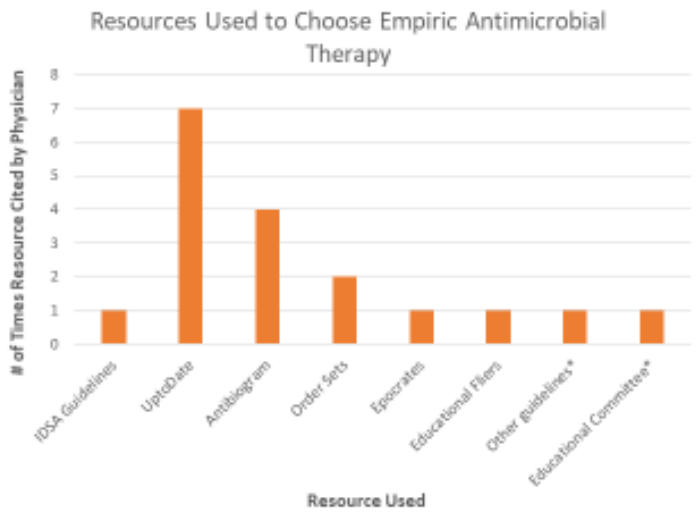
| Yes | No |
|---|---|
| 15 | 0 |

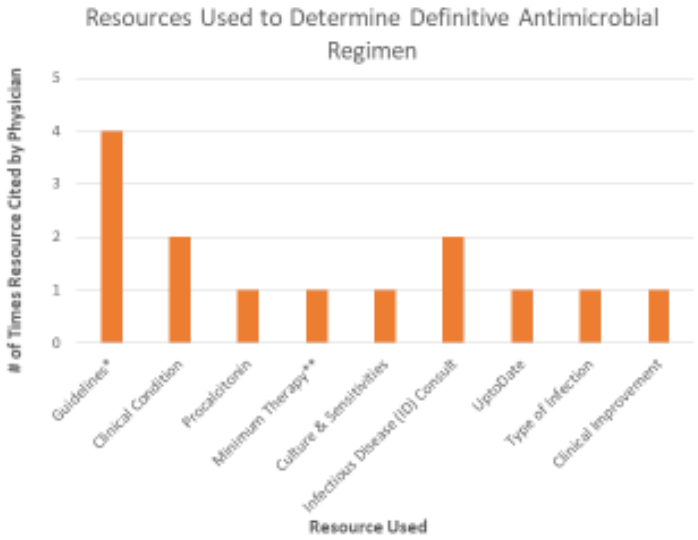


# Resources Utilized by Prescribers

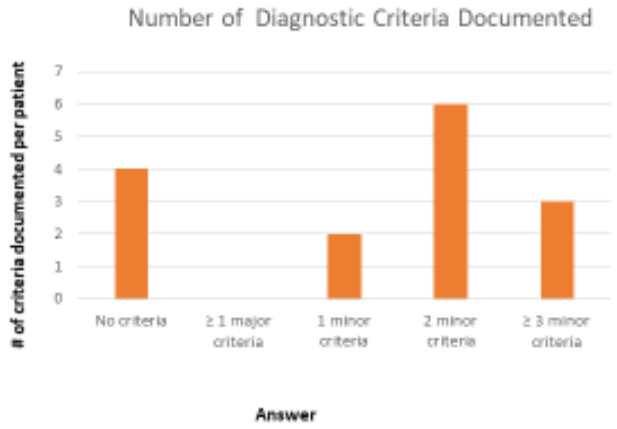
Do you find the resources available to you adequate?

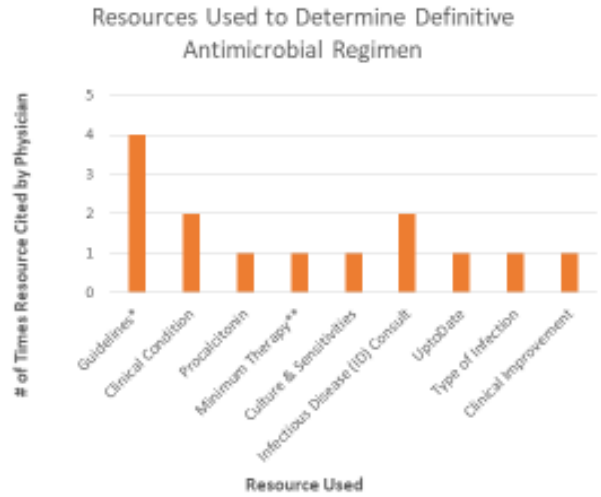
| Yes | No |
|---|---|
| 6 | 1 |



# Factors Influencing Treatment




**Patient tested for influenza?**

| Yes | No | No answer |
|---|---|---|
| 5 | 9 | 1 |

**Patient urine tested for Legionella antigen?**

| Yes | No |
|---|---|
| 7 | 8 |

**Patient urine tested for pneumococcal antigen?**

| Yes | No |
|---|---|
| 4 | 11 |

**Serum procalcitonin level ordered prior to initiation of antibiotics or prior to second dose of antibiotics?**

| Yes | No |
|---|---|
| 9 | 6 |

# Factors influencing treatment for MRSA, P. *aeruginosa* and other MDROs

**Do you think you have adequate knowledge of the treatment of pneumonia to choose empiric antibiotic therapy?**

| Yes | No |
|---|---|
| 7 | 0 |

**Cases in which vancomycin ordered**

| Yes | No |
|---|---|
| 3 | 12 |

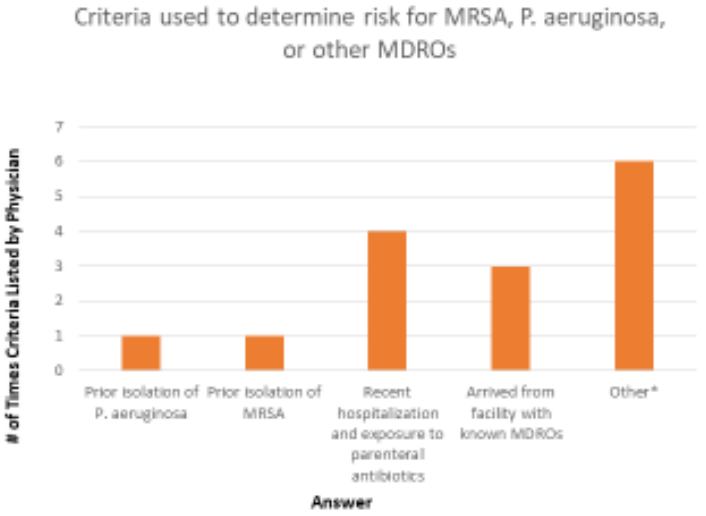
**Cases in which MRSA PCR ordered if vancomycin ordered**

| Yes | No |
|---|---|
| 1 | 2 |

**Pretreatment gram stain and culture of lower respiratory secretions ordered**

| Yes | No |
|---|---|
| 3* | 12 |

*cases in which gram stain and culture ordered do no correlate with cases in which vancomycin ordered, despite matching numbers



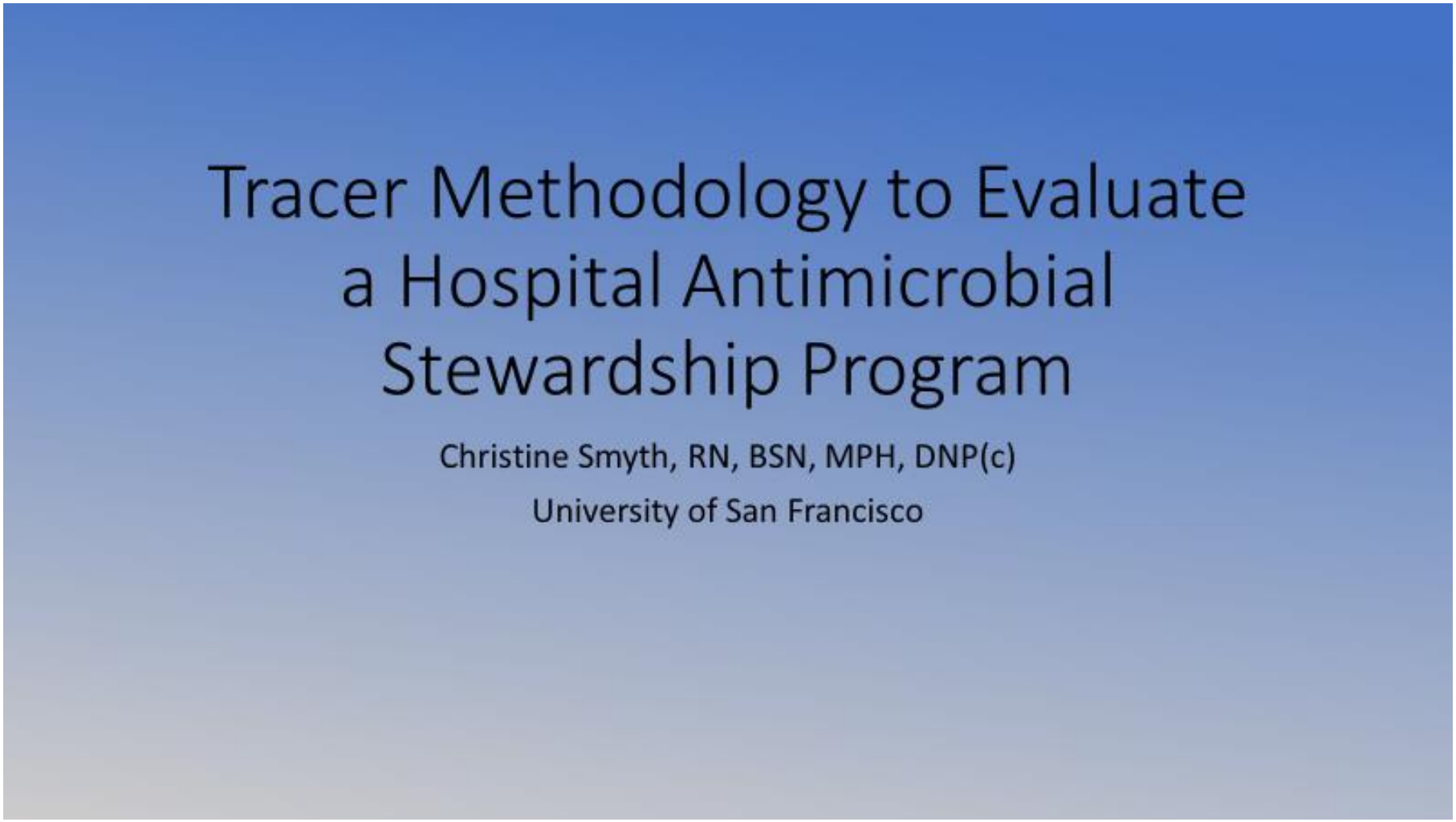

*drug abuse; "covered because pneumonia was severe, then ruled it out"; co-morbidities (COPD, emphysema, CT scan multilobar), "swab nares for MRSA"; nursing home; trach; baseline autoimmune disease; CF; DM; "through history"

Appendix M

System Regional Antimicrobial Stewardship Committee Presentation

Presented to System Regional Antimicrobial Stewardship Committee

Presented 9/21/2020



## Proposed Intervention

- CDPH introduced ASP assessment tool formatted as interview of frontline providers with goals to:
  - Assess practices of frontline providers
  - Inform frontline providers of best practices
  - Identify obstacles to stewardship practices

# Background

**Problem Description:** Need to assess Antimicrobial Stewardship Program (ASP), specifically, ASP's influence on clinical practice of frontline providers

**Setting**: Pilot at Eden Hospital

130-bed regional trauma center; 42 hospitalists on staff providing care coverage for six different units during twelve-hour shifts

**Disease State:** Community-Acquired Pneumonia (CAP)

Selected based on familiar national guidelines and opportunity for larger sample size

**PICO question**: Is conducting a tracer in an acute care hospital an effective method for evaluating a hospital-based ASP with regard to treatment for Community-Acquired Pneumonia when compared to only using process measures?

# Preparation

- Literature review for peer reviewed articles in which tracer methodology was proposed or implemented to evaluate a program addressing a clinical need within an acute care or outpatient setting
- Review of tracer methodology- individual tracers, systems tracers, and accreditation specific tracers
- Determine extent of tracer:
  - Assess knowledge and practice regarding AS of prescribers, pharmacists, and nurses
  - Focus on patients diagnosed with CAP

# Development of Tracer Questions

- Tracer created with use of :
  - CDC's Core Elements of Hospital Antibiotic Stewardship Programs
  - TJC's New Antimicrobial Stewardship Standards
  - American Thoracic Society's guidelines for diagnosing and treating adults with CAP
- Format of tracer:
  - Implemented tracer composed of provider interview and chart review
  - Interview questions focused on Action (factor influencing prescribing ), Education, Tracking and Reporting, and prescribing practices/knowledge (e.g. how are patients determined at risk for MDROs?)
  - Chart examined prescribing practices with regards to criteria used to diagnose severity of pneumonia, antibiotics prescribed, diagnostics ordered to aid treatment, and processes in place (e.g. use of order sets, antibiotics reviewed on day three).

# Challenges Encountered During Implementation

- COVID-19
- Ability of staff to participate
- Willingness of staff to participate
- Correlating interview portion to findings in chart review difficult due to small sample size
  - However, more patient chart reviews does not mean more providers interviews

# Findings: Physician Knowledge of ASP Interventions

Prior to today were you aware of your hospital having an antimicrobial stewardship program?

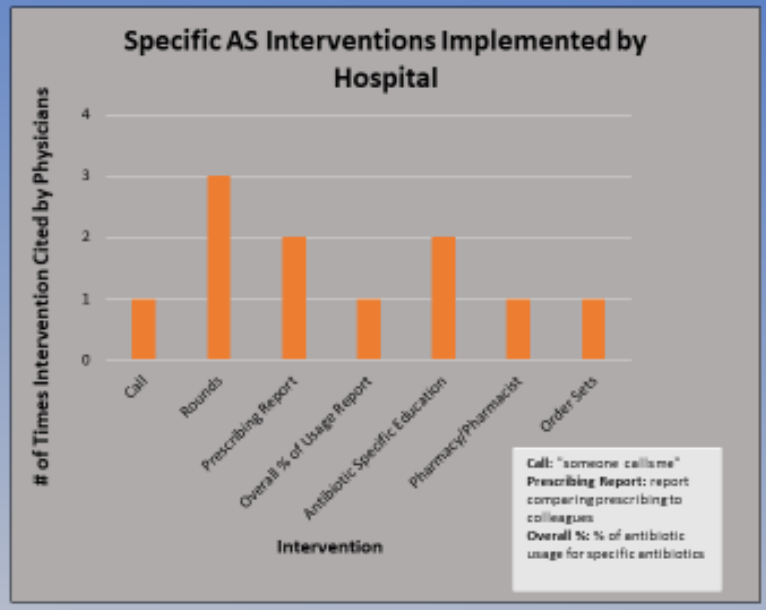
| Yes | No |
|---|---|
| 6 | 1 |

Does your hospital have hospital specific guidelines for any common infections?

| Yes | No |
|---|---|
| 5 | 2 |

Does your hospital implement any specific antimicrobial stewardship interventions?

| Yes | No |
|---|---|
| 7 | 0 |



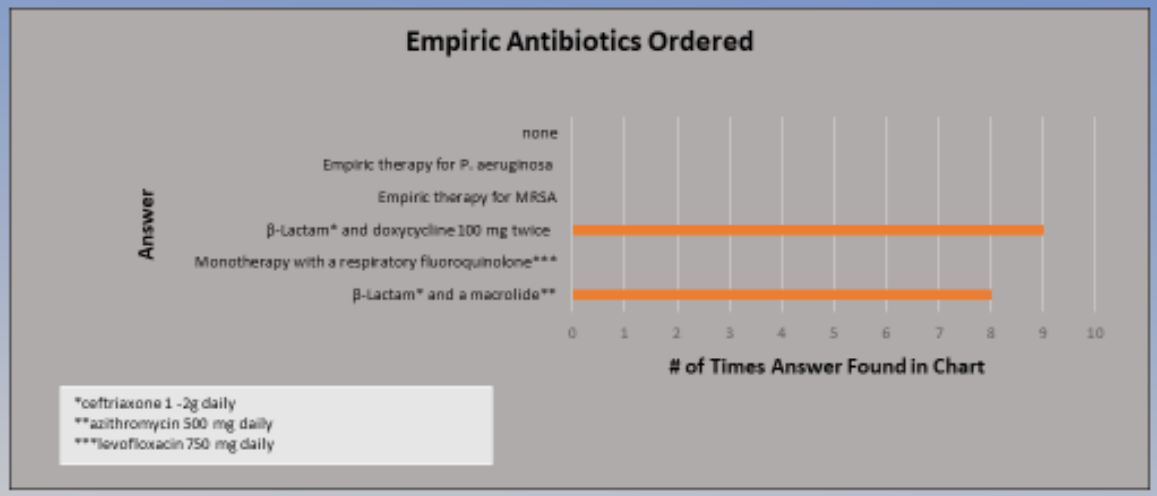
# Knowledge and Practice Regarding Empiric Antibiotic Therapy for Community-Acquired Pneumonia

**Do you think you have adequate knowledge of the treatment of pneumonia to choose empiric antibiotic therapy?**

| Yes | No |
|---|---|
| 7 | 0 |

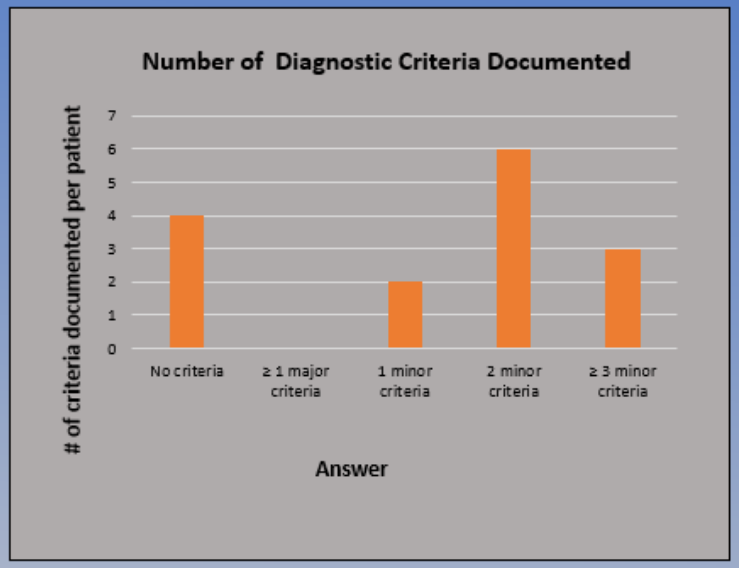
**Standard empiric treatment CAP used?**

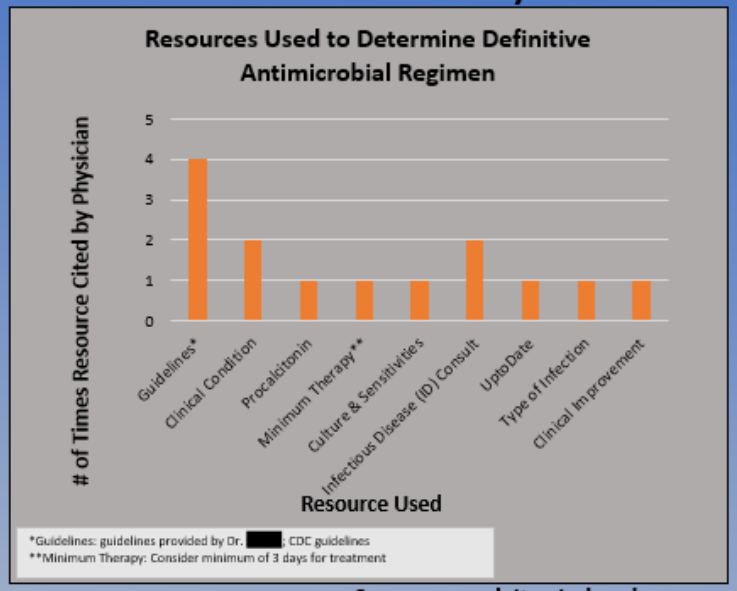
| Yes | No |
|---|---|
| 15 | 0 |



# Factors Influencing Treatment

## (Inconsistency with Chart Documentation and Guidelines)




**Patient tested for influenza?**

| Yes | No | No answer |
|---|---|---|
| 5 | 9 | 1 |

**Patient urine tested for Legionella antigen?**

| Yes | No |
|---|---|
| 7 | 8 |

**Patient urine tested for pneumococcal antigen?**

| Yes | No |
|---|---|
| 4 | 11 |

**Serum procalcitonin level ordered prior to initiation of antibiotics or prior to second dose of antibiotics?**

| Yes | No |
|---|---|
| 9 | 6 |

# Factors influencing treatment for MRSA, *P. aeruginosa* and other MDROs

**Do you think you have adequate knowledge of the treatment of pneumonia to choose empiric antibiotic therapy?**

| Yes | No |
|---|---|
| 7 | 0 |

**Cases in which vancomycin ordered**

| Yes | No |
|---|---|
| 3 | 12 |

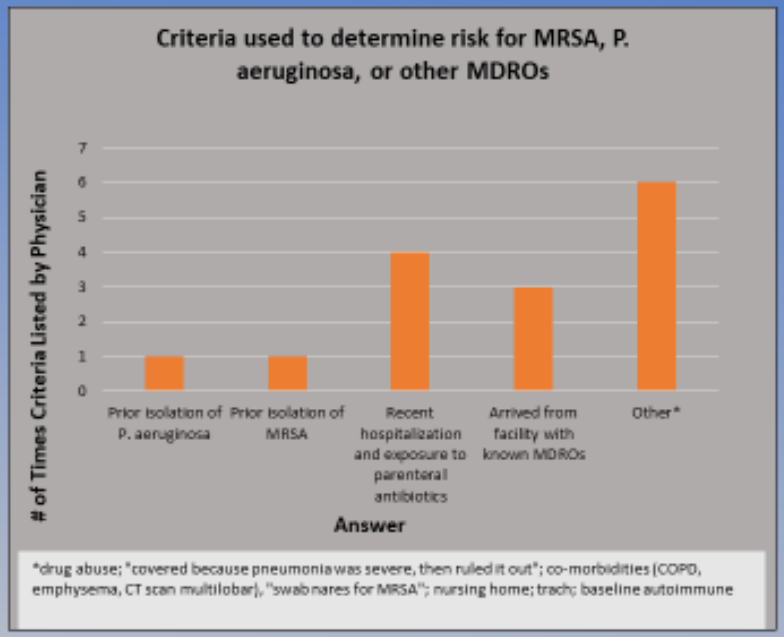
**Cases in which MRSA PCR ordered if vancomycin ordered**

| Yes | No |
|---|---|
| 1 | 2 |

**Pretreatment gram stain and culture of lower respiratory secretions ordered**

| Yes | No |
|---|---|
| 3* | 12 |

*cases in which gram stain and culture ordered do no correlate with cases in which vancomycin ordered, despite matching numbers



# Strengths/Weaknesses

+ Collecting data retrospectively provided insight into approach and flow of patient care- highlighted team approach

- Tracer doesn't capture variation with regards to orders placed by different providers, specialists, departments
- Uncertainty in classification of pneumonia
- Distrust (may have impacted the response)
- /+ Variability in knowledge and sources of treatment
  - Expected some commonality but there was variation in all responses especially by physicians
  - Difficult to determine which is best avenue for education and where to focus

# Lessons Learned

- Information gained from interview portion may be more efficiently obtained from e-survey
- Familiarity with surveyor may improve willingness of staff to participate
- Chart review examines if certain items have been done, but doesn't designate who completed the item- consider designation for who completes item to provide more insight into care processes
- Goal of tracer is to assess processes and provider knowledge in order to improve ASP, but care must be taken to avoid providers perceiving questions as being about them individually