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Beyond What the Eye Can See: Verifying Surgical Instrument and Endoscope

Cleanliness with Adenosine Triphosphate (ATP) Technology

Christy V. Mitchell MSN, RN, MAJ, USAF and Richard D. Anderson BSN, RN, MAJ, USAF

Malcolm Grow Medical Clinics and Surgery Center

Daniel K. Inouye Graduate School of Nursing

Uniformed Services University

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Richard Anderson, BSN, RN, MAJ, USAF

Daniel K. Inouye Graduate School of Nursing
Uniformed Services University

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Christy Mitchell, MSN, RN, MAJ, USAF

Daniel K. Inouye Graduate School of Nursing
Uniformed Services University

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Abstract

Phase II Site: Malcolm Grow Medical Clinics and Surgery Center (MGMSC)

Project Title: Beyond What the Eye Can See: Verifying Surgical Instrument and Endoscope Cleanliness with Adenosine Triphosphate (ATP) Technology

Authors: Mitchell, C. & Anderson, R.

Problem: Surgical site infections (SSIs) are the costliest type of healthcare-associated infection, estimated at \$3 billion per year. Approximately 110K cases yearly extend hospital admissions to 1M days annually. Visual inspection for bioburden on surgical instruments and endoscopes has been the predominant practice, however it has its limitations. With no standardized guidelines on verifying cleaning efficacy, healthcare facilities seek new and innovative tools, such as adenosine triphosphate (ATP) technology, for bioburden detection.

Purpose: Among manually cleaned surgical instruments and endoscopes at MGMSC, how do audits and ATP testing with visual assessment compared to visual assessment alone, increase bioburden detection and identify gaps in the cleaning process?

Project Design: The Plan-Do-Study-Act model guided the project's approach for utilizing audits and ATP testing to evaluate manual cleaning practices. The implementation of evidence-based interventions and outcome assessments occurred over 25 weeks.

Data Analysis: ATP testing and visualization was more effective at detecting bioburden than visualization alone. Baseline data showed 38 (95%) of 40 instruments and endoscopes were visibly clean; with five (13%) of 38 passing visualization but failing ATP testing. Two (5%) of 40 failed both visualization and ATP testing. Post-intervention data showed 37 (92%) of 40 instruments and endoscopes were visibly clean, with seven (19%) of 37 passing visualization but failing ATP testing. Three (8%) of 40 instruments failed both visualization and ATP testing.

Contaminated instruments were recleaned, avoiding 17 potential SSIs valued at \$340K.

Proposed Organizational Impact/Implications for Practice: Implementing auditing and ATP testing has enhanced bioburden identification and educational opportunities in improving cleaning practices. ATP testing is a low-cost, high-value option for mitigating SSI risks, contributing to Ready Reliable Care across the Military Health System.

Introduction

Over 14 million surgeries and five million endoscopic procedures are performed in the United States (CDC, 2019; National Healthcare Safety Network, 2021). Each time surgical instruments and scopes are used within the surgical environment, there is a high risk of microbial contamination and growth even after cleaning and disinfection, leading to some cases of healthcare-associated infections (HAIs) (Fernando et al., 2014). In 2015, there were more than 687,000 HAIs in the US. As a result of hospital procedures, 110,000 to 300,000 surgical site infections (SSIs) can occur yearly (Anderson et al., 2014, NHSN, 2021). Recent analyses show that SSIs make up about 20% of HAIs, and about 60% of the 20% are preventable using current evidence-based practices and guidelines (NHSN, 2021). It was also reported that SSI predictions decreased only 7% from 2015-to 2019 (CDC, 2021). These findings summarize how SSIs are a public health and safety issue. Out of all the HAIs, SSI is the costliest (NHSN, 2021). HAIs can present a financial-economic burden for healthcare organizations as they account for \$28.4 billion per year, while SSIs account for \$3.5 billion to \$10 billion per year (Anderson et al., 2014; CDC, 2021). Due to the number of patients affected, complications, and economic impact, organizations at the national level must improve standards in preoperative practices to reduce SSIs.

SSIs and National Guidelines

Hospitals and ambulatory surgical centers (ASCs) face similar patient safety issues. Surgical staff in the sterile processing department (SPD) follow manufacturer's instructions for use (IFUs) and guidelines from the Association of periOperative Nursing (AORN) and the Association for the Advancement of Medical Instrumentation (AAMI) when cleaning, disinfecting, and sterilizing surgical instruments and endoscopes. Although AORN, AAMI,

Centers for Disease and Control (CDC), and Healthcare Sterile Processing Association (HSPA) support strict instrument and endoscope cleaning, there is no consensus on which method is optimal for evaluating the efficacy of cleaning medical devices (Rodriguez & Hooper, 2019). Current practice in most SPD units is to verify instrument cleanliness through visual inspection only. National guidelines recognize implementing a cleaning verification testing process as “Recommendation” (AORN, 2021). This level of recommendation falls under “should,” as it is based on high-to-moderate quality of supporting evidence, and the benefits clearly exceed harms (AORN, 2021). However, the evaluation methodology for verifying cleaning effectiveness, still remains a “Conditional Recommendation,” where implementation by SPD units “may” be done, but is not required (AORN, 2021). These differences in recommendations provide SPD units the flexibility in finding the solution(s) necessary for instrument cleaning verification that best suits their needs and capabilities. To help with instrument cleaning verification, beyond that of visualization alone, adenosine triphosphate (ATP), protein, and hemoglobin are testing methods that can provide more accurate and objective data on the quality of instrumentation cleanliness.

SSIs and Healthcare Organizations

Healthcare organizations have created implementation guides and targeted metrics to help hospitals meet goals in reducing SSIs. The Department of Health and Human Services (HHS) created the HHS Steering Committee (HHS, 2021). The HHS Steering Committee worked on sharing the latest research, evidence-based practice, and challenges from various organizations (HHS, 2021). Since 2010, the Joint Commission (TJC) (2021) has made efforts to reduce SSIs by including infection prevention as a National Patient Safety Goal (NPSG). Focusing on the military healthcare system (MHS), the Defense Health Agency (DHA) has adopted its own model for high reliable care called Ready Reliable Care (RRC) (DHA, 2022). DHA created an

Infection Prevention and Control workgroup and infection prevention control (IPC) plan to prevent and eliminate HAIs to control infection rates across all military treatment facilities (MTFs). (DHA, 2017). Attention to patient safety and SSI reduction through combined efforts set by HHS, TJC, and DHA have provided direction to apply practices related to mitigating SSIs.

SSIs and the Military Population

Infections complicate the care and readiness of the military population and various deployment settings. Infection-related deaths is a major occurrence amongst soldiers who are injured and receive care and treatment in the hospital setting; the highest setting of service members data collected was that of the Vietnam War. Hospitals throughout Vietnam had over 132,000 admissions, 46.3% of those were surgical admissions (Blyth, 2015). Those surgical admissions accounted for 93% of deaths with sepsis the third leading cause of death (Blyth, 2015). In Iraq and Afghanistan, 28-34% of wounded service members were affected by infections; 38% of those occurred after discharge from their first in-patient encounter (Barsoumian et al., 2020). The contributing causes to the infection can range in time and events that introduce bacteria at the point of injury to medical treatments performed in the deployed setting (Barsoumian et al., 2020). In an Air Force clinic in Qatar, endoscopy procedures possibly exposed 135 service members over eight years to human immunodeficiency virus (HIV), Hepatitis B, and Hepatitis C due to improperly sterilized endoscopes (Losey, 2017). Combat-related infections can occur in various deployed settings. The growing awareness of the occurrences and impact of infections have called on military leadership to find prevention strategies to mitigate SSIs among our military population and beneficiaries.

Problem Synthesis

Due to the difficulty of cleaning and disinfecting surgical instruments and endoscopes, removing microorganisms such as spores, fungi, and viruses from surgical instruments and endoscopes poses challenges (CDC, 2016). The rising complexity and variation of instruments make it difficult to clean and visualize multiple areas in instruments and scopes (Fitts et al., 2020). Multiple pieces on instruments must be disassembled or actuated to ensure that disinfectants, fluid, and friction expose every area (CDC, 2016). Endoscopes are highly delicate and complex, making them difficult to clean, possibly causing more infections than any other medical device (Neves et al., 2016).

The reprocessing of devices is dependent on the SPD technician's close attention to detail (Quan et al., 2018). IFUs for instruments and endoscopes are developed by their corresponding manufacturers. The manufacturer's IFU provides SPD technicians the necessary instructions and parameters for cleaning to adequately remove bioburden while preventing damage and harm to both the item and technician respectively. Numerous steps of the cleaning and HLD process performed by SPD technicians can make the task exhaustive (Quan et al., 2018). Inadequate preparation, underperformance, and lack of oversight contribute to failures in removing soil from instruments before sterilization (Zhou et al., 2020). Additionally, knowledge gaps on proper instrument decontamination practices can exacerbate reprocessing inaccuracies, resulting in harmful patient outcomes. Special attention to auditing on device processing is recommended to ensure successful reprocessing (Duro, 2016). Auditing identifies failure points that contribute to errors in processing and help define actions for improvement and increased competencies (AORN, 2021).

The current standard at Malcolm Grow Medical Clinics and Surgery Center (MGMSC) for verifying instrument cleanliness is through visual inspection. The naked eye

does not detect microorganisms and viruses (CDC, 2016). National guidelines recommend the utilization of a more objective quality assurance tool to monitor manual and mechanical cleaning practices (Rodriguez & Hooper, 2019). Fitts et al. (2020) state that considerable evidence demonstrates the need for a tool that gives quantitative results to test cleaning efficacy. Understanding how the current cleaning process provides objective data to make accurate decisions and focus education and training efforts to improve reprocessing accuracy and can foster a continuous process improvement culture.

Clinical Question

Among manually cleaned surgical instruments and endoscopes at MGMCSC, how do audits and ATP testing with visual assessment compared to visual assessment alone, increase bioburden detection and identify gaps in the cleaning process?

Search Strategy and Results

The authors utilized multiple search engines to gather literature. This included PubMed, Embase, Cumulative Index to Nursing and Allied Health Literature (CINAHL). Search terms to find literature included: *ATP technology*, *sterile processing department*, *instrument*, *endoscopes*, and *quality assessment*. The search results were narrowed to 2015-2020, English language, and peer-reviewed journals for all the search databases. The PRISMA diagram in Figure 1 summarizes and provides the number of literature screened through the process.

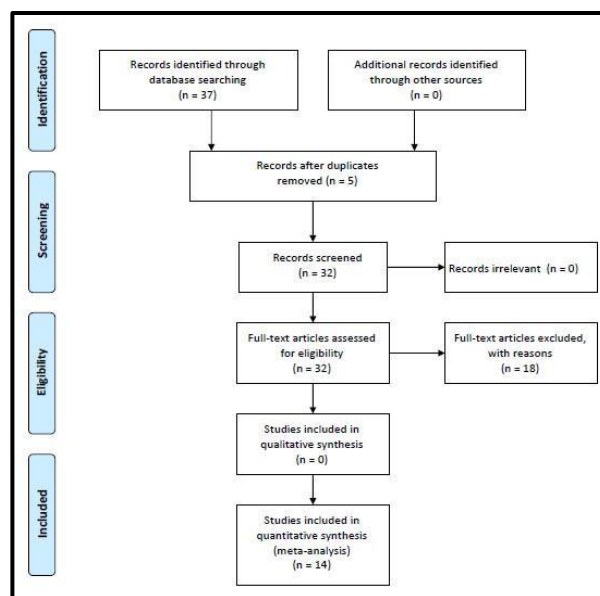


Figure 1. *Prisma Diagram (Moher et al., 2009)*

As of March 2021, the team identified 37 records through database searches, 5 were removed for duplication, and 32 were screened. The authors excluded 18 articles due to the wrong study design, setting, population, route of administration, intervention, and indication. A total of 14 articles remained for our literature review in Appendix A. Each article was appraised by the authors to ensure reliability and distinguish evidence.

Solution Synthesis

ATP-based technology has gained recognition for its accuracy, adaptability, objectivity, and use in the healthcare and food industry (Huang et al., 2015). Although multiple studies show the benefits of ATP technology in SPD, ongoing quality assessment is further warranted for ATP applicability on both instruments and endoscopes. Additionally, current staff training, education, and practices do not know how to use this technology to get beyond what the eye can see.

Launching ATP technology as a method to validate cleanliness has shown favorable results. A quality improvement (QI) project by Rodriguez and Hooper (2019) demonstrated that ATP technology and visualization detected the most contaminated cannulated instruments after

manual and ultrasonic cleaning compared to visual assessment alone. At the MTF in their study, 16 out of 118 surgical cannulated instruments failed the ATP testing showing they were inadequately cleaned (Rodriguez & Hooper, 2019). Their findings revealed that visual inspection alone does not show effective cleaning practices; however, tools such as ATP technology can detect bioburden and validate cleaning efficacy (Rodriguez & Hooper, 2019).

ATP technology also provides quick feedback on cleaning efficacy allowing a safe turnover of instruments on a busy unit (Fitts et al., 2020; Fernando et al., 2014). Out of 120 gastrointestinal (GI) scopes that were disinfected, 20 failed ATP technology testing. When these 20 scopes were tested with protein and culture, they resulted in negative results. These scopes that failed ATP technology testing were not used on patients and proceeded to be disinfected. These studies have shown that ATP technology has an essential role in quickly validating cleaning efficacy and preventing contaminated scopes from returning to circulation for patient use.

There are multiple ways to assess cleaning effectiveness. Visual inspection is the current national standard and commonly used method in healthcare facilities (Huang et al., 2015). This method is an easy process, but it cannot give objective and precise results. In a study by Huang et al. (2015), visual assessment of surfaces that were claimed to be clean picked up only 4.7% residual inadequacy, while ATP picked up 50.6% residual inadequacy on surfaces. Overall, the study results showed that visual assessment alone does not assess inadequate cleanliness. ATP technology is a sensitive tool that can effectively evaluate surface cleanliness compared to the standardized visual method.

Manual cleaning audit practices in SPD can be used to help improve systems. Using QI tools such as audits in SPD focuses on clinical practice in comparison to national standards of

care (Esposito & Canton, 2014). Audits are beneficial in several ways. The first is that it helps identify the discrepancies between the current practice and the standard. The second is that results of audits provide data for documentation, assessment, and a formulated report to assess whether or not there is improvement in practice that needs to be made (Esposito & Canton, 2014). In manual cleaning practices, AORN, AAMI, and HSPA will serve as a valuable blueprint for audit performance.

Relevance to Military Nursing

Effective surgical instrument and endoscope cleaning are complex, sequential, and multi-step processes requiring the right tools, technique(s), and attention to detail to break the chain of infection (IAHCSMM, 2016). A failure in any of these critical steps contributes to SSIs, leading to poor patient outcomes and absorbed costs by patients and healthcare facilities. According to the National Healthcare Safety Network (NHSN, 2021), SSIs are associated with a mortality rate of 3%, with 75% of SSI-associated deaths directly attributable to the SSI itself. Visibly cleaned instruments have been shown to harbor infectious microbes or biofilm that may be passed undetected to patients during invasive procedures. Additionally, SSIs may cost patients an average of \$1,400 to \$40,500 (Turner & Migaly, 2019). The estimated annual cost, nationally, is \$3.3 billion, with nearly 1 million additional inpatient-days annually (NHSN, 2021). Service members who contract SSIs, not only have their own health impacted, but their functional abilities to contribute to overall combat mission readiness and operational capabilities is greatly diminished. The incorporation of ATP technology objectively aids in identifying contaminated instruments within the process of instrument and endoscope cleaning prior to reaching the patient. Initial cost of the ATP handheld unit is approximately \$2,000, the cost of test swabs and lumen test sponges per endoscope is approximately \$5, and between \$2.50 to \$5 per surgical

instrument, making it a reasonable value compared to potentially incurred SSI-related costs. Implementing objective ATP technology satisfies the DHA's Quadruple Aim of better health, better care, increased readiness, and lower cost (DHA, 2020).

Aligning the Value of ATP with the Quadruple Aim

To help with the immense transition of the Army, Air Force, and Navy into one enterprise, DHA has established a strategy for each service to reorganize its priorities. The Quadruple Aim is a DHA strategy that focuses on improved readiness, better health, and better care at low cost. According to the DoD DHA Year Plan (2021), one of the measurements of success is data on safety-related hospital events with a key performance indicator (KPI) of near-miss-to-harm reports, also known as patient safety reports (PSRs). Applying QI initiatives can help reduce near-miss-to-harm reports (DoD DHA Year Plan, 2021). Thus, efforts to implement ATP technology can be essential to healthcare organizations in four ways: to reduce cost, provide better care, support better health for our military and beneficiaries, and improve the readiness of our soldiers, airmen, sailors, marines, and guardians.

Reduce Cost

Cost containment in the healthcare system involves the continual reproduction of costs and workload. While treating SSIs can vary depending on the severity and location of the SSI, an average cost can range from \$25,000 to the high range of \$90,000 (NHSN, 2022). When comparing the cost of treating SSIs to the purchase of ATP tool kits, Rodriguez and Hooper (2019) have found ATP tool kits to be inexpensive; a complete kit starts at \$4,500 for the handheld tool, \$6 for each swab, and \$12 for each cannulated instrument brush. Performing ATP testing is significantly less than the cost of treating SSIs. In addition, Schmitt et al., 2018 have found that an added step to instrument processing does not significantly interfere with staff

workload at a busy endoscopy center. It is evident that performing ATP testing is significantly less than the cost of treating an SSI, and implementing ATP technology does not dramatically change the processing workload. It is possible that MHS can prevent costly infections by promoting this innovative technology, thus meeting DHA's Quadruple Aim.

Better Care

Perioperative units follow guidelines to help ensure organizations follow the most up-to-date evidence supported by research. AAMI recommends that healthcare organizations select a method to test for bioburden on surgical instruments. A study by Schmitt et al. (2018) displayed that ATP technology can provide quick and objective results in bioburden detection in endoscopes. By strictly following professional organizational guidelines like AAMI and evidence-based practices, healthcare organizations can prevent infections, resulting in better care.

Better Health

In the perioperative environment, attaining desired outcomes among perioperative patients is a goal and responsibility of the healthcare team. Adopting innovative technology such as sampling hard-to-clean instruments with an ATP swab provides users with reliable, rapid, and objective data helping surgical technicians identify unsterile surgical instruments and return the contaminated instrument for recleaning. The use of properly sterilized surgical instruments and endoscopes can help decrease patient-to-patient transmission such as Hepatitis B and harmful pathogens like *Mycobacterium tuberculosis*, achieving positive patient outcomes (CDC, 2019).

Improved Readiness

Reducing SSI rates among military personnel is one way to enhance readiness. The Department of Defense describes readiness as the ability of warfighters to be ready to complete

mission objectives anywhere and anytime (Congressional Research Service, 2020). The US Army utilizes several physical profiles to measure personnel readiness (Headquarters Department of the Army, 2019). Medical diagnoses such as SSIs or any change in a service member's medical status can create temporary profiles leaving service members temporarily unqualified to be mission ready. Utilizing ATP technology as a QI tool may promote the reduction of SSIs through early identification of unsterile instruments and endoscopes before reaching patients.

As the only ambulatory surgical center in the National Capital Region (NCR), MGMCSC's success in adopting innovative approaches in healthcare can help improve the care experience of the organization, healthcare staff and the patient. To help ensure success is achieved and sustained, the unique skills of a doctorally prepared clinical nurse specialist (CNS) will lead practices to improve patient experiences while lowering costs transforming the way the SPD is managed and overseen.

Focus Areas

In this project, the authors focused on:

1. Auditing cleaning processes for 40 surgical instruments.
2. Identifying instruments that are difficult to clean and carry high bioburden based on the literature, PSRs, and staff interviews.
3. Performing ATP testing on the identified instrument and endoscope.
4. Auditing cleaning processes for the two medical tools.
5. Providing evidence-based-recommendations including ATP technology tool to improve medical device cleaning.

6. Repeating ATP testing and audit on the instrument and endoscope and synthesizing findings.

Organizing Framework

The Avedis Donabedian model was the organizing framework to guide and evaluate the proposed QI project. The Donabedian model is a conceptual model for examining the quality of clinical practice where healthcare is performed (Donabedian, 2002). Evaluation of healthcare quality is evaluated from three approaches: Structure, Process, and Outcome. Quality within each of the three approaches is not necessarily independent of one another, nor is it a continuum. Rather, respective quality within each may adjacently affect the other, developing a connected relationship (i.e., poor processes may result in poor outcomes) (Donabedian, 2002).

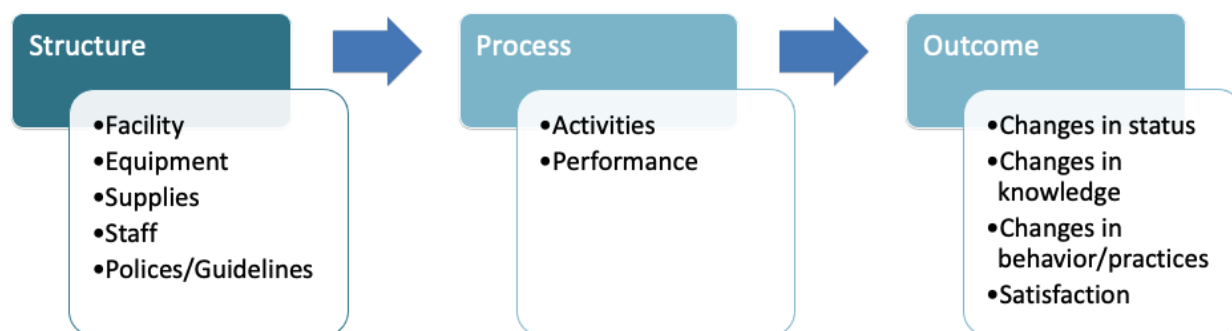


Figure 2. *Approaches to Assessing Quality. Applied from Donabedian (2002)*

Structure

Donabedian (2002) identifies structure as the condition under which activities of care are provided. These structural conditions include the facility, equipment, supplies, staff, and policies/guidelines (see Fig.2) (Donabedian, 2002). The availability of proper type and size brushes for decontamination cleaning of instruments and endoscopes is an example of a critical supply component (IAHCSMM, 2016). Failure to equip staff with appropriate brushes contributed to inadequate removal of organic debris and bioburden, thus increasing patient

exposure to infection organisms (AORN, 2017; IAHCSMM, 2016). Additional conditions within the structure include supervision and leadership, education and training, and human resources (Donabedian, 2002).

Process

According to Donabedian (2002), the process approach is those activities carried out by professional personnel in the delivery of healthcare. An example would be using and applying appropriate brushes to clean lumens of surgical instruments and endoscopes. Slight variations that deviate from the standards and best practices may have a substantial consequential effect on the outcome of care (Donabedian, 2002). The processes should be evaluated against both regulatory and voluntary standards. Regulatory standards imposed by federal and state government agencies require mandatory process adherence. Conversely, voluntary standards are evidence-based practice recommendations, i.e., AAMI, HSPA, and The Society of Gastroenterology Nurses and Associates (SGNA) (IAHCSMM, 2016). IFUs set out by equipment manufacturers are vital components in the safe reprocessing of surgical instruments and endoscopes and are emphasized among regulatory and voluntary standards.

Outcome

The third approach to evaluating quality, following structure and process, is outcome. According to Donabedian (2002), outcome refers to changes, desirable or undesirable, in personnel and care delivered. Examples include status changes, changes in knowledge, changes in behavior/practices, and satisfaction (see Fig.2) (Donabedian, 2002). Assessing quality within an outcome should have a method(s) of measurement and classification for evaluation (Ayanian, 2016; Donabedian, 2002). Measurements include existing facility standards, current

regulatory and voluntary requirements, manufacturer IFUs, and benchmarks from internal and external sources.

Project Design

Although the Donabedian model provides contextual understanding of the importance and process towards evaluating quality, it is not designed to orchestrate and bring about a desired practice change through a step-by-step process (Donabedian, 2002; Melnyk & Fineout-Overholdt, 2019). The Plan-Do-Study-Act (PDSA) model however, is a widely accepted approach for piloting and executing a planned change, then learning about the outcomes on a small scale (Melnik & Fineout-Overholt, 2019). The PDSA model was selected for the designing of the project's procedural process in assessing quality and practice change.

Within the PDSA model is a cycle of four procedural steps (see Fig. 3). According to Sylvia & Terhaar (2014), the Plan phase established team composition, the identified process(s) requiring improvement, measured for success, changed for improvement, and goals for the changes. Next, the Do phase conducted the change implementation and data is gathered for analysis and interpretation. In the Study phase, the gathered data is analyzed for trends, performances, and interpreted against standards, regulations, IFUs, EBP, and industry benchmarks. Finally, the Act phase integrates the learned data/information for either the adjustment, removal, or standardization of the changes to best address the goal of the project. As identified in Figure 3, the model is cyclic, thus continuing until an objective, goal or outcome is

achieved.

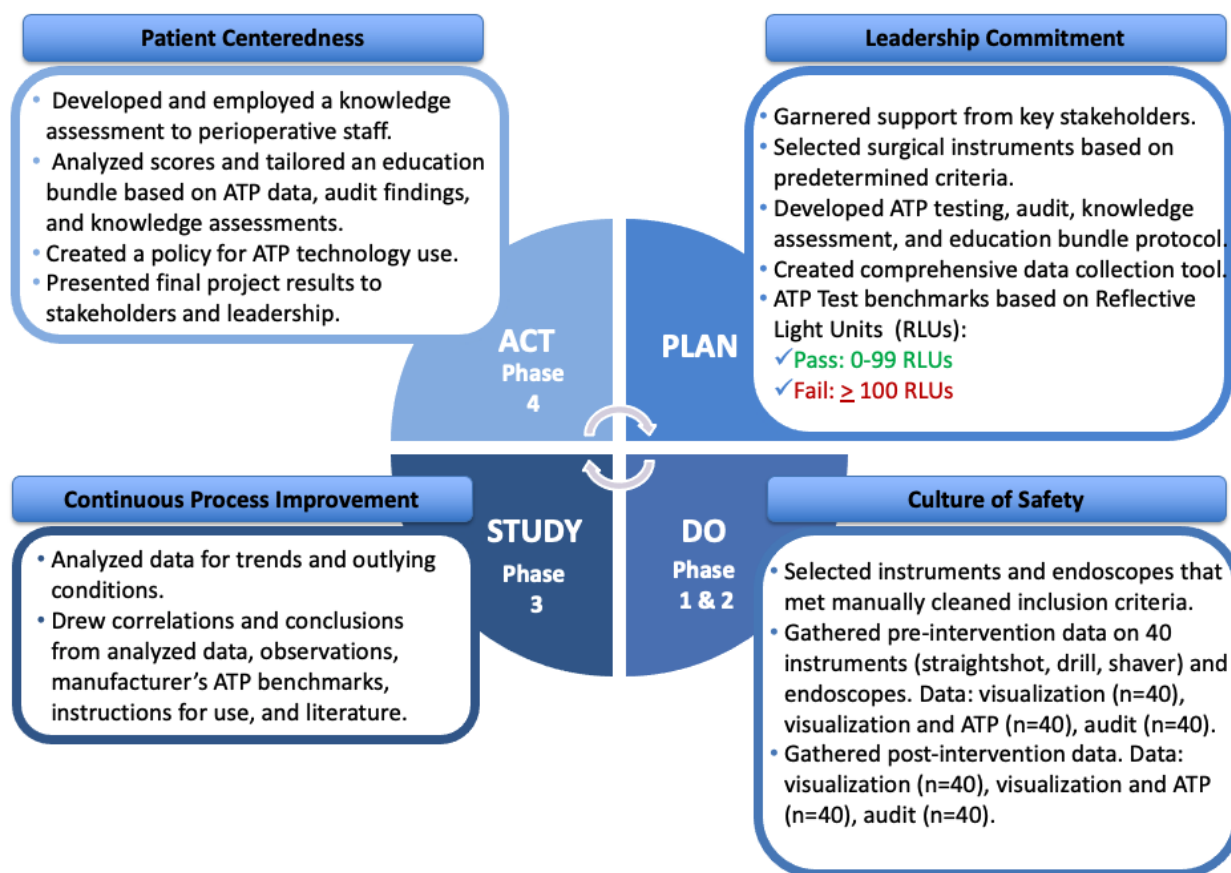


Figure 3. *Project Design. Applied from Melnyk & Fineout-Overholt (2019)*

Methods

This QI project evaluated the procedural use of visual and ATP technology versus visual observation alone for the identification of bioburden of complex surgical instruments and endoscope channels following manual cleaning in SPD at MGMSCS. We collected data on complex surgical instruments and endoscopic channels that are most difficult to clean. The selected instruments and endoscopes were compared between those confirmed to be clean by staff from the verification of cleanliness via ATP testing. Evaluation of staff compliance and cleaning practices were recorded on the specified instruments and endoscope channels, and gaps in competencies/knowledge by staff.

Setting and Population

The setting for the project occurred at MGMCSC. It is an outpatient surgical care center and one of several MTFs within the national capital region (NCR). MGMCSC employs approximately 1,500 active-duty military and civilian employees and provides care and services to over 455,000 beneficiaries (MGMCSC, n.d.). Within MGMCSC, the project was conducted within SPD. The SPD reprocesses a vast array of complex and standard surgical instruments and endoscopes for ten surgical specialties, covering four operating rooms.

Procedural Steps

The procedural steps of this QI process followed the Plan-Do-Study-Act (PDSA) model, in conjunction with the evaluation of quality per the Donabedian three-part model:

1. Plan: Established design for collecting data & baseline data gathering.

1. Acquired IRB approval.
2. Acquired Ruhof manufacturer's IFUs on ATP handheld device and testing equipment.

Reviewed IFUs for necessary knowledge and competency.

3. Identified, engaged, and garnered support from key MGMCSC stakeholders and leadership - briefed members on DNP project (aim, goal, process, timeline), established communication and resource accessibility:

- a. Key MGMCSC stakeholders and leadership: Medical Group Commander, Chief of Medical Staff, Chief Nurse, Senior 4N0 Functional Manager, Chief Administrator, PeriOperative Master Clinician, Surgical Services Flight Commander, Surgical Services Flight Chief, SPD Officer in charge (SPD OIC), SPD Non-Commissioned Officer in charge (SPD NCOIC), Nurse Scientist, Infection Preventionist, and Patient Safety Manager.

- b. Identified and engaged technician and nurse champions.
- 4. Identified, engaged, and garnered mentorship from available statistician; related to data collecting, data programs and tools, tracking, and analyzing. Established 'as needed' communication and guidance accessibility.
- 5. Obtained MGMCSC, Surgical Services Flight's Operating Instructions (OIs) and policies for OR and SPD.
- 6. Instrument identification for ATP testing: Selected surgical instruments and flexible endoscopes based on available data, criteria, and literature.
 - a. Analyzed available SPD surgical instrument and flexible endoscope tracking system data - identified those items with highest rates of bioburden. Up to twelve-month data history reviewed.
 - i. If no current bioburden tracking process was available within SPD:
 - 1. Sought bioburden data from Infection Preventionist, Patient Safety Reports (PSR) per Patient Safety Manager, Surgical Scheduling System (S3) notes, OR debriefs and Daily Reports, specialty clinics.
 - 2. Sought feedback and insight on problematic instruments related to bioburden from specialty clinic staff, OR staff, and SPD staff. In addition to available bioburden data, or, if available data was insufficient to support identification of specific surgical instrument and flexible endoscope with high rate of bioburden, item selection incorporated criteria based on:

- a. Surgical instruments and flexible endoscopes requiring manual cleaning only process, or items bypass automated washer disinfecter, or bypasses automated endoscope reprocessor (AER) (AORN, 2021; IAHCSMM, 2016).
 - b. Surgical instruments unable to be immersed in cleaning solution per manufacturer instruction for use (IFU).
 - c. Surgical instruments and flexible endoscopes with complex, multi-step cleaning process per manufacturer IFU, and per recommendations from AORN (2021) and IAHCSMM (2016).
 - d. Surgical instruments and flexible endoscopes identified with high rates of SSI, or highest potential for SSI per data and recommendations from MGMCS Patient Safety Manager, Infection Preventionist, AORN (2021), and IAHCSMM (2016).
 - e. Instruments and flexible endoscopes with single, multiple and/or varying sized lumens.
7. Obtained manufacturer's instruction for use (IFU) on select surgical instruments and endoscopes.
8. Acquired all necessary Ruhof supplies and equipment for ATP testing and verified testing resources in proper condition and function, and with excess supplies available as backup.

9. Developed ATP testing protocol of the selected instrumentation and flexible endoscope.

Goal is to test the instrumentation and flexible endoscope in a uniform manner.

- a. Instrumentation and flexible endoscope reprocessing evaluation, inspection, and ATP testing totaled 80.
 - i. 20 instruments and 20 flexible endoscopes pre-education & training event.
 - ii. 20 instruments and 20 flexible endoscopes post-education & training event.

10. Developed comprehensive data collection tool for recording - based on Ruhof ATP testing IFU and benchmarks, literature, national guidelines (AORN, 2021; IAHCSMM, 2016; etc.), selected instrumentation and flexible endoscope IFUs, and feedback from statistician.

- a. Included staff demographic data (i.e., years of experience, skill level, perioperative role) associated with the reprocessing of each observed instrumentation and endoscopes. Maintained compliance with HIPAA and prevented staff identification via a coding system.

2. Do: Executed action plan.

- a. Gathered baseline information:
 - i. Evaluated, identified, and mapped current SPD practices for bioburden identification, tracking, and reporting; and current processes and interventions used to prevent bioburden development. Note: Focus was on selected surgical instrumentation and flexible endoscope.
 - ii. Evaluated, identified, and mapped current SPD staffing conditions, physical layout and function, and available resources.

- iii. Audited current cleaning and inspection practices within SPD for the reprocessing of selected instrumentation and flexible endoscope in accordance-with (IAW) selected instrumentation and flexible endoscope IFUs, national guidelines (AAMI, 2017; AORN, 2021; IAHCSMM, 2016), literature, local policies and OIs.
- 4. Recorded information and data onto a collection tool, related to the reprocessing of selected instrumentation and flexible endoscope within SPD.
 - a. At the completion of manual cleaning of the selected instrumentation and flexible endoscope, the item was first visually inspected by staff for cleanliness. If an item was found visually dirty, the information was recorded, and the item returned to the decontamination section for re-cleaning. Note: This process was repeated till a confirmation of “clean” by staff was achieved.
 - b. Once an item had been visually confirmed “clean,” via visual inspection by inspectors, ATP testing was conducted, and test results were annotated into a data collection tool.
 - c. Items that failed Ruhof’s ATP benchmark criteria, based on relative light units (RLU), were recorded onto the data collection tool, and returned to the decontamination section for re-cleaning, then retested, and results recorded. Note: This process was repeated till a passing score was achieved. All visibly contaminated, or ATP failed instruments were returned to the decontamination section.

- d. The utilization of Ruhof's ATP testing equipment and supplies were conducted in-accordance-with (IAW) the manufacturer's guidelines and IFU. Aseptic technique (i.e., use of clean gloves) was maintained during testing.
- e. If ATP testing supply (i.e., swab) becomes compromised (i.e touches another surface other than the intended area of instrument/flexible endoscope, or used incorrectly IAW manufacturer's IFU, that testing supply item is discarded and a new one used.
- f. Recorded in the data collection tool, staff demographics associated with the cleaning and visual inspection of each selected instrumentation and endoscopes.

3. Study: Analyzed data and performances.

- a. Baseline data, observations, and information were reviewed:
 - i. Analyzed data collection tool for trends, patterns, and outlying conditions or variables.
 - ii. Extracted correlations and conclusions from analyzed data, observations, and information based on Ruhof ATP testing IFU and benchmarks, literature, national guidelines (AORN, 2021; IAHCSMM, 2016; etc.), selected instrumentation and flexible endoscope IFUs.

4. Act: Educated and implemented corrective actions.

- a. Intervention: Created and conducted education and training events to OR and SPD staff based on analyzed and supported baseline data and observations. Provided

recommendation changes for the improvement in the reprocessing of selected instrumentation.

- iii. Conducted pre- and post-knowledge assessments on the reprocessing of the selected instrumentation (No PII was gathered).

- 1. Survey responses were analyzed.

- b. Following staff education and training events, conducted ATP testing on selected instrumentation.

- i. This process occurred identically to that used for the collection of baseline data (Section 2.1.d.).

- 3. Analyzed outcome data from post education and training ATP testing of selected instrumentation and flexible endoscope. Extracted correlations and conclusions from analyzed data, observations, and information based on Ruhof ATP testing IFU and benchmarks, literature, national guidelines (AORN, 2021; IAHCSMM, 2016; etc.), selected instrumentation IFUs.

- 4. Developed an OI, policy, and a data utilization tool for the implementation of ATP practice into the SPD of MGMCS.

- 5. Presented project results to stakeholders and leadership:

- a. Baseline data
 - b. Education and training intervention
 - c. Pre and post survey results
 - d. Post-intervention ATP testing results
 - e. Evidence-based recommendations
 - f. Proposed OI and policy

- g. Data utilization tool for ATP practice

Data Analysis

The project authors organized and examined the data utilizing bar and pie graphs to exemplify the individual, and combined numbers and percentages of non-compliance cleaning audits, surgical instruments and endoscopes passed and failed rates, and cleaning knowledge before and after a multimodal education plan implementation.

Dissemination Plan and Sustainment

Disseminating ATP testing results with stakeholders is crucial to increase awareness, promote policy updates, and prevent hospital-acquired surgical site infections. Stakeholders include organizational leadership at this MTF, including the university program director and faculty, MTF medical group commander, nurse scientist, officer and non-commissioned officer in charge of the OR and SPD, perioperative consultants, and Chief for the DHA Surgical Services Clinical Community (S2C2).

The authors conducted a dissemination briefing to include the purpose of the QI project, the problem, short and long-term goals, method of gathering data, results, and recommendations for practice and policy change. The briefing was tailored to fit the stakeholder's vested interest and outcomes. Stakeholders were updated every four weeks at a minimum through email, virtual, or face-to-face meetings. The authors aimed to frequently engage with the perioperative community and receive feedback throughout the project. Project results were also shared with the national perioperative community, enhancing collaborative partnership, learning shared experiences and issues, and planning future goals in standardizing instrument testing practices in the MHS. The authors shared findings to a large community through a poster, slideshow, lectures, and podium presentations to further disseminate outside of the MHS and share

initiatives at the local, state, and national level to the nursing, infection control, and perioperative community.

HIPAA Considerations

The Health Insurance Portability and Accountability Act (HIPAA) protected patients and members involved with personally identifiable information (PII). Institutional Review Board (IRB) review and approval was performed under HHS regulation at 45 CFR 46.117(a). This action did not inhibit the authors from executing the procedural steps, collecting data, and dissemination. Interactions with the population involved the OR and SPD nurses, technicians, and managers. This QI project did not involve activities that gathered PII of human subjects; therefore, obtaining provider or patient consent was not applicable.

Project Results and Analysis

This project was implemented to support High Reliable Organization (HRO) practices to evaluate the use of audits on manual cleaning practices and ATP testing on surgical instruments and colonoscopes, a type of endoscope, to identify residual bioburden, mitigating the risks of SSIs in support of practicing ready and reliable care. The results of this project consisted of three elements: Manual cleaning audits, visual inspections, visual with ATP inspections, and knowledge assessments.

Phase 1: Manual Cleaning Audit Results

Phase 1 of the project involved a pre-intervention and post-intervention assessment conducted at MGMSCSC's SPD. The audits are based on AAMI, AORN, HSPA and industry product recommendations. The data from the manual cleaning audits were collected and converted into scores obtained from two periods across seven months (pre-intervention: 2021, September, and November; post-intervention: 2022: January, February, and March). Illustrated

in Figure 4, the audit scores are broken down into areas where non-compliance practices were observed in the manual cleaning process. When comparing the non-compliance scores pre-intervention and post-intervention, there is a decrease in non-compliance scores in each finding except for “Improper Cleaning Tools.”

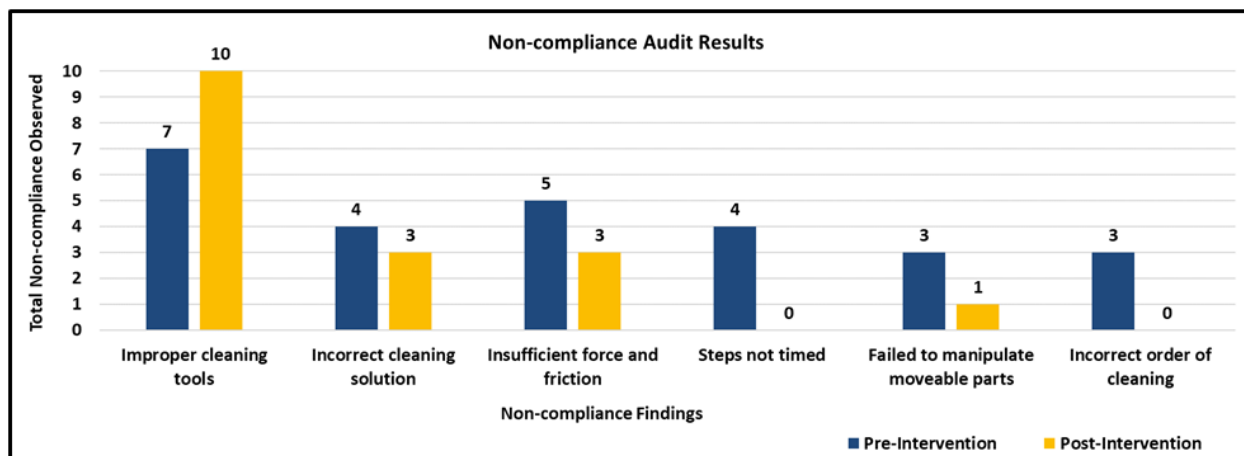


Figure 4. *Non-compliance Audit Results at MGMSC from September 2021 to March 2022*

After the pre-intervention phase of manual cleaning audits, the results were gathered and analyzed, identifying trends. Non-compliance scores were added up for each step of the decontamination process, and non-compliance findings were documented in the ATP data tracker and assigned a number. The assigned number indicated the particular non-compliance step. Audit findings and evidence-based recommendations were reported to perioperative leadership and staff members. Perioperative leadership supported HRO principles by addressing the gaps identified in decontaminating instruments and colonoscopes and following evidence-based practices recommended by the project managers.

Phase 1: Analysis of Manual Cleaning Audit Results

The highest observed non-compliance during both pre- and post-interventions was *incorrect use of cleaning tools*. Pre-intervention manual cleaning observations identified cannula pipe cleaners, a non-nylon material, not recognized for use for both the orthopedic

shaver handpieces and Ears, Nose, and Throat (ENT) straightshot handpiece and discouraged explicitly for use on the orthopedic System 8 drill. Compared to the instrument's lumen diameter, all three surgical instruments were cleaned with substantially smaller diameter-sized brushes by 2 to 4 mm. This discrepancy in brush and instrument lumen sizes contributed to the inability of the brush bristles to adequately contact the lumen surfaces, making bioburden removal highly difficult and inadequate (AORN, 2021). Insufficient force and friction took on a secondary effect to the incorrectly sized cleaning brushes for each of the three surgical instruments. Pre-intervention data showed that force and friction were not uniformly applied throughout the entire surface of the lumens, resulting in inconsistent bioburden removal (Alfa et al., 2017). Colonoscopes were the only items identified pre- and post-intervention as correctly having and using adequately sized brushes for bioburden removal per the manufacturer's IFU and best practices (Alfa et al., 2017). Brush size specifications for the colonoscopes, orthopedic System 8 drills and orthopedic shaver handpieces were outlined in their respective manufacturers' IFUs, with the orthopedic shaver handpiece being the only instrument having specified instructions on *frequency, method, and duration of brushing*. However, the ENT straightshot handpiece was the only item without details for specified brush size, frequency, and brushing duration.

The orthopedic shaver handpiece and the Medivators Scope Buddy Flushing Rinse Aid that used to clean colonoscopes, were the only items with written instructions specifying *timed cleaning steps*. All colonoscopes received the recommended cleaning time per Medivators Scope Buddy manufacturer's IFU pre- and post-intervention. The orthopedic shaver handpiece manufacturer's IFU contained 7 timed cleaning action steps. During pre-intervention audits, discrepancies between timed soaking, brushings, and rinsing of the orthopedic shaver handpiece were observed. It is essential for enzymatic cleaning solutions, in addition to concentration, to

be given the necessary timeframe to chemically break down fat, blood, protein, starches and carbohydrates (AORN, 2021; da Costa Luciano et al., 2016; IAHCSMM, 2016; Ruhof, 2006). Adequate physical debridement of bioburden through brushing is not a single one-time action. While no national timeframe for brushing has been established, consistent and repeated motions of non-abrasive brush bristles have been shown to be a highly effective and necessary action in removal of bioburden (AORN, 2021; da Costa Luciano et al., 2016; IAHCSMM, 2016). Adequate rinsing, especially when time specified, removes enzymatic and chemical residue and dislodged bioburden from surfaces (AAMI, 2017; AORN, 2021). Failure to achieve the recommended cleaning process timeframes, as outlined by the manufacturer's IFU, and considering the instrument's complex design contributed to inadequate removal of bioburden as detected during visualization and ATP testing (AORN, 2021; Bronzatti et al., 2020; da Costa Luciano et al., 2016; IAHCSMM, 2016).

Auditing observed *incorrect order of cleaning* on each of the surgical instruments. Procedural steps outlined by the manufacturer's IFUs per instrument depended on the type of device. Colonoscopes totaled the most with 28 steps (including the use of a flushing aid), followed by the orthopedic shaver handpiece with ten steps (not including three cleaning verification steps), the orthopedic System 8 drill with nine steps, and lastly, the ENT straightshot with eight steps. The number of procedural steps did not directly correlate to the number of audit discrepancies. Audit results for colonoscopes showed zero procedural steps performed incorrectly during pre- and post-intervention observations, while conversely, the orthopedic shaver handpiece, with ten procedural steps, totaled the most incorrectly performed steps pre-intervention. The consequences of incorrectly performing cleaning according to the manufacturer's IFU resulted in improperly performing decontamination processes needed to

effectively clean and remove bioburden (AORN, 2021). Visual aids were posted in the view from the colonoscope decontamination section and were referenced during manual cleaning by staff both pre- and post-intervention, significantly contributing to the full completion of cleaning steps (Jolly, Hildebrand & Branaghan, 2013). Comparatively, no visual aid was posted for any of the three surgical instruments during pre-intervention audits, possibly contributing to the discrepancies.

As previously noted, completion of all cleaning steps is critical for the removal of bioburden, especially with manual clean only instruments that are unable to receive the added benefits of being cleaned and processed through an automatic washer and disinfectant (AORN, 2021, p. 396; Evangelista et al., 2020). *Failure to manipulate movable parts* during manual cleaning according to their respective manufacturer's IFU prevents the dislodgement of gross contaminants and bioburden while further limiting cleaning solution and brush access to lumen surfaces during decontamination. While all four items required manipulation of one or more movable parts during cleaning, pre-intervention audits identified the orthopedic System 8 drill and ENT straightshot as the two surgical instruments contributing to the failure to manipulate movable parts during cleaning per the manufacturer's IFUs. Post-intervention audit data revealed an improvement in the orthopedic System 8 drill, however, the ENT straightshot was observed as the only item failing. Nonetheless, colonoscopes were the only item, pre- and post-intervention, with zero observed discrepancies in manipulating movable parts in accordance with the manufacturer's IFUs. Failure to manipulate for the dislodgement of bioburden appears to have further contributed to the ENT straightshot having overall high visualization and ATP test failures.

Auditing the correct usage of the *cleaning solution* resulted in observing non-compliance both pre- and post-intervention. Cleaning solution to water ratio measurements and water temperature were within parameters according to the manufacturer's IFU during pre- and post-intervention. The pre-intervention results reflected utilizing the same cleaning solution to clean manual clean only instruments following the cleaning of multiple contaminated instruments. The enzymatic cleaning solution used to clean devices was not antimicrobial and was designed only to remove fat, blood, protein, starches, and carbohydrates (da Costa Luciano et al., 2016; Ruhof, 2006). The saturation of deposited bioburden into the cleaning solution during repeated instrument cleanings could have led to cross-contamination, whereas adherence to the manufacturer's IFUs only may have had little impact to prevent retention of bioburden (AORN, 2021; da Costa Luciano et al., 2016; Ruhof, 2006). In contrast, each manual cleaning of the colonoscopes introduced a new cleaning solution for each new contaminated colonoscope, as well as along each step within the cleaning procedures outlined within the manufacturer's IFU, significantly contributing to the prevention of cross-contamination of bioburden between scopes and the optimal cleaning effectiveness of the enzymatic cleaning solution.

Phase 2: Visual Inspection and Visual Inspection with ATP Test Results

After manual cleaning, 40 surgical instruments were inspected through unaided visualization for retained bioburden. In the pre-implementation phase, a total of 38 out of 40 (95%) passed visual inspection, and two (5%) failed visual inspection. Of the surgical instruments, one was the orthopedic shaver handpiece and the orthopedic System 8 drill. When adding ATP technology as the quality assessment practice, the same two instruments that failed visual inspection also failed ATP testing. Illustrated in Figure 5, five (12%) additional instruments failed ATP testing although they have passed visual inspection. Among the four

types of surgical instruments tested, the System 8 drill had the most visual inspection and ATP testing failures. ATP-based technology effectively-identified contaminated instruments that were not identified from unaided visualization.

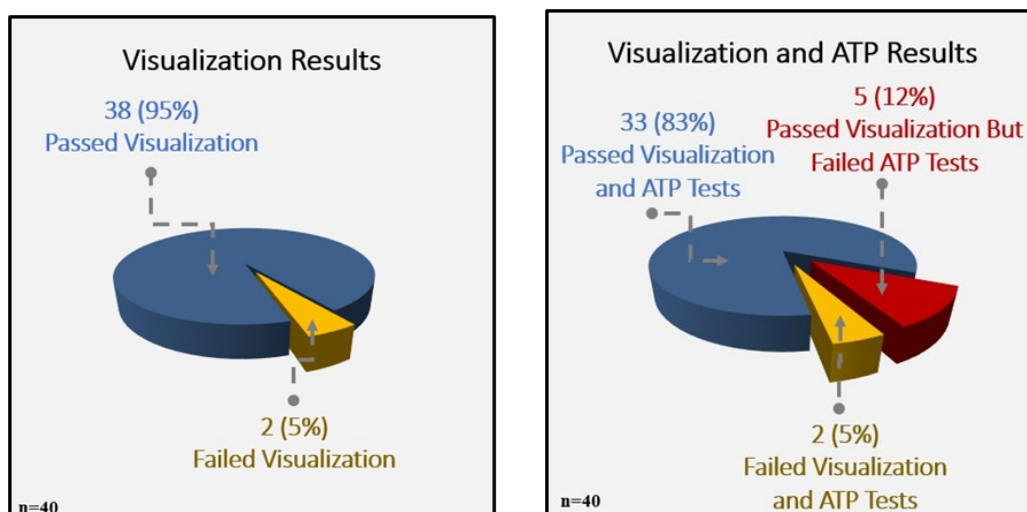


Figure 5. *Pre-Intervention Visualization and ATP with Visualization Results at MGMSC from September 2021 to March 2022*

Evidence-based recommendations and a tailored education bundle were implemented at MGMSC for improved practice. Post-intervention, 37 out of 40 (93%) instruments passed visual inspection, while three (7%) failed visual inspection. The three instruments that failed visual inspection were all ENT straightshots. After performing ATP testing on 40 surgical instruments and endoscopes, the authors found 30 (79%) instruments that passed visualization and ATP testing, three (6%) instruments failed visualization and ATP testing, and seven (15%) passed visualization but failed ATP testing. Among the instruments that failed both visual inspection and ATP testing, the ENT straightshot had the highest failures among the three instruments. Again, ATP based-technology discovered more contaminated instruments than visualization alone.

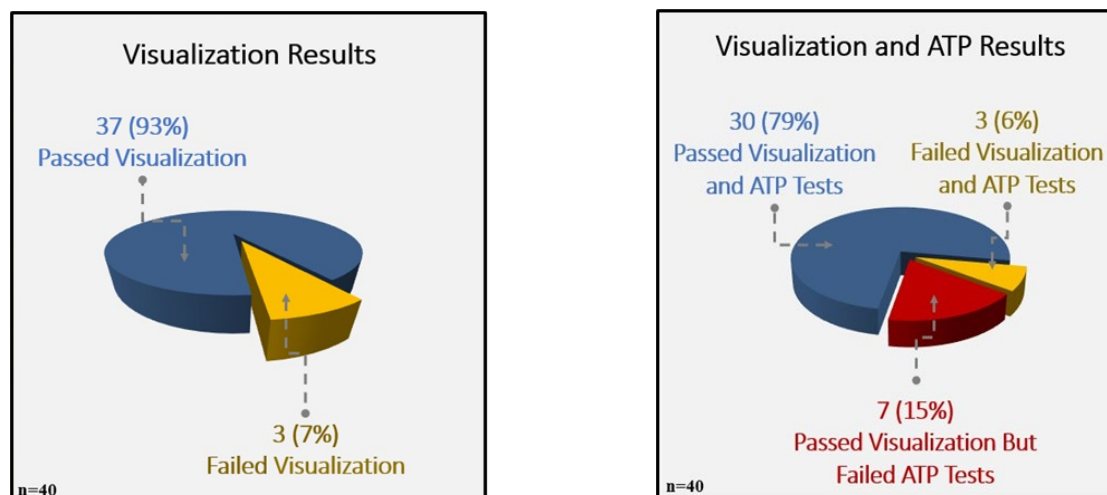


Figure 6. Post-Intervention Visualization and ATP with Visualization Results at MGMSCS from September 2021 to March 2022.

In both pre-intervention and post-intervention results, ATP testing confirmed that instruments that failed visual inspection also failed ATP testing. When combining all instruments tested in this project, 17 (21%) out of 80 instruments were contaminated, failing visual inspection and ATP testing.

Phase 2: Analysis of Visual Inspection and Visual Inspection with ATP Test Results

Both pre- and post-intervention results revealed a high percentage of devices passing via visualization alone, current practice at MGMSCS, for the detection of bioburden. This indicated that most devices were perceived to be bioburden free and safe for sterilization and eventual use on vulnerable patients. The introduction of ATP testing with visualization significantly affected such assumptions. Microbial bioburden, i.e., *Staphylococcus epidermidis*, a well-known opportunistic pathogen, causing infections in elderly, multimorbid, immunocompromised individuals, etc. is undetectable to the naked eye, and thus unknowingly can pass visual inspection alone without adequate adjunct technology such as ATP testing (Evangelista et al., 2020; Lopes et al., 2019). Pre-intervention ATP testing data validated current cleaning practices,

as indicated by pre-intervention audits, were insufficient at removing bioburden (Fitts et al., 2020). Additionally, ATP testing with visualization showed that 5 of the 40 instruments could have reached surgical patients unknowingly, possibly resulting in adverse patient outcomes and \$100,000 in readmission treatment costs due to reliance on current practices of visualization alone to detect bioburden (NHSN, 2021). Post-intervention data also confirmed the valued benefit of utilizing ATP testing similarly to pre-intervention to detect contaminated devices following manual cleaning and visualization alone of devices, thus preventing adverse surgical outcomes and contributing to SSIs. However, as the data indicated, there was an increase in bioburden detection via ATP testing with visualization during post-intervention data collection compared to pre-intervention. This uptick in ATP and visualization appears to correlate with the increase in improper cleaning tools, where inefficient use of proper cleaning tools, i.e., brushes, was inadequate at removing bioburden.

Furthermore, current practice at MGMSCSC utilizes protein testing following manual cleaning of each colonoscope prior to high-level disinfection (HLD). Protein testing is another bioburden detection method and a quality assurance practice backed by evidence (AAMI ST91, 2015; AORN, 2021). ATP and visualization of the 40 colonoscope *suction/biopsy* lumens were performed prior to protein testing by staff members following manual cleaning. This order of test verification was done to prevent possible removal of bioburden by protein test swabs, thus, potentially indicating inadequately cleaned colonoscopes. All 40 test results for ATP with visualization revealed no failures and were immediately confirmed by protein testing. The zero ATP with visualization and protein failures reinforced cleaning performances and practices observed during auditing. Contributing factors for the zero ATP with visualization failures were multiple and compounding. Visual aids on cleaning practices were posted for staff during manual

cleaning, adherence to manufacturer's IFUs and best practices, correctly sized brushes were utilized, and the robust education and training program – consisting of colonoscope manufacture competency training checklists and an internal hands-on training certification process.

Phase 3: Knowledge Assessments

Assessments played a role in understanding the test participants' knowledge before and after the implementation of evidence-based recommendations and learning and teaching activities. A total of 21 knowledge assessments were distributed to the perioperative staff. Of the 21 respondents that participated, ten were OR nurses, and 11 were OR surgical technicians. The knowledge assessments were completed prior to the implementation of recommendations and the education bundle by the authors. The perioperative staff (n=21) scored 42% on the knowledge assessment. More than half of the respondents (60%) could correctly respond to the purpose of ATP technology and how to perform ATP testing. Whereas knowledge assessment scores on the orthopedic shaver handpiece (14%), orthopedic System 8 drill (15%), and on ENT straightshot (38%) could correctly answer questions about manual cleaning practices on three surgical instruments (Figure 7). There was poor knowledge of ATP technology and instrument cleaning among the perioperative staff practicing in the OR and SPD. Hence, a tailored education bundle was strongly advocated and implemented in the following weeks.

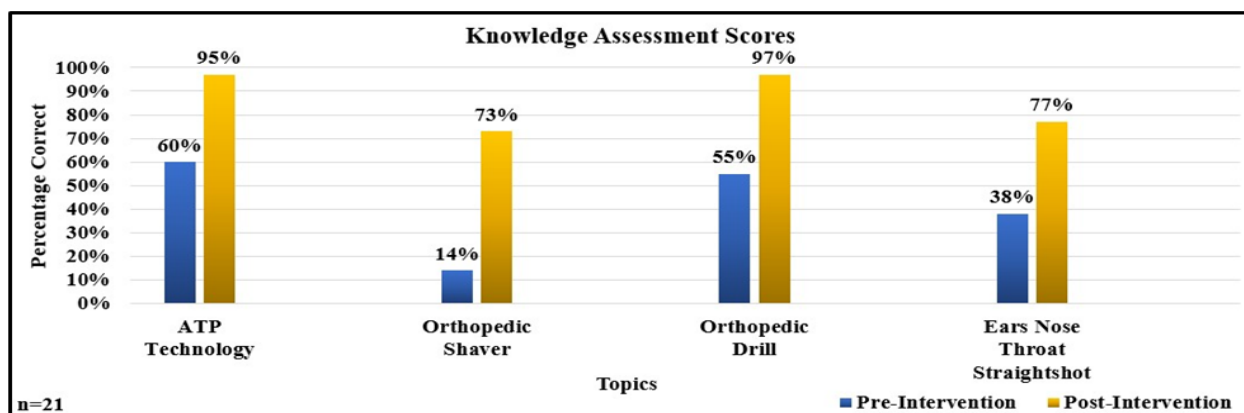


Figure 7. *Knowledge Assessment Score Results at MGMSC from September 2021 to March 2022*

After four weeks of recommending evidence-based recommendations and implementing an education bundle, a post-intervention knowledge assessment was distributed to the perioperative staff (n=21). Eight were OR nurses of the 21 respondents that participated, and 13 were OR surgical technicians. The perioperative staff scored nearly perfect on knowledge of ATP technology (95%) and the orthopedic drill (97%). About three-quarters of the respondents could correctly describe manual cleaning practices on the orthopedic shaver handpiece (73%) and the ENT straightshot (77%).

Phase 3: Analysis of Knowledge Assessment

The utilization of in-person training, decision support tools, and types of social media as part of a multifaceted educational intervention has been shown to improve adherence to evidence-based practices (Marino et al., 2018). To improve upon the existing pre-intervention audit gaps, the initial knowledge assessment, and the contamination of manually cleaned surgical instruments, as determined by ATP testing with visualization, the authors developed a tailored, evidence-based multimodal education bundle. The educational bundle consisted of three visual cues (fliers), four hands-on simulations stations, six project champion and author-led staff briefings, and six electronic notifications (emails) over three months.

Based on the results of the overall improvement of the manual cleaning audit results and knowledge by staff on cleaning practices and ATP testing, it is apparent that the focused multimodal education bundle had an overall positive clinical impact. Having the necessary knowledge and understanding of practice and performance gaps is essential to be equipped to make the necessary changes and improvements. Incorporating knowledge into effective training can directly impact change in results and outcomes (Chaghari et al., 2016). However, the correlation of improved cleaning practices and the increase in cleaning knowledge compared to the higher increase in bioburden via ATP testing with visualization is not direct. Based on the overall analysis of the results, it should be considered that without necessary cleaning tools – i.e., correctly sized brushes in accordance with manufacturer's recommendations, educational interventions and improved cleaning practices can only make marginal improvements to reduce bioburden contamination on manually cleaned devices.

Organizational Impact

The organizational impact of this project represents MGMSCSC's commitment to being a HRO, meeting Ready Reliable Care principles and the Quadruple Aim. The overall impact of this project involved 11 practice improvement initiatives collectively impacting medical personnel, the local military treatment facility, and DHA.

High Reliability Principles	Levels of Impact
	Medical Personnel
Continuous Process Improvement	● Provided timing devices to verify the duration of soaking, brushing, and rinsing instruments required by manufacturer guidelines. ● Ordered surgical instrument cleaning tools such as brushes required by manufacturer guidelines.

	● Standardized instrument processing binder containing manufacturer's instructions for use created as a resource for SPD staff.
Leadership Commitment	● HLD and Sterility Reprocessing Workshop offered and attended by perioperative staff for annual competency training. ● Leadership provided project champions with autonomy to communicate with front-line staff. Project champions provided daily status on bioburden numbers and instrument cleaning processes which led to increased staff engagement at evening staff meetings.
Culture of Safety	● Achieved readiness competency for 91% of the perioperative staff through the education bundle. ● Connected with two surgical instrument manufacturers to provide resources to perioperative staff. Retrieved large manual prints on instrument cleaning. Posters displayed in the decontamination unit to aid surgical technicians in cleaning compliance.
Malcolm Grow Medical Clinics and Surgery Center	
Leadership Commitment	● Gained perioperative leadership buy-in and engagement of all efforts to improve manual cleaning instruments at point-of-use and decontamination units. ● Collaborated with perioperative leadership to select project champions. Project champions selected provided the perioperative staff resources and expertise for ATP technology and manual cleaning practice improvement. ● TJC acknowledged leadership commitment to safety in validating the cleaning processes through accreditation in 2021. ● Perioperative unit adopted the SPD metric collection tool for monitoring and outperforming benchmarks. ● Role-modeled systems change to units within the organization by adopting evidence-based solutions to improve surgical outcomes leading to two awards for the perioperative department.
Culture of Safety	● Policy on instrument processing updated and aligns with AORN and AAMI ST 79 standards. ● Audits incorporated as standard practice to evaluate standards compliance. ● Approved ATP policy and purchased ATP technology in support of high reliable care.
Patient Centeredness	● No near-miss or harm reports have been reported in the Joint Patient Safety Report (JPSR) since project initiation.

Defense Health Agency

- Underlying framework for change supported the focus elements of the DHA's Quadruple Aim:
 - ✓ Better Care: Adopted technology such as ATP technology providing users with reliable, rapid, and objective data mitigating SSIs, leading to improved outcomes.
 - ✓ Better Health: Provided highly reliable medical care through a culture of embracing solutions by following national guidelines and evidence-based practice.
 - ✓ Increase Readiness: Education and training focused on knowledge gaps built a ready medical force.
 - ✓ Lower Costs: Performing ATP tests costs less than the cost of readmission and treatment of SSIs.

Future Directions for Research and Practice

Clinical nurse specialists can help improve patient outcomes through their leadership and participation in a QI and safety initiative supporting the organization's mission. Health clinicians have a fiscal responsibility to 1) the patient and 2) the organization by using the most cost-efficient combination of resources to maximize surgical outcomes and utilizing evidence-based practice to engage in quality of practice.

In response to supporting the MHS's commitment to high reliability, the authors developed and delivered an infection prevention plan focused on improving the system of care. ATP technology and recurring audits addressed deficiencies and recommended improved quality and safety solutions. Translating the information and disseminating the outcomes enhanced the awareness and spread of information to military healthcare leaders. After each phase of the project, leadership was informed of instrument contamination rates and compliance rates to help the perioperative leadership make informed decisions on equipment standardization, practices, and policies. This field of communication was critical in improving personal practice and the health of our beneficiaries.

Key performance indicators related to DHA's Line of Effort have been achieved through leadership support of this QI initiative to increase transparency and monitor progress. MGMSC has achieved exceptional care, as demonstrated by its complete accreditation award by TJC. Leadership support in efforts to validate the cleaning process contributed to a culture of safety. In addition, the near miss to harm ratio has decreased. No reports in JPSRs related to bioburden and contaminated instruments have been reported from project initiation to project conclusion. Improvements in these KPIs reflect the organization's alignment with the Quadruple Aim. Monitoring performance metrics enabled enterprise transparency and accountability and supported the calibration of goals by providing insight into whether an organization is doing well or could be improved.

To promote a joint system of validating instrument cleanliness, creating and integrating a standardized program and policy can be promoted to enhance performance across the services. Process standardization on ATP technology and audits as part of practice governs how healthcare leaders can provide safety measures and structures current with best practices and national guidelines.

A standardized policy and program are not meant to be rigid, but it is meant to leave room for continuous process improvement as new information is discovered. Continued surveillance on performance metrics related to contaminated instruments and JPSRs must be done to enable sustainability within the enterprise. A robust continuous process improvement plan integrated with sustainability metrics allows organizations to prioritize actions, monitor and assess practice, and make changes to improve practice and the quality of care. High cost-avoidance of unintended infections and minimal investment to implement ATP technology and an audit

program serves as an example for standardizing manual cleaning verification across the enterprise.

Potential Barriers

A potential barrier to performing this QI project was the setting. MGMCSC is a military ASC that strictly performs outpatient procedures. Due to ASCs performing few surgical procedures, a limited number of instruments were processed within the facility (Tanaka, 2019). The selected site may not apply to hospitals where numerous surgeries are performed, and various instruments affected by retained bioburden differ from what is presented in this QI project. A second potential barrier was not accounting for point-of-use (POU) cleaning verification. POU cleaning begins in the operating room and is the first part in the instrument cleaning process (AORN, 2021). POU cleaning is vital toward removing bioburden and preventing biofilm formation (AAMI, 2017; AORN, 2021). Another potential barrier was supply constraints. A select number of ATP testing supplies were available for this QI project, limiting both the size of the sample and diversity of testable items. MGMCSC's SPD had limited access to critical items outlined in the manufacturer's IFU's for each of the three surgical instruments, possibly leading to incomplete or inadequate cleaning capabilities and performance, impacting both audit and bioburden detection results.

Conclusion

The outcomes of HRO principles assisted this MTF in reaching its goal of zero preventable harm. As the only ambulatory surgical center in the National Capital Region, MGMCSC has successfully achieved Ready Reliable Care through piloting ATP Technology in conjunction with the audit tool. ATP technology provided objective data on instrument cleanliness and identified gaps in the manual cleaning process. Leadership's commitment to

implementing ATP technology audits and knowledge assessments has resulted in attaining accreditation by The Joint Commission 2021. Enhancing a safety culture was achieved by maintaining readiness competency of 91% of the staff and acquiring ATP technology as part of quality assessment. The education bundle reinforced manual cleaning practices leading to zero joint patient safety reports, ultimately delivering patient-centered care. Lastly, MGMCSC implemented 11 evidence-based QI initiatives, achieving improved processes and practice. MGMCSC serves as a robust role model to MTFs due to their efforts of supporting innovative solutions and standardization in practice.

The direct impact of this QI project immediately improved SPD's manual cleaning practices by 35%, adherence to manufacturer's IFUs and best practices, identified 17 contaminated instruments and obscured \$340,000 in SSI readmission costs through the combined use of audits and ATP testing with visualization for the detection of bioburden. These results led to the adoption and future integration of ATP testing as a quality assurance approach for monitoring safe cleaning practices and SSI mitigation at MGMCSC's SPD. This move toward sustainment in quality of practice further confirms MGMCSC's commitment to meeting Ready Reliable Care principles and DHA's Quadruple Aim.

Overall, the authors have shown that manual cleaning according to the manufacturer's guidelines can assist in the removal of bioburden. However, some microorganisms are challenging to eliminate and difficult to visualize with the naked eye. ATP technology is a highly effective quality assessment tool. This QI project showed that a program promoting effective cleaning may not always yield the best results. The strong clinical leadership of a doctoral-prepared CNS can provide strong evidence-based recommendations and ensure national quality and patient safety standards are met. Collaboration among perioperative CNSs and department

and MTF leadership and stakeholders can bring about positive change and improvements in the quality of care. Cost of adoption and integration of auditing with ATP testing (\$2,000) as a method of bolstering quality assurance far outweighs the impact costs of SSI readmission (\$20,000) and poor patient outcomes.

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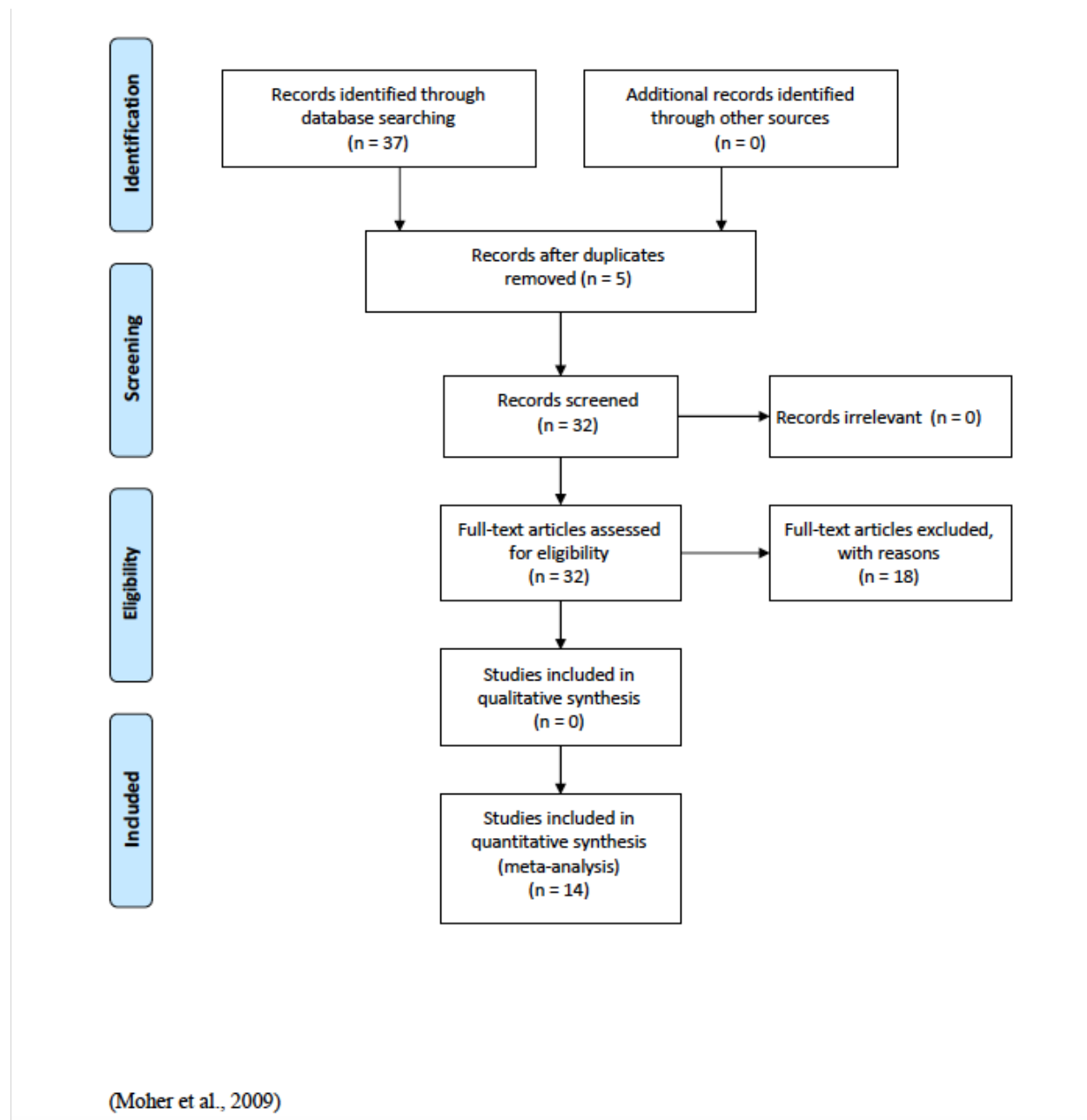
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APPENDICES

Appendix A: PRISMA Flow Diagram



nshot

Appendix C: Timeline

Project Timeline 2021 - 2022

Tasks:	JAN 2021	FEB	MAR	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN 2022	FEB	MAR	APR
Proposal topic approved/finalized				x	x									
USUHS VPR Submission and Approval				x	x									
CITI Training Completed	x													
Site IRB Submission and Approval				x	x									
Recruit interprofessional team	x													
Develop and refine EBP question	x													
Identify stakeholders	x	x												
Establish shared project stakeholders	x	x												
Establish project champions at local site					x									
Schedule team meetings	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Literature review	x	x	x	x	x	x	x	x	x	x	x			
Appraise the evidence	x	x	x	x	x	x	x	x	x	x	x			
Summarize the evidence	x	x	x	x	x	x	x	x	x	x	x			
Synthesize quality of evidence	x	x	x	x	x	x	x	x	x	x	x			
Develop recommendations	x	x	x	x	x	x	x	x	x	x	x			
Create action plan			x											
Determine action plan feasibility			x											
Gain organizational leadership approval and buy-in			x											
Secure resources and support			x	x	x									
Discuss data collection and analyzation with Statistician				x							x			
Pre-implementation baseline data gathering						x								
Audit PSRs, S3/debriefs, OR Daily Report Sheet/Excel						x								
Select instrumentation/endoscope for evaluation & testing						x								
Audit cleaning and decontamination in SPD						x	x							
Gather data on ATP testing and visual testing						x	x							
Implement action plan								x	x					
Conduct education & training to staff									x					
Audit cleaning & decontaminating process in SPD									x					
Gather data on ATP testing and visual testing									x					

[illegible]

Appendix D: Data Collection Form & Intervention Forms

[illegible]

Audit Codes	
*A	Staff did not use proper cleaning tool
B	Staff did not follow correct order of cleaning
C	Staff did not use recommended cleaning solution to clean
D	Staff did not use enough force and friction to clean
E	Staff did not utilized recommended visual inspection apparatus
F	Staff did not track time steps in the cleaning process
G	Staff did not move parts to clean and rinse hidden surfaces
H	Staff skipped a step in the cleaning process
I	> 1hr from end of surgery to decon for cleaning
*Sub-category for Code A	
a.	No flushing with syringe
b.	Wrong size brush
c.	Metal vs. plastic bristled brush
d.	Over used cleaning tool

Program Evaluation: Manual Cleaning Surgical Instruments

Adenosine Triphosphate (ATP) Testing		
	ATP Testing is best utilized for testing and measuring the amount of _____, on the surfaces of surgical instruments/lumens and endoscopes/lumens.	(a) Microbial contamination (i.e., bacteria) (b) Viral contamination (c) Microbial and viral contamination (d) Pixie dust
	Testing can be done <i>anytime</i> after cleaning, prior to high-level disinfection or sterilization?	True/False
Smith & Nephew Dyonics Handpiece (Ortho Shaver Handpiece)		
	With the connector protective cap on the distal end of the electrical cord, the handpiece should soak in ph neutral detergent for a minimum of how many minutes at the start of manual cleaning?	(a) 2min (b) 4min (c) 5min (d) None, the handpiece should never be submerged
	When manually cleaning, use brushes for _____ seconds, followed by rinsing for _____ seconds	(a) 120 sec. & 30 sec. (b) 60 sec. & 60 sec. (c) 90 sec. & 90 sec. (d) 30 sec. & 30 sec.
Stryker System 8 Drill		
	Rinse the instrument with _____ running water.	(a) tap (b) cold (c) warm
	When manually cleaning the drill's lumen, it is acceptable to use pipe cleaners or cotton swabs in lieu of a nylon brush?	True/False
Medtronic Straightshot		
	Soak the handpiece for 1 minute prior to brushing outer surfaces	True/False
	While running the instrument through running water, you should	(a) Rotate the wheel several times (b) Actuate the colette (c) Run the stream of water through the suction barb only (d) Both A and B (e) All of the above

Program Evaluation: Manual Cleaning Surgical Instruments

Adenosine Triphosphate (ATP) Testing		
	ATP Testing is best utilized for testing and measuring the amount of _____, on the surfaces of surgical instruments/lumens and endoscopes/lumens.	(a) Microbial contamination (i.e., bacteria) (b) Viral contamination (c) Microbial and viral contamination (d) Pixie dust
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Smith & Nephew Dyonics Handpiece (Ortho Shaver Handpiece)		
	With the connector protective cap on the distal end of the electrical cord, the handpiece should soak in ph neutral detergent for a minimum of how many minutes at the start of manual cleaning?	(a) 2min (b) 4min (c) 5min (d) None, the handpiece should never be submerged
	When manually cleaning, use brushes for _____seconds, followed by rinsing for _____seconds	(a) 120 sec. & 30 sec. (b) 60 sec. & 60 sec. (c) 90 sec. & 90 sec. (d) 30 sec. & 30 sec.
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	Soak the handpiece for 1 minute prior to brushing outer surfaces	True/False
	While running the instrument through running water, you should	(a) Rotate the wheel several times (b) Actuate the colette (c) Run the stream of water through the suction barb only (d) Both A and B (e) All of the above

Program Evaluation: Manual Cleaning Surgical Instruments

What is your learning style? (select all that apply)

- (a) Visual
- (b) Auditory
- (c) Kinesthetic

What educational method was the most beneficial to your learning?

- (a) Electronic notifications
- (b) In-person briefings
- (c) ATP and Instrument posters
- (d) In-person simulated skills fair

Why? _____

What educational method was the least beneficial to your learning?

- (a) Electronic notifications
- (b) In-person briefings
- (c) ATP and Instrument posters
- (d) In-person simulated skills fair

Why? _____

NAME: _____

DATE: 12/9/21

Station 1: Smith & Nephew Dyonics Handpiece (Ortho Shaver Handpiece)	Instructor's Initials:
Station 2: Stryker System 8 Drill	Instructor's Initials:
Station 3: Medtronic Straightshot	Instructor's Initials:
Station 4: Adenosine Triphosphate (ATP) Testing	Instructor's Initials:

NAME: _____

DATE: 12/9/21

Station 1: Smith & Nephew Dyonics Handpiece (Ortho Shaver Handpiece)	Instructor's Initials:
Station 2: Stryker System 8 Drill	Instructor's Initials:
Station 3: Medtronic Straightshot	Instructor's Initials:
Station 4: Adenosine Triphosphate (ATP) Testing	Instructor's Initials:



CLEANLINESS EXCELLENCE IS OUR HABIT

- Medical instrument cleanliness is **essential for patient safety**
- The potential for human residue (ATP) exists **even after** the cleaning process
- ATP Tests may **detect this residue**
- Testing has the potential to help **improve cleaning practices** and **protect our patients** from surgical site infections



DELIVER TRUSTED CARE WITH THE ATP SYSTEM

SPD Clinical Pearls

Instrument Cleaning 1-2-3

Factors that Affect Cleaning Efficacy -Stryker System 8 Drill-

1

Fluidics

- Fluidics is pressured running water
- Fluidics is a dependable cleaning method
- Use warm running water to clean the Stryker drill
- Warm water is warm to touch (no more than 140°F)

2

Equipment

- Manual cleaning is used for complex, delicate and difficult to clean instruments
- Do not use pipe cleaners and cotton swabs to clean the lumens of the Stryker drill

3

Friction

- Use friction and the correct sized soft bristled brush to scrub soiled areas
- The Stryker drill and cordless attachments require over 7 brush sizes to manually clean instruments
- Refer to Appendix A in the IFUs for brush size guidance

SPD Clinical Pearls

Instrument Cleaning 1-2-3 Factors that Affect Cleaning Efficacy -Dyonics Shaver-

1

Location

- Soil and debris are most difficult to clean in crevices, joints, lumens
- Clean the Dyonics shaver lumen from one end using a twisting in/out movement for 30 seconds. Then repeat cleaning process from the opposite end of the shaver

2

Organic Matter

- Dried organic matter acts as a physical barrier to cleaning and can cause instrument malfunction
- Remove soil immediately at point-of-use

3

Length of Exposure

- Instruments must be exposed to the disinfectant for the time listed in the instrument IFUs
- Soak the Dyonics Shaver for a minimum of 5 minutes in pH neutral enzymatic detergent

SPD Clinical Pearls

Instrument Cleaning 1-2-3 Factors that Affect Cleaning Efficacy -Medtronic Straightshot-

1

Cleaning

- Soil left on the instrument after sterilization are dry, baked, and difficult to remove.
- Clean the entire straightshot lumen, move the collet piece, and turn the thumbwheel when rinsing the handpiece

2

Equipment

- Never immerse any handpiece in any solution
- Doing so may cause corrosion and equipment damage
- The straightshot manual cleaning process does not involve any soaking

3

Friction

- Use a soft bristled brush and friction to scrub soiled areas
- Use a soft bristle brush with enzymatic cleaner, gently and thoroughly clean the entire lumen

Trivia!!

Did you know that brush rinsing and the method in which a brush is used when manually cleaning instruments matters?!

According to Bronzatti et al. (2020) "...cleaning effectiveness may be directly related to the rinsing of brush bristles between brushings."

Table 1. Effect of Brushing Motion and Rinsing Methods on Amount of Organic Material Remaining in Lumens as Measured by ATP Bioluminescence and Visual Inspection

Group	Manual Cleaning Method	Mean ATP Amount (RLU)	SD	Reduction in ATP Compared With Positive Control (%)	Visible Soil After Cleaning
1	• High-pressure water only	5,370	2,284	39.1	Yes
2	• Back-and-forth motions • No brush rinsing	7,908	566	10.3	Yes
3	• Back-and-forth motions • With brush rinsing	1,879	1,407	78.7	Yes
4	• Helical spinning motion • No brush rinsing	7,582	759	14.0	Yes
5	• Helical spinning motion • With brush rinsing	93	53	98.9	No

ATP = adenosine triphosphate; RLU = relative light units; SD = standard deviation.

Bronzatti et al., 2020)

Question & Answer! - Smith & Nephew Dyonics Handpiece (Ortho Shaver Handpiece)

1. With the connector protective cap on the distal end of the electrical cord, the handpiece should soak in pH-neutral detergent for a minimum of how many minutes at the start of manual cleaning? **Answer:** 5min
2. When manually cleaning, use brushes for _____seconds, followed by rinsing for _____seconds? **Answer:** 30 sec. & 30 sec.

Reference:

Bronzatti, J., Laranjeira, P. R., Bruna, C., & Graziano, K. U. (2020). The Effect of Brush Motion and Rinsing When Manually Cleaning Cannulated Medical Devices. *AORN journal*, 111(5), 508–514. <https://doi.org/10.1002/aorn.13014>

Trivia!! -----

Did you know bacteria can be found in cannulated orthopedic instruments after autoclaving from retained bone debris?

According to Smith et al., 2018, retained organic material is thought to protect bacteria from sterilization by acting as a physical barrier – the development and fixation of biofilm are x1000 more resistant than bacteria in suspension. Of 15 instruments cleaned and sterilized, 11% showed bacterial growth after 180min (Smith et al., 2018).

Is automated washer-disinfector the answer to kill bacteria? Not necessarily....A recent study showed the unacceptable cleaning of surgical equipment after an automatic washer-disinfector cycle was 5.7% rate, with an additional 15%-21% falling in the "caution zone" based on ATP bioluminescence assay (Smith et al., 2018).

Question & Answer! -----ATP

- T/F - Testing can be done *anytime* after cleaning, prior to high-level disinfection or sterilization? **Answer: True**

Stryker System 8 Drill

- Rinse the instrument with type of running water? **Answer: Warm**

Medtronic Straightshot Handpiece

- T/F - Soak the handpiece for 1 minute prior to brushing outer surfaces. **Answer: False (5min)**

Reference:

Smith, K., Araoye, I., Gilbert, S., Waites, K., Camins, B., Conklin, M., & Ponce, B. (2018). Is retained bone debris in cannulated orthopedic instruments sterile after autoclaving? *American Journal of Infection Control*, 46(9), 1009–1013. <https://doi-org.usu01.idm.oclc.org/10.1016/j.ajic.2018.02.024>

Appendix E: Team Mentor (Committee Membership) Agreement Form



Appendix C: Daniel K. Inouye Graduate School of Nursing
DNP Project Team Mentor (Committee Membership) Agreement Form

DOCTOR OF NURSING PRACTICE PROJECT
DNP Project Clinical Question and Team Mentor (Committee Membership) Agreement Form

Graduation Year: 2022 Phase 2 Site(s) Name: Andrews AFB, MGMC

Name(s) of DNP Project Student Team:

1. <u>Maj Anderson</u>	AGCNS ☒ FNP ☐ PMHNP ☐ RNA ☐ WHNP ☐
2. <u>Maj Mitchell</u>	AGCNS ☒ FNP ☐ PMHNP ☐ RNA ☐ WHNP ☐
3. _____	AGCNS ☐ FNP ☐ PMHNP ☐ RNA ☐ WHNP ☐
4. _____	AGCNS ☐ FNP ☐ PMHNP ☐ RNA ☐ WHNP ☐
5. _____	AGCNS ☐ FNP ☐ PMHNP ☐ RNA ☐ WHNP ☐
6. _____	AGCNS ☐ FNP ☐ PMHNP ☐ RNA ☐ WHNP ☐

The tentative title of the DNP Project Proposal for this student group is: Beyond what the eye can see: Verifying surgical instrument and endoscope cleaning efficacy with adenosine triphosphate technology

Committee Approved DNP Project Clinical Question: Among manual and mechanically cleaned surgical instruments at MGMC, is ATP testing and visual assessment compared to visualization alone a more accurate verification method for detecting bioburden?
MGMC - Malcolm Grow Medical Clinics and Surgery Center ATP - Adenosine Triphosphate

Names of DNP Project Team Mentors: I agree to serve as a member of the DNP Project Team (Team Mentors) for the above DNP Student Project Team. As a Project Team Mentor, I agree to the duties and responsibilities outlined within the DNP Project Manual which include but are not limited to the provision of consultation and guidance supporting the entire DNP project journey and to ensure the DNP project is of sufficient rigor and demonstrates doctoral level scholarship to meet the requirements for USUHS GSN graduation.

NOTE: You may have 3-4 DNP Team Mentors [committee members including your DNP Senior Mentor (Chair)]. The Phase II Site Director may also be a member of the group, as well as other USUHS faculty or others who may serve as content experts.

All non-USUHS faculty selected as a Team Mentor must be approved by the DNP Project Director.

Senior Mentor (Chair): Dr. Bradley

Signature: BRADLEY.DAVI Digitally signed by
D.FRANKLIN.JR. N.JR.1134185488 Date:
.1134185488 Data: 2021.06.22 13:48:06
-04'00'

Team Mentor (Member): Dr. Phillips

Signature: PHILLIPS.DANIEL.A. Digitally signed by
A.K.1125832845 Date:
Data: 2021.06.28 09:06:28
-04'00'

Form Version: 4 December 2020

Appendix F: CITI Program Certificate

COLLABORATIVE INSTITUTIONAL TRAINING INITIATIVE (CITI PROGRAM)**COMPLETION REPORT - PART 1 OF 2
COURSEWORK REQUIREMENTS***

* NOTE: Scores on this Requirements Report reflect quiz completions at the time all requirements for the course were met. See list below for details. See separate Transcript Report for more recent quiz scores, including those on optional (supplemental) course elements.

- **Name:** Richard Anderson (ID: 9040021)
- **Institution Affiliation:** Office of the Under Secretary of Defense (Personnel and Readiness) (ID: 603)
- **Institution Email:** richard.anderson@usuhs.edu
- **Phone:** 4408121077
- **Curriculum Group:** OUSD P&R Human Research
- **Course Learner Group:** Biomed Research Coordinators, Clinical Coordinators, Study Coordinators & Research Administrators
- **Stage:** Stage 1 - Basic Course
- **Record ID:** 36174064
- **Completion Date:** 01-Apr-2020
- **Expiration Date:** 01-Apr-2023
- **Minimum Passing:** 80
- **Reported Score*:** 92

REQUIRED AND ELECTIVE MODULES ONLY	DATE COMPLETED	SCORE
Module for Non-DoD Personnel Conducting Research Involving Human Subjects Supported by the DoD (ID: 16769)	31-Mar-2020	No Quiz
Belmont Report and Its Principles (ID: 1127)	31-Mar-2020	3/3 (100%)
History and Ethics of Human Subjects Research (ID: 498)	31-Mar-2020	5/5 (100%)
Informed Consent (ID: 3)	31-Mar-2020	5/5 (100%)
Social and Behavioral Research (SBR) for Biomedical Researchers (ID: 4)	01-Apr-2020	4/4 (100%)
Records-Based Research (ID: 5)	01-Apr-2020	3/3 (100%)
Genetic Research in Human Populations (ID: 6)	01-Apr-2020	4/5 (80%)
Populations in Research Requiring Additional Considerations and/or Protections (ID: 16680)	01-Apr-2020	4/5 (80%)
Research Involving Prisoners (ID: 8)	01-Apr-2020	4/4 (100%)
Research Involving Children (ID: 9)	01-Apr-2020	3/3 (100%)
Research Involving Pregnant Women, Fetuses, and Neonates (ID: 10)	01-Apr-2020	3/3 (100%)
FDA-Regulated Research (ID: 12)	01-Apr-2020	5/5 (100%)
Research and HIPAA Privacy Protections (ID: 14)	01-Apr-2020	4/5 (80%)
Conflicts of Interest in Human Subjects Research (ID: 17464)	01-Apr-2020	4/5 (80%)
Defining Research with Human Subjects - SBE (ID: 491)	01-Apr-2020	4/5 (80%)
The Federal Regulations - SBE (ID: 502)	01-Apr-2020	5/5 (100%)
Assessing Risk - SBE (ID: 503)	01-Apr-2020	5/5 (100%)
Privacy and Confidentiality - SBE (ID: 505)	01-Apr-2020	5/5 (100%)
Research in Public Elementary and Secondary Schools - SBE (ID: 508)	01-Apr-2020	4/5 (80%)
Internet-Based Research - SBE (ID: 510)	01-Apr-2020	5/5 (100%)
International Studies (ID: 971)	01-Apr-2020	3/3 (100%)
The IRB Member Module - 'What Every New IRB Member Needs to Know' (ID: 816)	01-Apr-2020	4/5 (80%)
Office of the Under Secretary of Defense (Personnel and Readiness) (ID: 912)	01-Apr-2020	No Quiz

For this Report to be valid, the learner identified above must have had a valid affiliation with the CITI Program subscribing institution identified above or have been a paid Independent Learner.

Verify at: www.citiprogram.org/verify/?k6f0fc06a-47d4-4db6-a70f-3c0bd2c91214-36174064

Collaborative Institutional Training Initiative (CITI Program)

Email: support@citiprogram.org

Phone: 888-529-5929

Web: <https://www.citiprogram.org>

COLLABORATIVE INSTITUTIONAL TRAINING INITIATIVE (CITI PROGRAM)

COMPLETION REPORT - PART 1 OF 2 COURSEWORK REQUIREMENTS*

* NOTE: Scores on this Requirements Report reflect quiz completions at the time all requirements for the course were met. See list below for details. See separate Transcript Report for more recent quiz scores, including those on optional (supplemental) course elements.

- **Name:** Christy Anne Velasquez (ID: 9034134)
- **Institution Affiliation:** Office of the Under Secretary of Defense (Personnel and Readiness) (ID: 603)
- **Institution Email:** christy-anne.velasquez@usuhs.edu
- **Phone:** 8083652721

- **Curriculum Group:** OUSD P&R Human Research
- **Course Learner Group:** Biomed Research Coordinators, Clinical Coordinators, Study Coordinators & Research Administrators
- **Stage:** Stage 1 - Basic Course

- **Record ID:** 36097905
- **Completion Date:** 29-Mar-2020
- **Expiration Date:** 29-Mar-2023
- **Minimum Passing:** 80
- **Reported Score*:** 91

REQUIRED AND ELECTIVE MODULES ONLY	DATE COMPLETED	SCORE
Module for Non-DoD Personnel Conducting Research Involving Human Subjects Supported by the DoD (ID: 16769)	29-Mar-2020	No Quiz
Belmont Report and Its Principles (ID: 1127)	29-Mar-2020	3/3 (100%)
History and Ethics of Human Subjects Research (ID: 498)	29-Mar-2020	5/5 (100%)
Informed Consent (ID: 3)	29-Mar-2020	4/5 (80%)
Social and Behavioral Research (SBR) for Biomedical Researchers (ID: 4)	29-Mar-2020	4/4 (100%)
Records-Based Research (ID: 5)	29-Mar-2020	3/3 (100%)
Genetic Research in Human Populations (ID: 6)	29-Mar-2020	5/5 (100%)
Populations in Research Requiring Additional Considerations and/or Protections (ID: 16680)	29-Mar-2020	5/5 (100%)
Research Involving Prisoners (ID: 8)	29-Mar-2020	4/4 (100%)
Research Involving Children (ID: 9)	29-Mar-2020	3/3 (100%)
Research Involving Pregnant Women, Fetuses, and Neonates (ID: 10)	29-Mar-2020	3/3 (100%)
FDA-Regulated Research (ID: 12)	29-Mar-2020	4/5 (80%)
Research and HIPAA Privacy Protections (ID: 14)	29-Mar-2020	4/5 (80%)
Conflicts of Interest in Human Subjects Research (ID: 17464)	29-Mar-2020	4/5 (80%)
Defining Research with Human Subjects - SBE (ID: 491)	29-Mar-2020	4/5 (80%)
The Federal Regulations - SBE (ID: 502)	29-Mar-2020	5/5 (100%)
Assessing Risk - SBE (ID: 503)	29-Mar-2020	5/5 (100%)
Privacy and Confidentiality - SBE (ID: 505)	29-Mar-2020	5/5 (100%)
Research in Public Elementary and Secondary Schools - SBE (ID: 508)	29-Mar-2020	4/5 (80%)
Internet-Based Research - SBE (ID: 510)	29-Mar-2020	4/5 (80%)
International Studies (ID: 971)	29-Mar-2020	3/3 (100%)
The IRB Member Module - 'What Every New IRB Member Needs to Know' (ID: 816)	29-Mar-2020	4/5 (80%)
Office of the Under Secretary of Defense (Personnel and Readiness) (ID: 912)	29-Mar-2020	No Quiz

For this Report to be valid, the learner identified above must have had a valid affiliation with the CITI Program subscribing institution identified above or have been a paid Independent Learner.

Verify at: www.citiprogram.org/verify/?kad76be98-504b-4119-a291-ad3df63260bb-36097905

Collaborative Institutional Training Initiative (CITI Program)

Email: support@citiprogram.org

Phone: 888-529-5929

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Appendix G: USU Form 3202N & NOPA

USUHS FORM 3202N
DANIEL K. INOUE GRADUATE SCHOOL OF NURSING
EVIDENCE-BASED PRACTICE/PERFORMANCE IMPROVEMENT PROPOSAL

VPR Date Stamp

Project Number: **GSN 61-12022**

(VPR will assign)

Project Title: **Beyond What the Eye Can See: Verifying Surgical Instrument and Endoscope Cleanliness with Adenosine Triphosphate Technology**

SECTION A: STUDENT POC INFORMATION	
1. Name (Last, First, MI): Mitchell, Christy	Student E-mail: christy-anne.mitchell@usuhs.edu
2. Home Address: 5108 Lahm Ct. JB Andrews, MD 20782	Cell Number: 808-385-2721
SECTION B: COMMITTEE CHAIR / SENIOR MENTOR INFORMATION	
3. Name (Last, First, MI): Bradley, David	
4. Telephone: _____	Fax: _____ E-mail: david.bradley@usuhs.edu
5. USUHS Building/ Room No.: _____	
SECTION C: PROJECT INFORMATION	
6. Attach the Abstract for the proposal, including the following sections: Site Location of the Project, Title, Authors, Background or Problem/Issue, Clinical Question/Purpose, Project Design, Anticipated Organizational Impact/Implications for Practice and also include the Proposed Timeline. Single space the abstract and use Times New Roman font, size 12.	
7. Is this proposal related to an active research project of the Chair/Senior Mentor identified in Section B? ☐ Yes ☒ No If yes, complete below; if no, proceed to Part 8. Project Number: _____ Project Title: _____ Project Start Date: _____ Project End Date: _____	
8. Anticipated period of performance: Project Start Date: 1/1/2022 Project End Date: 4/1/2022	
9. Performance Site(s): Andrews AFB, Malcolm Grow Medical Clinics and Surgical Center	
10. Does this project involve any classified information? (Contact the USUHS Security Office for guidance) ☐ Yes ☒ No	
11. Do you have a funding source for this project? ☐ Yes ☒ No ☐ NA If yes, specify the funding agency and the amount provided: _____	
SECTION D: SIGNATURES	
The following signatures attest to the validity of the above information:	
MITCHELL, CHRISTY ANNE.R.1391789033 Digitally signed by MITCHELL, CHRISTY ANNE.R.1391789033 Date: 2021.06.28 09:34:45 -0400	BRADLEY, DAVID, FRANKLIN, JR. 11341 85488 Digitally signed by BRADLEY, DAVID, FRANKLIN, JR. 11341 85488 Date: 2021.06.28 14:20:17 -0400
Student (Project Point of Contact for the Group) (Signature and Date)	Chair/Senior Mentor (Signature and Date)
Chair/Program Director (Signature and Date)	Chair/Program Director (Signature and Date)
DNP Project Director or PhD Director (Signature and Date)	Associate Dean for Academic Affairs, GSN (Signature and Date)
Associate Dean for Research, GSN (Signature and Date)	Dean, DKI Graduate School of Nursing (Signature and Date)
In light of the above signatures, the project is approved.	
USUHS Vice President for Research	Date

**OFFICE OF RESEARCH**

4301 JONES BRIDGE ROAD

BETHESDA, MARYLAND 20814

PHONE: (301) 295-3303; FAX: (301) 295-6771

NOTICE OF PROJECT APPROVAL

Change Number: Original

VPR Site Number: GSN-61-12022
Principal Investigator: Mitchell, Christy
Department: Graduate School of Nursing
Project Type: Student
Project Title: Beyond What the Eye Can See: Verifying Surgical Instrument and Endoscope Cleanliness with Adenosine Triphosphate Technology
Project Period: 7/14/2021 to 7/14/2022

Assurance and Progress Report Information:

<u>Name</u>	<u>Sup</u>	<u>Approval Type</u>	<u>Status</u>	<u>Approved On</u>	<u>Forms Received</u>
Progress Report	0			To be Submitted	N/A

Remarks:

This Notice Of Project Approval has been reviewed and approved. Please remember that you must submit a final Progress Report (Form 3210) upon completion of this project.

Questions regarding this approval should be directed to the following person in the Office of Research:

Sharon McIver, (301) 295-9814.

WOODBERRY.MITCHELL
 WAYNE.1060957114

Digitally signed by
 WOODBERRY.MITCHELL.WAYNE.1060957114
 Date: 2021.07.20 16:00:21 -0400

For/Mark G. Kortepeter, MD, MPH
 FACP, FIDSA, FASTMH
 COL (R) MC US Army
 Vice President for Research
 Uniformed Services University of the Health Sciences

Date

cc: File

Dr. Kennett Radford

Laura Taylor

Appendix H: IRB/PI Letter of Determination



UNIFORMED SERVICES UNIVERSITY OF THE HEALTH SCIENCES

4301 JONES BRIDGE ROAD
BETHESDA, MARYLAND
20814-4799
www.usuhs.edu



August 4, 2021

MEMORANDUM FOR Maj David F. Bradley, Daniel K. Inouye Graduate School of Nursing, P and R - Uniformed Services University of the Health Sciences (USUHS)

SUBJECT: Uniformed Services University Institutional Review Board (FWA 0001628; DoD Assurance P60001) Determination of Not Research Protocol DBS.2021.262.

The project DBS.2021.262 titled "Beyond What the Eye Can See: Verifying Surgical Instrument and Endoscope Cleaning Efficacy with Adenosine Triphosphate Technology" has been reviewed by the Uniformed Services University's Human Research Protections Program Office and was determined to not meet the criteria defining research at 32 CFR 219.102, and applicable DoD policy guidance. As such, this protocol does not require Institutional Review Board (IRB) review.

The purpose of this study is to assess whether adenosine triphosphate (ATP) testing and visual assessment compared to visualization alone among manual and mechanically cleaned surgical instruments and endoscopes is a more accurate verification method to detect bioburden.

This study meets the applicability of the NDAA 21, SEC 716, which provides an exemption from the requirements of 44 USC §§ 3506(c), 3507, and 3508 for the voluntary collection of information during the conduct of research and program evaluations that are conducted or sponsored by the Uniformed Services University of the Health Sciences; and funded through the Defense Health Program (DHP). Should your project, data sources or methodology change, please contact this office for guidance before you begin any new phase of your work. Otherwise, we cannot ensure that you will be in compliance with all applicable human subject research regulations.

If you have questions or concerns regarding this determination or questions of a more general nature concerning human participation in research, please contact Chris Murphy at christopher.murphy.ctr@usuhs.edu or (301) 319-0444.

LONGENECK Digitally signed by
LONGENECKER.PETRICE.
B
PETRICE.B.1554 1554161290
161290 Date: 2021.08.04 16:29:54
-04'00'

Petrice Longenecker, PhD,
CIP Human Protections
Administrator

Appendix I: PAO Clearance/Level of Dissemination Classification



Mitchell, Christy V. <christy-anne.mitchell@usuhs.edu>

***Important* Abstract & PAO verification**

Phillips, Angela K Maj USAF 316 MDG (USA) <angela.k.phillips6.mil@mail.mil>

Wed, Mar 9, 2022 at 4:17 PM

To: "Anderson, Richard" <richard.anderson@usuhs.edu>, Angela Phillips <angela.phillips@usuhs.edu>

Cc: "Christy V. Mitchell" <christy-anne.mitchell@usuhs.edu>

Good afternoon,

You do not need to repeat PAO from the 316th Wing for this project.

Great work on the edits! I am sending another round of feedback. I am recommending removing the educational intervention from the clinical question. It does not flow, is not actually part of the true purpose of the clinical question, and is not even part of your title. The educational intervention, in my view (and even how the abstract stands), was more of a "nicety" – like, that's nice that you educated along the way... and you happened to collect data about your niceness, and we like data... but it's not the clinical question. Hopefully my comments make sense. Happy to discuss further.

You guys are shining stars and deserve the most recognition for your work! Keep swimming, you're almost done.

Angela K. Phillips, PhD

Maj, USAF, NC

Chief of Clinical Research, 316 MDG

1060 W Perimeter Rd, Office 3K23, JB Andrews MD

drive.google.com/file/d/1irGUt18Y1mLnHB4ilqyb9fjPxRuYumM/view#approval=17glF4j-Mctk6RI9G_tMEKdA3AjgKETPsqtxE... Guest

Approvals

ATP Technology Manuscript PAO.pdf

1

Beyond What the Eye Can See: Verifying Surgical Instrument and Endoscope
Cleanliness with Adenosine Triphosphate (ATP) Technology
Christy V. Mitchell MSN, RN, MAJ, USAF and Richard D. Anderson BSN, RN, MAJ, USAF
Malcolm Grow Medical Clinics and Surgery Center
Daniel K. Inouye Graduate School of Nursing
Uniformed Services University

Page 1 / 76

Approvals

Approval complete
on Apr 28, 2022

Start a new approval

3 APPROVERS

- Diane Seibert
Approved
- Taylor, Laura
Approved
- USU Pub Clearance
Approved

APPROVAL ACTIVITY

Leave a comment...

- USU Pub Clearance approved
Wednesday, 6:35 AM
- Diane Seibert approved
Tuesday, 9:24 PM
- Taylor, Laura approved
Tuesday, 6:43 PM
- Richard Anderson requested approval from USU Pub Clearance, Diane Seibert, Taylor, Laura
Tuesday, 3:41 PM

"Appendix E: DNP Manuscript"
Due date Thu, Apr 28, 6:00 PM

Appendix J: DNP Project Completion Verification Form



Appendix G: Daniel K. Inouye Graduate School of Nursing
DNP Project Completion Verification Form

DOCTOR OF NURSING PRACTICE PROJECT Completion Verification Form

The DNP Project titled: **Beyond What the Eye Can See: Verifying Surgical Instrument and Endoscope Cleanliness Using Adenosine Triphosphate Technology**

was completed at **the Uniformed Services University** by the following student(s):

(Student Name)	(Digital Signature)
Richard Anderson	ANDERSON, RICHARD D. 1075476465 Digitally signed by ANDERSON, RICHARD D. 1075476465 Date: 2022.04.26 19:57:19 -0400
Christy Mitchell	MITCHELL, CHRISTY ANNE R. 1391786033 Digitally signed by MITCHELL, CHRISTY ANNE R. 1391786033 Date: 2022.04.26 20:06:35 -0400

The DNP Practice Project Team verifies that the following components of the DNP project, accomplished by the above students, is of sufficient rigor and demonstrates doctoral level scholarship to meet the requirements for USUHS GSN graduation:

- Presentation of DNP project to the leadership/stakeholders at the Phase II Site,
- Abstract/Impact Statement (*Appendix F*), and
- DNP Project written report (*Appendix E*).

Verified by:

(type name)	(Digital Signature)	
Dr. David Bradley Jr.	BRADLEY, DAVID FRANKLIN, JR. 1134185488 Digitally signed by BRADLEY, DAVID FRANKLIN, JR. 1134185488 Date: 2022.04.26 12:13:01 -0400	Senior Mentor
Dr. Angela Phillips	Angela K. Phillips -S (Affiliate) Digitally signed by Angela K. Phillips -S (Affiliate) Date: 2022.04.26 19:54:09 -0400	Team Mentor & Phase II Site Director
n/a		
n/a		

For RNA Students only - add the following additional signature for final verification of project completion:

RNA Project Director (type name)	(Digital Signature)

Form Version: 4 December 2020

Beyond What the Eye Can See: Verifying Surgical Instrument and Endoscope Cleanliness with Adenosine Triphosphate Technology

Christy V. Mitchell, MSN, RN, MAJ, USAF and Richard D. Anderson, BSN, RN, MAJ, USAF

Daniel K. Inouye Graduate School of Nursing, Uniformed Services University, Bethesda, MD

Background and Significance

- Contaminated surgical instruments and endoscopes pose serious health complications for patients in the form of surgical site infections (SSIs) and are a causative factor in the upsurge seen in financial costs for healthcare organizations.
- ✓ In 2015, there were 687,000 healthcare-associated infections (HAIs) in the US, of which 110,000 to 300,000 were SSIs.
- ✓ SSIs account for 20% of HAIs with a risk of a 2 to 11-fold increase in mortality. SSIs are the costliest type of HAI estimated at \$3 billion per year and \$20,000 per readmission.
- ✓ It is estimated that 40-60% of SSIs are preventable. Decreasing contamination rates of surgical instruments is critical to mitigating the risk of SSIs.
- ✓ Surgical instruments and endoscopes can harbor bioburden, serving as a reservoir and medium for the transmission of highly infectious pathogens.
- ✓ Adenosine triphosphate (ATP) molecules within bioburden are undetectable to the naked eye making it difficult to detect when performing manual cleaning.
- ✓ Cleaning practices and visual detection of bioburden is dramatically impeded by lumens, crevices, coils, and today's design complexity in both surgical instruments and endoscopes.
- ✓ According to national guidelines, the monitoring of manual and mechanical cleaning should be done as part of quality assurance.
- ✓ Malcolm Grow Surgical Center (MGSC) verifies the endoscope manual cleaning process through protein testing however, they do not utilize any quality assessment tools to verify the manual cleaning process of instruments.
- Use of ATP technology provides an objective measure to verify instrument cleanliness and identify gaps in manual cleaning quality and practices, helping to decrease SSI risks and support a medically ready force.

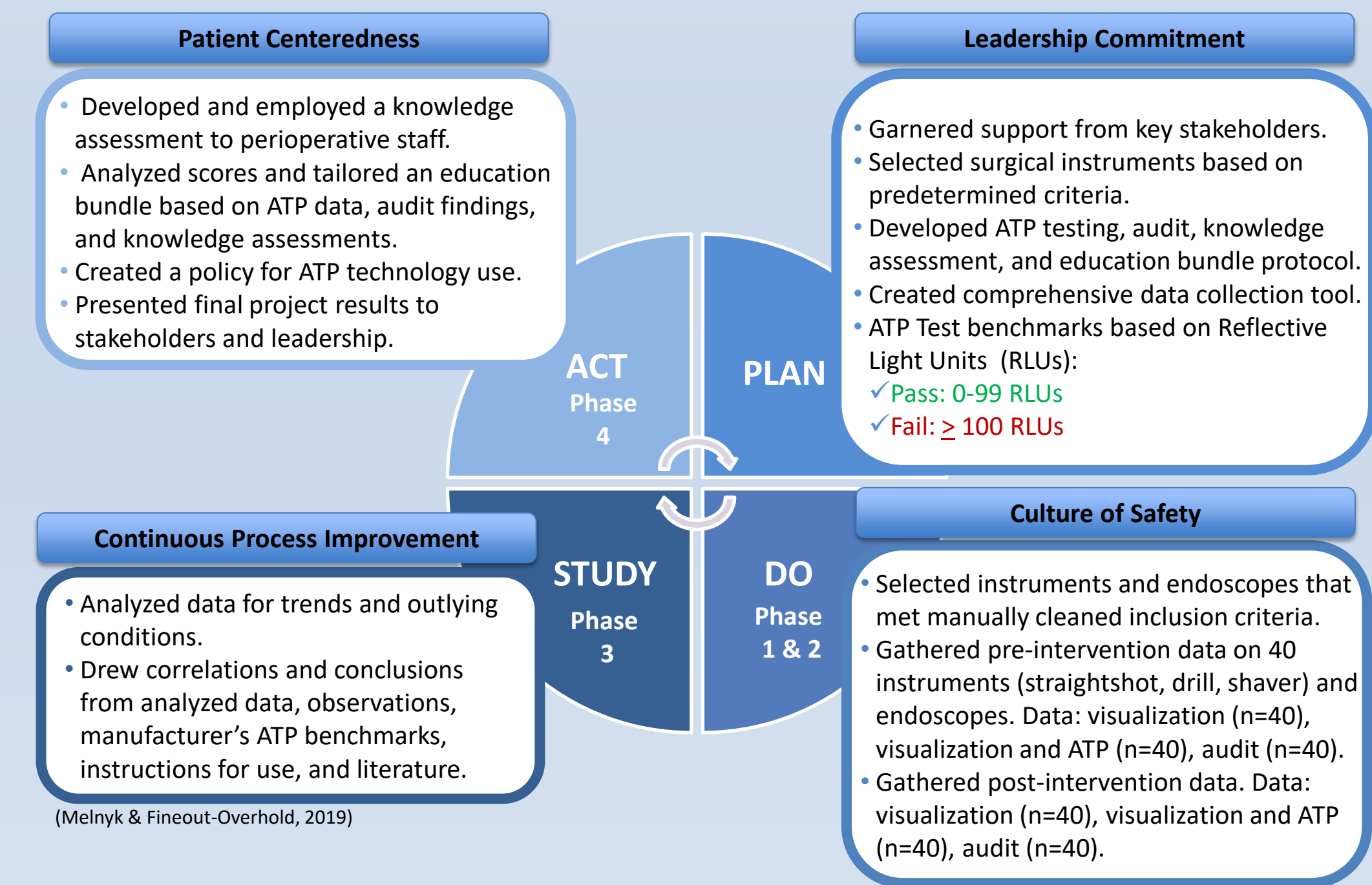
Purpose

Among manually cleaned surgical instruments and endoscopes at MGSC, how do audits and ATP testing with visual assessment compared to visualization alone increase bioburden detection and identify gaps in the cleaning process?

Project Design and Organizing Framework

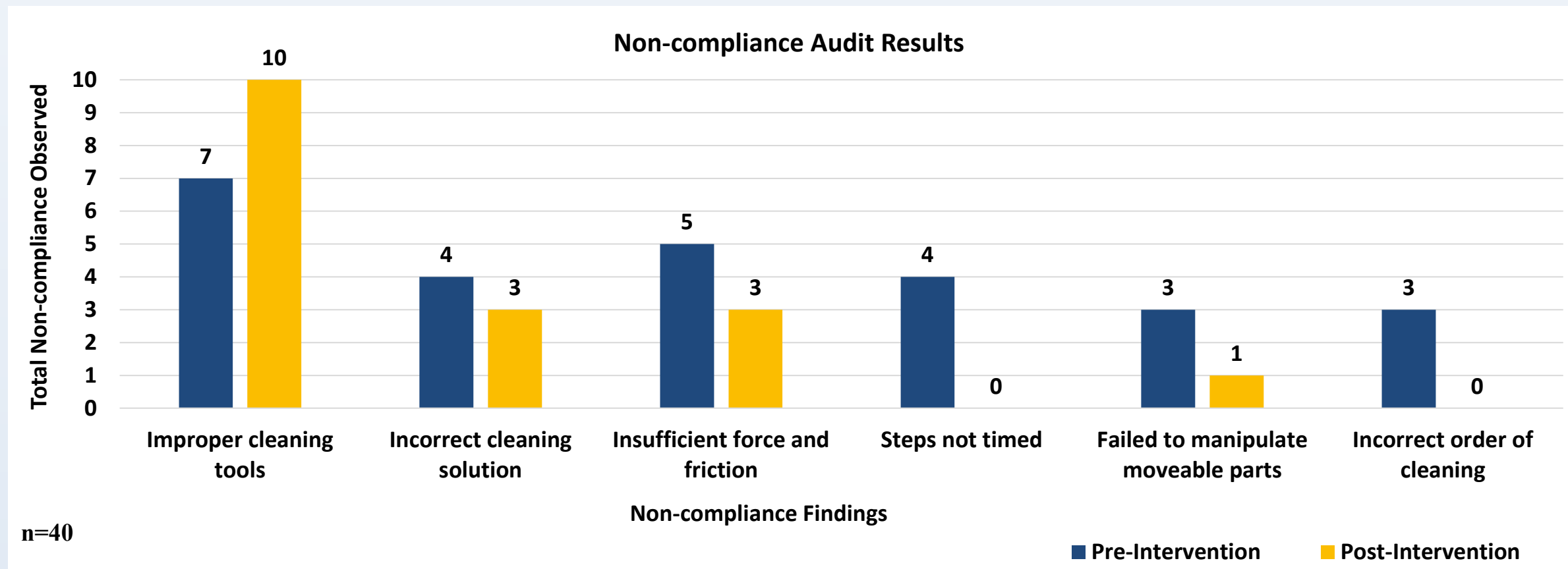
Plan-Do-Study-Act Model:

Piloting Change Through Ready Reliable Care Principles

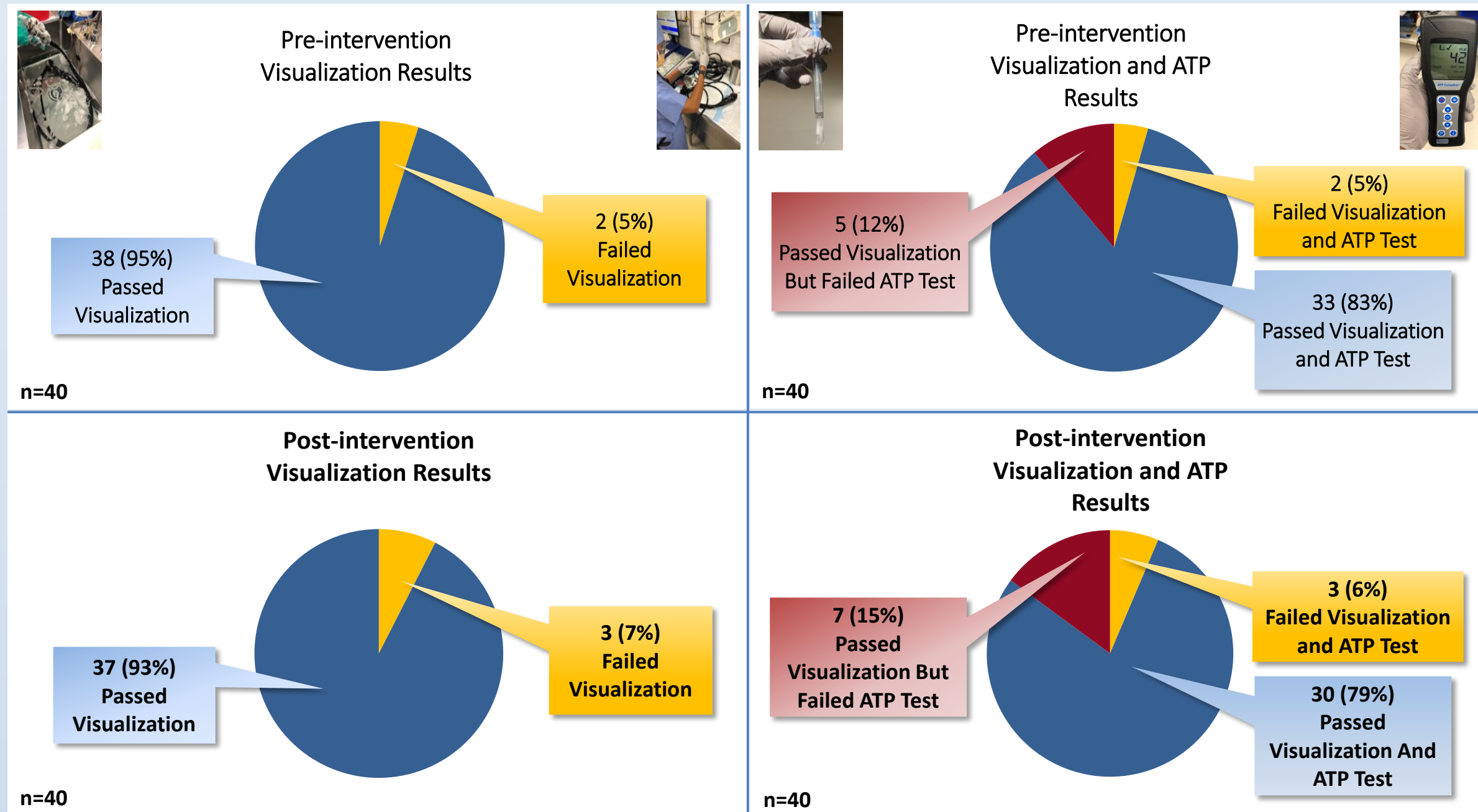


Results

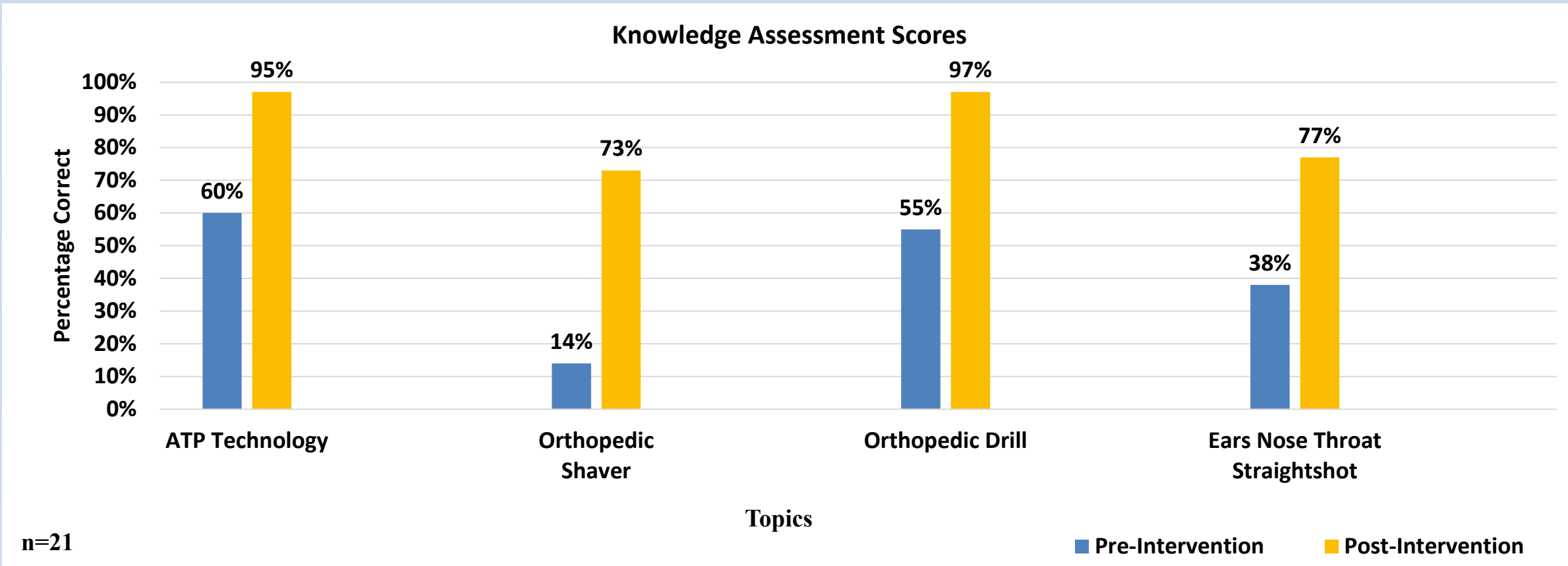
Phase 1: Performed Manual Cleaning Audits



Phase 2: Visualized and Tested 20 Instruments and 20 Endoscopes



Phase 3: Administered Knowledge Assessment Among Perioperative Staff, Employed Education Bundle and Reassessed



- Educational content focused on knowledge and practice gaps identified from Phase 1, 2, and 3.
- 91% of perioperative staff participated in a multimodal education bundle consisting of three visual cues, four simulations, six staff briefings, and six electronic notifications.
- The duration of the education bundle lasted three months.
- Knowledge and performance were commonly explored when reassessing outcomes.

Analysis of Results

Phases	Project Results	Findings	Causative Factors	Recommendations for Improvement
Phase 1 Manual Cleaning Audits	35% decrease in manual cleaning non-compliance.	Audits revealed critical step non-compliance and marked variances in manual cleaning.	Unfamiliarity with manufacturer and national guidelines.	Incorporate quarterly audits and implement solutions for identified gaps for a proactive approach.
Phase 2 Visualization and ATP Tests	17 contaminated instruments identified through visualization and ATP tests which avoided \$340K in readmission costs.	The addition of ATP technology identified more contaminated instruments than visualization alone and confirmed visual inspection results on failed instruments.	Reliance on visual inspection and failure to utilize adjunct technology to assess instrument cleanliness.	Purchase additional visual aids and ATP technology to enhance bioburden identification.
Phase 3 Knowledge Assessment, Education Bundle and Reassess	34% increase in staff knowledge after implementing the education bundle.	Knowledge assessment recognized targeted education and training topics. Education bundle provided a multimodal approach in delivering content.	Minimal knowledge on instrument decontamination. Currently, there is no identified education and training program focused on manual cleaning.	Continually assess staff knowledge and develop and adjust education and training topics based on identified gaps.

Organizational Impact

Medical Personnel

- Staff engagement through the education bundle attributed to competency maintenance.

Military Treatment Facility (MTF)

- Incorporating Ready Reliable Care principles in this project's design supported improvements in healthcare delivery related to instrument cleaning verification.
 - ✓ **Leadership Commitment:** Leadership support in efforts to validate cleaning processes contributed to the achievement of the Joint Commission accreditation.
 - ✓ **Culture of Safety:** Policy updates and purchase of ATP technology displayed commitment to safe practices.
 - ✓ **Continuous Process Improvement:** The incorporation of recurrent audits established a quality feedback loop leading to innovative solutions.
 - ✓ **Patient Centeredness:** Increasing critical step compliance with manual cleaning instruments and endoscopes supported MHS beneficiaries by minimizing SSI risks.

Defense Health Agency (DHA)

- The underlying framework for change used in this project supported the focus elements of the Quadruple Aim.
 - ✓ **Better Care:** Adopting technology such as ATP testing provides users with reliable, rapid, and objective data mitigating SSIs, leading to improved surgical outcomes.
 - ✓ **Better Health:** Provided highly-reliable medical care through a culture of embracing solutions by following national guidelines and evidence-based practice.
 - ✓ **Increase Readiness:** Education and training focused on knowledge gaps builds a ready medical force across the Military Health System (MHS).
 - ✓ **Lower Costs:** Performing ATP tests costs less than the cost of treating SSIs.

Implications for Future Practice

Collaborate with DHA leadership to:

- Disseminate project results, impact, and evidence-based recommendations for standardizing manual cleaning on endoscopes and instruments.
- Monitor performance metrics such as identified contaminated instruments through ATP technology and hospital readmissions for SSIs.
- Create and integrate a standardized program and policy to support the use of ATP technology for verifying instrument cleanliness across the MHS enterprise.
- Continue surveillance on performance metrics related to contaminated instruments after manual cleaning to support continuous process improvement.

Beyond What The Eye Can See: Validating Endoscope and Instrument Cleanliness with Adenosine Triphosphate Technology

Christy V. Mitchell, Maj, USAF

Richard D. Anderson, Maj, USAF

Senior Mentor: Dr. David Bradley, DNP, Lt Col, APRN, AGCNS-BC-CNOR

Phase II Site Director: Dr. Angela K. Phillips, PhD, Maj, WHNP-BC

Malcolm Grow Medical Clinics and Surgery Center

Daniel K. Inouye Graduate School of Nursing

Doctor of Nursing Practice Project

Disclaimer

The views expressed in the presentation are those of the authors and do not necessarily reflect the official policy or position of the Uniformed Services University, the Department of Defense, or the United States Government. There are no financial relationships with 3M, Ruhof, Smith & Nephew, Stryker, and medical instrument manufacturers that exist between the speakers and a commercial entity.

Surgical Site Infections

- 687K healthcare-associated infections; 110K-300K are SSIs (FedEx Field capacity 82K)
- 77% SSI deaths attributable to the infection itself
- DHA and TJC initiatives
- Ready Reliable Care: Audits and ATP Technology



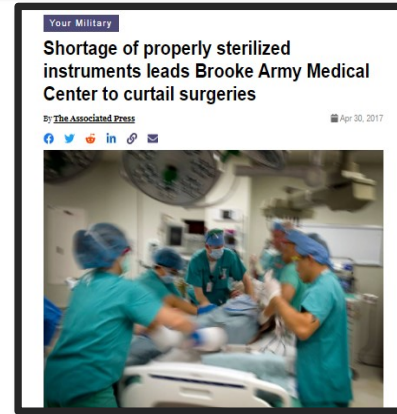
Headlines News

2016

2017

2017

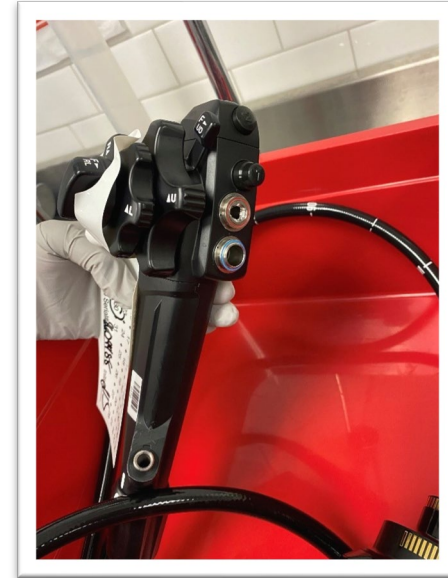
2022

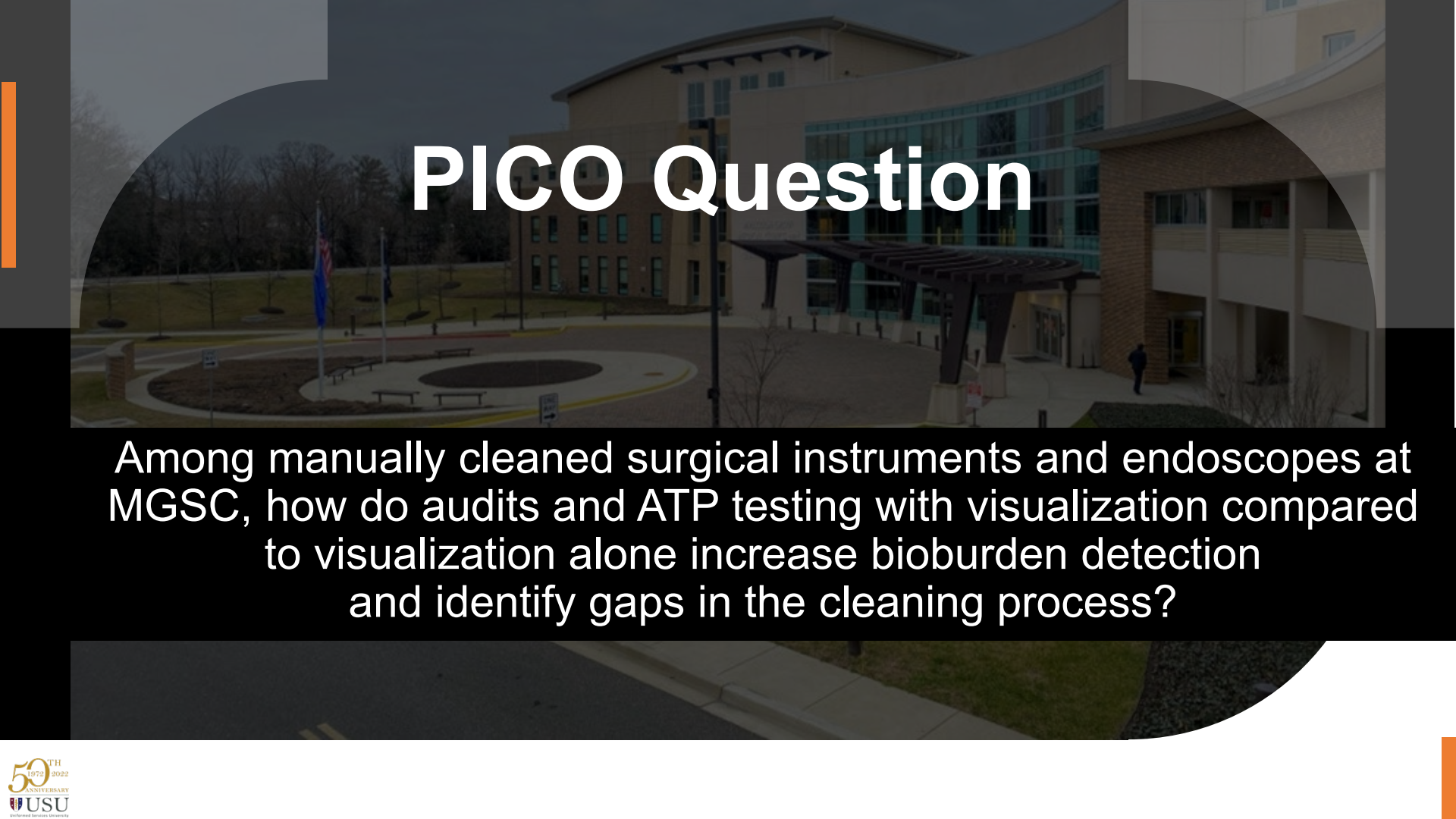


- MHS encounters issues with contaminated scopes and instruments
- SSI “never events” carry a 2 to 11-fold increase in mortality
- Costliest HAI: \$3.3B annually at \$20K/readmission

Surgical Instruments

- Complex construction
- Increased demand for rapid turnaround
- Problematic manufacturer cleaning guidelines
- A quality assessment tool to validate efficacy of manual cleaning is needed at MGSC





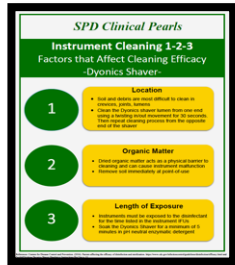
PICO Question

Among manually cleaned surgical instruments and endoscopes at MGSC, how do audits and ATP testing with visualization compared to visualization alone increase bioburden detection and identify gaps in the cleaning process?

Focus Areas



Identify **difficult to clean** surgical instruments and endoscopes → perform combined auditing and ATP testing

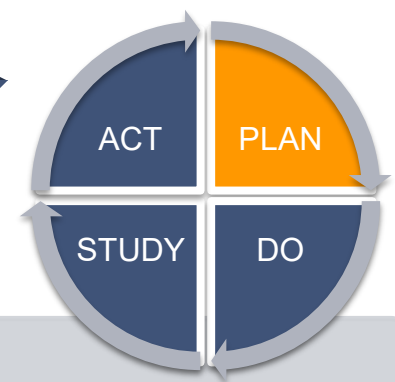


Provide **evidence-based-recommendations** including ATP technology tool to improve medical device cleaning



Repeat ATP testing and audit on the instrument and endoscope → **synthesize findings**

Procedural Steps



Plan

- Key stakeholder buy-in
- Establish design for collecting data

Do

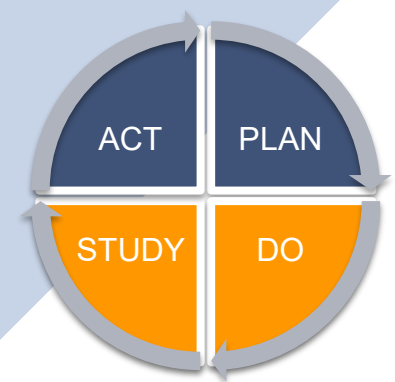
- Conduct audit, ATP tests, knowledge assessment

Study

- Analyze ATP data and audit performance

Act

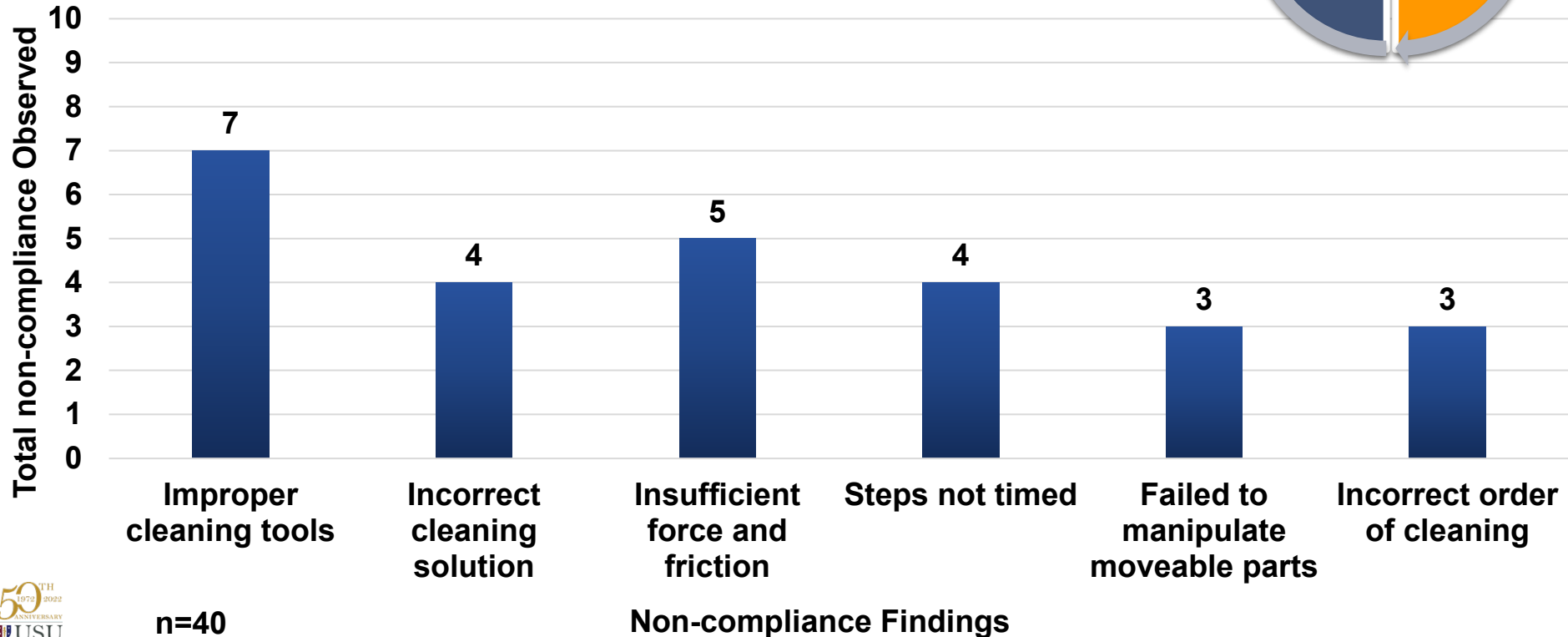
- Educate and implement corrective actions
- Disseminate results to stakeholders



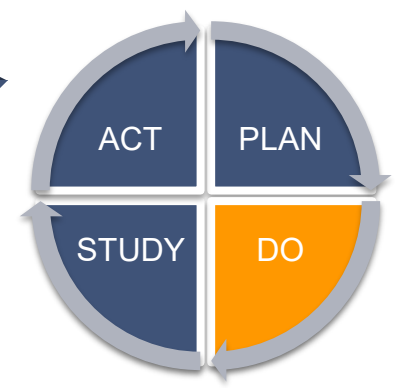
Pre-Intervention

**Audit
Visualization and ATP
Knowledge Assessment**

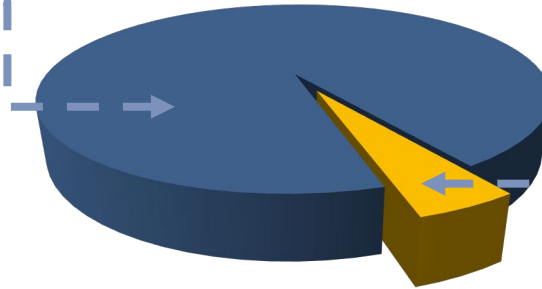
Audit



Visualization

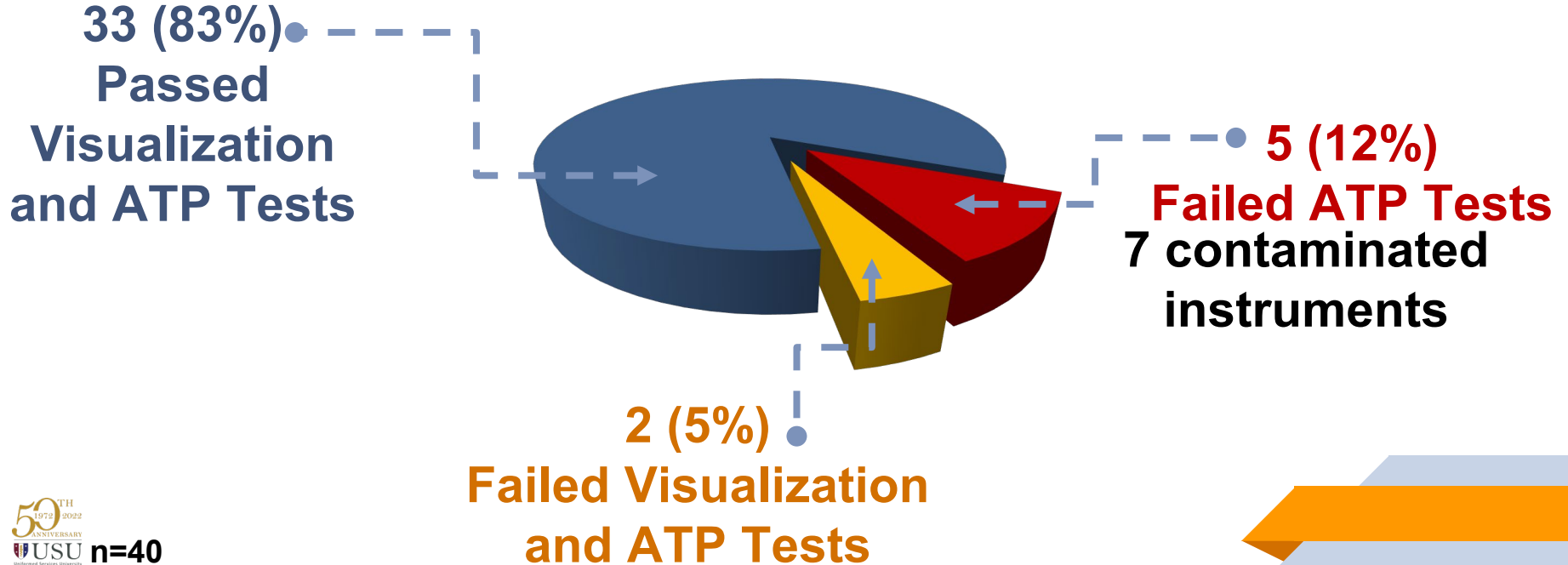
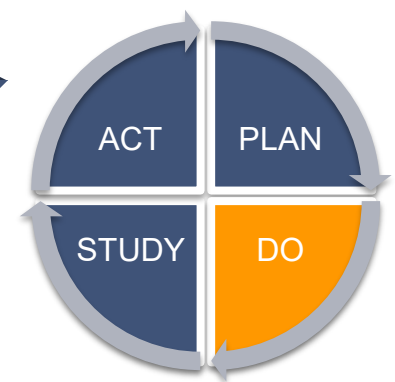


38 (95%)
Passed
Visualization

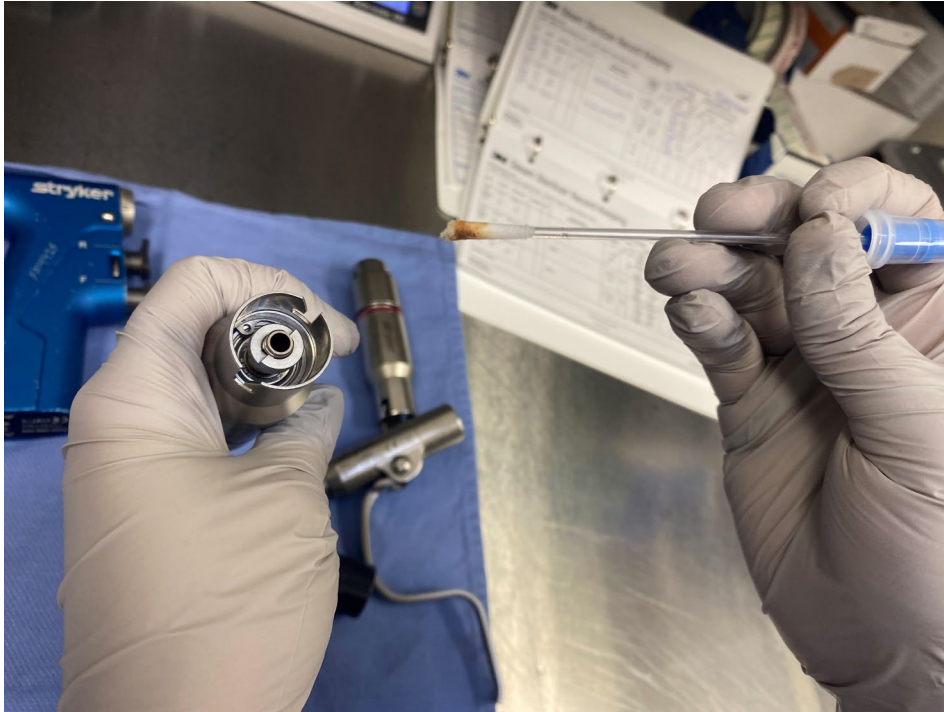
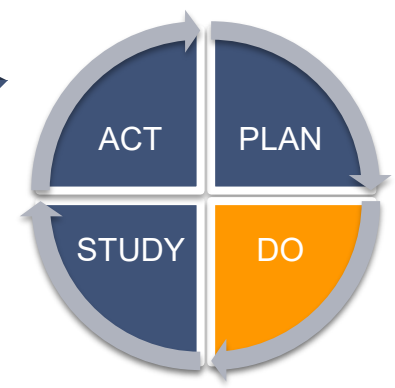


2 (5%)
Failed
Visualization

Visualization and ATP



Visualization and ATP

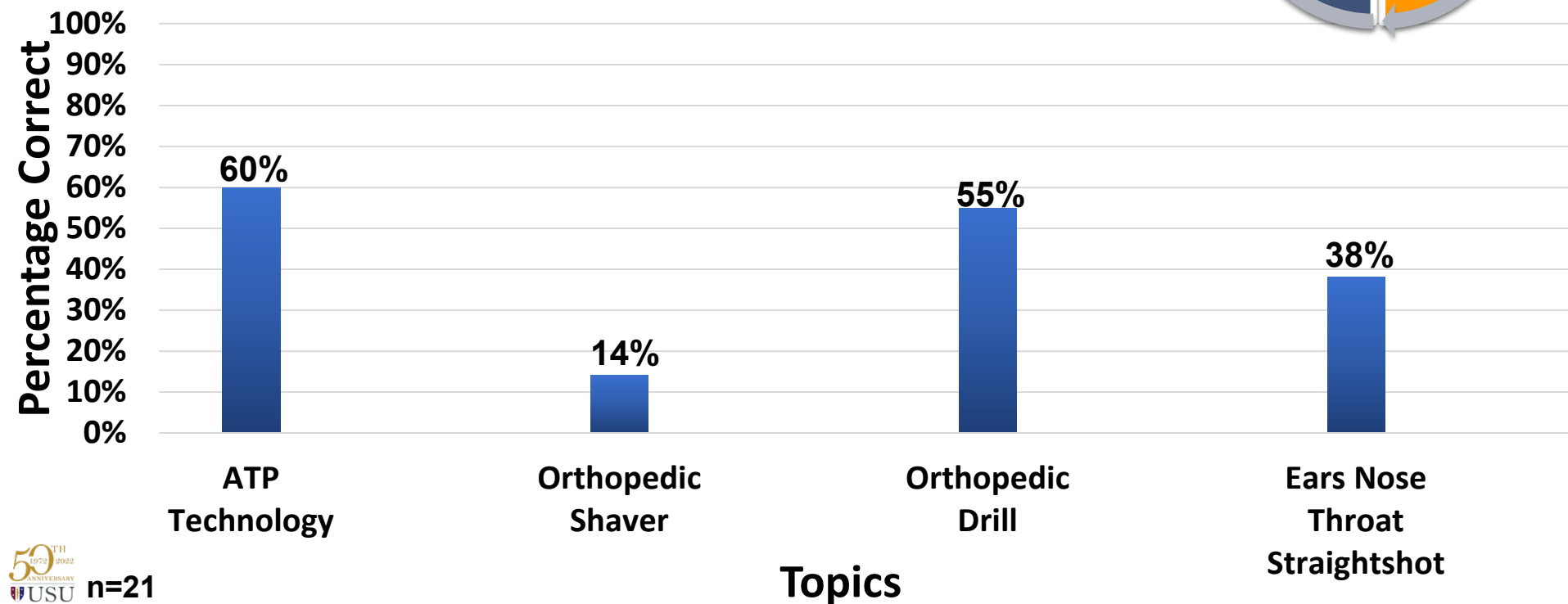


**7 contaminated
instruments**

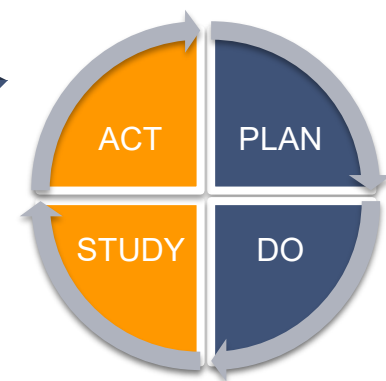
Knowledge Assessment



Scores



Interventions



Hands-On
Simulations

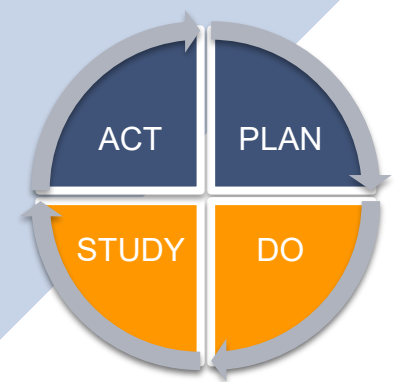
Electronic
Notifications

IFU Accessibility



Audit Feedback

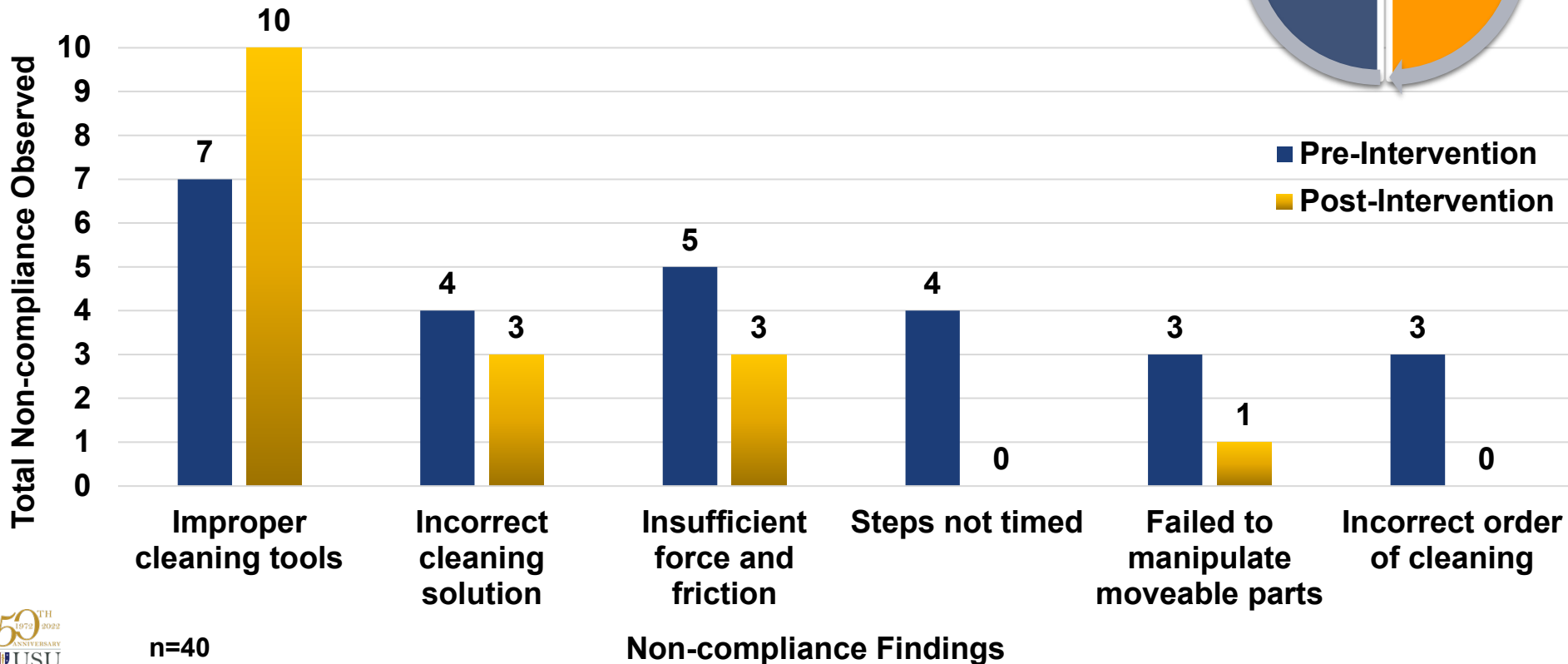
End of Day
Huddles

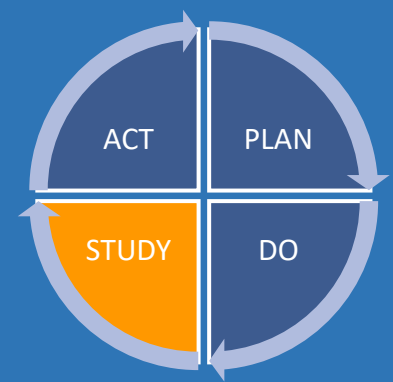


Post-Intervention

**Audit
Visualization and ATP
Knowledge Assessment**

Audit Results

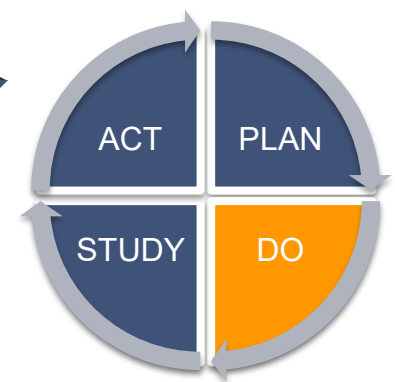




Audit Result

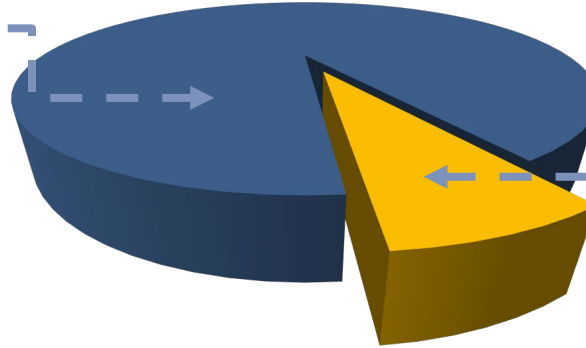
**35% decrease in manual
cleaning non-compliance**

Visualization



37 (93%)

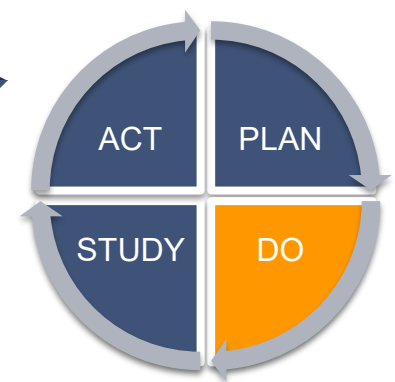
Passed Visualization



3 (7%)

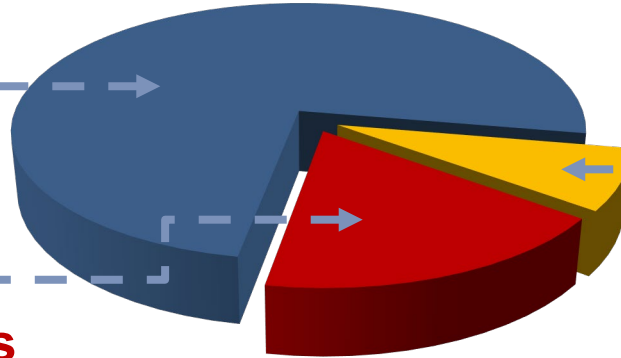
Failed Visualization

Visualization and ATP

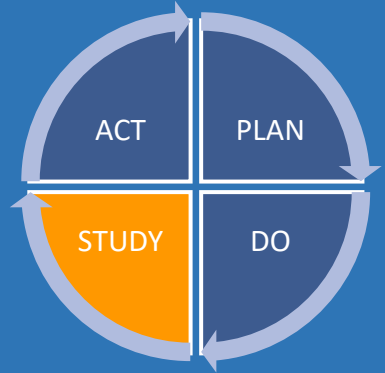


30 (75%)
Passed Visualization
and ATP Tests

7 (18%)
Failed ATP Tests



3 (7%)
Failed
Visualization
and ATP Tests



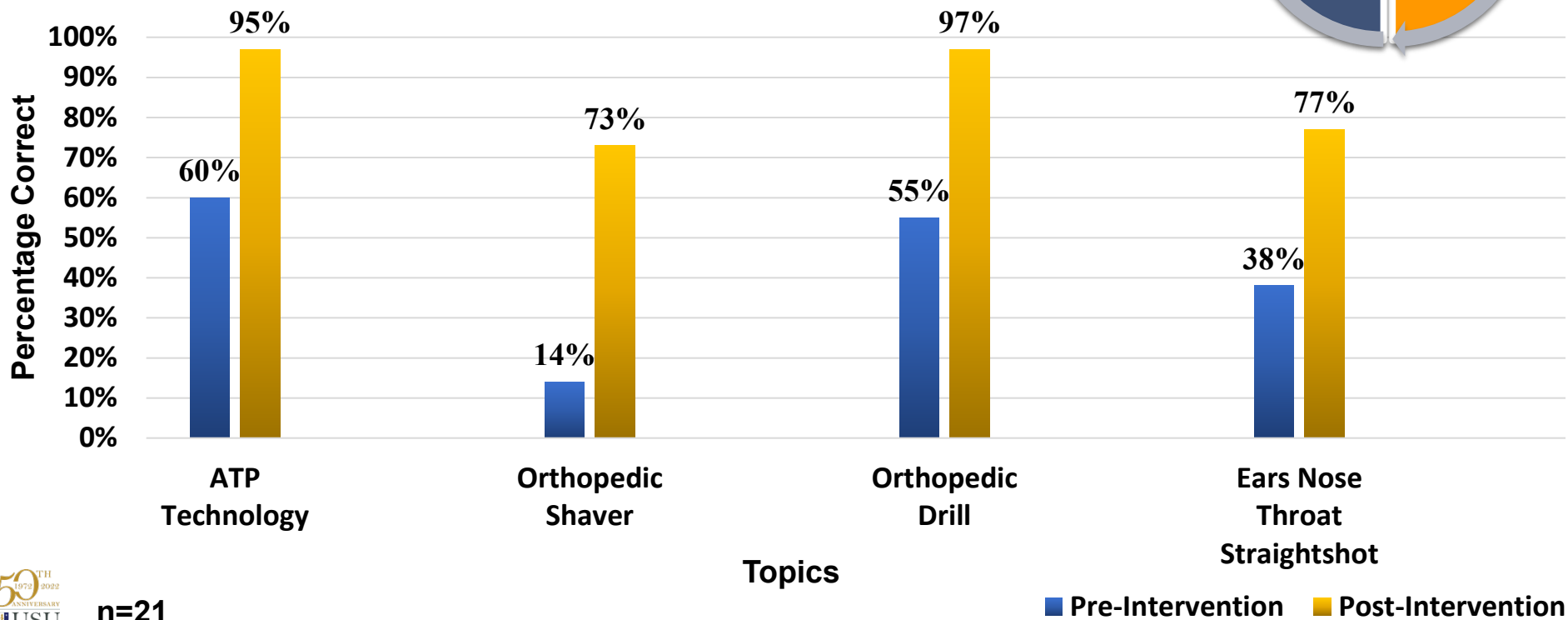
ATP Results

10 contaminated instruments

Knowledge Assessment



Knowledge Assessment Scores





Knowledge Assessment Results

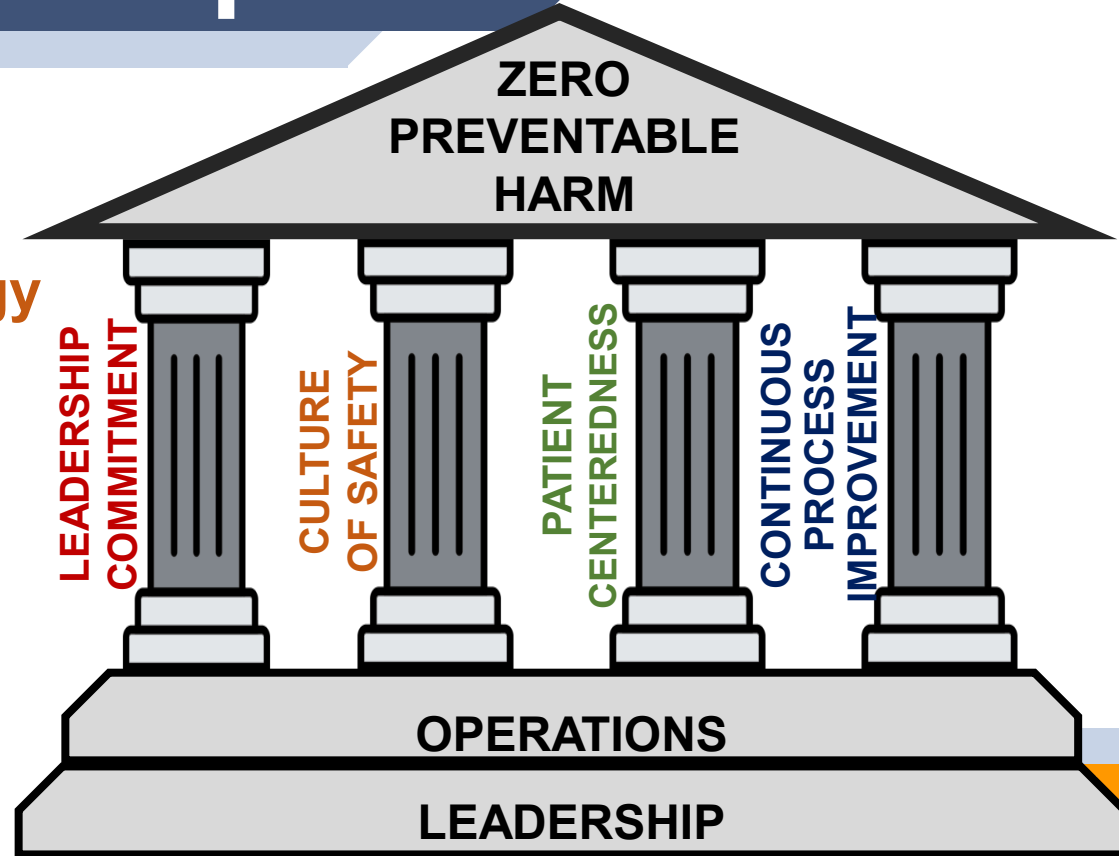
34% increase in staff knowledge

Overall Analysis



Organizational Impact

- **Recurrent audits**
→ 10 PI interventions
- **Acquired ATP technology**
→ Increase bioburden detection
- **Education bundle**
→ Zero PSR
- **Stakeholder support**
→ Achieved TJC accreditation



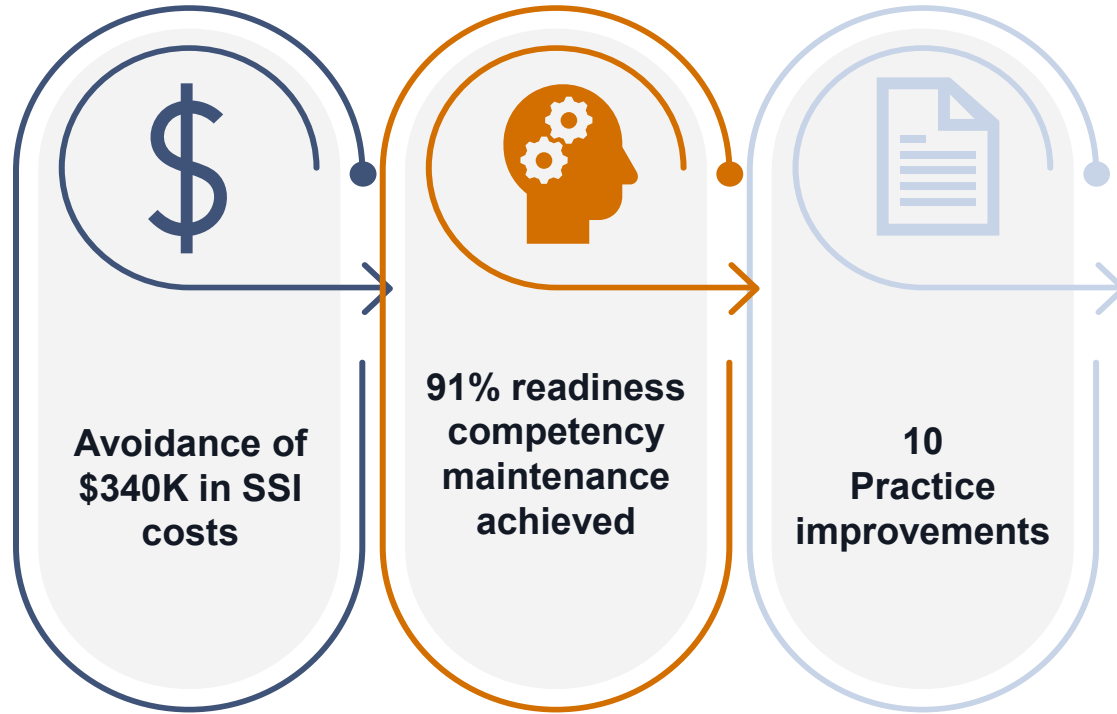
Barriers and Limitations

Point-of-Use cleaning verification

Limited operations & testing timeframe

Access to resources

Impact on MTF



Future Direction

Collaboration with DHA to:

1

Disseminate results

2

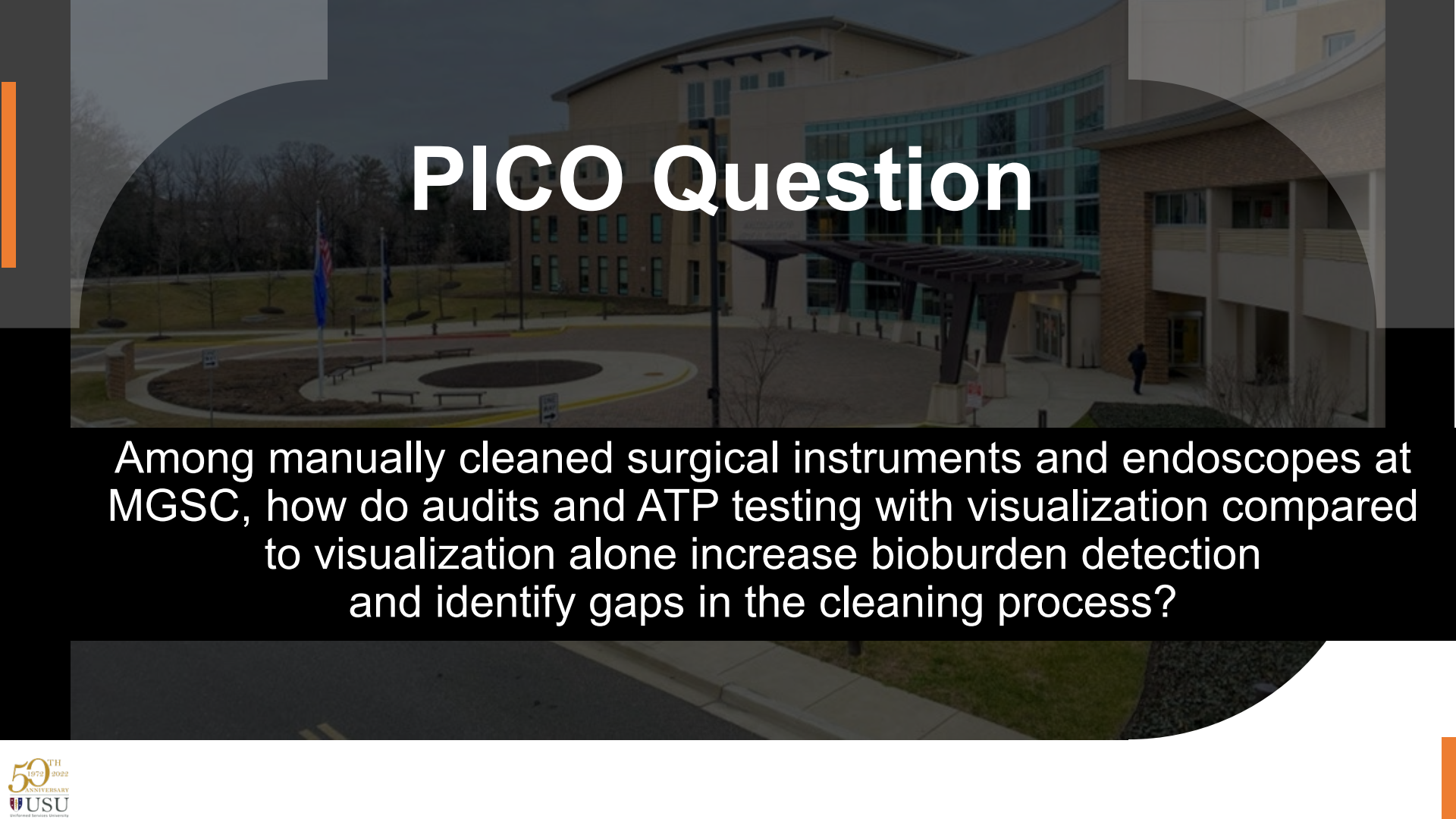
Develop program
and policy

3

Monitor
performance metrics

4

Quarterly safety
meetings



PICO Question

Among manually cleaned surgical instruments and endoscopes at MGSC, how do audits and ATP testing with visualization compared to visualization alone increase bioburden detection and identify gaps in the cleaning process?

Using Adenosine Triphosphate Bioluminescence-Based Technology to Verify Cleanliness of Perioperative High-Touch Surfaces

David F. Bradley Jr, DNP, RN, APRN, AGCNS-BC, CNOR, Lt Col, USAF, NC;

Jose A. Rodriguez, DNP, JM, RN, APRN, CCNS, CNOR, LTC, AN, USA

Surgical site infections (SSIs) comprise approximately 20% of all health care-associated infections in the United States¹ and are the most common and costly health care-associated infection.² Data adjusted to 2007 indicate that SSIs incurred annual hospital costs ranging from \$3.45 to \$10.07 billion.³ Surgical site infections may prolong the hospital length of stay and can cause patients to lose time from work,⁴ undergo reoperations,⁵ and experience an increased risk of mortality.^{4,6} Because of the costs and patient complications associated with SSIs, perioperative nurses should identify, examine,

can use to identify opportunities to improve policies and procedures, education, and training.

Adenosine triphosphate (ATP) bioluminescence-based technology testing provides an objective measurement of the levels of organic material of pathogens and can be useful in the line of en can assist le faces and e a threat to

Adenosine Triphosphate-Bioluminescence Technology as an Adjunct Tool to Validate Cleanliness of Surgical Instruments

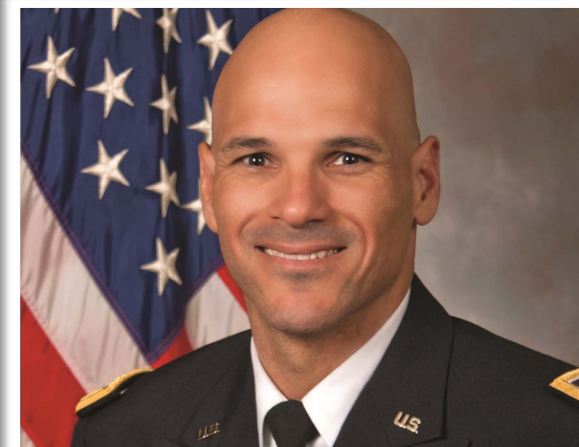
Jose A. Rodriguez, DNP, RN, APRN, CCNS, CNOR, MAJ, ANC, USA;

Gwendolyn Hooper, PhD, RN, APRN-BC, FNP

ABSTRACT

Perioperative and sterile processing department personnel commonly use visual inspection to validate surgical instrument cleanliness. This validation process does not detect microbes (eg, bacteria, viruses) and the resultant inadequately decontaminated instruments can put patients at risk for developing surgical site infections. Sterile

rapid, straightforward method to validate surgical instrument cleanliness project at a military treatment facility, staff members found that was a viable and affordable solution for detecting bioburden and compared manually and mechanically cleaned cannulated instruments, 14 of which had been manually cleaned. The con-



Summary



- Validating cleaning processes through a QA tool aligns with TJC and DHA's patient safety initiatives
- ATP technology integration can lead to \$98M in potential averted SSI costs per year in the MHS
- Adapting this concept supports the commitment to Ready Reliable Care and the Quadruple Aim

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Major Richard D. Anderson
richard.d.anderson.mil@mail.mil



Major Christy V. Mitchell
christyanne.r.mitchell.mil@mail.com