Research Article

iMedPub Journals
www.imedpub.com

DOI: 10.36648/2471-9668.6.1.01

Journal of Prevention and Infection Control
ISSN 2471-9668

2020
Vol.6 No.1:01

Infection Control Interventions to Improve Hospital-Acquired Infection Rates in Adult-Geriatric Patients

Alyssa Camille Caparros[1]*, Mary Wyckoff[2]

1 MSN AGACNP-BC, PCCN, and DNP alumni, Samuel Merritt University, Oakland, California, USA

2 Professor, PhD, DNP faculty, Samuel Merritt University, Sacramento, California, USA

***Corresponding author:** Alyssa Camille Caparros

Lyscaparros@gmail.com

Tel: 7474007895

Citation: Alyssa Camille Caparros, Mary Wyckoff (2020) Infection Control Interventions to Improve Hospital-Acquired Infection Rates in Adult-Geriatric Patients. J Prev Infec Contr Vol.6 No.1:01

Abstract

Introduction: Hospital-Acquired Infections (HAIs) are one of the leading preventable healthcare issues. HAIs have a negative impact including increased length of stay, morbidity, mortality, and increased healthcare cost. The project goal was to implement Infection Control (IC) interventions to reduce HAI rates and improve IC compliance by the healthcare workers with hand hygiene, routine fomite disinfection, and environmental decontamination. IC interventions are practices or measures to prevent the spread of infections.

Methodology: A pre- and post-interventional design was used. The project was implemented at a Magnet Hospital in California in a high acuity intermediate care telemetry unit.

Results/Discussion: There was an improvement in IC compliance by the healthcare workers, however, it is not statistically significant. There was a 70% significant reduction in HAI rates.

Limitations: There were various limitations, including Hawthorne effect, float pool staff use, and conflicting IC practices among staff. There were also possible confounding variables that may have contributed to HAIs. Additionally, there was limited data in evaluating fomite disinfection.

Conclusion: Infection control practices are a strategic methodology to reduce the risk of HAIs. Initiation of HAI protocols with ongoing data collection would determine the true impact of IC interventions on HAIs. This has major implications in healthcare since HAIs can have a tremendous negative impact on patient safety.

Received: February 27, 2020, **Accepted:** March 06, 2020, **Published:** April 30, 2020

Introduction

Hospital-acquired infections (HAIs) are a major issue in healthcare settings, especially in the hospitals. HAIs pose a safety concern for healthcare workers (HCWs) and patients [1]. Hospital infections may cause a negative impact on healthcare costs with increased length of stay (LOS) and financial burden. HAIs also have a detrimental effect on morbidity and mortality. Additionally, HAIs can increase resistance to antibiotics, while leading to long-term disability [2]. HAIs also cause complications including sepsis. HAIs are preventable and crucial steps are needed to provide a safe patient environment.

HAIs are patient infections that are acquired in a healthcare facility while receiving medical management (Centers of Disease Control and Prevention [CDC] [2,3]. HAIs are infections that occur after 48 hours of admission to a facility or within 30 days after patient discharge [4]. The primary categories include ventilator-associated pneumonia (vap), catheter-associated urinary tract infection (cauti), surgical site infection (ssi), central-line associated bloodstream infection (CLABSI), and *Clostridium difficile* infection (CDI) [5,6]. These infections can be transmitted via fomites.

Fomites are porous and nonporous objects that can be contaminated with pathogens. Fomites can present as vehicles in HAI transmission [7]. Fomites include hospital environment surfaces and patient care items. These items can be frequently contaminated by pathogens. Examples of fomites are stethoscopes, wheelchairs, tourniquets, electrocardiography lead wires, computer keyboards, mobile phones, tablets, thermometers, and hand soap or sanitizer dispensers [8]. These fomites can serve as carrier for infections. Pathogenic microorganisms that are responsible for causing HAIs are bacteria, fungi, parasites, and viruses. Bacteria is the most common pathogen responsible for causing HAIs. *Acinetobacter* is a pathogen that causes infection in the intensive care unit (ICU). *Acinetobacter* organisms are found in soil and water, which explains 80% of infections that are reported [2]. *Clostridium difficile* (c-diff) is also a very common pathogen implicated in HAIs. C-diff can be transmitted through an infected patient to others via HCWs from improperly cleansed hands [2]. *Escherichia coli*, *Staphylococcus aureus* (that includes methicillin-resistant *S. aureus* [MRSA]) are also frequently found hospital pathogens. Pathogens can be transmitted during patient care interaction such as direct contact with patients through saliva, hands, and body fluids; or through HCWs or other sources in the environment [2].

The CDC updated the HAI data and statistics and reported that in 2015, there were an estimated 687,000 HAIs in US hospitals. In addition, there was about 72,000 reported mortality of patients who had HAIs during their hospitalization [9]. HAIs cost over $30 billion annually in US healthcare [5]. HAIs are fiscally very costly accounting for billions of healthcare expenditures yearly in the US [10].

The CDC recommended steps for HAI control and prevention to decrease HAIs. By performing hand hygiene (HH) prior to and after each direct patient contact by the HCWs, it can decrease such risk and help prevent HAIs [9]. Infection control (IC) interventions can be beneficial and cost-effective [11,12]. Therefore, it is critical to implement IC interventions and follow national guidelines for IC compliance to improve the incidence of HAIs.

Gap in Clinical Practice

HAIs are one of the leading issues in healthcare that are preventable. HAIs affect one in ten patients who are hospitalized. HAIs are linked to significant morbidity and mortality, as well as increasing financial burden not only to healthcare organizations (HCOs), but also to patients [11]. Reduced HH compliance and hospital disinfection is an increasing concern with their associated risk of HAI transmission. HH that does not comply with CDC recommendations was also found to be accountable for 40% of infections that are transmitted in the hospital, and surveys showed that enhancing compliance of HH can significantly decrease HAIs [12].

On average, the CDC has estimated that HCWs follow HH guidelines less than half as frequently as they should [13]. There has been a tremendous emphasis on IC interventions with goals to decrease HAIs. However, research demonstrated a gap in HCWs' knowledge regarding fomites as vessels of transmission of pathogens, as well as practices to decrease this transmission. Having enough knowledge is not effective unless the knowledge is properly applied through IC practices [11].

Traditionally, patients have been passive in advocating for HAI prevention due to different levels of knowledge and concerns about infections; not receiving adequate information about IC and HAIs, and having the need for more awareness in terms of personal hygiene [14]. Seale and colleagues demonstrated that some patients were not likely ever to question HCWs about their IC behaviors due to feeling intimated, embarrassed, or reluctant, and other reasons of not engaging with the HCWs. Patients have expressed anxiety talking about IC [14]. Although 80% of patients were willing to assist the HCWs with IC and prevention (ICP), many did not feel comfortable saying something to HCWs such as hand sanitizing [15]. There was also a low ICP compliance that resulted in high incidence of HAIs, which indicated that changing attitudes is the best prevention for transmission of infection [16].

Despite compelling evidence showing that IC interventions help reduce the incidence of HAIs, there is still a large gap of knowledge, attitudes, and application of behaviors with IC compliance among HCWs. Further exploration about this concern is crucial. Implementing IC interventions to target the increasing HAI burden and consequences and evaluating the effectiveness of such measures in terms of improvement in HAIs are also needed.

Purpose of the Quality Improvement Project

The goal was to implement a Quality Improvement (QI) project focusing on IC interventions to improve compliance in HH, routine Fomite Disinfection (FD), and Environmental Decontamination (ED) among HCWs. Inadequate HH, FD, and ED compliance can have significant potential contributions to HAI transmission. The project also aimed to evaluate the effectiveness of these IC measures. The ultimate goal was to reduce the incidence of HAIs, thus improving patient outcomes and quality of care.

Review of Literature

The literature review was conducted using Samuel Merritt University library and search engines such as Google. Literature search terms used were HAIs, fomites, infection control interventions, hand hygiene, hospital disinfection, and environmental decontamination. There have been multiple studies showing potential fomites that were contaminated with disease-causing pathogens; studies on IC interventions to improve the incidence of HAIs; and assessing knowledge about IC practices. Aftab and colleagues conducted a descriptive cross-sectional study to assess the knowledge, attitudes, as well as the practices of HCWs about infection transmission. The investigators found a substantial gap in knowledge of fomites by the HCWs as a possible source of transmission of microorganisms and practices to decrease spread [11]. Treakle and colleagues conducted a cross-sectional study investigating the white coat contamination prevalence with vancomycin-resistant *Enterococci*, MRSA, and methicillin-sensitive *S. Aureus*. Large proportions of the white coats worn by HCWs were contaminated with hospital pathogens including MRSA. The investigators also found that white coats may be a significant source for patient-to-patient *S. Aureus* contamination [17]. Murni and colleagues conducted an interventional study design (prospective before-and-after study) evaluating the effectiveness of implementing multifaceted IC interventions and antibiotic stewardship program on HAIs [18]. Multifaceted IC interventions were found to be effective in decreasing the rate of HAIs, improving antibiotics' rational use and HH compliance, which may decrease mortality in hospitalized children in developing countries [18]. A systematic review was conducted by Haun, Hooper-Lane, and Safdar to examine the HCWs' attire and commonly used device with bacterial contamination. Stethoscopes, white coats, digital devices, and neckties were found to be frequently contaminated with bacterial pathogens, which included *S. aureus* (including MRSA), and gram negative rods [19]. Further studies are needed to explore the relationship of HCW's attire and device with clinical infection [19]. Prospective, randomized controlled trial by Burden and colleagues compared the level of bacterial contamination (that includes MRSA) of the physicians' white coats and the standardized newly laundered short-sleeved uniforms. Contamination of bacteria just within hours of putting the newly laundered uniforms was reported [20]. There was no difference in the level of bacterial contamination of these uniforms compared to the physicians' white coats that were infrequently laundered 8 hours later [20].

A prospective blinded study and post study were completed by Schroeder, Schroeder, and D'Amico which demonstrated that scrubbing the hands simultaneously and using alcohol-based foam to clean the head of the stethoscope, markedly decreased the bacterial count of stethoscopes [21]. Pal and colleagues conducted a prospective study aimed to investigate the bacterial contamination rate of mobile phones of HCWs compared to the control group (non-HCWs' phones) which demonstrated 100% contamination of mobile phones and the hands of the staff [22].

Infection Transmission

Hand hygiene compliance

HAIs are commonly viewed to be related to poor hand washing compliance. Hand washing is largely accepted as the main IC intervention, especially in the ICU [23]. The factors which cause reduced HH compliance among HCWs include irritation of the skin from the HH agents, limited materials, understaffing issue with high nurse-to-patient ratio and high patient care acuity, and other factors [10].

Fomite disinfection

There are many potential fomites, especially in healthcare. Fomites include stethoscopes, pens, bedside tables and bedside rails, thermometers, computers (including mouse and keyboards) and hospital phones and pagers [11]. Other potential objects including identification badges, purses, uniforms, and rings have also been reported [19]. Clothing contamination such as white coats and uniforms worn by HCWs were also found to be potential vectors for infection transmission [17]. Hand sanitizer dispensers also have the potential for pathogen contamination [24]. Evidence showed that stethoscopes and otoscopes were found to have 100% and 90% bacterial colonization, with MRSA found in 7.3% of stethoscopes and 9.5% in otoscopes [11]. It was reported that the reasons why HCWs did not clean their stethoscopes prior and after each patient care were lack of time, too busy, and forgetting to clean the stethoscopes in the emergency department (ED) [25].

Environmental decontamination

The hospital environment was also found to be contaminated by pathogens. Viruses, bacteria, and fungi can survive in inanimate hospital environment. IC measures that include environmental cleaning is important to get rid of potential disease-causing viruses including influenza and parainfluenza [25].

Hospital surfaces were found to be harbored by contaminants such as MRSA and VRE [11]. C-diff and other pathogens are resistant to regular cleaning agents. Environmental decontamination is an important IC measures to decrease the risk of HAI transmission and there are many disinfecting solutions to control such risk, with increased focus on HH measures [26].

Change Model: The ADKAR (**a**wareness, **d**esire, **k**nowledge, **a**bility, **r**einforcement) model was the change management framework for this project. Awareness that change was needed; desire of the staff to support such change; knowledge of how to bring about change; ability to apply the knowledge and skills; and reinforcement to maintain the change [27-28]. ICP was a vital part of hospital safety measures. The critical goal was to make the staff understand and realize that change was needed to improve HAIs (awareness). However, challenges can arise when implementing a change in any setting. Staff may resist such change or may even have passive reactions [27]. This is why the desire of the staff was crucial to participate in the change management. Unit leaders also have a critical role in helping the staff get involved in the change such as improving compliance with IC. Educating the staff on multiple areas of ICP will provide them with the knowledge and ability on how to reduce HAIs and also improve IC compliance. Reinforcement is ensuring that the staff will continue to practice good ICP measures. ICP is a continuous process and providing feedback from the unit leaders is important to ensure success of the change process.

Project Implementation: Due to the project being a quality improvement project, according to HHS regulations, there was no requirement under these regulations for the project to undergo review by an Institutional Review Board [29]. Approval from the stakeholders including the unit leaders was obtained prior to project implementation.

Design

The project used a pre- and post-intervention measures design. The monthly data was initially collected retrospectively for six months before and then two months after the intervention was implemented.

Setting

The project took place in a fast paced 36-bed intermediate care telemetry unit of a magnet designated hospital located in California. The unit provided cardiac and medical patient management care including pharmacological treatment and ventilator support.

Participants

The participants were the healthcare workers (HCWs) in the unit such as the registered nurses (RNs) and clinical care partners (CCPs) including the float pool staff assigned to the unit during the observation periods.

For HAI data collection, newly admitted patients with known or suspected infection(s) and transferred patients from other units with confirmed HAI(s) were excluded. HAIs with dialysis catheters or other catheters not accessed by the unit staff were also excluded since the staff from other units did not receive educational training on IC.

Table 1 Variable Table Worksheet.

Variable Name	Operational Definition
Hospital-acquired infections (HAIs) broken down into three (Calculated per 1000 days): **CAUTI** **CLABSI** **C-diff**	**CAUTI** rates were measured by the number of monthly patients CAUTI in the hospital unit over the number of total monthly Foley catheter days in the hospital unit times 1000. **CLABSI** rates were measured by the number of monthly patients CLABSI in the hospital unit over the number of total monthly central line days in the hospital unit times 1000. **C-diff** rates were measured by the number of monthly patient c-diff in the hospital unit over the number of total monthly patient days in the hospital unit times 1000s (day 4 after hospital admission to be considered hospital-acquired c-diff)
Hand hygiene (HH) compliance	Hand hygiene compliance was measured by dividing the number of directly observed HH actions over to the total number of HH opportunities times 100.
Fomite disinfection (FD)	Fomite disinfection was measured by dividing the number of directly observed FD actions over the total number of FD opportunities times 100.
Environmental decontamination (ED)	Environmental decontamination was measured by dividing the total number of HTWD actions over the total number of HTWD opportunities times 100.
Standardized Infection Ratio (SIR)	The SIR was measured by dividing the number of observed HAIs over the number of predicted HAIs.

Data

The variable names of the project with their operational definitions and measurements were listed in **Table 1**. To measure intervention fidelity of HH, FD, and ED compliance, the numerator consisted of the directly observed HH actions of the HCWs (for the HH compliance), directly observed FD actions (for the FD), and the high touch wipe down (HTWD) recorded by the CCPs. A checklist was made for each observation. The denominator of the three interventions consisted of the total number of items in the checklist. The numbers obtained from each intervention were multiplied by 100 to obtain meaningful results.

WHO Observation Tool

There has been a major emphasis in promoting HH in healthcare. In 2005, the first Global Patient Safety Challenge entitled "Clean Care is Safer Care" was launched. As part of the initiative, the WHO created HH guidelines including Multimodal HH Improvement Strategy (MHHIS) [30].

The WHO has 5 Moments of HH that recommends "moments" or times when the HCWs should clean their hands. This approach consisted of HH: (1) prior to touching a patient, (2) before performing clean or aseptic procedures, (3) after risk or exposure to body fluid, (4) after touching the patient, and (5) after touching patient environment [31]. The WHO Guidelines on HH in Health Care have been created with the objectives to change HCW behavior to improve compliance with HH using the 5 Moments of HH. The ultimate goal was to improve patient safety [32]. The WHO MHHIS has a Guide to Implementation with a variety of tools to assist with fostering improvement in HH in HCOs [32].

Numerous auditing tools for HH existed and most of these tools have been widely tested. These tools were also available online for public use and can be considered for use by any HCO. WHO Observation Tool is the most widely used tool to monitor HH compliance. The WHO Observation Tool is a user-friendly and a quite sophisticated tool [30]. The tool has been translated into multiple languages and has been validated extensively. The observation tool has also been used as an instrument development model for the promotional campaigns of HH in over 25 countries. The tool collects data at each HH opportunity. For each opportunity, HH indication associated with the five moments is recorded [30].

The WHO Observation Tool (https://www.who.int/gpsc/5may/tools/en/) was used to monitor HH compliance through direct observation of HH practices of HCWs.

Direct Observation

There are multiple ways to monitor HCW compliance in terms of IC behavior such as HH. Direct observation (DO) is considered to be the gold standard in monitoring HH compliance [10,30,32-34]. Monitoring compliance is an essential quality indicator in HCOs to prevent HAIs. However, DO have limitations including inter observer variation and the potential for Hawthorne effect [34,35]. Other potential biases include selection, observer, and observation bias [32]. DO can also be costly and labor extensive. It requires careful selection and training of the observers [10]. Secret observers are also great resources to minimize the potential for Hawthorne effect.

The DO method was used by the project manager to monitor compliance in HH, FD, and ED among unit staff. Due to cost and staffing issues, secret observers were not feasible.

Data collection

Pre-intervention data was collected for six months which was evaluated on a monthly basis. Monthly data was also collected post-intervention.

Outcome measures

HH compliance, routine FD, and ED were evaluated during the intervention period since these measures were new to the staff (except for the HTWD that was considered a part of the ED), and reassessed post-intervention to evaluate the effectiveness of IC interventions using HAI rates and evaluate improvement in IC practice with the three interventions. The HAI rates were the main outcome of this QI project.

Procedures

Intervention measures

Pre-intervention Period: During the pre-intervention period, the project was discussed in detail with the stakeholders such as the senior nurse scientist, practice mentor, unit leaders, and the unit staff. The author served as the project manager and observer of IC practices of the unit staff. The author followed the DO method by Magnus and colleagues on how to properly observe HH. The WHO had a training film that included scenarios where the observer had opportunities for assessing HH [36], although this was not available for viewing. The WHO PowerPoint slides was used instead, explaining the content of the training film, including how to use the observation tool (https://www.who.int/gpsc/5may/slides_accompanying_training_films_.ppt?ua=1). The ED with HTWD has already been practiced in the unit for some time by the CCPs. The unit also had a specific form where the HTWD record can be found.

Online Survey: Assessment of self-reported IC practices was gathered from the staff using six questions that focused on the importance of IC and IC practices of the staff with HH, FD, and ED. Incentives were given to the first few respondents (Starbucks gift cards) to increase participation. There were 43 respondents in the survey. Based on the survey, the respondents have basic awareness of IC and placed a very important role on ICP, including performing HH (handwashing or using alcohol-based handrub) and duration (minimum of 20 seconds), disinfecting fomites such as stethoscopes, phones, pagers, glucometers and other potential carriers of infection, and decontaminating the high touch patient care areas.

Intervention Period: Intervention Period: The project was implemented on June 01, 2019 to August 31, 2019 for three months.

IC and HAIs: During the intervention period, educational teachings regarding IC measures were provided to the staff. Active engagement of the staff was also encouraged. Staff education was provided through shift huddles, weekly unit reminders, and announcements in the unit. A weekly and monthly performance feedback was discussed to monitor progress. Education materials such as posters, pamphlets, printouts, and laminated materials covered the topics of ICP, HAIs and types of HAIs, fomites and potential for cross-contamination, HH highlighting the 5 Moments of HH by the WHO, and the importance of HH, FD, and ED. Pamphlets were disseminated to the unit staff. A weekly reminder through emails and day/night mid shift huddles were included to ensure compliance with the interventions and ongoing education.

Reminders were also placed on each patient's pod to remind staff to perform HH, disinfect stethoscopes, glucometers, and other potential fomites before and after each patient encounter using bleach wipes. Clorox bleach wipes and two types of Sani-Cloth wipes were the three surface disinfecting wipes approved for use at the hospital. Alcohol wipes do not completely eradicate the microorganisms that can be found in the stethoscopes or other fomites. Phones and pagers were disinfected with the bleach or Sani-Cloth wipes before and after each shift by the resource nurse, and as needed by the staff if risk of contamination was observed. Alcohol hand sanitizer dispensers and ABHR were also available outside of every patient room for use by the staff. There was also a sink in every patient room for hand washing.

For the ED, the CCPs disinfected the high touch areas in each patient's rooms with Bleach wipes at the beginning of each shift.

The intervention period was broken down into weeks in terms of teachings:

A. Week 1-3 – general education regarding IC including the 5 Moments of HH by the WHO, HH, FD, and ED.

B. Week 4-6 – staff teachings on how to properly perform HH (hand washing and ABHR) with the visual images by the WHO during huddles. Clarification regarding the disinfecting wipes used for HTWD by the CCPs and fomites were also discussed with the IC specialist, staff and the unit leaders. This included the type of disinfecting wipes used for HTWD and FD.

C. Week 7-8 – the staff was given printed stickers of the CDC [37]. "Clean hands count (ask me if I cleaned my hands)" to be placed on their uniforms to remind them of HH. Education on the importance of good IC practices throughout the intervention period continued.

The staff was also asked to write names of those who have done an outstanding job with IC practices. This was to increase their participation with IC measures and to motivate all staff to incorporate good IC practices into their habit. Every month, one to two staff who did an exceptional job practicing good IC such as doing hand washing, disinfecting potential fomites, or HTWD were recognized and given incentives.

Stressing the importance of IC and further education were also provided during the quarterly staff meeting in which PowerPoint slides were presented to the staff.

D. Week 9-11 – due to few cases of CLABSI in the unit, CLABSI education was provided to the staff during huddles and one-to-one education including CLABSI care bundle and maintenance care from the Association for Professionals in Infection Control and Epidemiology (APIC), TJC's "Scrub the hub!". (https://www.jointcommission.org/-/media/tjc/documents/resources/health-services-research/clabsi-toolkit/clabsi_toolkit_tool_3-21_scrub_the_hubpdf.pdf?db=web&hash=79BF0D29BD4AAF13DEC3C3DE5AB90494)

E. Week 12-13 – ongoing IC intervention including CLABSI prevention, "gel in" and "gel out" with ABHR during huddles and one-to-one education. The staff was encouraged to continuously acknowledge co-workers who exemplify great IC practices.

IC Measures: The intervention process included recording measurements of the IC interventions using three audit tools. HH was measured using the WHO Observation Tool while incorporating the 5 Moments of HH. The FD measurement tool was created by the project manager but also incorporating the same principles of HH. This measured the directly observed FD actions such as disinfecting the stethoscopes and glucometers before and after patient use, and the phones and pagers before and after each shift and as needed. The measurement also included recording the type of disinfectant that was used for FD. The high touch patient room surfaces included the bedrails, bedside table, intravenous (IV) pumps and poles, patient television, computer-on-wheels, sink, call light button, and light switch.

HH, FD, and ED practices were directly observed throughout the intervention period and these IC practices were documented and evaluated if there is an improvement in compliance with IC practices. This project can be replicated based on the above intervention steps.

Post intervention Period: The post-intervention period consisted of continued observation of IC measures such as HH, FD, and ED. The post-intervention lasted for two months from September 01, 2019 to October 31, 2019 (originally three months but was cut down due to time-constraints). To evaluate for compliance with HH in addition to the WHO Observation Tool, the Glo Germ ™ tool was used intermittently to evaluate the effectiveness of the HH. The Glo Germ ™ is a visual teaching tool to evaluate for proper hand washing technique. A Glo Germ lotion rubbed into the hands to "simulate germs". After washing hands, a UV light was used to reveal a glow that turned the invisible into "germs you can see!" [39]. Residue (bright white spots in the hands) from the Glo Germ ™ lotion indicated that the staff did not effectively perform hand washing. The Glo Germ ™ UV light showed areas of the hands that were not washed properly. Additionally, to evaluate compliance with ED, a masking spray was used to spray the high touch patient care areas prior to HTWD by the CCPs. The UV black light was then used to check if the areas were completely disinfected. Similar to the Glo Germ ™, it also showed residue(s) if the areas were not properly disinfected with Clorox bleach wipes.

Consent: Informed consent was obtained from the unit leaders and staff.

Risks: There was a minimal risk associated with the IC measures, such as loss of confidentiality. Patients were not directly involved in the project nor there was a direct treatment. However, monthly reporting of HAI patient data was collected. The unit staff was monitored and directly observed in measuring IC intervention compliance.

Benefits: Potential benefits include adherence to IC interventions and the understanding, awareness, and information achieved from this project can significantly improve HAI incidence. This can also improve patient outcomes as reduction in HAIs can prevent further complications such as sepsis and other consequences. Reduction in HAIs can lead to decreased healthcare costs and improved reimbursement rate from payers, having a significant financial impact to the organization.

Costs/Payments: There was no cost to the unit staff to participate in the project, and no payment was made. However, there were incentives given to the staff to increase participation.

Confidentiality: The identity of the unit staff was kept anonymous and confidential. However, the job titles were indicated to distinguish roles between the HCWs. Patient confidentiality were protected under the HIPAA law. Patient medical records were not accessed, however, reported mini root cause analysis paper forms of the unit HAI cases were obtained and presented by the Practice Mentors to assess if the HAI cases fall into the exclusion criteria.

Conflict of Interest: There was no financial conflict of interest disclosed.

Data Analysis

A Chi-Square test was used to analyze IC compliance data. A *p* value of <0.05 denotes a statistically significant result.

During the post-intervention period, another monitoring of HH, FD, and ED similar to that of the intervention period were assessed and the results were compared to the intervention data to evaluate the effectiveness of IC interventions. IC run charts were utilized to observe monthly HAI trends from the pre-intervention to post-intervention periods. Data analysis was performed using SPSS version 26 and Intellectus Statistics.

Results

Baseline HAI data

HAI data was collected from the months of December 2018 to May 2019. There were two CAUTIs, one CLABSI, and seven CDIs during the pre-intervention period – total of ten HAI rates. The Standardized Infection Ratio (SIR) developed by the CDC's National Healthcare Safety Network (NHSN) was used to measure the incidence of HAIs [40]. The SIR was used by the project site to track their HAI rates. It was measured by dividing the number of observed HAIs over the number of predicted HAIs **Table 1.**

Post-intervention Period

CAUTI: There was one reported case of CAUTI. However, this patient was transferred from another unit where the Foley catheter was placed. Additionally, the wound care team was strictly collaborating with the unit and strongly opposed placement of indwelling catheterization; and if catheterization should be attempted, they recommended straight catheterization instead. The most frequent cause of patient infections in healthcare facilities is attributed to indwelling urinary catheter use [41]. Evidence showed that intermittent catheterization is beneficial over indwelling catheterization in reducing CAUTI rates. It is also reported that intermittent catheterization is one of the most effective strategies (and frequently used) in patients who are having urinary retention in terms of bladder management [42].

CLABSI: Data showed five CLABSI rates (during the intervention period). Interestingly, there were significant cases of CLABSI in the unit (total of five cases) during the intervention period. However, it was found that four cases have dialysis catheters used for either hemodialysis or apheresis which were not accessed by unit staff. Additionally, there was also an increased need for float staff in the unit since the unit was one of the busiest in the hospital because of high patient admissions/discharges and complex patient care management.

CDI: Post-intervention data showed two CDI cases. The monthly HAI rates, specifically CAUTI, CLABSI, and C-diff were presented in **Figure 1 and Table 2.**

IC Intervention Compliance Rates

HH, FD, and ED compliance rates for the IC interventions are found in **Table 2.1-2.5.** FD compliance rate was difficult to assess

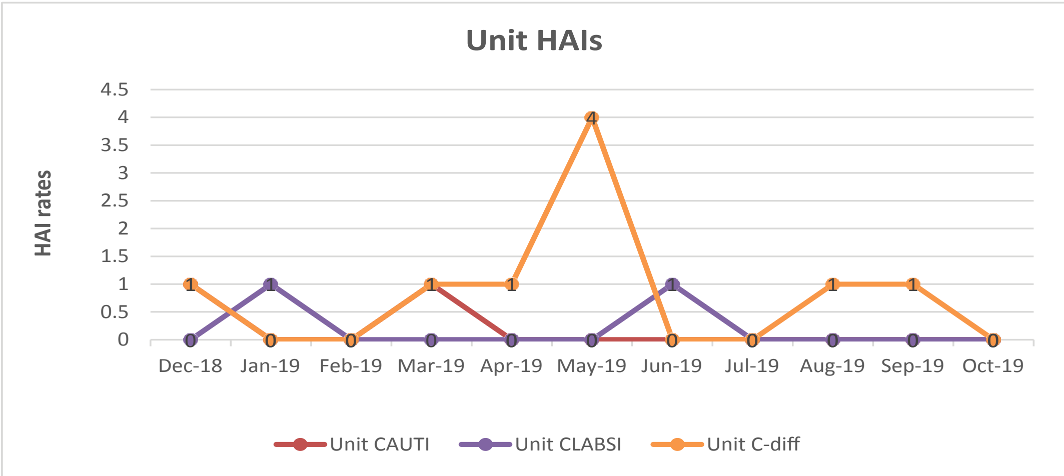

Figure 1 HAI rates.

Table 2. HAI rates.

	Unit CAUTI	Unit CLABSI	Unit C-diff
Dec-18	1	0	1
Jan-19	0	1	0
Feb-19	0	0	0
Mar-19	1	0	1
Apr-19	0	0	1
May-19	0	0	4
Jun-19	0	1	0
Jul-19	0	0	0
Aug-19	0	0	1
Sep-19	0	0	1
Oct-19	0	0	0

Table 2.1 Hand Hygiene Compliance Rates for RNs.

	Hand washing	Hand rub	Total
June	9 %	64 %	73 %
July	12.2 %	87.8 %	100 %
August	12.5 %	80.4 %	92.9 %
September	24.6 %	66.2 %	90.8 %
October	17.65 %	82.35 %	100 %

Table 2.2 Hand Hygiene Compliance Rates for CCPs.

	Hand washing	Hand rub	Total
June	5 %	32 %	37 %
July	9.75 %	65.85 %	75.6 %
August	8.3 %	91.7 %	100 %
September	17.4 %	56.5 %	73.9 %
October	5.55 %	88.88 %	94.4 %

Table 2.3 Hand Hygiene Compliance Rates for RNs + CCPs.

	Handwashing	Handrub	Total
June	8 %	54 %	62 %
July	11.4 %	80.5 %	91.9 %
August	11.76 %	82.35 %	94.1 %
September	22.73 %	63.64 %	86.4 %
October	13.5 %	84.6 %	98.1 %

Table 2.4 Fomite disinfection.

	Compliance Rate
June	33.3 %
July	83.3 %
August	100 %
September	Limited data
October	Limited data

Table 2.5 Environmental decontamination.

	Compliance Rate (Days)	Compliance Rate (Nights)
June	97.8%	97.6%
July	99.7%	100%
August	99.5%	100%
September	99.5%	99.6%
October	99.6%	99.7%

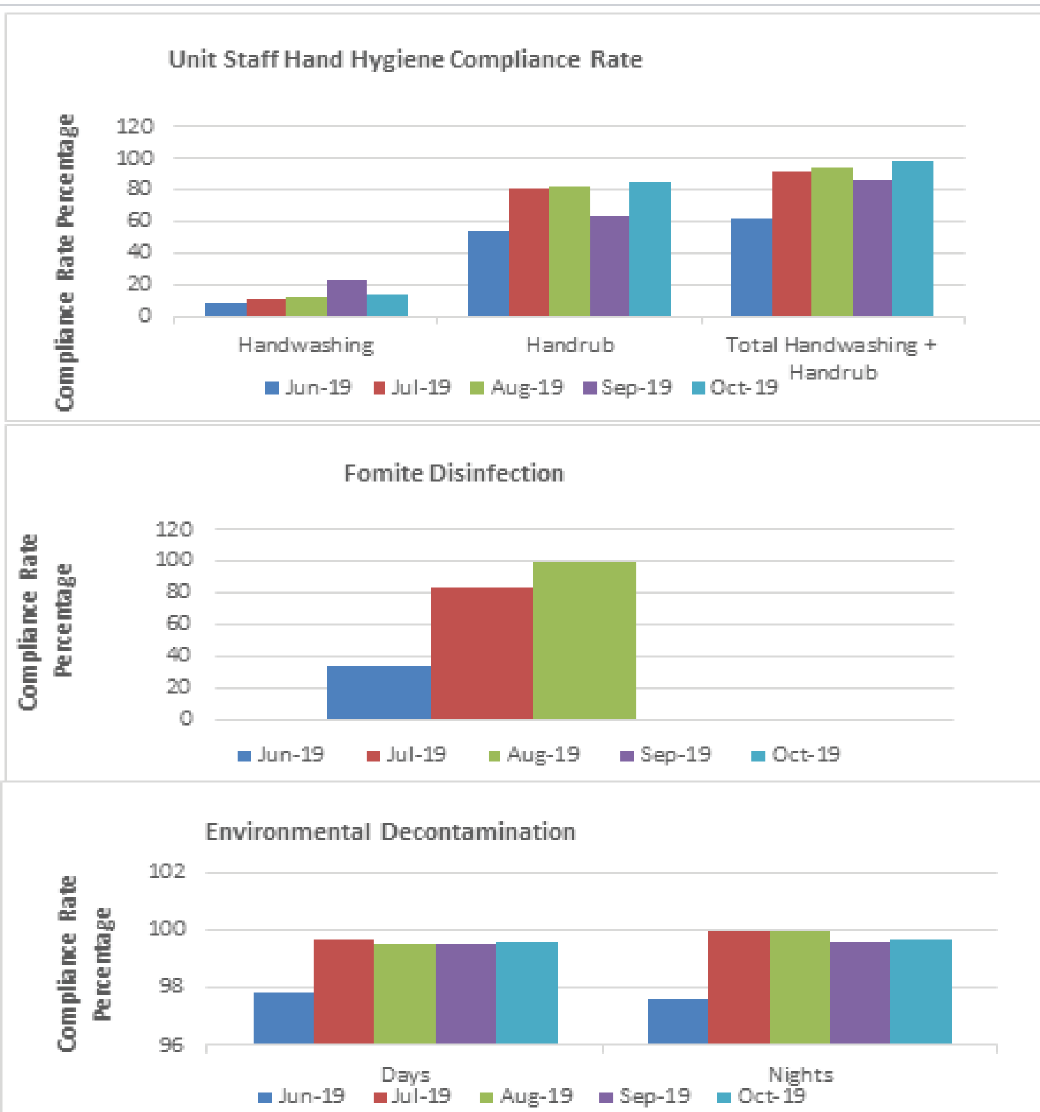

Figure 2 Infection control compliance rate and percentage.

compared to HH and ED due to difficulty observing staff with disinfecting potential fomites such as glucometer, stethoscopes, and phones/pagers. However, the resource nurse disinfected all phones and pagers at the end of the shift in preparation for the next staff use. Issues with the HTWD include having float CCPs who may not be aware of the HTWD in the floor; may not have done the HTWD; or may have not remembered documenting on the form. Some of the documentation forms were also incomplete. This may be due to CCPs not doing the forms, forgetting to submit the forms, or misplaced forms.

Discussion

A total of 459 HH opportunities and 383 HH actions (90 total sessions) were observed in the intervention and post-intervention periods. Between the months of June to August 2019, there were 256 actions out of 319 opportunities (53 sessions) in the intervention period. Post-intervention period consisted of 127 HH action out of 140 HH opportunities (37 sessions). Using the Chi-Square test to measure the HH variables, χ^2 = 0.6813 not significant with p = .4092. However, an increase in HH compliance was found in the post-intervention period (90.7%) compared to the intervention period (80.3%).

During the post-intervention period, the HH compliance was evaluated using the Glo Germ™ UV light. There were 96 participants, and 70 RNs and CCPs (73%) were evaluated and they were able to demonstrate effective hand washing. ED with HTWD was also evaluated using the marking spray with UV light. Twelve out of 20 CCPs (60%) were also evaluated and they were able to demonstrate effective HTWD as evidenced by complete decontamination of high touch patient care areas.

Dayshift ED during the intervention period showed 2192 HTWD out of 2214 opportunities (99.1%) and post-intervention showed 1729 HTWD out of 1737 opportunities (99.5%). Nightshift ED during the intervention period showed 1901 HTWD out of 1918 opportunities (99.1%), and post-intervention showed 1489 HTWD out of 1494 opportunities (99.7%). Due to lack of data, FD data were not analyzed.

HAI data showed one CAUTI case post-intervention. However, it was an ICU transfer and therefore excluded from the data. Additionally, despite the CLABSI outbreak, four cases were excluded following the exclusion criteria (presence of dialysis catheters). The unit staff did not access these types of central lines. Only hemodialysis nurses from a different unit department can only access the site during patient hemodialysis or apheresis. There were ten HAI rates during the pre-intervention period. During the post-intervention period, there were total of three HAI rates minus the excluded cases.

Data showed a significant improvement in HAI rates from pre-intervention to post-intervention period with 70% reduction from ten cases to three cases of HAIs. However, post-intervention phase was cut down to two months due to time constraints, to allow ample time for data analysis as seen in **Table 2**.

Conclusion

There was a statistically non-significant difference between the hand hygiene variables. However, there was a 10.4% improvement in HH compliance in the post-intervention from the intervention period. Given the excellent ED compliance rates throughout the intervention and post-intervention period (over 99% compliance) with no significant difference, data analysis was not performed. Due to lack of data, fomite disinfection data analysis was not calculated. Additionally, there was a 70% reduction in hospital-acquired infection rates. Initiation of infection control protocols with ongoing data collection would determine the true impact of infection control interventions on hospital-acquired infections.

This project has a major implication in healthcare especially that hospital-acquired infections are a major culprit for increased patient morbidity, length of stay, and mortality. Hospital-acquired infections also have negative effect on healthcare costs. These infections are preventable, and interventions are needed to reduce infection rates. Infection control and prevention is an effective strategy to minimize the risk of infection. Healthcare workers are the patient's first line caregivers and it is our main responsibility as part of the healthcare team to ensure that our patients are safe from harm. Hand hygiene, routine fomite disinfection, and environmental decontamination are basic infection control practices that we can incorporate in our daily routine to help prevent the transmission of infection. These are simple measures that can positively impact patient safety.

Limitations

There were few limitations of the project. The main limitation was the presence of Hawthorne effect. This was not minimized by the variability of visit schedule of the project manager to the unit at different times of the day and days of the week (including weekends and nighttime hours). Secret observation was not feasible and recruiting secret observers to perform DO in a busy unit was very challenging. Due to this reason, the staff was aware that they were being audited for their infection control practices, thus skewing the data. The other limitation was staffing issues. Due to the high-acuity patient demands and patient volumes, the unit regularly utilized nursing staff from the float pool team to fill in the need. The float pool RNs and CCPs were not unit staff and they were not usually aware of the daily practices in the unit. This made it difficult to completely educate them and monitor their compliance especially that their full cooperation was difficult to obtain. Another limitation was the conflicting practices or miscommunication between the staff in terms of infection control early in the project implementation. Some of the staff used Sani-Cloth wipes (germicidal disinfecting wipes) to clean the glucometer and for the HTWD even though the hospital policy stated to use Clorox bleach wipes. Some CCPs also did not do HTWD on the IV pump (but cleaned around it and the IV pole) with the concern of making any change to the IV medication such as accidentally changing the rate or possibly turning it off.

In terms of the sudden rise in the CLABSI cases during the intervention period, confounding variables may have influenced these infections. IC is a complex process and IC measures such as HH, FD, and ED are not all inclusive to completely eradicate the risk of infection. There were also other factors such as patient comorbidities, immunosuppression, antibiotic use, or complex patient care needs among many others. These patients had higher risk for HAIs.

Acknowledgments

This project was completed in partial fulfillment of the requirements for the Doctor of Nursing Practice (DNP) degree at Samuel Merritt University (SMU), Oakland, CA. First of all, I would like to thank my school, SMU for providing me with educational resources to help implement this project. I would like to thank my project chair, Dr. Mary Wyckoff, who was also the co-author of this project, for being such an excellent teacher and for her continuous guidance, support, and feedback throughout the project. She offered great feedback and tremendous assistance in shaping and completing this project. I would also like to acknowledge the stakeholders of the project site for their support in regard to the process of implementing this quality improvement project. Additionally, I would like to thank my practice mentors Ms. Susan Singh and Ms. Mary Nichols-Lawanson for their assistance in data collection and great feedback and recommendations to help improve this project. I also would like to thank the unit leaders and staff for their full support and cooperation in completing the project. I also would like to thank Dr. Ellen Daroszewski, SMU Interim DNP Director, for her assistance with final corrections including data analysis. Lastly, I would like to thank my fiancé Kevin Quinonez for being very supportive of this project. I would not have done this without his unconditional love and support knowing that this project would require a great amount of time away from family.

Funding

The costs incurred in the project implementation were personally paid by the primary author, AC. However, Samuel Merritt University would cover the publishing fee through reimbursement to the author.

References

1. Mehta Y, Gupta A, Todi S, Myatra S, Samaddar DP, et al. (2014). Guidelines for prevention of hospital acquired infections. Indian J Crit Care Med 8: 149-163.
2. Khan HA, Baig FK, Mehboob R (2017). Nosocomial infections epidemiology, prevention, control and surveillance. Asian Pac J Trop Biomed 7: 478-482.
3. Centers for Disease Control and Prevention (2019a). National data for acute care hospitals, year 2017. Retrieved from https://gis.cdc.gov/grasp/PSA/HAIreport.html
4. Haque M, Sartelli M, McKimm J, Abu Bakar M (2018). Health care-associated infections-An overview. Infect and Drug Resi 11: 2321-2333.
5. Anderson DJ, Pyatt DG, WeberDJ, Rutala WA and North Carolina Department of Public Health HAI Advisory Group (2013). State wide costs of healthcare-associated infection estimates for acute care hospitals in north behavior. Am J of Infec Cont 41: 764-768.
6. Centers for Disease Control and Prevention (2014, March 26). Types of healthcare-associated infections. Retrieved from https://www.cdc.gov/hai/infectiontypes.html
7. Boone SA, Gerba CP (2007). Significance of fomites in the spread of respiratory and enteric viral disease. App and Envi Microbiol, 73: 1687-1696.
8. Kanamori H, Rutala WA, Weber DJ (2017). The role of patient care items as a fomite in healthcare-associated outbreaks and infection prevention. Clin Infect Pract 65: 1412-1419.
9. Centers for Disease Control and Prevention (2018, October 05). Data portal. Retrieved from https://www.cdc.gov/hai/data/portal/index.html
10. Srejic E. (2015). Hand hygiene compliance monitoring provides benefits, challenges. Infection Control Today. Retrieved from https://www.infectioncontroltoday.com/hand-hygiene/hand-hygiene-compliance-monitoring-provides-benefits-challenges.
11. Aftab HB, Zia B, Zahid, MF, Raheem A, Beg MA (2015). Knowledge, attitude, and practices of healthcare personnel regarding the transmission of pathogens via fomites at a tertiary care hospital in Karachi, Pakistan. Open Forum Infect Dis *3:* 1-2*.*
12. Revelas A (2012). Healthcare -associated infections: A public health problem. J of the Nigeria Medi Ass 53: 59-64.
13. Brockway M. (2018). Hand hygiene compliance now mandatory in all ambulatory care settings. The Joint Commission. Retrieved from https://www.jointcommission.org/ambulatory_buzz/hand_hygiene_compliance_now_mandatory_in_all_ambulatory_care_settings/
14. Seale H, Travaglia J, Chughtai AA, Phillipson L, Novytska Y (2015a). "I don't want to cause any trouble': the attitudes of hospital patients towards patient empowerment strategies to reduce healthcare-acquired infections. J of Infec Prev 16: 167-173.
15. Seale H, Novytska Y, Gallard J, Kaur R (2015b). Examining hospital patients' knowledge and attitudes toward hospital-acquired infections and their participation in infection control. Infec Cont & Hosp Epidem *36*: 461-3.
16. Ocran I, Tagoe D (2014). Knowledge and attitude of healthcare workers and patients on healthcare associated infections in a regional hospital in Ghana. Asian Pac J Trop Dis 4: 135-139.
17. Treakle AM, Thom KA, Furuno, JP, Strauss SM, Harris AD (2009). Bacterial contamination of health care workers' white coats. Am J of Infect Cont 37:101-105.
18. Murni IK, Duke T, Kinney S, Daley AJ, Soenarto Y (2015). Reducing hospital-acquired infections and improving the rational use of antibiotics in a developing country: an effectiveness study. Archives of Disease in Childhood 100: 454-459.
19. Haun N, Hooper-Lane C, Safda N (2016). Healthcare personnel attire and devices as fomites: A systematic review. Infection Control and Hospital Epidemiology 37: 1367-1373.
20. Burden M, Cervantes L, Weed D, Keniston A, Price CS (2011). Newly cleaned physician uniforms and infrequently washed white coats have similar rates of bacterial contamination after an 8-hour workday: A randomized controlled trial. Am J Hosp Med 6: 177-82.
21. Schroeder A, Schroeder MA, D'Amico F (2009). What's growing on your stethoscope? (And what you can do about it). The J of Fam Pract 58: 404-409.
22. Pal S, Juyal D, Adekhandi S, Sharma M, Prakash R, et al. (2015). Mobile phones: Reservoirs for the transmission of nosocomial pathogens. Adva Biomedi Res 4: 144.
23. Salama MF, Jamal WY, Al Mousa H, Al-AbdulGhani KA, & Rotimi VO (2013). The effect of hand hygiene compliance on hospital-acquired infections in an ICU setting in a Kuwaiti teaching hospital. *J Infe and PubHealth* 6: 27-34.
24. Eiref S, Leitman I, Riley W (2012). Hand sanitizer dispensers and associated hospital-acquired infections: friend or fomite?. Surg Infect 13: 137-140.

25. Tang PP, Worster A, Srigley JA, Main CL (2011). Examination of staphylococcal stethoscope contamination in the emergency department (pilot) study (EXSSCITED pilot study). CJEM 13: 239-244.

26. Weinstein RA, Hota B (2004). Contamination, disinfection, and cross-colonization: Are hospital surfaces reservoirs for nosocomial infection? Clin Infect Pract 39: 1182-1189.

27. Pearson S (2018). What's the ADKAR model and how to use it. Tallyfy. Retrieved from https://tallyfy.com/adkar-model/

28. Prosci (n.d.). The prosci ADKAR model. Retrieved from https://www.prosci.com/adkar

29. HHS.gov (n.d.). Quality improvement activities FAQs. Retrieved from https://www.hhs.gov/ohrp/regulations-and-policy/guidance/faq/quality-improvement-activities/index.html

30. The Joint Commission (2010, May 04). Measuring hand hygiene adherence: Overcoming the challenges. Retrieved from https://www.jointcommission.org/topics/hai_hand_hygiene.aspx

31. World Health Organization (2018). My 5 moments for hand hygiene. Retrieved from http://www.who.int/infection-prevention/campaigns/clean-hands/5moments/en/

32. World Health Organization (2009). WHO guidelines on hand hygiene in health care: First global patient safety challenge clean care is safer care. Retrieved from whqlibdoc.who.int/publications/2009/9789241597906_eng.pdf

33. Chen LF, Carriker C, Staheli R, Isaacs P, Elliott B, et al. (2013). Observing and improving hand hygiene compliance: Implementation and refinement of an electronic-assisted direct-observer hand hygiene audit program. Infect Control Hosp Epidemiol 34: 207-210.

34. Garcell HG, Arias AV, Miranda FR, Jimenez RR, Serrano RNA (2017). Direct observation of hand hygiene can show differences in staff compliance: Do we need to evaluate the accuracy for patient safety? Qatar Med J 2: 1.

35. Chen LF, Weg MWV, Hofmann DA, Reisinger HS (2015). The hawthorne effect in infection prevention and epidemiology. Infect Control Hosp Epidemiol *36*: 1444-1450.

36. Magnus TP, Marra AR, Camargo TS, Victor ES, Costa LD (2015). Measuring hand hygiene compliance rates in different special care settings: A comparative study of methodologies. Intl J Infect Dis 33: 205-208.

37. Centers for Disease Control and Prevention (2019c, June). Hand hygiene in healthcare settings. Retrieved from https://www.cdc.gov/handhygiene/campaign/promotional.html

38. The Joint Commission (2013, Nov 20). Scrub the hub! Retrieved from https://www.jointcommission.org/-/media/tjc/documents/resources/health-services-research/clabsi-toolkit/clabsi_toolkit_tool_3-21_scrub_the_hubpdf.pdf?db=web&hash=79BF0D29BD4AAF13DEC3C3DE5AB90494

39. GloGerm ™ (n.d.). The original visual tool for teaching proper handwashing, aseptic techniques, and general infection control. Retrieved from https://www.glogerm.com/#

40. Centers for Disease Control and Prevention (2019b, March). The NHSN standardized infection ratio (SIR). Retrieved from https://www.cdc.gov/nhsn/pdfs/ps-analysis-resources/nhsn-sir-guide.pdf

41. Nicolle LE (2014). Catheter associated urinary tract infections. Antimicro Resi Infect Control *3*: 23.

42. Lopez JR, Stucka SA (2016). Decreased Foley insertion: Serial straight catheterization versus indwelling catheterization. Lehigh Valley Health Network LVHN Scholarly Works 1: 34-35.

43. Intellectus Statistics (2017). Intellectus Statistics [Online computer software]. Retrieved from http://analyze.intellectusstatistics.com/