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Bleach-It-Away Clostridium difficile

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This is to certify that the doctoral study by

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has been found to be complete and satisfactory in all respects,
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Abstract

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MS, Walden University, 2010

Project Submitted in Partial Fulfillment

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Abstract

Hospital-associated infections (HAIs) are infections patients contract as a result of being hospitalized. HAI rates decreased for almost all pathogens in the past few years, with the exception of *Clostridium difficile* infections (CDIs), which have been steadily climbing, placing hospital-acquired CDI at the top of the HAI list. The Center for Disease Control and Prevention reported in 2010 almost a half a million people were infected with CDIs yearly in the United States, and CDIs claimed the lives of approximately 29,000 people, representing a 4-fold increase from 1993. To address the problem in the local hospital, a quality improvement initiative called Bleach-It-Away was initiated. The initiative involved nurses wiping down the high touch areas in the patient's medical intensive care (MICU) rooms once every shift. The purpose of this quantitative research project was to evaluate the effectiveness of the Bleach-It-Away practice. The project question asked if the Bleach-It-Away practice was effective in reducing CDI rates. Deidentified CDI rates were provided by the clinical practice site covering a period of 12 months prior to implementation and 12 months after implementation of the practice. An independent *t-test* was used to determine whether there were significant improvements in CDI rates in the MICU. No significant improvement was seen in the postimplementation total CDI rates ($p=.07$) compared to the preimplementation rates. While the process did not demonstrate a significant improvement, positive social change is possible as hospitals recognize the many factors contributing to CDIs and the need for collaboration from various disciplines to control the problem.

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Section 1: Nature of the Project

Introduction

The purpose of this doctoral project was to evaluate the impact of the recently implemented Bleach-It-Away practice on the incidence of *Clostridium difficile* infections (CDIs) at a community acute care hospital in the medical intensive care unit (MICU) in California. The desired nursing practice outcome was the elimination of hospital-acquired *C difficile* infection (HA-CDI) by eliminating *C difficile* from the patient's environment. Bleach-It-Away requires the bedside nurse to wipe down the patient's room once per shift, concentrating on the high-touch areas with Food and Drug Administration (FDA)-approved bleach-based wipes.

Hospital-acquired infection caused by the *C difficile* bacterium has decreased 8% in the United States; however, in California, the rate increased 9% from 2011 to 2014 (National Healthcare Safety Network [NHSN], 2016). The *C difficile* organism can be easily transmitted by fecal-oral route or aerosolized endospores contaminating surfaces such as door handles, patient bed rails, light switches, and computers in the patient's room; the organism can then be passed on to nurses and patients (Best et al., 2017). Nurses and patients who were in contact continually reinfect one another through the daily process of patient care. Should there be an elimination of the *C difficile* organism it would create a positive social change in the community and in this MICU by sparing the patient from agonizing and debilitating diarrhea and gastrointestinal problems.

Problem Statement

C difficile continued to be a serious problem in the MICU in this community acute hospital. The focus of the DNP project was to evaluate the effectiveness of the Bleach-It-Away practice. Despite the implementation of several strategies to eliminate infections related to C *difficile* over the past 2 years, the MICU continues to experience a rise in the number of cases of CDIs. In 2015, the total reported cases of HA-CDI were 10, and in 2016 it increased to 14 cases, an increase of 29%, and the first 10 months of 2017, a total of eight cases were reported in the MICU. However, according to the ICU supervisor, Ms. Navaro, the MICU has been CDI-free since July 2017.

The evaluation of the effectiveness of Bleach-It-Away is important because it provides critical information to the bedside nurse, medical unit, the hospital, and the community to prevented patients from suffering the agonizing effects of CDIs. This hospital-acquired infection is devastating both physically and emotionally; it has the potential for enormous medical and financial consequences for the patients.

This project has great significance to the nursing profession by requiring nurses to take on another responsibility. Nurses possess the education and knowledge to assure the quality of care and patient safety. The new task for nurses could either come with a positive acceptance of the implemented practice. Where the bedside nurse embraced the opportunity and control to protect their patients from infection, or it could come with an adverse reaction, where the nurse's view this as an inconvenience and considered this task beneath their skill set, creating a barrier to the success of the project.

Purpose

The purpose of this project was to evaluate the impact the Bleach-It-Away intervention had on the occurrences of HA-CDI in the MICU. In the unit, after patients with CDIs were discharged, their rooms were cleaned using a process called terminal cleaning, which included the use of bleach-based solutions. The average length of stay for a CDI patient was between 3 to 5 days in the MICU. Cleaning with a bleach-based product was especially crucial because *C difficile* spores are resistant to most other cleaning products. Spores on surfaces in the patient's environment are capable of infecting any viable host, most likely the patient in the infected room; however, these spores could be transported throughout the hospital and introduced to another unsuspecting host (Shrestha, Bime & Taleban, 2017).

The gap in the nursing practice was the lack of attention to the hospital environment throughout the CDI patient's hospitalization until the discharge or transfer of the patient. The spores' ability to spread easily between the patient and nurse, makes the nurses action of being vigilant about cleaning critical. Designated high-touch surfaces were cleaned in the patient's room every shift, which decreased the number of infectious agents in the patient's environment, thereby drastically reducing HA-CDIs.

The practice-focused question that guided this project was: Is the Bleach-It-Away practice effective in combating the *C difficile* bacterium, thereby eliminating HA-CDIs as a result of implementing this practice? I answered this question by reviewing the data obtained from the infection control department. Additionally, the primary measurement of success will be the absence of any CDIs after the implementation of Bleach-It-Away

practices occurs. However, the result was important information to also forward to the nursing staff of the MICU, to view Bleach-It-Away's benefits and encourage commitment to the implementation of this intervention as a long-term solution to HA-CDIs.

Nature of the Doctoral Project

The review of the literature was comprehensive and thorough, and I provided the theoretical underpinnings in support of the project. Databases for the search consisted of CINAHL, PubMed, OVID, Medline, Cochrane, and Google Scholar. The majority of scholarly sources I used for this project were not more than 5 years old and peer-reviewed. I organized and analyzed evidence in Microsoft Excel and Zotero.

Archival and operational data were available, tracking the incidence of CDIs, and I evaluated the data to determine the impact of the Bleach-It-Away intervention on rates of HA-CDI. I reviewed and interpreted the data and created a report outlining the findings and the significance of the Bleach-It-Away practice.

Significance

The success of the Bleach-It-Away practice could significantly impact stakeholders including patients, nurses, and the project facility. The stakeholder most effected and who would experience the greatest impact are the hospitalized patients, because they no longer need to suffer from the horrible experience of relentless diarrhea and pain from gastrointestinal problems. The greatest benefit is the ability to end and reverse the rising trend the MICU, with the potential residual effect of decreasing or eliminating the financial waste and lost revenue from third party payers.

This doctoral project contributes to nursing practice because it empowers nurses to look beyond the patient and to look at the environment more broadly. It provides knowledge and evidence to the nursing profession. The practice of cleaning the patient's environment with a bleach-based solution could cross over to any frontline nurse working on other units throughout the organization. The nurse has the tools to keep their patients safe and to contribute to positive social change. The acute hospital will not lose reimbursement revenue because a patient was diagnosed with a hospital-acquired illness. The health care facility can reestablish a positive standing in the community as a safe place to obtain care.

Summary

The rate of infection from *C difficile* had increased for this facility in the past few years. Despite their efforts, patients were still contracting a CDI, which is considered a preventable illness, while hospitalized. The implementation of the Bleach-It-Away practice helped eliminate CDIs. Frontline nurses were empowered by protecting their patients as a result of using the Bleach-It-Away practice. In this doctoral project, I evaluated the effectiveness of this practice, assessing the data produced by this practice and data obtained through research.

In Section 2, I discuss the background and context of the project. In this section I also explain the concepts, models, and theories of *C difficile* and its components. Additionally, I address the relevance of the project as it relates to the nursing practice. I discuss my role as a DNP student.

Section 2: Background and Context

Introduction

The practice problem for my project was the following: Is the Bleach-It-Away practice effective in combating the *C difficile* bacterium, thereby eliminating HA-CDIs as a result of implementing this practice? The purpose of the project was to evaluate the impact of the Bleach-It-Away intervention on the incidence of HA-CDI in the MICU. The implemented practice enhances the current practice of terminal cleaning in rooms previously occupied by a patient with CDI. The cleaning method includes the use of Environmental Protection Agency (EPA) approved bleach-based solutions. In this section, I present pertinent concepts, models, and theories; discuss the project's relevance to the nursing practice; describe the local background and context; and address my role as a DNP student.

Concepts, Models, and theories

C difficile:

C difficile is a gram-positive, anaerobic, spore-forming, rod-shaped pathogen (Vindigni & Surawicz, 2015). It has been over 80 years since the discovery of *C difficile* by Hall and O'Toole, in 1935. The *C difficile* findings came from meconium and stool of healthy newborn infants (Hall & O'Toole, 1935). The logical and initial deduction was that *C difficile* was not harmful to humans and simply part of the microbiota in the gut. In a study by Savage and Dubos (1968), results did not support Hall and O'Toole's conclusion; they found *C difficile* was deadly in mice and responsible for numerous clinical diseases in humans.

Since the first identification of *C difficile,* scientists discovered unique qualities this bacterium has that very few other bacteria have, resulting in a powerful and deadly organism. *C difficile* causes disease through the release of entertoxin A and cytotoxin B, causing a chain reaction of other actions to occur. An active bacterium is considered to be in a vegetative state, most bacterium's vegetative cells cannot survive an environment lacking their nutrients, often considered a stressful environment (Seekatz & Young, 2014). *C difficile* is one of the few bacteria with the ability to survive in stressful environments. When *C difficile* vegetative cells encounter an environment lacking the nutrients it needs to thrive it immediately transforms into bacterial endospores, providing the protection needed to survive without vital nutrients. This transition to endospore formation is a pivotal moment in the longevity of *C difficile* and greatly contributes to the ease in which *C difficile* is transmitted (Vindigni & Surawicz, 2015). Endospores are dormant and nonreproductive cells; their primary job is to protect the genetic material of *C difficile* (VindiWeber, Anderson, Sexton & Rutala, 2013).

This gram-positive, anaerobic, spore-forming, rod-shaped pathogen is especially problematic in the clinical setting because of its ability to survive for up to five months. Health care settings are not the only problem, CDIs have become increasingly more problematic in the community setting for the same reasons (Luciano & Zuckerbraun, 2014). *C difficile* endospore formation is central to the ease of the transmission cycle, from contaminated surfaces in a patient's environment to health care workers to patients and back (Gladys et al., 2014). Typically, sporulation is the outcome of environmental stresses (Weber, 2013).

In the hospital setting there are various methods of transferring *C difficile* in a vegetative state or as an endospore. It is transferred from patient-to-patient, HCW-patient, or from contaminated surfaces in and outside the patient's room (Weber, 2013). There are three methods of the transmission of *C difficile* in the hospital setting (Figure 1). First, *C difficile* bacterium transferred from the hands of the HCW to a noninfected patient. Second, the pathogen transferred via the contaminated environment and then directly into the mouth or into the colon of the noninfected patient or HCW. Third and final the mode is when the HCWs are contaminated from the environment and indirectly transfer to a noninfected patient. This can be a vicious cycle if not controlled.

Clinical symptoms range from mild diarrhea to sudden onset of inflammation of the large intestines known as pseudomembranous colitis (Furuya-Kanamori et al., 2015; Luciano & Zuckerbraun, 2014). Other clinical symptom can include fever, nausea, and abdominal pain. Complications may include pseudomembranous colitis, toxic megacolon, and perforation of the colon, sepsis, and death (Olson, Shaukat, Schwehr, Shippee, Wilt, 2016). Asymptomatic *C difficile* colonization begins with the ingestion of *C difficile* spores or vegetative bacterium (Lucado, Gould & Elixhauser, 2012; Luciano & Zuckerbraun, 2014). The spores survive the gastric acid and germinate into vegetative cells in the anaerobic environment of the colon (Sheekatz & Young, 2014).

Hospital-Acquired *C difficile*

Hand Hygiene

C difficile is transferred by oral-fecal route, and the primary method of transmission is from the hands of the health care staff (Magil et al., 2014). This was

crucial information when developing an intervention in preventing the spread of *C difficile*. The assumption was that health care workers were not washing their hands effectively, thus spreading *C difficile* infectious agents (Dubberke, 2014; Nagaraja, Visintainer, Hass, Menz, Wormser, & Montecalvo, 2015). Health care workers not adequately washing their hands with soap and water may suggest patient care was substandard. While the rate of HA-CDIs was on the rise, all the other HAIs in the facility decreased. Most bacterium causing the HAIs are eliminated from hands with the alcohol-based hand sanitizers (ABHSs), which does not remove *C diffic*ile sufficiently (Jabbar *et al*, 2010).

According to the California Department of Public Health ([CDPH], 2016), reported up to a 39% decrease in incidences with central line-associated infection (CLABSI), bloodstream infections due to methicillin-resistant Staphylococcus aureus (MRSA BSI), vancomycin-resistant enterococci (VRE BSI), and surgical site infections (SSI). CDIs were the only reported HAI with increased incidence rate (8%), between 2015 to 2016 (CDPH, 2016).

The increase compliance in the use of alcohol-based hand sanitizers by nurses contributes to the decrease HAI incidence rates. *C difficile* is not eliminated by the alcohol-based hand sanitizers, which is reflective in the 2016 report by the CDPH. Reports determined hand washing with soap and water is the preferred method of hand hygiene to eliminate *C difficile.* improved their compliance with hand washing with soap and water has been proven to be the preferred method of decreasing the spread of *C difficile* when caring for CDI patients (Edmonds et al., 2013; Jabbar et al., 2010). Both

Edmonds et al. and Jabbar et al. studied the effects of ABHSs verses soap and water hand washing for hand hygiene. Jabbar et al. studied the ABHS's effectiveness in decreasing *C difficile* spore transmission through physical contact. In addition to evaluating ABHSs the study also examined the effectiveness of using only water, and hand washing with chlorhexidine soap-and-water.

Jabbar et al. (2010) found hand washing with soap and water was significantly more effective at removing *C difficile* spores from the hands of volunteers than ABHSs. Residual spores were readily transferred by a handshake after the use of ABHS. Jabar's data showed there were no statistically significant differences between the reductions achieved by the two of the three ABHSs used in the study. After ABHS use, handshaking transferred a mean of 30% of the residual *C difficile* spores to the hands of recipients. The size of the study was small with only 10 volunteers, perhaps a larger pool of volunteers may reveal different results.

Edmonds et al. (2013), evaluated the efficacy of hand washing in removing *C difficile* spores in a 2-phased study. The results reveal *C difficile* spores are more difficult to remove than vegetative bacteria. Results showed that hand washing was better than ABHRs, however, the efficacy was relatively low (less than $\log_2$ or 99% reduction), suggesting that the *C difficile* spores may be more difficult to remove than the vegetative bacteria.

There were several contributing factors causing the rise of HA-CDIs. Health care workers were most likely the primary source of transmission for *C difficile* and the environment was a significant source for the transmission of *C difficile* (Edmonds et al.,

2013). Although previous studies showed that hand washing was better than ABHRs, the reported efficacy was relatively low (less than log_2 or 99% reduction), suggesting that the *C difficile* spores may be more difficult to remove than the vegetative bacteria (Chemaly et al., 2014).

In phase 1 of the study, subjects completed evaluations for tap water or non-microbial body wash for removal of *B atrophaeus, C sporogenes* and *C difficile*. In phase 2 subjects completed evaluation for 10 different test products and tap water control for the removal of *C difficile* spores. Study performed one-way analysis of variance, statistical analysis with a post hoc test (alpha=0.05) (Edmonds et al., 2015).

The results from the phase 1 of the 2-phase study showed that tap water removes *B atrophaeus* significantly better than *C difficile* ($P<0.001$). Similarly, the body wash removed both *B atrophaeus* ($P<0.0001$) and *C sporogenes* ($P<0.01$) significantly better than *C difficile* and body wash was statistically superior than tap water in the removal of *B atrophaeus* and *C sporogenes*. However, body wash was statistically equivalent to tap water when tested against *C difficile* ($P>0.05$) (Edmonds et al., 2015).

The results from phase 2 of the study suggest that a peracetic acid and surfactant formulation was the most effective test preparation. The method achieved greater reductions of *C difficile* compared to tap water control, 4% Chlorhexidine gluconate (CHG) hand wash, 0.5% bleach, 8% hydrogen peroxide, 0.3% triclosan hand wash, nonantimicrobial body wash ($P<0.05$). An ink and stain remover and sodium tetraborate decahydrate powder were both significantly more effective than tap water. Edmonds et al.

(2015) had similar findings which showed hand hygiene interventions used now have minimal effectiveness against *C difficile* spores.

Landelle et al. (2014), found that the use of gloves decreased the spread of *C difficile*. They found the proportion of HCWs with both vegetative spores and spores of *C difficile* hand contamination after care of patient's spore count varied from the low teens to the mid-50s, depending on their role as a HCW. Because the vegetative spores and *C difficile* spores were resistant to oxygen, desiccation, and most disinfectants, they can persist for longer periods of time in the hospital environment. Landelle et al. focused on finding the percentage of HCWs contaminated with *C difficile* spores after caring for the CDI patients and analyzing the risk factors associated with contamination.

Landelle et al. (2014), observed 2 groups of patients. The first group (n=66) or the exposed group took care of patients who were exposed to CDI patients and the second group (n=44) or the unexposed group comprised of HCWs that took care of non-CDI patients (control group). The hand contamination rate was compared between the exposed group and the unexposed group. *C difficile* spores were recovered from the hands of HCWs shortly after the patient care but not before the HCWs rubbed their fingers and palms in alcohol. Statistical analysis using bivariate and multivariate analysis was done to find the associations between HCW and hand contamination category, type (patient or environment), and risk level of HCW contacts and their duration and use of gloves.

Twenty-four percent (16/66) of the exposed group HCWs hands were contaminated with *C difficile* spores while none from the unexposed group HCWs were contaminated (P<0.001). Nursing assistants had the highest percentage of hand

contamination at 42% compared to nurses at 19% and physicians at 23%. These findings support the fact that nursing assistants are in contact with high-risk patients 47% compared to 15% and 4% for nurses and physicians. An important observation from the study was that 44% (seven of 16) HCWs with contaminated hands and 18% (nine of 50) HCWs without contaminated hands had at least one patient contact without gloves. HCWs with contaminated hands were more likely to have a higher number of contacts (P=0.003), with the patient (P=0.02) or with environment (P=0.02). Hand contamination was associated with higher number of high risk contacts and a longer duration of high risk contacts (P<0.0001). The researchers concluded that hand contamination was positively associated with exposure to fecal soiling and lack of glove use, and further studies were needed to determine how long spores can remain viable on HCWs hands (Landelle, 2014).

Noteworthy were the 66 HCWs in the exposed group who had 386 observed contacts with CDI patients or their environment and only 30 of the 386 (7.8%) contacts were without gloves, a 92.2% compliance rate. The 30 ungloved encounters represent almost half (seven of 16) of the HWC *C difficile* contaminations (Landelle, 2014). Dubberke (2015) reported that the compliance rate for hand washing for a full 15 to 30 seconds with soap and water was between 20% to 40%; other reports showed up to 85% compliance (The Joint Commission on Accreditation of Healthcare Organization [JCAHO], 2015). Landelle (20014) found glove compliance was greater at 92%.

The CDC (2016) recommends hand hygiene after removing gloves. Hand hygiene was defined by the CDC as the use of soap and water, claiming it to be more efficacious

than ABHSs. They acknowledge that, even with the use of soap and water, *C difficile* spores can be difficult to remove. The evidence from recent studies (Landelle, 2014) suggested that gloves were the foundation for preventing the transmission of *C difficile*. According to the CDC, that theory does not always translate to the practice; in their recommendation "any theoretical benefit from instituting soap and water must be balanced against the potential for decreased compliance resulting from a more complex hand hygiene message" (CDC, *C difficile*, Q&A, para. 9, 2012b; Landelle, 2014). The CDC (2017) encourages using only soap and water for hand hygiene, in addition to gloves, when caring for a patient with a CDI.

Most studies concur with the CDC's (2012b) recommendation: continue hand washing with soap and water for CDI settings and use of the ABHS for non-outbreak areas. The problem is I could not find any studies confirming an increase in CDIs with the use of only ABHS or a decrease in CDIs with the use of soap and water (Dubberke, 2015). Subsequent studies looked beyond handwashing and focused on environmental contamination and recontamination of health care workers hands (Weber, Anderson, Sexton & Rutula, 2013).

Antibiotics Association

According to the CDC (2017) antibiotic usage continues to be a major issue in the United States. The effects of the antibiotics are considered one of the primary reasons for HA-CDIs. The chances of contracting CDI increase in patients on antibiotics or a history of antibiotics. The antibiotic affects the microbiota as it interrupts the normal bowel flora and promotes *C difficile* overgrowth, which makes antibiotics one of the most significant

risk factors for CDI (Brown, Khanafer, Daneman & Fisman, 2013). It can take approximately 2 weeks to restore gut back to normal flora (Skeetz & Young, 2014). *C difficile* infection is the most significant consequence of antibiotic treatment and is a major cause of morbidity and mortality. A meta-analysis by Brown and associates (2013), assessed 465 studies dating back to 1994 with a total of 26,435 patients for their meta-analysis. They found the risk for contracting CDI tripled after any antibiotic treatment (odds ratio, 3.55).

The impact of antibiotic was well demonstrated in a study done in 2007 by Valiquestte et al., after significant outbreaks associated with the *C difficile* strain NAP1/027, hospitals that restricted the use of antibiotics saw an immediate decline in CDIs. Following the cut back on antibiotics their CDI rates dropped 60%.

The CDC launched an antibiotic awareness to the medical professionals and to the community. The CDC (2017) reported in the United States approximately 20-50% of all antibiotics prescribed in acute care hospitals were either unnecessary or inappropriate. To support the Antibiotic Stewardship, frontline HCW need to educate the patient on antibiotic treatments why it was required or the rationale if it was withheld. The pressure to please the patient may influence physicians into prescribing antibiotics.

The Elderly

The elderly, ≥ 65 years old, is considered a significant risk factor (Vindigni & Surawicz, 2015). In the elderly, there is a reduction in microbial diversity subsequently increasing their vulnerability to CDIs (Seekatz & Young, 2014). Increased age (≥ 65 years old) continues to be a risk factor and the rate continues to rise in HA-CDI cases in

patients over the age of 65. Moreover, the rate of CDI discharge diagnoses was seven-fold higher in patients ≥65 years compared with patients aged 45–64 years (P<0.001) (Vindigni & Surawicz, 2015).

Patients with CDI were nearly 20 years older (67.9 years vs. 48.1 years) and patients ≥85 years had the highest rate, 1,089 per 100,000 population, compared with only 11 per 100,000 for patients under 18 years old (Lucado, Gould, & Elixhauser, 2012). In 2008, *C difficile* ranked as the 18th leading cause of death among persons aged ≥65; 93% of *C difficile*-associated deaths occurred in persons aged ≥65 (Vindigni & Surawicz, 2015).

Hospitalization

Regardless of the age, hospitalized patients are at higher risk for contracting *C difficile,* more than any other nosocomial agents. CDIs has taken over one spot as the most contracted HAI, surpassing methicillin-resistant *Staphylococcus aureus* (MRSA). The threat of CDI increases the longer patients stays in the hospital and increases even more if the patient was admitted to a room previously occupied by a patient with a CDI as a 40%. (Weber, Anderson, Sexton & Rutala, 2013). The cause of increased HA-CDIs was reported to be the direct result of contaminated environments in the patient's room (Chmaley et al., 2014; Edmonds et al., 2013).

According to Bagdasarian et al. (2015) almost 50% of hospitalized patients, with no previous contact with *C difficile*, became carriers, usually following a lengthy hospitalization. Individuals who were colonized by the *C difficile* organism may acquire an immunity protection from developing into a disease state; however, they can serve as

potential vector for the transmission of *C difficile* in healthcare settings and contribute to the global spread of the developing hyper virulent toxigenic strain (Boyle et al., 2015; Furuya-Kanamori et al., 2015).

The spores spread very quickly in a hospital setting because *C difficile* spores can originate and be transmitted by various vectors; the patient's environment, other patient's even asymptomatic *C difficile* carriers and hands of health care workers. Ingested endospores travel down into the stomach, unaffected by the gastric acid; it continues to travel into the bowel, normally colonizing in the mucous membrane of the large intestines. Outside the body, endospores can survive up to 5 months, whereas the *C difficile* cells in the vegetative state can withstand dry environment only 15 minutes and then encapsulates itself into an endospore (Furuya-Kanamori, 2015; Weber et al., 2013).

Asymptomatic carriers and symptomatic carriers can contaminate the hospital surroundings. The spores on *C difficile* carriers can slough off *C difficile* into the hospital environment and are a common source of contributors to hospital contamination phenomenon. Studies have connected the majority of the newly acquired cases of *C difficile* as coming from asymptomatic patients in different rooms (Dubberke, 2015; Furuya-Kanamori, 2015).

The hypothesis of Riggs et al. (2007), "do asymptomatic carriers see frequently *C difficile* isolates onto their skin and into the environment and that fecal incontinence was associated with increased shedding?" (pp. 993). Even though this study was more than 10 years old, I thought it had some great data on the transmission of *C difficile.* What they

found implied carriers of epidemic and non-epidemic *C difficile* strains could be a significant cause of disease transmission in long-term care facility (LTCF).

The study was a prospective study of using LTCF patients from two adjacent wards. The study was from July through September 2006, study started with all 73 inpatients from both wards. Stool samples or rectal swab specimens and samples from skin sites and environmental sites were cultured for *C difficile* to determine the point-prevalence of transmission. The study participants were reduced by five patients due to positive for *C difficile* associated diarrhea (CDAD). Of the remaining 68 asymptomatic 35 patients, almost half were carriers of toxigenic *C difficile* and 13 of the 35 carried epidemic strains. Compared with non-carriers, asymptomatic carriers had higher percentages of skin (61% vs. 19%; $P = .001$) and environmental contamination (59% vs. 24%; $P = .004$). Eighty-seven percent of isolates found in skin samples and 58% of isolates found in environmental samples were identical to concurrent isolates found in stool samples. Spores on the skin of asymptomatic patients were easily transferred to investigators' hands. Previous *C difficile*–associated disease ($P < .001$) and previous antibiotic use ($P = .017$) were associated with asymptomatic carrier, and the combination of these two variables was predictive of asymptomatic carrier (sensitivity, 77%; specificity, 58%; positive predictive value, 66%; negative predictive value, 70%) (Riggs et al., 2007).

Environment

Patients and HCW are re-contaminating themselves and the environment from patients with and carriers of *C difficile*. Many of the studies suggest to take special

precautions with CDI patients, however, asymptomatic patients can transfer *C difficile* spores to HCW and the environment. By focusing only on the symptomatic patient and not addressing the non-symptomatic patient, potentially leaves a big gap for *C difficile* to contaminate other patients and HCW.

A critical factor in the dissemination of *C difficile* is the lack of proper cleaning and disinfecting of the patient's room. Contaminated surfaces occur throughout medical units; it was not limited to patient's rooms, in one study *C difficile* was found on doctors' and nurses' work areas, keyboards, and telephones (Weber, 2013). The contamination outside the patient's environment was attributed to the ease of transporting, transmission and the resiliency of the new virulent strain of *C difficile* (Furuya-Kanamori et al., 2015).

The focus of several studies had been on methods and a strategy used to terminally clean patient's rooms. Several researchers studied the procedures used by various hospitals to terminally clean the discharged patient and often found these practices to be substandard (Nararaja, 2015, Weber, 2013). Anderson et al. (2017) found a major problem in the transmission of *C difficile* was caused from the inadequate cleaning of hospital rooms after a patient has been discharged from that room, an estimate of only half of the rooms were cleaned adequately.

Ultraviolet lights were introduced as a method of combating the *C difficile* crisis and depending on the study they were considered to be very effective, or they don't have much effect on CDIs. Nagaraja et al. (2015), examined the effectiveness of Ultraviolet disinfection (UVD) methods. Careful examination of patient intensive care rooms which

were previously occupied by CDI patients in the non-control group a UVD was added to the standard hospital cleaning process. The finding indicated there was a 22% reduction in HA-CDIs over the span of one year (2011-2012).

A similar and more recent study by Anderson et al. (2017), used a realistic, cluster-randomized, crossover study examining various bacterium agents, however, for purposes of this doctoral paper only the results for *C difficile* were discussed. This study was the first multicenter randomized controlled trial to evaluate the effects of enhanced disinfection strategies on hospital-acquired infections from four target organisms, methicillin-resistant *Staphylococcus aureus*, vancomycin-resistant staphylococci, multidrug-resistant *Acinetobacter*, and *C difficile*. The trial study used 4,916 patients in the reference group, 5,178 in the UV group, 5,438 in the bleach group, and 5,863 in the bleach and UV group. This study used two methods either by itself or in combination; each strategy was used for three months, for seven consecutive months. Rooms exposed *C difficile* spores from previously occupied CDI patients were used for the study. The study evaluated the use of bleach versus the use of bleach plus UVD. The findings showed there was no significant difference between the two methods, with the bleach only method had a 1.4% incidence, and with the bleach and UVD combination, there was a 1.8% incidence rate (Anderson et al., 2017).

The increased prevalence of CDIs, the associated morbidity, mortality and direct healthcare costs due to long stays has motivated efforts towards the greater need of effective infection control measures. The measures to date have greatly focused on taking

extra measures with CDI diagnosed patients for infection and sterilization of healthcare facilities.

The study by Kenters et al. (2017) focuses on testing four cleaning products commonly used in the hospital setting for their efficacy against 3 different strains of *C difficile* PCR ribotypes. (PCR ribotype [027], an endemic PCR ribotype [014] and non-toxigenic PCR ribotype [010]). Each identified A, B, C, & D.

Product A: Incidin Wipes, Glucoprotamin 1.5%, B: Aseptix Sterimax Sporicide wipes, Hydrogen Peroxide 15mg/g and C (Bacillol 30 tissues, mixture of ethanol, propane and N-alkyl Amino propyl glycine) were tested in the form of wipes. Wipes A and C were ready to use products, while wipes B had to be prepared for use. Product D: Formula 429 Spray, Chloride, Benzalkonium Chloride, Polyaminopropyl, Biguanide, Dimenthicone, was currently not used in healthcare facilities. A test solution containing $5x10^6$ CFU/ml spores of *C difficile* of PCR ribotype strain was used to contaminate the tiles. The researchers used two different methods to test the efficiency of the products. Adenosine Triphosphate (ATP) method counts the CFU's to measure the killing of *C difficile* spores before and after tiles underwent cleaning/disinfection with a wipe or spray. For the second method, the researchers used clean trace 3M swabs and RLU's were measured in a clean trace NG 3M luminometer (Kenter, 2017).

PCR ribotype 010 had the highest CFU reduction compared to PCR ribotype 027 and PCR ribotype 014 ($P<0.001$). Wipe B had the highest CFU reduction of all the wipe products and Spray B had the highest CFU reduction among all the spray products and

the efficacy between wipe B and spray B was significantly different (P<0.001). Overall the wipes were more effective than sprays (P <0.001) (Kenter, 2017)

The wipes A and B had a higher RLU $\log_{10}$ reduction. there wasn't any significant difference in effectiveness between wipe and spray (p=0.62 and P=0.36) for products A and C but there was a significant difference between wipes and spray for product C (P<0.001). The researcher's concluded that cleaning/disinfecting wipes generally outperform sprays even if based on the same ingredient. *C difficile* spores of 014 and 027 were much harder to eliminate from contaminated surfaces than non-toxigenic strain 010. These findings will be reported to the infection control department, along with my other findings.

Controlling CDI outbreaks was multifaceted, and none of the interventions were a stand-alone solution and require the collaboration of experts in other fields to work together. The primary risk factor in contracting *C difficile* was the use of antibiotics. The CDC (2017), suggested an Antibiotic Stewardship Program be implemented in all acute care hospitals. By reducing the unnecessary uses of antibiotics, will consequentially improve patient outcomes by reducing microbial resistance and decreases the spread of infections caused by multidrug-resistant organisms. In addition, it suggests a review of current policies to achieve a faster response upon the detection of *C difficile* and the ability to execute isolation precautions quickly and effectively. Hospitals must have methods to check rooms are cleaned thoroughly with spore-killing disinfectant using an EPA-approved disinfectant especially in rooms where a patient was diagnosed with CDI.

Terms to Clarify:

- Bleach-It-Away practice: The practice consists of the patient's primary nurse wiping down all the high-touch surfaces in the patient's room once per shift. The wipes come in a tub, allowing one wipe to be pulled at a time. The wipes were in an EPA-approved bleach-based solution.
- *C difficile* infection was a patient with three or more unformed stools within 24 hours and has either a positive stool test or diagnosis of pseudomembranous colitis (Eyre & Walker, 2013).
- Hospital-acquired infection, also known as healthcare-onset infection: A CDI was considered hospital-acquired when CDI was diagnosed 48 hours after admission or within 28 days after discharge (Eyre & Walker, 2013).
- Asymptomatic *C difficile* colonization was the condition where *C difficile* was detected without having symptoms of infection. Individuals colonized by *C difficile* may be protected from the progression to the infectious disease state; however, they may contribute to transmission in healthcare settings (Vindigini, 2015).

Relevance to Nursing Practice

The primary goal of a bedside nurse is to care for their patients, to deliver the best possible quality of care, and to do no harm. Through education, nurses learned how evidence-based practices improve patient's outcomes, by providing the tools to deliver the best care possible. Preventing HA-CDIs requires nurses to identify possible outbreaks

of CDIs quickly and implement the policies and procedures, including isolation of the patient, hand hygiene and the use of appropriate personal protective equipment (PPE).

Much of the data points to the HCW, which in most cases were nurses and nursing assistants, as the culprits for the spread of *C difficile*. These findings were not surprising, as HCWs have the most contact with the patient, however, collaborating with other professionals there may be a chance to make a difference in the CDI outbreaks. It is difficult to eliminate the spores and bacteria from high touch surfaces, using a team approach HCW can help EVS workers to combat the ever-changing *C difficile* bacteria.

Early detection could be even more effective if facilities would allow nurse-driven protocols to be allowed to initiate orders based on admission screening or change in patient's health, by being vigilant in patient's conditions, ready to trigger the CDI precautions, to wear gloves at all times while in the room with a CDI patient and clean (with *C difficile* approved disinfectant) the high-touch surfaces in the patient's room at least once a shift. Nurses have the power and ability to make a significant change resulting in decreasing and eliminating HA-CDIs.

Local Background and Context

This DNP project was chosen based on the needs of the patients at the project hospital. The director of nurses suggested investigating the prevention of CDIs. This was an appropriate suggestion because, at that time the facility was battling an upward trend of CDIs. In previous years, the rate of CDIs increased by 29%, and the trend for 2017 was on schedule to surpass the previous rate increase. The implementation of Bleach-It-Away implemented in April 2017. The project facility previously implemented

preventative measures suggested by the CDC (2016); however, the rates continued to rise.

There have been improvements in the battle against HA-CDIs nationally, but California as a state that still struggles to control CDIs. According to the CDC (2016), *C difficile* has become the most common nosocomial infection, surpassing MRSA. Preventing further *C difficile* outbreaks continues to be a priority, controlling *C difficile* is necessary before it transforms into an even more resilient pathogen.

Role of the DNP student

As a DNP student, I am responsible for evaluating nursing practices and finding evidence to improve patient care when gaps were identified. Through the application of skills learned in the DNP program and experiences learned at the bedside, I seek to improve the quality of care to provide better patient outcomes. As a DNP, I know not to take the obvious conclusion, to dig deeper into the problem and solution, sometimes knowing the conclusion was not what it first appeared. I play a fundamental role in translating and synthesizing evidence and then adapting it into nursing practice.

Summary

In this section, I discuss concepts, strategies, and methods for controlling the spread of *C difficile* bacteria. I review the conception of the project and the need to complete this project. I also evaluate my role as the DNP student in this project. In Section 3, I restate the practice-focused question and identify the sources of evidence supporting the suggested nursing practice. I then explain participants roles, procedures

that I used for this DNP project. Finally, I address analysis and synthesis of the data I used.

Section 3: Collection and Analysis of Evidence

Introduction

Despite the implementation of several strategies to eliminate infections related to *C difficile* over the past 2 years, the MICU continued to experience a rise in the number of cases of HA-CDIs. In 2015, the total reported cases of HA-CDI were 10, and in 2016 it increased to 14 cases, an increase of 29%. In the first10 months of 2017, there were a total of eight reported HA-CDIs cases for MICU, later reduced the number to 5 cases of CDI. However, they have been CDI free since July 2017. The purpose of this project was to evaluate the impact of the Bleach-It-Away intervention has on the occurrences of CDI in the MICU.

The intervention under evaluation was Bleach-It-Away, as it was implemented in the MICU and hospital-wide in April 2017. The DNP project's goal was to evaluate the effectiveness of the cleaning of high-touch surfaces with a bleach-based wipe performed by the bedside nurse per shift. In Section 2, I reviewed the characteristics of *C difficile* and the different practices used in the community and globally to eliminate *C difficile*. In this section I will discuss the practice-focused question, sources of evidence, and the analysis and synthesis plan.

Practice-focused question(s)

The growing number of preventable HA-CDIs translates into increased cost due to the extended length of hospital stays, use of limited resources, and high morbidity and mortality (CDC, 2017). In this project, I focused on a MICU based in a 243-bed acute hospital in San Diego County in the state of California, that has a higher rate of HA-CDIs

than the national average (Office of Statewide Health Planning and Development, 2016). This facility had attempted various strategies to eliminate *C difficile* from their medical facility. I evaluated the effectiveness of Bleach-It-Away in the MICU for 6 months prior to the intervention and 6 months post-intervention.

Preventing HA-CDI has various implications for nursing practice. The intervention promotes collaborations between multiple disciplines. Bedside nurses have an important role in the battle against CDIs. When nurses adhere to the implemented intervention of Bleach-It-Away they could prevent CDIs and help eradicate *C difficile*. Strict PPE, handwashing, educating, and identifying physiologic signs of CDI so nurses can implement immediate actions can also contribute to the efforts of eliminating CDIs Nursing leaders and administrators are key in supporting bedside nurses in general but especially when the patient is a CDI patient. Support by recognizing the time-consuming measures nurses must take to safely care for the complex CDI patients and then assigning appropriate nurses patient loads while they are taking care of a CDI patient to minimize workload and in order for the nurse to provide the time-consuming care safely.

This nursing practice produces an environment free from HA-*C difficile* thus protecting the patient from debilitating gastrointestinal pain, potential complications, astronomical expenses, and possible death. Eliminating *C difficile* improves the quality of care resulting in improved patient outcomes and prevent unnecessary expenses (Dubberke, 2014).

The practice-focused question and its associated hypotheses for my project are the following:

Research Question 1 (RQ1): Is the Bleach-It-Away practice effective in combating the *C difficile* bacterium, thereby eliminating or reducing HA-CDIs as a result of implementing this practice?

Null Hypothesis ($H_0$1): There is no significant difference on the HA-CDIs of patients between pre- and post-implementation of Bleach-It-Away practice

Alternative Hypothesis (H_a1): There is a significant difference on the HA-CDIs of patients between pre- and post-implementation of Bleach-It-Away practice.

Sources of Evidence

To address the practice-focused questions, I used several methods to obtain the most relevant information. I used electronic and online databases, government websites, and nursing organization websites. The evidence supports the intervention Bleach-It-Away and provides data for other interventions to help eliminate HA-CDIs.

The project location infection control department has been working on reducing HA-CDIs for many years and has established an efficient method of collecting data on diagnosed HA-CDIs and potential HA-CDI. The department continues to collaborate with all the medical units in the hospital, hospital and surrounding laboratories, physicians and hospital administrators. The data collection from these areas and data from the surveys provided evidence needed to answer the practice-focused question.

The data of the CDI rates were from January 2016 to December 2017. The intervention under evaluation was Bleach-It-Away, as it was implemented in the MICU and hospital-wide in April 2017. The dataset included CDI rates from the pre-implementation period between January 2016 to March 2017 and CDI rates from the

post-implementation period between April 2017 to December 2017. There were five measures of CDI rates collected from these different months: (a) hospital onset incident (HO-I) and hospital onset recurrent (HO-R); (b) community onset (CO); (c) community onset hospital facility associated (CO-HFA); (d) no admission to the hospital (N/A), either outpatient, lab or ED; and (e) total CDI rate. The unit of analysis was the CDI rates per month for each of the different measures of CDI rates. Each of the months was divided into the two groups of pre- and post-implementation of the Bleach-It-Away practice.

Published Research and Outcomes

The literature review was performed to gain a systematic understanding of the epidemiologic studies related to *C difficile*, CDIs and methods to combat the spread of the *C difficile* bacterium. The review aided in understanding the past, present and proposed models used to fight CDIs. The literature review helped gain perspective of the historical and current beliefs of CDI epidemiology.

I used of the following search terms: *Clostridium difficile, C diff, C difficile, endospores, CDI, healthcare associated infections/hospital acquired infection (HAIs), community infection, antibiotic stewardship,* and *CDI prevention* and included articles to identify the gap in the increasing phenomenon of the rising rates of HA-CDIs.

The literature review was conducted through various databases included were EBSCOhost, ProQuest, CINAHL, PubMed, MEDLINE, Sage and Science Direct. In addition to the full text peer reviewed journals, I searched through professional organizational websites, such as the CDC, NHRN and the World Health Organization.

This process aided in the dissemination of the findings. I primarily used original research articles and articles after 2013; however, there are some articles I used that are older articles because of their historical importance, the research method, or findings that remain relevant today.

Archival and Operational Data

The archival and operational data was partially collected by the facility's infection control department. They were responsible for collecting the data that has to do with any part of the infectious process. They kept records updated daily. If there was an outbreak, the team concentrated on the data related to the outbreak. The organization was very proactive in detecting CDIs. The organization developed specific criteria to diagnosis HA-CDI.

Evidence Collected for the Doctoral Project

Participants. The retrospective data collection will use information from previously hospitalized patients diagnosed with hospital acquired CDI. A master code list was used to protect the identity of patients.

Procedures. After receiving approval from Walden Institutional Review Board (IRB) and the facility's IRB, the infection control manager was asked for data from the January 1, 2016, to review months prior to the implementation of Bleach-It-Away, to December 30, 2017. There was no direct contact with the patients, information was only obtained through the electronic charts and data collection methods of the infection control department. I also used a data information sheet I created to collect and organize data from patient's EMR and when obtaining information from the infection control

department.

Protections. This project is a quality improvement (QI) project. Lynn et al. (2007) define QI as a data-driven method for the improvement of health care delivery. Improving the quality of health care was considered a responsibility of the health care professional and was expected and ethical to seek out improvements in the quality of health care.

The project intervention that I evaluated was implemented and being practiced in the hospital, including the MICU, which was the focus of the evaluation. Protection of human rights was maintained for the HA-CDI data obtained in this project. The Master Code List was not stored with data collection sheets in order to protect patient confidentiality as required by The Health Insurance Portability and Accountability Act (HIPAA). Further, all data obtained were password-protected on my personal laptop computer for as long as required by the IRB.

Analysis and Synthesis

All data for the study were collected from the hospital's archival. The independent variable was the period of implementation (pre and post) of the Bleach-It-Away practice while the dependent variable was the CDI rates. All data were pre-processed using Microsoft Excel. Once a complete, clean data set was achieved, it was then exported to SPSS Version 25 for data analysis.

I conducted two types of statistical techniques and these were descriptive statistics and inferential statistics. The descriptive statistics provided basic information, such as the frequency and percentages for the independent variable and the demographical data,

while the mean and standard deviation was used for continuous variable (the dependent variable of CDI rates). I used inferential statistics because the aim of this research was to determine the effectiveness of Bleach-It-Away practice by comparing pre- and post-implementation on CDI rates of patients.

Assumptions for parametric test of independent sample *t*-test must be tested before its use. There are four assumptions of parametric tests and these included: (a) no presence of outlier, (b) normality, and (c) homogeneity of variance (Sedgwick, 2015). Each of these assumptions were tested in this study. For the outlier assumption, outlier of the dataset of the dependent variable of CDI rates can be checked through visual inspection using boxplot (Huber & Melly, 2015). For the normality assumption, a Kolmogorov-Smirnov test should be performed to detect if all study variables complied with the normality assumption (Siddiqi, 2014). Normal Q-Q plot was also created to visually check the data if it followed normality. Lastly, a test for homogeneity of variance was conducted using Levene's test by Levene (1960). Levene's test investigates for a constant variance of error for the independent variable, by plotting residuals versus predicted values, and residuals versus independent variables (Parra-Frutos, 2013).

Hypothesis testing was conducted using an independent sample *t*-test to determine whether the Bleach-It-Away practice was effective in combating the *C difficile* bacterium to make a recommendation regarding eliminating or reducing HA-CDIs as a result of implementing this practice. An independent sample *t*-test was conducted to test whether there was significant difference on the CI rates of patients between pre- and post-implementation of Bleach-It-Away practice. An independent sample *t*-test was conducted

to test difference of values of continuous measured dependent variables of CDI rates between independent variables with two categorical grouping. A 0.05 level of significance was used in the independent sample *t*-test. There is a significant difference if the *p*-value of the *t* statistic is less than the level of significance value. A *p*-value of less than or equal to 0.05 dictated that the null hypothesis was rejected, whereas a value of greater than 0.05 dictated that there was no statistically significant difference that exists on CDI rates of patients between pre- and post-implementation of Bleach-It-Away practice and that the alternate hypothesis was rejected. Once a significant different was observed, mean comparison was conducted to further investigate the differences in the CDI rates of patients between pre- and post-implementation of Bleach-It-Away practice. The results of the mean comparison provided a result to determine whether the Bleach-It-Away practice is effective in combating the *C difficile* bacterium. The result was used to make a recommendation regarding eliminating or reducing HA-CDIs as a result of implementing this practice.

Summary

In Section 3, I described my approach to addressing the identified research problem. The problem statement and purpose of the study was restated for brevity. The practice-focused question and its associated hypotheses, sources of evidence, participants and procedures, and protections for the participants were discussed. Data pre-processing procedures and data analysis plan using descriptive and inferential statistics were discussed as well. In Section 4, I will discuss the findings and implications, recommendations, and the strengths and limitation of the project.

Section 4: Analysis and Results

Introduction

The growing number of preventable HA-CDIs translates into increased cost due to the extended length of hospital stays, use of limited resources, and high morbidity and mortality (CDC, 2017). I focused on a MICU based in a 243-bed acute hospital in San Diego County in the state of California that has a higher rate of HA-CDIs than the national average (Office of Statewide Health Planning and Development, 2016). This facility had attempted various strategies to eliminate *C difficile* from their medical facility. This project evaluated the effectiveness of Bleach-It-Away pre- and post-intervention.

The intervention under evaluation was Bleach-It-Away, as it was implemented in the MICU and hospital-wide in April 2017. My goal was to evaluate the effectiveness of the cleaning of high-touch surfaces with a bleach-based wipe performed by the bedside nurse per shift.

The evidence analyzed was obtained in the form of an Excel spread sheet. The spread sheet reflected *C difficile* occurrences for the calendar years 2016 and 2017. The occurrences were categorized into (a) hospital onset incident (HO-I) and hospital onset recurrent (HO-R); (b) community onset (CO); (c) community onset hospital facility associated (CO-HFA); (d) no admission to the hospital (N/A), either outpatient, lab or ED; and (e) total CDI rate. Additional data were obtained which included data from NHSN assay, gender, date of birth, date admitted to facility, date specimen was collected, number of days specimen collected after admission date, location specimen was collected

(medical unit), discharged from the facility in the past four weeks, date of last discharge, discrepant result, discharged from another facility in the past four weeks, name of other facility, history of CDI, current rooms, rooms pre-admit, comments, proton pump inhibitor (PPI), antibiotics, probiotics, and ID MD.

The purpose of this quantitative project was to evaluate the impact of the Bleach-It-Away intervention had on the occurrences of HA-CDI in the MICU. Descriptive statistics analysis and independent sample *t*-test were conducted to determine the objectives of the project. SPSS was used to run the different statistical analyses. Specifically, the following research question and hypotheses were tested in the quantitative analysis:

RQ1: Is the Bleach-It-Away practice effective in combating the *C difficile* bacterium, thereby eliminating or reducing HA-CDIs as a result of implementing this practice?

$H1_0$: There is no significant difference on the HA-CDIs of patients between pre- and post-implementation of Bleach-It-Away practice

$H1_a$: There is a significant difference on the HA-CDIs of patients between pre- and post-implementation of Bleach-It-Away practice.

Test of Required Assumption

Outlier. First assumption tested was to check for outliers since the independent sample *t*-test is sensitive to outlier effects. Outliers were checked in each of the different measures of CDI rates. There were five measures of CDI rates which include hospital (a) onset-incident (HO-I) and hospital onset-recurrent (HO-R), (b) community onset (CO),

(c) community onset hospital facility associated (CO-HFA), (d) no admission to the hospital (N/A) - either outpatient, lab or ED, and (e) total CDI rate. The boxplots are shown in Figures 1 to 5. Boxplot of the five different measures of CDI rates showed there was the presence of an outlier in the dataset of rate of CO (1 outlier), no admission to the hospital – tested in outpatient, lab or ED (3 outliers), and total CDI rate (1 rate). These outliers were removed from the dataset to be used in the main quantitative analyses. Scatterplots in Figures 6 to 10 show no outliers in the dataset of the five different measures of CDI rates after removal of the outliers mentioned. Thus, the assumption of no outliers was not violated.

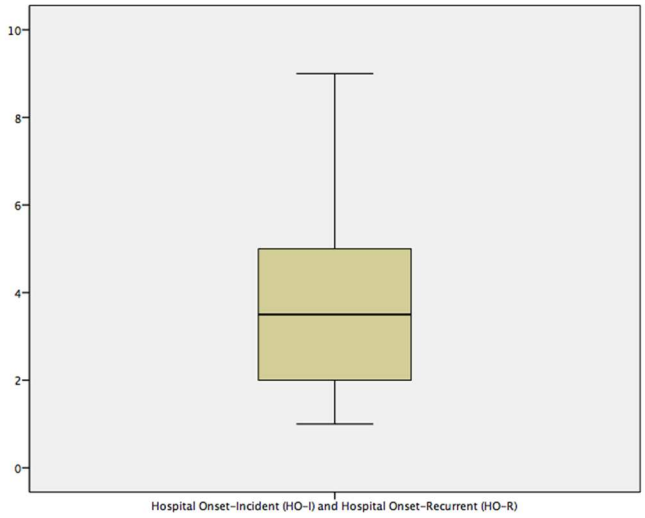

Figure 1. Boxplot of Rate of Hospital Onset-Incident (HO-I) and Hospital Onset-Recurrent (HO-R)

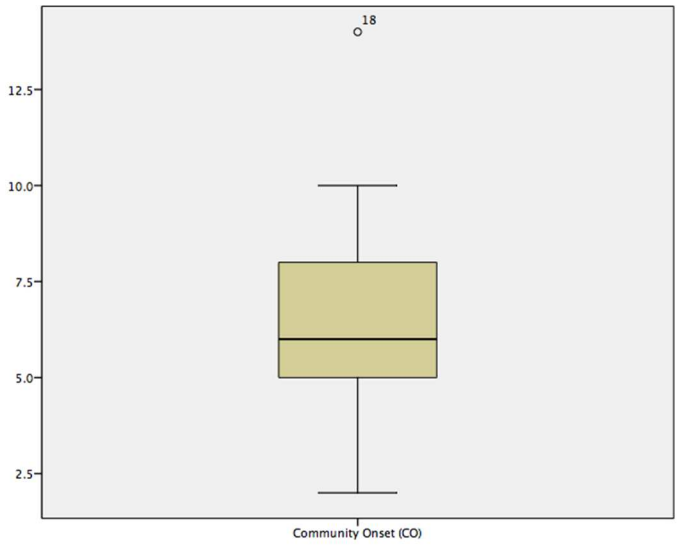

Figure 2. Boxplot of Rate of Community Onset (CO)

Figure 3. Boxplot lot of Rate of Community Onset Hospital Facility Associated (CO-HFA)

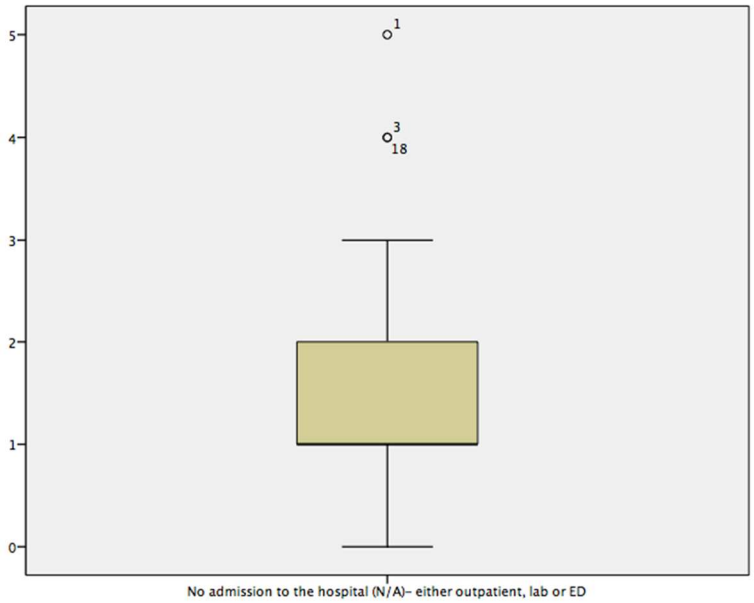

Figure 4. Boxplot of Rate of No admission to the hospital (N/A) - either outpatient, lab or ED

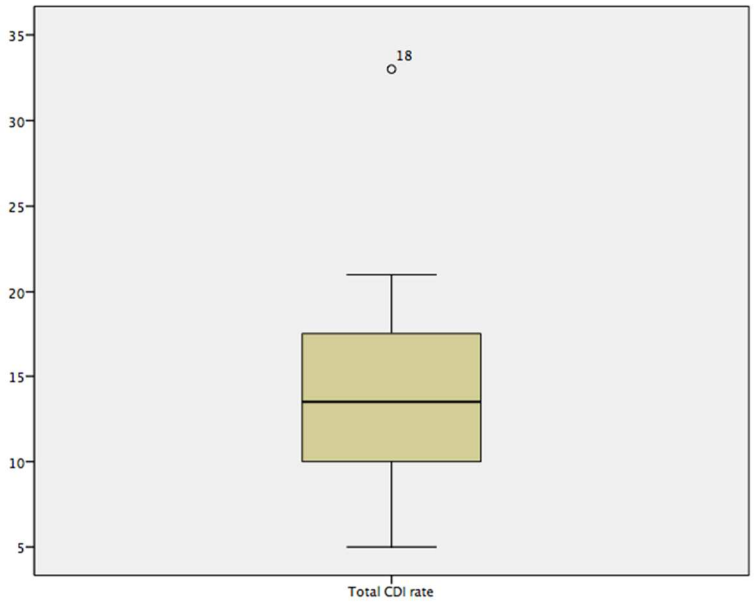

Figure 5. Boxplot of Total CDI Rate

Figure 6. Boxplot of Rate of Hospital Onset-Incident (HO-I) and Hospital Onset-Recurrent (HO-R) (without outlier)

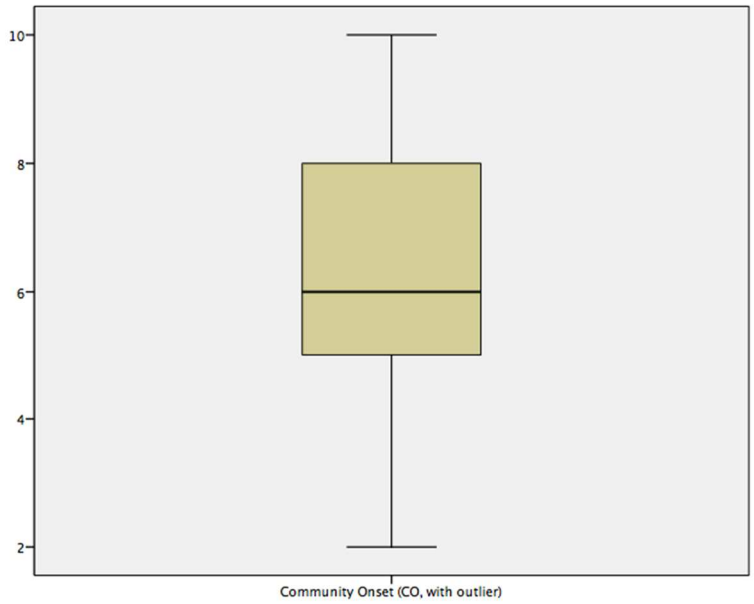

Figure 7. Boxplot of Rate of Community Onset (CO) (without outlier)

Figure 8. Boxplot of Rate of Community Onset Hospital Facility Associated (CO-HFA) (without outlier)

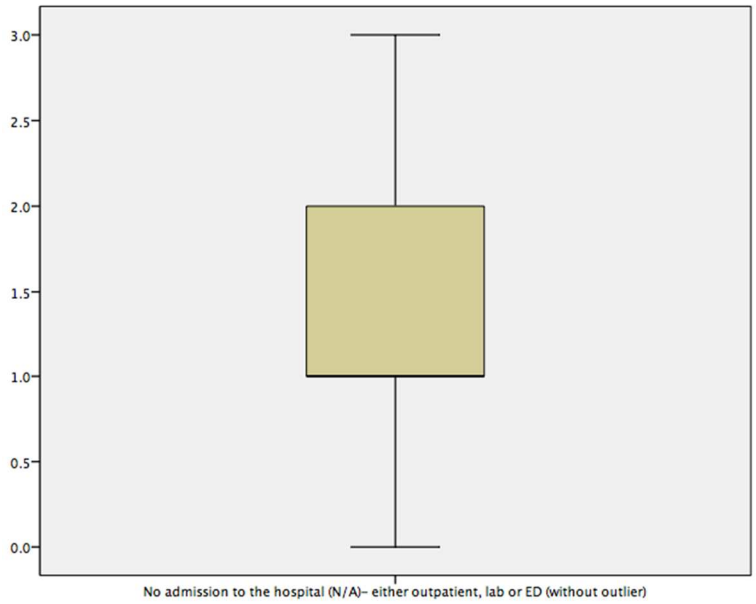

Figure 9. Boxplot of Rate of No Admission to the Hospital (N/A) - either outpatient, lab or ED (without outlier)

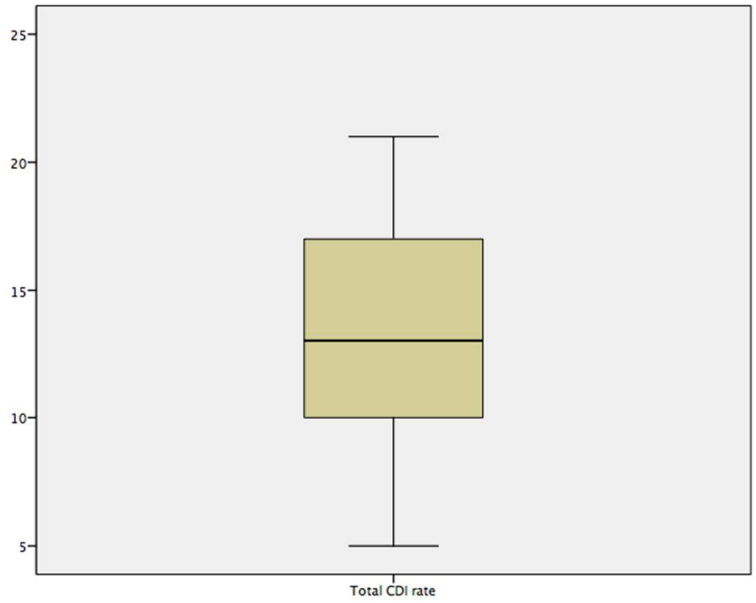

Figure 10. Boxplot of Total CDI Rate Without Outlier

Normality. The second assumption tested was normality of the data of the dependent variable of CDI rates. This is a required assumption of the independent sample

t-test hat the data of the dependent variable should exhibit normal distribution. Kolmogorov-Smirnov test was conducted to test normality of the data of the dependent variable of CDI rates. The only measure not exhibiting normal distribution was the no admission to the hospital, from either outpatient, lab or ED reflected in the results of Kolmogorov-Smirnov test. Other than this, all the other measures of CDI rates exhibited normal distribution. However, the normal Q-Q plots in Figures 11 to 15 the Q-Q plots of all five measures of CDI rates indicated they followed the normality line pattern. With these results, the data of the measures of the dependent variable of CDI rates did not violate the normality distribution assumption, but they did not exhibit perfect normality. Thus, the assumption of normality was not violated.

Table 1

Results of Kolmogorov-Smirnov Test of Normality of CDI Rates

Measures	Kolmogorov-Smirnov[a]		
	Statistic	df	Sig.
Hospital Onset-Incident (HO-I) and Hospital Onset-Recurrent (HO-R, without outlier)	0.19	21	0.06*
Community Onset (CO, with outlier)	0.12	21	0.20*
Community Onset Hospital Facility Associated (CO-HFA, without outlier)	0.16	21	0.16*
No admission to the hospital (N/A)- either outpatient, lab or ED (without outlier)	0.30	21	0.00
Total CDI rate	0.17	21	0.13*

*Normally distributed

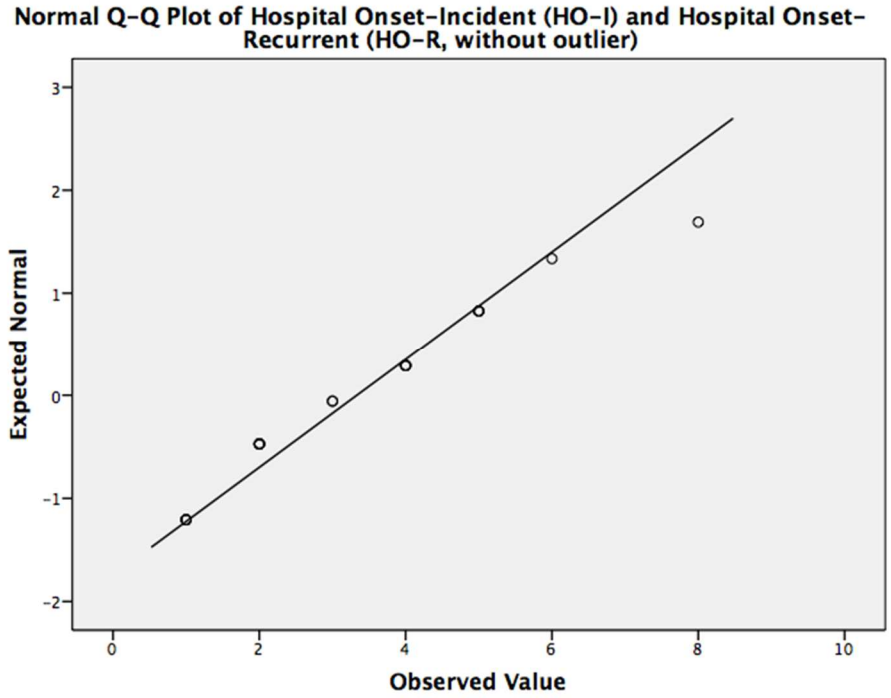

Figure 11. Normal Q-Q Plots of Hospital Onset-Incident (HO-I) and Hospital Onset-Recurrent (HO-R without outlier)

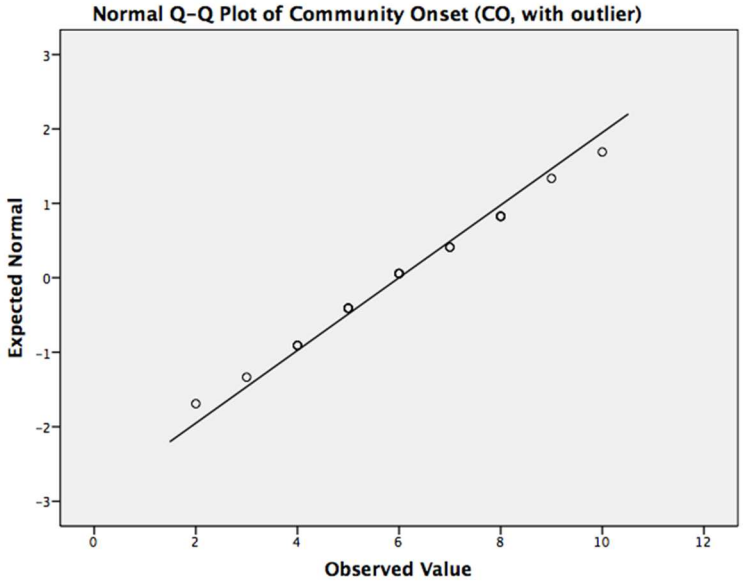

Figure 12. Normal Q-Q Plots of Community Onset (CO, without outlier)

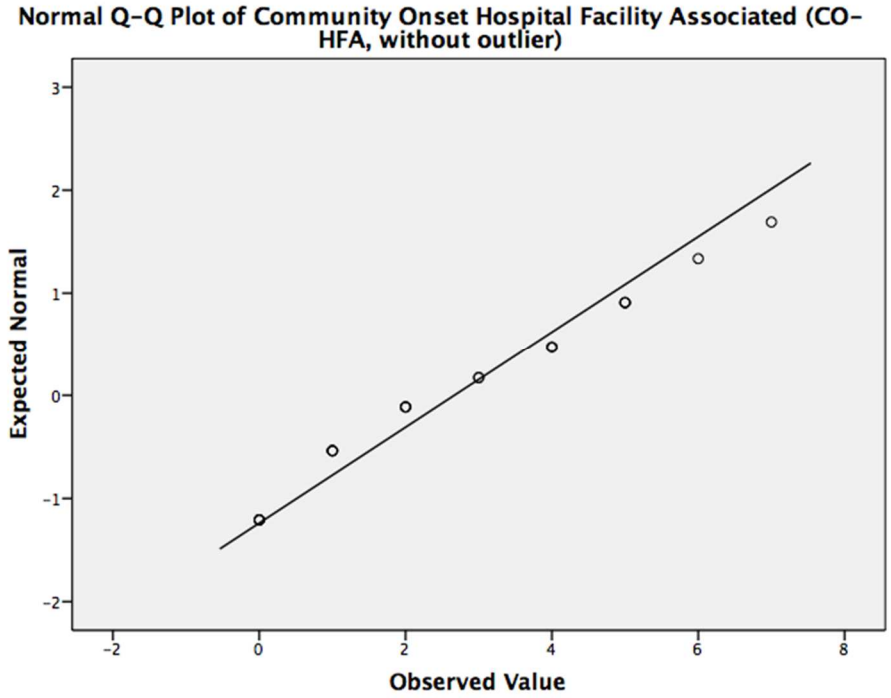

Figure 13. Normal Q-Q Plots of Community Onset Hospital Facility Associated (CO-HFA without outlier)

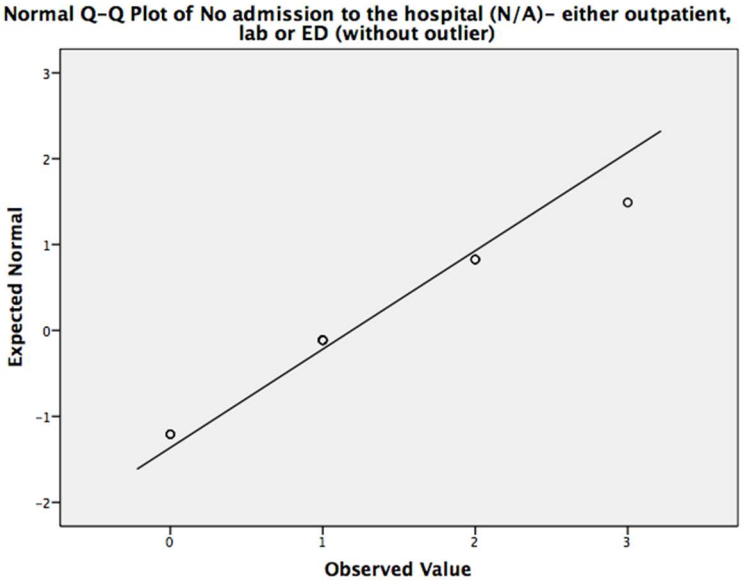

Figure 14. Normal Q-Q Plots of No admission to the hospital (N/A) - either outpatient, lab or ED (without outlier)

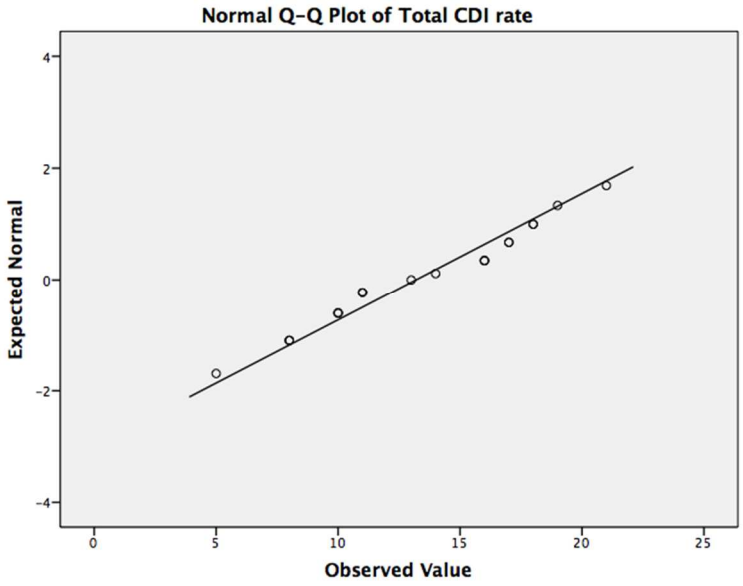

Figure 15. Normal Q-Q Plots of Total CDI Rate

Homogeneity of Variance. The third assumption tested was homogeneity or equality of variance of the data of the dependent variable across the different categorical groupings of the independent variable. Levene's test of homogeneity of variance was conducted to determine whether the five measures of the dependent CDI rate variables have homogeneous variances between the two groupings of independent variables related to the implementation of the Bleach-It-Away practice (pre- and post-implementation). Results of the Levene's test in Table 2 showed the variance of the five measures of CDI rates were homogenous between the pre- and post-implementation of the Bleach-It-Away practice. Thus, the assumption of homogeneity of variance was not violated.

Table 2

Results of Levene's Test of Homogeneity of Variance of CDI Rates

Measures	Levene's Test for Equality of Variances		
	F	Sig.	Results
Hospital Onset-Incident (HO-I) and Hospital Onset-Recurrent (HO-R, without outlier)	0.10	0.76	Equal variances assumed
Community Onset (CO, with outlier)	0.32	0.58	Equal variances assumed
Community Onset Hospital Facility Associated (CO-HFA, without outlier)	0.18	0.68	Equal variances assumed
No admission to the hospital (N/A)- either outpatient, lab or ED (without outlier)	0.04	0.85	Equal variances assumed
Total CDI rate	0.01	0.91	Equal variances assumed

Descriptive Statistics of Study Variables

Descriptive statistics were conducted to summarize the data of the CDI rates of patients during the two periods of pre- and post-implementation of Bleach-It-Away practice. Specifically, central tendency measures of means and standard deviation were used to summarize the data of the CDI rates. As stated, there were five measures of CDI rates which include HO-I and HO-R, CO, CO-HFA, no admission to the hospital - either outpatient, lab or ED, and the total CDI rate. The dataset included only those months removing the presence of outliers. Table 3 summarized the descriptive statistics summaries of the CDI rates.

The outcome demonstrated the rate of HO-I and HO-R had there is a slightly higher mean the period of pre-implementation ($M = 3.60$; $SD = 2.20$) than in the period of post-

implementation (*M* = 3.56; *SD* = 2.46) of Bleach-It-Away practice. The rate of CO, had a higher mean during the period of pre-implementation (*M* = 6.40; *SD* = 1.90) than in the period of post-implementation (*M* = 5.13; *SD* = 1.81) of Bleach-It-Away practice. The rate of CO-HFA had a higher mean during the period of pre-implementation (*M* = 3.00; *SD* = 2.10) than in the period of post-implementation (*M* = 2.33; *SD* = 2.29) of Bleach-It-Away practice. The rate of no admission to the hospital, the result was opposite wherein, there was a lower mean during the period of pre-implementation (*M* = 1.15; *SD* = 0.90) than in the period of post-implementation (*M* = 1.25; *SD* = 0.89) of Bleach-It-Away practice. Overall, there was a higher mean number of total CDI rate during the period of pre-implementation (*M* = 14.60; *SD* = 4.03) than in the period of post-implementation (*M* = 11.13; *SD* = 4.32) of Bleach-It-Away practice. As a summary, mean comparison showed that the CDI rates were higher in the period of pre-implementation than in the period of post-implementation of Bleach-It-Away practice. However, the significance of the difference observed should be validated in the test of significance of difference of independent sample *t*-test.

Table 3

Descriptive Statistics of CDI Rates between Pre- and Post-Implementation of the Bleach-It-Away Practice

		Implementation of the Bleach-It-Away practice			
Measures		N	Mean	Std. Deviation	Std. Error Mean
Hospital Onset-Incident (HO-I) and Hospital Onset-Recurrent (HO-R, without outlier)	Pre-implementation	15	3.60	2.20	0.57
	Post-implementation	9	3.56	2.46	0.82
Community Onset (CO, with outlier)	Pre-implementation	15	6.40	1.96	0.51
	Post-implementation	8	5.13	1.81	0.64
Community Onset Hospital Facility Associated (CO-HFA, without outlier)	Pre-implementation	15	3.00	2.10	0.54
	Post-implementation	9	2.33	2.29	0.76
No admission to the hospital (N/A)-either outpatient, lab or ED (without outlier)	Pre-implementation	13	1.15	0.90	0.25
	Post-implementation	8	1.25	0.89	0.31
Total CDI rate	Pre-implementation	15	14.60	4.03	1.04
	Post-implementation	8	11.13	4.32	1.53

Hypothesis Testing

An independent sample *t*-test was conducted to determine whether the Bleach-It-Away practice is effective in combating the *C difficile* bacterium to make a recommendation regarding eliminating or reducing HA-CDIs as a result of implementing this practice. An independent sample *t*-test was conducted to test whether there is

significant difference on the HA-CDIs of patients between pre- and post-implementation of Bleach-It-Away practice. An independent sample *t*-test was conducted to test difference of values of continuous measured dependent variables of CDI rates between independent variables with two categorical grouping. A level of significance of 0.05 was used in the test of difference. There is a significant difference if the *p*-value of the *t* statistic is less than the level of significance value. Results of the independent sample *t*-test are showed in Table 4.

Results of the independent sample *t*-test (Table 4) showed that there were no significant differences in any of the five measures of CDI rates, between pre- and post-implementation of Bleach-It-Away practice. There were no significant differences in the CDI rates because all the *p*-values were all greater than the level of significance value. Given these results, the hypothesis that "There is no significant difference on the HA-CDIs of patients between pre- and post-implementation of Bleach-It-Away practice" was not rejected by the results of the independent sample *t*-test.

Table 4

Independent Sample *t*-test Results of Difference CDI Rates between Pre- and Post-Implementation of the Bleach-It-Away Practice

	t-test for Equality of Means						
						95% Confidence Interval of the Difference	
Measures	*t*	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Hospital Onset-Incident (HO-I) and Hospital Onset-Recurrent (HO-R, without outlier)	0.05	22	0.96	0.04	0.97	-1.96	2.05
Community Onset (CO, with outlier)	1.53	21	0.14	1.28	0.84	-0.46	3.01
Community Onset Hospital Facility Associated (CO-HFA, without outlier)	0.73	22	0.48	0.67	0.92	-1.23	2.57
No admission to the hospital (N/A)- either outpatient, lab or ED (without outlier)	-0.24	19	0.81	-0.10	0.40	-0.94	0.74
Total CDI rate	1.92	21	0.07	3.48	1.81	-0.29	7.24

Strength of the data in this proposed study is that the CDI rate of the MICU at pre- and post-implementation of the Bleach-It-Away practice can be statistically compared since there was available data of different measures of CDI rates at periods or different months of pre- and post-implementation. There are five measures of CDI rates which include (a) hospital onset-incident (HO-I) and hospital onset-recurrent (HO-R), (b) community onset (CO), (c) community onset hospital facility associated (CO-HFA), (d)

no admission to the hospital (N/A) - either outpatient, lab or ED, and (e) total CDI rate. Thus, there were multiple measures to reflect the CDI rates or occurrences of HA-CDI in the MICU at different periods. Then I can make multiple comparisons of different CDI rates at the two periods of pre- and post-implementation of the Bleach-It-Away practice in order to thoroughly evaluate whether the Bleach-It-Away practice is effective in combating the *C difficile* bacterium to make a recommendation regarding eliminating or reducing HA-CDIs as a result of implementing this practice.

C difficile has been extremely difficult to control, the impact of this intervention has positive implications for all the stakeholders, from the patients to the administrators. One of the best things about this intervention is it can be easily adapted to any health care facility, preventing contamination of *C difficile* to patients and healthcare workers all over the world. The community acquired CDIs must be contained, the strains of *C difficile* are becoming more resilient to treatment, implementing a similar practice in the community, including the homeless will have a positive social change.

Recommendations

To provide an accurate recommendation, it is necessary to study all the contributing factors to CDIs. The data collected was not complete and was not collected from the perspective of obtaining scientific data. If all factors were equal, it would appear the intervention was effective, according to the data. The facility decided to replace the Bleach-It-Away intervention with a hydrogen peroxide solution. However, the process of wiping down the high touch areas once per shift remains in effect.

Working in the neonatal intensive care unit, it was my practice was to wipe down my patient's area as part of my assuming care routine. I recommend this practice, performing the intervention at the onset of the nurse's shift. The Bleach-It-Away intervention did not specify a particular time to perform the wipe down, only during their shift.

Study's Strengths and Limitations

A limitation of the data is that there was not enough data for the CDI rate of the MICU. The dataset only included total monthly data in 24 months of data of CDI rates from January 2016 to December 2017. The total monthly CDI rate cannot reflect the individual patient data, only the total number of CDI cases in the MICU. Thus, the covariates of patient's age, antibiotic history, previous hospitalization, history of CDI, date of CDI diagnosis, length of hospital stay, and where they came from prior to the admission (long term care facility, another hospital, home, etc.) cannot be incorporated in the analysis test of difference of CDI rates in the MICU between pre- and post-implementation of Bleach-It-Away practice. This is because the covariates are individual patient data while the dependent variable of CDI rate is a total hospital data. With this, the covariates of patient's age, antibiotic history, previous hospitalization, history of CDI, date of CDI diagnosis, length of hospital stay, and where they came from before the admission were removed

Most of the data used were collected by the hospital. I was given a spreadsheet with a set of variables not necessarily variables I wanted to include in my study. However, I was able to look up more information on patients in the MICU. The data was

documented by medical staff and then transferred to spreadsheet it is not known the accuracy of the data and must be taken at face value.

Summary

The purpose of this quantitative project was to evaluate the impact of the Bleach-It-Away intervention had on the occurrences of HA-CDI in the MICU. Descriptive statistics analysis and independent sample *t*-test were conducted to test the research question and hypotheses posed in this study. Chapter Five concludes this study. Chapter Five contains, the dissemination plan and self-analysis through this process.

Section 5: Dissemination Plan

Clostridium difficile is one of the most feared pathogens in hospitals today, surpassing MRSA as the number one hospital acquired infection (Magill et al., 2014). The impressive changes in the epidemiology of *C difficile* in the past few years studies reveal new strains of *C difficile,* more virulent and increased prevalence. The toxicity and virulence of this pathogen support its survival and ability to thrive in healthcare settings (Lessa, F. et al., 2015).

The purpose of this research was to evaluate the impact of the recently implemented Bleach-It-Away practice on the incidence of *Clostridium difficile* infections at a community acute care hospital in the MICU in California. The desired nursing practice outcome was the elimination of hospital-acquired *C difficile* infection by eliminating *C difficile* from the patient's environment. Bleach-It-Away requires the bedside nurse to wipe down the patient's room once per shift, concentrating on the high-touch areas with FDA approved bleach-based wipes. The knowledge gained from this research will increase the understanding of CDI in select healthcare populations and settings.

The findings are intended to inform the MICU leadership and hospital infection control of the outcomes and any recommendation and strategies for combating CDIs through daily room wipe downs with a bleach-based solution. The hospital, including the MICU, have changed protocol from the use of bleach-based wipes to the use of hydrogen peroxide wipes. Wiping down of the patient's room by the nurse each shift remains constant. According, to the manager of the ICUs at the research site, the bleach was very

hard on the furniture and diagnostic equipment, and the committee decided to change the cleaning solution to one that is hydrogen peroxide based.

Dissemination is an essential part of all research projects, the impact of the research leads to vital evidence-based practice improving nursing practice standards (Marin-Gonzales et al., 2017). The primary audience for this project dissemination is the educator at the MICU of the project site. The stakeholders involved in supporting this project include the director of MICU, the nursing unit manager, and the practicum site mentor. To disseminate the project outcomes, I will post a chart in the MICU break room to illustrate the outcomes of Bleach-It-Away. I also plan to provide a detailed report that highlights the specific outcomes for each variable examined.

The information contained in this project is important not only to this healthcare facility but to all facilities nationwide. I will present at national and international conferences. This information will be available to other students and interested professional through ProQuest.

Analysis of Self

In 2007, I decided to further my education by going back to school for a master's degree in nursing education. After earning my MSN and working in the hospital in the critical care setting for over 20 years, it was time to pass on my experiences. To do this, I needed to grow professionally to acquire a platform that allowed me to improve the nursing profession. To achieve all of this I sought out and will earn my degree as a Doctor of Nursing Practice. I teach nursing students and I am excited to continue to mentor our future nurses.

The journey of obtaining my DNP has given me a greater appreciation for the nursing practice process. I have experienced every aspect of evidence-based practice, the evolution of recognizing the problem, identifying the gap between the implementation and maintenance of an evidence-based practice intervention. I am fortunate to live in a time where technology has catapulted scientific accessibility to all nurses, regardless of educational merits.

Summary

The project had to be modified a few times due to policies and changes within the hospital. I was pleased with the HA-CDI rate of the MICU during the study, and despite having changed cleaning solution, the same action is required from the nurse as described in this study. The study reveals they will continue to have success in combating CDIs in their facility using this evidence-based nursing practice.

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