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THE EFFECT OF BUNDLED INTERVENTIONS ON PREVENTION OF HOSPITAL ACQUIRED CLOSTRIDIUM DIFFICILE INFECTION

by

KAITLIN KENDYS, BSN, RN

EVIDENCE-BASED PRACTICE PROJECT REPORT

Submitted to the College of Nursing and Health Professions

of Valparaiso University,

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For the degree of

DOCTOR OF NURSING PRACTICE

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Kaitlin Kendys RN 5/12/17 DNP FNP-BC 5-10-17

Student Date Advisor Date

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DEDICATION

I would like to dedicate this EBP project to my family, without whom I would not have completed this degree. My mother who watched over me from heaven and my husband helped carry me through this process. I share this with my family and friends who made it all possible.

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I would like to thank many for their support and direction with this EBP project. First, I would like to thank Professor Jamie El Harit, DNP, RN, FNP-BC, CSSBB for her support and knowledge that guided me through this process. Additionally, I would like to thank Chris Shakula, MSN, RN for her support with the project implementation. I would like to thank Holly Dinell, BSN, RN and Lynn Idalski, BSN, RN for their assistance with this project. Finally, I would also like to acknowledge the staff and management team at X Hospital for welcoming and accepting this project.

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ABSTRACT

Clostridium difficile infection (CDI) rates have steadily increased in hospitalized patients due to the change in epidemiology. Approximately 13 of every 1,000 inpatients are either infected or colonized with C. difficile (CDC, 2013). CDI rates continue to rise due to the hyper-virulent strain of C. difficile and length of therapy needed to treat CDI. The average cost for a single inpatient CDI is more than $35,000, and the estimated annual cost burden for the healthcare system exceeds $3 billion (Walsh, 2012). The purpose of this evidence-based project (EBP) was to reduce hospital-acquired CDI rates over a 3-month period-of-time from November 2016 to February 2017 through the implementation of a bundle of care including: (a) proper hand hygiene practices, (b) adequate and appropriate surface cleaning practices, (c) compliance to contact isolation procedures, and (d) strengthening of an existing antibiotic stewardship committee. The Health Promotion Model and the Stetler Model of EBP guided this system change. A longitudinal pre-test post-test design using all CDI inpatients from a general medical unit in Northwest Indiana was implemented. Descriptive statistics were used to document specific interventions used during the EBP project and compared with post-test chart audits from the same timeframe of the previous year. Collected data included CDI incidence, compliance to hand hygiene, contact isolation procedures, and environmental surface cleaning protocols, as well as de-escalation and timely discontinuation of antibiotics, and appropriate selection of antimicrobial therapy. An independent samples t-test indicated that there was no significant difference between the CDI incidence pre-intervention (M =.30, SD =.470) and post-intervention (M =.24, SD =.431); t (19) = .000, p = .059. Despite the lack of significance in CDI rates, a repeated-measures ANOVA was performed to examine the relation between pre- and post-test hand hygiene compliance and contact isolation precaution compliance which did demonstrate significant effects with both hand hygiene compliance and on compliance to contact isolation precautions, Wilks' Lambda= .558, F (3, 37) = 9, p = .000 and Wilks' Lambda= .375, F (3, 37) = 20, p = .000. A 96.8% surface cleaning compliance with 10% sodium hypochlorite solution was noted post-intervention. The educational data provided in this EBP project has been adopted by the facility and will be used for new hire education and annual competencies. An electronic best practice advisory will be implemented in the electronic health record to alert healthcare providers of alternative antimicrobial therapies.

CHAPTER 1

INTRODUCTION

Clostridium difficile (CD) infection rates have steadily increased in hospitalized patients and have contributed to increased length of hospital stay, adverse patient outcomes, and increased health care costs (Cohen et. al, 2010). C. difficile is a gram-positive, anaerobic, spore-forming bacterium that causes a spectrum of disease severity. Severity of C. difficile illnesses ranges from mild infection, self-limiting diarrhea, serious diarrhea, pseudomembranous colitis, to life-threatening fulminant colitis; sometimes so severe the infection can lead to death (Khan & Elzouki, 2014). Per the CDC, one of every 10-20 hospitalized patients in the United States develops a hospital-associated infection (Centers for Disease Control and Prevention [CDC], 2013). Approximately 13 of every 1,000 inpatients are either infected or colonized with C. difficile (CDC, 2013). C. difficile infection (CDI) is the leading cause of antibiotic-associated diarrhea and due to the difficulty in treating CDI and the risk of contamination is a highly problematic healthcare-associated infection (HAI) (Cohen et. al, 2010). The average total cost for a single inpatient CDI is more than $35,000, and the estimated annual cost burden for the healthcare system exceeds $3 billion (Walsh, 2012).

C. difficile infection occurs by ingestion of spores resulting from a contaminated patient environment, shared equipment, or the hands of healthcare personnel (Shaughnessy et. al, 2011). Infection from C. difficile (CD) can be spread by touching unclean surfaces, especially those in healthcare settings and encountering contaminated feces from an infected individual. Significant risk factors for acquiring a CDI are exposure to antibiotics, hospitalization, and advanced age (CDC, 2013). Evidence suggests that the incubation period for CD following ingestion of spores is 2-3 days; however, patients may remain at risk for contracting CDI for 3 or more months after they have stopped antibiotic treatment (Hensgens, Goorhuis, Dekkers, & Kuijper, 2012). In recent years, the epidemiology of CDI has changed dramatically; with increases in incidence and severity of cases reported across the United States, Canada, and Europe (Agency for Healthcare Research and Quality [AHRQ], 2012). The change in epidemiology of CDI has been attributed to the emergence of a hyper-virulent epidemic strain of C. difficile (AHRQ, 2012). Therefore, CDI should be suspected in any patient with diarrhea or abdominal pain with a recent history of antibiotic use, healthcare exposure, or in patients with unexplained leukocytosis (Khan & Elzouki, 2014). Due to the increase in hyper-virulence, CDI should also be considered in any patient who has diarrhea lasting longer than 3 days with fever or abdominal pain (Khan & Elzouki, 2014). Confirmation of CDI is confirmed with a laboratory assay (Lanzas, et. al 2011).

C. difficile cells die rapidly outside of the colon, within approximately 24 hours. However, spores produced by C. difficile can persist in the environment for many months and are highly resistant to cleaning and disinfection measures (Badr, Badr, & Ali, 2012). The two most common reservoirs of C. difficile in the healthcare setting are infected humans (symptomatic or asymptomatic) and inanimate objects (Badr, Badr, & Ali, 2012). Symptomatic patients are considered to be the largest source of contamination; however, asymptomatic patients may also be a source of contamination. Patient care items such as electronic devices, thermometers, and contaminated commodes have been implicated in the transmission of CDI between hospitalized patients (CDC, 2013). Many patient care activities can provide an opportunity for transmission of CDI. Some common activities performed in the hospital setting include: (a) sharing of electronic thermometers, (b) oral care or oral suctioning with contaminated hands, (c) administration of feedings or medication, (d) emergency procedures, (e) poor hand hygiene practices, (f) sharing of patient care items without appropriate disinfectant, and(g) ineffective environmental cleaning (Badr, Badr, & Ali, 2012). The chief risk factor for CDI is prior to exposure antimicrobials (Khan & Elzouki, 2014). In the hospital setting, most cases are associated with antibiotics. Nearly all antimicrobials have been associated with CDI (Khan & Elzouki, 2014). In addition to infected patients, persons who carry CD have emerged as a key player in the CD epidemiology

(Grigoras et al., 2016). CDI rates continue to rise due to: (a) increased number of carriers, (b) virulence of CDI, (c) inadequate hand hygiene of healthcare workers, (d) improper cleansing of room and equipment, and (e) increased use of antimicrobials.

Statement of the Problem

Hospitalized patients are at an increased risk for acquiring CDI. Increased virulence of CD strains and increased use of antimicrobials have caused a CDI treatment challenge for healthcare organizations. Proper hand hygiene techniques, room cleaning, and equipment cleaning are not consistently being adhered to by healthcare workers, leading to increased spread of CDI between hospitalized patients. Due to the changing epidemiology of CD and the increased virulence, prevention measures should be implemented among healthcare workers (HCWs) and visitors when entering an infected patient's room to prevent the spread of C. difficile in hospitalized patients. Contact isolation precautions are necessary to prevent the spread of CD to other hospitalized patients, visitors, and HCWs.

Data from the Literature Supporting Need for the Project. In January 2013, Centers for Medicare and Medicaid Services (CMS) began requiring acute care hospitals that participate in the CMS Inpatient Prospective Payment System (IPPS) to report laboratory-identified CDI via the National Health Safety Network (NHSN). Information reported to CMS includes: (a) patient identification, (b) patient age, (c) patient gender, (d) admission date, (e) patient location, (f) service/ area of the hospital, CDI symptom onset date, (g) CDI test date, (h) discharge date, and (j) known risk factors for CDI (CDC, 2013). The 2014 hospital acquired infection (HAI) Prevalence Survey was published with data from 2011 which demonstrated that approximately 722,000 acute care patients have HAIs in the United States with an estimated 123,100 patients exhibiting gastrointestinal illness such as CD (CDC, 2014). The prevalence report revealed an 8 percent decrease in hospital–onset CDI between 2011-2014 (CDC, 2014). Nearly a half million illnesses per year and re-infection in approximately 1 in 5 patients are attributed to a CDI diagnosis (CDC, 2014). Approximately 9% of patients over the age of 65 died within one month after being diagnosed with CDI (CDC, 2014). Recommendations from the CDC include: (a) improved prescription practices relating to antimicrobials, (b) utilization of the best tests for accurate results to prevent spread, (c) rapid identification and isolation of CDI patients, (d) HCW adherence to donning of gloves and gowns when treating patients with CD, (e) improved hand hygiene compliance utilizing soap and water after contact with CDI patients, (f) environmental cleaning practices which include cleaning of all surfaces in room with an environmental protection agency (EPA)-approved, spore killing disinfectant (such as bleach). Additionally, the implementation of an antimicrobial stewardship committee should be used to monitor use of antibiotics in relation to CDI (CDC, 2013).

Hand hygiene utilizing soap and water following any contact with a CDI patient is critical in preventing the spread of CDI to other inpatients. Alcohol based hand sanitizers are not effective in eradicating the CDI spores; therefore, this option for hand hygiene is not recommended after contact with CDI patients (CDC, 2013). There is much evidence to suggest that healthcare providers clean their hands and/or wear isolation equipment less than half of the time they are required to do so (CDC, 2016). Since spores may be difficult to remove from hands even with hand washing, adherence to glove use and contact precautions should be emphasized within the hospital settings for preventing CDI transmission via the hands of HCWs (CDC, 2013). Hand hygiene compliance data is not accurate due to the non-standard reporting and measurement of hand washing and use of hand sanitizer. Oughton et al. (2009) conducted a study comparing plain soap and water with use of warm or cold water versus no hand hygiene or alcohol-based hand rub. The largest reductions in mean colony count of CD on HCW hands after intervention were observed for plain soap with warm water (95% CI, 1.99 colony-forming unit (CFU)/mL). Alcohol based hand rub and no intervention did not demonstrate any significance. Another study conducted in an Intensive Care Unit resulted that hand hygiene compliance was the lowest after brief encounters that lasted less than 2 minutes (APIC, 2013). Patient hand hygiene is also recommended for the prevention of CDI and should be completed after using the bathroom to prevent spread of CDI (CDC, 2013). A study conducted by Pokrywka et al., (2014) had a goal to decrease CDI incidence by including patient hand hygiene into a CDI care bundle. A care bundle consisted of a group of multidisciplinary interventions put into place to decrease CDI in inpatients. The care bundle included (a) early detection of C. difficile cases by toxin testing of any patient with onset of unexplained diarrhea, (b) electronic alerts on positive toxin results to nursing units to initiate barrier precautions with glove and gown use, (c) staff hand hygiene with soap and water, (d) extended duration of isolation for entire hospital stay, (e) staff and patient education on C. difficile disease, and (f) cleaning of all patient rooms with sodium hypochlorite solution. This study focused on the current care bundled and the new intervention of patient hand hygiene. The inclusion of patient hand hygiene to the prevention bundle was found to be statistically significant (p = 0.0009).

Early identification of patients who are being investigated for or diagnosed with CDI is the first step in preventing the spread of the disease (CDC, 2013). The use of presumptive isolation and contact precautions have been recommended while awaiting the results of assay screening for patients who develop health-care associated diarrhea (APIC, 2013). All CDI patients should be assigned to a private room with a bathroom that is only for use by the patient; if a private room is not available, CDI patients should be paired up to prevent the spread of CDI (APIC, 2013). Personal protective equipment (PPE) must be donned before contact with the patient and discarded before exiting the patient's room/cubicle (CDC, 2013). Barrier precautions are crucial for preventing the transmission from the patient to the HCW and/or patient. Hand hygiene should always be the final step after removing and disposing of PPE (CDC, 2013). Patient transportation and movement outside the room should be limited to medically necessary purposes. If transporting is necessary for testing or treatment, the patient must perform hand hygiene prior to exiting the room and utilize appropriate barriers such as gown and gloves (APIC, 2013). Health care provider's hands are frequently contaminated with CDI following patient contact. Therefore, wearing gloves can significantly reduce the spread of CDI by providing a physical barrier against CD spores (APIC, 2013). Donning gloves prior to entering the room is the single highest strength CDI prevention recommendation (Dubberke & Gerding, 2011).

CDI is shed in feces. Any surface, item, or medical device that becomes contaminated with feces can act as a source for spores and, therefore, be involved in infection transmission (APIC, 2013). Cleaning reduces spores in the environment by removing organic debris with vigorous wiping and or scrubbing until all visible soil is removed (CDC, 2013). Disinfection removes or disables some or all pathogens on inanimate objects with sporicidal inactivating solutions. The use of a 10% sodium hypochlorite solution mixed fresh daily has been associated with a reduction in CDI (APIC, 2013). The surface being disinfected should be exposed to the germicide for 10 minutes (APIC, 2013). Sethi et al. (2010) conducted a study to monitor the percentage of positive CDI cultures from patient rooms. All rooms housing a CDI patient yielded positive cultures for CD and 33% of rooms without a CDI patient resulted with positive cultures for CD. Patient's that have been treated for CDI may continue to shed spores for up to 6 weeks and can contaminate rooms and increase the spread of CDI (Sethi et al., 2010). This data demonstrates the life span of spores as patient rooms tested positive even though the current inhabitant of the room was not a CDI patient. Therefore, there is no substitute for meticulous cleaning.

Exposure to any antimicrobial is the single most important factor for CDI (APIC, 2013). Because CDI is nearly always a complication of antibiotic use, the development of a healthcare facility program to ensure appropriate antibiotic use is considered an important prevention (APIC, 2013). Antimicrobial stewardship committees monitor the prescribing practices of high risk antibiotics, such as Fluoroquinolones and $3^{rd}/4^{th}$ generation cephalosporin's, to assist in reducing CDI rates. Risk of CDI is elevated 7-10-fold during and in the 3 months following antimicrobial therapy (CDC, 2013). Eighty-five to ninety percent of CDI occurs within 30 days of antimicrobial exposure (APIC, 2013). The goal of an antimicrobial stewardship program is to optimize the use of the right drug, for the right purpose, at the right dose, and for the right duration to promote the judicious use of the antimicrobial agent (APIC, 2013). An antimicrobial stewardship program should consist of (a) written guidelines for use of specific antimicrobials that have been developed based off evidence, (b) input from clinicians, (c) accurate microbiologic results, and prompt reporting of those results, (c) the compilation and dissemination of antibiograms in a manner that enables clinicians to select the appropriate agent(s) for empiric therapy, (d) systems that minimize opportunities for inappropriate duration of therapy, (e) processes that actively support de-escalation of therapy to a more narrow-spectrum agent, (f) feedback on adherence to guidelines, and (g) monitoring of systems that support the total program (APIC, 2013).

Data from the Clinical Agency Supporting Need for the Project. The site of implementation for this EBP project is a 50-bed general medical floor located within a 259-bed community hospital located in northwest Indiana. The hospital serves patients from birth until death. The northwest Indiana hospital is one of fourteen hospitals in the corporation. Admissions for the 2015 year totaled 8,150 for the facility. Of the 8,150 admissions 93% of patients were Caucasian, 3% African American, 0.49% Asian, 0.18% American Indian/ Alaskan Native, 0.91% multi-racial, 0.02% Native Hawaiian/Other Pacific Islander and 1.45% were unavailable. The hospital services the surrounding towns and cities and attends outreach programs in the community at the local YMCA. The average hospital census is 170, with the average age of admitted inpatients at 60 years. The hospital based infection preventionist (IP) provided descriptions of established and current practices for hand hygiene, surface cleaning, contact isolation precautions and the hospital-based antibiotic stewardship committee. The data provided by the IP identified the general medical unit as having had 9 hospital-acquired cases of CDI in 2015, which is double the amount of cases of any other unit at this facility (IP, personal communication, August 20, 2016).

Direct observation of all contact isolation rooms is performed weekly by the IP with focus on the use of hand sanitizer for non-CDI patients and soap and water for CDI patients after patient care. This data is collected via direct observation by the IP herself. Since the staff are aware that this data is being collected there may be a Hawthorne effect and therefore the data collected may not in fact represent true compliance to established protocols. Data is compiled into monthly statistics which are shared at the monthly unit meetings with the following staff in attendance, registered nurses, patient care technicians, and unit secretaries. Hand hygiene statistics are typed with the unit meeting minutes and staff are to read and sign minutes if unable to attend unit meeting. Staff is required to come to at least half of the monthly unit meetings in a year. Hygiene compliance data is also reported monthly to the President/CEO, Chief Nursing Officer Vice President of Medical Affairs, Chief Financial Officer, Vice President of Clinical Services, Vice President of Administrative Services, all directors and all managers at the monthly management meeting. Providers receive hand hygiene information via an electronic scroll in the physician lounge that is updated monthly to display current hang hygiene statistics. The quarterly data is also presented to the providers at the department of surgery and department of medicine meetings that occur quarterly. Providers are required to attend at least one of the four meetings per year.

All patients are asked a series of stool-related questions to screen for CDI on admission to the inpatient unit. The stool screening is located in the electronic medical record (EMR) and consists of the following questions (a) how many bowel movements (BMs) have you had in the last 24 hours, (b) describe the consistency of BMs in the last 24 hours, (c) describe the color of the BMs in the last 24 hours, (d) describe the amount of BMs in the last 24 hours, (e) have you been in the hospital in the last 6 weeks, (f) have you been on any antibiotic therapy in the last 6 months, and (g) have you been diagnosed with CDI in the last 3 months. All patients with 3 episodes of diarrhea in the last 24 hours are put into contact isolation and a stool for CD is sent. Per hospital policy/protocol, these patients are assigned to private rooms per the bed planning nurse and remain in contact isolation until the sample is resulted. If the patient continues to experience diarrhea, the patient will remain in contact isolation within a private room. If the results are negative and the patient is no longer experiencing diarrhea, the patient can be removed from contact isolation per hospital policy. All patient rooms are cleaned daily and after discharge from the hospital by environmental services. A PDI Sani-Cloth Bleach Germicidal Disposable Wipe is utilized by environmental services when cleaning a CDI patient room. The Sani-cloth is a germicidal wipe that is EPA registered hospital-grade disinfectant manufactured by PDI Healthcare that can be used on hard non-porous surfaces and equipment (Environmental Services Manager, personal communication, August 20, 2016). The active ingredient in the PDI Sani-Cloth Bleach Germicidal Disposable Wipe is 0.63% of sodium hypochlorite (Environmental Services Manager, personal communication, August 20, 2016). All curtains of contact isolation rooms including CDI patients are removed after discharge and replaced with clean curtains for the next patient. A report generated from the electronic medical record (EMR) is printed in the storage room for environmental services daily. This report provides the room number, name of the patient, isolation status and positive CDI results. The room number, isolation and CDI patients are also identified daily on a white board based on the generated report. The manager of environmental services updates the whiteboard every morning before the start of the day shift staff members. During the day shift, each floor has one environmental services staff member that is responsible for cleaning each patient room. Once cleaned, the environmental services staff member checks off the room on his/her assignment sheet then the form is returned to the Manager after every shift. The evening shift has environmental services staff that clean only the discharged patient rooms and ancillary areas of the facility. An assignment sheet is also completed by the environmental staff worker every shift and returned to the manager (Environmental Services Manager, personal communication, August 20, 2016). Cleansing of the telemetry monitors, leads, and IV poles are the responsibility of the nursing staff.

Computer-based training (CBT) followed by a competency test is deployed annually and completed by the direct patient care staff however, the opportunity for CBT training is not currently afforded to the environmental services staff. Information covered in this CBT includes explanation of gown and gloves for contact isolation, dedicated equipment to CDI patient rooms, diarrhea and what criteria to use for placing a patient in contact isolation for diarrhea, basic information about CDI, and the importance of using soap and water for hand hygiene after contact with a CDI patient (IP, personal communication, August 20, 2016). A CBT for the CDC hand hygiene campaign including the Joint Commission's "5-moments of Hand Hygiene" is required annually for all clinical staff such as nurses and patient care assistants. The CBT is not required by environmental services staff. Information on HAI's, including CDI, is briefly provided to all staff during face-to-face hospital orientation by the IP. The information provided at general orientation for the hospital is basic hand hygiene and the different isolation precautions (IP, personal communication, August 20, 2016).

Possible gaps identified in the current practices within the organization include training of environmental services staff on hand hygiene, contact isolation precautions, disease process of clostridium difficile and cleaning of patient rooms and equipment. Clinical staff are required to complete a CBT annually on hand hygiene but specific education for Clostridium difficile and contact isolation is not available to all staff. In addition, education or information regarding the antimicrobial stewardship committee was not provided to clinical staff, environmental services staff or providers. Education regarding contact isolation precautions, hand hygiene and the involvement of antimicrobial stewardship committee were identified as deficient for clinical staff, environmental services staff, and providers (IP, personal communication, May 22, 2016). Yearly education for all clinical staff is required via a CBT module. Additionally, the IP attends monthly department meetings to review current prevalence rates of CD patients and prevalence of hand washing with clinical staff on each hospital unit, including registered nurses, patient care assistants, and unit secretaries (IP, personal communication, May 22, 2016). A formal cleaning process and education for CDI patient rooms has not been previously established at this facility. Current practice includes hand hygiene education, contact isolation precautions for all patients suspected of CDI, and a corporate-based antibiotic stewardship committee (IP, personal communication, May 22, 2016).

The corporate-based antimicrobial stewardship committee is a group of Pharmacists with two to three representatives from each facility in the corporation. The corporation is fourteen hospitals through Indiana and northeast Illinois. This group meets monthly to discuss possible changes and updates to the current standards set-up for pharmacy per the current antibiograms. The antibiograms is defined as a corporation and as individual hospitals since not all the facilities are in the same areas of Indiana. Antibiograms can differ depending on area of the state and require pharmacy collaboration from all hospitals in the corporation to have an accurate corporate antibiograms as well as facility specific. The corporate group created standardized policies and procedures which direct Clinical Pharmacists to inquire with prescribers to provide guidance on appropriate antibiotic prescribing practices to reduce the risk of CDI. The policies and procedures serve as evidence based guidelines that empower the Clinical Pharmacist to advise prescribers on change in antibiotic selection, dose adjustments, and reduce the frequency or duration of the medication. The corporate committee meets monthly and provides data from each of the facilities regarding the utilization of specific high risk medications such as Fluoroquinolones and 3rd/4th generation cephalosporin's. Rates of all HAI are also reviewed for each facility during this corporate meeting. The group also serves as a think-tank for the corporation to develop improvement ideas for practice change leading to improved outcomes related to CDI. Information from this meeting is shared at the monthly management meeting, but front-line staff are not aware of the committee work. This is a possible gap in communication and transparency for the committee to staff (Sonja Damjanoski-Farias, Clinical Pharmacy Manager, July 12, 2016).

A facility-based antimicrobial stewardship committee was initiated at the clinical site on September 2016. The committee consists of: (a) a physician intensivist, (b) an infectious disease physician, (c) pharmacists, (d) primary care providers, (e) quality representative and (f) a member of hospital administration. The facility-based committee was formed to examine the facilities' antibiograms with the goal of improving HAIs. The focus of this local group is policy and procedure implementation directing efforts to examine practices related to antibiotic usage for diagnoses including pneumonia, urinary tract infections as they relate to CDI treatment and prevention. The group's responsibilities are to make recommendations on specific patient management, monitor appropriate intravenous to oral conversions of antibiotics, monitor de-escalation practices, as well as analyze data relating to length of stay for patients with diagnoses of pneumonia, sepsis, and CDI. The current antibiogram and sensitivity was revised by this committee. The antimicrobial stewardship committee focuses its efforts towards decreasing use of antibiotics known to cause CDI in hospitalized patients.

Purpose of the Evidence-Based Practice Project

The purpose of this evidence-based project (EBP) is to reduce hospital-acquired CDI (HA-CDI) rates over a 3-month period through the implementation of a bundle of care including: (a) proper hand hygiene practices, (b) adequate and appropriate surface cleaning practices, (c) compliance to contact isolation procedures, and (d) strengthening of an existing antibiotic stewardship committee.

Compelling Clinical Question. Inpatients are at increased risk for acquiring CDI during hospitalization. A process, education, and implementation of an antimicrobial stewardship committee is required for healthcare staff to implement proper environment and surface cleaning, proper hand hygiene, contact isolation precautions for the prevention of CDI. The resulting clinical question was developed, "will a bundle intervention focused on improving hand hygiene practices among staff members, compliance to recommended environmental and surface cleaning, compliance to contact isolation procedures, and an antimicrobial stewardship committee reduce HA-CDI among hospitalized inpatients on a general medical unit?"

PICOT Question. Formulating clinical questions in a structured format leads to the identification of the most relevant evidence **(**Fineout-Overholt & Stillwell, 2011). The format used for this EBP project was based upon by Fineout-Overholt & Stillwell's (2011) recommendations which include: the population of interest (P), the intervention or issue of interest (I), the comparison (C), the outcomes, and the time frame (T). The clinical question for this EBP project was developed using the PICOT format:

P- The population of interest for this study is adult general medical inpatients at a community hospital in Northwest Indiana

I-The development and implementation of an evidence-based process to improve compliance rates to hand hygiene, contact isolation precautions, environmental and surface cleaning, and the empowerment of an existing antimicrobial stewardship committee to affect change in clinical practices as they relate to the utilization of antibiotic therapies in the inpatient setting.

C-The comparison is the same 3-month timeframe a year prior to the intervention

O-The outcome measure is post-intervention CDI rates.

T-Three months in fall of 2016.

Significance of the EBP Project

The environment plays a significant role in the spread of CDI. As CD is shed in feces any surface, item or medical device that becomes contaminated with feces can act as a source for spores and can be involved in infection transmission (Otter, Yezli & French, 2011). Additionally, as levels of environmental contamination increase the level of hand contamination of healthcare personnel also increases (CDC, 2014). Some improvements in CDI were identified in the HAI Prevalence Survey with an 8 percent decrease in CDI cases in the United States between the years 2011-2014. Despite this decrease, 123,100 patients were still identified during this same time frame as acquiring gastrointestinal illness as a HAI (CDC, 2014). Although a decrease in CDI was identified with this study, many patients are still infected with CD and prevention interventions are needed for these patients. Prevention of CD contamination in the healthcare setting can decrease the number of identified patients with CDI. Prevention can be achieved by appropriate activities: utilization and de-escalation practices with antibiotic therapies, using the best testing for accurate lab results, rapid identification and isolation of patients with CDI, proper isolation attire when treating a patient with CDI, appropriate cleaning of reusable equipment with EPA-approved, spore-killing disinfectant, and cleaning room surfaces with EPA-approved, spore-killing disinfectant where CDI patients are treated (CDC, 2014).

CHAPTER 2

THEORETICAL FRAMEWORK, EBP MODEL, AND REVIEW OF LITERATURE

Theoretical Framework

Overview of Theoretical Framework

The Health Promotion Model was chosen as the theoretical framework for this EBP project as the health promotion model describes the multidimensional nature of persons as they interact within their environment to pursue health. C. difficile infections are influenced by individual characteristics and experiences, prior behavior, and the frequency of the similar behavior in the past which are the major concepts of the health promotion model. The Stetler Model of Evidence Based Practice was utilized as the framework for project implementation. In the following paragraphs, key concepts of the Health Promotion Model are presented and connected with application specialized to this EBP project. Each of the five phases of the EBP project implementation are reviewed concerning the Stetler Model of Evidence Based Practice, and the literature review which provided the basis of the synthesis of literature is also presented.

Application of Theoretical Framework to EBP Project

The Health Promotion Model defines health as a positive dynamic state rather than simply the absence of disease. Health promotion is directed at increasing a patient's level of well-being (Pender, Murdaugh & Parsons, 2011). The model focuses on three areas: individual characteristics and experiences, behavior-specific cognitions and affect, and behavioral outcomes. The set of variables for behavior specific knowledge and affect have important motivational significance. Health promoting behavior is the desired behavioral outcome and these behaviors should result in improved health, enhanced functional ability and better quality of life (Pender, Murdaugh & Parsons, 2011).

Individual characteristics and experiences. Individual characteristics and experiences are prior related behavior and personal factors (Pender, Murdaugh & Parsons, 2011). The

Health promotion model includes personal factors, psychological factors, and socio-cultural personal factors. Personal factors are categorized as biological, psychological and socio-cultural. These factors are predictive of behavior and shaped by the nature of the target behavior (Pender, Murdaugh & Parsons, 2011). Biological personal factors include variables such as age, gender, body mass index, strength, agility and balance (Pender, Murdaugh & Parsons, 2011). Psychological personal factors include variables such as self-esteem, self-motivation, personal competence, perceived health status and definition of health (Pender, Murdaugh & Parsons, 2011). Socio-cultural personal factors include variables such as race, ethnicity, acculturation, education and socioeconomic status (Pender, Murdaugh & Parsons, 2011). Personal, psychological and socio-cultural personal factors place a large role in CDI prevention and treatment. Both patient and staff personal factors can affect the plan of care for a patient with CDI and prevention bundles.

Behavior-specific cognitions and affect. Behavior-specific cognitions and affect include: perceived benefits of action, perceived barriers to action, perceived self-efficacy, activity-related affect, interpersonal influences, and a situational influence (Pender, Murdaugh & Parsons, 2011). Perceived benefits of action are the anticipated positive outcomes that will occur from health behavior (Pender, Murdaugh & Parsons, 2011). Perceived benefits of CDI prevention bundles are the prevention of further CDI spread, decreased inappropriate antibiotic use, improved patient outcomes, and decreased cost to the healthcare system. Perceived barriers to action are anticipated, imagined, or real blocks and costs of understanding a given behavior (Pender, Murdaugh & Parsons, 2011). Perceived barriers to implementation of a CDI prevention bundle include change in workflow for hospital staff, new policy and procedure changes at the facility level, possible change in cleaning products, and difficulty in complying with isolation protocols completely. Perceived self-efficacy is the judgment or personal capability to organize and execute a health-promoting behavior (Pender, Murdaugh & Parsons, 2011). Perceived self-efficacy influences perceived barriers to action so higher efficacy result in lowered perceptions of barriers to the performance of the behavior (Pender, Murdaugh & Parsons, 2011). Both patients and healthcare staff have the self-efficacy to provide a prevention bundle that will improve patient outcomes and decrease costs but barriers to change exist with all process improvement projects. Activity-related affect is defined as the subjective positive or negative feeing that occurs based on the stimulus properties of the behavior itself (Pender, Murdaugh & Parsons, 2011). Activity-related affect influences self-efficacy, which means the more positive the subjective feeling, the greater the feeling of efficacy (Pender, Murdaugh & Parsons, 2011). Engaging front-line staff members in the CDI improvement project bundle will increase staff efficacy. The staff members included in the CDI improvement project bundle implementation actively participated in the change as well as champion the new process. Increased staff compliance and improved patient outcomes will follow, once the bundle is accepted by front-line staff.

Interpersonal influences are cognition-concerning behaviors, beliefs, or attitudes of others (Pender, Murdaugh & Parsons, 2011). Interpersonal influences include norms, social support, and modeling (Pender, Murdaugh & Parsons, 2011). Norms are the expected informal understandings that direct behavior of society, significant others, family, friends and peers. Social support can be instrumental or emotional encouragement. Instrumental support refers to tangible help that others can provide such as financial assistance, material goods or services. Emotional support is the delivery of reassurance, acceptance, and encouragement. Modeling is vicarious learning through observing others engaged in a particular behavior with the intent to engage in the behavior in the future. Primary sources of interpersonal influences are families, peers, and healthcare providers. Interpersonal influences can serve as barriers to a project based on norms and comfort level of the health care staff and patients. Interpersonal influences can be used to improve processes by receiving front-line staff buy-in with the CDI prevention bundle.

Situational influences are personal perceptions and cognitions that can facilitate or impede behavior. They include perceptions of options available, as well as demand characteristics and aesthetic features of the environment in which given health promoting is proposed to take place (Pender, Murdaugh & Parsons, 2011). Perception of options can be defined as the individual's judgment of the worth of a product or service. Demand characteristics are behavioral changes to conform to the expectations of society. Aesthetics are concerned with beauty or appreciation of the surrounding environment. Situational influences may have direct or indirect influences on health behavior (Pender, Murdaugh & Parsons, 2011). Situational influences can be used to assist front-line staff to influence change and processes improvement.

Behavioral outcomes. Behavioral outcomes are a commitment to a plan of action, immediate competing demands and preferences, and health-promoting behavior (Pender, Murdaugh & Parsons, 2011). There is a commitment to a plan of action, which is the concept of intention and identification of a planned strategy that leads to implementation of health behavior (Pender, Murdaugh & Parsons, 2011). Commitment of staff to each intervention, included in the prevention bundle, will lead to improved patient health outcomes and a decrease in spread of CDI. Competing demands are those alternative behaviors which individuals have low control because environmental contingencies such as work or family care responsibilities (Pender, Murdaugh & Parsons, 2011). Competing preferences are alternative behavior which individuals exert relatively high control (Pender, Murdaugh & Parsons, 2011). Other patient improvement initiatives and work can impede the staff's adaptation of the prevention bundle. Health promoting behavior is the endpoint or action outcome directed toward attaining a positive health outcome such as optimal well-being, personal fulfillment, and productive living (Pender, Murdaugh & Parsons, 2011).

Strengths and Limitations of Theoretical Framework for EBP Project

Strengths of the health promotion model include complex structure that is highly applicable to the health care setting and easy to understand. This model promotes the independent practice of nurses to reduced CDI incidence in a healthcare setting. The focus of the model is health promotion and disease prevention which aligns with the EBP projects main goal of reducing CDI spread. Limitations of the health promotion model include the conceptual framework which could be confusing to readers. Also, this model does not emphasis the individual. The model also does not define man, nursing, environment, and health such as other nursing theories.

Evidence-based Practice Model

Overview of EBP Model

During preparations for this EBP project, seven different evidence-based frameworks were reviewed for appropriateness. Many different frameworks could have been used due to the common following steps: (a) problem identification, (b) selection of change agents, (c) search and analyze high-quality research to support a practice change, (d) identify potential barriers, (e) design practice change, (f) implement practice change, (g) evaluate change processes and outcomes measures, and (h) develop strategies to maintain practice change (Stetler, 2001). The Stetler framework was chosen for simplicity, use of research findings for care, practitioner-oriented model, and updated to include implementation of evidence-informed practice changes.

The Stetler Model of Evidence-based Practice was originally developed in 1976 as the Stetler/Merram model for Research Utilization (Stetler, 2001). The main-focus of this model is to critically think and use research findings to update practice (Stetler, 2001). This model has gone through three revisions with the latest revision in 2001, which created more modifications to achieve improved clarify of the supplemental evidence role and highlight implementation tools (Young, 2012). The Stetler model uses five steps to guide clinicians in practice change: (a) preparation, (b) validation, (c) comparative evaluation/decision making, (d) translation/application, and (e) evaluation.

Application of EBP Model to EBP Project

Preparation. The preparation phase starts with identification of a problem. With this EBP project, increased rates of CDI in hospitalized patients on the medical surgical unit were noted to be higher than other inpatient units at the same community hospital; these findings demonstrated a need for intervention. A plan was initiated using key search terms to initiate a thorough literature search. A comprehensive literature review was completed to identify practices to decrease CDI rates on a medical surgical unit at a community-based hospital. The most relevant evidence was identified using key search terms, a thorough literature search, citation chasing, and practice guidelines. Environmental concerns were considered, such as staff resistance to practice change, increased time to complete bundle, and possible cost of changing cleaning supplies/products.

Validation. During the validation phase a systematic critique of each study and relevant document is completed (Stetler, 2001). All evidence is analyzed to determine sufficiency and credibility to the topic. The evidence reviewed for this EBP was critiqued using evidence appraisal tools and with a focus on applicability, sufficiency and credibility.

Comparative evaluation/decision making. In this phase of the Stetler model, the project manager applies a set of utilization criteria and determines if the evidence is usable for the EBP topic (Stetler, 2001). The project manager needs to take into consideration feasibility, current practice, substantiating evidence, and fit of setting (Stetler, 2001). The project manager can decide on four different courses of action: (a) decide to use the research findings either instrumentally, conceptually, or symbolically, (b) consider use by gathering more internal information, (c) delay use by determining more research is needed, or (d) reject use (Stetler, 2001).

Translation/application. In this phase of the Stetler model, findings are converted into practice change recommendations. Practice change recommendations are disseminated to the appropriate staff, procedures and protocols are developed, and change is implemented (Stetler, 2001). For this EBP project, research findings were summarized, a plan of implementation to reduce CDI rates was developed with input from the infection preventionist and other identified stakeholders. Current facility statistics and best practice recommendations were evaluated and combined to form a training program for staff to prevent the spread of CDI. Current best practice recommendations were presented to environmental services staff, healthcare workers on the general medical floor including nurses, nurses' aides and unit secretaries.

Evaluation. During this phase, data is collected to determine the impact of the practice change. For this EBP project, planned data to be collected includes gender, age, admitting diagnosis, CD testing results, antibiotic use prior to hospitalization, time of symptom onset, past medical history, hospitalization within last three months, hand hygiene compliance, de-escalation of antibiotics, timely discontinuation of antibiotics, appropriate antimicrobial therapy, compliance to contact isolation procedures and compliance to environmental surface cleaning protocol. The collected data will be combined and reviewed to monitor compliance of hand washing, compliance of room cleaning and compliance of contact isolation to reduce the CDI rate for the general medical unit. The collected data will determine if the education and interventions of the bundle decreased the incidence of CDI on the general medical unit. The collected data will also assist the antimicrobial stewardship committee in monitoring appropriate use of antibiotic therapy.

Strengths and Limitations of EBP Model for EBP Project

The main-focus of this model is to critically think and use research findings to update practice (Stetler, 2001). This EBP project aims to improve CDI incidence rates by using the current evidence to create an implementation plan. Both the focus of the EBP model and the

EBP project are parallel. The strengths of this model include the applicability of the model to the EBP project. The revisions of the EBP model have led to more clarification of the steps.

Literature Search

The preparation phase was completed by performing a thorough search of the literature using the PICOT question. Validation, the second phase of the Stetler model was initiated. Per the Stetler model, the validation phase involved conducting an in-depth literature review, critique, synthesis and analysis (Stetler, 2001). An explanation of the literature search, appraisal and synthesis of evidence follows in the below paragraphs.

Sources Examined for Relevant Evidence

To obtain relevant evidence for the best practice intervention for CD prevention, a computer-based search of five different databases was conducted. A hand search of reference lists, a review of expert practice recommendations and review of the World Health Organization (WHO) website was also performed. Searched databases included Cumulative Index to Nursing and Allied Health Literature (CINAHL), Medline via EBSCO Interface, ProQuest Nursing and Allied Health Source, Cochrane Collaboration and Library, Joanna Briggs Institute Evidence Based Practice (JBI), and National Guideline Clearinghouse. Searches were conducted for peer-reviewed literature published between the years 2011-2016 within CINAHL, Medline, ProQuest, Cochrane Library, and Joanna Briggs Institute using the below described subject headings. Searched key words included “Clostridium difficile prevention” AND “control” in CINAHL yielding 29 articles and in Medline yielding 55 articles. Searched key words included “C. difficile” AND “prevention” OR “control” in ProQuest yielding 65 articles. Searched key words included “Clostridium difficile” in Cochrane Library yielding 8 articles. Searched key words included “Clostridium difficile prevention” in Joanna Briggs Institute EBP Database yielding 25 articles. A hand search of reference lists resulted in two additional articles (see Table 2.1).

Inclusion and exclusion criteria. Strict inclusion and exclusion criteria were developed using the PICOT question to focus the search for relevant evidence. Inclusion criteria included the following: (a) published in a scholarly, peer-reviewed journal, (b) published after 2011, (c) printed in English language, and (d) included adult patients over the age of eighteen years of age. Exclusion criteria included: (a) exclusive outpatient treatment, (b) age less than 18 years of age, and (c) interventions not focused on bundled interventions. Search results from the databases were reviewed and all duplicate studies were eliminated. Each article abstract was reviewed. In addition, the WHO recommendations, the United States Preventative Task Force (USPSTF), and the National Guideline Clearinghouse were reviewed to ensure all relevant literature was included. Eighteen references were identified for potential inclusion and the full texts of the articles were printed and reviewed. Of the 18 articles, 6 were included in the final literature review based upon the inclusion and exclusion criteria. These articles were analyzed and critically appraised.

Levels of evidence

After appraisal of evidence, each was rated using Melnyk & Fineout-Overholt's (2011) rating system for hierarchy of evidence. Level I evidence is from a systematic review or meta-analysis of randomized control trials (RCT). Level II evidence is from single RCTs that are well-designed. Level III evidence is from non-randomized control trails. Level IV evidence is from single case-control and cohort studies. Level V evidence is from systematic reviews of descriptive or qualitative studies. Level VI evidence is from single descriptive studies. Level VII evidence is from expert opinions (Melnyk & Fineout-Overholt, 2011). The evidence was reviewed and met the quality criteria to be included in the supporting evidence for this EBP project. Within the literature which provided the supportive evidence for this project, one article was Level II evidence, three articles were Level III evidence, one article was Level V evidence and one article was Level VII evidence. Table 2.2 includes the leveling of the evidence included in this EBP project.

Appraisal of Relevant Evidence

Melynk and Fineout-Overholt's (2011) rapid critical appraisal checklists were used to evaluate each article. The one Level II evidence was reviewed utilizing Melnyk and Fineout-Overholt's (2011) rapid critical appraisal checklist for randomized control trials. The four Level III evidence was reviewed utilizing Melnyk and Fineout-Overholt's (2011) rapid critical appraisal of quantitative studies. The Level V evidence was reviewed utilizing Melnyk and Fineout-Overholt's (2011) rapid critical appraisal checklist for qualitative evidence (Melnyk & Fineout-Overholt, 2011). Finally, Broughton and Rathbone's (n.d.) evaluation criteria were used to evaluate the clinical practice guidelines included in the literature. All nine articles met the quality standards and were included in the body of evidence.

Construction of Evidence-based Practice

Synthesis of Critically Appraised Literature

Level II evidence. Rubin et al. (2013) conducted a study using computer simulation model called agent-based modeling (ABM). The purpose of the study was to simulate a typical hospital environment and the spread of CD between patients by contaminated environmental surfaces and health care worker hands. The agent-based model was constructed to study complex systems involving multiple dynamic interactions among and between individuals and their environment overtime (Rubin et al., 2013). In order to represent diverse facilities and intervention scenarios, five sub-models were created. The five sub-models included patient flow governed processes of patient admission, transfer, and discharge. The virtual hospital represented a medium-sized facility with nine 30-bed acute care floors and two 15-bed intensive care units. All rooms were private and Veterans Affairs data was obtained for length of stay and time to inter-floor transfers (Rubin et al., 2013).

The patient states sub-model included representations of infection status, symptoms, and antimicrobial use. Non-colonized patients transitioned to “asymptomatic C. difficile infection” and asymptomatic patients transitioned to “diarrhea due to C. difficile infection”. Both toxigenic and non-toxigenic C. difficile caused asymptomatic carriage but only toxigenic CD caused diarrhea. Antimicrobial drugs were grouped into five classes to represent different effects on risk of CD acquisition, progression to symptomatic CDI and organism shedding (Ruben et al., 2013). The contact event sub-model governed processes of contamination of environmental surfaces within the room, transfer of organisms to health care worker hands and acquisition of organisms by susceptible patients. The level of contamination while the room was occupied by an infected patient was represented by the pathogen load and the fraction of contaminated surfaces in the room (Ruben et al., 2013).

The response and intervention sub-model governed policies for managing infected patients and preventing transmission. Cases of CDI were identified through diagnostic testing and patient's positive for CD toxins were placed in contact isolation (Ruben et al., 2013). The contact network sub-model represented the connections between patients, nurses and doctors. Each patient was assigned a random number of nurses within their unit using a shifted Poisson distribution, as well as two physicians. Nurses only had contact with the patient's in their own unit and physicians had contact with multiple patients across multiple floors. Nursing assignments changed twice daily (Rubin et al., 2013). The model parameters were based on national and local data as well as face-to-face panel discussions. An experimental design was used to explore the impact of the following six infection control interventions and policies for reducing CD transmission and infection: (a) improved adherence with hand hygiene, (b) improved use of soap and water for hand hygiene for contacts with CDI patients, (c) improved adherence with contact precautions for contacts with CDI patients, (d) improved environmental decontamination, (e) aggressive/early testing for CD, and (f) empiric isolation and treatment of suspected cases of CDI (Rubin et al., 2013). All six interventions were studied individually and in combination.

Initially interventions parameters were set at base-case values which are values that reflect current realities in a hospital. Two additional experiment scenarios were identified including intervention values which represent an improvement over the base-case values and maximum feasible or optimal values which represent the maximum effects that can be reasonably expected from strong adherence to an intensive and aggressive campaign to reduce CD transmission (Rubin et al., 2013). A total of 2,000 iterations for each scenario were performed and each of the 486 combinations of component values were run 36 times (Ruben et al., 2013). Epidemic conditions were explored using experimental scenarios at different levels of CD importation and transmissibility: (a) base-case, (b) high levels for each, and (c) low levels for each (Ruben et al., 2013).

The outcomes among the three experimental scenarios were assessed using boxplots of rates and comparing estimates rates of actual and reported CDI. The differences in epidemiologic conditions were also assessed (Ruben et al., 2013). In the base-case scenarios, CD infection rates ranged from 8-21 cases per 10,000 patient-days, with a case detection fraction between 32%-50%. The acquisition of CD ranged from 115 to 202 events per 10,000 patient-days, with approximately 40% of acquisitions originating from rooms of symptomatic CDI patients and 60% originated from the rooms of asymptomatic carriers (Ruben et al., 2013). The implementation of the bundle interventions during the typical intervention scenario had a large impact on acquisition of CD rates at 50 events per 10,000 patient-days, and base-case scenario of 150 events per 10,000 patient-days. The bundle interventions during the typical intervention scenario also improved for actual CDI rates and reported CDI rates of 40 events per 10,000 patient-days with a base-case scenario of 140 events per 10,000 patient-days actual CDI rates and 80 events per 10,000 patient-days reported CDI rates. The impact of each single component at the typical intervention scenario was greatest for hand hygiene (7 events per 10,000 patient-days), empiric isolation (9 events per 10,000 patient-days), and testing (13 events per 10,000 patient-days). The bundle intervention including hand hygiene and empiric isolation had the largest impact on actual CDI (5 events per 10,000 patient-days).

Bundled CDI control interventions dramatically reduced both CD acquisition and CDI rates in non-outbreak settings (Ruben et al., 2013). When each intervention was examined individually, hang hygiene substantially affected acquisition of CDI and infection rates. Hand hygiene, empiric isolation and treatment of suspected CDI cases were the next most effective components of bundled interventions. This study suggests that a standard CDI bundle intervention provides a marked reduction in CD acquisitions and infections, although a highly optimized intervention provides only minimal additional benefit when compared to the typical intervention scenarios. A strong hang hygiene program and a policy of early isolation and treatment of suspected CDI cases are the most important components of C. difficile-targeted interventions (Rubin et al., 2013).

The findings from this research provided support for this EBP project. This study supported a bundled approach to interventions such as a hand hygiene program, policy for early empiric isolation of suspected CDI patients and early treatment. In addition, this study identified individual interventions within the bundle that were proven to be less effective and therefore would not help to decrease acquisition and treatment of CD patients. Implementation of a bundle consisting of: (a) hand hygiene, (b) empiric isolation, and (c) treatment of suspected CD cases are supported by this study.

Level III evidence. Waqar et al. (2016) conducted a study in a 531-bed tertiary care center to reduce the rates of CDI A multidisciplinary taskforce was initiated as part of a performance improvement plan for the facility. All data was shared among the task force members during the data collection phase from January 2013 until December 2014. Informational posters regarding transmission and the appropriate precautions needed to prevent spread were placed in all units (Waqar et al., (2016). CDI patient rooms had a modified contact sign on the door to signify that hand washing with soap and water was necessary after contact with the patient and their environment. This sign was also a visual alert to environmental services staff to use bleach at a dilution if 1:10 for terminal cleaning instead of the quaternary cleaner used for all other patient rooms at the facility (Waqar et al., 2016). Environmental services staff were provided with training and feedback regarding proper cleaning of CDI rooms. Patients with CDI were kept in contact isolation for the entire admission.

A computer-based learning module was created and was required to be reviewed by all health care providers including physicians, nursing staff and ancillary staff members. Monitoring of high-touch surface cleanliness during terminal cleaning was by use of the Clean-Trace Hygiene Management System. This involved swabbing six high-touch surfaces in a patient's room after terminal cleaning and checking for the level of adenosine triphosphate (ATP) as measured with relative light. Levels of relative light less than 500 were considered clean. An antimicrobial stewardship committee sought to further the reduction of Fluoroquinolones use in addition to the existing goals. This committee introduced appropriate guidelines for antimicrobial use for urinary tract and intra-abdominal infections. Fluoroquinolones were added to the restricted list at the facility and required an indication for use and appropriate intervention.

Data was analyzed using a 2-sample *t* test. From January to December 2013 the CDI rate decreased from 15.38 to 6.94 per 10,000 patient-days (Waqar et al., 2016). The average monthly rate of CDI decreased per 10,000 patient-days from 12.5 to 7.8 (p=.001). The mean rate of hang hygiene adherence was 63% and did not change during the study period. The percent of cleanliness if high-touch surfaces improved from 62.7 to 91 and Fluoroquinolones use decreased from 65 defined daily dose per 1,000 patient-days to 31 defined daily dose per 1,000 patient-days. The implementation of multiple interventions in the study was associated with a decrease in the rate of CDI over a two-year period.

The findings from this research provided support for this EBP project. The study supported a bundled approach to CDI acquisition prevention and transmission prevention. The interventions in the bundle for this study included: (a) hand hygiene, (b) multimodal education including education posters and computer-based learning modules, (c) contact isolation signs, (d) use of bleach for room cleaning, (e) Clean Trace Hygiene Management System, and (f) antimicrobial stewardship committee that focused on restricted use of Fluoroquinolones. The evidence from this study supports a bundled intervention approach to CDI prevention in a hospital setting.

Koll et al. (2013) conducted a study using the collaborative model to promote interdisciplinary cooperation from multiple organizations to test and implement interventions, institute change, and regularly collect and report data results. The study was conducted over a 22-month period to evaluate a multifaceted intervention to prevent CDI within acute care hospitals in the New York Metropolitan region. Data was collected monthly from March 2008 to December 2009. Inclusion criteria for this study included: patients 18 years of age or older with documented diarrhea and laboratory confirmed CDI. All hospitals involved in the study were asked to complete a survey of their current C. difficile related practices, and were required to demonstrate the facility's executive leadership support through an application process. The participating hospitals were required to create an internal interdisciplinary team to drive CDI reduction efforts. At a minimum, the team comprised of (a) an Infection Preventionist, (b) physician champion, (c) nurse champion, (d) support staff from environmental and transport services, and (e) quality improvement personnel. A steering committee guided all aspects of the Collaborative, including designing the intervention, developing data definitions, data collection strategy, and using standardization collection tools. The steering committee members included infectious disease physicians, infection preventionist, hospital epidemiologists, nurses from the hospitals and additional staff. Each hospital received monthly data reports to monitor changes in performance and compare performance to the overall Collaborative. A teleconference was conducted monthly with all the hospitals to review current data. In addition, a physician expert was available to provide consultation regarding CDI to assist in standardization and consistent data collection (Koll et al., 2013).

The C. difficile bundle intervention utilized in this study included an infection prevention bundle and an environmental cleaning protocol which were implemented in the first six months of the Collaborative. The infection prevention bundle included: (a) contact precautions instituted immediately for patients with diarrhea, (b) sign placement for patients with confirmed or suspected CDI, (c) personal protective equipment readily available and used, (d)adherence to hand hygiene protocols, (e) dedicated rectal thermometers, (f) patient placement protocols including, private rooms for CDI patients (confirmed or suspected), cohorting of CDI patients, if private room unavailable, and, as a last option, dedicated bathroom for CDI patients in a shared room with non-CDI patient. The environmental cleaning protocol included standardized cleaning with a hypochlorite-based disinfectant for routine and terminal cleaning and a 48-item checklist to assess compliance. Standardized data collection tools were used by all participating hospitals and data was submitted monthly. The data collected by the hospitals included both demographic patient data as well as total CDI cases, length of stay, mortality, and process measures. Patients were classified by the infection preventionist into four categories (a) hospital-onset or hospital-associated, (b) non-hospital associated, (c) community-onset and (d) recurrent CDI. Compliance data for both bundle and environmental checklist were obtained through direct observation (Koll et al., 2013).

A total of thirty-five hospitals were included in the analyses for this study. The most prevalent type of CDI was hospital-onset CDI which accounted for 44% of all reported cases. More women had hospital-onset CDI (53%) and were more frequently reported with nonhospital-associated CDI (58%) compared to men. Most CDI cases (73%) were not transferred from another facility. Hospital onset CDI cases had a mean length of stay more than twice as long (26 days) and all-cause mortality rate almost twice as high (M= 18%) as cases with nonhospital-associated length of stay was 11 days and all-cause mortality rate (M=10%) or community-onset, hospital-associated CDI length of stay 12 days and all-cause mortality rate (M=13%) (Koll et al., 2013). The mean compliance with the prevention bundle was 95% and the mean compliance with the environmental cleaning protocol was 96%. A pronounced downward trend was noted in the mean hospital-onset CDI rate from 12 to 8 per 10,000 patient-days. The predicted hospital-onset reduction over time was significant over the course of the project (*p*<.001). The expected number of hospital-onset CDI cases was 6,461 and the actual number of cases was 5,377. Based on the regression estimation, hospitals had 1,084 fewer cases of hospital-onset CDI than expected. This would equal a total estimated cost savings of $2.7 million to $6.8 million for the Collaborative.

The Collaborative model focused on preventing transmission of CD through evidence-based infection prevention measures and standardized environmental cleaning protocols. This study demonstrated a significant reduction in the incidence of hospital-onset CDI. This study did not address antimicrobial prescribing practices and few, if any new resources were used for implementation. No changes were made to any of the facility policies. Prior comparison data was not available due to the customized definitions used by the Collaborative. The CD Collaborative focused on implementing infection prevention and environmental services protocols in the acute care hospital setting.

The findings from this research provided support for this EBP project. The approach taken by the Collaborative group was both a multidisciplinary group as well as bundled interventions. The interventions for this study included hand hygiene, environmental cleaning and isolation practices. The implementation of these interventions in an acute care hospital setting depicted a significant decrease in hospital-associated CDI.

Pokrywka et al. (2014) conducted a study that added patient hand hygiene in a care bundle to decrease the rate of C. difficile disease in hospitalized patients. The previous bundle used at the facility included (a) early detection of C. difficile cases by toxin testing of any patient with onset of unexplained diarrhea, (b) electronic alerts on positive toxin results to nursing units to initiate barrier precautions with glove and gown use, (c) staff hand hygiene with soap and water, (d) extended duration of isolation for entire hospital stay, (e) staff and patient education on CD disease, and (f) cleaning of all patient rooms with sodium hypochlorite solution. A CD prevention team was initiated with members from infection prevention and control, nursing, pharmacy, laboratory, housekeeping and infectious disease physician. Education for patient hand hygiene was created and disseminated to all staff members. Patient hand hygiene was promoted prior to meals with soap and water or an alcohol wipe that was placed on the patient's meal tray by the dietary staff.

The study was completed in a 520-bed tertiary care facility, with the previously mentioned CD prevention bundle already in place. The only component added to the existing prevention bundle was patient hand hygiene. Cases of CD were defined during and prior to the study period using National Healthcare Safety Network criteria as a patient with new onset of unexplained diarrhea for at least twelve hours occurring more than 48 hours after admission and having a positive C. difficile toxin test. An expanded definition was created for patients that were discharged within the previous three months without an intermediate stay at another healthcare or rehabilitation facility. All positive toxin tests were classified as (a) hospital-acquired, (b) hospital-acquired expanded including cases with prior to admissions in the last 3 months, (c) health-care acquired with transfer from another hospital or rehabilitation facility, and (d) community-acquired with no prior hospitalizations. The rate of CDI was calculated using hospital-acquired and hospital-acquired expanded as the numerator and hospital wide inpatient days (per 10,000 patient-days) as the denominator. Data was gathered for this study from July 2009 to June 2010 and rates were compared to the previous year's data.

Patient hand hygiene was promoted prior to meals using soap and water or with a commercially available alcohol wipe placed on patient trays by dietary staff. The wipe was used for mechanical removal of CD contamination rather than killing spores. Units at the facility created unit-specific protocols for patient hand hygiene which included brochures or signage in hospital rooms, reminding patients to perform hand hygiene, and enlisting nurses, nurse's aides, patient care technicians, student nurses, hospital volunteers, and elder care professionals to help patients with hand hygiene prior to meals or as needed. From July 2009 to Jun 2010, 336 positive results were investigated and rate of incidence was 6.95 per 10,000 patient-days. In comparison, the previous year's incidence of CDI was 10.45 per 10,000 patient-days. The inclusion of patient hand hygiene to the prevention bundle was found to be statistically significant (p=0.0009).

The findings from this research provided support for patient hand hygiene as part of bundled interventions for CDI patients. The CDI prevention bundle was already present at this facility with incidence of CDI still occurring. The interventions focusing on patient hand hygiene were successful in decreasing the incidence rate.

Level V evidence. You, Song, Cho, and Lee (2014) conducted a study combining infection control interventions, education, isolation, hand hygiene, contact precautions, and environmental disinfection to reduce the incidence of hospital-acquired CD. The researchers of this study examined the incidence of CDI in a University hospital from April 1, 2011 to December 31, 2011. The overall incidence of CDI was 0.93 cases per 1,000 patient-days, but the incidence in the medical intensive care unit was five times higher at 4.70 cases per 1,000 patient-days. During this recording period the healthcare practitioner’s infection control procedure was hand hygiene only. The infection control interventions that were implemented in the medical intensive care unit and consisted of (a) education, (b) isolation, (c) hand hygiene, (d) contact precautions, and (e) environmental disinfection. Restrictions on antimicrobial use were not included in this study. Educational interventions consisted of a lecture presentation to all medical staff and attending physicians. Information included in the lecture consisted of survey results, baseline data, proper isolation, hand hygiene, contact precautions and environmental disinfection. Patients with CDI were placed in a private isolation zone and separate hand-washing sinks were positioned near each bed. Isolation was maintained until the patient had remained free of diarrhea symptoms for 48 hours. Healthcare workers and visitors were required to wear clean gloves and gowns prior to contact with a CDI patient and perform proper hand hygiene with soap and water after caring for or having contact with CDI patients. The frequency of environmental disinfection was increased to twice a day using sodium hypochlorite.

Data was collected for comparison prior to intervention and post intervention. Pre-intervention cases totaled 290 patients and post-intervention data included 277 patients. Data collected included demographic data, length of stay in the medical intensive care unit, and Acute Physiology and Chronic Health Evaluation (APACHE III) score, as well as CDI infection rates. The overall incidence rate of CDI increased within the hospital from 0.93 to 1.17 per 1,000 patient-days, but the incidence of CDI in the medical intensive care unit decreased significantly from 4.70 to 1.53 cases per 1,000 patient-days (p=0.012, *OR* 0.36, 95% *CI* 0.13-0.85). Of note during the implementation period other units within the hospital also received hand hygiene and educational interventions, although the entire bundle was not implemented in these units. During the intervention period the other units observed an increased in CDI incidence while the medical intensive care unit demonstrated a 67% reduction. This suggests that compliance to bundled elements of care including patient isolation, environmental cleaning, and the use of personal protective equipment results in decreased incidence of CDI. Hand hygiene compliance in the medical intensive care unit prior to the intervention was 58.2% and post-intervention was 86.4%.

This study supports the use of hand hygiene, patient isolation and surface cleaning as a care bundle to prevent CDI infection as well as transmission in an acute care hospital setting. This study supports the use of hand hygiene, patient isolation and surface cleaning as a care bundle to prevent CDI infection as well as transmission in an acute care hospital setting. The findings from this study demonstrate statistical significance in using the bundle versus general education that was given to the other floors receiving the intervention bundle (p=0.012). This study provides further support of a bundled approach to preventing CDI incidence.

Level VII evidence. The Association for Professionals in Infection Control and Epidemiology (APIC) in 2013 created a guide to prevent CDI in an acute care setting. This guide focuses on the diagnosis, modes of transmission, surveillance, prevention using hand hygiene, prevention using contact/isolation precautions, prevention using environmental cleaning antimicrobial stewardship, and fecal bacteriotherapy. For diagnosis, it is recommended that only diarrhea be tested for CD. A test to detect CD toxins A and B should be used to test only watery or loose stool. Modes of transmission include infected humans and inanimate objects. Vegetative cells of CD die within 24 hours but the spores can stay on a surface for many months and are extremely resistant to cleaning.

The most likely mode of transmission is on the hands of healthcare workers. Transmission can also occur from contaminated cellphones, electronic thermometers, oral care or oral suctioning, poor hand hygiene, and ineffective environmental cleaning. Surveillance is an ongoing, systemic collection, analysis, interpretation, and dissemination of data regarding a health-related event to reduce morbidity and mortality. This guides essential components of a surveillance system are standardized definitions, identification of a patient populations at risk for infection, statistical analysis and feedback of results. Prevention strategies focus on hand hygiene, patient contact isolation and environmental cleaning.

Hand hygiene interventions are focused at healthcare workers, families, visitors and patients to wash their hands with soap and water to prevent the spread of C. difficile. Gloves are recommended to be worn for all CDI patients and hands should be washed with antimicrobial soap and water. Families, visitors and patients should be included in education to wash hands with soap and water when leaving a CDI room, after using the bathroom and prior to eating. When completing hand washing hand should be wet before applying soap then rub hands vigorously for 20 secs before rinsing with water. Finally, dry hands and turn off water with paper towel.

Contact isolation precautions should be used on all patients suspected of having CDI. If possible patients should be assigned to a private room with a bathroom that is only for use by the patient (APIC, 2013). Personal protective equipment (PPE) should be used by patients, families and visitors and should include gloves and a gown. PPE should be donned before going into the room and discarded before exiting the patient’s room (APIC, 2013). Patient transportation and movement outside of the room should be limited to medically necessary purposes. Prior to leaving the room, the patient should perform hand hygiene and use appropriate barriers (APIC, 2013). The cleaning and disinfection of all frequently touched surfaces in all patient care areas is important (APIC, 2013). Special attention should be paid to those areas closer to the patient, including bedrails, bedside tables, commodes, doorknobs, sinks, surfaces, and equipment near the patient (APIC, 2013).

Environmental cleaning should be completed using 10% sodium hypochlorite solution that should stay on the surface for a contact time of one minute and should air dry (APIC, 2013). A clean cloth should be used during cleaning and the dirty cloth should not return to the clean bucket with germicide solution. Privacy curtains should be changed with each terminal cleaning. All mobile devices that enter or leave a contact room with a patient suspected of CDI should be cleaned with appropriate solution (APIC, 2013). Consistency with recommended cleaning and disinfection procedures should be routinely monitored. Cleaning and disinfection of computers or workstations on wheels should be a normal part of a daily routine. Per the CDC (2013), the risk of disease transmission from soiled linen is negligible and common sense hygienic practices for processing and storage of linen are recommended.

Antimicrobial stewardship programs ensure that appropriate antibiotic use is considered for all patients to prevent CDI (CDC, 2013). Another important role of the antimicrobial stewardship committee is to achieve optimal medical therapy for treatment of CDI. Because CDI is nearly always a complication of antibiotic use, the development of a healthcare facility program to ensure appropriate antibiotic use is considered an important prevention intervention. The normal gastrointestinal flora is the main protection mechanism of the host to prevent colonization and infection with pathogens such as CDI (APIC, 2013). If the microbiome is disrupted C. difficile can attach to the gastrointestinal epithelial cells, produce toxins and cause damage (APIC, 2013). Because antibiotics kill bacteria and are not specific to one particular bacterium, they all have the ability to disrupt the balance of bacteria in the microbiome (APIC, 2013). The first two elements that need to be considered when evaluating the risk for CDI produced by a particular antibiotic include antibiotic spectrum and duration. The most common inappropriate antibiotic use that places a patient at increased risk is the continuation of broad-spectrum antibiotics after the etiology of the infection has been identified (APIC, 2013). The dose of antibiotic administered is another important consideration for antimicrobial stewardship programs. Over-or under dosing may be lead to CDI or may not be enough to treat the infection (APIC, 2013). Once a patient is diagnosed with CDI, antimicrobial stewardship is important to achieve optimal medical therapy. The main treatment goals are killing C. difficile, killing toxin, and restoring normal flora (CDC, 2013). The goal of an antimicrobial stewardship program is to optimize the use of the right drug, for the right purpose, at the right dose, and for the right duration in an effort to promote judicious use of the antimicrobial agent (APIC, 2013).

Transplantation of enteric bacteria is becoming a more common therapy for CDI patients. Fecal bacteriotherapy is transplantation of enteric bacteria from one host to another (APIC, 2013). Many factors can cause a disruption in a person’s normal flora or good bacteria in the gastrointestinal tract and this can lead to CDI. Without the normal flora, CDI is able to flourish and cause disease (APIC, 2013). Factors affect the normal microflora include advanced age, gastric acid modifying agents and antimicrobials (CDC, 2013). Once the normal fecal microflora is disrupted, it is critical to restore balance of these beneficial bacteria (APIC, 2013). Fecal bacteriotherapy includes identification of a healthy stool donor, obtaining the healthy stool specimen, screening the healthy stool for infectious disease, identifying the route for transplantation, preparing the recipient for transplantation, preparing the stool specimen for transplantation, transplantation the specimen, patient education and follow-up (APIC, 2013).

This article was chosen for inclusion because this guide focuses on the diagnosis, modes of transmission, surveillance, prevention using hand hygiene, prevention using contact/isolation precautions, prevention using environmental cleaning antimicrobial stewardship, and fecal bacteriotherapy. This guide for preventing C. difficile infections provide a step-wise approach to implementing a prevention bundle in an acute care setting.

Construct Evidence-Based Practice

Per Melnyk and Fineout-Overholt (2011) appraising the evidence for validity, reliability and applicability to the clinical site, evidence is synthesized to generate a best practice recommendation. The appraisal of evidence provided the basis for developing a best practice intervention to implement this EBP project. The process of critically appraising articles led to the development of an appropriate intervention and an appropriate measurement tool to evaluate the effectiveness of the proposed intervention. The population and facility were taken into consideration when determining the intervention and data collection criteria to appropriately answer the clinical question.

Synthesis of Critically Appraised Literature

The evidence clearly demonstrated the significance of four bundled strategies to prevent CDI in an acute care setting, those being:(a) hand hygiene that includes soap and water in patients, healthcare workers, families and visitors, (b) isolation and contact precautions including gloves and gown, (c) environmental cleaning using a sodium hypochlorite solution, and (d) antibiotic stewardship committee. The evidence from the literature appraisal was synthesized using these strategies.

Hand hygiene. Per the CDC (2013), healthcare worker's hands are frequently contaminated with C. difficile following patient contact and contribute to the spread of C. difficile. Wearing gloves prior to contact with a suspected CDI patient can reduce the spread of C. difficile. All healthcare workers should wash their hands with a non-antimicrobial or an antimicrobial soap and water or disinfectant (APIC, 2011). Families, visitors and patients should be involved in prevention of CDI. The HHS Partnership for Patients created "Do the Wave" to teach families and patients how to protect themselves when they are in the hospital. The "Wave" reminds families and visitors to (W) wash hands to protect against germs, (A) ask questions to improve quality of care, (V) vaccinate against flu and pneumonia, and (E) ensure safety by making sure medical devices are cleaned and properly used (APIC, 2013). Pokrywka et al., (2014) reported that more than 50% of patients were not offered the opportunity to perform hand hygiene during hospitalization. A randomized CDC trial of soap and water wash versus alcohol hand rub shows soap and water are more effective at removal of CD spores on patient hands. Many of the studies appraised for this EBP project included hand hygiene in the bundle of care for prevention of CD transmission. The guide to prevent CDI created by APIC focuses on the diagnosis, modes of transmission, surveillance, prevention using hand hygiene, prevention using contact/isolation precautions, prevention using environmental cleaning antimicrobial stewardship, and fecal bacteriotherapy (APIC, 2013). You, Song, Cho, and Lee (2014) performed a study to monitor the incidence of CDI and how implementation of a bundle can affect incidence of CDI. The bundle consisted of (a) education, (b) isolation, (c) hand hygiene, (d) contact precautions, and (e) environmental disinfection. A study was conducted that added patient hand hygiene in a care bundle by offering hand hygiene to patients with soap and water prior to meals or with sanitation wipes on patient trays (Pokrywka et al. 2014). Rubin et al. conducted a study that found hand hygiene, empiric isolation and treatment of suspected CDI cases were the next most effective components of bundled interventions (Rubin et al., 2013).

Compliance of the infection prevention bundle should be monitored monthly with a recommended target sample size. Five observations per week should be performed on suspected or confirmed CDI patients (APIC, 2013). A checklist should be used when doing to observation to make sure that all observations are conducted the same and the same data is being gathered. An environmental cleaning tracking tool should also be implemented. This form would be used by environmental services when terminally cleaning a room and would be signed off by his/her supervisor once completed (CDC, 2013).

Isolation and contact precautions. Early identification of patents who are being investigated for, or diagnosed with CDI is the first step to preventing spread of the disease. C.

difficile can be spread by direct or indirect contact with the patient or the patient’s environment (APIC, 2013). Adherence to the components of Contact Precautions will help break the chain of infection. Patient’s suspected of or diagnosed with CDI should be placed in a private room if possible to decrease the spread of CDI. Personal protective equipment must be donned before going into the room and discarded before exiting the patient’s room (CDC, 2013). A gown and gloves should be worn for patient’s in contact isolation and for all patient’s suspected or diagnosed with CDI. Rubin et al. (2013) found bundle intervention including hand hygiene and empiric isolation had the largest impact on actual CDI (5 events per 10,000 patient-days). Waqar et al. study found that the average monthly rate of CDI decreased per 10,000 patient-days from 12.5 to 7.8 (p=.001) using a bundle which included contact isolation (Waqar et al., 2016). A study conducted by Koll et al. found a pronounced downward trend noted in the mean hospital-onset CDI rate from 12 to 8 per 10,000 patient-days (Koll et al., 2013). The medical intensive care unit had a reduction in CDI incidence by approximately 67%. This suggests that patient isolation, environmental cleaning, and the use of personal protective equipment can decrease incidence of CDI (You, Song, Cho, and Lee, 2014).

Environmental surface cleaning. The environment plays a key role in the spread of CDI. Because C. difficile is shed in feces, any surface or medical equipment that becomes contaminated with feces can act as a source for spores and be involved in infection transmission (APIC, 2013). CD spores can exist for up to five months on hard surfaces (CDC, 2013). The heaviest contamination can be found on floors and in bathrooms. Any removable items from a patient’s room can become contaminated including thermometers, blood pressure cuffs, bedrails, call buttons, tube feedings, flow control devices, bed sheets commode, toilets, scales, telephones TV controls, light controls, and stethoscopes. Many disinfectants commonly used in healthcare will not kill the C. difficile spores. Only chlorine-based disinfectants and high-concentration hydrogen peroxide formulations kill spores (CDC, 2013). The use of 10% sodium hypochlorite solution mixed fresh daily should be used with a clean cloth for each use. The contact time of one minute for the hypochlorite solution should provide adequate disinfection and should air dry (APIC, 2013). Privacy curtains should be changed during terminal cleaning. Waqar et al. completed a study using a modified contact sign on the door to signify that hand washing with soap and water was necessary after contact with the patient and their environment. This sign was also a visual alert to environmental services staff to use bleach at a dilution if 1:10 for terminal cleaning instead of the quaternary cleaner used for all other patient rooms at the facility (Waqar et al., 2016). Environmental services staff were provided with training and feedback regarding proper cleaning of CDI rooms. The Collaborative model focused on preventing transmission of C. difficile through evidence-based infection prevention measures and standardized environmental cleaning protocols. This study demonstrated a significant reduction in the incidence of hospital-onset CDI (Waqar, 2016). The medical intensive care unit had a reduction in CDI incidence by approximately 67%. This suggests that patient isolation, environmental cleaning, and the use of personal protective equipment can decrease incidence of CDI (You, Song, Cho, and Lee, 2014).

Antimicrobial stewardship committee. CDI is frequently a complication of antibiotic use, and the development of a healthcare facility program to ensure appropriate antibiotic use is considered an important prevention intervention (APIC, 2013). The most important protection mechanism against CDI in humans is the normal gut flora. Antimicrobial stewardship programs ensure that appropriate antibiotic use is considered for all patients to prevent CDI. Another important role of the antimicrobial stewardship committee is to achieve optimal medical therapy for treatment of CDI. The main treatment goals are killing CD, killing toxin, and restoring normal flora. Waqar et al. conducted a study in 2016 using an antimicrobial stewardship committee sought to further the reduction of Fluoroquinolones use in addition to the existing goals. This committee introduced appropriate guidelines for antimicrobial use for urinary tract and intra-abdominal infections. Fluoroquinolones were added to the restricted list at the facility and required an indication for use and appropriate intervention. The average monthly rate of CDI decreased per 10,000 patient-days from 12.5 to 7.8 (p=.001) (Waqar et al., 2016).

Best Practice Model Recommendation

The best practice recommendations based upon the synthesis of the appraised evidence (Appendix A) was that a bundle strategy of hand hygiene, isolation/contact precautions, environmental cleaning and antimicrobial stewardship committee to prevent the transmission and spread of C. difficile. The evidence reviewed and synthesized reflects that education to all staff should include hand hygiene, isolation/contact precautions and environmental cleaning, use of contact isolation signs and formation of an antimicrobial stewardship committee.

Hand hygiene education should include only soap and water after contact with CDI patients, because alcohol based hand sanitizers do not kill the spores. Patient hand hygiene education should also be provided to all staff to include encouragement of patients to wash hands with soap and water prior to all meals and after using the bathroom. All patients suspected or diagnosed with CDI should be immediately put in contact isolation with a contact isolation sign on the door and a soap and water only sign should be hung outside the door. CDI patients should be admitted to private rooms or in a cohort with another CDI patient to prevent the spread of CDI. All staff should strictly adhere to the contact isolation procedure of gown and gloves when entering any CDI patient room. This equipment should be removed upon leaving the patient room and hand hygiene with soap and water should follow. Environmental cleaning should be completed in the CDI patient's room daily with an EPA-approved, spore killing hypochlorite solution. Any removable device or reusable device should be cleaned with the same solution upon leaving the patient room. The patient room after discharge should be terminally cleaned and all areas of the room cleaned with the EPA-approved, spore killing hypochlorite solution. An antimicrobial stewardship committee should be initiated to review the use of antimicrobial agents, de-escalation of antibiotics, and to reduce the use of inappropriate antibiotics. Restriction of Fluoroquinolones in all patients should be initiated and monitored.

Recommendations from the committee should be made to de-escalate Fluoroquinolones when not necessary.

The educational content should be completed using a computer based module or through an in-service with small groups of healthcare staff. Specific contact isolation signs for outside patient door should be available on the inpatient unit and staff as well as housekeeping should be educated on proper contact isolation precautions with use of gowns and gloves. Proper cleaning products should be validated with the facility and education on environmental cleaning should be directed at housekeeping and healthcare staff that clean small movable devices.

How the Best Practice Model Will Answer the Clinical Question

Will implementation of a CDI prevention bundle decrease the incidence of C. difficile in adult general medicine inpatients at a community hospital? To answer this clinical question, the project manager will implement a program utilizing the best practice recommendations detailed above among a group of adult general medicine inpatients at a community hospital. Pre- and post- intervention for C. difficile incidence, hand hygiene compliance, compliance to contact isolation procedures, compliance to environmental surface cleaning protocol, de-escalation of antibiotics, timely discontinuation of antibiotics, and appropriate selection of antimicrobial therapy will be measured to determine how effective the interventions are in answering the clinical question.

Table 2.1

Database Search Results

Database	**Results**	**Included Article(s)**
CINAHL	29	3
Cochrane	8	0
JBI	25	0
Medline	55	0
ProQuest	65	2
Citation Chasing	2	1

Table 2.2

Levels of Evidence

Author (s)	Level of Evidence
APIC (2013)	VII
Koll et al. (2013)	III
Pokrywka et al. (2014)	III
Rubin et al. (2013)	II
Waqar et al. (2016)	III
You, Song, Cho & Lee (2014)	V

CHAPTER 3

IMPLEMENTATION OF PRACTICE CHANGE

Baseline data was utilized as the control data from November 2015 to February 2016 and case data consisted of post-intervention data, which was collected from November 9, 2016 to February 9, 2017. Patients diagnosed with CDI were followed through the entire admission to determine incidence rates, compliance to environmental surface cleaning protocol, de-escalation of antibiotics, timely discontinuation of antibiotics, and appropriate selection of antimicrobial therapy. Data for hand hygiene compliance and compliance to contact isolation procedures was collected on various patients on the medical surgical unit. The following sections provide detail of the intervention.

Participants and Setting

Participants were adult inpatients, over 18 years of age, admitted to the medical surgical unit with a diagnosis of CDI or suspected diagnosis of CDI. Participants observed for compliance to hand hygiene and contact isolation precautions included registered nurses on the medical surgical unit, patient care assistants on the general medical unit, physician assistants, physicians, nurse practitioners and environmental service workers on the medical surgical unit. Hospital X is a community, non-profit tertiary care hospital, located in Northwest Indiana; a 259-bed facility and part of a larger 14 hospital corporation. The medical surgical unit consists of 50 beds and patients with all types of payer sources were accepted for in-patient services on this unit. Patients have had private insurance, Medicare, Medicaid, and self-pay. Registered nurses on this unit have a five to six patient per nurse ratio and work either eight or twelve hour shifts. Patient care assistants on this unit work eight hour shifts and have an eight to ten patient per PCA ratio. Unit secretaries on this unit work twelve-hour day shifts and only one unit secretary is scheduled per day. The average census on this unit is forty patients with the following common diagnoses: pneumonia, renal dialysis, acute kidney failure, chronic renal failure, sepsis, colitis, chronic obstructive pulmonary disease, dehydration, aspiration pneumonia and acute gastrointestinal bleeding.

Outcomes

This EBP project involved an educational intervention designed to focus on: (a) CDI prevention, (b) improved hand hygiene compliance, (c) compliance to contact isolation procedures, (d) compliance to environmental surface cleaning protocol, (e) de-escalation of antibiotics, and (f) appropriate selection of antimicrobial therapy.

Hand hygiene and contact isolation precautions. Direct observation was completed by the project manager and two staff nurses for hand hygiene compliance and contact isolation precaution compliance on the medical surgical unit. Observed participants included registered nurses, patient care assistants, environmental services, physicians, physician assistants and nurse practitioners. Direct observation was not specific to CDI patients only. Hand hygiene compliance was measured using the World Health Organization Hand Hygiene Observation Form and contact isolation procedures compliance was measured using the Contact Precautions Monitoring Tool (Appendix B). Data collection for hand hygiene compliance and contact isolation compliance was completed on ten separate days and ten separate instances. Data was collected at various times throughout the day by the project manager and the two staff nurses. All data was given to the project manager weekly for review.

Environmental surface cleaning. Compliance to environmental service cleaning protocols was measured by completion of the CDC Environmental Checklist for Monitoring Terminal Cleaning checklist that was completed after every CDI room was cleaned and was placed in a folder outside the environmental services managers' office door (Appendix B). This data was given to the project manager on a weekly basis, and data was reviewed by the project manager.

CDI incidence. CDI incidence data was provided to the project manager monthly by the IP. Electronic review of each CDI patient chart was completed by the project manager every month. All hospital-acquired CDI cases were identified and a thorough chart review was completed.

Antimicrobial stewardship. The hospital based antimicrobial stewardship committee met monthly to write a new policy and review specific cases. The pharmacy members of the antimicrobial stewardship committee reviewed all patients with antimicrobial therapy and created a note in the electronic health record to identify possible changes to antibiotics. Providers would review the note and then make adjustments to antibiotics based on the pharmacists policy based recommendations. De-escalation of antibiotics and appropriate selection of antimicrobial therapy was measured by chart audits performed by the project manager monthly.

Intervention

The EBP project involved 15 minute face-to-face sessions offered to medical surgical nurses, patient care assistants and unit secretaries. The 15 minute in-services were provided three different days at three different times during the day to ensure all shifts received the education. The education sessions were completed by the project manager on Tuesday November 1, 2016 at 06:00, Wednesday November 2, 2016 at 12:00, and Friday November 4, 2016 at 16:00 to ensure that all shifts had an opportunity to attend the face-to-face sessions (Appendix B). All sessions included an overview of CD, CDI risk factors, how to decrease the spread of CD, documentation of stool screening in the admission section of the electronic health record, and prevention interventions (see Appendix C for an outline of educational sessions). A stool screening existed in the admission section of the electronic health record that was used on all patients to identify suspected CDI patients. Patient’s suspected of CDI or confirmed CDI were placed in contact isolation per hospital policy. The 15 minute in-services to staff included the early identification stool screening as well as proper contact isolation techniques. Medical surgical staff members were responsible for cleaning IV pumps and portable equipment. Environmental services clean patient rooms daily and then post discharge. The goal for surface cleaning is for all surfaces to be cleansed daily with a 10% sodium hypochlorite solution and a more thorough terminal cleaning upon discharge.

A poster of CDI information was placed by the project manager on the bulletin board in the break room of the medical surgical unit and the environmental services staff lounge. The same poster and handouts were placed in the medical staff lounge by the project manager for providers. The project manager presented education at the department of surgery meeting on October 12, 2016 at 07:00 and the department of medicine meeting on October 13, 2016 at 0700. The project manager presented education to the environmental services mandatory unit meeting on October 26, 2016 at 14:00. Copies of CDI handouts were available to staff and providers at each of the in-person sessions, environmental services unit meeting, department of medicine and department of surgery meetings. A power point was created by the project manager and sent to the education department at the hospital to be created into a CBT module. The education department then sent out the CBT to all hospital employees with a mandatory completion date of October 31, 2016. The completion rate as of October 31, 2016 was 80% by all employees at the hospital.

Hand hygiene and contact isolation precautions. Random data collection for hand hygiene compliance and contact isolation precaution compliance was obtained by direct observation from October 3, 2016 through October 31, 2016 for initial compliance data by the project manager. Data from ten days and ten instances per day was collected on registered nurses, patient care assistants, environmental services staff, nurse practitioners, physician assistants, physicians. Data was collected at various times during the day and on various patients admitted to the medical surgical unit. All hand hygiene data collection was completed using the World Health Organization's Observation Form for hand hygiene and contact isolation precaution compliance was collected using the Contact Precautions Monitoring Tool (Appendix B). Random data collection for hand hygiene compliance and contact isolation precaution compliance was collected by direct observation from November 9, 2016 through February 9, 2017 for post implementation data. Data was collected on thirty different days and ten instances per day was collected on registered nurses, patient care assistants, environmental services staff, nurse practitioners, physician assistants, physicians. Data was collected by the project manager and two staff nurses not from the medical surgical unit. Data was collected at various times during the day and on various patients admitted to the medical surgical unit. All hand hygiene data collection was completed using the World Health Organization's Observation Form for hand hygiene and contact isolation precaution compliance was collected using the Contact Precautions Monitoring Tool (Appendix B).

Environmental surface cleaning. The project manager presented education to the environmental services mandatory unit meeting on October 26, 2016 at 14:00. All sessions included an overview of CD, CDI risk factors, how to decrease the spread of CD, the proper technique for surface cleaning, proper surface cleaning solution, and prevention interventions. Compliance to environmental service cleaning protocols was measured by completion of the CDC Environmental Checklist for Monitoring Terminal Cleaning checklist that was completed after every CDI room was cleaned and was placed in a folder outside the environmental services managers' office door (Appendix B). The CDC Environmental Checklist for Monitoring Terminal Cleaning was completed by the environmental services staff member cleaning the patient room. All checklists were given to the project manager on a weekly basis, and data was reviewed by the project manager.

Antimicrobial stewardship committee. An antimicrobial stewardship program was initiated at the facility level on September 29, 2016. The antimicrobial stewardship committee consists of the intensivist, infectious disease physician, clinical pharmacist, pharmacy Informaticist, clinical informatics, IP, and Vice President of Medical Affairs. The group examined the practices of high risk medications and implemented initiatives to decrease the use of high risk antibiotics. The focus of this collaborative group was to decrease use of fluoroquinolones, 3rd generation Cephalosporin's and Clindamycin which is part of the hospital's corporate antimicrobial stewardship initiative. Utilization rates of identified high-risk antibiotic medications were collected by the Clinical Pharmacist on a weekly basis by chart audits. A new policy was developed with the assistance of the antimicrobial stewardship group to all pharmacy to alert physicians of needed de-escalation of antimicrobial therapy on a patient. The policy was reviewed and finalized. This data was reported to the antimicrobial stewardship committee at the monthly meeting via a handout. Implementation of a best practice advisory (BPA) within the electronic health record was developed by the antimicrobial stewardship committee and was built by the Information Services EHR build team, with the purpose of alerting healthcare providers to alternative antimicrobial therapies to reduce CDI rates. The BPA was unable to be initiated during the implementation phase of the EBP project due to the need for corporate approval

The intervention did require all hospital employees to complete a fifteen minute CBT. All registered nurses, patient care assistants and unit secretaries on the general medical unit to attend a fifteen-minute face-to-face session with the project manager and the environmental services staff to attend a mandatory fifteen-minute in-service during a mandatory unit meeting. The department of medicine and department of surgery meeting was a fifteen-minute in-service for all physicians that attended. The only cost to participants was time to complete the face-to-face sessions and CBT. The intended benefits were personal enrichment and decrease in CDI rates.

Participants were given the opportunity to ask questions after all in person presentations. A paper copy of the power point presentation was given to all staff that attended the face-to-face sessions, department of medicine, department of surgery and the environmental services unit meeting. The power point handout included proper hand hygiene, proper contact isolation and identification of contact isolation signs and significance, environmental surface cleaning with appropriate products including all removable and reusable equipment, and the empowerment of the antimicrobial stewardship program. A paper handout from the CDC titled Deadly Diarrhea was given to all staff at the in-person presentations which included a quick reference on the impact, risk, spread, and prevention of CD (Appendix C). Staff at the in-person meetings did not have questions about the process and appreciated the additional disease process information and references. Additional hand outs were left in the break-room or staff lounge for any participants that could not attend. Additional paper power point and Deadly Diarrhea handouts were given to the environmental services manager and the medical surgical unit manager to be included in the next unit meeting and unit meeting minutes for staff to review that was unable to attend an in-person session. Laminated, color copies of the Deadly Diarrhea handout were hung by the medical surgical unit manager and environmental services manager in both departments for all staff to view. The handout can be found in the bathrooms, break rooms or lounges and nurse's stations.

Planning

Preparation. The Stetler Model of Evidence Based Practice was utilized for this project. The stage of preparation involved identifying a need for a practice change and identifying a setting to which the change would be implemented. CDI causes close to half a million illnesses in one year (CDC, 2013). Increased virulence of C. difficile and reporting CDI data to CMS has caused hospitals to investigate rising HA-CDI numbers more closely. The medical surgical unit of the EBP project had 9 hospital acquired CDI (HA-CDI) patients in 2015, which is twice the number of HA-CDI patients on any other unit in the hospital. A need for practice change was identified on the medical surgical unit.

Validation. The validation phase of the model involved developing search criteria for a literature review and appraisal to determine the evidence relating to the target population. A plan was initiated using key search terms to initiate a thorough literature search. A comprehensive literature review was completed to identify practices to decrease CDI rates on a medical surgical unit at a community-based hospital. Strict inclusion and exclusion criteria were developed using the PICOT question to focus the search for relevant evidence. Inclusion criteria included the following: (a) published in a scholarly, peer-reviewed journal, (b) published after 2011, (c) printed in English language, and (d) included adult patients over the age of eighteen years of age. Exclusion criteria included: (a) exclusive outpatient treatment, (b) age less than 18 years of age, and (c) interventions not focused on bundled interventions. The most relevant evidence was identified using key search terms, a thorough literature search, citation chasing, and practice guidelines. All evidence was analyzed to determine sufficiency and credibility to the topic. The evidence reviewed for this EBP was critiqued using evidence appraisal tools and with a focus on applicability, sufficiency and credibility.

Comparative evaluation/decision making. During the comparative phase, the appraised evidence was narrowed based on relevancy and synthesized to develop a best practice recommendation. The project manager took into consideration feasibility, current practice, substantiating evidence, and fit of setting (Stetler, 2001). During this phase, the project manager decided which research evidence to use and which evidence to reject from the EBP project. Melynk and Fineout-Overholt's (2011) rapid critical appraisal checklists were used to evaluate each article. The one Level II evidence was reviewed utilizing Melnyk and Fineout-Overholt's (2011) rapid critical appraisal checklist for randomized control trials. The four Level III evidence was reviewed utilizing Melnyk and Fineout-Overholt's (2011) rapid critical appraisal of quantitative studies. The Level V evidence was reviewed utilizing Melnyk and Fineout-Overholt's (2011) rapid critical appraisal checklist for qualitative evidence (Melnyk & Fineout-Overholt, 2011). Finally, Broughton and Rathbone's (n.d.) evaluation criteria were used to evaluate the clinical practice guidelines included in the literature. All nine articles met the quality standards and were included in the body of evidence.

Translation/application. The translation phase involved taking the synthesized evidence and formulating a recommendation based upon time, financial, and environmental constraints identified from the implementation facility and key informants. During this phase, the project manager worked with the facility IP, Chief Nursing Officer, medical surgical unit manager, director of environmental services, manager of environmental services, and the clinical pharmacist. Education material was identified, reviewed, and obtained. The intervention was developed specifically for this facility. During this phase, Institutional Review Board (IRB) permission was obtained by the hospital on June 20, 2016 by the Regional hospital IRB. IRB for Valparaiso University was obtained on September 22, 2016, to ensure protection of the rights of participants both from the Valparaiso University IRB and the facility IRB. The intervention was implemented and evaluated as detailed within this section.

Individual characteristics and experiences. The Health Promotion Model was utilized for this project. Individual characteristics and experiences are prior related behavior and personal factors (Pender, Murdaugh & Parsons, 2011). Personal, psychological and socio-cultural personal factors place a large role in CDI prevention and treatment. Both patient and staff personal factors can affect the plan of care for a patient with C. difficile infection and prevention bundles. Biological personal factors such as age, gender, body mass index, strength, agility and balance can affect compliance with hand hygiene compliance, contact isolation precaution compliance and environmental surface cleaning protocols for staff. Psychological personal factors such as self-esteem, self-motivation, personal competence, perceived health status and definition of health can affect compliance with hand hygiene compliance, contact isolation precaution compliance and environmental surface cleaning protocols for staff. Socio-cultural personal factors such as race, ethnicity, acculturation, education and socioeconomic status can affect compliance with hand hygiene compliance, contact isolation precaution compliance and environmental surface cleaning protocols for staff.

Behavior-specific cognitions and affect. Behavior-specific cognitions and affect include: perceived benefits of action, perceived barriers to action, perceived self-efficacy, activity-related affect, interpersonal influences, and a situational influence (Pender, Murdaugh & Parsons, 2011). Perceived benefits of CDI prevention bundles are the prevention of further CDI spread, decreased inappropriate antibiotic use, improved patient outcomes, and decreased cost to the healthcare system. Perceived barriers to implementation of a CDI prevention bundle include change in workflow for hospital staff, new policy and procedure changes at the facility level, possible change in cleaning products, and difficulty in complying with isolation protocols completely. Both patients and healthcare staff have the self-efficacy to provide a prevention bundle that will improve patient outcomes and decrease costs but barriers to change exist with all process improvement projects. Interpersonal influences can serve as barriers to a project based on norms and comfort level of the health care staff and patients. Interpersonal influences can be used to improve processes by receiving front-line staff buy-in with the CDI prevention bundle. Situational influences are personal perceptions and cognitions that can facilitate or impede behavior. Situational influences can be used to assist front-line staff to influence change and processes improvement.

Behavioral outcomes. Behavioral outcomes are a commitment to a plan of action, immediate competing demands and preferences, and health-promoting behavior (Pender, Murdaugh & Parsons, 2011). Commitment of staff to each intervention, included in the prevention bundle, will lead to improved patient health outcomes and a decrease in spread of CDI. Other patient improvement initiatives and work can impede the staff's adaptation of the prevention bundle.

Data

After receiving IRB approval on September 22, 2016, a recruitment of participants was undertaken. All adult patients admitted to the medical-surgical unit with a diagnosis of CDI or suspected diagnosis of CDI was recruited at hospital X. All pertinent patient identification was given to the project manager by the IP monthly. Data was manually extracted from the electronic inpatient chart by the project manager, relating to de-escalation of antibiotics and appropriate selection of antibiotics. Direct observation was completed to measure hand hygiene compliance using the World Health Organization's Observation Form for hand hygiene. The Observation Form for contact isolation compliance was utilized during direct observation, and the environmental checklist was completed after cleaning CDI rooms to monitor room cleaning compliance. The reliability and validity of the measurement tools are detailed below.

Measures

Collection

The World Health Organization's Observation Form was developed by the World Health Organization by a group of researchers to measure hand hygiene compliance. The tool was administered as a pre-test, prior to the interventional session, and as a post-test, immediately after the data collection period. Compliance data for hand hygiene and contact isolation was collected by two staff nurses not from the medical surgical unit and the project manager stressed the importance of honesty in data procurement to help determine if the intervention was effective. Environmental surface cleaning data was collected by self-report via a paper checklist which was anticipated to result in higher reliability of participant responses because environmental services staff was aware that the information was being collected. Since the staff was aware that hang hygiene and contact isolation data was being collected there may have been a Hawthorne effect and therefore the data collected may not in fact represent true compliance to established protocols. CDI incidence data was collected by the IP via positive lab results for CDI. The IP provided the CDI incidence data monthly to the project manager.

Management and Analysis

Data for compliance of staff with the CBT by October 31, 2016 was given to the project manager by the education department at the facility. Sign in sheets from the department of medicine meeting, the department of surgery meeting, the mandatory environmental services staff meeting and the fifteen-minute face-to-face in-services were obtained by the project manager to calculate how many staff members received the education. The impact of the educational in-service sessions was determined by pre- and post-testing using the World Health Organization Observation Form and the Observation Form for contact isolation compliance. The environmental checklist was completed during the post implementation period after cleaning

CDI rooms. Demographic data, as depicted in Appendix D, was collected prior to any part of the intervention and was utilized to formulate descriptive analyses of the sample. CDI incidence data was provided to the project manager by the IP monthly.

Protection of Human Subjects

The rights of the subjects within the study were protected through various mechanisms. First, the project manager completed training by the National Institutes of Health on the protection of human subjects participating in research. Permission to complete the EBP project was obtained from Regional X hospital IRB on June 20, 2016 and Valparaiso University on September 22, 2016. All confidential information was kept in a locked location to which only the project manager had access. The data collected for hand hygiene compliance and contact isolation compliance contained only the staff role, no names of staff were collected. After the completion of the study all data was destroyed by the project manager using the locked patient health information shredder containers located in the hospital. These measures were undertaken to minimize the risk for participants within this project implementation.

CHAPTER 4

FINDINGS

The purpose of this evidence-based project (EBP) was to reduce hospital-acquired CDI (HA-CDI) rates over a 3-month period through the implementation of a bundle of care including: (a) proper hand hygiene practices, (b) adequate and appropriate surface cleaning practices, (c) compliance to contact isolation procedures, and (d) strengthening of an existing antibiotic stewardship committee. The following data analyses feature participants, characteristics and project outcomes. These outcomes compared pre-and post-intervention contact isolation precaution compliance, pre-and post-intervention hand hygiene compliance, post-intervention surface cleaning compliance, CDI incidence pre- and post-intervention, and antimicrobial de-escalation compliance.

Participants

Size

Twenty patient participants were included in the pre-intervention chart audit from the same time-period in the previous year, with three healthcare acquired CDI participants. Thirty-four patient participants were included in the post-intervention chart audit from November 2016 through February 2017, with nine healthcare acquired CDI participants. All participants with hospital acquired CDI were audited for de-escalation of antibiotics, timely discontinuation of antibiotics, and appropriate selection of antimicrobial therapy. Of the nine post-intervention hospital acquired CDI participants, four were male and five were female. Additionally, 100 observation of hospital staff were included in the pre-intervention hand hygiene compliance data, and 300 observations of hospital staff were included in the post-intervention hand hygiene compliance data. One hundred observations of hospital staff were included in the pre-intervention contact isolation compliance data, and 300 observations of hospital staff were included in the post-intervention contact isolation compliance data. Two hundred twenty-two observations were included in the surface cleaning compliance data.

Characteristics

Hang hygiene and contact isolation precautions. The World Health Organization's Observation Form was used to obtain hand hygiene compliance data for both the pre-intervention and post-intervention participants. The World Health Organization's Observation Form was developed on behalf of WHO, by a group of researchers to measure hand hygiene compliance. The hand hygiene form included the date of observation, unit of observation, hand hygiene action, and hand hygiene indication. The Observation Form for Contact Isolation Compliance was utilized to collect the contact isolation compliance data. The observation form for contact isolation compliance included the date of observation, time of observation, the unit of observation, healthcare worker type, precautions, gloves worn, gown worn, and gloves and gown removal on room exit.

Environmental surface cleaning and CDI Incidence. A paper checklist was used to collect the environmental surface cleaning compliance data by self-report. The Environmental Surface Cleaning Checklist included the date of data collection, the unit of data collection, patient room number, environmental services worker initials and cleaning or not cleaning of the following patient room areas (bed rails/controls, tray table, IV pole, call box/button, telephone, bedside table handle, chair, room sink, room light switch, inner door knob, bathroom inner door knob, bathroom light switch, bathroom handrail, bathroom sink, toilet seat, toilet flush handle, and toilet bedpan). This checklist was created by the CDC to offer guidance on evaluation of environmental cleaning to assist facilities in implementation and monitoring compliance. CDI incidence data was provided monthly by the IP to the project manager. Data was obtained by positive lab testing for CDI. All CDI cases are entered into NHSN by the Infection Preventionist monthly. The NHSN uses a standardized infection ratio for reporting which consists of the number of observed cases divided by the number of expected cases.

Antimicrobial stewardship committee. CDI incidence data was provided to the project manager by the IP. Chart audits were completed by the project manager using the APIC guidelines. Each CDI patient chart was audited for de-escalation of antibiotics within twenty-four hours of admission, appropriate selection of antibiotics for CDI patients, and timely discontinuation of antimicrobial therapy using the APIC guidelines and corporate policy. Fifty-four participant cases were identified as being infected with Clostridium difficile. All fifty-four participant charts were then audited by the project manager to identify de-escalation of antibiotics, timely discontinuation of antibiotics, and appropriate selection of antimicrobial therapy. Hospital-wide usage of fluoroquinolones, 3rd generation cephalosporin's and clindamycin should be decreased or eliminated per the APIC guidelines and corporate policy.

Changes in Outcomes

Statistical Testing

Significance

The clinical question for this EBP project was to determine if a CDI prevention bundle would decrease the incidence of C. difficile in adult general medicine inpatients at a community hospital. To answer this clinical question, the project manager implemented a program utilizing best practice recommendations among a group of adult general medicine inpatients at a community hospital. Pre- and post- intervention data for C. difficile incidence, hand hygiene compliance, compliance to contact isolation procedures was collected in addition to data relating to the de-escalation of antibiotics, timely discontinuation of antibiotics, and appropriate selection of antimicrobial therapy to determine how effective the interventions were in answering the clinical question. Post-intervention compliance to environmental surface cleaning protocol data was also collected to determine the impact of the bundled intervention.

Hand hygiene. Descriptive statistics and a repeated-measures ANOVA was performed on the pre-intervention and post-intervention hand hygiene compliance data. A repeated-measures ANOVA was conducted to compare the effect of the CDI bundle education on hand hygiene in November 2016, December 2016, January 2017 and February 2017. There was a significant effect on hand hygiene compliance post intervention, Wilks' Lambda= .558, *F* (3, 37) = 9, *p* = <.001. Four paired samples *t*-tests were used to make post hoc comparisons between conditions. A first paired samples *t*-test indicated that there was a significant difference between the hand hygiene compliance pre-intervention (*M* =.58, *SD* =.497) and post-intervention November (*M* =.87, *SD*=.343); *t* (59) = -3.95, *p* = .000. A second paired samples *t*-test indicated that there was a significant difference between the hand hygiene compliance pre-intervention (*M* =.58, *SD* =.497) and post-intervention December (*M* =.93, *SD* =.256); *t* (99) =-6.23, *p* = <.001. A third paired samples *t*-test indicated that there was a significant difference between the hand hygiene compliance pre-intervention (*M* =.58, *SD* =.497) and post-intervention January (*M* =1.00, *SD* =.000); *t* (99) =-8.64, *p* = <.001. A fourth paired samples *t*-test indicated that there was a significant difference between the hand hygiene compliance pre-intervention (*M* =.58, *SD* =.497) and post-intervention February (*M* =1.00, *SD* =.000); *t* (39) =-4.58, *p* = <.001. Hand hygiene compliance improved each month during the post-intervention phase of the project and maintained significant.

Contact isolation precautions. Descriptive statistics and a repeated-measures ANOVA was performed on the pre-intervention and post-intervention contact isolation precautions compliance data. A repeated-measures ANOVA was conducted to compare the effect of the CDI bundle education on contact isolation precautions in November 2016, December 2016, January 2017 and February 2017. There was a significant effect on contact isolation precautions compliance post intervention, Wilks' Lambda= .375, *F* (3, 37) = 20, *p* = <.001. Four paired samples *t*-tests were used to make post hoc comparisons between conditions. A first paired samples *t*-test indicated that there was a significant difference between the contact isolation precautions compliance pre-intervention (*M* =.39, *SD* =.492) and post-intervention November (*M* =.88, *SD* =.326); *t* (58) = -6.64, *p* = <.001. A second paired samples *t*-test indicated that there was a significant difference between the contact isolation precautions compliance pre-intervention (*M* =.39, *SD* =.492) and post-intervention December (*M* =.93, *SD* =.256); *t* (99) = -11.34, *p* = <.001. A third paired samples *t*-test indicated that there was a significant difference between the contact isolation precautions compliance pre-intervention (*M* =.39, *SD* =.492) and post-intervention January (*M* =1.00, *SD* =.000); *t* (99) = -14.84, *p* = <.001. A fourth paired samples *t*-test indicated that there was a significant difference between the contact isolation precautions compliance pre-intervention (*M* =.39, *SD* =.492) and post-intervention February (*M* =1.00, *SD* =.000); *t* (39) = -7.64, *p* = <.001. Contact isolation precautions compliance improved each month during the post-intervention phase of the project and maintained significant.

Environmental surface cleaning. Two hundred twenty-two environmental checklists were turned in to the project manager during the post-intervention phase. This represents 222 self-reports of compliance to environmental surface cleaning. The data from the checklists was reviewed by the project manager with a 96.84% surface cleaning compliance with a 10% sodium hypochlorite solution. As this data was only collected post-intervention there is no comparison data pre-intervention.

CDI incidence. Descriptive statistics and an independent samples t-test was performed on the pre-intervention and post-intervention CDI incidence. An independent samples t-test was conducted to compare the effect of the CDI bundle education on hospital acquired CDI incidence. An independent samples t-test indicated that there was no significant difference between the CDI incidence pre-intervention (*M* =.30, *SD* =.470) and post-intervention (*M* =.24, *SD* =.431); *t* (19) = .000, *p* = .059.

Antimicrobial stewardship committee. Eight hospital acquired CDI patients were identified from November 9, 2016 to February 9, 2017. Of the eight patients, seven had antibiotics that were de-escalated from a fluoroquinolone or third or fourth generation cephalosporin within twenty-four hours of admission to the hospital. Five of the eight CDI patients had a note from the clinical pharmacist informing the providers that a de-escalation of antibiotics was needed. The de-escalation process was a new process for the facility, and therefore one of the patients did not have de-escalation of antibiotics within the first twenty-four hours of admission.

Figure 4.1

Pre-intervention Hand Hygiene

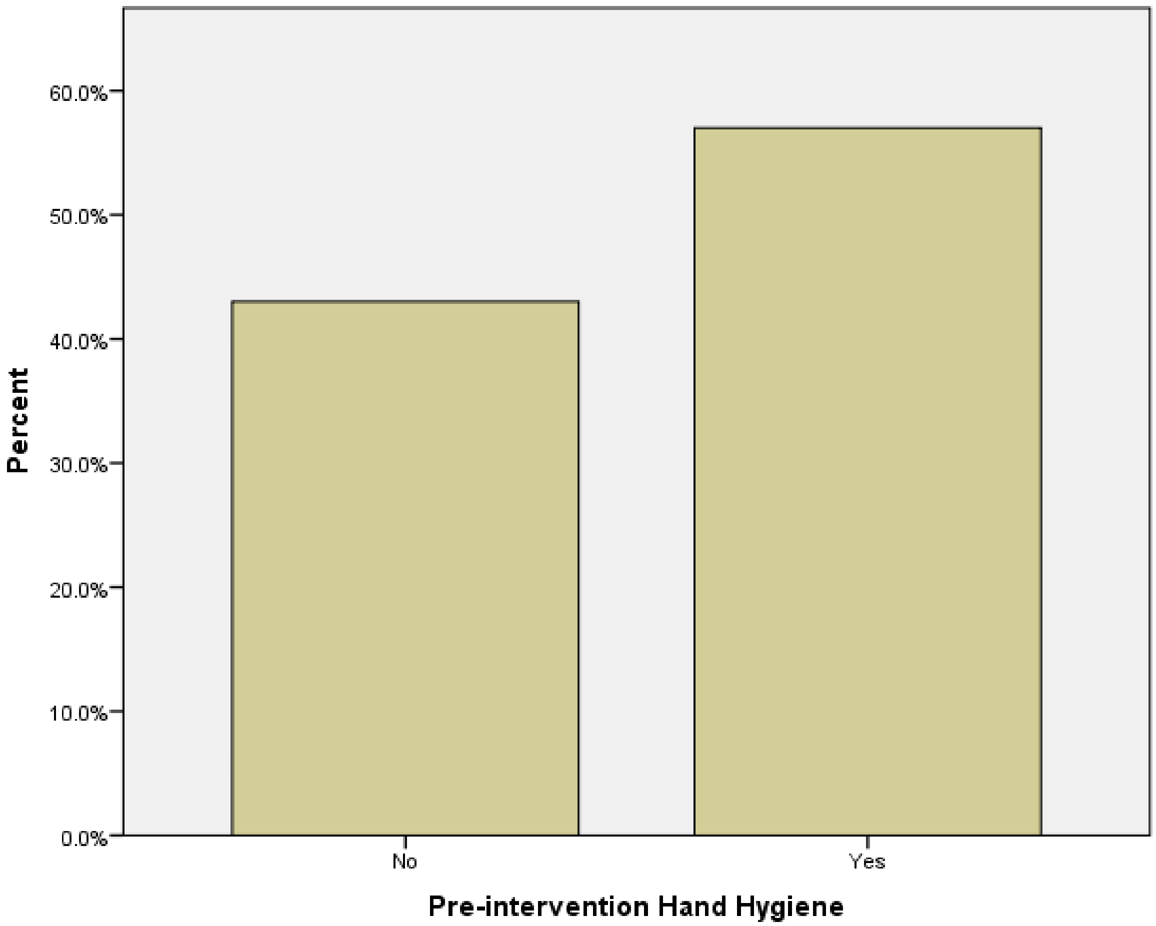

Figure 4.2

Post-intervention Hand Hygiene

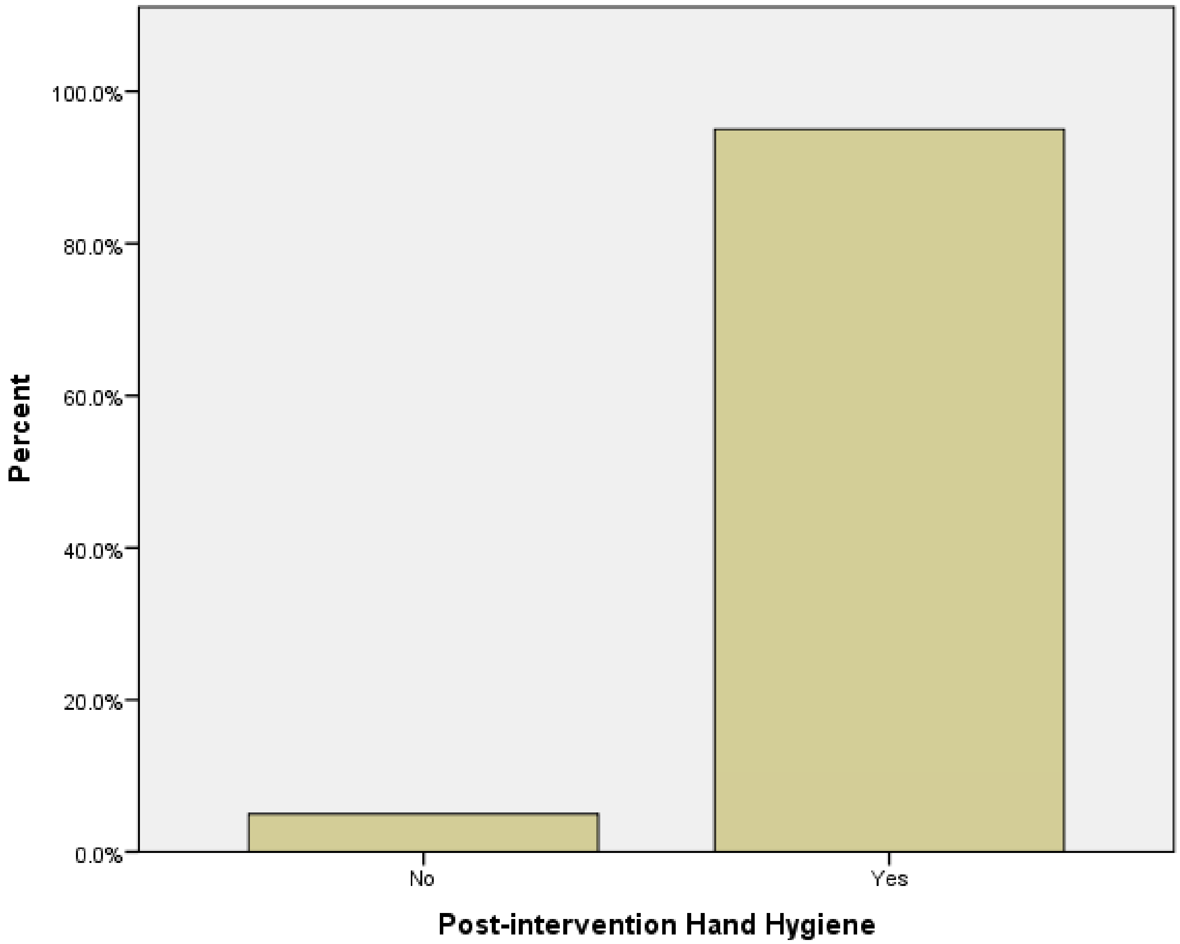

Figure 4.3

Hand Hygiene Compliance

Descriptive Statistics

	Mean	Std. Deviation	N
Pre HH data	.65	.483	40
Post HH Nov	.87	.335	40
Post HH Dec	.87	.335	40
Post Jan HH	1.00	.000	40
Post Feb HH	1.00	.000	40

Multivariate Tests[a]

Effect		Value	F	Hypothesis df	Error df	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[c]
HH	Pillai's Trace	.442	9.774[b]	3.000	37.000	.000	.442	29.323	.995
	Wilks' Lambda	.558	9.774[b]	3.000	37.000	.000	.442	29.323	.995
	Hotelling's Trace	.793	9.774[b]	3.000	37.000	.000	.442	29.323	.995
	Roy's Largest Root	.793	9.774[b]	3.000	37.000	.000	.442	29.323	.995

Figure 4.4

Pre-intervention Contact Isolation Precautions

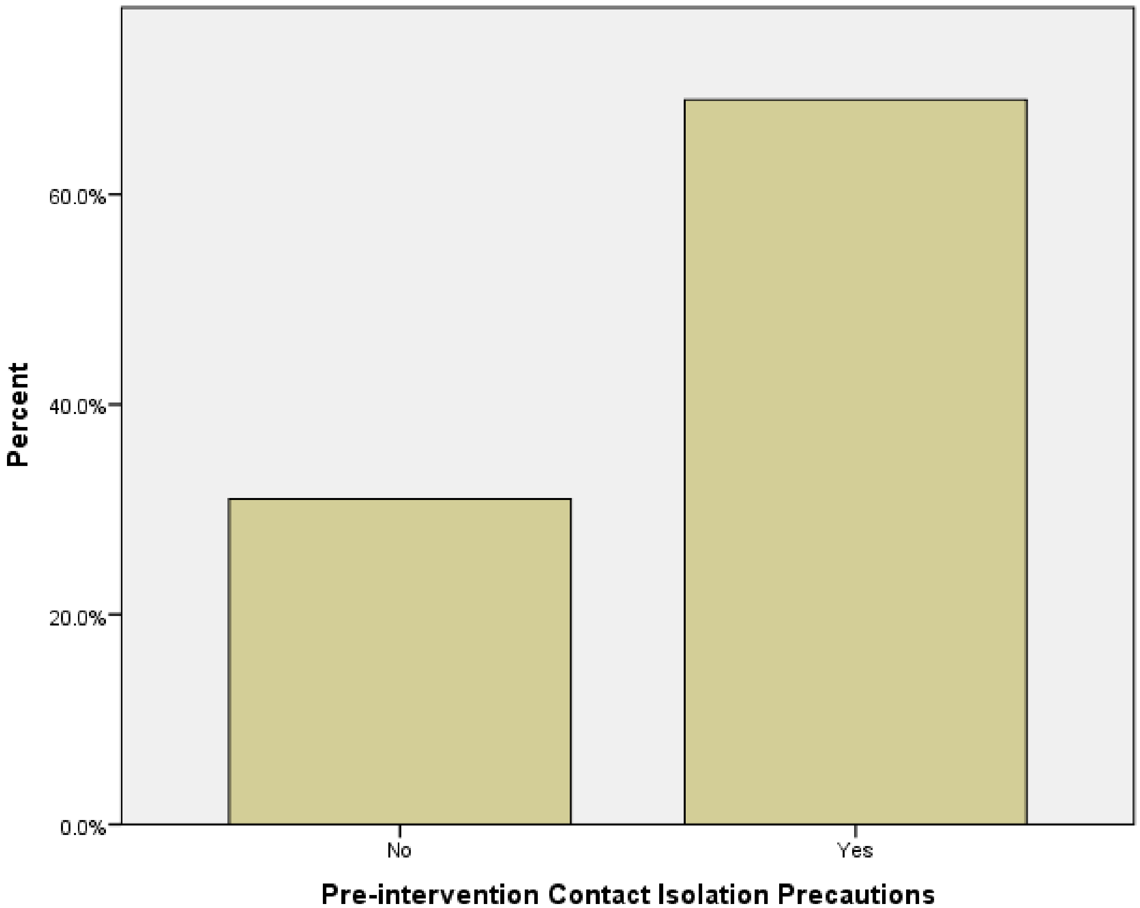

Figure 4.5

Post-intervention Contact Isolation Precautions

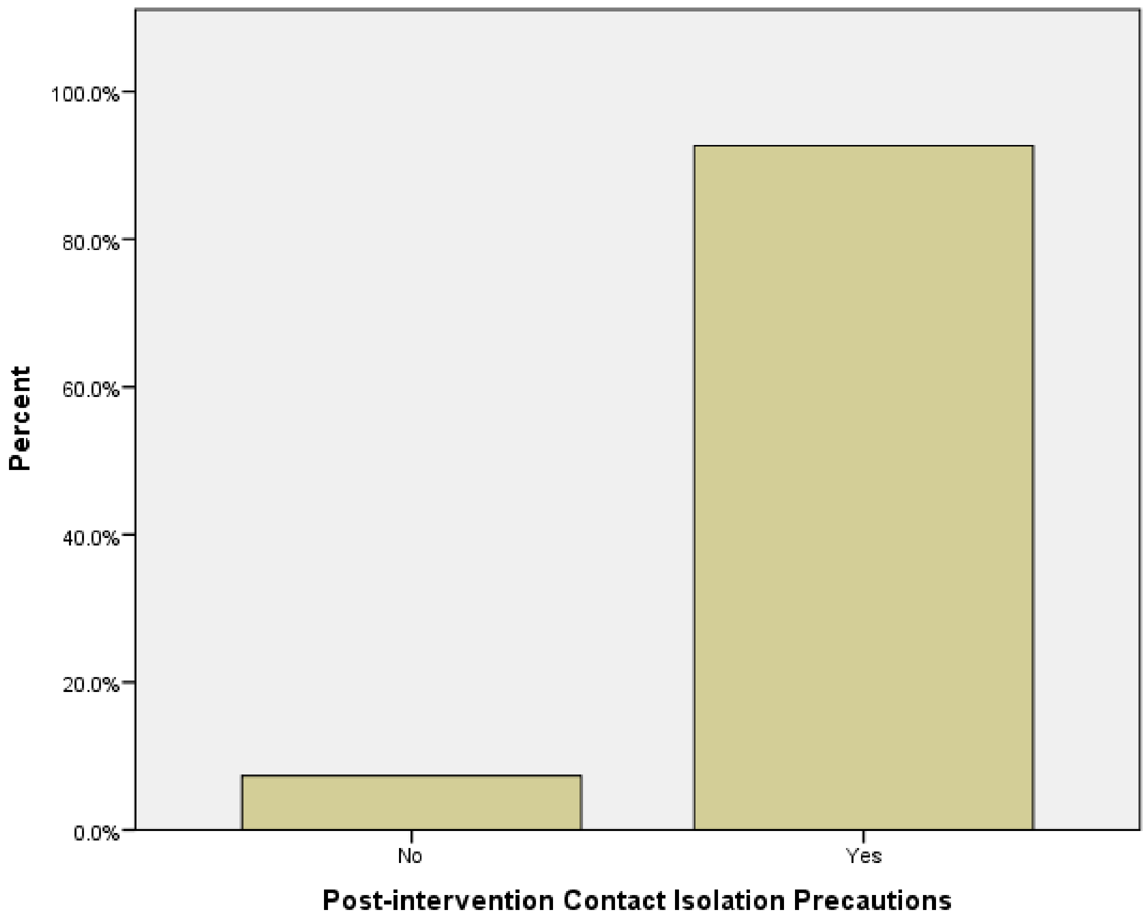

Figure 4.6

Contact Isolation Precaution Compliance

Descriptive Statistics

	Mean	Std. Deviation	N
Pre Contact	.40	.496	40
Post Nov Contact	.87	.335	40
Post Dec Contact	.87	.335	40
Post Jan Contact	1.00	.000	40
Post Feb Contact	1.00	.000	40

Multivariate Tests[a]

Effect		Value	F	Hypothesis df	Error df	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[c]
Contact	Pillai's Trace	.625	20.574[b]	3.000	37.000	.000	.625	61.722	1.000
	Wilks' Lambda	.375	20.574[b]	3.000	37.000	.000	.625	61.722	1.000
	Hotelling's Trace	1.668	20.574[b]	3.000	37.000	.000	.625	61.722	1.000
	Roy's Largest Root	1.668	20.574[b]	3.000	37.000	.000	.625	61.722	1.000

Figure 4.7

CDI Incidence Pre-intervention

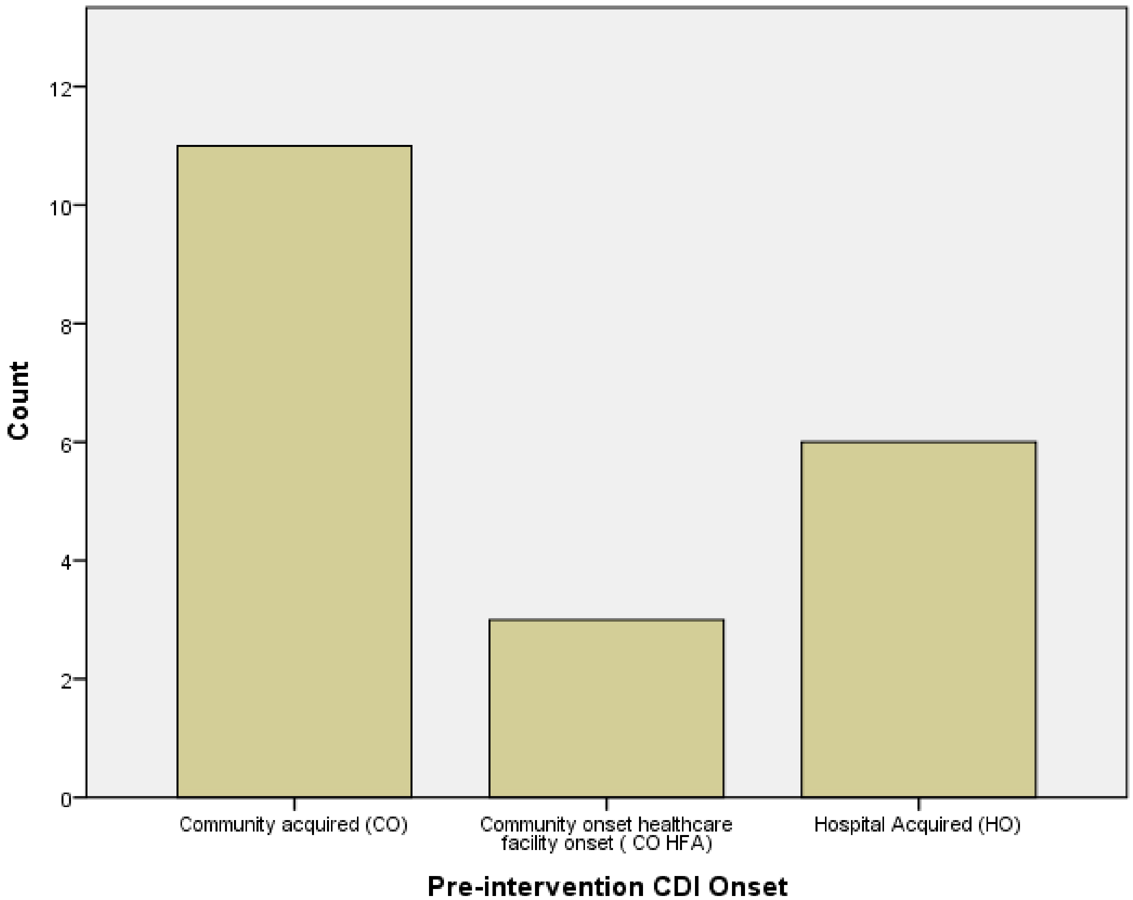

Figure 4.8

CDI Incidence Post-intervention

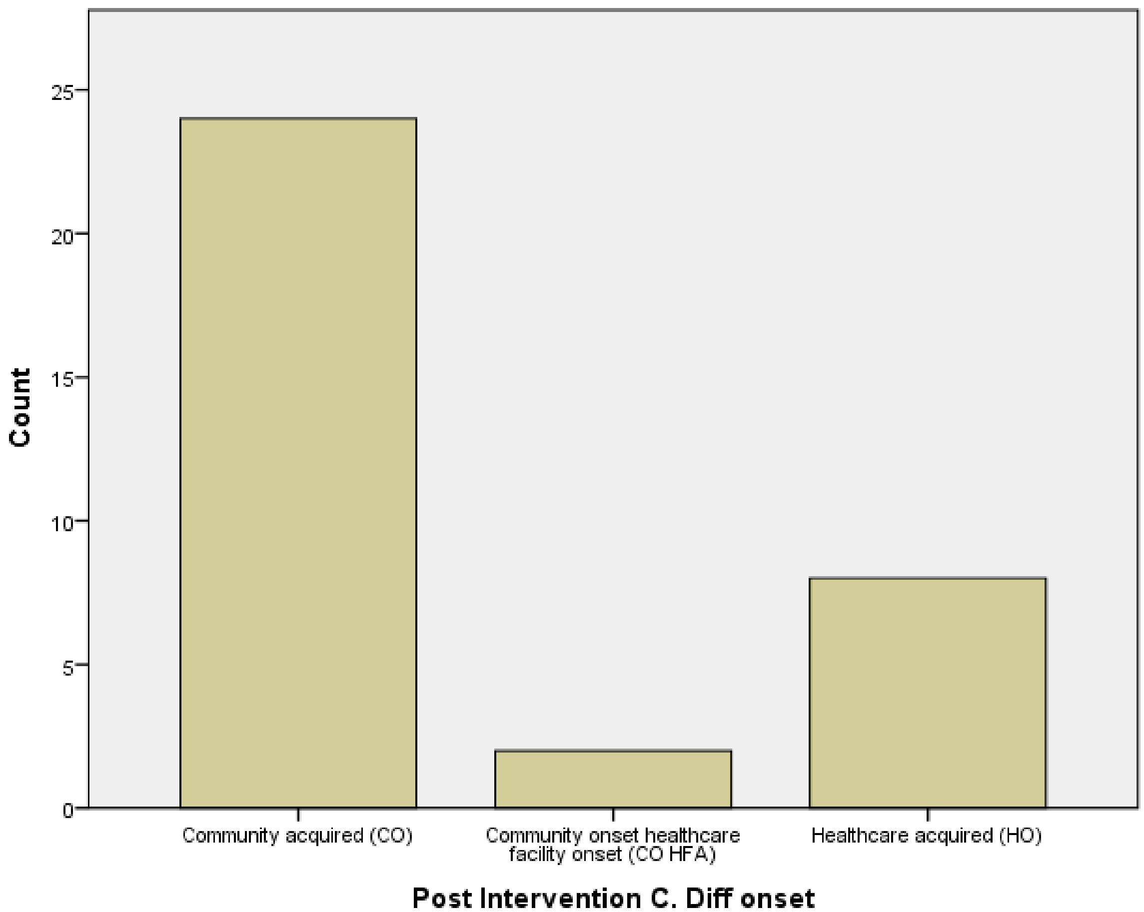

Figure 4.9

CDI Incidence Data

One-Sample Statistics

	N	Mean	Std. Deviation	Std. Error Mean
C Diff HO	20	.30	.470	.105
C diff Post HO	34	.24	.431	.074

One-Sample Test

	Test Value = 0					
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
C Diff HO	2.854	19	.010	.300	.08	.52
C diff Post HO	3.187	33	.003	.235	.09	.39

CHAPTER 5

DISCUSSION

The purpose of this EBP project was to reduce hospital-acquired CDI rates over a 3-month period of time from November 2016 to February 2017 through the implementation of a bundle of care including: (a) proper hand hygiene practices, (b) adequate and appropriate surface cleaning practices, (c) compliance to contact isolation procedures, and (d) strengthening of an existing antibiotic stewardship committee. Patients are susceptible to acquiring CDI while hospitalized, bundles of care need to be developed and implemented to prevent HA-CDI. The resulting clinical question “will a bundle intervention focused on improving hand hygiene practices among staff members, compliance to recommended environmental and surface cleaning, compliance to contact isolation procedures, and an antimicrobial stewardship committee reduce HA-CDI among hospitalized inpatients on a general medical unit?”

Explanation of Findings

The EBP project implementation did not result in a statistically significant impact on HA-CDI incidence rates. There was, however, a statistically significant difference in pre- and post-intervention hand hygiene compliance and contact isolation procedures compliance data. Post-intervention hand hygiene compliance rates increased each month after the initial intervention and maintained statistical significance throughout the project. Post-intervention contact isolation precaution compliance rates increased each month after the initial intervention and maintained statistical significance throughout the project. No pre-intervention data for environmental surface cleaning was available to compare to post-intervention data. The post-intervention data suggests that environmental services cleaned the high-risk surface areas with sodium hypochlorite solution. The antimicrobial stewardship committee at the facility level was not implemented until the start of the EBP project therefore there was no pre-intervention data for de-escalation of antibiotics, timely discontinuation of antibiotics, and appropriate selection of antimicrobial therapy. The corporate data demonstrated an increased use of fluoroquinolones, clindamycin and third or fourth generation cephalosporin. Due to the increased risk for CDI with these medications, corporate antimicrobial stewardship committee decided to put the practice of de-escalation of antibiotics, timely discontinuation of antibiotics, and appropriate selection for antimicrobial therapy into the policy. The facility level policy for the antimicrobial stewardship committee mirrored the corporate level policy and included de-escalation of antibiotics, timely discontinuation of antibiotics, and appropriate selection for antimicrobial therapy. This policy was implemented with the expectation of decreasing CDI incidence levels. An increased sample size over a longer period of time may have generated more statistically significant results for CDI incidence rates.

Evaluation of Applicability of Theoretical and EBP Frameworks

Health Promotion Model

The Health Promotion Model was especially applicable as the framework for this EBP project. This model describes the multidimensional nature of persons as they interact within their environment to pursue health. Health promotion is directed at increasing a patient's level of well-being (Pender, Murdaugh & Parsons, 2011). Pender focused on three areas: individual characteristics and experiences, behavior-specific cognitions and affect, and behavioral outcomes. The set of variables for behavior specific knowledge and affect have important motivational significance. Health promoting behavior is the desired behavioral outcome and these behaviors should result in improved health, enhanced functional ability and better quality of life (Pender, Murdaugh & Parsons, 2011).

Within this EBP project, the intervention strongly used the health promotion model as the educational face-to-face sessions, computer-based training, and unit meetings focused on providing participants with knowledge of CDI and prevention methods. In addition, the intervention incorporated techniques to identify early individual characteristics of possible CDI patients, benefits of bundled intervention for CDI prevention, and commitment to a plan of action for health promotion of patients. The education focused on identifying barriers to action and the need for a multi-disciplinary team to prevent HA-CDI.

The intervention within this EBP project focused on the individual characteristics and experiences of both the patients and the healthcare workers. The Health Promotion Model includes personal factors, psychological factors, and socio-cultural personal factors. Patients over the age of sixty-five have a greater chance of acquiring CDI while hospitalized than other age groups, and early identification of these patients will assist in prevention. Self-motivation of staff to perform early identification screenings and placing all suspected CDI patients in contact isolation was stressed during educational sessions. Personal, psychological and socio-cultural personal factors place a large role in CDI prevention and treatment. Both patient and staff personal factors can affect the plan of care for a patient with CDI and prevention bundles.

The intervention within this EBP project focused on behavior-specific cognitions and affect. Behavior-specific cognitions and affect include: perceived benefits of action, perceived barriers to action, perceived self-efficacy, activity-related affect, interpersonal influences, and a situational influence (Pender, Murdaugh & Parsons, 2011). The perceived benefit of HA-CDI prevention using bundles was a focus of the educational sessions to decrease further CDI spread, decreased inappropriate antibiotic use, improved patient outcomes, and decreased cost to the healthcare system. Perceived barriers were identified and discussed during the educational sessions. Perceived barriers to implementation of a CDI prevention bundle included change in workflow for staff, new policy and procedure changes at the facility level, and difficulty in complying with isolation protocols completely. Staff were empowered to have the self-efficacy to provide a prevention bundle that will improve patient outcomes and decrease costs. All registered nurses, patient care assistants, unit secretaries, environmental services staff, physicians, physician assistants, and nurse practitioners were provided with education, in hopes that modeling would occur. Modeling is vicarious learning through observing others engaged in a particular-behavior with the intent to engage in the behavior in the future. Current national and facility statistics on CDI incidence rates were provided during the education to assist staff to demonstrate the worth of this EBP project.

The intervention within this EBP project focused on behavior outcomes. The purpose of the educational sessions was to empower staff and get a commitment to a plan of action to decrease CDI incidence rates at the facility. Staff struggled with other patient improvement initiatives and paperwork associated with these projects which required additional work to be done by staff. Health promoting behavior is the endpoint or action outcome directed toward attaining a positive health outcome such as optimal well-being, personal fulfillment, and productive living (Pender, Murdaugh & Parsons, 2011).

Stetler Model of EBP

The Stetler Model of EBP consists of five steps to guide clinicians in practice change: preparation, validation, comparative evaluation/decision making, translation/application, and evaluation. Each phase is designed to (a) facilitate critical thinking, (b) result in the use of evidence in daily practice, and (c) reduce human error made in decision-making (Stetler, 2001). The strength of this model was the ease of use within this EBP project. The first step of the preparation involved identification of a problem and need for improvement. During this step, the project manager identified literature demonstrating that HA-CDI incidence rates were rising in hospitals. The project manager then identified the site of implementation after meeting with the Infection Preventionist and the Chief Nursing Officer (CNO) at X Community Hospital. Increased rates of CDI in hospitalized patients on the medical surgical unit were noted to be higher than other inpatient units at the same community hospital; these findings demonstrated a need for intervention. A plan was initiated using key search terms to initiate a thorough literature search. A comprehensive literature review was completed to identify practices to decrease CDI rates on a medical surgical unit at a community-based hospital. The most relevant evidence was identified using key search terms, a thorough literature search, citation chasing, and practice guidelines. Environmental concerns were considered, such as staff resistance to practice change, increased time to complete bundle, and possible cost of changing cleaning supplies/products.

During the validation step, the project manager developed the PICOT question and preformed a thorough review of literature to identify best practice recommendations. Five different computer-based databases were included in the search, as well as a hand search of reference lists, a review of expert practice recommendations and review of the World Health Organization (WHO) website was also performed. Searched databases included Cumulative Index to Nursing and Allied Health Literature (CINAHL), Medline via EBSCO Interface, ProQuest Nursing and Allied Health Source, Cochrane Collaboration and Library, Joanna Briggs Institute Evidence Based Practice (JBI), and National Guideline Clearinghouse for peer-reviewed literature published between the years 2011-2016. Inclusion and exclusion criteria were developed and all literature was assessed for inclusion. Six articles were chosen for inclusion. All evidence is analyzed to determine sufficiency and credibility to the topic. The evidence reviewed for this EBP was critiqued using evidence appraisal tools and with a focus on applicability, sufficiency and credibility.

The evaluation and decision-making step of the Stetler model included the synthesis of evidence and development of the EBP project implementation plan. The project manager first appraised all included literature using the Melnyk and Fineout-Overholt’s (2011) rapid critical appraisal checklists and leveled the evidence per the rating system for hierarchy of evidence developed by Melnyk and Fineout-Overholt (2011). The project manager then evaluated the identified EBP practices and analyzed the possibility of implementation at X Community Hospital. The project manager used the synthesized evidence to determine the educational content and number of sessions. The project manager determined that the intervention would include: (a) fifteen-minute face-to face sessions, (b) computer based training for entire facility, (c) unit meetings, (d) department of medicine and department of surgery meetings, and (e) poster for breakrooms with hand-outs.

During translation step of the model, the project manager considered input from the IP from X Community Hospital regarding educational content and education planning. Support from the CNO, IP, Managers and Directors was attained. Educational materials were identified and IRB approvals were obtained. Time constraints of the project and costs were identified and evaluated by the project manager, resulting in the decision to deliver the fifteen-minute face-to-face sessions over three sessions. Due to time constraints, pre-intervention data was only collected for hand hygiene compliance and contact isolation procedure compliance.

The last step of the Stetler model is evaluation. The project manager gathered data from direct observation, CDI incidence data from the IP and chart audits. The World Health Organization's Observation Form for hand hygiene was used for both pre- and post-intervention during direct observation by the project manager and two staff nurses not from the medical surgical unit. The Contact Precautions Monitoring Tool was used during direct observation to obtain contact isolation procedure compliance for both pre- and post-intervention data by the project manager and two staff nurses not from the medical surgical unit. The CDC Environmental Checklist for Monitoring Terminal Cleaning checklist was used post-intervention as a self-reporting tool by the environmental service staff. The collected data determined if the education and interventions of the bundle decreased the incidence of CDI on the general medical unit. The collected data also assisted the antimicrobial stewardship committee in monitoring appropriate use of antibiotic therapy.

The Stetler model as a guide for this EBP project implementation was effective for many reasons. The steps used in this model were intuitive, practitioner-focused and easy to implement. The ease of use allowed a novice practitioner to implement this EBP project without issues.

Strengths and Limitations of the EBP Project

Evaluation of the project implementation by the project manager revealed many strengths and weaknesses which helped to implement the EBP project successfully and provided some context to the results of the project. In addition, these factors could help to identify areas for future inquiry in practice, research, and theory.

Strengths

A strength of this implementation was the site and the management team. The manager and director of the medical surgical unit and the manager and director of environmental services were eager to implement the EBP project and assisted the project manager as needed. The IP assisted the project manager with education plan development and reviewed all the educational material prior to dissemination. The entire senior management, including the CNO were eager to implement this project at X Community Hospital. The relationship of the project manager with the management of X Community Hospital may have aided in the quick adoption of this EBP project.

Another strength was the project manager's involvement with the electronic health record (EHR) and knowledge of the system. The project manager was able to suggest a best practice advisory (BPA) pop-up to alert staff that could be built in the electronic health record. The project manager's knowledge of the system, lead to the antimicrobial stewardship committee approving a BPA to be built into the EHR.

A major strength of this project implementation was the ability of the project manager to bridge the staff knowledge of CDI and the plan for a bundled approach to CDI prevention. The educational materials and the supportive material were available to staff during and after the presentations due to X Community Hospital support. Education provided to the environmental services staff will continue for all new hires in the department and will continue to assist in improving environmental surface cleaning.

Another strength of this project was the potential for future work in this area. During the project, the manager and director of environmental services obtained the educational materials so that they could be included in new hire packets for education. The manager of the medical surgical unit as well as the other units laminated the Deadly Diarrhea hand out from the CDC and hung them throughout the units and breakrooms for further staff education. The IP continues to collect hand hygiene data for al inpatient units at X Community Hospital.

Limitations

There were a few limitations identified with the EBP project. First, the project was limited to a three-months post-intervention data collection period and a longer collection time may have demonstrated statistical significance in CDI incidence rates at the facility. The project identified statistical significance for hand hygiene compliance and contact isolation precaution compliance, but due to the low number of HA-CDI cases and the limited timeframe, the findings did not reach statistical significance. A longer period of data collection or collection of data from more than one unit may have resulted in statistically significant data for CDI incidence rates.

A limitation was the hand hygiene compliance and contact isolation precaution compliance data were obtained only on the medical surgical unit at X Community Hospital. Contact isolation precaution compliance data was collected on all patients in contact isolation and not just patients in enteric precautions with CDI. Possible contact isolation precaution compliance data on enteric patients only would yield different results. Hand hygiene compliance data was obtained on random medical surgical patients, and not enteric patients only. Hand hygiene data on enteric patients only may have yielded different results. Another limitation related to the Hawthorne effect and knowledge of staff that they were being observed for compliance to contact isolation precautions and hand hygiene compliance. Future use of staff tracking technology for use of hand sanitizer may eliminate the Hawthorne effect. Staff would be tracked every time they used the hand sanitizer with a device on the dispenser. Future research with this device could eliminate the Hawthorne effect.

Another limitation was the lack of environmental surface cleaning pre-intervention data. This data was not collected by the facility prior to implementation and therefore did not allow the project manager to identify any statistical significance. The environmental surface cleaning data was obtained by self-report and data could have been documented inaccurately. Collection of pre-intervention surface cleaning compliance in future research would allow the project manager to compare pre- and post-intervention data. The use of surface cleaning testing in future studies could validate the actual compliance of environmental surface cleaning.

Due to the corporate standards of the facility, the BPA was not able to be implemented during the implementation phase of the project. The request for an addition to the EHR had to go through many committees to get implemented into the system, this delayed the implementation of the BPA during this project. Also during the implementation of the project, a change in the senior management staff took place and the CNO retired. Lack of senior management support for the project and lack of a CNO from January 2017 to February 2017 may have led to a decrease in acceptance of the project. Support from the environmental services manager, environmental services director, medical surgical manager and the Infection Preventionist remained after the CNO's retirement. The project continued without issue, but the lack of nursing leadership could have led to a lack of support for the project.

Implications for the Future

This EBP project had many implications for future implementation. The project manager thoroughly evaluated these implications. Those included recommendations for future research, practice, theory and educational developments. These implications are discussed below.

Practice

CDI is currently reported in NHSN by the IP at X Community Hospital and is a growing concern for hospitals. Due to increased cost of treatment for patients with CDI, practice changes are necessary to protect patients from CDI. This purpose of this project was to implement evidence-based recommendations to improve HA-CDI rates. This project sought to change the current practice to reduce CDI rates and future research is needed to continue to improve practice to align with reduced CDI rates. Practice changes are necessary to align with best-practice recommendations and provide the best care for hospitalized patients. Future research is needed to identify the most relevant or possibly more bundle components to reduce CDI rates.

Theory

The Health Promotion Model was a good fit for implementing an intervention to reduce HA-CDI incidence and improve patient's health. This project needed a theoretical framework that included all the necessary elements of sustained behavior change and commitment to an action plan to decrease CDI rates. Personal, psychological and socio-cultural personal factors place a large role in CDI prevention and treatment. Both patient and staff personal factors can affect the plan of care for a patient with C. difficile infection and prevention bundles. Perceived benefits of CDI prevention bundles are the prevention of further CDI spread, decreased inappropriate antibiotic use, improved patient outcomes, and decreased cost to the healthcare system. Perceived barriers to implementation of a CDI prevention bundle include change in workflow for hospital staff, new policy and procedure changes at the facility level, possible change in cleaning products, and difficulty in complying with isolation protocols completely. Both patients and healthcare staff have the self-efficacy to provide a prevention bundle that will improve patient outcomes and decrease costs but barriers to change exist with all process improvement projects. Interpersonal influences can serve as barriers to a project based on norms and comfort level of the health care staff and patients. Sustained self-efficacy of staff will ensure a decrease in the number of HA-CDI cases at the facility. Commitment of staff to each intervention, included in the prevention bundle, led to improved patient health outcomes and a decrease in spread of CDI. Other patient improvement initiatives and work can impede the staff's adaptation of the prevention bundle. The Health Promotion Model appropriately addressed these issues. In addition, the use of the Stetler model should be encouraged for future EBP projects due to its ease of use for novice practitioners. The step-by-step process allowed the project manager to accurately assess the evidence, link to evidence to practice, develop EBP interventions and evaluate the outcomes implemented.

Research

Implications for future research were identified. The synthesis of literature generally suggested a bundle of interventions including hand hygiene, contact isolation, environmental surface leaning and antimicrobial stewardship committee, with some of the research including patient hand hygiene compliance as an intervention in the bundle. In addition, education for the bundle was suggested in all the research with no best way to educate identified. The research included a combination of direct education, computer based training, hand-outs, and presentations. The delivery method of the educational materials needs to be evaluated both quantitatively and qualitatively. This EBP project utilized face-to-face sessions, presentations at unit and staff meetings, computer based training, hand-outs and posters. More research needs to be performed to determine the most effective delivery method for education. Continued research to decrease HA-CDI is necessary to improve patient outcomes and satisfaction.

Education

The project manager identified early in the project that lack of education on CDI with environmental services staff was a concern for the IP and CNO. Education was a large component of the intervention to this project. Education focused on an overview of CD, CDI risk factors, how to decrease the spread of CD, documentation of stool screening in the admission section of the electronic health record, and prevention interventions. Education was provided by the project manager at unit and staff meetings, during face-to-face sessions, and with a computer based training module. Posters were created by the project manager and left in break-rooms with hand-outs. Future research to determine the most effective delivery method for education would assist future project implementations. Continued education of staff will be an integral part of decreasing HA-CDI incidence.

Conclusion

This EBP project was considered a success with statistical significance in pre- and post-intervention hand hygiene compliance and contact isolation compliance rates and no statistical significance in pre- and post-intervention CDI rates. The knowledge obtained by staff during the educational sessions will undeniably prove to be successful in generating future efforts to engage members and provide continued education to established staff. Continued monitoring of hand hygiene compliance, contact isolation precaution compliance, and environmental surface cleaning protocols will be paramount in continuing CDI prevention efforts. Sustained self-efficacy of staff will ensure a decrease in the number of HA-CDI cases in the future.

REFERENCES

Carrico, R.M., Bryant, K., Lessa, F., Limbago, B., Fauerbach, L.L., Marx, J.F., Sands, F., Stephens, D., Westhusing, K., & Wiemken, T. (2013). Guide to preventing clostridium difficile infections. *Association for Professionals in Infection Control and Epidemiology* 1-100.

Carter, Y., & Barry, D. (2011). Tackling C difficile with environmental cleaning. *Nursing Times, 107*, 22-5. Retrieved from http://ezproxy.valpo.edu/login?url=http://search.proquest.com/docview/103930529?accountid=14811

Centers for Disease Control and Prevention. (2013). Clostridium difficile infection prevention primer.

Ciliska, D., DiCenso, A., Melnyk, B. M., Fineout-Overholt, E., Stetler, C. B., Cullen, L., Newhouse, R. P. (2011). Models to guide implementation of evidence-based practice. In B. M. Melnyk & E. Fineout (Eds.), *Evidence-based practice in nursing and healthcare* (2nd ed., pp.241-275). Philadelphia, PA: Lippincott Williams & Wilkins.

Cohen, S.H., Gerding, D.N., Johnson, S., Kelly, C.P., Loo, V.G., & McDonald, L.C. (2010). Clinical practice guidelines for clostridium difficile infection in adults:2010 updates by the society for healthcare epidemiology of america and the infectious diseases society of America. *Infection Control Hospital Epidemiology, 31, 431-455.*

Khan, F.Y., & Elzouki, A. (2014). Clostridium difficile infection: a review of the literature. *Asian Pacific Journal of Tropical Medicine, 7(1), 6-13.*

Koll, B. S., Ruiz, R. E., Calfee, D. P., Jalon, H. S., Stricof, R. L., Adams, A., Smith, B.A., Shin, G., Guse, K., Woods, M.K., & Sirtalan, I. (2014). Prevention of Hospital-Onset Clostridium difficile Infection in the New York Metropolitan Region Using a Collaborative Intervention Model. *Journal for Healthcare Quality: Promoting Excellence In Healthcare*, *36*(3), 35-45 . doi:10.1111/jhq.12002

Melnyk, B. M., & Fineout-Overholt, E. (2011). Evidence-based practice in nursing and healthcare: A guide to best practice. Philadelphia, PA: Lippincott, Williams & Wilkins.

Pokrywka, M., Feigel, J., Douglas, B., Grossberger, S., Hensler, A., & Weber, D. (2014). A bundle strategy including patient hand hygiene to decrease clostridium difficile infections. *Medsurg Nursing, 23*(3), 145-8, 164. Retrieved from http://ezproxy.valpo.edu/login?url=http://search.proquest.com/docview/1544897499?accountid=14811

Potter P.A., & Perry A.G. (2006). Fundamentals of nursing. 6th ed. St.Louis: Elsevier Mosby; 2006.

Rubin, M. A., Jones, M., Leecaster, M., Khader, K., Ray, W., Huttner, A., Huttner, B., Toth, D., Sablay, T., Borotkanics, R.J., Gerding, D.N., & Samore, M. H. (2013). A simulation-based assessment of strategies to control clostridium difficile transmission and infection. *PLoS One, 8*(11) doi:http://dx.doi.org/10.1371/journal.pone.0080671

Stetler, C. B. (2003). Role of the organization in translating research into evidence-based practice. *Outcomes Management, 7*, 97-105.

Waqar, S., Nigh, K., Sisler, L., Fanning, M., Tancin, S., Brozik, E., Jones, R., Briggs, F., Keller, L., LaSala, P.R., Krautz, S.,& Khakoo, R. (2016). Multidisciplinary performance improvement team for reducing health care–associated Clostridium difficile infection. *American Journal of Infection Control*, *44*(3), 352-354 3p. doi:10.1016/j.ajic.2015.09.022.

You, E., Song, H., Cho, J., & Lee, J. (2014). Reduction in the incidence of hospital-acquired clostridium difficile infection through infection control interventions other than the restriction of antimicrobial use. *International Journal of Infectious Disease, 22,* 9-10. doi:10.1016/j.ijid.2014.01.011.

BIOGRAPHICAL MATERIAL

After earning her BSN from Valparaiso University in 2009, Kaitlin gained extensive experience as a Critical Care nurse at a local hospital. In that clinical role, she cared for a wide variety of critically ill adults. Kaitlin was chosen to become a Credentialed Trainer for the new electronic medical record (EMR) roll out at the hospital. She accepted the position and trained all the medical staff prior to implementation. After implementation, Kaitlin accepted a position in Clinical Informatics. She now works as a manager in Nursing Informatics. Kaitlin is also an adjunct clinical professor at Valparaiso University for undergraduate nursing students as well as a Certified instructor for Advanced Cardiac Life Support (ACLS). She is currently working toward her Doctor of Nursing Practice at Valparaiso University with an expected graduation date of May 2017. Kaitlin is a member of the American Nurses Association (ANA) and Coalition of Advanced Practice Nurses of Indiana (CAPNI). She has recently passed her certification exam and upon graduation will be certified as a Family Nurse Practitioner through the American Nurse Credentialing Center (ANCC). With her role in Informatics and her critical care experience Kaitlin became interested in studying hospital acquired Clostridium difficile rates and the impact of interventions to reduce those rates. Kaitlin's current position in Clinical Informatics had allowed her to integrate clinical expertise and maximize functionality of the EMR to improve patient care and outcomes.

ACRONYM LIST

AHRQ: Agency for Healthcare Research and Quality

APIC: Association for Professionals in Infection Control and Epidemiology

CBT: Computer-based training

CD: Clostridium difficile

CDC: Centers for Disease Control and Prevention

CDI: Clostridium difficile infection

CMS: Centers for Medicare and Medicaid Services

EBP: Evidence-based practice

EMR: Electronic medical record

EPA: Environmental protection agency

HA-CDI: Hospital-acquired clostridium difficile infection

HAI: Hospital-acquired infection

HCW: Healthcare workers

IP: Infection Preventionist

IPPS: Inpatient Prospective Payment System

NHSN: National Health Safety Network

APPENDIX A

SUMMARY OF APPRAISED LITERATURE

STUDY/LEVEL	PARTICIPANTS	PURPOSE/METHODS	INTERVENTION	RESULTS
Carrico et al., (2013). **Level VII**	Adult patients diagnosed with C. difficile infection	To develop and implement a guide to prevent Cl. difficile infection. Prevention interventions include diagnosis, hand hygiene, contact isolation precautions, environmental infection prevention, antimicrobial stewardship, and fecal bacteriotherapy.		Formal guideline for C. difficile prevention using early diagnosis and identification of potential C. difficile patents, proper hand hygiene procedures with soap and water, contact isolation precautions for all patients suspected of CDI, environmental and surface cleaning with an EPA-approved spore killing hypochlorite solution, implementation of an antimicrobial stewardship committee to monitor antibiotic use and de-escalation of antibiotics, and fecal bacteriotherapy offered as treatment option.
Koll et al., (2014). **Level III**	Used collaborative model. Local hospitals created collaborative steering committees including infectious disease physicians, infection preventionist, hospital epidemiologists, nurses, and additional staff.	Reduce the incidence of hospital-onset CDI. 2 bundles were implemented (1) infection prevention bundle (2) environmental cleaning protocol	In first 6 months of Collaborative group implemented an infection prevention bundle including (a) contact precautions instituted immediately for patients with diarrhea, (b) sign placement for patients with confirmed or suspected CDI, (c) personal protective equipment readily available and used, (d)adherence to hand hygiene protocols, (e)	35 hospitals were included in the analysis. Hospital onset-CDI accounted for 44% of all cases. Hospital onset CDI cases mean length of stay more than twice as long (26 days) and all-cause mortality rate almost twice as high (mean= 18%), nonhospital-associated length of stay was 11 days and all-cause mortality rate (mean=10%) or community-onset, hospital-associated CDI length of stay 12 days and all-cause mortality rate (mean=13%). The mean compliance with the prevention

			dedicated rectal thermometers, (f) patient placement, (g) private room for CDI patients (confirmed or suspected), (h) cohorting of CDI patients, if private room unavailable, and (i) as a last option, dedicated bathroom for CDI patients in a shared room with non-CDI patient. Implementation of an environmental cleaning protocol including standardized cleaning with a hypochlorite-based disinfectant for routine and terminal cleaning and a 48-item checklist to assess compliance.	bundle was 95% and the mean compliance with the environmental cleaning protocol was 96%. A pronounced downward trend in the mean hospital-onset CDI rate from 12 to 8 per 10,000 patient-days. The predicted hospital-onset reduction over time was significant over the course of the project (*p*<.001). The expected number of hospital-onset CDI cases was 6,461 and the actual number of cases was 5,377.
Pokrywka et al., (2014). **Level III**	Admitted patient to hospital with new onset of unexplained diarrhea for at least 12 hours occurring more than 48 hours after admission, and having a positive C. difficile toxins test.	Determine the effect of an expanded bundle, including patient hand hygiene, on the rate of C. difficile disease in hospitalized patients.	The intervention of patient hand hygiene was added to the current C. difficile prevention bundle. Patient hand hygiene was promoted prior to meals using soap and water or with a commercially available alcohol wipe placed on patient trays by dietary staff. The current bundle included (a) early detection of C. difficile cases by toxin testing of any patient with onset of	From July 2009 to Jun 2010, 336 positive results and rate of CDI incidence was 6.95 per 10,000 patient-days. In comparison, the previous year's incidence of C. difficile infection was 10.45 per 10,000 patient-days. The inclusion of patient hand hygiene to the prevention bundle was found to be statistically significant (*p*=0.0009).

			unexplained diarrhea, (b) electronic alerts on positive toxin results to nursing units to initiate barrier precautions with glove and gown use, (c) staff hand hygiene with soap and water, (d) extended duration of isolation for entire hospital stay, (e) staff and patient education on C. difficile disease, and (f) cleaning of all patient rooms with sodium hypochlorite solution.	
Rubin et al., (2013). **Level II**	Computer simulation model – agent-based modeling (ABM)	To simulate a typical hospital environment and the spread of C. difficile between patients by contaminated environmental surfaces and health care worker hands.	5 sub-models were created (1) the patient flow sub-model governed processes of patient admission, transfer and discharge (2) the virtual hospital represented a medium-sized facility with nine 30-bed acute care floors and two 15-bed intensive care units (3) The response and intervention sub-model governed policies for managing infected patients and preventing transmission (4) The contact event sub-model governed processes of contamination of environmental surfaces within the room, transfer of	The bundle interventions during the typical intervention scenario improved for actual CDI rates and reported CDI rates of 40 events per 10,000 patient-days with a base-case scenario of 140 events per 10,000 patient-days actual CDI rates and 80 events per 10,000 patient-days reported CDI rates. The impact of each single component at the typical intervention scenario was greatest for hand hygiene (7 events per 10,000 patient-days), empiric isolation (9 events per 10,000 patient-days), and testing (13 events per 10,000 patient-days).

			organisms to health care worker hands and acquisition of organisms by susceptible patients (5) The contact network sub-model represented the connections between patients, nurses and doctors.	
Waqar et al., (2016). **Level III**	All patients admitted to the tertiary care center with suspected CDI.	To reduce the rates of HA-CDI at a tertiary care center	Implementation of a modified contact isolation sign for all CDI patients to only use soap and water for hand washing, the sign was a visual alert to environmental service to use 1:10 dilution of bleach for terminal cleaning. Training and feedback of proper room cleaning for CDI patients was conducted with environmental service staff. All CDI patients were kept in contact isolation. A computer-based learning module was created and required to be reviewed by all health care providers including nursing, physicians, and ancillary staff members. Monitoring high-touch surface cleanliness during terminal cleaning with use of Clean-Trace Hygiene	CDI rate decreased from 15.38 to 6.94 per 10,000 patient-days (The average monthly rate of CDI decreased per 10,000 patient-days from 12.5 to 7.8 (p=.001). The mean rate of hand hygiene adherence was 63% and did not change during the study period. The percent of cleanliness if high-touch surfaces improved from 62.7 to 91 and Fluoroquinolones use decreased from 65 defined daily dose per 1,000 patient-days to 31 defined daily dose per 1,000 patient-days.

			Management System. An antimicrobial stewardship committee was created to reduce Fluoroquinolones use in addition to existing goals.	
You, E., Song, H., Cho, J., & Lee, J. (2014). **Level V**	Patients admitted to the unit with presence of symptoms (diarrhea or fever and unexplained leukocytosis) and a positive stool test for C. difficile toxins.	To prevent CDI in hospitalized patients admitted to the medical intensive care unit	Infection control interventions that were implemented in the medical intensive care unit consisted of (a) education, (b) isolation, (c) hand hygiene, (d) contact precautions, and (e) environmental cleaning. Prior to intervention, hand hygiene was the only C. difficile prevention procedure. Educational interventions consisted of a lecture which was presented to all medical staff and attending physicians. Information included: survey results, baseline data, proper isolation, hand hygiene, contact precautions and environmental disinfection. Patients with CDI were placed in a private isolation zone and separate hand-washing sinks were positioned near each bed. Isolation was maintained until the patient had	The overall incidence rate of CDI increased within the hospital from 0.93 to 1.17 per 1,000 patient-days, but the incidence of CDI in the medical intensive care unit decreased significantly from 4.70 to 1.53 cases per 1,000 patient-days (p=0.012, *OR* 0.36, 95% *CI* 0.13-0.85). The medical intensive care unit had a reduction in CDI incidence by approximately 67%.

			remained free of diarrhea symptoms for 48 hours. Healthcare workers and visitors were required to wear clean gloves and gowns prior to contact with a CDI patient and perform proper hand hygiene with soap and water after caring for or coming into contact with CDI patients. The frequency of environmental disinfection was increased to twice a day using sodium hypochlorite.	

APPENDIX B

CDC Environmental Checklist for Monitoring Terminal Cleaning[1]

Date:	
Unit:	
Room Number:	
Initials of ES staff (optional):[2]	

Evaluate the following priority sites for each patient room:

High-touch Room Surfaces[3]	Cleaned	Not Cleaned	Not Present in Room
Bed rails / controls			
Tray table			
IV pole (grab area)			
Call box / button			
Telephone			
Bedside table handle			
Chair			
Room sink			
Room light switch			
Room inner door knob			
Bathroom inner door knob / plate			
Bathroom light switch			
Bathroom handrails by toilet			
Bathroom sink			
Toilet seat			
Toilet flush handle			
Toilet bedpan cleaner			

Evaluate the following additional sites if these equipment are present in the room:

High-touch Room Surfaces[3]	Cleaned	Not Cleaned	Not Present in Room
IV pump control			
Multi-module monitor controls			
Multi-module monitor touch screen			
Multi-module monitor cables			
Ventilator control panel			

[1]Selection of detergents and disinfectants should be according to institutional policies and procedures
[2]Hospitals may choose to include identifiers of individual environmental services staff for feedback purposes.
[3]Sites most frequently contaminated and touched by patients and/or healthcare worker

Contact Precautions Monitoring Tool
Patient Care Unit/Dept.:____________________________ Month/Year ________________
Initials of Monitor:________________
Healthcare Worker (HCW) Type: **Y=Yes** **N=No**

1= Physician
2= Nurse Practitioner
3= Physician Assistant
4= Registered Nurse
5= Patient Care Technician (PCA)
6= Environmental Services

#Obs	Date	Time	HCW type	Isolation Precautions		Gloves worn		Gown worn		Gloves & gown removed on room exit		Comments
			See Key	Yes	No	Yes	No	Yes	No	Yes	No	
1												
2												
3												
4												
5												
6												
7												
8												
9												
10												

World Health Organization | Patient Safety — A World Alliance for Safer Health Care | SAVE LIVES — Clean Your Hands

Observation Form

Facility:		Period Number*:		Session Number*:	
Service:		Date: (dd/mm/yy)	/ /	Observer: (initials)	
Ward:		Start/End time: (hh:mm)	: / :	Page N°:	
Department:		Session duration: (mm)		City**:	
Country**:					

Prof.cat			Prof.cat			Prof.cat			Prof.cat		
Code			Code			Code			Code		
N°			N°			N°			N°		
Opp.	Indication	HH Action	Opp.	Indication	HH Action	Opp.	Indication	HH Action	Opp.	Indication	HH Action
1	☐ bef-pat. ☐ bef-asept ☐ aft-b.f. ☐ aft-pat. ☐ aft.p.surr.	☐ HR ☐ HW ○ missed ○ gloves	1	☐ bef-pat. ☐ bef-asept ☐ aft-b.f. ☐ aft-pat. ☐ aft.p.surr.	☐ HR ☐ HW ○ missed ○ gloves	1	☐ bef-pat. ☐ bef-asept ☐ aft-b.f. ☐ aft-pat. ☐ aft.p.surr.	☐ HR ☐ HW ○ missed ○ gloves	1	☐ bef-pat. ☐ bef-asept. ☐ aft-b.f. ☐ aft-pat. ☐ aft.p.surr.	☐ HR ☐ HW ○ missed ○ gloves
2	☐ bef-pat. ☐ bef-asept ☐ aft-b.f. ☐ aft-pat. ☐ aft.p.surr.	☐ HR ☐ HW ○ missed ○ gloves	2	☐ bef-pat. ☐ bef-asept ☐ aft-b.f. ☐ aft-pat. ☐ aft.p.surr.	☐ HR ☐ HW ○ missed ○ gloves	2	☐ bef-pat. ☐ bef-asept ☐ aft-b.f. ☐ aft-pat. ☐ aft.p.surr.	☐ HR ☐ HW ○ missed ○ gloves	2	☐ bef-pat. ☐ bef-asept. ☐ aft-b.f. ☐ aft-pat. ☐ aft.p.surr.	☐ HR ☐ HW ○ missed ○ gloves
3	☐ bef-pat. ☐ bef-asept ☐ aft-b.f. ☐ aft-pat. ☐ aft.p.surr.	☐ HR ☐ HW ○ missed ○ gloves	3	☐ bef-pat. ☐ bef-asept ☐ aft-b.f. ☐ aft-pat. ☐ aft.p.surr.	☐ HR ☐ HW ○ missed ○ gloves	3	☐ bef-pat. ☐ bef-asept ☐ aft-b.f. ☐ aft-pat. ☐ aft.p.surr.	☐ HR ☐ HW ○ missed ○ gloves	3	☐ bef-pat. ☐ bef-asept. ☐ aft-b.f. ☐ aft-pat. ☐ aft.p.surr.	☐ HR ☐ HW ○ missed ○ gloves
4	☐ bef-pat. ☐ bef-asept ☐ aft-b.f. ☐ aft-pat. ☐ aft.p.surr.	☐ HR ☐ HW ○ missed ○ gloves	4	☐ bef-pat. ☐ bef-asept ☐ aft-b.f. ☐ aft-pat. ☐ aft.p.surr.	☐ HR ☐ HW ○ missed ○ gloves	4	☐ bef-pat. ☐ bef-asept ☐ aft-b.f. ☐ aft-pat. ☐ aft.p.surr.	☐ HR ☐ HW ○ missed ○ gloves	4	☐ bef-pat. ☐ bef-asept. ☐ aft-b.f. ☐ aft-pat. ☐ aft.p.surr.	☐ HR ☐ HW ○ missed ○ gloves
5	☐ bef-pat. ☐ bef-asept ☐ aft-b.f. ☐ aft-pat. ☐ aft.p.surr.	☐ HR ☐ HW ○ missed ○ gloves	5	☐ bef-pat. ☐ bef-asept ☐ aft-b.f. ☐ aft-pat. ☐ aft.p.surr.	☐ HR ☐ HW ○ missed ○ gloves	5	☐ bef-pat. ☐ bef-asept ☐ aft-b.f. ☐ aft-pat. ☐ aft.p.surr.	☐ HR ☐ HW ○ missed ○ gloves	5	☐ bef-pat. ☐ bef-asept. ☐ aft-b.f. ☐ aft-pat. ☐ aft.p.surr.	☐ HR ☐ HW ○ missed ○ gloves
6	☐ bef-pat. ☐ bef-asept ☐ aft-b.f. ☐ aft-pat. ☐ aft.p.surr.	☐ HR ☐ HW ○ missed ○ gloves	6	☐ bef-pat. ☐ bef-asept ☐ aft-b.f. ☐ aft-pat. ☐ aft.p.surr.	☐ HR ☐ HW ○ missed ○ gloves	6	☐ bef-pat. ☐ bef-asept ☐ aft-b.f. ☐ aft-pat. ☐ aft.p.surr.	☐ HR ☐ HW ○ missed ○ gloves	6	☐ bef-pat. ☐ bef-asept. ☐ aft-b.f. ☐ aft-pat. ☐ aft.p.surr.	☐ HR ☐ HW ○ missed ○ gloves
7	☐ bef-pat. ☐ bef-asept ☐ aft-b.f. ☐ aft-pat. ☐ aft.p.surr.	☐ HR ☐ HW ○ missed ○ gloves	7	☐ bef-pat. ☐ bef-asept ☐ aft-b.f. ☐ aft-pat. ☐ aft.p.surr.	☐ HR ☐ HW ○ missed ○ gloves	7	☐ bef-pat. ☐ bef-asept ☐ aft-b.f. ☐ aft-pat. ☐ aft.p.surr.	☐ HR ☐ HW ○ missed ○ gloves	7	☐ bef-pat. ☐ bef-asept. ☐ aft-b.f. ☐ aft-pat. ☐ aft.p.surr.	☐ HR ☐ HW ○ missed ○ gloves
8	☐ bef-pat. ☐ bef-asept ☐ aft-b.f. ☐ aft-pat. ☐ aft.p.surr.	☐ HR ☐ HW ○ missed ○ gloves	8	☐ bef-pat. ☐ bef-asept ☐ aft-b.f. ☐ aft-pat. ☐ aft.p.surr.	☐ HR ☐ HW ○ missed ○ gloves	8	☐ bef-pat. ☐ bef-asept ☐ aft-b.f. ☐ aft-pat. ☐ aft.p.surr.	☐ HR ☐ HW ○ missed ○ gloves	8	☐ bef-pat. ☐ bef-asept. ☐ aft-b.f. ☐ aft-pat. ☐ aft.p.surr.	☐ HR ☐ HW ○ missed ○ gloves

* To be completed by the data manager.
** Optional, to be used if appropriate, according to the local needs and regulations.

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Revised August 2009

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General Recommendations

(refer to the Hand Hygiene Technical Reference Manual)

1. In the context of open and direct observations, the observer introduces him/herself to the health-care worker and to the patient when appropriate, explains his/her task and proposes immediate informal feed back.
2. The health-care worker, belonging to one of the main four following professional categories (see below), is observed during the delivery of health-care activities to patients.
3. Detected and observed data should be recorded with a pencil in order to be immediately corrected if needed.
4. The top of the form (header) is completed before starting data collection (excepted end time and session duration).
5. The session should last no more than 20 minutes (± 10 minutes according to the observed activity); the end time and the session duration are to be completed at the end of the observation session.
6. The observer may observe up to three health-care workers simultaneously, if the density of hand hygiene opportunities permits.
7. Each column of the grid to record hand hygiene practices is intended to be dedicated to a specific professional category. Therefore numerous health-care workers may be sequentially included during one session in the column dedicated to their category. Alternatively each column may be dedicated to a single health-care worker only of whom the professional category should be indicated.
8. As soon as you detect an indication for hand hygiene, count an opportunity in the appropriate column and cross the square corresponding to the indication(s) you detected. Then complete all the indications that apply and the related hand hygiene actions observed or missed.
9. Each opportunity refers to one line in each column; each line is independent from one column to another.
10. Cross items in squares (several may apply for one opportunity) or circles (only a single item may apply at one moment).
11. When several indications fall in one opportunity, each one must be recorded by crossing the squares.
12. Performed or missed actions must always be registered within the context of an opportunity.
13. Glove use may be recorded only when the hand hygiene action is missed while the health-care worker is wearing gloves.

Short description of items

Facility:	to complete according to the local nomenclature	
Service:	to complete according to the local nomenclature	
Ward:	to complete according to the local nomenclature	
Department:	to complete according to the following standardized nomenclature:	
	medical, including dermatology, neurology, haematology, oncology, etc.	surgery, including neurosurgery, urology, EENT, ophthalmology, etc.
	mixed (medical & surgical), including gynaecology	obstetrics, including related surgery
	paediatrics, including related surgery	intensive care & resuscitation
	emergency unit	long term care & rehabilitation
	ambulatory care, including related surgery	other (to specify)
Period N°:	1) pre- / 2) post-intervention; and then according to the institutional counter.	
Date:	day (dd) / month (mm) / year (yy)	
Start/end time:	hour (hh) / minute (mm).	
Session duration:	difference between start and end time, resulting in minutes of observation.	
Session N°:	attributed at the moment of data entry for analysis.	
Observer:	observer's initials (the observer is responsible for the data collection and for checking their accuracy before submitting the form for analysis.	
Page N°:	to write only when more than one form is used for one session.	
Prof.cat:	according to the following classification:	
	1. nurse / midwife	1.1 nurse, 1.2 midwife, 1.3 student
	2. auxiliary	
	3. medical doctor	3.1 in internal medicine, 3.2 surgeon, 3.3 anaesthetist / resuscitator / emergency physician, 3.4 paediatrician, 3.5 gynaecologist, 3.6 consultant, 3.7 medical student.
	4. other health-care worker	4.1 therapist (physiotherapist, occupational therapist, audiologist, speech therapist), 4.2 technician (radiologist, cardiology technician, operating room technician, laboratory technician, etc), 4.3 other (dietician, dentist, social worker and any other health-related professional involved in patient care), 4.4 student.
Number:	number of observed health-care workers belonging to the same professional category (same code) as they enter the field of observation and you detect opportunities.	
Opp(ortunity):	defined by one indication at least	
Indication:	reason(s) that motivate(s) hand hygiene action; all indications that apply at one moment must be recorded	
	bef.pat: before touching a patient	aft.b.f: after body fluid exposure risk
	bef.asept: before clean/aseptic procedure	aft.pat: after touching a patient
		aft.p.surr: after touching patient surroundings
HH action:	response to the hand hygiene indication(s); it can be either a positive action by performing handrub or handwash, or a negative action by missing handrub or handwash	
	HR: hand hygiene action by handrubbing with an alcohol-based formula HW: hand hygiene action by handwashing with soap and water	Missed: no hand hygiene action performed

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Observation Form – Basic Compliance Calculation

	Facility:						Period:			Setting:					
	Prof.cat.			Prof.cat.			Prof.cat.			Prof.cat.			Total per session		
Session N°	Opp (n)	HW (n)	HR (n)	Opp (n)	HW (n)	HR (n)	Opp (n)	HW (n)	HR (n)	Opp (n)	HW (n)	HR (n)	Opp (n)	HW (n)	HR (n)
1															
2															
3															
4															
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16															
17															
18															
19															
20															
Total															
Calculation	Act (n) = Opp (n) =			Act (n) = Opp (n) =			Act (n) = Opp (n) =			Act (n) = Opp (n) =			Act (n) = Opp (n) =		
Compliance															

$$\text{Compliance (\%)} = \frac{\text{Actions}}{\text{Opportunities}} \times 100$$

Instructions for use

1. Define the setting outlining the scope for analysis and report related data according to the chosen setting.
2. Check data in the observation form. Hand hygiene actions not related to an indication should not be taken into account and vice versa.
3. Report the session number and the related observation data in the same line. This attribution of session number validates the fact that data has been taken into count for compliance calculation.
4. Results per professional category and per session (vertical):
   - 4.1 Sum up recorded opportunities (opp) in the case report form per professional category: report the sum in the corresponding cell in the calculation form.
   - 4.2 Sum up the positive hand hygiene actions related to the total of opportunities above, making difference between handwash (HW) and handrub (HR): report the sum in the corresponding cell in the calculation form.
   - 4.3 Proceed in the same way for each session (data record form).
   - 4.4 Add up all sums per each professional category and put the calculation to calculate the compliance rate (given in percent)
5. The addition of results of each line permits to get the global compliance at the end of the last right column.

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Observation Form – Optional Calculation Form

(Indication-related compliance with hand hygiene)

	Facility:						Period:			Setting:					
	Before touching a patient			Before clean/aseptic procedure			After body fluid exposure risk			After touching a patient			After touching patient surroundings		
Session Nº	Indic (n)	HW (n)	HR (n)	Indic (n)	HW (n)	HR (n)	Indic (n)	HW (n)	HR (n)	Indic (n)	HW (n)	HR (n)	Indic (n)	HW (n)	HR (n)
1															
2															
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14															
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16															
17															
18															
19															
20															
Total															
Calculation	Act (n) = / Indic1 (n) =			Act (n) = / Indic2 (n) =			Act (n) = / Indic3 (n) =			Act (n) = / Indic4 (n) =			Act (n) = / Indic5 (n) =		
Ratio act/indic*															

Instructions for use

1. Define the setting outlining the scope for analysis and report related data according to the chosen setting.
2. Check data in the observation form. Hand hygiene actions not related to an indication should not be taken into account and vice versa.
3. If several indications occur within the same opportunity, each one should be considered separately as well as the related action.
4. Report the session number and the related observation data in the same line. This attribution of session number validates the fact that data has been taken into count for compliance calculation.
5. Results per indication (indic) and per session (vertical):
   4.1 Sum up indications per indication in the observation form: report the sum in the corresponding cell in the calculation form.
   4.2 Sum up positive hand hygiene actions related to the total of indications above, making the difference between handwash (HW) and handrub (HR): report the sum in the corresponding cell in the calculation form.
   4.3 Proceed in the same way for each session (observation form).
   4.4 Add up all sums per each indication and put the calculation to calculate the ratio (given in percent)

***Note:** This calculation is not exactly a compliance result, as the denominator of the calculation is an indication instead of an opportunity. Action is artificially overestimated according to each indication. However, the result gives an overall idea of health-care worker's behaviour towards each type of indication.

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APPENDIX C

Face-to face In-service Sessions Flyer

CLOSTRIDIUM DIFFICILE

IN-SERVICE

Topics include:

1. Early identification of CDI patients
2. Proper hand hygiene
3. Proper contact isolation
4. Environmental surface cleaning with appropriate products
5. Empowerment of the antimicrobial stewardship program

Dates/Times:

Tuesday 11/1/16 @ 0600

Wednesday 11/2/16 @ 1200

Friday 11/4/16 @ 1600

Please attend one of the 15 minute face-to-face sessions

Intervention Outline

1. Preventing Clostridium Difficile Infection (CDI)
2. Objectives
    - Identify what CDI is and why it is challenging to treat
    - List the role of staff in infection prevention
    - Improve the process of how to keep staff and patients safe
3. What is Clostridium Difficile?
    - Clostridium difficile (C. diff) is a serious cause of infectious diarrhea
    - C. diff can cause severe infections and can be life threatening
    - C. diff is a spore-forming bacteria that cannot be seen and can survive on surfaces up to 5 months

    (CDC, 2013 & Shaughnessy et. al, 2011)
4. How is Clostridium Difficile Spread?
    - Contact with contaminated feces
    - Ingestion of spores from a contaminated patient environment
    - On the hands of healthcare workers
    - Exposure to antibiotics
    - Recent hospitalization
    - Advanced Age
5. Risk Factors for Clostridium Difficile
    - Recent antibiotic use
    - Advanced age
    - Recent hospitalization
6. Statistics
    - 13 of every 1,000 inpatients are infected or colonized with C. difficile

- Average cost for an inpatient CDI is more than $35,000
- Annual cost burden for the healthcare system exceeds $3 billion

(CDC, 2013)

7. Clostridium Difficile Prevention Bundle
    - Early identification of suspected CDI patients
        - Stool screening in EHR admission section
    - Immediate Contact isolation
    - Perform hand hygiene with soap and water only
    - Surface cleaning with a bleach/hypochlorite-based solution daily
    - Implementation of an Antimicrobial Stewardship Committee

(APIC, 2013; CDC, 2013)

8. Early Identification & Contact Isolation
    - Stool screening to be completed on every admission
    - Suspected or confirmed CDI should be placed in contact isolation (gown and gloves)
    - Contact isolation sign and soap and water hand washing sign to be placed outside patient room

(APIC, 2013; CDC, 2013;Koll et al., 2013)

9. Hand hygiene
    - Only soap and water should be used to clean hands for CDI patients
    - Patients should wash hands with soap and water if able prior to meals and after the bathroom
    - Do not use alcohol based hand sanitizer

(APIC, 2013; CDC, 2013)

10. Surface Cleaning

- All surfaces in the patient room should be cleaned with a bleach/hypochlorite solution daily
- All movable equipment should be cleaned with a bleach/hypochlorite solution prior to use with next patient
- Terminal cleaning of all CDI rooms with hypochlorite solution and removal of curtains

(APIC, 2013; CDC, 2013; You, Song, Cho, and Lee, 2014)

11. Surface Cleaning
    - Role of Environmental Services
        - Room surface cleaning daily with bleach/ hypochlorite solution
        - Terminal cleaning of CDI patient rooms and removal of curtain
    - Role of Unit staff
        - Clean all movable equipment with bleach/hypochlorite solution

(APIC, 2013; CDC, 2013; You, Song, Cho, and Lee, 2014)

12. Antimicrobial Stewardship Committee
    - CDI is nearly always a complication of antibiotics use
    - Goals of this committee:
        - Review use of antimicrobial agents and recommend restriction of use
        - Reduce use of inappropriate medications
        - De-escalate antibiotics for appropriate treatment

(APIC, 2013; CDC, 2013; Waqar et al., 2016)

13. Putting it all Together
    - Early identification of suspected CDI patients with stool screenings on admission
    - Immediate Contact isolation (gown and gloves)

    - Contact isolation sign and soap and water hand washing sign outside patient door
- Perform hand hygiene with soap and water only
- Surface cleaning with a bleach/hypochlorite-based solution daily and for all removable equipment
- Implementation of an Antimicrobial Stewardship Committee

CDC Deadly Diarrhea Handout

APPENDIX D

Participant Demographic Data

1. Patient MRN number
2. Age
3. Gender
4. Race
5. CDI Onset
6. Admit Date
7. Admit Unit
8. Discharge Date
9. Discharge Unit
10. Initial Antimicrobial therapy
11. De-escalation of Antimicrobial therapy
12. Discharge Antimicrobial