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The University of Southern Mississippi

Nurse Knowledge of *Clostridium difficile*

by

Ashley Frosch

A Thesis
Submitted to Honors College of
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of the Requirements for the Degree of
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NURSE KNOWLEDGE OF C. DIFFICILE

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Abstract

The purpose of this study is to determine the amount of knowledge nurses have about *Clostridium difficile*. Seventy-five nurses participated in this study. A 25-question true/false survey was distributed via email to graduates of The University of Southern Mississippi. The survey consisted of a brief demographic section and 25 questions addressing *Clostridium difficile* knowledge. A total of 582 surveys were sent out with a total of 75 completed. Out of 25 questions in the survey, the majority of respondents (>50%) only answered 7 questions incorrectly. Overall, the nurses in this study possessed accurate knowledge about C. difficile; although, there were areas of knowledge that need improvement. Thus, nurses need continuing education about C. difficile.

Key words: Nurse knowledge, C. difficile, Clostridium difficile, survey

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Chapter 1: The Problem

Clostridium difficile is a bacterium that causes severe diarrhea and gastrointestinal upset. In some cases *C. difficile* can lead to a ruptured colon, kidney failure, and other severe complications that could potentially cause death. According to the CDC, *C. difficile* causes 14,000 deaths a year and costs the healthcare industry \$1 billion annually (2012). *C. difficile* is contracted 94% of the time in a healthcare setting. It is considered to be a severe hospital acquired infection. Patients most susceptible in hospital settings include the elderly, immunocompromised, and patients on antibiotics. While incidences of other hospital-acquired infections have decreased, incidences of *C. difficile* have increased. The rates of *C. difficile* infections have surpassed those of Methicillin-resistant *Staphylococcus aureus* (MRSA) since 2009 (Miller, Chen, Sexton, and Anderson, 2011). The number of *C. difficile* infections requiring hospital stays has increased three times over the past decade (CDC, 2012). Many patients infected with *C. difficile*, have relapses throughout their lives.

C. difficile is a bacterium that produces spores that can live on surfaces for months at a time. These spores are extremely difficult to kill. Alcohol-based hand rubs are ineffective in killing *C. difficile* spores. Only soap and water are effective at killing these spores off the hands of healthcare workers (Jabbar et al., 2010). It is important for nurses to know that when caring for patients infected with *C. difficile* using the alcohol-based hand rubs are not enough.

Nurses and certified nurse assistants (CNAs) have the most direct contact with patients, so they are at the highest risk of transmitting *C. difficile* from patient to patient. In recent study from the *Journal of Infection Control and Hospital Epidemiology*,

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Landelle et al., (2014) found that a high proportion of healthcare workers have C. difficile contaminated hands after coming into contact with infected patients. Certified nurse assistants (CNAs) had the highest rate of contaminated hands in the study. It is imperative that nurses have the knowledge to care for their patients with or without C. difficile and to prevent the spread.

Healthcare workers' knowledge is an important aspect of preventing the spread of any infection. Various studies have been completed regarding knowledge about hospital-acquired infections, infections, standard precautions, and hand hygiene. Most studies have shown that healthcare workers have a lack of knowledge regarding preventing the spread of infections. In a study from the *Journal of Infection Control and Hospital Epidemiology*, Sax et al. (2005) found that 44.1% of healthcare workers had insufficient knowledge about transmission precautions. They also found that healthcare workers believed that lack of knowledge was a contributing factor to non-compliance with precautions.

There has been limited research that specifically assessed nurse knowledge about C. difficile. Aroori, Blencowe, Pye, and West (2009) completed a study in the United Kingdom that tested the knowledge of C. difficile on various members of the staff at Weston General Hospital. Volunteers were given a test with questions about C. difficile ranging from basic knowledge to preventing the spread. The results showed that many healthcare workers did not know the answers to many of the questions about C. difficile. Only 38% of the nursing staff correctly identified that washing their hands with soap and water was the best way to prevent the spread of C. difficile. The study concluded that overall there was a lack of knowledge about C. difficile among various healthcare

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workers. Increasing the knowledge base of healthcare workers about C. difficile could help stop new cases from developing.

Further research is needed to see if knowledge statistically affects infection and compliance rates. Even though knowledge will not solve the problem completely, it can contribute to prevention. Studies have shown that continuing education is a key factor in adherence to precautions to prevent infection.

Since there have been a limited research regarding nurses' knowledge of C. difficile and even fewer in the United States, it is important to gather data about the knowledge nurses have about C. difficile. Knowing the areas where knowledge is accurate and where knowledge is lacking can help determine the education nurses need. The research question for this study was what is the extent of the knowledge nurses have about *Clostridium difficile*?

Chapter 2: Literature Review

Clostridium difficile and Hand Cleaning Techniques

Clostridium difficile (*C. difficile*) is a life-threatening hospital acquired infection that causes 14,000 deaths and costs the healthcare industry \$1 billion annually (CDC, 2012).

Miller, Chen, Sexton, and Anderson (2011) found that rates of *C. difficile* infections were surpassing rates of Methicillin-resistant *Staphylococcus aureus* (MRSA). They completed a prospective cohort study in twenty-eight hospitals between January 2008 and December 2009. *C. difficile* infections were the most prevalent infections that occurred during the study with 847 documented cases. There were only 680 documented cases of MRSA. *C. difficile* infections occurred 25% more frequently than MRSA infections. The team concluded that there could be various reasons for the increasing rate of *C. difficile* cases including new strains of *C. difficile*, changes in antibiotic prescribing practices, and increased diagnosing. The investigators also found that since *C. difficile* produces spores that are shed in the stool and can last for months, current infection control measures used may not be extensive enough.

C. difficile is unique from other hospital-acquired infections (HAIs) like MRSA due to the spores it produces. The spores are difficult to kill and contribute to increasing infection rates. Alcohol-based hand rubs are ineffective in killing *C. difficile* spores. Jabbar et al. (2010) found that after using alcohol-based hand rubs residual spores were still present on the hands of volunteers. Ten volunteers had nontoxigenic spores spread on their palms and then cleaned their hands with three alcohol-based hand rubs, soap and water, and just water. Cultures were taken before and after hand hygiene was completed.

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Further, each volunteer shook hands with uninfected volunteers after completing hand hygiene to see if the spores spread. The results showed that using soap and water is significantly more effective at removing *C. difficile* spores than when using alcohol-based hand rubs. The investigators also found the spores were more likely to be spread to the uninfected volunteers when the alcohol-based hand rubs were used. The authors concluded that alcohol-based hand rubs are ineffective at removing *C. difficile* spores.

C. difficile and At-Risk Healthcare Workers

Landelle et al. (2014) discovered that a high percentage of healthcare workers have contaminated hands after coming into contact with *C. difficile* patients. They compared the contamination rate of the hands of healthcare workers that were not exposed to *C. difficile* with the hands of healthcare workers who were exposed to *C. difficile* through contact with infected patients. The study began with a trained observer observing healthcare workers for eight weeks in their normal hospital setting. After the observation period, a trained technician sampled the hands of the workers. The sample was taken after the healthcare workers removed their gloves, but before they completed hand hygiene with soap and water. The samples were then tested for *C. difficile* spores. The results showed that 24% of healthcare workers that came into contact with infected patients had contaminated hands. The study also found that high-risk contact and contact without gloves were both associated with contamination. Hand contamination was the highest among nursing assistants, who overall have the most high-risk contact with patients. The authors came to the conclusion that a high proportion of healthcare workers' hands are contaminated when coming into contact with *C. difficile* patients. They also concluded that high-risk contact, including direct exposure to fecal matter, and not

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wearing gloves contributes to the problem. The amount of time spent with an infected patient was also associated with hand contamination. Since nurses and CNAs spend the most time with patients, it is essential they have knowledge about C. difficile and general infection prevention.

Knowledge of Infection Prevention and Standard Precautions

Sax et al. (2005) tested healthcare workers to see how much they actually knew about standard and isolation precautions. A confidential survey was given to a sample of 1,500 nurses and 500 physicians in a large teaching hospital. The results showed that more than half (55.9%) gave correct answers to 10 or more of the 13 knowledge based questions. During the study, 47% of the participants rated lack of knowledge as an important reason for noncompliance. The authors concluded that knowledge of transmission precautions for pathogens was insufficient.

Askarian, Mirzaei, Mundy, and McLaws (2005) investigated healthcare workers' knowledge, attitudes, and self-reporting practices concerning isolation precautions. Trained interviewers conducted a questionnaire to 623 physicians, 152 dentists, and 273 nurses about isolation precautions in an Iranian hospital. The results showed that while nurses scored the highest out of the three groups, all three groups had scores below 50%. Levels of high knowledge did not strongly associate with self reported practices, but low levels of knowledge correlated with poor attitudes and poor practices. The authors concluded that educating healthcare workers about infection control is a critical part of an effective infection control program.

In contrast, a study by Sodhi, Shrivastava, Arya, and Kumar (2013), found that knowledge about infection control was good. One hundred intensive care nurses in an

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Indian hospital were given a forty-question multiple-choice test regarding infection control. The results showed that overall knowledge and awareness about infection control was very good. On the test 5% of the nurses scored 90% or over, 37% scored 80-90%, 40% score 70-80%, and 18% score less than 70%. The authors concluded that nurse infection control knowledge was fairly good, but there was still room for improvement. They also concluded that nurses should have regular educational programs and training. Although this study showed good knowledge of infection control, the authors recommended that expanding knowledge through education was a key part of preventing the spread of infection.

Knowledge and the Problem

In a brief item, “Knowledge Key in Slowing Spread of Hospital Acquired Infections (HAIs),” from *AACN Bold Voices* (2012), argued that knowledge was considered the key factor in preventing the spread of hospital-acquired infections like *C. difficile*. In a study by Pittet (2001), healthcare workers were asked about why there was noncompliance with hand hygiene. They reported that one of the reasons listed for noncompliance was lack of knowledge. The authors concluded that there were valid solutions that could be implemented to help overcome these barriers. If these barriers were overcome, hand hygiene compliance could improve and infection rates could decrease. While knowledge will not completely eradicate *C. difficile* and other hospital-acquired infections, it is a key factor in reducing rates. It is imperative that healthcare workers be informed about the hazards about *C. difficile* and what part they play in the prevention of the spread.

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Knowledge of C. difficile

In a structured literature review, Burnett, Kearney, Johnston, Corlett, MacGillivray (2013) found four articles about knowledge and perceptions of C. difficile and they were all completed outside of the United States. All of the studies the authors reviewed about C. difficile showed that there was a lack of technical understanding. This included knowledge about microbiologic aspects, risk factors, diagnosis, treatment, and prevention. The literature revealed that healthcare professionals were concerned about both themselves and their patients in regards to C. difficile. The authors concluded that there needs to be more research completed about risk perceptions to understand how healthcare workers perceive and deal with C. difficile.

Aroori, Blencowe, Pye, and West (2009), completed one of the few studies that tested knowledge of C. difficile. A survey with seventeen questions about C. difficile was given to 132 healthcare professionals including 58 doctors, 61 nurses, and 13 other staff members in a U.K. hospital. The survey results showed that there was a significant knowledge deficit about C. difficile, especially among the nursing staff. Fayerberg, Bouchard, and Kellie (2013) completed a similar study in the United States that only focused on physician knowledge and found similar results. In this sample of New Mexico hospital physicians, 171 subjects took a twenty-one-question survey. The results showed that knowledge and practice of infection control in regards to C. difficile did not follow the facility guidelines. The authors concluded that there were significant gaps in knowledge concerning both facility policies and C. difficile clinical practice guidelines.

In contrast, Tsagkaraki, Sampaziotis, Cooke, and Gkrania-Klotsas (2009), found that nurses and physicians had good general knowledge about C. difficile, but knowledge

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was lacking in certain areas. They received 142 true/false surveys about C. difficile from doctors and nurses. The results showed that although general knowledge about C. difficile was adequate, knowledge about treatment protocols, major risk factors, and the use of alcohol-based hand rubs still needs to be improved. The authors determined that physicians and nurses need more education about C. difficile. Randle, Adams, and Vaughan (2006) found similar results when testing the knowledge of infection control link professionals' (ICLP) knowledge. Twenty ICLPs underwent a semi-structured interview to assess their knowledge, attitudes and perceptions of C. difficile. The results showed that while knowledge of standard precautions was good, microbiological knowledge of C. difficile was insufficient. The authors concluded that nurses and nursing students need a concrete base knowledge of biology and microbiology.

The review of literature revealed that while knowledge of C. difficile in some areas may be good, there are still many areas where knowledge is severely lacking. There has been limited research related to C. difficile knowledge and scant research in the United States, especially testing nurses. It is important to discover where knowledge lies and to identify the gaps to ensure that nurses get the education they need to protect patients. The research question for this study was what is the extent of the knowledge nurses have about *Clostridium difficile*?

Chapter 3: Methods

Purpose and Variables Defined

The purpose of this study was to determine the knowledge that nurses have about C. difficile. The study aimed to find where knowledge was sufficient and where knowledge was lacking. To answer this question a survey to assess knowledge of C. difficile was given to registered nurses. Nurses are defined as persons who are licensed by the state board of nursing to practice nursing. Knowledge is defined as how much general knowledge and strategies for decreased contamination is retained and known about C. difficile.

Sample

Although the sample of nurses all had a degree from the University of Southern Mississippi (USM), they had a range of education and experience. The convenience sample included in this study was accessed through the USM College of Nursing alumni listserv. The University of Southern Mississippi Internal Review Board (IRB) approved this study (see Appendix D). Inclusion criteria included that all participants be at least 21 years of age and speak English.

Instrumentation

Nurse knowledge was assessed using a true/false survey adapted from Tsagkaraki, Sampaziotis, Cooke, and Gkrania-Klotsas (2009) (see Appendix A). The author granted permission to use the survey (see Appendix B). A brief demographic section was included (see Appendix C).

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Procedures

A link to the survey was emailed via the USM College of Nursing alumni listserv (see Appendix E). The project was explained in the email and it was requested that the participants should not look answers up or ask others for help. Completion of the survey constituted informed consent to participate in the study. After the surveys were completed the scores on each individual question were analyzed. The scores on each individual question showed the specific areas where C. difficile knowledge was good or lacking and also showed an overall picture of C. difficile knowledge.

The survey was sent on August 13, 2014. The participants had until August 30, 2014 to complete the survey. Once the final surveys were collected, the data was analyzed.

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Chapter 4: Results

Demographics

A survey was sent out to determine the knowledge nurses had regarding C. difficile. The survey was sent out to various graduates from the University of Southern Mississippi. A total of 582 surveys were sent out with 62 going to Gulf Coast BSN graduates, 73 RN to BSN graduates, 335 to Hattiesburg BSN graduates, and 112 to alumni of graduate programs. A total of 107 surveys were started and 75 were completed. Out of the 75 completed 57 were completed by BSN graduates, 14 by MSN graduates, 3 by DNP graduates, and 1 by a PhD graduate. 89.3% of the respondents were currently working as registered nurses. 61.3% had 0-2 years of experience, 10.7% had 3-5 years, 5.3% had 6-10 years, and 22.7% had over 10 years of experience.

Table 1

Demographic Data

<i>Demographic</i>	<i>Categories</i>	<i>Nurses (%)</i>
Age	21-25	44%
	26-30	9.3%
	31-35	17.3%
	36-40	6%
	41-45	8%
	46-50	3%
	over 50	5%
Education Level	BSN	76%
	MSN	18.7%
	DNP	4.0%
	PhD	1.3%

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Table 1 (continued)

Demographic Data

<i>Demographic</i>	<i>Categories</i>	<i>Nurses (%)</i>
Years as an RN	0-2	61.3%
	3-5	10.7%
	6-10	5.3%
	over 10	22.7%
Currently working as an RN	Yes	89.3%
	No	10.7%
Gender	Male	17.3%
	Female	82.7%

Causes and Risk Factors

There were 25 true/false questions in the survey regarding C. difficile. The questions were broken into several categories to analyze the results. The first category of questions was related to the causes and risk factors of C. difficile. In the first question, asking if antibiotic-related diarrhea in the hospital is caused by C. difficile, 54.7% of the respondents answered true, which was incorrect. C. difficile is not the only cause of antibiotic-related diarrhea. Another question asked the respondents if community acquired C. difficile is not a frequent issue. Fifty-two percent of the respondents answered false, which was incorrect.

There were several questions that asked about the risk factors for C. difficile. The majority of the respondents correctly identified gastrointestinal surgery (72%), use of Clindamycin (76%), clinically significant comorbidities (74.7%), use of Ampicillin (69.3%), recent chemotherapy (77.3%), and age greater than 65 years (86.7%) as risk

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factors for C. difficile. They also correctly identified beta blockers (94.7%) as not being a risk factor. The majority of the respondents incorrectly identified foreign travel (50.7%) as a risk factor and did not identify proton pump inhibitors (70.7%) as a risk factor for C. difficile.

Table 2

Causes and Risk Factors

Question	Correct Answer	True	False
Antibiotic-related diarrhea that occurs in hospital is due to C. difficile.	False	54.7%	45.3%
By contrast to in-hospital CDAD, community-acquired C. difficile infection is not a frequent issue.	True	48%	52%
Risk Factors			
Gastrointestinal Surgery	True	72%	28%
Clindamycin	True	76%	24%
Foreign Travel	False	50.7%	49.3%
Clinically Significant Comorbidities	True	74.7%	25.3%
Proton Pump Inhibitors	True	29.3%	70.7%
Ampicillin	True	69.3%	30.7%
Recent Chemotherapy	True	77.3%	22.7%
Age >65 years	True	86.7%	13.3%
Beta Blockers	False	5.3%	94.7%

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Signs and Symptoms

Another category of questions asked the respondents about the signs and symptoms of C. difficile. The majority of the respondents (74.7%) correctly answered that bloody diarrhea does not suggest a diagnosis of C. difficile. 70.7% did not correctly identify that C. difficile is usually accompanied by a fever. A majority of the respondents (53.3%) also answered that after antibiotic use it characteristically takes about 7 days for C. difficile to appear incorrectly.

Table 3

Signs and Symptoms

Question	Correct Answer	True	False
Bloody diarrhea suggests a diagnosis of CDAD.	False	25.3%	74.7%
CDAD is usually accompanied by a fever.	True	29.3%	70.7%
After antibiotic use it characteristically takes about 7 days for CDAD to appear.	False	53.3%	46.7%

Consequences of C. difficile

A third category of questions included questions regarding the consequences of contracting C. difficile. 96% of the respondents correctly identified that C. difficile can cause multiple syndromes including pseudomembranous colitis. 92% correctly answered that C. difficile can be fatal. 98.7% correctly identified that C. difficile associated diarrhea confers lifelong immunity against C. difficile as false. 80% correctly identified

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that the recurrence of C. difficile after successful treatment is infrequent as false also. The only question that the majority answered incorrectly (68%) was that patients can be discharged after the diarrhea has ceased.

Table 4

Consequences of C. difficile

Question	Correct Answer	True	False
C. difficile can cause multiple syndromes, one of which is pseudomembranous colitis	True	96%	4%
CDAD can be fatal.	True	92%	8%
CDAD confers lifelong immunity against C. difficile.	False	1.3%	98.7%
Recurrence of CDAD after successful treatment is infrequent.	False	20%	80%
After the diarrhea has ceased the patient can be discharged.	True	32%	68%

Transmission and Prevention of Spread

A final category of questions included questions regarding the transmission of C. difficile and the prevention of its spread. 61.3% of the respondents correctly chose false for the question asking if reducing the quantity of broad-spectrum antibiotics prescribed is unlikely to reduce the incidence of C. difficile associated diarrhea because of the ongoing transmission of C. difficile spores. 85.3% of the respondents correctly identified that C. difficile is transmitted by the fecal-oral route. For the question, only those who

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come into contact with the patient's stool are able to transfer the microorganism, the majority (58.7%) answered false correctly, but 41.3% answered true incorrectly. Also for the question washing hands with alcohol gel before and after dealing with C. difficile patients prevents the spread of infection, 82.7% of the respondents answered false correctly, but 17.3% answered true incorrectly. 80% answered correctly that chlorine-containing detergents are superior to non-chlorine containing detergents in C. difficile and 80% answered false correctly the deep cleaning has not been shown to alter the number of spores remaining on environmental surfaces.

Table 5

Transmission and Prevention of Spread

Question	Correct Answer	True	False
Reducing the quantity of broad-spectrum antibiotics prescribed is unlikely to reduce the incidence of CDAD, because of the ongoing transmission of C. difficile spores.	False	38.7%	61.3%
Transmission of C. difficile is by fecal-oral route.	True	85.3%	14.7%
Only those who come into contact with the patient's stool are able to transfer the micro-organism.	False	41.3%	58.7%
Washing hands with alcohol gel before and after dealing with CDAD patients prevents spread of infection.	False	17.3%	82.7%
Deep cleaning has not been shown to alter the number of spores remaining on environmental surfaces.	False	20%	80%

Chapter 5: Discussion

Nurse Knowledge and Knowledge Deficits

The purpose of this study was to determine the knowledge nurses had regarding C. difficile and its spread. Overall, the results showed that nurses possess accurate knowledge regarding C. difficile. There were only 6 questions out of 25 that the majority of the respondents missed. There were questions missed in every category, except in the category regarding the spread of C. difficile and its transmission. In the category concerning causes and risk factors the respondents were able to identify all of the risk factors for C. difficile except for the use of proton pump inhibitors. It is extremely important for nurses to be able to identify patients who have a high chance of contracting C. difficile. Nurses need to be vigilant in looking for signs and symptoms in high-risk patients and be taking extra precautions to prevent the spread of C. difficile. The nurses who participated in this study were better at identifying risk factors than the nurses in the study by Tsagkaraki et al. (2009). The majority of the nurse respondents in the study by Tsagkaraki et al. (2009) failed to identify four risk factors including Clindamycin, Ampicillin proton pump inhibitors, and recent chemotherapy. The majority of nurses in this study only failed to identify one risk factor, proton pump inhibitors.

Nurses were knowledgeable in the category regarding the consequences of C. difficile. Their correct responses showed that the nurses had an understanding of the serious consequences of C. difficile and the importance of preventing its spread. Knowledge regarding the transmission of C. difficile and the prevention of its spread was also good. The majority of the respondents answered all of the questions in the category correctly. Although the majority of the respondents answered these questions correctly,

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there was still a percentage of the respondents that answered the questions about preventing the spread of C. difficile incorrectly. Forty-one point three percent failed to know that there are more ways to spread C. difficile other than just coming into contact with an infected patients stool. Seventeen point three percent did not know that washing their hands with alcohol gels is ineffective at preventing the spread of C. difficile. It is especially crucial that all nurses understand that alcohol gels are ineffective at killing C. difficile spores and that C. difficile can be spread from more than coming into contact with an infected patient's stool. The more nurses that understand these concepts, the better the chance at preventing the spread.

An area where knowledge was slightly insufficient was regarding the signs and symptoms of C. difficile. Out of the three questions regarding signs and symptoms, the majority got two wrong. It is important to know the signs and symptoms of C. difficile to be able to identify, prevent, and treat it early.

Overall, the results from the survey were very similar to the results from the study the survey was adapted from by Tsagkaraki et al. (2009). They found that overall knowledge among their participants was good, but there were still areas where their knowledge was lacking. The same results were found in this study. In contrast in a study completed by Aroori et al. (2009), they found that the nurses who participated in their study had significant knowledge deficits. While there were some areas where knowledge was deficient in this study, the majority of the questions were answered correctly by a large percentage of participants. The results found in this study compared to the study completed in the United Kingdom by Aroori et al. (2009) are significant because C. difficile is a continuing problem in the United States. According to the CDC cases of C.

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difficile have been increasing. The results indicated that nurses in the United States are becoming more aware of C. difficile and realizing the scope of the problem. Nurses possessing knowledge about C. difficile is one of the first step in stopping the spread.

Although overall knowledge of C. difficile was good, there is room for improvement. It was important to see where the knowledge deficits were to improve education regarding C. difficile. In this study there was only one area that showed a knowledge deficit, signs and symptoms of C. difficile. Nurses need more education regarding the signs and symptoms of C. difficile to be able to recognize the illness. Even though knowledge of C. difficile was relatively good across all of the categories, nurses could still use more education about all aspects of C. difficile, especially regarding the prevention if its spread.

Based on the results of this study it appears that nurses are knowledgeable about C. difficile. In the review of literature, there were mixed results in different studies. In comparison to the results in this study, Aroori et al. (2009) and Burnett et al. (2013) found significant knowledge deficits and a lack of understanding about C. difficile. The differing results could indicate that nurses are gaining more knowledge about C. difficile and are more aware of the problem. Two studies, one by Tsagkaraki et al. (2009) that included both doctors and nurses and one by Fayerberg et al. (2013) that included just physicians, found similar results to the current study. The participants in both studies demonstrated they possessed current knowledge about C. difficile. In congruence with the current study, the authors both concluded that although overall knowledge was good, nurses still need continuing education about C. difficile.

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Limitations

There were some limitations in this study. The first was the questions being only true/false style. This type of questions allowed the respondents to have a 50% chance of guessing the correct answer if they did not previously have the knowledge to answer the questions. If the respondents guessed on many of the questions, the results would not show a true representation of the knowledge nurses have. Another limitation was the diversity of the sample. Most of the participants who completed the survey were young, BSN graduates, with 0-2 years experience. This sample does not adequately represent all nurses in the field. A third limitation was that the participants were all graduates from various nursing programs at the same institution. The sample was not a representation of all the nurses in Mississippi in regards to educational level because most Mississippi nurses have associate degrees in nursing rather than baccalaureate and higher degrees in nursing.

Further Areas of Study

This study examined the knowledge of nurses related to C. difficile as well as areas of knowledge deficits. It can help pinpoint where education needs to be improved in regards to C. difficile. There needs to be more research regarding whether continuing education to increase knowledge can truly improve nursing practice. It is important to study if providing education to nurses about C. difficile can truly reduce transmission rates of the illness.

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Appendix A

Survey assessing knowledge of C. difficile/Clostridium difficile-associated diarrhea (CDAD):

1. Antibiotic-related diarrhea that occurs in hospital is due to C. difficile (false)
2. Bloody diarrhea suggests a diagnosis of CDAD (false)
3. CDAD is usually accompanied by a fever (true)
4. After the diarrhea has ceased the patient can be discharged (true)
5. After antibiotic use it characteristically takes about 7 days for CDAD to appear (false)
6. C. difficile can cause multiple syndromes, one of which is pseudomembranous colitis (true)

Risk factors for CDAD include:

7. Gastrointestinal surgery (true)
8. Clindamycin (true)
9. Foreign travel (false)
10. Clinically significant comorbidities (true)
11. Proton pump inhibitors (true)
12. Ampicillin (true)
13. Recent chemotherapy (true)
14. Age >65 years (true)
15. b-Blockers (false)
16. Reducing the quantity of broad-spectrum antibiotics prescribed is unlikely to reduce the incidence of CDAD, because of the ongoing transmission of C. difficile spores (false)
17. Recurrence of CDAD after successful treatment is infrequent (false)
18. CDAD can be fatal (true)
19. CDAD confers lifelong immunity against C. difficile (false)
20. By contrast to in-hospital CDAD, community-acquired C. difficile infection is not a frequent issue (true)

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21. Transmission of C. difficile is by fecal-oral route (true)
22. Only those who come into contact with the patient's stool are able to transfer the micro-organism (false)
23. Washing hands with alcohol gel before and after dealing with CDAD patients prevents spread of infection (false)
24. Chlorine-containing detergents are superior to non-chlorine- containing ones in reducing the incidence of CDAD (true)
25. Deep cleaning has not been shown to alter the number of spores remaining on environmental surfaces (false)

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Appendix B

Original Email:

To whom it may concern,

My name is Ashley Frosch and I am an undergraduate nursing and honors student at the University of Southern Mississippi. I'm currently working on my undergraduate thesis project. My research aims to assess the knowledge that nurses have about C. difficile, especially regarding preventing the spread. While searching through the literature, I came across your study, "Assessing staff knowledge about Clostridium difficile diarrhea." I am interested in using your questionnaire with a few modifications in my study. If given permission to use the questionnaire, you would be properly credited in my thesis. Let me know if you need anymore information or have any questions. If you would like to contact my thesis chair/adviser her email is kathleen.masters@usm.edu. Please let me know as soon as possible if I can have permission to use your questionnaire. Thank you for taking the time to consider my email.

Thanks again,

Ashley Frosch

Response:

Sent on behalf of Dr Gkrania-Klotsas

Dear Ashley

I am happy for you to use my questionnaire.

Regards

NURSE KNOWLEDGE OF C. DIFFICILE

Dr Effrossyni Gkrania-Klotsas
Consultant in Infectious Diseases

Helen Helen Gilson PA to the Infectious Diseases Department Ex 56637 (External
01223 256637)

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Appendix C

Demographic Survey:

5. Gender:

Male
Female

2. Age:

21-25
26-30
31-35
36-40
41-45
46-50
over 50 years

3. Education Level:

BSN
MSN
DNP
PhD

4. Years as an RN

0-2 years
3-5 years
6-10 years
over 10 years

5. Are you currently working as an RN?

Yes
No

Appendix D

IRB Approval:



INSTITUTIONAL REVIEW BOARD
118 College Drive #5147 | Hattiesburg, MS 39406-0001
Phone: 601.266.5997 | Fax: 601.266.4377 | www.usm.edu/research/institutional.review.board

NOTICE OF COMMITTEE ACTION

The project has been reviewed by The University of Southern Mississippi Institutional Review Board in accordance with Federal Drug Administration regulations (21 CFR 26, 111), Department of Health and Human Services (45 CFR Part 46), and university guidelines to ensure adherence to the following criteria:

- The risks to subjects are minimized.
- The risks to subjects are reasonable in relation to the anticipated benefits.
- The selection of subjects is equitable.
- Informed consent is adequate and appropriately documented.
- Where appropriate, the research plan makes adequate provisions for monitoring the data collected to ensure the safety of the subjects.
- Where appropriate, there are adequate provisions to protect the privacy of subjects and to maintain the confidentiality of all data.
- Appropriate additional safeguards have been included to protect vulnerable subjects.
- Any unanticipated, serious, or continuing problems encountered regarding risks to subjects must be reported immediately, but not later than 10 days following the event. This should be reported to the IRB Office via the "Adverse Effect Report Form".
- If approved, the maximum period of approval is limited to twelve months.
Projects that exceed this period must submit an application for renewal or continuation.

PROTOCOL NUMBER: 14061001
PROJECT TITLE: Nurse Knowledge of Clostridium Difficile
PROJECT TYPE: New Project
RESEARCHER(S): Ashley Frosch
COLLEGE/DIVISION: College of Nursing
DEPARTMENT: Collaborative Nursing Care
FUNDING AGENCY/SPONSOR: N/A
IRB COMMITTEE ACTION: Exempt Review Approval
PERIOD OF APPROVAL: 07/31/2014 to 07/30/2015

Lawrence A. Hosman, Ph.D.
Institutional Review Board

Appendix E

Email Sending Out Survey:

My name is Ashley Frosch and I am a senior nursing student at the University of Southern Mississippi. I am currently working on my undergraduate honors thesis project with Dr. Kathleen Masters as my thesis adviser. The project aims to discover the knowledge nurses have related to *Clostridium difficile*. Below is a link to a short true/false survey about *Clostridium difficile* that also includes a few demographic questions. The survey should only take about 5-10 minutes of your time. I would greatly appreciate it if you took the time to complete the survey. The survey can be found at: <https://www.surveymonkey.com/s/978NT9M>.

All data collected will remain anonymous, which means that responses are not tied to email addresses or identities. The study is entirely voluntary and you can end the survey at any time by pressing the survey complete button or send. Please refrain from looking up answers and use only your current knowledge to complete the survey. Please complete the survey by August 31, 2014. Completion of the survey will constitute informed consent. Permission for this project was obtained from the USM Institutional Review Board (IRB) and if you have any questions contact them via IRB@usm.edu. If you have any additional questions please contact me at ashley.frosch@eagles.usm.edu. Thank you for your time and participation.

Thanks again,

Ashley Frosch