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The Role of Education and Training on Enhancing Nurses Compliance with Clostridium Difficile Infection Care Bundle

Asmaa Ibrahiem Rateeb[1], Mervat Anwer Abd Elazize[2] & Manal Mohammed Abd Elnaeem[3]
[1.] Nursing Specialist at Al-Azhar Hospital in Assiut, Egypt.
[2.] Professor of Critical Care and Emergency Nursing, Faculty of Nursing, Assiut University, Egypt.
[3.] Assistant Professor of Critical Care and Emergency Nursing, Department Faculty of Nursing, Assiut University, Egypt.

Abstract:
Background: Clostridium difficile infection remains a significant challenge among nosocomial infections due to its evolving nature, posing critical issues for healthcare professionals. **Aim of the Study:** To evaluate the Role of Education and Training on Enhancing Nurses Compliance with Clostridium Difficile Infection Care Bundle**, Research Design:** A quasi-experimental study utilizing a pretest-posttest design. **Setting:** Intensive care units at Assiut University Hospital. **Sample:** A convenient sample of 60 critical care nurses working in the specified setting, assessed at two points—before and after implementing **the educational program. Tools: Tool I:** Demographic data of nursing staff. **Tool II:** Compliance with the Clostridium difficile infection care bundle. **Results:** Nurses' compliance with the Clostridium Difficile Infection care bundle showed a significant improvement in **Mean ± SD scores (8.0 ± 2.5 vs. 13.3 ± 2.2).** Before the educational program, the compliance level was **poor (66.7%),** while after the program, it reached a **good level (65.0%),** with a statistically significant difference (**P-value = .001**). **Conclusions:** The educational program significantly enhanced nurses' compliance with Clostridium difficile infection control practices. **Recommendation:** Regular education and training for all Intensive Care Unit nurses at Assiut University Hospital on the Clostridium Difficile Infection care bundle are essential to reduce Clostridium difficile infection rates in the Intensive Care Unit .

Keywords: Clostridium difficile, Critical Care Nurses, Infection Control & Prevention

Introduction
Clostridium difficile (CDI) is a gram-positive spore forming anaerobe associated with infection ranging from mild-moderate diarrhea to severe disease Clostridium difficile **(Adelman, et al. (2021)** C**.** Difficile infection case is defined as clinically significant diarrhea (unformed stools and abdominal cramping or toxic megacolon with no other identified etiology and presence of at least one or more of the following criteria **(Ahmadipour, et al. (2022)** Unformed stool sample (conforming the shape of container) positive for C. difficile toxin A and/or B production or detection of toxigenic C. difficile strain by culture or other methods, pseudomembranous colitis on endoscopic examination or surgery and detected on histopathology. **(Albougami, & Banawas, (2024).)**

Pathogens of Clostridium difficile infection (CDI) is fecal oral organism and CDI is spread via the fecal oral route, patient ingest the bacteria into their stomachs **(R.M, et al 2008)** C. Difficile symptoms are severe diarrhea, fever, colitis (an inflammation of the colon, toxic megacolon (a dilated colon that may be accompanied by septic shock), stomach tenderness or pain, loss of appetite, nausea and, in some cases, death. The C. difficile bacterium colonizes in the large intestine. In infected patients, toxins produced by the organism cause CDI symptoms, primarily diarrhea and colitis **(Schoyer et al. 2011)**

C. Difficile complications as pseudomembranous colitis, toxic megacolon, and death. **(Schoyer, et al. 2017)**

Risk factors for CDI are Advanced age (>64 years), Antimicrobial use in past 3 months, Prolonged hospitalization, Immunocompromised patient, HIV/AIDS, ongoing chemotherapy and Concomitant co-morbidities e.g., Inflammatory bowel disease (IBD) **Bahegwa, et al. (2022)** history of CDI, , cancer, stools characteristic of CDI (elevated WBC, fever, cramping or abdominal pain.) (**Bahegwa, et al. (2022)**

Environmental contamination with C. difficile plays an important role in the transmission of CDI. Contaminated environmental surfaces, especially high-touch surfaces (e.g. bed rails, call buttons, tray tables) and soiled surfaces (e.g. bedpans, commodes), have been identified as the main reservoirs for pathogen transmission through direct patient contact or indirect contact via the hands of healthcare providers **(Chau, et al. (2020)** the risk of hand contamination with C. difficile after contact with contaminated environmental surfaces was equivalent to the risk after contact with the skin of patients with CDI**. (Chau, et al. (2020)** patient with Clostridioides

difficile (C. diff) infection needs education on **proper hand hygiene, Environmental cleaning bundles , medication management, and infection control measures.** This includes understanding how the infection is spread, the importance of adhering to prescribed medications, and how to prevent future infections. Family members and caregivers should also be educated on these aspects to support the patient's recovery and prevent transmission **(Ahmadipour, et al. (2022)**

Hand hygiene is a critical aspect of the clinical care of a patient with a CDI that can mitigate transmission of the pathogen to others. It is important for nurses to perform hand hygiene to prevent C. difficile spores from reaching patients. Donning gowns and gloves before entering the patients' rooms can also be an effective barrier method. The use of disposable thermometers for patients who have CDI can reduce the spread of CDI **(Ahmadipour, et al. (2022)**

The environmental cleaning bundles were delivered by healthcare workers, such as nurses and microbiologists, environmental services departments, infection control units or multidisciplinary. It is important for nurses to understand the diagnosis and treatment of CDI as it is the leading cause of hospital-associated illness affecting the health care system **Chau, et al. (2020)** Medication Management Patients who are experiencing high- volume diarrhea with a recent history of antibiotic exposure should be presumed to have CDI. Stool specimens should be collected to verify the presence of the pathogen. Stringent contact precautions and hand hygiene should be implemented to prevent the transmission of the pathogen.

Bundles and protocols have become standard practice in a variety of inpatient settings, with pre-printed order sets and care pathways being shown to improve patient outcomes for common admission diagnoses. Bundles used in critical care nursing have been associated with varying degrees of benefit, compared with usual care. Care bundle is a simple tool used to improve reliability in care delivery. Elements of the care bundle must be evidenced based. It can be used for different conditions or treatments and adapted locally. Interventions of care bundle when implemented collectively and consistently, they will result in significantly better outcomes than when implemented individually **Ngam, et al. (2017)** Compliance in ICU nursing is crucial for patient safety and positive patient outcomes. It involves adhering to established protocols, guidelines, and best practices to minimize risks and ensure consistent, high-quality care. Non-compliance can lead to increased risk of infections, medication errors, and other adverse events, negatively impacting patient well-being and potentially increasing healthcare costs **(Vicent Bankanie , et al 2021)**

Significance of the study

Clostridioides Difficile has been recognized as a leading cause of healthcare-associated infections (HAIs) and a substantial threat to public health globally the CDI incidence rate ranges from 1.1 to 631.8 per 100,000 population per year globally it is associated with substantial morbidity and mortality worldwide **(Finn et al., 2021).**

Aim of the Study:

The Role of Education and Training on-Enhancing Nurses Compliance with Clostridium Difficile Infection Care Bundle

Research Question:

What is the impact of an educational program on ICU nurses' compliance with Clostridium difficile infection control care bundles?

Study Design:

A quasi-experimental study employing a pretest-posttest design utilized to conduct the current research.

Setting:

The study was conducted in the intensive care units of Assiut University **Hospital**, which includes several specialized units. The general ICU has 16 beds distributed across four separate rooms, with 8 head nurses, 40 nurses, and 4 assistant nurses, maintaining a nurse-to-patient ratio of 1:3. The trauma ICU also has 16 beds in three separate rooms, staffed by 5 head nurses, 28 nurses, and 6 assistant nurses, with the same nurse-to-patient ratio of 1:3. The anesthesia ICU consists of 12 beds in three separate rooms, with 7 head nurses, 35 nurses, and 4 assistant nurses, and a nurse-to-patient ratio of 1:2. Finally, the allergy ICU has 11 beds in two separate rooms, staffed by 2 head nurses, 20 nurses, and 4 assistant nurses, also with a nurse-to-patient ratio of 1:2. These units are all critical care environments, providing specialized care to patients requiring intensive monitoring and treatment.

Sampling:

A total of 60 critical care nurses were selected through a convenience sampling method from the intensive care units of Assiut University Hospital**,** the sample size for this study was calculated using **G*Power** software, a widely used statistical tool for power analysis in research. The calculation considered the expected effect size, significance level ($\alpha = 0.05$), and desired power ($1-\beta = 0.80$). Based on these parameters, The selected nurses were assessed at two time points: once before the implementation of the educational and training program and again after its completion. The G*Power analysis confirmed that the sample size was sufficient to detect a significant difference in nurses' compliance with Clostridium

difficile infection control practices, ensuring adequate statistical power for the study. The inclusion criteria for the study required that participants of head nurse and nurses working in the intensive care units, including both male and female nurses. Nurses who refused to participate were excluded from the study.

Tools for Data Collection

Data collection was carried out using two primary tools. **The first tool** will gather the demographic data of ICU nurses, including age, gender, marital status, educational level, and years of experience. This was provided insight into the characteristics of the sample. **The second tool** was developed by the researcher based on an extensive review of literature **(CDC, 2016 & CDC, 2018),** to assess the adherence and compliance of ICU nurses regarding infection control bundles which consisted of two parts as following , Part 1: Nursing staff's demographic data , This part was included ICU nurse's demographic data such as age, gender, marital status, educational level and experience, Part 2: Adherence of nursing staff to bundle assessment sheet The components of the care bundle will be scored as follows**:** (0) not done, (1) done incorrectly**,** and (2) done correctly**.** The adherence level will be evaluated based on the total score: a score less than 60% indicates poor score between 60–75% indicates fair, and a score **above** 75% indicates good. This approach will help assess the effectiveness of the educational program in improving compliance with infection control practices.

Preparatory Phase:

Approval from the ethical committee of the Faculty of Nursing, Assiut University Hospitals, was obtained. Official permission to conduct the study was granted by the administrative authorities of the mentioned settings after explaining the aim of the study. The current study followed common ethical principles in clinical research and was approved by the local ethics committee.

Validity and Reliability*:*

The validity of the Clostridium difficile infection care bundle tool was established through 5 expertise reviews in critical care nursing and infection control, ensuring it accurately measures adherence to infection control practices. Content validity was confirmed by aligning the tool's components with global health standards, such as those from the CDC, while construct validity was ensured by aligning the tool with theoretical infection control compliance frameworks. These methods are consistent with those demonstrated by **(Taherdoost ,2019)**, who validated healthcare practice tools through expert reviews and alignment with clinical guidelines. The reliability of the tool was assessed using both the test-retest method and internal consistency (Cronbach's alpha), ensuring consistent measurement of infection control adherence over time. In previous studies, such as those conducted by **(Taherdoost ,2019**), Cronbach's alpha was used to assess the reliability of similar tools, confirming their strong reliability in measuring adherence to infection control practices. Additionally**, a pilot study with 10% of (3 nurses) the sample to assess the clarity and applicability of the tool in ICU settings not included , Based on the findings, necessary modifications were made to ensure stable and reliable results.**

Ethical principles:

- The Research was approved from Ethical Committee in the Faculty of Nursing Assiut university in 30 August 2021 , session number 32 with serial number 317
- In this study, we followed the ethical principles in the Declaration of Helsinki and its updates.
- Research proposal was approved from Ethical Committee in the Faculty of Nursing.
- There was no risk for study subject during application of the research.
- Informed consent was obtained from nurses in this study, after explaining the nature and purpose of the study.
- Confidentiality and anonymity was assured.
- Nurses have the right to participate, refuse and or withdraw from the study without any rational at any time.
- Study subject's privacy was considered during collection of data.

Field Work:

- The data were collected in **a six-month period, from September 2021 to February 2022**.
- The session done **on the morning shift,** and taking about

Theoretical approach include: -

1- C, Difficile definition
2- C. Difficile signs and symptoms
3- Risk factor and complication

Practical approach include:

CDI care bundle **(hand hygiene** (five moment of hand hygiene)**-Donning and Dofing PPE-environmental and equipment cleaning–various care bundle as PVC,CVC,VAP,UC,SSI)**

- The session was divided into 3 sessions weekly in each nurse group , the each nurse group consist of 6 nurses ,so total groups were 10 groups and total sessions were 30 sessions and the one session was taking 20 minutes .
- Data collection from nurses **started with the initial assessment of nursing staff interacting with patients** to evaluate their adherence levels regarding infection care bundles.

Implementation Phase:

- Once the sample of ICU nurses meeting the research criteria was identified, the researcher initiated the data collection process.
- During the **initial interview** on the Morning shift the researcher introduced himself to establish rapport and begin communication with the nursing staff. The first tool, **Tool 1: Nursing Staff's Demographic Data**, was used to collect basic information about the participants. Following this, **Tool 2** was utilized to assess the nurses' **baseline knowledge and practices** regarding Clostridium difficile infection (CDI) control prior to the educational intervention.

The **educational program** was then delivered to the nursing staff, focusing on key aspects of CDI. The program included information on **risk factors for acquiring CDI**, are Advanced age (>64 years), Antimicrobial use in past 3 months, Prolonged hospitalization, Immunocompromised patient, HIV/AIDS, ongoing chemotherapy and Concomitant co-morbidities e.g., Inflammatory bowel disease (IBD)**,** history of CDI, , cancer, stools characteristic of CDI (elevated WBC, fever, cramping or abdominal pain.) **modes of transmission of CDI** there are direct method as fecal oral route meaning the bacteria or its spores are ingested after contact with contaminated feces or indirectly through contaminated surfaces ,equipment , or other hands of health care workers .

and the **importance of using barrier precautions** such as gloves and gowns. Additionally, the significance of **strict hand hygiene practices** was emphasized to enhance infection control measures.

- The nurses were also educated on the **implementation of the CDI care bundle**, which outlines essential practices to follow when caring for patients diagnosed with Clostridium difficile infection. These care bundle are **Make hand hygiene with soap and water effectively, Effective environmental cleaning with sporicidal agent leaves no spore behind**, **Antibiotic stewardship** that includes avoiding certain antibiotics and proton pump inhibitor while promoting probiotic , **Diagnostic testing** with the purpose to confirm C. Difficile diagnosis diarrhea >3 liquid stools in 24 hours , **Equipment cleaning with sporicidal agent**, **Donning and doffing PPE and gloves** the right way when using standard and contact precaution , **Minimize number of patient s per room**
- aimed to improve the overall management and reduction of CDI transmission within the ICU.
- Throughout the implementation phase, the researcher ensured active engagement and addressed any questions or concerns from the nursing staff to maximize the effectiveness of the educational program.

Evaluation Phase:

- The **same group of ICU nurses** was evaluated **both before and after** the implementation of the educational program to monitor changes in their adherence levels to infection control bundles, particularly the **CDI care bundle** for the prevention of Clostridium difficile infection (CDI).
- The researcher conducted a **comparison of the nurses' adherence levels** to the infection control bundles, focusing specifically on the **CDI care bundle**, before and after the educational program. This evaluation aimed to assess the **impact of the educational intervention** on the nurses' practices and the effectiveness of the program in improving adherence to the recommended infection control protocols for CDI prevention.
- The evaluation outcomes were analyzed to identify any **significant improvements** in the adherence to best practices, as well as any areas where further reinforcement may be needed. This process was crucial for determining the overall success of the educational program and its potential for sustaining changes in infection control behavior within the ICU setting.

Statistical Design:

- The obtained data was **carefully reviewed and prepared** for computer entry. The data was then **coded**, **categorized**, **analyzed**, and **tabulated** to ensure it was organized for subsequent analysis.
- The researcher employed an **appropriate statistical method** and tests for analyzing the results. The **Statistical Package for Social Sciences (SPSS) software, version 26**, was utilized for data analysis.
- **Descriptive statistics** including **frequencies**, **percentages**, **mean**, **standard deviation**, **Pearson correlation coefficients**, **paired sample t-test**, and **Chi-square tests** were conducted using SPSS. These methods were applied to both **quantitative and qualitative data** to assess and determine **statistical significance**.
- The **critical value of the tests** was considered **statistically significant** when the **P-value** was less than **0.05**, indicating that the findings were unlikely to have occurred by chance.

Result:

Table(1): Distribution of the studied nurses according to their demographic characteristics (n=60)

Demographic data	No	%
Age (Mean±SD)	**35.4 ± 9.0**	
20 - 30 years	28	46.7
> 30 - 40 years	18	30.0
> 40 -50 years	9	15.0
> 50 - 60 years	5	8.3
Gender		
Male	18	30.0
Female	42	70.0
Level of education		
secondary school of Nursing	23	38.3
Nursing Technical Institute	34	56.7
Bachelor of Nursing	3	5.0
Marital status		
Single	9	15.0
Married	46	76.7
Divorced	5	8.3
Years of experience (Mean±SD)	11.1 ± 8.7	

Frequencies (number and percent).

Table (2): Distribution of CDI care bundle items before and after education (n=60)

Items of CDI care bundle		Pre N (%)	Post N(%)	P-value
1. Make hand hygiene with soap and water effectively and is vital as alcohol-based hand sanitizer are not effective against C.difficile spores	Not done	7 (11.7)	4 (6.7)	.007**
	Done incorrect	36 (60.0)	22 (36.7)	
	Done correct	17 (28.3)	34 (56.7)	
2. Effective environmental cleaning with sporicidal agent leaves no spore behind.	Not done	0 (0.0)	0 (0.0)	
	Done incorrect	50 (83.3)	22 (36.7)	.001**
	Done correct	10 (16.7)	38 (63.3)	
3. Appropriate antibiotic use (minimize the use of antibiotics that increase the risk of CDI) such as certain fluoroquinolones ,cephalosporings	Not done	20 (33.3)	3 (5.0)	.001**
	Done incorrect	27 (45.0)	21 (35.0)	
	Done correct	13 (21.7)	36 (60.0)	
4. Diagnostic testing with purpose to confirm C diff diagnosis. Diarrhea ≥ 3 liquid stools in 24 hrs.	Not done	9 (15.0)	6 (10.0)	.001**
	Done incorrect	39 (65.0)	4 (6.7)	
	Done correct	12 (20.0)	50 (83.3)	
5. Equipment cleaning with sporicidal agent between each patient every time.	Not done	17 (28.3)	0 (0.0)	.001**
	Done incorrect	27 (45.0)	14 (23.3)	
	Done correct	16 (26.7)	46 (76.7)	
6. **Donning PEE as gown** (fully cover torso from neck to knee ,arms to end of wrists ,and wrap around the back – fasten in the back of neck and waist) **Mask** (secure ties or elastic bands at middle of head and neck – fit flexible band to nose bridge -fit snug to face and below chin -fit check respirator) **gloves** (extend to cover wrist of isolation gown) **7. and doffing PPE gloves ,goggles , gown , mask**	Not done	11 (18.3)	3 (5.0)	.001**
	Done incorrect	36 (60.0)	20 (33.3)	
	Done correct	13 (21.7)	37 (61.7)	
8. Implementing contact precautions (isolation of patients with CDI)	Not done	26 (43.3)	0 (0.0)	.001**
	Done incorrect	18 (30.0)	12 (20.0)	
	Done correct	16 (26.7)	48 (80.0)	
9. Educate patient how to wash hand and when to perform, also signs and symptoms of CDI.((wet your hand with clean running water , apply soap and rub your hands together for at least 20 seconds , rinse your hand until the soap is gone , turn off the faucet with paper towel , dry your hands with clean paper towel or hand towel)	Not done	16 (26.7)	7 (11,7)	.001**
	Done incorrect	28 (46.7)	6 (10.0)	
	Not done	16 (26.7)	47(3,7)	

*Chi-square test, * statistically significant difference (p<0.05), ** highly statistically significant difference (p<0.01).*

Table (3): Level of Nurses compliance For CDI infection control care bundle before and after implementation of education and training program (n=60

CDI care bundle	Pre	Post	P-value
Categories			
Poor	40 (66.7%)	3 (5.0%)	.001**
Fair	17 (28.3%)	18 (30.0%)	
Good	3 (5.0%)	39 (65.0%)	

*Chi-square test, * statistically significant difference (p<0.05), ** highly statistically significant difference (p<0.01).*

Table (4): Percentage distribution of nurse compliance about various care bundles categories before and after education (n = 60):

Care bundle	Categories	Pre	Post	P-value
Personal and environmental infection prevention and control	Poor	28 (46.7)	3 (5.0)	.001*
	Fair	29 (48.3)	12 (20.0)	
	Good	3 (5.0)	45 (75.0)	
PVC care bundle	Poor	32 (53.3)	3 (5.0)	.001*
	Fair	21 (35.0)	32 (53.3)	
	Good	7 (11.7)	25 (41.7)	
CVC care bundle	Poor	30 (50.0)	0 (0.0)	.001*
	Fair	23 (38.3)	18 (30.0)	
	Good	7 (11.7)	42 (70.0)	
VAP care bundle	Poor	36 (60.0)	3 (5.0)	.001*
	Fair	17 (28.3)	7 (11.7)	
	Good	7 (11.7)	50 (83.3)	
UC care bundle	Poor	38 (63.3)	3 (5.0)	.001*
	Fair	19 (31.7)	15 (25.0)	
	Good	3 (5.0)	42 (70.0)	
SSI care bundle	Poor	40 (66.7)	0 (0.0)	.001*
	Fair	17 (28.3)	15 (25.0)	
	Good	3 (5.0)	45 (75.0)	
CDI care bundle	Poor	40 (66.7)	3 (5.0)	.001*
	Fair	17 (28.3)	18 (30.0)	
	Good	3 (5.0)	39 (65.0)	

Chi-square test. ** Statistically significant difference (p<0.05).*

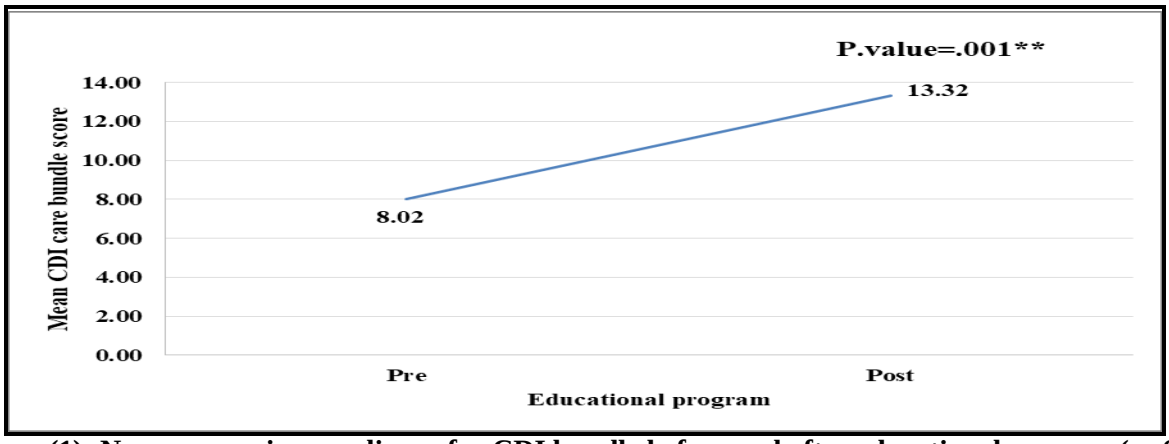

Figure (1): Nurses score in compliance for CDI bundle before and after educational program(n=60)

Table (1): Presents the demographic characteristics of the nursing staff (n=60) had a **mean age** of **35.4 ± 9.0 years**, with most nurses (46.7%) falling in the **20-30 years** age group. The sample was predominantly **female** (70.0%), and **56.7%** graduated from the **Nursing Technical Institute**. The majority of nurses were **married** (76.7%), and the **mean years of experience** was **11.1 ± 8.7 years**, indicating varied professional experience levels within the group.

Table (2): Show significant improvements in nurses' adherence to the **CDI care bundle** after the educational intervention. Key improvements include

hand hygiene (correct practices increased from 28.3% to 56.7%), environmental cleaning (correct practices increased from 16.7% to 63.3%), antibiotic stewardship (correct practices increased from 21.7% to 60.0%), and diagnostic testing for C. difficile (correct practices increased from 20.0% to 83.3%). Additionally, nurses' equipment cleaning practices improved from 26.7% to 76.7%, PPE usage from 21.7% to 61.7%, patient room management from 26.7% to 80.0%, and patient education on hand hygiene from 26.7% to 78.3%. All changes were statistically significant (P <0.01), highlighting the positive impact of the educational program on infection control practices.

Table (3): Highlights a significant improvement in nurses' compliance with the **CDI care bundle** following the educational program. Prior to the education, 66.7% of nurses had poor compliance, and only 5.0% had good compliance. After the educational intervention, 65.0% of nurses achieved good compliance, while poor compliance dropped to 5.0%. This change was statistically significant (P = .001**), demonstrating the effectiveness of the program in enhancing adherence to CDI infection control practices.

This table (4): Shows percentage distribution of various care bundles categories before and after education. There is significant difference (P- value .001*) between categories of these bundles before and after application of educational program, because the highest percentages presented after implementation of this program. This table with figure (1), both demonstrate that more than half (66.7%) of nurses had poor practice before education, but after about (65.0%) of these nurses had good practice .

Figure (1): Presents the nurses' compliance scores for the **CDI care bundle** before and after the educational program. Prior to the educational intervention, the average compliance score was 8.02. After the program, the compliance score significantly increased to 13.32, indicating a notable improvement in nurses' adherence to the CDI care bundle practices.

Discussion:

Clostridium difficile (CDI) is the most prevalent pathogen among healthcare-associated infections and is identified by the Centers for Disease Control and Prevention (CDC) as one of the top three urgent threats to public health. Despite its recognition as a critical concern, there remain significant gaps in nursing practice, particularly regarding infection control protocols. Our research aimed to address and reduce these gaps by improving nursing adherence to the CDI care bundle through an educational intervention. **(R.M, et al 2008)**

A key area of concern before the educational program was the practice of hand hygiene with soap and water. More than half of the nurses were found to perform hand hygiene incorrectly. We hypothesize that this is largely due to inaccurate knowledge and improper practice. This finding is supported by **(Hillier, 2020),** who stated that hand hygiene compliance is influenced by several factors, including proper education, technique, psychological barriers, environmental factors, and leadership. These elements contribute to the complexity of hand hygiene compliance, highlighting the need for targeted education to improve practice.

Similarly, many nurses were not performing environmental cleaning effectively. The hypothesis here is that ineffective cleaning practices were due to a lack of knowledge about appropriate disinfectants and cleaning techniques. **(**reported that nurses were unclear about how to properly handle equipment and sterilize surfaces, and **(Chau et al., 2020)** emphasized the importance of training and education for healthcare staff regarding infection control procedures. These findings suggest that an education-focused approach could enhance nurses' understanding and practice of effective environmental cleaning.

Antibiotic stewardship was another area where compliance was lacking. Less than half of the nurses were able to avoid certain antibiotics as part of appropriate stewardship. This gap can be attributed to insufficient support for nurses and a lack of comprehensive staff education on the topic. **(Fitzpatrick et al. 2021)** noted that knowledge gaps and a lack of collaboration between doctors and nursing staff were significant barriers to effective antibiotic stewardship. Thus, fostering a collaborative environment and enhancing education on this subject are essential to improving antibiotic management.

Regarding diagnostic testing for CDI, more than half of the nurses did not correctly understand when and how to use diagnostic testing to confirm a CDI diagnosis. emphasized that healthcare staff must be educated about the full scope of CDI, including treatment, prevention, diagnosis, transmission, and epidemiology, to ensure proper diagnostic practices. This gap in knowledge underlines the necessity of incorporating CDI-related information into staff education programs to improve clinical decision-making. **(Cecile Gateau, et al 2018)**

In terms of cleaning equipment between patients, less than half of the nurses demonstrated correct practices. This issue was primarily attributed to a lack of cleaning supplies and insufficient knowledge about proper disinfection protocols. According to **(Birlie et al. 2021)**, many nurses' cleaning practices were suboptimal, often due to inadequate training, lack of

proper supplies, and carelessness. These findings highlight the need for better training and resource allocation to improve cleaning practices.

Donning and doffing personal protective equipment (PPE) was another area where non-compliance was observed. More than half of the nurses were found to wear PPE incorrectly, which was attributed to inadequate training and the time-consuming nature of PPE use. **Shalika Hegde, et al., (2020)** identified the length of time required for putting on and removing PPE as a barrier to compliance. This suggests that improving PPE-related training and streamlining the process could contribute to better adherence to infection control practices.

Furthermore, many nurses did not minimize the number of patients per room, which is a crucial measure for preventing the spread of CDI. Less than half of the nurses followed this guideline, primarily due to a lack of isolation rooms in the hospital. **(Legeza et al. 2018**) found that infrastructure limitations, including insufficient isolation rooms, hindered infection prevention efforts. Addressing these infrastructure issues, such as expanding isolation capacities, is essential to enhance compliance with this important practice.

In terms of patient education, less than half of the nurses were able to correctly educate patients about hand hygiene and the signs and symptoms of CDI. This gap can be attributed to work overload and time constraints. **(Falk et al. 2019)** discussed the challenges faced in resource-limited environments, where the emphasis on medical care often left little time for patient education. This highlights the need to prioritize patient education and allocate sufficient time for nurses to effectively communicate prevention and treatment strategies for CDI.

Data collection will be carried out using two primary tools. **The first tool** will gather the demographic data of ICU nurses, including age, gender, marital status, educational level, and years of experience. This will provide insight into the characteristics of the sample. **The second tool** was developed by the researcher based on an extensive review of literature **(CDC, 2016 & CDC, 2018),** to assess the adherence and compliance of ICU nurses regarding infection control bundles which consisted of two parts as following , **Part 1:** Nursing staff's demographic data , This part was included ICU nurse's demographic data such as age, gender, marital status, educational level and experience, **Part 2:** Adherence of nursing staff to bundle assessment sheet The components of the care bundle

Finally, in terms of overall compliance with the CDI care bundle, there was a marked improvement in nurse adherence following the educational program. Similar findings were reported by **(Lovely 2020)**, who noted that staff education significantly enhanced the knowledge and practice of nursing staff regarding the CDI care bundle. This study reinforces the effectiveness of educational interventions in improving infection control practices and suggests that ongoing education is crucial for maintaining high standards of care.

Conclusion:

Our research demonstrates that educational interventions can effectively improve nurses' compliance with the CDI care bundle, addressing key gaps in knowledge and practice. The findings highlight the importance of continuous education, adequate resources, and improved collaboration between healthcare professionals to optimize infection control practices and reduce the burden of healthcare-associated infections like CDI. Future research should focus on the long-term sustainability of these improvements and the impact of enhanced compliance on patient outcomes.

Recommendation:

Based on our findings, it is recommended to enhance nurses' awareness by providing targeted education and training within intensive care units. Emphasis should be placed on the critical importance of strict adherence to the Clostridium difficile infection (CDI) care bundle. This approach will help reduce the risk of complications, promote effective infection control practices, and ultimately improve the overall quality of care provided to patients.

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