

*Original article*

## The knowledge of nurses about prevention of infections caused by the bacteria *Clostridium difficile*

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### Summary

**Introduction.** *Clostridium difficile* is the leading cause of nosocomial diarrhea, associated with the use of antibiotics. The most common ways of transmitting the infection in hospitals are contaminated surfaces of the premises and the hands of medical staff.

**Methods.** The study involved 68 nurses/technicians employed at the University Hospital Foca in the departments of surgery and internal medicine. As a research instrument, we used a specially designed questionnaire, created by the authors for the purpose of this research.

**Results.** The research showed that 61.8% of respondents knew that hand washing with warm water and soap was considered the most effective prevention of the spread of infections, and 55.88% meant that they used chlorine-based preparations and hydrogen peroxide as the only effective disinfectant. Nurses with a work experience of less than 5 years showed better knowledge than other groups.

**Conclusion.** The knowledge of nurses about the prevention of *C. difficile* infection is not at a satisfactory level, which indicates the growing need for education of nurses.

**Key words:** *Clostridium difficile*, nurses' knowledge, nosocomial infections

## Introduction

*Clostridium difficile* (*C. difficile*) is an anaerobic Gram-positive, sporogenic bacterium present in the soil and colon of the digestive tract of animals, healthy children and adults up to 5% of the microflora. It is excreted in the host's stool, and the infection is caused by spores present in the human digestive tract or by ingestion of spores and vegetative forms of the bacterium, contaminated food, water, and by dirty hands. Studies published so far indicate that *C. difficile* in most cases causes infections in hospitalized patients. The most common routes of transmitting the infection in hospitals are contaminated hospital surfaces and hands of medical staff [1].

Clostridium difficile infection (CDI) is acquired by ingestion of spores, usually transmitted from other patients, through the hands of medical staff and contaminated surfaces [2]. The spores of this bacterium are resistant to stomach acidity, so they can germinate into a vegetative form in the small intestine. Disruption of the normal intestinal flora, usually by exposure to antibiotics, allows *C. difficile* proliferation, causing a wide range of clinical manifestations that can range from asymptomatic colonization, diarrhea of varying severity to fulminant colitis, and even death [3]. Manifestations of CDI are abdominal pain and cramps, profuse diarrhea (mucous, dirty-green, watery stools with unpleasant odor) with fever and leukocytosis, and life-threatening complications such as pseudomembranous colitis, toxic megacolon and colon perforation [4]. CDI usually manifests a few days after taking antibiotics [1].

The topic of knowledge of health professionals about CDI has not been much covered in the professional literature, so there was not much data to compare the knowledge of nurses at the University Hospital in Foca. So far, there is no standardized questionnaire on nurses' knowledge of CDI.

## Methods

The research was conducted as an observational cross-sectional study, in which 68 nurses and technicians participated, including interns (volunteers), at the University Hospital in Foca, employed in the departments of internal medicine and surgery. The study included nurses/ technicians who were at work on the days of the study and who gave their voluntary consent to participate in the study. The study was conducted in the period from June to October 2018.

A specially designed questionnaire, developed by the authors for the purposes of this research, was used to assess the knowledge of

nurses/technicians about CDI prevention. The questionnaire contained 16 multiple-choice questions.

Computer processing of the data was performed using the Statistical Package for the Social Sciences (SPSS) version 20. Data are presented as percentages (%). The Chi-square test was used to determine knowledge about prevention in relation to work experience.

## Results

The study involved 68 nurses and technicians, 39 from surgery and 29 from the internal medicine department. The total ratio of technicians and nurses was 19:49 or 27.9% of medical technicians and 72.1% of nurses.

The research involved nurses/technicians with different levels of education and different lengths of work experience. In the surgery department there were 29 nurses with high school, 1 nurse with higher school and 9 nurses with the university degree, while in the internal department there were 19 nurses with high school and 10 nurses with the university degree, there were no nurses with higher school.

There were 13 nurses with work experience of up to 5 years, 13 nurses with work experience of 5–10 years and 13 nurses with work experience of over 10 years, while the internal medicine department had 16 nurses with work experience of up to 5 years, 3 nurses with work experience of 5–10 years and 10 nurses with work experience over 10 years.

We have to mention that not all employees from these departments participated in the survey, so the data presented were obtained exclusively from survey participants.

During the survey, we found that 8.8% of respondents thought that *Clostridium difficile* causes urogenital infections, 7.4% thought that it causes wound infections, 5.9% thought that it causes respiratory infections, while 77.9% knew the correct answer or that *Clostridium difficile* causes infections of the gastrointestinal tract.

By processing the data, we have found that 10.3% of respondents think that *Clostridium difficile* infection is transmitted by droplets, 7.4% of them think that it is transmitted by blood, while 82.4% of respondents have an opinion that it is transmitted by fecal-oral route, which is the correct answer.

Among the respondents, 41 of 68 of them knew that all the listed antibiotics (cephalosporins, penicillins, fluoroquinolones and clindamycin) could be associated with the occurrence of CDI, which is 60.29% of the participants in the study. We received the most correct answers from the group of employees with work experience shorter than 5 years, which makes as many as 72.41% of respondents from this group. While 43.75% of employees with work experience from 5 to 10 years gave the correct answer, and the employees with work experience over 10 years, or 56.52% gave the correct answer.

In Table 1 we can see that only 36.8% of respondents know the correct answer, that the most successful preventive measure for the occurrence of CDI is the correct use of antibiotics. Also, 5.9% of respondents consider that the most successful preventive measure is the use of gloves during the examination of patients, hand washing 8.8%, preventive use of metronidazole 10.3%, and all of the given answers 38.2%.

By processing the data, we came to the conclusion that 10.3% of respondents thought that the most effective measure to prevent the spread of infection in hospital conditions was wearing gloves while working with patients, 7.4% believed that it was hand disinfection with alcohol-based disinfectants, 61.8% were aware that the most effective prevention of spreading CDI was washing hands with warm water and soap, while 20.6% thought that all of the offered answers were correct.

We also obtained data that 38 out of 68 subjects knew that the best disinfectant for the prevention of CDI was chlorine and hydrogen peroxide-based disinfectants, which is 55.88%

of the participants. On this question, we received as many as 21 correct answers from employees whose work experience is shorter than 5 years, which makes 30.88% of all correct answers.

28 respondents or 41.2% knew that oral metronidazole was used as the first drug of choice.

Only 2.9% of respondents did not link the beneficial properties of probiotics during or after antibiotic therapy and do not recommend it to patients, 26.5% believed that it was sometimes recommended to give probiotics to patients during or after antibiotic therapy, while 70.6% of respondents believed that the use of probiotics was recommended with or after antibiotic therapy.

**Table 1.** Nurses' knowledge on the most successful CDI prevention measure

| The most successful preventive measure   | CDI Respondents |
|--|-----------------|
| Proper use of antibiotics                | 36.8            |
| Use of gloves during patient examination | 5.9             |
| Hand washing                             | 8.8             |
| Preventive use of metronidazole          | 10.3            |
| All of the above                         | 38.2            |

## Discussion

*Clostridium difficile* is an anaerobic, sporogenic, gram-positive bacillus. It is the main cause of antibiotic-associated diarrhea, which is prevalent in hospital settings. Morbidity and mortality from CDI increased significantly due to the emergence of hypervirulent strains. Due to the poor clinical distinction between CDI and other causes of hospital-acquired diarrhea, a laboratory test for *C. difficile* is a very important intervention for the diagnosis of CDI [5]. Observing the

results of this research, we could notice that 77.9% of nurses and technicians knew what type of infection was caused by *Clostridium difficile*, or that they were infections of the gastrointestinal system. While as many as 82.4% were familiar with the route of CDI spread, or that it was a fecal-oral route of spread.

In 2012, Brady and colleagues published a paper on creating a standardized questionnaire to assess knowledge about CDI infection and prevention. These questionnaires were tested in control populations that included either a nurse - infection control specialist, or non-clinically trained individuals, and a cohort of medical staff. They found that all questionnaires studied significant discrimination between non-clinical and clinical populations and had similar levels of sensitivity and specificity in discrimination between these target populations. This study describes the development of a usable CDI knowledge assessment tool that can be used to assess knowledge levels, compare populations, and prepare targeted education [6].

Studies clearly indicate that certain antibiotics used for treatment are able to disrupt the intestinal microflora and lead to increased sensitivity of the patient, and thus allow the colonization of *C. difficile*. Broad-spectrum antibiotics disrupt the normal intestinal flora, so CDI is thought to be associated with antibiotic use [7].

Significant risk factors for patient-related CDI are antibiotic exposure, old age, and hospitalization [7]. Age > 65 increases the risk of CDI by 5 to 10 times compared with patients younger than 65. However, a significant share of CDI also occurs in the younger population. Age > 65 is a significant risk factor not only for CDI, but also for poor clinical outcome of the disease, due to comorbidities in the elderly [8,9]. Residents of nursing homes are at higher risk for CDI of the total population, but at lower risk than hospitalized patients (15%). This is mainly due to older age, comorbidities,

more frequent hospitalizations and more frequent antibiotic therapies in this group compared to the non-institutionalized population. *C. difficile* is the most common cause of nosocomial diarrhea [10].

Today, the use of broad-spectrum antibiotics is extremely widespread and controlling the spread of *C. difficile* has become a huge task. The most common antibiotics often associated with CDI are cephalosporins, clindamycin, amoxicillin, and fluoroquinolones [11]. Almost every antibiotic is associated with the development of CDI, including drugs used to treat CDI: metronidazole and vancomycin [8]. Other well-defined risk factors for CDI include inflammatory bowel disease, gastrointestinal surgery, decreased immune response as a result of malignancies, transplantation, chronic kidney diseases, or the use of immunosuppressants [8,12]. Observing the results of the study, 60.29% of nurses and technicians knew that the above mentioned antibiotics could be associated with the occurrence of CDI. Other respondents thought that some of them could be associated with infection, which we cannot consider as a mistake since they are all associated with CDI. Even 30.38% of correct answers were from employees with a length of experience of less than 5 years.

The choice of antibiotic therapy should be adjusted to the severity of a disease. Common antibiotics used for milder forms of the disease are either oral metronidazole or vancomycin. Among them, metronidazole is usually recommended for the treatment of mild and moderate diseases, while oral vancomycin is generally not recommended [13,14,15]. New evidence suggests that vancomycin is superior to metronidazole and fidaxomicin is superior to vancomycin. The differences in efficacy between these antibiotics are not large, and the advantage of metronidazole is its far lower price compared to the other two antibiotics [16]. In our study, 41.2% of respondents knew that oral metronidazole was used as the first-choice antibiotic.

Hygienic hand washing with running water and soap is mandatory because alcohol-based hand sanitizers are not effective in neutralizing *C. difficile* spores. The patient's environment should be disinfected with chlorine preparations [17]. As the best way to prevent the spread of infection in hospital conditions, the World Health Organization advocates the use of soap with the use of alcohol-based preparations to limit the spread of spores [18], which was confirmed by 61.8% of respondents. However, 55.88% of respondents knew that chlorine and hydrogen peroxide-based preparations were recommended as the best means of disinfecting bedside tables, handles, bed rails, etc. Even 30.88% of respondents had a work experience of less than 5 years, which leads us to think that younger workers are more informed about modern research.

Thirty-one studies (8,672 participants) evaluated the efficacy of probiotics for preventing CDI among participants taking antibiotics. Their results suggest that when probiotics are given with antibiotics, the risk of developing CDI is reduced by an average of 60% [19], which was confirmed by 70.6% of respondents, believing that the use of probiotics during or after the use of antibiotics is recommended.

In a survey conducted in the United Kingdom in January 2007, we found that more than 50% of healthcare professionals correctly identified *C. difficile* as anaerobic bacillus. One-third of nurses were aware that 5% of adults carried *C. difficile* in their intestines. Among the respondents, 40% of healthcare workers were aware of the spectrum of diseases caused by *C. difficile*, while 26 (37%) nurses correctly identified various predisposing factors for acquiring CDI. Only 8% of medical staff was aware that antibiotic restriction was the simplest measure of CDI control. Only 28 (38%) nurses were aware that hand washing with soap and water was the most effective way to prevent CDI transmission. The results show that 70% of nurses correctly answered that oral metronidazole is a drug of choice for

the treatment of CDI [20]. In our study, only 36.8% of respondents knew that the most successful preventive measure for the occurrence of CDI was the correct use of antibiotics, or limited use of antibiotics. Comparing other data, it can be said that the knowledge of our nurses is somewhat better than the results in the above given study.

Regardless of the mentioned results, we can consider that the knowledge of nurses about CDI prevention is not at a satisfactory level. The importance of CDI is indicated by a study of the prevalence of nosocomial infections, conducted in hospitals in eastern Herzegovina in August 2011, which shows that the prevalence of patients with nosocomial infections was 4.2%, of which *Clostridium difficile* is considered to be the cause of 40% or 1.68% of total infections [21]. At the time when the above study was done, the diagnosis was not well established, so there is an impression of low frequency. There are no recent data on the incidence of nosocomial infections at the University Hospital in Foca. Given that nurses' knowledge of CDI prevention is not at a satisfactory level, it is to be expected that the current incidence of these infections is higher.

The rate of *C. difficile* resistance to antimicrobial agents is growing rapidly worldwide. The CDI has become a major concern for the public health service. CDIs are unique due to increased incidence as well as the increased use of certain antibiotics [22].

## Conclusion

Nurses' knowledge of CDI prevention is not satisfactory. Accordingly, it is necessary to define prevention measures and early detection of infected patients, and to prevent the spread of infection, in order to minimize this phenomenon. This indicates the growing need for education and information of nurses, both with high school and with the faculty. This problem could be solved through the

organization of seminars or online education for health professionals, training on methods of proper dressing, undressing and disposal of protective equipment used in the care of infected patients. Also, the introduction of train-

ing on disinfectants and methods of cleaning the ward, for staff involved in maintaining the hygiene of the ward, would help preventing the spread of infection in the ward, and thus the frequency of CDI.

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**Ethical approval.** The Ethics Committee of the University Hospital Foca approved the study and informed consent was obtained from all individual respondents.

**Conflicts of interest.** The authors declare no conflict of interest.

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## Znanje medicinskih sestara o prevenciji infekcija izazvanih bakterijom *Clostridium difficile*

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**Uvod.** *Clostridium difficile* je vodeći uzročnik nozokomijalnih dijareja povezanih sa upotrebom antibiotika. Najčešći putevi prenosa infekcije u bolnicama su kontaminirane površine prostorija i ruke medicinskog osoblja. Cilj rada je bio da se ispita znanje medicinskih sestara o prevenciji infekcija izazvanih bakterijom *Clostridium difficile*.

**Metode.** U studiji je učestvovalo 68 medicinskih sestara/tehničara zaposlenih u Univerzitetskoj bolnici u Foči na odeljenjima hirurgije i interne medicine. Kao instrument istraživanja korišćen je posebno dizajniran upitnik, kreiran od strane autora u svrhu ovog istraživanja.

**Rezultati.** Istraživanjem smo došli do podatka da je 61,8% ispitanika znalo da se pod najefikasnijom prevencijom širenja infekcije smatra pranje ruku toplom vodom i sapunom, a 55,88% da se kao efektivno dezinfekciono sredstvo koriste preparati na bazi hlora i vodonik peroksida. Zaposleni sa radnim stažom kraćim od pet godina su pokazali bolje znanje od ostalih grupa.

**Zaključak.** Znanje medicinskih sestara o prevenciji infekcija izazvanih bakterijom *Clostridium difficile* nije na zadovoljavajućem nivou, što ukazuje na sve veću potrebu za edukacijom i informisanjem medicinskih sestara.

**Ključne reči:** *Clostridium difficile*, znanje medicinskih sestara, nozokomijalne infekcije