Effectiveness of Prevention of *Clostridium difficile* Infection by Chemical Methods

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Medical assistance-related infections are acquired through medical care and are caused by germs resistant to several antibiotics, requiring specific antibiotherapy. One of these germs is Clostridium difficile, responsible for the occurrence of a large number of cases with diarrheal syndrome lately, increasing the cost of care per patient, morbidity and mortality. One of the methods of fighting is the use of disinfectants.

Keywords: infection, Clostridium difficile, diarrhea, spores, disinfectant

Disinfectants are substances that can destroy microbial agents. They are mixtures of liquid bactericides, containing at least two substances, solvents or disinfectants, to be applied on the surface of the objects. They are less effective than sterilization,they do not destroy the micro-organisms in their entirety, bacteria spores in particular. The ideal disinfectant should ensure full sterilization, be inexpensive, non-corrosive, non-flammable and should not harmful to users. Most disinfectants are potentially toxic to animals and humans.

Clostridium is a group of anaerobic bacteria. There are over 1,000 species of *Clostridium*, better known as *Clostridium difficile*, *C. perfringens* and *C.botulinum*. Clostridium difficile is a gram-positive, anaerobic germ, accounting for the occurrence of diarrhea or colitis secondary to antibiotic treatment.Unlike other germs that are multi-resistant to antibiotics, *C. difficile* spreads spores which are resistant to the bactericidal effects of alcohol and the disinfectants used in the hospital routine.

The *C. difficile infection* is responsible for a large number of healthcare-associated infections (HAI), rivaling today with other infections with multi-resistant germs, such as *Staphylococcus aureus methicillin-resistant* (MRSA) [1, 2, 3]and *enterococci resistant to vancomycin* (VRE).

For example, in the United States, during the period 2000 - 2009, the number of diagnoses of healthcare associated infections with *C. difficile* doubled, infections occurring especially in the elderly.

Clostridium infection prolongs the hospital stay by 2.8 days to 5.5, increases the cost of hospitalization and the mortality is considered to be 5-10%. That is why it's important to respect imperative measures which prevent the *C. difficile* infection.

Among the species *of C. difficile*, it seems that I/NAP 1/027 (ribotip 027) strains cause more frequent and severe infections because these strains produce more A and B toxins and have increased sporulation capacity.

The risk factors for *C. difficile* are represented by the use of antibiotics in the prior, proton pump inhibitors, above 60 years, hospitalization, severe diseases, immune suppression.

The most important risk factor is the misuse of antibiotics.The antibiotics incriminated in causing infections are cephalosporins, especially the second and third generation, fluoroquinolones, ampicillin/ amoxicillin, clindamycin.

C. difficile infection complications are severe diarrhea ranging from dehydration to kidney failure (most often precipitated by dehydration and decreased renal perfusion), toxic megacolon, bowel perforation and death, even being able to reach 70% despite intensive treatment.[15, 16]

Experimental part

Guideline recommendations to prevent *C. difficile* infections are: use of gloves, protective coats; educating health professionals, families and visitors on clinical symptoms, mode of transmission of the disease and its epidemiology; rigorous hand hygiene with soap and water upon contact with the patient with Clostridium, preferably instead of alcohol based solutions; measures of cleaning and disinfecting the wards and monitoring devices used in patients with *C.*

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difficile; cleaning team with utensils used only in those wards; decontamination of wards and departments with solutions of sodium hypochlorite (household bleach) in 1:10 dilution with water or other sporicidal solution approved by the Ministry of Health; isolation of infected patients; measure the use of antibiotics.

Disinfection steps are: 1. daily maintenance - care according to current medical interventions, contamination salon; cleanliness starts with less contaminated wards, each ward begins cleaning less dirty objects; 2. terminal disinfection (cyclical) - shall be performed if the HAI outbreaks evolve.

For an efficient cleaning and disinfection, cleaning the surfaces with a detergent for degreasing (it removes of fatty substances that inactivate the disinfectant) is the first step recommended [16]. The disinfection is then continued with sporocidal substances containing chlorine, kept under suitable conditions, within 24 hours after preparation of the solution (eg. 10% sodium hypochlorite).

Sodium hypochlorite (NaOCl) is aclear, pale yellow or greenish aqueous solution with a specific odor of chlorine, obtained from the reaction of soda. Sodium hypochlorite has a wide range of uses and is an effective disinfectant agent. There is also the possibility of resorting to additional hydrogen peroxide vapor to improve the efficiency of terminal disinfection.

Given the increased mortality potential and infection with Clostridium difficile, prevention of disease transmission is very important, along with simple things like handwashing with water and soap.

Methods

The present study has aimed to assess the presence of HCAIs type in ICU *C. difficile* Emergency County Hospital "St. Andrew"Galati, correlated with the effectiveness of disinfection methods the study is retrospective, observational, conducted one year.

Both descriptive and analytical models have been used in the statistical analysis. After collecting the data in an accesible form in order to ensure their informational character, they were processed. The primary processing, data systematization through centralization and grouping, respectively, lead to obtaining the primary indicators, which are presented as absolute values. Based on the primary indicators, through various statistical methods for comparison, abstraction and generalization, derived indicators were obtained. The data were centralized in Excel and SPSS 13.0 databases andprocessed with the related statistical functions.

Results and discussions

During the period studied (2016) a total of 82 cases of HAI were declared, 13 of which were *C. difficile*. Out of the 13 cases, five responded to treatment according to guidelines; 7 cases were in progress towards death from multiple causes. Positive tests for epidemiological control were > 3UFC / cm^2.

At the ICU section, besides daily cleaning, disinfection is performed after each transferred case, and terminal disinfection each week. As disinfectants for the disinfection and cleaning of floors, walls, equipment, devices and medical instruments, detergent solutions with strong bactericidal properties are used: tuberculocidal (mycobacteria), sporicidal and virucidal (HIV – 1. HBV, HCV, H1N1. To act against *C.difficile*, clorigene disinfectant tablets are used in each process of cleaning, for surfaces, inventory items, equipment, medical devises, and the disinfection of sanitary groups. Over the course of one year, 13 cases of *C. difficile* infections (ICD) were declared.

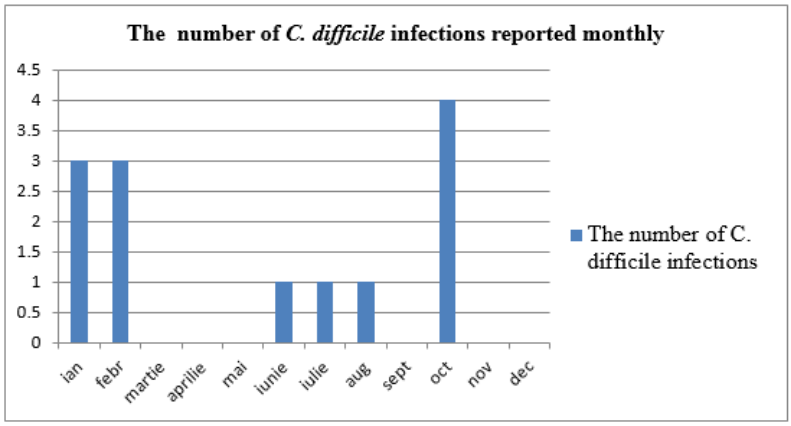

Fig. 1. Monthly reporting of ICD

Although *C. difficile* active substances are used every disinfection procedure, cases of DCI were uneven, ranging from no event (March, April, May, September, November, December) to a maximum of 4 cases in one month (October).

Over the same period, 81 cases of infectious diseases have been reported (Figure 2).

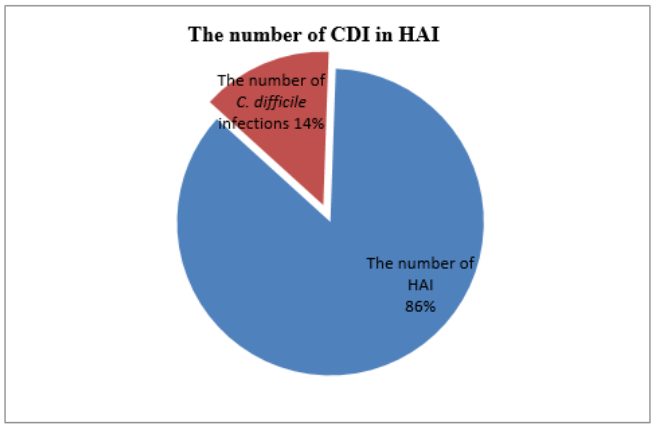

Fig. 2. The percentage of CDI in HAI

Regarding the influence of the contamination of the hospital environment, it was found that only during two months (April and September) the reduction of the bacterial burden is associated with the lack of ICD cases (Figure 3).

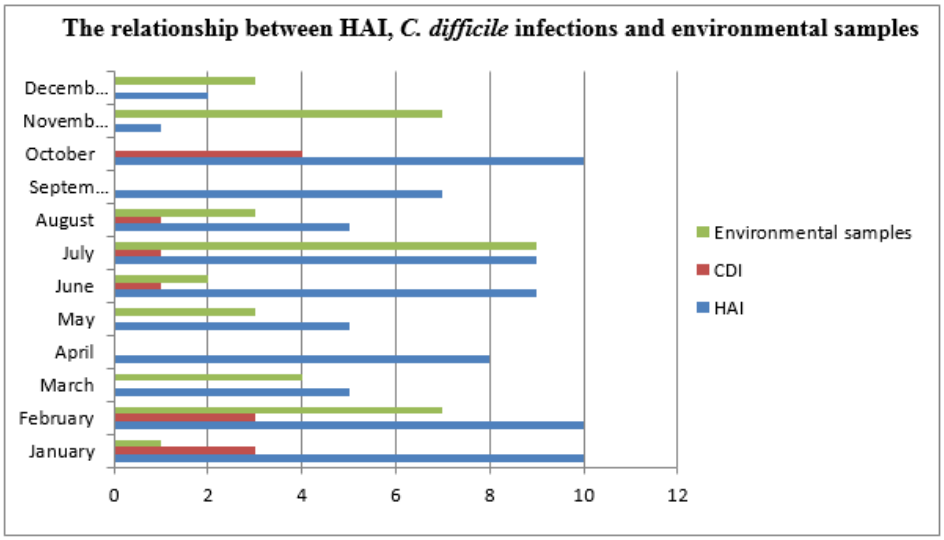

Fig. 3. Relationship between IAAM, ICD and positive samples to epidemiological control

This fact corresponds to the study by Curtis J. Donskey [17] which, considering nine studies about the effectiveness of certain interventions (daily environmental disinfection, disinfection portable equipment, educating carers etc.) to improve cleaning and disinfection practices, found that in 7 out of 9 interventions, the number of purchases of pathogens decreased as a result of the introduction of this practice changed.

There are periods without ICD but with loading of bacterial routine checks, consistent with another finding of the same study [17]: it is necessary to reduce the bacterial load in the environmemt to zero to decrease the number of new cases of HAI [18]. There are periods with negative samples but with the presence of cases of *C. difficile* infection, which could be explained by the transfer of patients with ICD in other sectors.

Consistent with those found in the present study, a study reveals the ineffectiveness of efforts to improve the disinfection methods (replacing the usual hypochlorite bleach or hydrogen peroxide 7%) in the control of infections with *C. difficile* [19].

Numerous studies proved the effectiveness of sodium hypochlorite as a disinfectant to control outbreaks of *C. difficile*, along with other methods such as staff training on cleaning, time spent in contact with disinfectants, cleaning duration. It also may be taken into account that the use of disinfectants and especially hypochlorite may sometimes be suboptimal, given that cleaning procedures are difficult to standardize.

In many studies, the effectiveness of sodium hypochlorite as a disinfectant for controlling C. difficile outbreaks has been proven, along with other methods such as staff training on cleanliness, contact time with disinfectants, cleaning duration [20].

These data require further supervision of IAAM cases and especially DCI and effectiveness of disinfection measures, stressing the importance of *C. difficile* transmission by direct contact with contaminated hands of staff to patients or surrounding areas.

Conclusions

Preventing the occurrence and spreading of healthcare associated infections requires sustained efforts deployed for long periods (years), with the need to implement multiple methods of control.

Besides training for carers and supervising them, protocols should be established for the completing phase or even lists some steps in the disinfection process.

Disinfection in combination with other methods of prevention methods such as trimming patients with chlorhexidine, compliance with hygiene of hands, isolation of cases of multi-resistant bacteria, using specific disinfectants and effective concentrations could help decrease the number of hospital infections.

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