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“ ” August 2017

# TEST REPORT

Efficiency evaluation of using the UIKb-01-Alpha unit produced by Scientific and Industrial Enterprise "Melitta", Ltd, generating continuous UV light, for reducing the infections incidence caused by *C. Difficile in sporous form* at surgical facilities

**Moscow, 2017**

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**Research relevance**

In recent years, there has been a downward trend in the prevalence of some types of HAI (bloodstream infections, urinary tract infections) [1,2]. At the same time, in most countries, infections caused by *C. difficile* continue to be one of serious public health problems. According to ECDC PPS (2013) in European emergency hospitals, *C. difficile* is the causative agent of 48 % of gastrointestinal infections. At the same time, 20 % of them are severe, including 10 % ending in colectomy. Mortality from *C. difficile* associated infections reaches 4 %, and the recurrence rate of the disease is 25 % [3].

A multicenter prospective study (EUCLID), conducted in 482 hospitals in 20 European countries from September 2011 to August 2013, showed an increase in the incidence of patients with *C. difficile* associated infections from August 2012 to August 2013 from 6.6 to 7.9 cases for 10,000 bed days. At the same time, no clear relationship with seasonality was revealed, but the migration of clostridia ribotype 027 to the Eastern Europe countries was shown, where in 2013 it already prevailed among the selected cultures, ensuring the severity of the disease clinical course [4].

Today, medical facilities are the main place for the emergence of infectious diseases caused by *C. difficile* due to the widespread antibiotics use, associated diseases of patients, ease of pathogens' transmission throughout hospital environment due to its high resistance to standard disinfectants. Among hospitalized adults, the frequency of *C. difficile* caused HAIs varies from 0.3 to 78 cases per 1,000 hospitalized patients, depending on the department profile and varies from year to year within one medical facility. In the research of Gulazyan N.M. it was shown that in hospitalized patients with acute intestinal infections of various etiologies, the antigens of *C. difficile* A and B toxins, type A *C. perfiringens* enterotoxin were detected in 40.7 % of cases; during the course of the disease, the detection rate was 43.9 % enterocolitis (EC), 41.9 % for gastroenterocolitis (GEC), and 39.3 % for gastroenteritis (GE). In the acute period of the disease (1-3rd day), higher levels of antigens of all toxins were revealed for GE and EC than for GEC. Further disease dynamics (4-6 days) showed a short-term increase (reliable at *C. difficile* B) of antigen levels of all investigated toxins in coprofiltrates for GEC, and a consecutive decrease for GE and EC. At the moment of discharge, 16.4 % of patients had retained toxin markers in their feces (more often *C. difficile* A), mainly for the GEC type [5].

*C. difficile* infection in a hospital environment occurs through contact. Direct pathogens transmission from an infected or colonized patient to an uninfected person is possible through direct contact or through objects in close surroundings (e.g. bedside table, toilet seat, rectal thermometer, enema). An indirect transfer through medical personnel hands is possible with the participation of a wider list of contaminated facilities (medical devices, indoor surfaces, etc.).

As far back as 1989, McFarland et al. reported that 49 % of wards for patients with clinically expressed *C. difficile* associated infections and 29 % of wards for asymptomatic patients and carriers were contaminated with clostridia spores [6]. N.AL Saif and J.S. Brasier (1996), when studying the *C. difficile* contamination of hospital rooms, found this microorganism in 20 % of samples from the floors, tables, chairs, nightstands, carpets, curtains, windows, and bathrooms. Almost all isolated cultures (94.7 %) were toxigenic [7].

In several more recent studies, *C. difficile* spores were isolated from wipe samples from hospital environment in 2.9 -75 % of cases. In addition, *C. difficile* was isolated from air samples.

The development and implementation of highly effective disinfection methods of hospital environment in healthcare practice is extremely important, since the control of *C. difficile* spores presents significant difficulties due to their resistance to QAS, PHMG, amines, phenols, and alcohol based disinfectants. On the contrary, use of these agents' solutions stimulates *C. difficile* sporulation. The spores can survive for up to 5 months on various objects.

Sporicidal concentrations of chemical agents' solutions are suitable for disinfection measures aimed at bacterial spores' destruction. The highest sporicidal activity possess oxygen- and chlorine-based active agents. At the same time, use of halogens, hydrogen peroxide and peracetic acid solutions for prevention and focal disinfection has serious limitations in terms of concentration, safety, and impact on various materials of hospital objects.

Numerous studies conducted in Europe and the USA indicate that chlorine-based agents with concentration of less than 1000 ppm are not effective against clostridia spores. A concentration of 5000 ppm is effective for 5 minutes in a suspension test, but not always so in a clinical setting, especially when eliminating outbreaks. In sporicidal concentration they should not be used in the presence of patients, and personnel should use respiratory, eye and skin protection.

Hydrogen peroxide mist generators are now widely used. Disinfection with these units is long lasting and requires good pre-cleaning. For example, treating a room by a Glossair unit (Steris) takes 3-3.5 hours.

In Russia, the United States and other countries, ultraviolet units with pulsed xenon lamps are ever more widely used for air and open surfaces disinfection at healthcare facilities to prevent healthcare-associated infections (HAI) [8]. For instance, hospitals in the US use Xenex LightStrike Germ-Zapping Robots®, similar to UIKb-01-Alpha, in an updated design (manufactured since 2012 on the US territory by "XENEX DISINFECTION SERVICES" under the license agreement with Scientific and Industrial Enterprise "Melitta").

Numerous tests conducted in accredited testing centers in the Russian Federation, the United States and some European countries have shown their high efficiency against the entire microorganisms range, including XDR- and panresistant clinical strains. Thus, in 2016, a laboratory scientific research cycle demonstrated that pulsed continuous UV light has a significant sporicidal effect. At 2 meters' distance from the radiation source, the efficiency against sporous forms of clinical *C. difficile* strain reached 100 % (over 4 log) after 8 minutes' exposure. Increased distance from the radiation source to contaminated surfaces from 2 to 4 meters doubles the time required to achieve 100 % efficiency, which amounts to 16 minutes [9]. It was found that the efficiency against pathogens barely depends on the protein contamination presence, which allows for using the lamp without any efficiency loss even before cleaning.

The official statistics of our country does not contain any data on clostridium associated HAIs, therefore, the scientific literature has few reports on the UIKb-01-Alfa clinical effectiveness [10]. Meanwhile, epidemiological studies conducted over the past 3 years have found that the use of the Xenex pulsed system has become a key factor in reducing the C. difficile associated infections' incidence in a number of US hospitals. For example, the study by Levin J et al. shown that treating the patient rooms by a Xenex robot has reduced the C. difficile associated infections' incidence from 9.85 per 10,000 bed days in 2009 to 4.45 per 10,000 bed days in 2011 (p=0.01) [11].

## Research design

The present combined (retrospective and operational epidemiological analysis) study was conducted from January to December 2016 in two departments of a Moscow healthcare facility of surgical profile specializing in large intestine diseases. Both departments had similar composition of patients in terms of diseases nosology, preventive and focal disinfection routine, and similar indicators of staff hand hygiene. The first department served for control (No. 3), the second (No. 4) was a test one, where from January 2016 the UIKb-01-Alpha unit was used for preventive disinfection.

**Research goal:** Efficiency evaluation of using the UIKb-01-Alpha unit generating continuous UV light

for reducing the *C. difficile* spores associated infections incidence at surgical facilities.

**The main research objectives:**

1. Conduct a retrospective epidemiological analysis of *C. difficile* associated infections' prevalence in patients of 2 surgical departments (test and control) using fecal A/B toxins and their combination when colitis clinical signs are present (LFIA method) in 2012-2016. Identification of epidemic process patterns;
2. Compare the number of LFIA examined patients with colitis signs in the test department in 2012-2015 and in 2016;
3. Compare the toxins presence in feces samples from patients with the colitis signs in the test department in 2012-2014 and in 2016;
4. Compare the number of LFIA examined patients with colitis signs and A/B toxins presence in the control and test departments.

**Materials and methods**

**Methods:** Retrospective and operational epidemiological analysis, microbiological, LFIA, statistical analysis, physical surfaces disinfection by a pulsed UV unit.

UIKb-01-Alpha pulsed xenon UV-bactericidal system for urgent air disinfection in 1 and 2 category rooms in the absence of people, manufactured by Scientific and Industrial Enterprise "Melitta", Russia (Registration Certificate No. OCP 2010/06906 dated 26.02.2010; GOST R Certificate of Conformity No. РОСС RU.ИМ04.В07590 dated 08.03.2013).

**Materials:**

*Reported data on healthcare facilities for 5 years, including the bacteriological laboratory* were used.

**Disinfection procedure in test and control rooms**

Daily since January 2016 in test department No. 4, UIKb-01-Alpha was used for disinfection. The daily routine included treatment, dressing, examination, enema, and laundry rooms, as well as 4 rooms indicated by the doctor.

In control department No. 3, the rooms were only subjected to standard cleaning and manual chemical disinfection.

**The rooms where air and surfaces disinfection was performed by UIKb-01-Alpha:**

1. Rooms of diarrhea patients (laboratory-confirmed infection caused by toxin-producing *C. difficile* and diarrhea until a negative laboratory test result);
2. Rooms after discharge of a patient with a toxin-producing *C. difficile* caused infection.

If the number of rooms to be treated exceeded 5, the sixth room was treated the expense of the treatment room; if the number of rooms was smaller, common areas (buffet, hall) were also treated.

**Rooms' disinfection and cleaning procedure**

**Substantiation of the methodology.** Previous studies (9, 12) showed that the disinfection efficiency of surfaces, contaminated with clinical strains of gram-negative and gram-positive bacteria, by a pulsed UV unit does not depend on the biological contamination level. In order to prevent massive contamination of cleaning pads with clostridia spores during cleaning, and their cross-contamination during washing, it was decided to treat them with a pulsed UV unit before chemical disinfection by 0.3 % "Rotamicid" solution. The rooms were disinfected and cleaned after main works' completion (like dressings, blood sampling, linen sorting).

1. The personnel were led out to corridor;

2. The room was treated by pulsed UV unit as per operating mode (exposure) and at points indicated in the information card for the specific room;
3. Horizontal surfaces were wiped with a clean/disposable cloth soaked in 3.0% "Bebidez Ultra" solution;
4. The floor was washed with pure cleaning pads moistened with a 0.3% "Rotamicid" solution.

**Rooms' disinfection and cleaning procedure:**

1. The personnel were led out to corridor;
2. The room was treated by pulsed UV unit as per operating mode (exposure) and at points indicated in the information card for the specific room;
3. Horizontal surfaces (buttons for calling medical staff, door handles, bed handrails, switches, bedside tables, table) were wiped with a clean/disposable cloth soaked in 3.0% "Bebidez Ultra" solution;
4. The floor was washed with pure cleaning pads moistened with a 0.3% "Rotamicid" solution.

**The procedure for disinfecting and cleaning of a sanitary unit:**

1. The patients/personnel were led out to corridor.
2. Epidemiologically significant surfaces (sink mixer knobs, toilet button, paper dispenser, mop handle, door handles, switch, toilet bowl) were wiped/irrigated with a clean/disposable cloth soaked in 3.0% "Bebidez Ultra" solution, or with a spray gun;
3. Processing the sanitary unit using a pulsed UV unit according to the mode (exposure) and at the points indicated in the information card for the room.
4. The toilet bowl and other surfaces that may come into contact with the patient's skin were wiped with a clean/disposable cloth;
5. The floor was washed with pure cleaning pads with a red mark (for bathrooms) moistened with a 0.3% "Rotamicid" solution.

The person responsible for rooms' disinfection and cleaning indicated the treatment time for each room in the worksheet (for example, 10.00-10.28). If the room was not treated by an PXUV unit, the reason was also indicated in the worksheet (lack of time, lamp replacement required, impossible to free the ward from patients, etc.).

Cleaning pads and reusable wipes were washed and disinfected in a washing machine, then dried. Before use, they were soaked with a disinfectant solution.

**Results and discussion**

1. The research results of fecal samples in patients with acute intestinal infection were collected and LFIA tested for presence of A, B, and A+B toxins. The results are presented in Tables 1 and 2.

**Table 1.** LFIA research results of fecal samples in patients with acute intestinal infection for 2012-2016 by months

| month | Department No. 3 (control) | | | | | | Department No. 4 (test) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | toxins identified | | | | Negative result | Total LFIA surveyed | toxins identified | | | | Negative result | Total LFIA surveyed |
| | A | B | A+B | Total | | | A | B | A+B | Total | | |
| 2012 | | | | | | | | | | | | |
| January | 1 | 4 | 1 | 6 | 3 | 9 | | | | | | |
| February | | 8 | 7 | 8 | 10 | 25 | | 2 | 1 | 3 | 1 | 4 |
| March | | 5 | 7 | 5 | 9 | 21 | | 7 | 4 | 11 | 6 | 17 |
| April | | 0 | 3 | 0 | 14 | 17 | | 0 | 2 | 2 | 8 | 10 |
| May | | 2 | 1 | 2 | 10 | 13 | | 1 | | 1 | 4 | 5 |
| June | | 5 | 4 | 5 | 20 | 29 | | 1 | | 1 | 6 | 7 |
| July | | 11 | 9 | 11 | 16 | 36 | | 2 | | 2 | 7 | 9 |
| August | | 1 | 1 | 1 | 5 | 7 | | 1 | | 1 | 5 | 6 |
| September | | 1 | 7 | 1 | 9 | 17 | | | | | 6 | 17 |
| October | 2 | 8 | 3 | 10 | 12 | 25 | | 2 | 1 | 3 | 12 | 15 |
| November | | 3 | 4 | 3 | 15 | 22 | | 4 | | 4 | 13 | 17 |
| December | 1 | 6 | 6 | 7 | 10 | 23 | | 2 | | 2 | 10 | 12 |
| Total | 4 | 54 | 53 | 59 | 133 | 244 | | 22 | 8 | 30 | 78 | 119 |
| 2013 | | | | | | | | | | | | |
| January | | 4 | 3 | 4 | 7 | 14 | | 2 | 1 | 3 | 8 | 11 |
| February | | 1 | | 1 | | 1 | | | | | | |
| March | | | 2 | 0 | 6 | 8 | | | | | 2 | 2 |
| April | 1 | 13 | 3 | 14 | 13 | 30 | | 4 | 1 | 5 | 12 | 17 |
| May | | 6 | 1 | 6 | 14 | 21 | | 5 | 3 | 8 | 16 | 24 |
| June | | | 6 | 0 | 7 | 13 | | 4 | 3 | 7 | 14 | 21 |
| July | | 6 | 6 | 6 | 9 | 21 | | 1 | 6 | 7 | 14 | 21 |
| August | 1 | 8 | 6 | 9 | 10 | 25 | | 2 | | 2 | 8 | 10 |
| September | | 3 | 2 | 3 | 1 | 6 | | 2 | 2 | 4 | 4 | 8 |
| October | | 8 | 3 | 8 | 5 | 16 | | 6 | 2 | 8 | 15 | 23 |
| November | | 9 | 2 | 9 | 10 | 21 | | 5 | | 5 | 23 | 28 |
| December | | 5 | 4 | 5 | 27 | 36 | | | 1 | 1 | 12 | 13 |
| | 2 | 63 | 38 | 65 | 109 | 212 | | 31 | 19 | 50 | 128 | 178 |
| 2014 | | | | | | | | | | | | |
| January | | 4 | 1 | 4 | 14 | 19 | | 2 | 0 | 2 | 10 | 12 |
| February | | 7 | 3 | 7 | 11 | 21 | | 4 | 1 | 5 | 8 | 13 |
| March | | 1 | | 1 | 18 | 19 | | 2 | | 2 | 16 | 18 |
| April | | 1 | 3 | 1 | 6 | 10 | 2 | 7 | 4 | 13 | 20 | 33 |
| May | | 6 | 4 | 6 | 11 | 21 | | 6 | | 6 | 10 | 16 |
| June | | 5 | 5 | 5 | 8 | 18 | | 7 | 3 | 10 | 16 | 26 |
| July | | 2 | 1 | 2 | 21 | 24 | | 1 | 1 | 2 | 29 | 31 |
| August | | | | | 13 | 13 | | | | | 18 | 18 |
| September | | 3 | 2 | 3 | 5 | 10 | | | 1 | 1 | 12 | 12 |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| October | | 7 | 7 | 14 | 14 | 28 | | 5 | 4 | 9 | 27 | 36 |
| November | | 1 | 3 | 4 | 3 | 7 | | 8 | 2 | 10 | 19 | 29 |
| December | | 3 | 1 | 4 | 9 | 13 | | 11 | 3 | 14 | 24 | 38 |
| Total | | 40 | 30 | 51 | 133 | 203 | 2 | 53 | 19 | 74 | 209 | 282 |
| 2015 | | | | | | | | | | | | |
| January | | 2 | 1 | 3 | 8 | 11 | 1 | 4 | | 5 | 11 | 16 |
| February | | 1 | 3 | 4 | 6 | 10 | | 3 | 1 | 4 | 26 | 30 |
| March | | 3 | 1 | 4 | 12 | 16 | 1 | 5 | 1 | 7 | 24 | 31 |
| April | | 5 | 2 | 7 | 7 | 14 | | 9 | 1 | 10 | 21 | 31 |
| May | | 3 | | 3 | 9 | 12 | | 7 | | 7 | 21 | 28 |
| June | | 5 | | 5 | 19 | 24 | | 7 | | 7 | 20 | 27 |
| July | | 7 | 2 | 9 | 12 | 21 | | 7 | | 7 | 30 | 37 |
| August | | 5 | | 5 | 9 | 14 | | 1 | | 1 | 12 | 13 |
| September | | 7 | 3 | 10 | 17 | 27 | | 5 | 1 | 6 | 19 | 25 |
| October | | 12 | 1 | 13 | 15 | 28 | | 12 | 5 | 17 | 13 | 30 |
| November | | 12 | | 12 | 7 | 19 | | 10 | | 10 | 25 | 35 |
| December | | 6 | | 6 | 15 | 21 | | 11 | | 11 | 15 | 26 |
| Total | | 68 | 13 | 81 | | 217 | 2 | 81 | 9 | 92 | | 329 |
| 2016 | | | | | | | | | | | | |
| January | 0 | 2 | 0 | 2 | 9 | 11 | | 2 | 0 | 2 | 11 | 13 |
| February | 0 | 2 | 0 | 2 | 9 | 11 | | | | 0 | 12 | 12 |
| March | 0 | 6 | 1 | 6 | 6 | 12 | | 2 | | 2 | 16 | 18 |
| April | 0 | 6 | 1 | 6 | 10 | 16 | 2 | 7 | 4 | 13 | 20 | 33 |
| May | 0 | 4 | 0 | 4 | 5 | 9 | | 6 | | 6 | 10 | 16 |
| June | 0 | 3 | 0 | 3 | 5 | 8 | | 7 | 3 | 10 | 16 | 26 |
| July | 0 | 4 | 0 | 4 | 3 | 7 | | 1 | 1 | 2 | 29 | 31 |
| August | 0 | 3 | 2 | 3 | 8 | 11 | | | | | 18 | 18 |
| September | 1 | 5 | 0 | 6 | 4 | 10 | | | 1 | 1 | 12 | 12 |
| October | 0 | 2 | 0 | 2 | 8 | 10 | | 5 | 4 | 9 | 27 | 36 |
| November | 0 | 1 | 0 | 1 | 5 | 6 | | 8 | 2 | 10 | 19 | 29 |
| December | 0 | 11 | 0 | 11 | 5 | 16 | | 11 | 3 | 14 | 24 | 38 |
| Total | 1 | 49 | 4 | 50 | 77 | 127 | 2 | 49 | 18 | 69 | 214 | 282 |

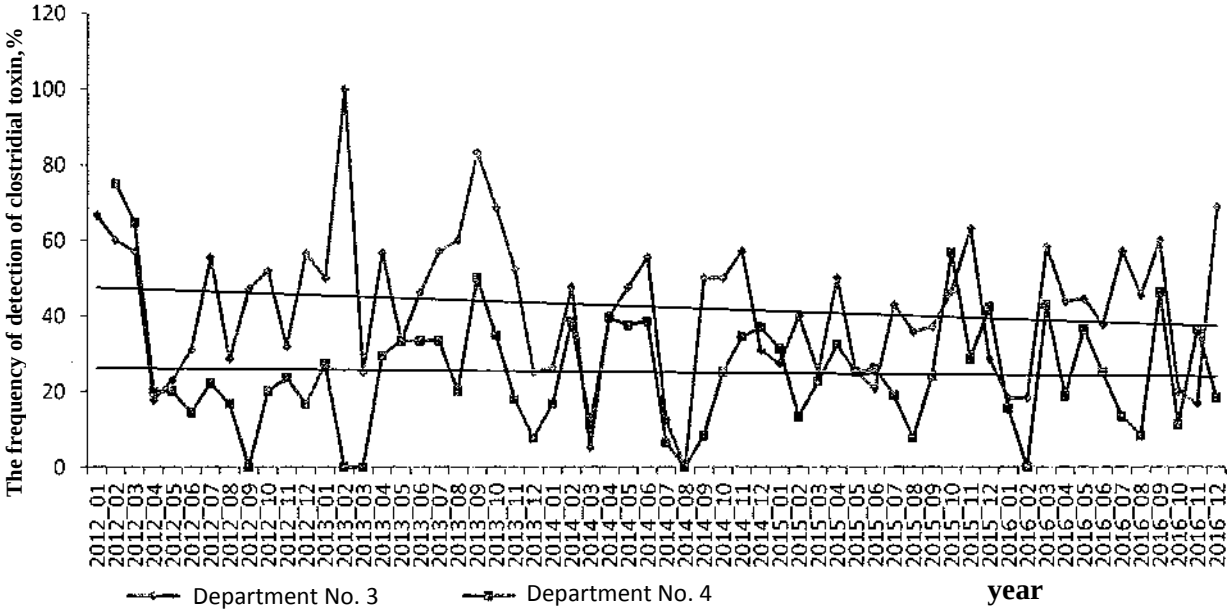


**Figure 1.** The frequency of clostridial difficile toxin detection in fecal samples in patients with acute intestinal infection

**Table 2.** LFIA research results of fecal samples in patients with acute intestinal infection for 2012-2016

| year | treated | had indications for CD toxin screening and were examined | | LFIA detected toxins, total | | | including toxin B | |
|---|---|---|---|---|---|---|---|---|
| | | absolute count | % | absolute count | of the number surveyed, % | of the number treated, % | absolute count | % |
| Department No. 3 | | | | | | | | |
| 2012 | 822 | 244 | 29.68 | 111 | 45.49 | 13.50 | 54 | 48.65 |
| 2013 | 838 | 212 | 25.30 | 103 | 48.58 | 12.29 | 63 | 61.17 |
| 2014 | 794 | 203 | 25.57 | 70 | 34.48 | 8.82 | 40 | 57.14 |
| 2015 | 792 | 217 | 27.40 | 81 | 37.33 | 10.23 | 68 | ***83.95**** |
| 2016 | 860 | 127 | ***14.77**** | 54 | 42.52 | ***6.28**** | 49 | 90.74 |
| average | | | | | | 10.2±2.8 | | |
| Department No. 4 | | | | | | | | |
| 2012 | 894 | 108 | 12.08 | 30 | 27.78 | 3.36 | 22 | 73.33 |
| 2013 | 1123 | 178 | 15.85 | 50 | 28.09 | 4.45 | 31 | 62.00 |
| 2014 | 1129 | 282 | 24.98 | 74 | 26.24 | 6.55 | 53 | 71.62 |
| 2015 | 1162 | 329 | 28.31 | 92 | 27.96 | 7.92 | 81 | 88.04 |
| 2016 | 1399 | 142 | ***10.15**** | 31 | ***21.83**** | ***2.22**** | 23 | ***74.19**** |
| average | | | | | | 5.6±3.1* | | |

**Note:** * reliable differences from the previous year (p=0.05)

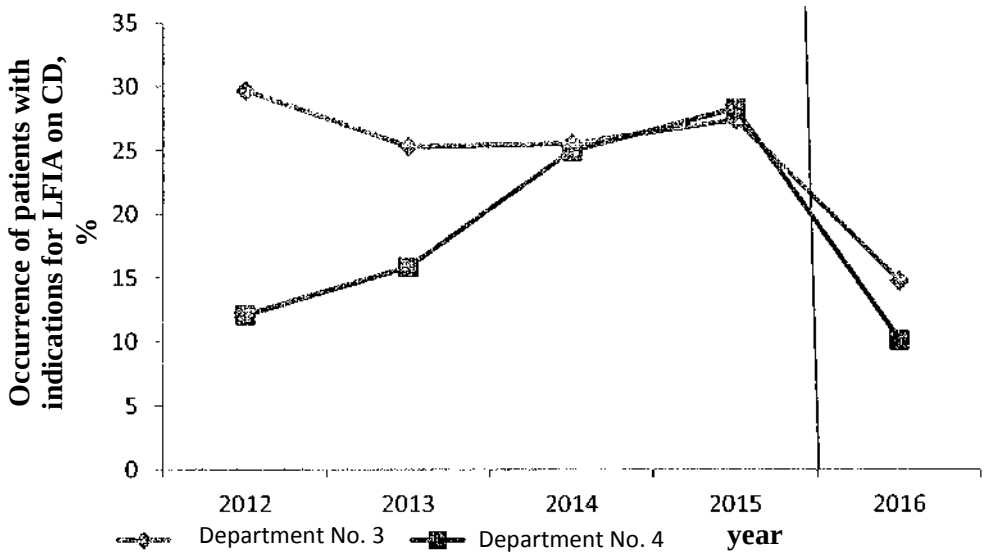


**Figure 2.** Occurrence of patients with indication for LFIA diagnostics of acute intestinal infection (detection of *C. difficile* toxins)

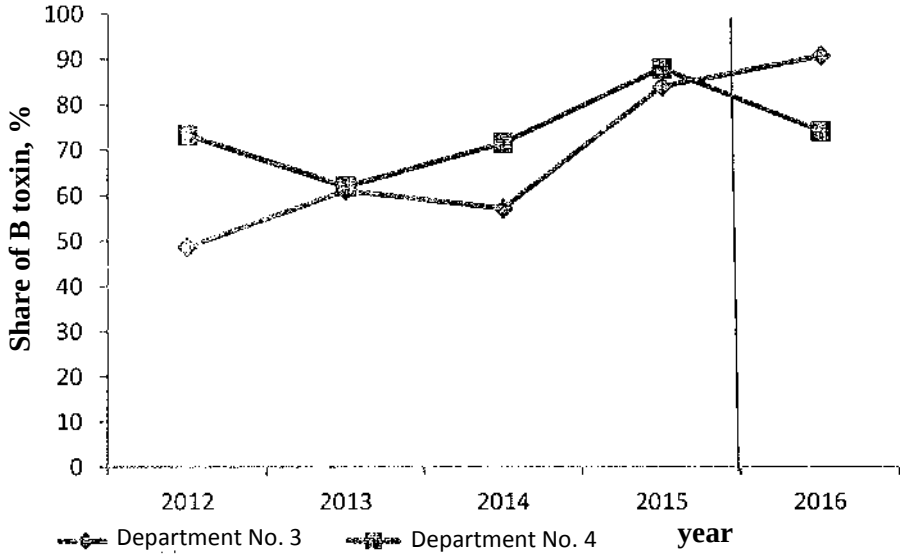


**Figure 3**. Share of B toxin in the total of isolated clostridial toxins

Analysis of the data on *C. difficile* toxins occurrence in feces samples from patients with an acute intestinal infection (Figure 1) indicates that the incidence of toxin-forming *C. difficile* caused HAIs has no seasonality, which correlates with the European studies data.

At the same time, it is clearly seen that the epidemic transmission of *C. difficile* associated infection **in the third (control) department** is consistently more intensive than in the 4th department with local outbreaks 1-2 times a year in different months (Figure 2). It should be noted, that in 2016 the toxin B share in the total number detected by LFIA increased to 90.74 %, which indirectly indicates the formation of a dominant *C. difficile* strain in the 3rd department. In 2016, there was a statistically significant decrease of the LFIA inspected patients' number with acute intestinal infection from 27.40 % in 2015 to 14.77 % in 2016. However, it should be noted that this process was not associated with a toxins occurrence decrease in tested samples. On the contrary, it increased from 37.33% in 2015 to 42.52% in 2016.

The data in Table 2 for **the fourth (test) department** in the period 2012-2015 demonstrates an obvious increase in the epidemic process intensity, as can be seen from the annual increase in the

patients' number with acute intestinal infections, detected and examined by LFIA (from 12.8 % in 2012 up to 28.31 % in 2015). However, the toxin detection frequency in fecal samples during these years remained at the level with no statistical differences. After the UIKb-01-Alpha unit was introduced into the disinfection measures complex there was an almost **three-fold decrease in the number of patients with acute intestinal infections** (from 28.3 %1 in 2015 to 10.15 % in 2016) and a statistically significant decrease in the frequency of *C. difficile* toxins occurrence in their feces samples (from 27.96 % in 2015 to 21.82 % in 2016). The B toxins occurrence frequency decreased from 88.04 % (maximum for 2012-2015) in 2015 to 74.19 % in 2016.

**Conclusions and recommendations:**

1. Epidemic process caused by *C. difficile* associated HAIs in the third department is sufficiently more intensive, as evidenced by the fact that for five years 10.2±2.8 % of annually treated patients had acute intestinal infections probably caused by *C. difficile* (feces samples contain toxins detected by LFIA). Toxin B was detected in 91% of samples in 2016, which demonstrates the mono-etiological nature of the infection. No disease seasonality was revealed. There were local bursts of morbidity;
2. In the fourth (test) department in the period from 2012 to 2015, epidemic process was more intensive as evidenced by increased occurrence of acute intestinal infections among treated patients, along with increased occurrence of toxin B, LFIA determined in their feces samples;
3. Implementation of a pulsed UV unit UIKb-01-Alpha in the complex of disinfection measures of the test department No. 4 since January 2016 allowed for significantly ($p<0.005$) reducing the number of patients with acute intestinal infections (from 28.3 % in 2015 to 10, 15 % in 2016) and the *C. difficile* toxins occurrence frequency in the studied feces samples (from 27.96 % in 2015 to 21.82 % in 2016). The B toxins occurrence frequency decreased from 88.04 % (maximum for 2012-2015) in 2015 to 74.19 % in 2016;
4. The present study and the laboratory cycle of bacteriological studies allow for concluding that the UIKb-01-Alpha unit is highly efficient against toxin-forming *C. difficile* in sporous form. This is sufficient ground for recommending to implement it as part of preventive and focal disinfection measures in departments with high risks of the development of *C. difficile* associated HAIs;
5. The performed research allowed for developing a new cleaning and disinfection procedure of rooms and surgical department wards with high risk of *C. difficile* infection:
   Step 1 - preliminary air and open surfaces disinfection of rooms and wards by a pulsed UV unit;
   Stage 2 - cleaning by chemical detergent disinfectants. This disinfection procedure allows for destroying clostridium spores in the air and on open surfaces, minimizing the cleaning pads contamination;
6. The developed procedure is recommended to be implemented as part of the existing disinfection protocol for surgical department rooms at healthcare facilities with high risk of *C. difficile* associated infections occurrence and spread;
7. The following procedure is recommended for sanitary rooms (bathroom, enema, etc.) disinfection to avoid the aerogenic clostridium spores cross-contamination:
   Step 1 – surfaces wiping/irrigation by oxygen based disinfectants;
   Step 2 – room treatment by a pulsed UV unit.

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