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Assessment of the Microbiological Quality of the Medico-Technical Equipment, Surfaces, Premises and Staff Hands in the Department of Neonatology of the Departmental University Hospital Center of Ouémé-Plateau in Benin in 2018

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Abstract

Introduction: Hospital hygiene is a set of preventive measures essential to ensure the quality of care in health facilities.

Objective: The objective of the present study was to evaluate the microbiological quality of the medico-technical equipment, the surfaces, the premises and the hands of the personnel in the neonatology department of the Ouémé-Plateau's Departmental University Hospital Center (CHUD-O/P).

Method: This was a descriptive cross-sectional study that included 131 swab samples divided into four batches: Batch #1 (Medico-technical equipment); Batch #2 (surfaces); Batch #3 (Premises); Batch #4 (Staff Hands) and Batch #5 (sur-blouses of baby visitors) and ran from April 14 to August 31, 2018.

Results: The results showed that 105 samples out of 131 gave a positive culture, 80.15% (high risk of contamination). A total of 369 germs were identified. The isolated microorganisms were *Staphylococcus* aureus (21.95%), *Staphylococcus spp* (20.32%), *Klebsiella* pneumoniae (18.97%), *Escherichia coli* (17.07%), *Candida spp* (12.73%) and *Candida albicans* (8.94%). The majority of identified bacteria had resistance to commonly used antibiotics (only 3 antibiotics sensitive on the 7 tested).

Conclusion: It is useful to organize bio-cleaning and high-level disinfection in a short time in order to provide the care in hygienic conditions recommended by the World Health Organization.

Keywords: Microbiological Quality; Resistances; Antibiotics; Neonatology; Benin

Introduction

In health facilities, many sources of infectious germs are responsible for infections whose frequency varies depending on the nature and structure of the hospital or health center on the one hand, the activity of the hospitalization units and the quality of the care team on the other hand. The users of the healthcare facilities are exposed to a large number of microbes, most of which are present on surfaces, floors in the premises, and in the air [1]. Healthcare Associated Infections (HAI), formerly known as nosocomial infections, are a public health problem and represents a significant burden for patients, caregivers and health systems [2]. HAIs affect hundreds of millions of patients worldwide each year. These infections cause serious illnesses, prolonged hospital stay, long-term disability, and even the tragic loss of life [3]. They occur all over the world and affect both developed and poor or developing countries [4]. The prevalence of these infections is not negligible even in developed countries with adequate infrastructure, materials and equipment [5,6].

Healthcare-associated infection is a reflection of the quality of care delivery in a health system [7]. Quality of care has always been a concern for the health system. HAIs prevention is a requirement for the quality of care provided to the population [8]. Safety of healthcare requires a rigorous application of hospital hygiene rules.

Since 2006 in Benin, efforts have been made to control infections associated with care and services, but statistical data on the subject are not always kept [8]. In the Hubert Koutoukou MAGA National University Hospital Center in Cotonou (CNHU-HKM), the studies conducted in 2011 on the prevalence of Surgical Site Infections (SSI) in visceral surgery departments A and B, and in 2012 on the quality of medico-technical equipment used in the operating theaters for the prevention of infections associated with care and services, showed nosocomial infection rates of 6.30% and 6.17% respectively [9,10]. The recent study conducted in 2015 on the management of infectious risk associated with care and services in the same center reported a prevalence of 9.84% [8].

Preventing the transmission of infectious diseases in hospitals is a topical issue in public health. It should be noted that this study refers to bacterial and fungal infections.

The risk of epidemics caused by these germs is still worrying with a high frequency of multi-resistance of bacteria to antibiotics due to the accumulation of natural or acquired resistance.

The prevention of infectious risk by health professionals is an integral part of the fight against HAI. The development of a prevention program and the implementation of specific measures to protect all users of healthcare facilities must take into account all transmission risks of infectious agents through its hygiene component of the hospital environment and staff hands for example. The professional infectious risk in the care environment is therefore omnipresent [11].

Thus, Benin, like all the countries of the whole world, has also appropriated this fight against HAI, by creating by ministerial decree No. 2006/6501/MS/DC/SGM/CNHU-HKM of 06/07/2006, the first hospital hygiene department. It was also set up the Committee for the Fight against Nosocomial Infections in Departmental Hospital Centers and Coordination Centers for the Control of Nosocomial Infections in the health districts throughout the country. Unfortunately, these organizations are not operational [12]. The hospital hygiene decision-making bodies are not operational for the simple reason that the different members are not motivated and also the non-existent budget line allocated to these bodies for their operations. The hospital established to treat and cure thus becomes a source of healthy man contamination and complication of the patient's initial illness leading to prolonged hospitalization, expensive cost of treatment, multi-visceral failures and sometimes death. The present study investigated the microbiological profile of medico-technical equipment, surfaces and premises in the neonatology department of Ouémé/Plateau Departmental University Hospital Center.

This study was conducted in this department to mitigate the recrudescence of nosocomial infections in the neonatology service and also to reinforce preventive measures in hospital hygiene.

Study Methods

This study took place in the neonatology department of Ouémé/Plateau Departmental University Hospital Centre and the samples were analyzed in the bacteriology laboratory section. It was a descriptive cross-sectional study, aimed to study the microbiological profile of medico-technical equipment, surfaces, premises and staff hands in the departmental University hospital center of ouémé- plateau (CHUD-O/P) neonatology department.

The study population consisted of: medico-technical equipment (infant beds, infant incubators or cradles, vacuum cleaners, CPAP, electronic syringes, IV stands, instruments trays, kidney dishes, sterilizer drums, carts, baby scales, bowls, jugs, jars, refrigerator and heat lamp), surfaces (mattresses, sheets, benches, door latches, washbasin, gowns), premises (floors, air, walls) and on-duty staff's hand.

The sampling method is non-probabilistic for the study. Two techniques of sampling were used, the first is the reasoned choice technique for medical-technical equipment, surfaces and premises; the second is the convenience technique or the staff.

The sample of 131 swab specimen taken before and after cleaning was composed of four batches: Batch #1: Medico-technical equipment (50 swabs); Batch #2: surfaces (34 swabs); Batch #3: Premises (23 swabs); Batch #4: Staff hands (18 swabs) and Batch #5: sur-blouses of baby visitors (6 swabs). The different sites were swabbed separately, with at least two sterile swabs (before and after cleaning).

Bionettoyage Procedure

- Discard clear water and scrape dirt.
- Pour the necessary amount of soap (detergent) into a bucket and mix the solution.
- Clean with the squeegee provided with a cloth soaked in water with soap.
- Rinse the towel in the bucket of clear water and then plunge it back into the bucket with soap to continue cleaning.
- Rinse surfaces thoroughly.
- Allow to dry.
- Rinse the towel and empty both buckets and rinse them

In Case of Disinfection

- Fill the two buckets with clean water again. In a bucket pour the necessary amount of chlorine (bleach) to obtain a 0.5% chlorine solution and mix.
- Disinfect by passing the soaked towel in the disinfectant solution.
- Rinse the towel in the bucket of clean water and then immerse it in the chlorinated water seal to continue the disinfection.
- Do not rinse and allow to air dry (the disinfectant must work).
- Thoroughly rinse the cleaning equipment, dry it and store it dry until next use. Never allow the cleaning material to be soaked in water (even with the addition of disinfectant).

Samples were systematically sent to the laboratory for the various bacteriological tests.

For each sample, the fresh state, the Gram stain and then the culture of the sample were made on specific culture media. The different culture media used were: MH broth, EMB agar, CHAPMAN agar, SABOURAUD agar, DNASE agar and MH agar. The identification of the bacteria was made on the Le Minor gallery, which was seeded and incubated in an oven at 37 °C for 24 hours for the identification of enterobacteria (Gram-negative bacilli).

Gram-positive cocci (staphylococci) were identified using biochemical tests (catalase and Dnase)

The antibiotic sensitivity test was performed on Mueller Hinton agar by the flood method. Seven blotter discs impregnated with different antibiotics to be tested were deposited on the agar surface. Then the medium dishes were incubated at 37 °C for 24 hours.

The collected data were manually analyzed and processed using WORD and EXCEL software.

Results

Microbiological Profile of Medico-Technical Equipment (50 Swabs: 25 before Cleaning and 25 after Cleaning)

A total of 138 germs were identified; i.e. 91 on the unclean equipment and 47 after cleaning, which eliminated 44 germs (almost 50%). The presence of germs on this equipment even after cleaning could explain that the cleaning was not effective because the ideal would be not to find germs after cleaning. All medico-technical equipment collected were contaminated by at least five different species of microorganisms before cleaning. After cleaning, some of them still carried at least two species of microorganisms. It should be noted that no germs were found on the metal equipment (trays, instrument boxes and sterilizer drums) that had undergone sterilization. In other words, the swabs made on this sterilized material resulted in absence of germ thus sterile culture (Table 1).

Microorganisms	Before Cleaning	After Cleaning	Total
Staphylococcus aureus	21	13	34
Staphylococcus spp	17	07	24
Klebsiella pneumoniae	16	09	25
Escherichia coli	15	07	22
Candida spp	12	06	18
Candida albicans	10	05	15
Total	91	47	138

Table 1: Microbiological profile of medical-technical equipment (Batch #1)

Microbiological Profile of Surfaces (34 Swabs: 17 before Cleaning and 17 After Cleaning)

A total of 127 germs were identified; i.e. 82 on un cleaned surfaces and 45 on the same surfaces after cleaning. The cleaning eliminated 37 germs (almost 50%). The sampled surfaces were all polluted by at least five different species of microorganisms before cleaning. After cleaning, some of them still contained at least two species of microorganisms. The presence of germs even after cleaning could explain that the cleaning has not been effective (Table 2).

Microorganisms	Before Cleaning	After Cleaning	Total
Staphylococcus aureus	13	06	19
Staphylococcus spp	22	15	37
Klebsiella pneumoniae	11	06	17
Escherichia coli	18	05	23
Candida spp	10	08	18
Candida albicans	08	05	13
Total	82	45	127

Table 2: Microbiological profile of surfaces (Batch #2)

Microbiological Profile of the Premises (23 Swabs: 13 before Cleaning and 10 After Cleaning)

A total of 73 germs were identified with 48 before cleaning and 25 after cleaning; an elimination of 23 germs (almost 50%). The premises sampled were all polluted by at least five different species of microorganisms before cleaning. After cleaning, some of them still contained at least two species of microorganisms. It was an unsatisfactory result since the 133 premises should be free of germs (Table 3).

Microorganisms	Before Cleaning	After Cleaning	Total
Staphylococcus aureus	12	09	21
Staphylococcus spp	05	03	08
Klebsiella pneumoniae	13	08	21
Escherichia coli	09	03	12
Candida spp	06	02	08
Candida albicans	03	00	03
Total	48	25	73

Table 3: Microbiological profile of premises (Batch #3)

Microbiological Profile of Staff Hands: 18 Swabs (3 per Agents: before Hand Washing, after Simple Hand Washing and after Rubbing Hands with the Hydro-Alcoholic Solution)

The results showed that the hands of the nursing staff also included the same germs as medico-technical equipment, surfaces and premises before simple washing. After simple washing (water + mild soap) of these same hands, we noticed that there only 3 of the 28 germs left on the hands; i.e. an elimination of 25 germs. The results of the same hands rubbed with the service's hydro-alcoholic solution or the benzothelium chloride-based gel rendered the hands shortly sterile (Table 4).

Microorganisms	Before Washing Hands	After Washing Hands With Mild Soap	After Hand Rubbing	Total
Staphylococcus aureus	06	01	00	07
Staphylococcus spp	06	00	00	06
Klebsiella pneumoniae	06	01	00	07
Escherichia coli	05	01	00	06
Candida spp	03	00	00	03
Candida albicans	02	00	00	02
Total	28	03	00	31

Table 4: Microbiological profile of staff's hands (Batch #4)

Microbiological Profile of Gowns Worn By Visitors of Babies: 6 Swabs (Batch #5)

Gowns worn by visitors even after washing still included dangerous germs (*S.aureus*, *K.pneumoniae* and *E. coli*). Six species of microorganisms were identified before washing. Three species (2 yeast species and *Staphylococcus spp*) were removed after washing (Table 5).

Microorganisms	Before washing	After washing with "omo"	Total
Staphylococcus aureus	06	03	09
Staphylococcus spp	06	00	06
Klebsiella pneumoniae	06	03	09
Escherichia coli	05	02	07
Candida spp	03	00	03
Candida albicans	02	00	02
Total	28	08	36

Table 5: Microbiological Profile of coats worn by Baby Visitors

Frequencies of the Identified Germs According to their Level of Resistance to Antibiotics

The analysis in Table 6 showed that, with regard to the frequencies of the identified germs, *S. aureus* was more common (21.95%), followed by *Staphylococcus spp* (20.33%), then *K. pneumoniae* (18.97%), *E. coli* (17.08%), *Candida spp* (12.73%) and *Candida albicans* (8.94%). Concerning the antibiotic resistance, *Staphylococcus* aureus was more resistant (37.01%), followed by *E. coli* (23.81%), *K. pneumoniae* (18.57%) and *Staphylococcus spp* (16.00%).

Germs	Germ number	Sensitive germs	Resistant germs
Staphylococcus aureus	81 (21.95%)	51 (23.28%)	30 (42.85%)
Staphylococcus spp	75 (20.33%)	63 (28. 76%)	12 (17. 14%)
Klebsiella pneumoniae	70 (18.97%)	57 (26. 02%)	13 (18.57%)
Escherichia coli	63 (17.08%)	48 (21.91%)	15 (21.42)
Candida spp	47 (12.73%)	NA	NA
Candida albicans	33 (8.94%)	NA	NA
Total	369 (100%)	219 (100%)	70(100%)

NA = Not applicable

Table 6: Frequencies of identified germs according to their level of resistance to antibiotics

The different antibiotics tested on gram- and gram-positive cocci are: Amoxicillin + Clavulanic acid, Gentamycin, Vancomycin, Cefoxitin, Erythromycin, Nitrofurans, Imipenem, Artoneam, Ceftriaxone, Ciprofloxacin, Netilmicin, Chloramphenicol

It should be emphasized that the antibiotic sensitivity test of the yeasts identified was not done.

Discussion

The analysis of the different results showed a large quantity of pathogenic microorganisms that contaminated the medico-technical equipment, the surfaces, the premises and even the hands of the staff of the neonatology department were isolated. Better still, they were the same species of microbes that were identified in all batches but at various frequencies: *S. aureus* (21.95%), *Staphylococcus spp* (20.32%), *K. pneumoniae* (18.97%), *E. coli* (17.07%), *Candida spp* (12.73%) and *Candida albicans* (8.94%). As well it was found that the observed percentages of antibiotic resistance were also significant after "as follows 37.01% for *S. aureus*, 23.81% for *Escherichia coli*, 18.57% for *K. pneumoniae* and 16.00% for *Staphylococcus spp*. Moreover, the same micro-organisms were also present on the protective gowns worn by the visitors of babies. These gowns were not for single use and they were washed only when they were visibly dirty. Babies were therefore more exposed to germs than protected by the wearing of these gowns.

Putting two or three babies of different mothers and different pathologies in the same incubator increased the exposure of these sensitive souls and their stay in this nursery rather than being short and beneficial could become long, even fatal.

The study conducted by Ouendo et al in 2013 at CNHU-HKM reported after microbiological tests that 48.8% of sterilized medical equipment was contaminated with *S. aureus*, *P. aeruginosa* and enterobacteriaceae [13]. It also reported that no germ was identified on compresses. *S. aureus* was found on instruments sterilized by the poupinel (dry heat sterilizer) in the main unit of the hospital sterilization and on those who were used in the surgery department [10]. The results reported by these authors were similar to those reported by other studies [14, 15].

In the Zou-Collines Departmental Hospital Center, the study carried out on the bacteriological profile of the bedding of the surgery department in 2016 revealed that almost all the swabbed beds were infected by multi-resistant germs (*Staphylococcus*, *Klebsiella*, *Pseudomonas*, ...) [16]. Similarly, the study entitled: assessment of contact precautions at ABPF Sikèkodji in 2016 revealed that the hand hygiene rules were not well respected hence the presence of germs (*S. aureus* , *K. pneumoniae* , *E. coli*, ...) on the hands of the staff. These identified germs were also mostly resistant to antibiotics [11]. The bio-cleaning policy was insufficient. The quality of the cleaning products used and the lack of control of the dilution procedure bleach would be questionable.

Hand washing reduced the resident flora by 50%. The hydro-alcoholic solution used in this service and the hydro-alcoholic gel based on benzothelium chloride were effective in rendering the hands temporarily sterile. Isolation gowns worn by the babies' parents, especially mothers would be the source of contamination, because they were not for single use and were better washed only when they were obviously dirty. As proof, there were six gowns for the visitors of about forty hospitalized babies. The multi-resistance observed suggested a public health problem that might preoccupy all the actors of the sanitary system of this hospital. The workload would be the source of bad bio-cleaning. The high rate of contamination of this service by pathogenic microorganisms exposed the users of this service to infections associated with care and hospital infections. The reduced number of staff in addition to the lack of incubators that forced them to put sometimes two or three babies of different mothers with different pathologies in the same bed. The means, which the hospital administration had made available to this service (medico-technical equipment, maintenance product and personnel), were very inadequate. Added to this, the high workload could be one of the causes of these results.

Concerning the antibacterial susceptibility testing interpretation, three disks (42.85%) from the seven used, were often sensitive and four disks (57.15%) resistant. The fact of having sensitive antibiotic disks is an advantage because it would allow to operate the riposte in the sense of performing high level decontamination operations which would destroy the nests of these bacteria.

The leaders must be aware of the gravity of the risks to which users of this are exposed to.

It is important to set out the different results of this study with a view to improving the quality of the hospital environment and to encourage the rigorous application of good practices in the healthcare environment by all users of health facilities.

Conclusion

This study allowed us to record: A high rate of bacterial contamination of medical-technical equipment, surfaces and premises in the CHUD-O / P neonatal department, More than half (57.14%) of identified bacterial strains are resistant to several families of antibiotics, Poor observance of good practices of basic hygiene would be at the base of the advent of this situation which is already the nest of infections associated with care, and / or hospital infections. This is already a real public health problem and specifically concerns the hospital administration in particular and each of the actors of the health system in general for the implementation of actions to eradicate these bacteria and reduce the level of infectious risk in this service. There is therefore a need to strengthen the capacity of staff on care-related infection prevention measures.

Data Availability

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Competing interests

All authors report no conflicts of interest relevant to this article.

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