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Safe Maternity in a Context of Limited Resources: Bacteriological Study of the Obstetrical Environment of the Laquintinie Hospital in Douala, Cameroon

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Abstract

Introduction: Microorganisms capable of causing nosocomial infections in our healthcare environment are a major cause of morbidity and mortality in our maternity wards. **Objective:** Our objective was to qualify and quantify the bacterial flora of the hospital environment (surfaces and air) of the Laquintine Hospital Douala gynecology and obstetrics department. **Methodology:** We took forty-two (42) samples in three units (delivery room, obstetrical theatre and a postpartum unit) of the Laquintine Hospital Douala gynecology and obstetrics department. These samples concerned: surfaces (trolley, operating room light, bedside table, window, wall, IV pole, door handle, switches, footrest, cupboard, operating table, bed, oxygen cannula: n = 37) and air: n = 5. Standard bacterial isolation and identification methods were used. **Results:** In our study, cultures were positive in 69.04% of samples (29/42), with 67.57% of surfaces and 100% of air samples; 86.21% (25/29) consisted of potentially pathogenic species. The distribution of these potentially pathogenic species

showed a predominance of staphylococci with 70.83% coagulase negative staphylococci and 29.67% *Staphylococcus aureus*. Gram-negative bacilli (*Enterobacter cloacae*, *A. baumanii*), and *Micrococcus* sp were isolated respectively in 5.4%, 8.1% and 10.81% of cases. **Conclusion:** It appears essential to improve basic hygiene and asepsis in the maternity ward by establishing continuous monitoring and evaluation of hand washing and periodic decontamination of premises.

Keywords

Bacterial Ecology, Antibiotic Sensitivity, Maternity, Douala

1. Introduction

Microorganisms likely to cause nosocomial infections in our healthcare environment are a major cause of morbidity and mortality in our maternity wards. However, it is difficult to establish a direct link between environmental contamination and the occurrence of nosocomial infections. The germs found on surfaces depend on the quality of the air because particles suspended in the air will inevitably end up being deposited on surfaces and even more quickly the larger they are. The samples from the surfaces of a room will therefore reflect, in addition to the quality of biocleaning, the effectiveness or failures of an air treatment system [1]-[4].

In Cameroon, contamination of the hospital environment remains a major problem in the occurrence of nosocomial infections. Several studies have been carried out there, notably that of Luma *et al.* in 2013, the results of which reported bacterial contamination of the environment at 83.3% on surfaces, 37.56% of air samples, and 100% of caregivers' hands [5]. Although hand washing is the single most appropriate measure to prevent transmission of infection from person to person, knowledge of the movement of microorganisms from the healthcare environment is essential to prevent and control infections during routine clinical care [6].

These measures must be implemented in a relevant manner and comply with very precise objectives while avoiding an inflation of unnecessary analyses, consuming time and financial resources and therefore overconsumption of antibiotics [1]. Efforts are being made today to reduce contamination of the hospital environment by establishing methods for monitoring air, water, surfaces, food, medical devices, healthcare equipment and strengthening hospital hygiene measures [1] [4] [6].

The prevention of nosocomial infections being one of the major concerns of all local, interregional or national authorities, this prompted us to study the bacterial flora of the hospital environment of the maternity department of the Laquintinie hospital in Douala, with the aim of identifying potential micro-organisms of nosocomial infections, and thus making our contribution to the fight against these intra-hospital infections.

2. Methodology

2.1. Study Framework

This study was carried out at the Laquintinie hospital in Douala, which is a reference health establishment with a large hosting capacity and a large patient turnover.

2.2. Type of Study

This was a descriptive cross-sectional study.

2.3. Period and Duration of the Study

Our study took place from December 6, 2020 to June 1, 2021; *i.e.* 06 months.

2.4. Clinical and Technical Procedure

It involved three units of the gynecology and obstetrics department which include a delivery room, an obstetric operating room and a postpartum unit.

Air and surface samples were collected according to standard sampling recommendations [7].

The surface samples were taken using the swab moistened with a sterile 9% isotonic NaCl solution. The sampling consisted of passing the swab over defined areas using our measuring instrument (25 cm^2) in close parallel streaks by slightly rotating the swab, then over the same areas in streaks perpendicular to the first.

Then the swab was put back in its well-identified protective case (location of the area; sampling site; date).

These surfaces were: trolley, operating light, bedside table, window, wall, IV pole, door handle, switches, footrest, cupboard, operating table, bed, oxygen cannula.

The air was sampled by sedimentation using the passive method. Boxes filled with MRSA agar (90 mm in diameter) were placed, opened at different points in the units: delivery rooms, obstetric theater. After 30 minutes, they were recovered, labeled and taken to the laboratory at room temperature.

All samples were immediately put in coolers with temperatures set at 4˚C and transported by road the same day, with a maximum delay of <2 hours to the reference clinical biology laboratory of the Douala General Hospital located in Cameroon in the city of Douala, where microbiological analyses were carried out.

The samples were taken in two phases.

2.5. Bacteriological Procedures

Once in the bacteriology laboratory, each cotton pad was aseptically placed in a tube containing 2 ml of sterile physiological solution.

0.1 to 0.4 ml were introduced using a pipette into the appropriate culture media:

- MRSA agar for total flora;
- eosin methylene blue agar for enterobacteriacae;
- mannitol salt agar for *Staphylococcus* species;

-and incubated at 30˚C for a minimum period of 48 hours for aerobic microorganisms and at 37˚C for 24 hours for specific germs.

After incubation, bacterial isolates were identified using standard biochemical methods.

The study was approved by the ethics committee of Laquintinie Hospital.

2.6. Statistical Analysis

The entry, exploitation and analysis of our data used Statview software version 5.0 (SAS Institute, Inc., USA). During our study, we took 42 samples distributed according to Figure 1.

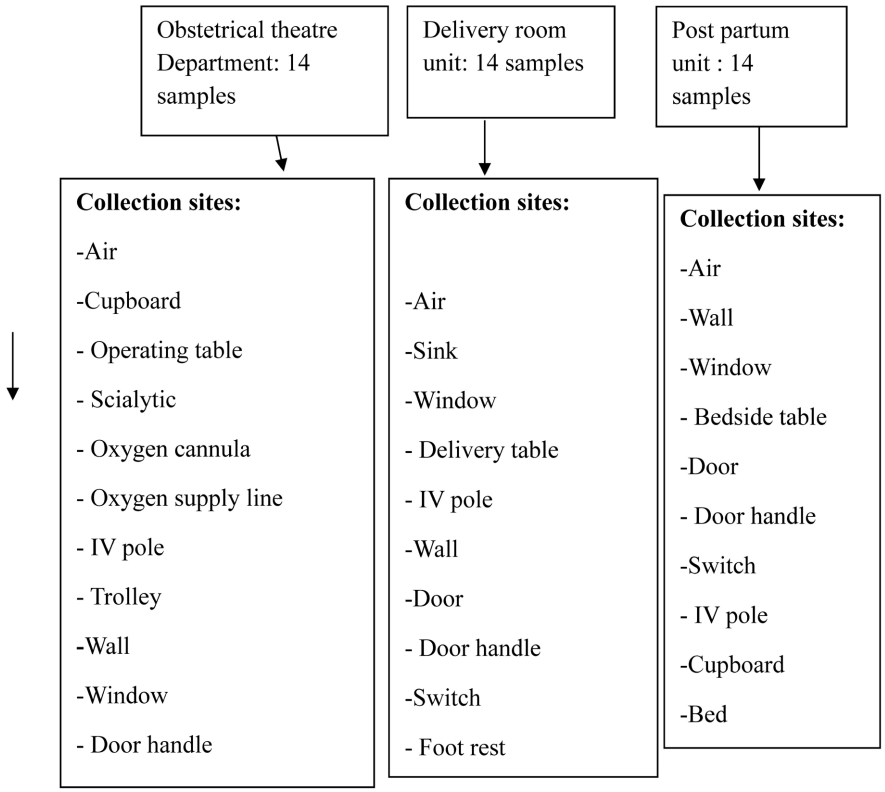

Figure 1. Distribution of samples taken according to units.

3. Summary of Results

In our study, a total of 42 samples were taken, including 37 surface samples and 05 air samples. Positive cultures of surface samples were respectively 54.54% for the Delivery Room, 45.45% for the Obstetrical theatre and 80% in the postpartum unit; 100% of air sample cultures were positive in all three units (Table 1).

The postpartum unit was heavily soiled and was the only unit where *Burkolderia cepacia* and *Bacillus* sp were found on surface samples.

Coagulase-negative staphylococci were the bacterial species most generally found in the sampling units, with 66.67% in the obstetrical theater (Table 2).

Table 1. Distribution of positive cultures according to the types of samples and the collection units of the hospital maternity ward.

	Sampling units		
	Delivery room	Obstetrical Theatre	Post partum unit
	(%)	(%)	(%)
Type of sample			
AIR	100	100	100
SURFACE	54.54	45.45	80

Table 2. Distribution of germs isolated from the environment (air, surfaces) according to sampling units.

		Sampling units		
	Delivery room		Obstetric Theatre	Post partum unit
Group of bacteria		(%)	(%)	(%)
Gram positive cocci	Coagulase negative *Staphylococcus*	54.54	66.67	35
	Staphylococcus aureus	9.09	33.33	20
Gram positive bacilli	*Micrococcus* sp	9.09	00	20
	Bacillus sp	00	00	05
Gram negative bacilli	*Enterobacter cloacae*	18.18	00	00
	A. baumanii	9.09	00	10
	Burkolderia cepacia	00	00	10

Table 3. Different germs isolated in the three sites of the maternity department.

Group of bacteria	Isolated germs	Number (n)	Percentage (%)
Gram positif cocci	*Staphylococcus aureus*	5	19.23
	Staphylococcus hominis	3	11.54
	Staphylococcus warneri	3	11.54
	Staphylococcus xylosus	2	7.69
	Staphylococcus saprophyticus	2	7.69
	Staphylococcus cohnii ureal	2	7.69
	Staphylococcus capitis	2	7.69
	Micrococcus ssp	2	7.69
	Staphylococcus cohniicohnii	1	3.86
	Total	22	84.62
Gram negative bacilli	*Enterobacter cloacae*	2	7.69
	Acinetobacter baumanii	2	7.69
	Total	4	15.38
	TOTAL	26	100.00

In our study, cultures were positive in 69.04% of samples (29/42) in a distribution of 67.57% of surfaces and 100% of air samples.

Bacillus sp and *Burkolderia cepacia* represented the least isolated environmental species in 13.79% of cases (04/29) compared to 86.21% (25/29) for potentially pathogenic species.

The distribution of these potentially pathogenic species shows a predominance of staphylococci with 70.83% of coagulase negative staphylococci and 29.67% of *Staphylococcus aureus*.

Gram-negative bacilli (*Enterobacter cloacae*, *A. baumanii*), and *Micrococcus* sp were isolated respectively in 5.4%, 8.1% and 10.81% of cases (Table 3).

The majority (84.62%) of the isolated germs belonged to the Gram-positive cocci groups.

3.1. Distribution of Germs Isolated According to Sampling Sites

A. Delivery room

Table 4. Distribution of germs isolated in the delivery room.

Sampling site	Number of isolated germs	Nature of germs
Bed	3	*S. capitis* + *E. cloacae* + *A. baumanii*
Air	2	*Staphylococcus aureus* + *Staphylococcus hominis*
Sink	2	*Micrococcus* sp + *Enterobacter cloacae*
Trolley	1	*Staphylococcus hominis*
Wall	1	*Staphylococcus cohnii cohnii*
Door handle	1	*Staphylococcus warneri*
Foot rest	1	*Staphylococcus cohnii ureal*

In the delivery room the bed was the site where the greatest number of germs had been isolated (n = 3); these were *S. capitis*, *E. cloacae* and *A. baumanii* (Table 4).

B. Obstetric operating room

Table 5. Distribution of germs isolated in the obstetric operating room.

Sampling site	Number of isolated germs	Nature of Germs
Air	1	*Staphylococcus aureus*
Trolley	1	*Staphylococcus xylosus*
Oxygen supply line	1	*Staphylococcus saprophyticus*
Wall	1	*Staphylococcus aureus*
IV Pole	1	*Staphylococcus hominis*
Operating table	1	*Staphylococcus warneri*

The obstetrical unit was contaminated by a single germ: the *Staphylococcus* genus (Table 5).

C. Post partum unit

Table 6. Distribution of germs isolated in post partum unit.

Sampling site	Number of isolated germ	Nature of germs
Bedside table	2	*Staphylococcus xylosus* + *Acinetobacter baumanii*
Air	1	*Staphylococcus aureus*
Cupboard	1	*Micrococcus* sp
Window	1	*Staphylococcus saprophyticus*
Bed	1	*Staphylococcus aureus*
Wall	1	*Micrococcus* sp
Door handle	1	*Staphylococcus warneri*
Door	1	*Staphylococcus cohnii ureal*

The bedside table was the area with the most soiling (n = 2); these were *S. xylosus* and *A. baumanii* (Table 6).

Table 7. Bacterial population in the post-partum unit.

		BACTERIAL POPULATION (UFC/container)		
Sampling site	**Number**	**$<10^1$**	**$[10^1 - 10^2]$**	**$>10^2$**
Bedside table	**1**	0	0	1
Air	**1**	0	1	0
Cupboard	**1**	0	1	0
Window	**1**	0	1	0
Bed	**1**	0	1	0
Wall	**1**	0	1	0
Door handle	**1**	0	1	0
Door	**1**	0	0	1
Number of samples (%)	**8**	**0 (0.00%)**	**6 (75.00%)**	**2 (25.00%)**

The bacterial density which presents the greatest number belonged to the class $10 - 10^2$ UFC/box with a rate of 75.0% (Table 7).

3.2. Antibiotic Resistance Profile

A. Antibiotic resistance profile of staphylococci (Phases 1 and 2)

Resistance rate > 50% regardless of the phase for fosfomycin, oxacycline, erythromycin, kanamycin, Penicillin G, Vancomycin, Cefoxitime, Fusidic acid and Rifampicin (Figure 2)

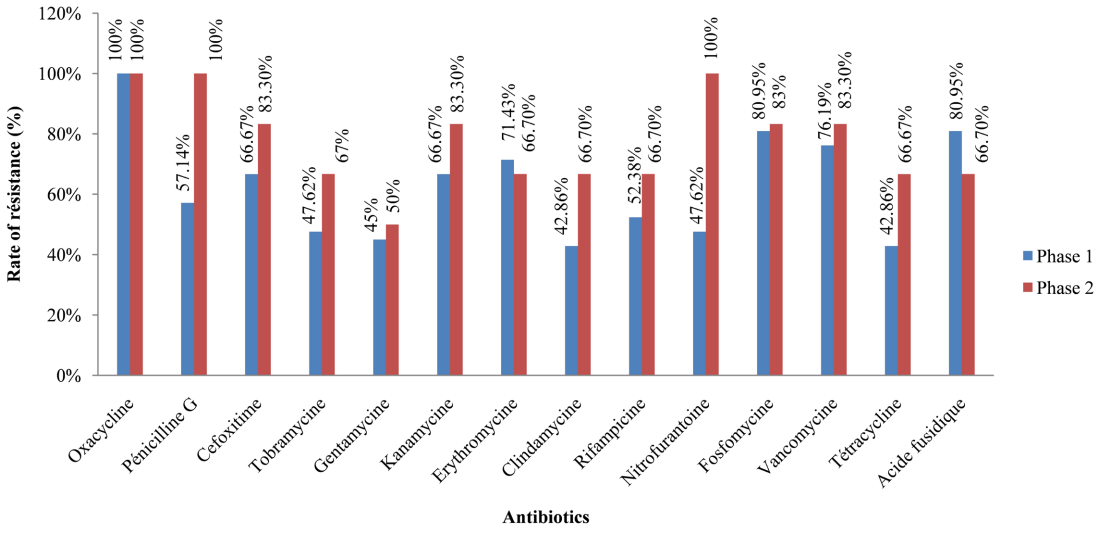

Figure 2. Antibiotic resistance profile of staphylococci (Phases 1 and 2).

b. Antibiotic resistance profile of Gram-negative bacilli (Phases 1 and 2)

Resistance rate > 50% regardless of the phase for colistin, ceftriaxone and Imipenem (**Figure 3**).

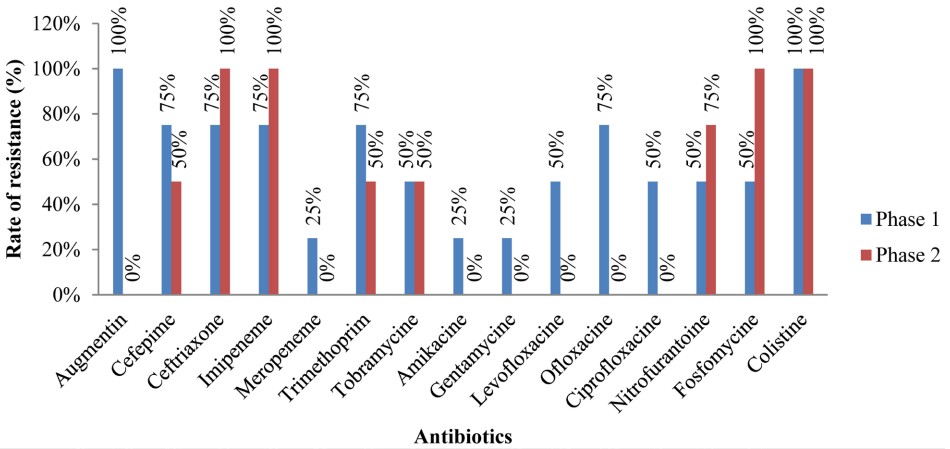

Figure 3. Antibiotic resistance profile of Gram-negative bacilli (Phases 1 and 2).

4. Discussion

The role of the environment in the occurrence of nosocomial infection has long been ignored. It is known today that the hospital environment is a real reservoir of microorganisms involved in many cases of nosocomial infections. The aim of our study was to qualify and quantify the bacterial flora likely to cause nosocomial infections in the environment of the maternity ward of the Laquintinie hospital in Douala.

The results of microbiological culture showed that the maternity environment was heavily contaminated by bacteria. In fact, 69.04% of the samples revealed the presence of microorganisms. This result is lower than that obtained by Meunier

et al. in Strasbourg, 87% (266/313) of positive cultures [8] but close to those of Luma *et al.*, where 73% of the samples taken were contaminated [5].

Air is one of the main routes of transmission for germs involved in nosocomial infections. This could explain the preponderance in our study of staphylococci which greatly used this pathway.

For Ortiz *et al.* in Spain, airborne transmission is an important route for many microbes in the hospital environment [9]. Environmental contamination varies in the same establishment from one department to another [4] [7]. Our study corroborates this assertion because all samples taken following delivery were 80% (8/10) positive, while those from the delivery room and the obstetrical suite were, respectively only positive in 63.64% (7/11) and 54.55% (6/11) of cases.

All these sampling areas constitute critical points in the service and often escape vigilance during disinfection. The bacterial density that presented the greatest number belonged to the 10 - 10^2 CFU/container. This bacterial load is well above the tolerable standard for these services, which must be <5 CFU/container with the absence of pathogenic germs [1].

In our study, Gram-positive cocci (GPC) were the bacterial group mainly isolated at 69.56%. This result is slightly higher than those of Gbonon *et al.* and Saouid *et al.* who reported rates of 56.3% and 46% [10] [11].

Coagulase negative staphylococci represented the majority of staphylococci isolated with a prevalence of 75%. Rutala *et al.* (2007) in California had a similar result with keyboards, where all cultures were positive for coagulase-negative staphylococci (CNS) [12].

The resistance rate of staphylococci isolated in our study was 100% resistance to antibiotics such as colistin, Augmentin, ceftriaxone, imipeneme. For colistin resistance, this was a confirmation of the intrinsic resistance of staphylococci to colistin. The rate of MRSA and SCN resistant to methicillin was 100%. This methicillin resistance is much higher than that reported by Boukadida in Tunisia (5.2%) with staphylococci isolated from septicemia [13].

Our sample size had no statistical power, which constitutes a major limitation to our study.

5. Conclusions

In the light of our study, the environment of the Laquintinie hospital, Douala gynecology and obstetrics department is heavily contaminated by Gram-positive Cocci (GPC) with marked resistance mainly to fosfomycin, vancomycin, and fusidic acid, with resistance rates greater than 50%. The same trend was observed in Gram negative bacilli (GNB) for Colistin, Ceftriaxone and imipenem. This justifies the integration of directives on practices and strategies implemented for the improvement and compliance of the hygiene of our environment.

In the context of the fight against nosocomial infections, this work shows the importance of prevention, which remains the only way to limit the risk of nosocomial infection based on the establishment of written recommendations specifying the rules.

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Contribution of Authors

Essome supervised the study and wrote the manuscript.

Meya collected the data.

Tocki and Essome Tocky provided the English translation as well as the formatting of the manuscript.

Medi, Moustapha, Boten, Michelle, Essola, Mangala, Koundo, Tchounzou, Ngalame, Ngaha, Ndolo, Eyenga, Ehète, Obono, Ofakem, Mounchikpou, Ekono, Makongo, and Ntago read and corrected the manuscript; Wafo and Adiogo supervised the study.

All authors have read and approved the final manuscript.

Conflicts of Interest

The authors declare that they have no conflict of interest.

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