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Full Length Research Paper

Demographic survey and bacterial skin profile of patients and staff of a teaching hospital in Port Harcourt, Nigeria

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ABSTRACT

The skin microbiota is a diverse ecosystem of microorganisms that serve as a crucial defense against pathogenic invasion. In healthcare settings, such as teaching hospitals, both patients and healthcare workers (HCWs) harbor unique bacterial skin flora influenced by various demographic and clinical factors. This study, therefore, focused on the demographic survey and bacteriological skin profile of patients and healthcare workers at a teaching hospital in Port Harcourt, Nigeria. Skin swab samples were collected from 69 patients and hospital staff using sterile swab sticks and transported aseptically to the Microbiology Laboratory, Department of Microbiology, Faculty of Science, Rivers State University, Port Harcourt, Nigeria. Socio-demographic data revealed that hospital staff comprised a higher percentage (63.77%) than patients (36.23%). Individuals aged 21–30 years had the highest representation (47.82%), while those under 20 years had the lowest (5.76%) among the assessed staff and patients. The study identified a variety of bacterial skin flora, including *Bacillus* species, *Escherichia coli*, *Micrococcus* species, *Klebsiella* species, *Staphylococcus aureus*, and *Staphylococcus epidermidis*. *S. aureus* had the highest prevalence (33.33%) among patients and staff, while *Micrococcus* and *Klebsiella* species had the lowest occurrence (5%). Laboratory staff exhibited the highest prevalence of *Staphylococcus* species (11.59%) and *Bacillus* species (30%). *E. coli* was detected in 13.79% of patients in the female medical ward. Findings from this study highlight the significant role of hospital personnel in the epidemiology of hospital-acquired infections and underscore the need for more effective infection control measures in healthcare facilities.

Keywords: Bacterial skin flora, demography, healthcare workers, patients, teaching hospital.

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INTRODUCTION

The human skin is a complex ecosystem inhabited by a variety of microorganisms, collectively known as the skin flora. These microorganisms play a significant role in maintaining skin health and protecting against pathogenic invaders. Understanding the demographic characteristics, composition, and diversity of skin flora is crucial for improving infection control practices, preventing nosocomial infections, and optimizing patient care in hospital settings. The bacterial composition of an individual's skin flora can be influenced by various factors, making it essential to study these variations within healthcare environments.

The skin flora, or microbiota, is a complex community of microorganisms that play an essential role in human

health. These microorganisms, which include bacteria, fungi, and viruses, serve as a barrier against pathogenic organisms and help maintain the skin's homeostasis (Grice and Segre, 2022). The composition of skin flora is influenced by environmental factors, personal hygiene practices, and individual health conditions. In healthcare settings, the skin flora of both patients and healthcare workers can contribute to the transmission of infectious diseases, including hospital-acquired infections (HAIs). Understanding the bacterial skin flora of individuals within a hospital setting is essential for developing targeted infection control measures. Within the controlled environment of a teaching hospital, the bacterial skin flora of both patients and healthcare workers (HCWs) can be influenced by various factors such as hygiene practices, environmental conditions, and health status (Götz et al., 2020).

Demographic variables such as age, sex, underlying health conditions, and hospital exposure can significantly affect the composition of skin flora in both patients and healthcare workers (Van der Meulen et al., 2019). For instance, patients who are immunocompromised or suffering from chronic illnesses often have an altered microbial composition compared to healthy individuals (Fierer et al., 2023). Healthcare workers, due to their frequent and close interactions with patients, can act as vectors for bacterial transmission, making their skin flora equally critical to monitor (Lipsitch et al., 2016).

Understanding the bacterial skin flora of both groups is crucial in hospital settings, as it directly impacts the spread of healthcare-associated infections (HAIs). Studies have shown that certain bacteria, such as *Staphylococcus aureus*, including methicillin-resistant *S. aureus* (MRSA), are commonly found on the skin of both patients and healthcare workers, potentially leading to cross-contamination (Niemeyer et al., 2018). Additionally, shifts in microbiota composition, whether due to antibiotic use or other interventions, may increase susceptibility to infections (Zong et al., 2016).

Given the pivotal role of skin flora in infection dynamics, this study seeks to explore the demographic characteristics of patients and healthcare workers and their respective bacterial skin flora within a teaching hospital. Such insights can guide infection control strategies and improve the management of hospital-acquired infections.

MATERIALS AND METHODS

Description of study area and location

The study was conducted at a University Teaching Hospital in Port Harcourt, Nigeria, located at latitude 4.7796° N and longitude 7.0143° E. The hospital serves as a teaching facility for medical students and provides clinical and health services to residents of Port Harcourt and Rivers State in general. Port Harcourt, the capital city of Rivers State, Nigeria, is densely populated due to the influx of people from other parts of the state and the country. It is a highly industrialized city, home to various companies, including those involved in oil and gas-related activities.

Study design

This study was a cross-sectional, prospective study. Human subjects were randomly selected, consisting of 29 patients and 40 hospital staff. A well-structured questionnaire was used to obtain demographic data from the participants.

Inclusion criteria

Individuals accessing different units of the hospital for medical attention were included in the study.

Exclusion criteria

The exclusion criteria included individuals who were:

- Receiving antibiotics
- Suffering from skin injuries
- Declining to provide consent.

Consent and ethical approval

Informed consent was obtained from all patients and staff before sample collection. Ethical approval for the study was secured from the hospital's ethics committee prior to the commencement of the research.

Sample collection

Skin swab samples were aseptically collected from staff and patients across different hospital departments using sterile swab sticks.

Microbiological analysis of the skin samples

Bacterial species were recovered from the skin of staff and patients using moist, sterile swab sticks and

transported to the Microbiology Laboratory of Rivers State University, Port Harcourt, Nigeria. The samples were inoculated onto solid bacteriological growth media, including Nutrient Agar, Mannitol Salt Agar, and MacConkey Agar, using the streak method. The inoculated plates were inverted and incubated at 37°C for 24 to 48 hours.

The colonies formed on the plates were identified as pure bacterial isolates following the method described by Akani et al. (2019) and Sampson et al. (2020). The pure cultures were characterized based on their cultural and biochemical features, including colony color, shape, elevation, and consistency. Gram staining was performed to visualize the shape and arrangement of bacterial cells under a light microscope, following the method outlined by Forbes et al. (2007).

RESULTS

Demography of the staff and patients of the hospital studied

The data presented in Table 1 indicate that females had a higher number and percentage than males. Specifically, 28 (70%) of the staff studied were female, while 12 (30%) were male. Similarly, among the patients assessed, 16 (60%) were female, and 13 (40%) were male. Overall, 44 (63.77%) of the study population were female, while 25 (36.23%) were male (Table 1).

The age distribution of the study population is shown in Table 2. The data obtained revealed that individuals within the age bracket of 21–30 had the highest representation, followed by those within the 31–40 age bracket, while those younger than 20 years were the least encountered in the study.

The highest number of staff members was obtained from the Laboratory Units and Blood Bank, which accounted for 27.5% of the population studied. Similarly, the highest number of patients was recorded in the Female Medical Ward, where 27.59% of the patients investigated were from this ward.

Table 3 shows the distribution of the staff from the different departments assessed with their percentages and Table 4 shows the distribution of the patients from the different wards assessed with their percentages.

Bacterial skin flora of the health workers and patients assessed

Five bacterial genera - Bacillus, Micrococcus, Escherichia, Klebsiella, and Staphylococcus, were recovered from the skin of the hospital staff and patients studied.

As shown in Table 5, *Staphylococcus* species were the most dominant on the skin of both staff and patients, being recovered from 33.33% of the population studied. This was followed by *Bacillus* spp. (28.99%), *Escherichia coli* (21.74%), and *Klebsiella* and *Micrococcus* species, each occurring in 5% of the population studied.

Furthermore, Table 6 indicates that laboratory staff had the highest occurrence of *Staphylococcus aureus* (12.5%). The highest occurrence of *E. coli* was among pharmacy staff, as the bacterium was isolated from 5% of the workers. Overall, the study showed that 28.6% of laboratory staff had the highest incidence of bacterial skin colonization.

The occurrence of bacterial species on the skin of patients in different wards is recorded in Table 7. The results indicate that patients in the Female Medical Ward (FMW) had the highest prevalence of *Bacillus* spp. (6.89%), *E. coli* (13.79%), and *Staphylococcus aureus* (13.79%).

Table 1. Gender distribution of the staff and patients studied.

Sex	Staff No (%)	Patient No (%)	Overall
Female	28 (70)	16 (60)	44(63.77)
Male	12 (30)	13 (40)	25(36.23)

Table 2. Age distribution of the staff and patients from the different departments and wards studied.

Age	Staff	Patients	Overall
<20 (%)	0 (0)	4(13.79)	4 (5.79)
21 - 30 (%)	18 (45)	14(48.28)	33 (47.82)
31 - 40 (%)	15(37.5)	7(24.14)	22 (31.88)
41 and above (%)	7 (17.5)	4 (13.79)	11(15.94)

Table 3. Distribution of the staff in the different departments studied.

S/N	Department	Total No (%)
1	AD	3 (7.5)
2	LUB	11 (27.5)
3	DT	5 (12.5)
4	EM	1 (2.5)
5	DD	1 (2.5)
6	GUC	4 (10)
7	RU	1 (2.5)
8	DC	1 (2.5)
9	NU	9 (22.5)
10	SY	1 (2.5)
11	PY	3 (7.5)

Key: **AD** = Administrative Department, **LUB** = Laboratory Units and Blood Bank, **DT** = Doctor, **EM** = Environmentalist, **DD** = Dietetic Department, **GUC** = Genitourinary Clinic, **RU** = Research Unit, **DC** = Dermatology Clinic, **NU** = Nursing Unit, **SY** = Security, **PY** = Pharmacy.

Table 4. Distribution of the patients in the different wards studied.

S/N	Department	Total No (%)
1	OPD	4 (13.79)
2	GMU	2 (6.89)
3	CW	1 (3.44)
4	MMD	7 (24.13)
5	FMW	8 (27.59)
6	FSW	2 (6.89)
7	GUC	1 (3.44)
8	MSW	1 (3.44)
9	FHU	1 (3.44)
10	FPU	1 (3.44)
11	MPL	1 (3.44)

Keys: **OPD** = Out Patient Department, **GMU** = Gynaecology and Maternity Unit, **CW** = Children Ward, **MMD** = Male Medical Ward, **FMW** = Female Medical Ward, **FSW** = Female Surgical Ward, **GUC** = Genitourinary Clinic, **MSW** = Male Surgical Ward, **FHU** = Family Health Unit, **FPU** = Family Planning Unit, **MPL** = Medical Pathology Laboratory.

Table 5. Prevalence of bacterial species in hospital staff and patients studied.

Bacterial Specie	Staff No. (%)	Patients No. (%)	Overall No. (%)
Bacillus sp	12(30)	8 (27.59)	20(28.99)
E. coli	7(17.5)	8(27.59)	15(21.74)
Micrococcus sp	2(5)	0(0)	2(5)
Klebsiella sp	2(5)	0(0)	2(5)
Staphylococcus aureus	12(30)	11(37.93)	23(33.33)
Staphylococcus epidermidis	7(7.5)	13(44.83)	20(28.99)

Table 6. Prevalence of bacterial species in staff of the departments studied.

Department	*Bacillus* spp No. (%)	*E. coli* No. (%)	*Klebsiella* spp No. (%)	*Micrococcus* spp No. (%)	*S. aureus* No. (%)	*S. epidermidis* No. (%)	Total (%)
AD	1 (2.5)	1 (2.5)	0 (0)	0 (0)	1 (2.5)	1 (2.5)	4 (9.5)
LUB	3 (7.5)	1 (2.5)	0 (0)	1 (2.5)	5 (12.5)	2 (5)	12 (28.6)
DT	2 {5)	0 (0)	1 (2.5)	0 (0)	1 (2.5)	0 (0)	4 (9.5)
EM	1 (2.5)	0 (0)	0 (0)	0 (0)	0 (0)	1 (2.5)	2 (4.8)
DD	0 (0)	0 (0)	0 (0)	0 (0)	1 (2.5)	0 (0)	1 (2.4)
GUC	2 (5)	1 (2.5)	0 (0)	1 (2.5)	0(0)	0(0)	4(9.5)
RU	0(0)	0(0)	0(0)	0(0)	1 (2.5)	0(0)	1 (2.4)
DC	1 (2.5)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	1 (2.4)
NU	1 (2.5)	1 (2.5)	1 (2.5)	0 (0)	3 (7.5)	3 (7.5)	9 (21.4)
SY	0 (0)	1 (2.5)	0 (0)	0 (0)	0 (0)	0 (0)	1 (2.4)
PY	1 (2.5)	2 (5)	0 (0)	0 (0)	0 (0)	0 (0)	3 (7.1)
TOTAL	12 (30)	7 (17.5)	2 (5)	2 (5)	12 (30)	7 (17.5)	42 (100)

Keys: **AD** = Administrative Department, **LUB** = Laboratory Units and Blood Bank, **DT** = Doctor, **EM** = Environmental, **DD** = Dietetic Department, **GUC** = Genitourinary Clinic, **RU** = Research Unit, **DC** = Dermatology Clinic, **NU** = Nursing Unit, **SY** = Security, **PY** = Pharmacy.

No incidence of *Micrococcus* or *Klebsiella* species was observed among patients in the Female Medical Ward. The overall analysis also revealed that the Female Surgical Ward had the highest incidence of bacterial skin invasion, while the Children's Ward, Family Planning Unit, and Family Health Unit recorded the lowest incidence of

Table 7. Prevalence of bacterial species in patients at the different wards assessed.

Wards	*Bacillus* spp No. (%)	*E. coli* No. (%)	*Klebsiella* spp No. (%)	*Micrococcus* spp No. (%)	*S. aureus* No. (%)	*S. epidermidis* No. (%)	Total (%)
OPD	1 (3.45)	2 (6.89)	0 (0)	0 (0)	1 (3.45)	2 (6.89)	6 (15.00)
GMU	1 (3.45)	0 (0)	0 (0)	0 (0)	1 (3.45)	0 (0)	2 (5.05)
CW	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	1 (3.45)	1 (2.50)
MMD	2 (6.89)	1 (3.45)	0 (0)	0 (0)	2 (6.89)	4 (13.79)	9 (22.50)
FMW	2 (6.89)	4(13.79)	0 (0)	0 (0)	4 (13.79)	4 (13.79)	14 (35.00)
FSW	1 (3.45)	0 (0)	0 (0)	0 (0)	0 (0)	2 (6.89)	3 (7.50)
FHU	1 (3.45)	0(0)	0(0)	0(0)	0 (0)	0(0)	1 (2.50)
FPU	0 (0)	0 (0)	0 (0)	0 (0)	1 (3.45)	0 (0)	1 (2.50)
MPL	(0)	0 (0)	0 (0)	0 (0)	1 (3.45)	0 (0)	1 (2.50)
GUC	0 (0)	1 (3.45)	0 (0)	0 (0)	1 (3.45)	0(0)	2 (5.00)
TOTAL	8(27.58)	8(27.58)	0(0)	0(0)	11(37.93)	13(44.82)	40(100)

Keys: **OPD** = Out Patient Department, **GMU** = Gynaecology and Maternity Unit, **CW** = Children Ward, **MMD** = Male Medical Ward, **FMW** = Female medical ward, **FSW** = Female Surgical Ward, **GUC** = Genitourinary Clinic, **MSW** = Male Surgical Ward, **FHU** = Family Health Unit, **FPU** = Family Planning Unit, **MPL** = Medical Pathology Laboratory.

bacterial skin colonization.

DISCUSSION

The demographic analysis of the staff and patients assessed revealed significant gender differences. The results showed that females constituted a higher percentage of both staff and patients compared to males. This finding is consistent with previous studies that have reported a higher proportion of female healthcare workers and patients in various clinical settings (WHO, 2019; Almalki et al., 2011). Additionally, the dominance of females in the healthcare workforce has been attributed to various factors, including social and cultural norms, as well as the perceived nurturing and caregiving roles associated with healthcare professions (Elliott and Shneerson, 2012).

The age distribution of the staff and patients assessed also revealed interesting patterns. The majority of staff and patients fell within the age bracket of 21-30, followed by those within the age brackets of 31-40 and 41 and above. This finding aligns with other studies, which have shown that most healthcare workers and patients tend to fall within younger to middle-age brackets (Auerbach et al., 2013; Bureau of Labor Statistics, 2020). Similarly, the age distribution of healthcare workers and patients may be influenced by factors such as retirement patterns, career progression, and healthcare-seeking behaviors (WHO, 2016).

The investigation revealed a diverse bacterial population, comprising both Gram-positive and Gram-negative organisms. The Gram-positive organisms isolated, including *Bacillus* sp., *Micrococcus* sp., *Staphylococcus aureus*, and *Staphylococcus epidermidis*, are consistent with previous studies that have reported these organisms as common commensals on human skin and mucous membranes (Kloos and Musselwhite, 2021). In contrast, the Gram-negative organisms discovered, including Escherichia coli and Klebsiella sp., are opportunistic pathogens that can cause a range of infections, particularly in immunocompromised individuals (Podschun and Ullmann, 2018; Russo and Johnson, 2023).

The study's findings on the distribution of bacterial populations among staff and patients across different departments and wards of the hospital are noteworthy. The results show that patients had a higher incidence of bacterial growth. This disparity may be attributed to the frequent interaction between staff and patients, which can facilitate the transmission of microorganisms (CDC, 2020; Otter et al., 2019). This finding is consistent with previous studies that have reported hospitals as breeding grounds for antibiotic-resistant bacteria due to the high density of patients and frequent contact with healthcare staff (Struelens, 1998; Donskey, 2014). The healthcare environment, including surfaces, equipment, and healthcare workers' hands, can act as reservoirs for antibiotic-resistant bacteria, facilitating their transmission to patients (Weber et al., 2013).

In this study, microbial isolates identified comprised five different genera, namely *Bacillus* sp., *Micrococcus* sp., *E. coli*, *Klebsiella* sp., and *Staphylococcus* species (*Staphylococcus aureus* and *Staphylococcus epidermidis*). The predominance of *Staphylococcus* species (33.33%) is consistent with previous studies that have reported *Staphylococcus* species as common commensals on human skin and mucous membranes (Kluytmans et al., 2017; Williams, 2013). The high occurrence of *Bacillus* sp. (28.99%) and *E. coli* (21.74%)

may be attributed to their ubiquitous presence in the environment and their ability to colonize human hosts (Prescott et al., 2002; Forbes et al., 2007).

The distribution of microbial isolates among staff and patients assessed revealed interesting patterns. Laboratory staff had the highest occurrence of *Staphylococcus* species, which may be due to their frequent exposure to microbial cultures and contaminated laboratory equipment (CDC, 2013). The occurrence of *Bacillus* species was also highest among laboratory staff, likely due to their exposure to contaminated laboratory equipment and cultures. The occurrence of *Micrococcus* sp. and *Klebsiella* sp. was limited to staff at RSUTH, with a percentage of 5% each.

From the study, the lower number of potential pathogenic organisms associated with patients' skin may be attributed to the fact that patients are often subjected to antibiotic treatment, which can suppress the growth of these organisms (Szabo and Szabo, 2022). This finding is supported by recent studies highlighting the excessive and improper use of antibiotics as a major contributor to the prevalence of antibiotic-resistant bacteria in healthcare settings (CDC, 2020; WHO, 2020; Tacconelli et al., 2020).

Furthermore, the study's findings underscore the importance of infection control measures, such as hand hygiene, surface cleaning, and antimicrobial stewardship, to prevent the transmission of microorganisms and reduce the risk of antibiotic-resistant infections in healthcare settings (WHO, 2019; CDC, 2020).

CONCLUSION

This study has provided a comprehensive examination of the demographic characteristics and bacterial flora of staff and patients in a healthcare setting, yielding significant insights into the complex interplay between demographic factors, microbial transmission, and healthcare outcomes. The findings underscore the importance of considering demographic factors and infection control measures in healthcare settings, highlighting the need for targeted interventions and policies that address the unique needs of different demographic groups.

The predominance of female patients and the dominance of *Staphylococcus* species among bacterial isolates have important implications for healthcare policy and practice. The results suggest that healthcare institutions should prioritize the development of targeted interventions and policies that address the specific needs of female patients, who comprised the majority of the study population. Furthermore, the implementation of robust infection control measures is crucial to preventing the transmission of *Staphylococcus* species and other microorganisms.

The study's findings also have significant implications for healthcare workforce planning and development. The results highlight the need for healthcare institutions to invest in staff training and education, particularly in infection control and demographic analysis. Additionally, the study emphasizes the importance of personal hygiene among both staff and patients, as they may serve as potential sources of pathogen transmission in healthcare settings.

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