



Bacteria Associated with Hospital Handrails in a Tertiary Institution in Nigeria

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Authors' contributions

This work was carried out in collaboration between both authors. Author ASE designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Author MTP managed the analyses of the study, literature searches. Both authors read and approved the final manuscript.

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ABSTRACT

Background: Hospital acquired infections are serious health issues in the health-care system. These infectious agents are usually drug resistant and complicate patient treatments after diagnosis by physicians.

Aim: The aim of this research was to isolate and identify important bacteria associated with handrails at Braithwaite Memorial Specialist Hospital (BMSH) hospital, Port Harcourt, Rivers State, Nigeria as this will assist in solving issues associated with hospital acquired infection in health facilities.

Methods: Ten (10) samples were examined by swabbing the different types of handrails at various wards and inoculating onto different media for isolation and identification of isolated bacteria. In this study, only three types of handrails were investigated.

Results: The study show different prevalence of the four (4) types of bacteria isolated: *S. aureus* (37.5%), *E. coli* (31.3%), *Streptococcus* (18.7%) and *Proteus* (12.5%). In addition, the different types of hand rails examined were: iron (10), wooden handrails (4) and stainless steel (2).

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Conclusion: These data have shown that handrails can serve as a potential source of transmitting pathogenic agents as they harbor pathogens and opportunistic pathogens which may thrive in immunocompromised or immunosuppressed individuals.

Keywords: Bacteria; hospital; handrail; Nigeria.

1. INTRODUCTION

Nosocomial infections are infections caused by hospital acquired pathogens that invade host tissues, multiply and produce toxins which damage host tissues [1]. Nosocomial pathogens caused by drug resistant pathogens in health facilities can cause constant challenges for the general practitioners handling critically sick patients. The major cause of mortality and morbidity globally are hospital-acquired infections [2]. This has been shown by previous study that the presence of human in a surrounding changes the microbiome of that environment [3]. Identification of key sources in the hospital that serve as reservoir of infection is very important in ensuring appropriate control of infection within the hospital settings.

A major source of hospital acquired infection is the contamination of inanimate object surfaces [4], and cross-transmission of virulent microorganisms among critically ill patients. This contamination can occur by transfer of microbes on the hands, nostrils etc. of workers in health facilities as well as from patients and visitors. Different reports have pointed that multidrug-resistant pathogens contaminate hospital surfaces and medical equipment [5,6]. Bacteria can survive and persist for several months in humid conditions [7]. Due to this mode of survival of some bacteria, they remain viable and when picked up by susceptible host colonize and invade tissues.

There are other means of transmitting pathogens within the hospital settings. One medium through which the hospital surfaces can be contaminated include droplet from coughs or sneezes. This does not only contaminate the surfaces but also the air, hence it is a means of air-borne infection as well [8]. Nosocomial infections can also be transmitted by vector-mediated mechanisms which are organisms that only transmit the infection by direct contact from one individual to another [9,10]. This can occur by vectors such as houseflies perching on hospital surfaces.

There are many factors influencing the transmission of microorganisms from one surface

to another. First the type of pathogen is important. This is because some pathogenic microorganism cannot survive on dry surfaces due to their level of oxygen and nutrient requirement as seen in organisms such as *Neisseria meningitides*, *Clostridium* species and *Propionibacterium* among others [6].

A study carried out by Penny, [11] on the level of bacterial contamination of telephones and objects handled by hospital staff showed that an individual carries an average of one hundred and fifty species of bacteria. This demonstrates that humans serve as a huge reservoir for microorganisms and some of these microbes may be pathogenic. Pittet et al. [12] demonstrated that humans come in contact with up to 300 different surfaces and touch their face 18 times every one hour. The constant touching of the face provides means via which bacteria taken from surfaces can be transmitted through the oral and nasal routes.

Each hospital, although have a specific design, have peculiar design that could permit transmission of infection. Personal hygiene of staff and visitors are important in maintaining and controlling infection. No information has been provided for handrail-mediated transmission of infection in Braithwaite Memorial Specialist Hospital (BMSH). Hence, the main aim of this research was to isolate and identify medically important bacteria associated with handrails at BMSH. A good understanding of this will assist in solving issues related to hospital acquired infection in this health facility as it is patronized by a number of persons within Rivers, Nigeria. This can pinpoint additional areas within the hospital that adequate sanitary measures should be applied.

2. MATERIALS AND METHODS

2.1 Study Area

Samples were collected from BMSH, Rivers State (Nigeria). These samples were taken from handrails in different parts of the hospital which are: laboratory section, Gynaecology &

Antenatal, Paediatric, Family Medicine, Ear, Nose & Throat (ENT), Male Surgical Ward (MSW), Female Surgical, Internal Medicine, Ophthalmology, Physiotherapy, and Doctors residence. These samples were collected using sterile swab.

2.2 Media Preparation and Isolation of Bacteria

Nutrient and MacConkey agar powder were weighed, dissolved and sterilized according to the manufacturer's instructions. The sterilized molten agar was cooled to 47°C and about 20 ml was poured into sterile disposable petri dishes. Blood agar was made by the adding 5% human blood to nutrient agar. They were allowed to set and stored in refrigerator at 4°C for subsequent uses.

2.3 Inoculation of Media and Identification of isolates

Commercially purchased swab sticks were used to swab each hospital handrail. Each swab stick was directly used to inoculate blood, nutrient and MacConkey agar plates, and streaked out with a sterile wireloop. The plates were incubated at 37°C and examined for growth after 18-24 hours. A sterile swab stick was inoculated onto blood agar plate to serve as quality control to monitor sterility of the swab sticks and one of the prepared plates was incubated un-inoculated to check the sterility of agar plates.

Bacteria identification were performed using morphological, Gram's staining reaction, chemical and biochemical tests such as catalase, coagulase, Indole, and Urease tests etc [13].

2.4 Data Analysis

Data obtained were analyzed using Graph Pad Prism 6.

3. RESULTS

3.1 Number of Isolates from Different Hospital Wards

A total of sixteen 16 bacteria were isolated from the different handrail. As shown in Table 1, one (1) each was isolated from Gynecology and Antenatal, Family Medicine, Female Surgical, Ophthalmology ward; whereas two (2) each were isolated from Pediatric, Ear, Nose and Throat, Male Surgical, Internal Medicine, Physiotherapy Wards and Doctors resident. The handrails, seven (7) were iron, two (2) wooden handrails and one (1) stainless steel. The iron handrail had ten (10) isolates of bacteria, the wooden handrails had four (4) isolated bacteria and the stainless steel had two (2) bacteria.

3.2 Organisms Associated With Different Handrails

Four (4) bacteria were isolated from the handrails, these were, *S. aureus*, *E. coli*, *Streptococcus* and *Proteus*. Their frequencies of occurrences on the handrails were: iron, *S. aureus* 4(25%), *E. coli* 3(18.8%), *Streptococcus* 2(12.5%) and *Proteus* 1(6.3%) respectively. A total of 4 bacteria were isolated wooden handrails, and one 1(6.3%) each were *S. aureus*, *E. coli*, *Streptococcus* and *Proteus* respectively. Two 2(6.3%) bacteria are isolated from stainless steel, namely *S. aureus* (1) and *E. coli* (1) respectively.

Table 1. Shows the number of isolates identified from the different hospital wards together with the type of rail handle they were isolated from

S/N	Wards	Type of rail	Number of isolates
1	Gynaecology and Antenatal	Iron	1
2	Paediatric	Iron	2
3	Family medicine	Iron	1
4	Ear, Nose and Throat	Wood	2
5	Male Surgical Ward	Stainless steel	2
6	Female Surgical Ward	Iron	1
7	Internal Medicine	Wood	2
8	Ophthalmology	Iron	1
9	Physiotherapy	Iron	2
10	Doctors residence	Iron	2
			16

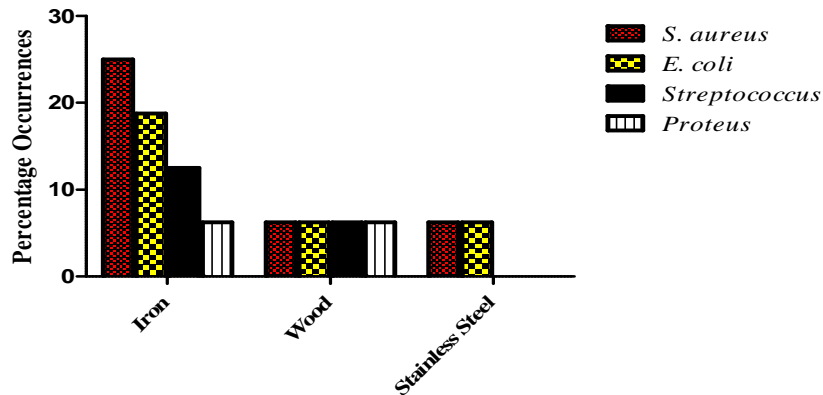


Fig. 1. Percentage occurrences of isolated bacteria from the different handrails

Table 2. Shows the different type of organisms isolated from different type of handrail surfaces at BMSH

S/N	Wards	Type of rail surface	Organism (s) isolated
1	Gynecology and Antenatal	Iron	<i>Escherichia coli</i>
2	Pediatric	Iron	<i>Staphylococcus aureus</i> and <i>Streptococcus</i>
3	Family medicine	Iron	<i>Staphylococcus aureus</i>
4	Ear, Nose and Throat	Wood	<i>Staphylococcus aureus</i> and <i>Streptococcus</i>
5	Male Surgical Ward	Stainless steel	<i>Escherichia coli</i> and <i>Staphylococcus aureus</i>
6	Female Surgical Ward	Iron	<i>Escherichia coli</i>
7	Internal Medicine	Wood	<i>Proteus</i> and <i>Escherichia coli</i>
8	Ophthalmology	Iron	<i>Staphylococcus aureus</i>
9	Physiotherapy	Iron	<i>Proteus</i> and <i>Escherichia coli</i>
10	Doctors residence	Iron	<i>Staphylococcus aureus</i> and <i>Streptococcus</i>

3.3 Types of Bacteria Isolated from Different Hospital Wards

There were four (4) different bacteria isolated from all the wards. These include *S. aureus*, *E. coli*, *Streptococcus* and *Proteus*. The types of bacteria isolated from different wards are as follows: Gynecology and Antenatal (*E. coli*) Family Medicine, Pediatric (*Staphylococcus aureus* and *Streptococcus*) Female Surgical, Ophthalmology ward; Ear, Nose and Throat, Male Surgical, Internal Medicine, Physiotherapy Wards and Doctors resident. *S. aureus* and *E. coli* are found on all types of handrail surfaces.

3.4 Percentage Occurrence of Different Bacteria Isolated

The result of all the isolated organisms showed: *S. aureus* (37.5%), *E. coli* (31.3%), *Streptococcus* (18.7%) and *Proteus* (12.5%).

3.5 Percentage Occurrence of Isolated bacteria on Different Types of Handrails Surfaces

From the total isolated bacteria; 62.5% were isolated from iron surface; 25% were isolated from wooden surfaces and 12.5% are isolated from stainless steel surface as shown in Fig. 3.

3.6 Percentage Occurrence of Microorganisms Isolated from Different Hospital Wards

The Fig. 4 shows that Pediatric, Ear, Nose and Throat, Male Surgical, Internal Medicine, Physiotherapy wards and Doctors resident had high percentages of bacteria, while Gynecology, Antenatal, Family Medicine, Female Surgical and Ophthalmology wards had low percentages respectively.

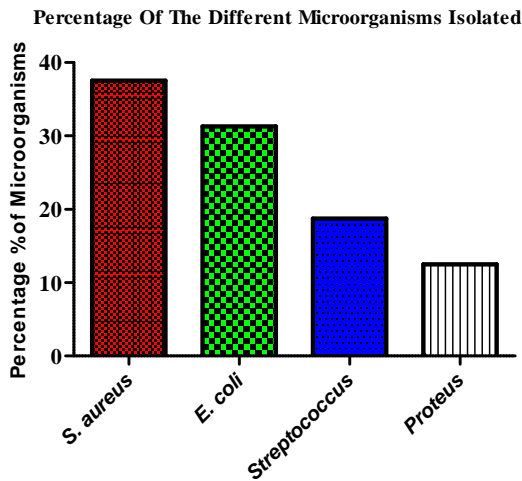


Fig. 2. Shows the percentage occurrences of isolated bacteria from the handrails

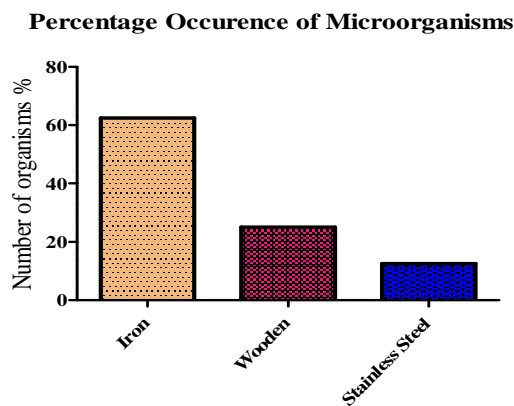


Fig. 3. Show the percentage occurrence of isolated microorganisms on different types of handrails at BMSH

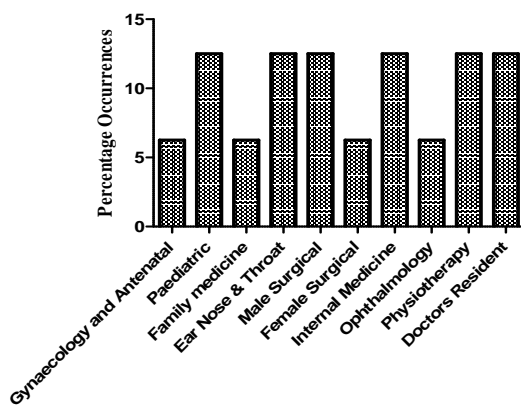


Fig. 4. Show the percentage occurrence of microorganisms associated with different hospital wards

4. DISCUSSION

Hygiene and proper sanitation is essential in public places such as the health facilities where there is prevalence of infectious agents. Without adequate sanitary practices drug resistant pathogens may be transmitted from one point to another or person to person through overlooked contaminated inanimate objects such as handrails in hospital environments. Handrail are installed on staircases to serve as support for those climbing or descending the staircases, especially, the sick, the elderly, the fatigued staff, patient relations, visitors etc, and handrail also serve as protection for those who have phobia for height. As people make use of the handrails, the possibility of picking and depositing bacteria is eminent. Handrails as one of the silent vehicles for transmitting pathogenic bacteria, especially in hospital setting have never been seen as an inanimate object worth disinfecting to reduce the microbial load. The volume of traffic to and fro each ward and the level of sanitation of the individuals (staff, patient, visitors and patient relations) may determine the bacterial load and the species that will colonize or be resident on the handrails. The major public health concern of bacterial colonization of hospital handrails is that some of the bacteria might possess multi-drug resistant genes which may pose problems to the clinicians in course of treating an infection.

The percentage occurrences of bacteria isolated from the handrails showed that *Staphylococcus spp.* was the most prevalent bacteria. *Staphylococcus aureus* is a normal flora of human skin, hands, nostrils etc; the prevalence is not a surprise. *E. coli* is the most predominant aerobic bacteria in the gut of humans and warm blooded animals; their presence suggests faecal contamination arising from poor personal hygiene. It may also be associated with the low level of sanitation within the hospital.

The percentage occurrences of isolated bacteria from the different handrail types showed that iron surfaces had high number of isolated bacteria. The metal surfaces are rough, and with age they have small pores on their rough surfaces. These pores can trap some dirt alongside bacteria for distribution to users.

The activities in the different wards sampled, rate of visits and personal hygiene of individuals may be associated with the number and types of

bacteria isolated from them. For instance, the pediatric, ENT, MSW, Internal Medicine, Physiotherapy and Doctors' residents all had high numbers of isolated bacteria compared to other wards. Children care less about hygiene hence the increase in the number of bacteria; Internal Medicine has high influx of patients which also explain the high presence of bacteria. Doctors residence have a high number of bacteria due to the population of medical personal, family members and visitors coming in and out. The presence of bacteria such as *E. coli*, *S. aureus*, *Streptococcus* and *Proteus* in the different ward as observed in our research could imply that there could be transfer of these bacteria by guests, staff or residents within the hospital environment. This is synonymous to the findings of [14] where they concluded possible transmission of pathogens from toilet lock handles to office lock handles and vice versa by users.

Kramer et al. [7] had shown that *S. aureus* and *E. coli* are the most common types of bacteria that exist in nature, hence their predominance. This was in accordance with our findings as we isolated mainly normal flora which could also be pathogen. Sorum and Sunde (2001) demonstrated that opportunistic normal floras have antimicrobial resistant genes which could be upregulated upon exposure to their susceptible drugs. *S. aureus* has been shown to demonstrate resistance as in Methicillin resistance *S. aureus*. Hence, their presence on handrails surfaces implies the possible transmission of drug resistant genes to other bacteria.

There was a pattern in the association with the number of isolated bacteria and the type of handrails surfaces. The percentage occurrence of bacteria on different types of handrail surfaces showed that more isolation was made from iron surfaces, followed by wooden surfaces and finally stainless steel. This may reflect the ability of these surfaces to harbor bacteria relative to their roughness. In addition, the percentages of different bacteria isolated from the hospital in order of prevalence from the highest to the lowest were as follows: *S. aureus*, *E. coli*, *Streptococcus* and *Proteus*. This observation is very similar to the work of Yusha'u et al. [15] and Amala and Ejikema, [16] where they investigated the prevalence of different bacteria on cell phones which showed that *S. aureus* was about 84% prevalent and *Streptococcus* was about 16%.

5. CONCLUSION

A critical implication of this research is that bacteria which could be potentially virulent might be found in hospital environment such as handrails; where patients, staff and visitors frequently come in contact with. Some of these pathogens isolated, although are opportunistic pathogen, can result in severe infections in immunocompromised patients. Therefore, to prevent and control colonization of hospital surroundings by these potential pathogens, adequate sanitary surveillance must be adopted by hospitals. Personal hygiene of staff, patients and visitors should be ensured through the provision of soap and water for hand-washing and subsequent application of disinfectant where necessary. Sterilization of medical instruments and devices after use in order not to allow the harbor of pathogens is important in maintaining good aseptic practice.

CONSENT

It is not applicable.

ETHICAL APPROVAL

It is not applicable.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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