

EVALUATION OF PUBLIC HEALTH HAZARDS OF DOOR HANDLES IN UNIVERSITY OF CALABAR COMMUNITY

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ABSTRACT

The study to evaluate public health hazards of door handles within Unical community was investigated. Eighty-five (85) swab samples from laboratories, offices and toilets within Unical community were analyzed. Sterile swabs were firmly pressed on the various door handles; up/down, left/right and diagonally. Samples collected were cultured and incubated at 37⁰C for 24hours. Isolation and identification of pathogenic bacteria was done using standard microbiological procedures. Results from this study revealed that out of the eighty five (85) samples collected 64(75.29%) were positive and were contaminated with bacterial pathogens. Among 141 isolates obtained the distribution according to gram reaction showed that 87(61.70%) were gram-positive and 54(38.30%) were gram-negative. Bacterial species isolated from the samples were identified as *Staphylococcus aureus*, *Bacillus sp.*, *Micrococcus sp.*, *Pseudomonas sp.*, *Escherichia Coli*, *Klebsiella Sp.*, and *Salmonella sp.* Frequency distribution and percentage prevalence of the bacterial isolates showed that *Staphylococcus aureus* had the highest 40(28.37%) compared to other bacterial isolates that had, *Bacillus*,

28(19.86%), *Micrococcus*, 19(13.48%); *Escherichia coli* 20(14.18%); *Pseudomonas*, 13(9.22%), *Salmonella sp.*, 13(9.22%) and *Klebsiella*, 8(5.67%). However, the presence of these pathogenic organisms is an indication that public contact surfaces such as door handles are often colonized by pathogenic microorganisms and may serve as potential source of infections. It is therefore a necessity that personnel hygiene be made a priority so as to help curb the public health hazards that may be associated with these contaminated door handles.

Keywords; Public, Hazards, Door handles, Pathogenic, Microorganisms

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INTRODUCTION

Microorganisms which refers to forms of life of microscopic dimensions, are ubiquitous and constitutes a major part of every ecosystem. In such environment/habitat they could exist freely as parasites. In some cases, they live as transient contaminants in firmities or hands where they constitute a major health hazard as sources of community and hospital acquired infections (Pittet *et al.*, 1999). The increasing incidence of epidermis outbreaks of certain disease and its rate of spread from one community to the other has become a major public health concern (Gatelli *et al.*, 2006). Beside the day to day interactions/contact of the people which constitutes a way of spreading disease (from the infected person to the healthy person), the major source of spread of community acquired infections are fomites (Li *et al.*, 2009). Fomites (also known as formes) refer to an object that is not in itself harmful but is able to harbor or transmit pathogenic organisms to people that come in contact with such object (Oxford English Dictionary,2005). They also refer to inanimate objects or materials that act as intermediate carries of microbial contamination e.g utensils, pen, door knobs, tables, towels, money, clothing, dishes, books,

toys, lockers, chairs etc. This is possible when they are in constant with humans or natural habitats of pathogenic organisms (Osterholm *et al.*, 1995).

Door knob is one of the most common fomite that serves as a route for contamination (Reynolds, 2005). It has been shown that hard, non-porous surfaces such as door handles, have the highest bacterial transfer rates to hands (Rusin *et al.*, 2002). This is so because not much attention is given to door knobs, utensils towels and some others are regularly cleaned, washed or in some cases not shared, but this is not always the case with door knobs.

Also, our environment as it is, supports opening doors before one can gain entrance into almost everywhere, for instance one needs to open a door in order to walk into his/her office, room or toilet and so many places. When you touch a door knob handled by someone ill with the flu or some sort of contamination for example, you can pick up the germs he or she left behind. Some of the contaminants can be transferred from one person to another or may result in auto inoculation (Kennedy *et al.*, 2005; Li *et al.*, 2009). Due to the mere insignificance of opening a door, it is not considered necessary by many to wash hands used in opening doors. If you then touch your eyes, mouth, nose or an open wound with such hands you may become infected. An infection is the result of an interaction between a host and a microorganism or some of its products. An infection leads to disease ; therefore a disease is any

condition that causes pain dysfunction, distress, social problems or death. However, the risk of disease transmission through fomites is determined by the frequency of site contamination and exposure, level of pathogen excreted by the host, likelihood of transfer of the organism, immune competence of the person in contact, the practice of control measure (Prescott *et al.*, 1993).

Bacterial pathogens that have been isolated from door knobs in previous studies include; *S. aureus*, *K. pneumonia*, *E. coli*, *Enterobacter sp*, *Citrtobacter sp*, *P. aeruginosa*, *Proteus sp*, *Streptococcus*, *Salmonella*, *Shigella*, *Campylobacter* (Nwoire *et al.*, 2012). These organisms have been known to cause one or more diseases that are mild and could sometimes be serious. Examples are but not limited to pimple, impetigo, scalded skin syndrome, pneumonia, meningitis, osteomyelitis, rhinoscleroma, kidney failure, septicemia (Tanner, 2009 ; Clauditz *et al.*, 2006).

Contaminated hands can also be the source of re-contamination of the surface as demonstrated with hepatitis A virus (Kramer *et al.*, 2006). As a result of this, it is critical to note that healthcare worker's compliance with hand hygiene varies between 13% and 94% with a median of less than 50% (Pittet, 2000). Moreover hand hygiene is performed less frequently after contact with the environment than with the patient (Pittet, 2000). Both facts underline the necessity to perform additional surface decontamination procedures to

interrupt the transmission of nosocomial pathogens. Due to the overwhelming evidence of low compliance of hand disinfection, the risk from contaminated surfaces cannot be overlooked and must not be down played by hospital administrations.

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MATERIALS AND METHODS

Sampling sites

A microbiological survey was conducted in eighty five (85) different sites within the University of Calabar, Calabar.

Sampling collection

Door handles within different locations in University of Calabar were swabbed from faculty of Biological Sciences Department offices, Physics Department offices, Botany Department offices, Library Law rooms, Hall 8 toilets. A total of eighty five (85) door handles contact surfaces were swabbed. The samples were collected at noon when people made use of these door handles so as to maximize the chances of isolation (Amala *et al.*, 2015). The swabs were moisture with 5ml of normal saline added to the swab stick case (Cheesbrough, 2000). Individual moistened sterile cotton swabs were used to swab the door handles which are hand related public surfaces. This was accomplished of a tri directional manner; up/down left/right and diagonally, recapped and properly labeled. The samples were then promptly transported in an ice-cooled pack to the laboratory of Department of Microbiology in University of Calabar, Calabar for further analysis.

Materials

Media

The media used in this study were nutrient agar (oxiord) *Salmonella-Shigella* agar (oxoid), eosin Methylene blue agar and MacConkey agar (oxoid) and were prepared in accordance to the manufacturer's instructions.

Chemical and reagents

Chemical used in this study were of analytical grades. They include absolute alcohol, neutral red, methyl red, iodine crystals, methyl red indicators and phenol red indicator (Titan biotech). Some reagents used were prepared in the laboratory using these chemicals. Other reagents used such as oxidase strips and indole- Kovacs and were products of hardly diagnostics, USA.

Laboratory equipment

Laboratory equipment used for this study are; test tubes, conical flasks, wire loop, autoclave, microwave oven, petri- dishes, marking cap, permanent marker, pressure pot, stock bottles foil papers, glass slides.

Methods

Sample analysis

Each sample was inoculated onto nutrient agar (oxide) and MacConkey agar (oxoid) plates. Using the swab stick, a primary streak was made while secondary and tertiary streaks were made from primary streak in parallel

pattern with the aid of sterilized were loop to make a four way streak plate technique. All the plates were inverted for 24hours at 37⁰C. After the overnight incubation, the plates were removed from the incubator and observed for colony characteristics.

Isolation and purification

Following incubation, distinct colonies were sub-cultured onto fresh nutrient agar, Eosin-ethylene blue and *Salmonella- Shigella* agar plates for proper preliminary identification (Cheesbrough, 2000). Purified isolates were stocked in nutrient agar slants for further studies.

Characterization and identification of isolates

Purified isolates were characterized by gram morphology and biochemical test using the scheme in Bergey's manual of determinative bacteriology (Holt *et al.*, 1994; Cheesbrough, 2000)

RESULTS

Prevalence of positive and negative samples and distribution of isolates

Table 1 present the result of prevalence of positive and negative samples from door handle sampling sites within University of Calabar community. It showed that 64(75.29%) out of the 85 samples analyzed were positive and were contaminated with bacteria.

Table 2 present the result of distribution of isolates according to gram reactions. It showed that 87(61.70%) of the bacterial isolates in the contaminated samples were gram positive while 54(38.30%) were gram negative.

Biochemical characterization and identification of isolates

Table 3 present the result of biochemical characterization and identification of isolates from samples. It showed that bacteria species isolated from the analyzed samples were identified as *Micrococcus sp.*, *Staphylococcus aureus*, *Pseudomonas spp.*, *Salmonella sp.*, *Escherichia coli*, *Bacillus sp.*, and *Klebsiella sp.*

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TABLE 1

**Prevalence of positive and negative samples from various door handle
sampling sites within University Calabar community**

Sample sites	Total number of sample examined	Number of positive samples (%)
Faculty of Biosciences offices	10	6(60)
Malabor hostel Hall 8 toilets	10	10(100)
Geology shell work station	4	3(75)
Chemistry Dept. offices	10	6(60)
Library Law rooms	5	3(60)
Computer Science Dept. Office,	10	7(70)
Biosciences Lab 222 and 226	6	6(100)
Microbiology Dept. Offices	10	9(90)
Physics Dept. Offices	10	6(60)
Botany Dept. Offices	<u>10</u>	<u>8(80)</u>
Total	85	64 (75.29)

TABLE 2

Distribution of isolates according to Gram reactions

Isolates	Number of isolates	Percentage
Gram positive	87	61.70
Gram negative	<u>54</u>	<u>38.30</u>
Total	141	100

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TABLE 3

Biochemical characterization and identification of isolates from samples

Sample code	Microscopic cell morphology	Gram staining	Motility	Indole	Or nithine	Citrate	Catalase	Oxidase	Coagulase	Methyl-Red	Voge-proskauer	Glucose	Lactose	Sucrose	Gas	H ₂ S	Probable organism
M ₁	Cocci in cluster	+	-	-	+	+	+	+	-	+	-	+	-	-	-	-	<i>Micrococcus sp</i>
M ₂	Cocci in cluster	+	-	-	+	-	+	-	+	-	+	+	-	-	-	-	<i>Staphylococcus aureus</i>
M ₃	Curved rod	-	+	-	-	+	+	+	-	+	-	+	-	-	A	+	<i>Pseudomonas sp.</i>
M ₄	Short rod	-	+	-	-	+	+	-	-	+	-	+	-	-	A	+	<i>Salmonella sp.</i>
M ₅	Single short rod	-	+	+	+	-	+	-	-	+	+	+	+	+	AG	+	<i>Escherichia coli</i>
M ₆	Bacilli rod	+	+	-	+	+	+	+	-	-	+	+	-	-	A	+	<i>Bacillus sp.</i>
M ₇	Short rod	-	+	+	+	-	+	+	-	-	+	+	-	-	A	+	<i>Klebsiella sp.</i>

Key; - = Negative, + = Positive, AG = Acid and Gas, A=Acid

Frequency distribution and percentage prevalence of isolates

Figure 1-7 present the result of frequency distribution of isolates according to sample sites. It showed that *Staphylococcus aureus* (8) had the highest frequency distribution in Biological Sciences Lab 222 and 226, as compared to other isolates that had; *Bacillus sp* and *Escherichia coli* (4) in Malabor Hostel Hall 8 toilets and Biological Sciences Lab 222 and 226; *Micrococcus sp* and *Salmonella sp* (3) in Biological Sciences Lab 222 and 226.

Table 4 and Figure 8 present the result of percentage prevalence of the isolates on positive samples from various sampling sites. It showed that *Staphylococcus aureus* had the highest percentage prevalence (28.37%) as compared to *Bacillus* (19.86%), *Escherichia coli* (14.18%), *Micrococcus* (13.48%), *Pseudomonas* (9.22%), *Salmonella* (9.22%) and *Klebsiella* (5.67%).

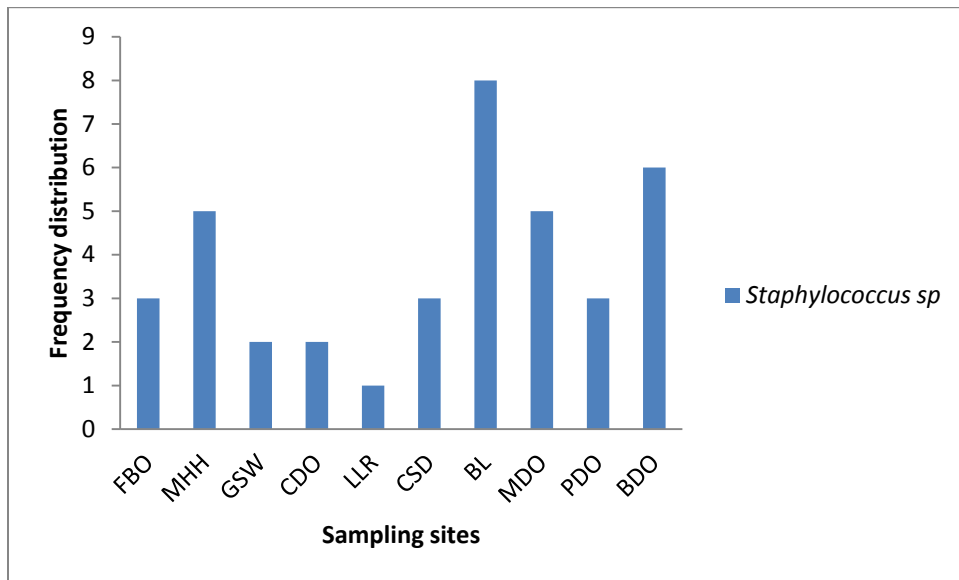


Fig 1: Frequency distribution of *Staphylococcus sp* according to sampling sites

Key: FBO= Faculty of Biological Sciences Offices, MHH= Malabar Hostel Hall 8 toilets, GSW= Geology shell work station, CDO = Chemistry Dept. Offices, LLR= Library Law rooms, CSD= Computer Science Dept. Offices, BL= Biological Sciences Lab 222 and 226, MDO = Microbiology Dept. offices, PDO= Physics Dept. offices, BDO= Botany Dept. offices

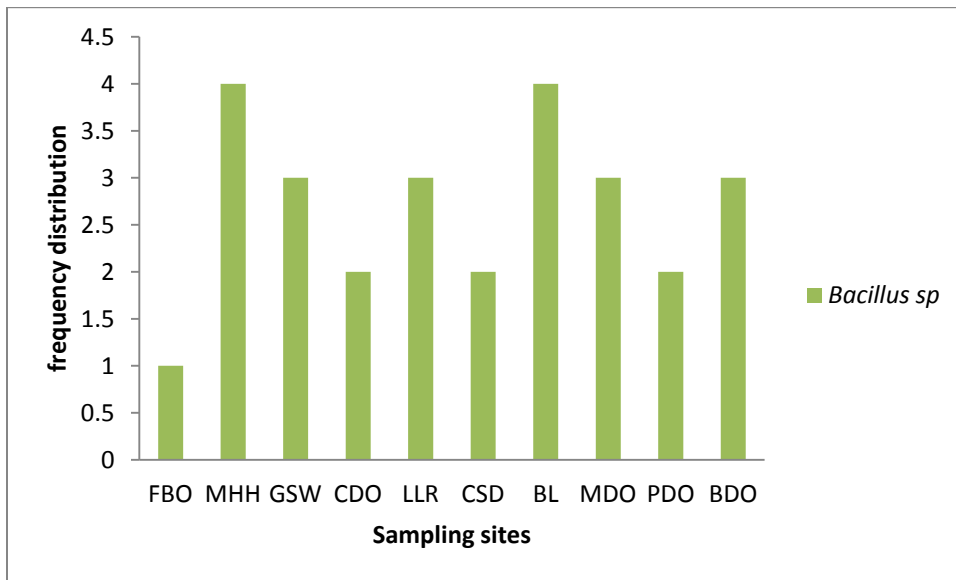


Fig 2: Frequency distribution of *Bacillus sp* according to sampling sites

Key: FBO= Faculty of Biological Sciences Offices, MHH= Malabar Hostel Hall 8 toilets, GSW= Geology shell work station, CDO = Chemistry Dept. Offices, LLR= Library Law rooms, CSD= Computer Science Dept. Offices, BL= Biological Sciences Lab 222 and 226, MDO = Microbiology Dept. offices, PDO= Physics Dept. offices, BDO= Botany Dept. offices

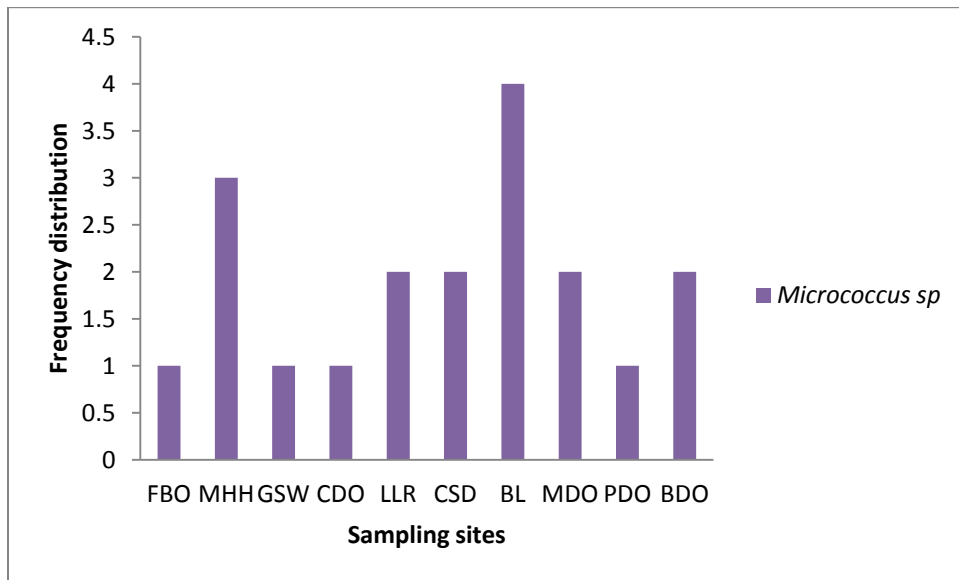


Fig 3: Frequency distribution of *Micrococcus sp* according to sampling sites

Key: FBO= Faculty of Biological Sciences Offices, MHH= Malabar Hostel Hall 8 toilets, GSW= Geology shell work station, CDO = Chemistry Dept. Offices, LLR= Library Law rooms, CSD= Computer Science Dept. Offices, BL= Biological Sciences Lab 222 and 226, MDO = Microbiology Dept. offices, PDO= Physics Dept. offices, BDO= Botany Dept. offices

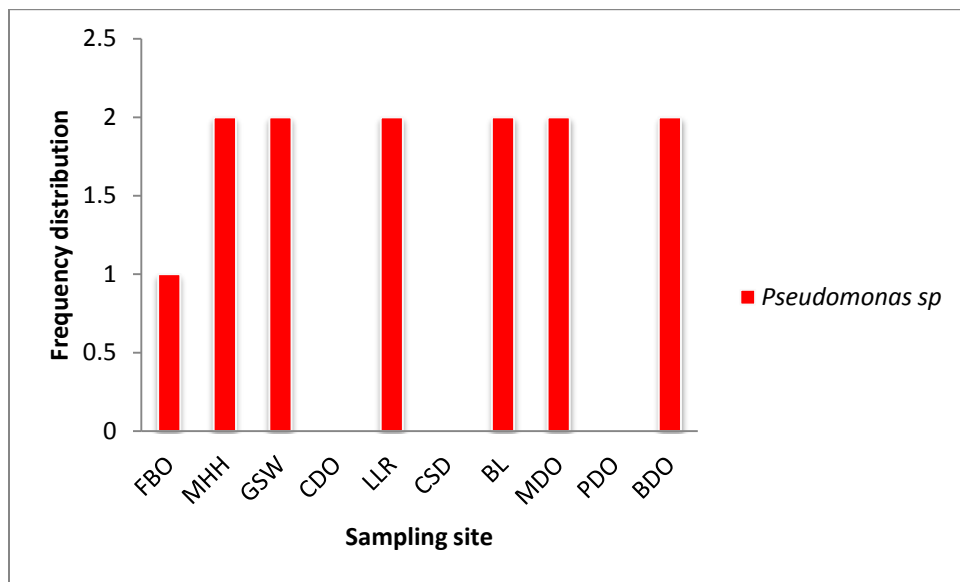


Fig 4: Frequency distribution of *Pseudomonas sp* according to sampling sites

Key: FBO= Faculty of Biological Sciences Offices, MHH= Malabar Hostel Hall 8 toilets, GSW= Geology shell work station, CDO = Chemistry Dept. Offices, LLR= Library Law rooms, CSD= Computer Science Dept. Offices, BL= Biological Sciences Lab 222 and 226, MDO = Microbiology Dept. offices, PDO= Physics Dept. offices, BDO= Botany Dept. offices

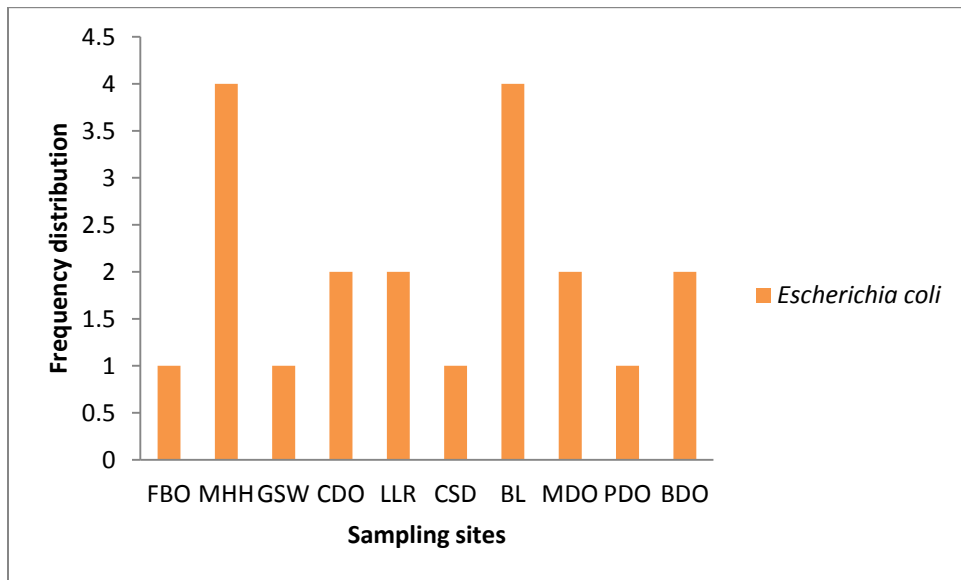


Fig 5: Frequency distribution of *Escherichia coli* according to sampling sites

Key: FBO= Faculty of Biological Sciences Offices, MHH= Malabar Hostel Hall 8 toilets, GSW= Geology shell work station, CDO = Chemistry Dept. Offices, LLR= Library Law rooms, CSD= Computer Science Dept. Offices, BL= Biological Sciences Lab 222 and 226, MDO = Microbiology Dept. offices, PDO= Physics Dept. offices, BDO= Botany Dept. offices

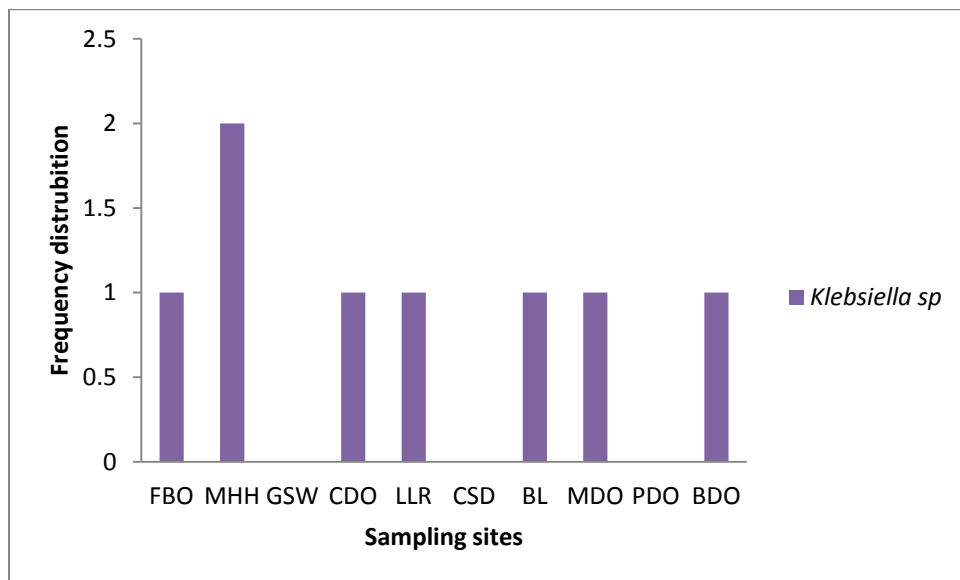


Fig 6: Frequency distribution of *Klebsiella sp* according to sampling sites

Key: FBO= Faculty of Biological Sciences Offices, MHH= Malabar Hostel Hall 8 toilets, GSW= Geology shell work station, CDO = Chemistry Dept. Offices, LLR= Library Law rooms, CSD= Computer Science Dept. Offices, BL= Biological Sciences Lab 222 and 226, MDO = Microbiology Dept. offices, PDO= Physics Dept. offices, BDO= Botany Dept. offices

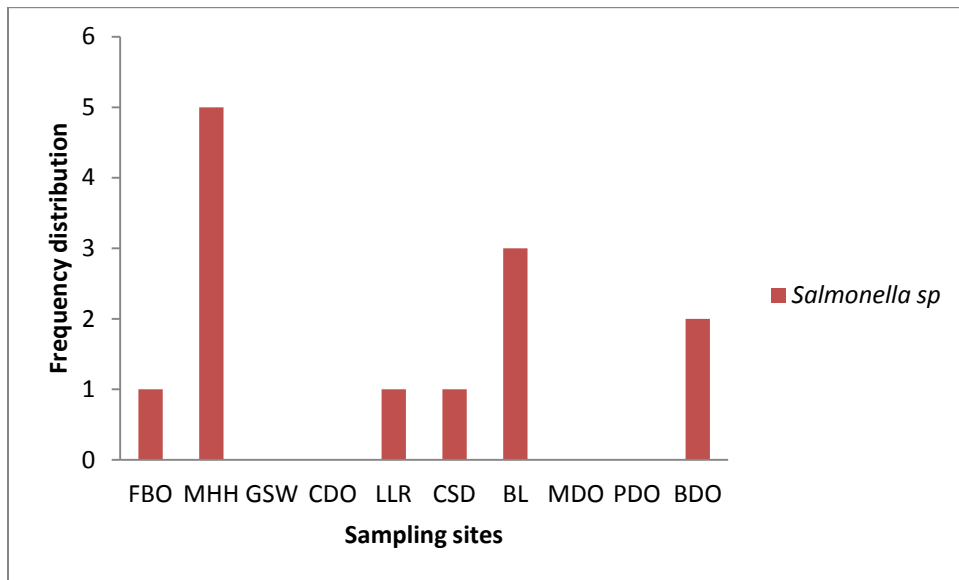


Fig 7: Frequency distribution of *Salmonella sp* according to sampling sites

Key: FBO= Faculty of Biological Sciences Offices, MHH= Malabar Hostel Hall 8 toilets, GSW= Geology shell work station, CDO = Chemistry Dept. Offices, LLR= Library Law rooms, CSD= Computer Science Dept. Offices, BL= Biological Sciences Lab 222 and 226, MDO = Microbiology Dept. offices, PDO= Physics Dept. offices, BDO= Botany Dept. offices

TABLE 4

**Percentage prevalence of isolates on positive samples from various
sampling sites**

Bacterial isolates	Number of isolates	Percentage prevalence
<i>Staphylococcus aureus</i>	40	28.37
<i>Bacillus sp.</i>	28	19.86
<i>Micrococcus sp.</i>	19	13.48
<i>Escherichia coli</i>	20	14.18
<i>Pseudomonas sp.</i>	13	9.22
<i>Klebsiella sp.</i>	8	5.67
<i>Salmonella sp.</i>	<u>13</u>	<u>9.22</u>
Total	141	100

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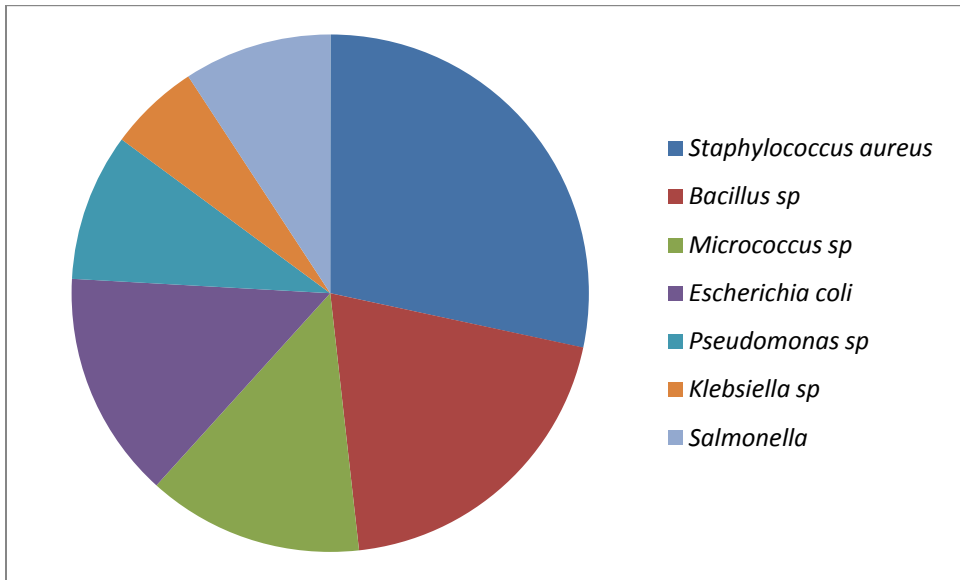


Fig. 8: Percentage prevalence of isolates on positive samples from various sampling sites

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Discussion

The results obtained in this study revealed a higher level of bacterial contaminants on door handles of selected offices, laboratories and hostel toilet, in which 75.29% of the analyzed door handles swab samples were contaminated with considerable number of pathogenic bacteria most of which were gram- positive bacteria (61.70%) and others, gram-negative bacteria (38.30%). This observation could be due to the fact that most skin bacteria flora are gram positive and may have found their way onto the surface, through cross contamination, poor personal hygiene of the users or diseases spreading vectors such as cockroaches and flies (Salim *et al.*, 2016). This observation collaborates with that of Lynn *et al.*, (2013) who reported the presence of pathogenic microorganisms on 70% of the selected door handles within secondary schools in Bokokos. Also similar study by Nworie *et al.*, (2012), reported 86.7% of door handle samples of selected public conveniences in Abuja Metropolis, were positive with pathogenic bacteria contamination.

This observation was not surprising, as similar study by Amala *et al.*, (2015) observed (85%) bacterial contamination in offices and toilets door knobs. This variation in the number of positive samples from one place to another is likely to be as a result of the differences in hygiene and sanitary conditions in the environment. Microbial contamination of door knobs or handles are well of documented and this could serve as vehicles for cross infections and re-contamination of washed hands (Monarca *et al.*, 2000; Otter and French, 2009; Bright *et al.*, 2010). Some of the contaminants can be highly pathogenic and can be transferred from one person to another or may result in auto- inoculation (Kennedy *et al.*, 2005; Li *et al.*, 2009).

The result of this study showed that *Staphylococcus aureus*, *Bacillus sp.*, *Micrococcus sp.*, *Escherichia coli*, *Salmonella sp.*, *Pseudomonas sp.*, and *Klebsiella sp.*, were the main bacterial isolates identified from the door handle swab samples. This observation is line with that of Salim *et al.*, (2016) who reported to have isolated *Staphylococcus aureus*, *Bacillus sp* and *Escherichia coli* from selected door handles of public toilets in Federal University Dutse, Jigawa- State, Nigeria. Also study by Mensha *et al.*, (2016) reported to have isolated *Pseudomonas sp.*, *Klebsiella Pneumonia*, *Neisseria sp.*, and *Escherichia coli* in selected door handles in a Southwestern University in Nigeria.

The most frequently isolated bacterium was *Staphylococcus aureus* 40(28.37%) compared to other of its bacterial isolate counterpart. This could be due to the fact that *Staphylococcus sp* are major components of the normal flora of the skin and nose, which probably explain its high prevalence as contaminant as it can easily be discharged by several human activities. This observation is in conformity with the finding of other researchers (Brooks *et al.*, 2007; Nworie *et al.*, 2012). *Staphylococcus aureus* is the most important potential pathogen that cause boils, abscesses, wound infection, toxic shock syndrome and pimples.

A high percentage prevalence of *Bacillus sp* (19.806%) observed in this study, could be explained by their spore forming ability which makes them able to resist harsh environmental conditions, withstand dry heat and certain chemical disinfectant for a considerable period. This observation is in line with report by Samy *et al.*, (2012) who reported the isolation of *Bacillus sp* from environmental sites in Mecca city. The isolation of *Micrococcus sp* in this study was in conformity with the work of Opera *et al.*, (2013) who reported the isolation of *Micrococcus sp* from door handles of public toilets. The presence of gram negative rods such as *Escherichia coli*, *Pseudomonas sp.*, *Klebsiella sp* and *Salmonella sp.*, isolates in this study indicates the possibility of the presence of faecal contamination on the door handles. This might be due

to the fact that most people go to toilet and end up contaminating their hands with faecal and urinal material and fail to wash their hand because they take the issue of hygiene with levity, they also lack the concept of hand washing as a simple means of stopping this spread of infectious agents. Gram negative sepsis and urinary tract infections are most commonly caused by *Escherichia coli* and *Klebsiella sp.*, *Salmonella sp* is the most important pathogen and one of the leading causes of gastroenteritis and typhoid fever in developing countries. The occurrences of *Salmonella* on the door handle samples analyzed was not surprising as similar study by Amala *et al.*,(2015) also reported to have isolated *Salmonella sp.* from offices and toilets lock hands.

Conclusion

The presence of *Staphylococcus aureus*, *Bacillus sp.*, *Micrococcus sp.*, *Escherichia coli*, *Pseudomonas sp.*, *Salmonella sp* and *Klebsiella sp.*, in the analyzed door handle swab samples is an indication that public contact surfaces such as door handles are often colonized by pathogenic microorganisms and may serve as a potential source of infections. It is therefore a necessity that personal hygiene be made a priority so as to help curb the public health hazards that may be associated with these contaminated door handles.

Recommendation

On the basis of the above findings, it is therefore recommended that;

- (i) Hand sanitizers or spray disinfectants should be made available in all offices, laboratories and toilets within Unical community.
- (ii) Individuals both adult and young should adopt the habit of hand washing practice after using toilets.
- (iii) Routine surface disinfection of toilets, laboratories and office door handles should be practice as this can prevent cross contamination.

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