EVALUATION OF BACTERIA ISOLATED FROM DOOR HANDLES IN MADONNA UNIVERSITY, NIGERIA

Abstract

Microorganisms can be found everywhere, bacteria and fungi contaminate human body, houses, workplaces, and environment. Fortunately, among many billions of bacteria, only 1500 can be dangerous for health, causing different disease such as pneumonia or skin infection. In the university environment, students have access to service offices regularly for different purposes. Given that the door handles are not routinely disinfected, the opportunity for the transmission of contaminating microorganisms is great. This study was carried out to evaluate the bacteria on door handles in Madonna University, Nigeria. Samples were collected using the swab-rinse method of the American Public Health Association. Each collected specimen was processed to identify the bacteria in the sample. The following processing techniques were employed: Culture, Gram staining and Biochemical test. The result of the study shows student affairs had *Echerichia coli* as the highest prevailing organism with 100%. Medlabscienece building had *Staphylococcus aureus* as the highest prevailing organism with a percentage of 50% *klebsiella pneumoniae* with 33.3% and *Echerichia coli* with 16.7%. meanwhile, the blue and white administrative building had *Staphylococcus saprophyticus* and *klebsiella pneumonia* as the highest prevailing organism, with a percentage of 40% respectively. science hall had a 100% prevalence of *Klebsiella pneumoniae*. the study also revealed the various percentage of gram reactions with gram negative having a higher percentage of reactions than the Gram positive. Since there are various forms of microorganisms found in the various door handles of these offices, it therefore, recommended that a proper sanitization be carried out from time to time, to ensure complete disinfection of these handles in other to limit or reduce the spread of these microorganisms.

INTRODUCTION

1.1 Background to the study

Microorganisms can be found everywhere, bacteria and fungi contaminate human body, houses, workplaces, and environment. Fortunately, among many billions of bacteria, only 1500 can be dangerous for health, causing different disease such as pneumonia or skin infection *(*5*).* The human hand serves as a medium for the propagation of microorganisms from place to place, and from person to person. Although, it is nearly impossible for the hand to be free of microorganisms, as the presence of pathogenic bacteria may lead to chronic or acute illness (4).

Every day, door handles are often hotspots for bacteria, public handles especially because of the

frequent and inevitable use of most door handles, it can often be expected that bacteria are present (9). Many factors determine the suitability and population of bacteria. The material of the handle itself contributes to the growth of bacteria, with most door handles being constructed with stainless steel which are more suitable homes for bacteria. The material affects the time bacteria can survive on door handles; but more so, the temperature and humidity of the surrounding air, depending on these bacteria can thrive anywhere from a few hours to a few weeks. Human hands usually harbor microorganisms both as part of body normal flora as well as transient microbes contacted from the environment (8).

The major source of the spread of community acquired infections are formites; such formites include door handles of convenience, showers toilet seats and faucets, sinks lockers, chairs, and tables especially those found in public places such as markets, banks, dormitories, schools, churches, public offices, hospitals, hotels, restaurants and rest rooms (3).The increasing incidence of epidemic outbreaks of certain diseases and its rate of spread from one community to the other has become a major public health concern (12). Hand washing is fundamental cautionary measure to protect against the spread of diseases and is one of the primary practices to reduce the transfer of bacteria from person to person, or from person to food contact surfaces (4). It is established that unwashed hands can transmit pathogens, especially fecal pathogens, to food product after visit to the toilet. Investigation of food borne illness showed that poor personal hygiene, primarily ineffective hand washing is an important contributor to foodborne illness. Microbial contamination is a serious issue because it can lead to a wide range of health problem. (7).

In the university environment, students have access to service offices regularly for different purposes. Given that the door handles are not routinely disinfected, the opportunity for the

transmission of contaminating microorganisms is great. Although it is accepted that the infection risk in general community is less than that associated with patients in hospital. People believe that microbes are only present in hospitals, clinics and research laboratories. Thus they have a misleading feeling of security in other places. This is due to lack of knowledge about microorganisms being ubiquitous and could be found on door handles of public toilet which when picked up could cause health problems. Researchers considered that 80% of infections are spread through contact with hands or other objects (1). The main reasons are difficulties to prevent the transfer of microbes that are already present in human bodies.Therefore, this study seeks to evaluate and characterize the bacterial species isolated from door handles, providing valuable insights into the potential risks posed by these commonly touched surfaces.

METHODOLOGY

2.1 Study area

This study was carried out in Madonna University, Nigeria.

2.2 Study population

A total of 30 office door handles/knobs were included in this study

2.3 Sample collection

Samples were collected using the swab-rinse method of the American Public Health Association *(13)*. Door handles were swabbed asceptically with normal saline, using a cotton wool the door handle was sterilized and allow to dry, then another sample was collected as a control and it was then introduced into a bijou bottle containing normal saline, (the bijou was well sterilized using

an autoclave) shaken, and ensured tight closure and transported to Madonna university teaching hospital medical laboratory science. The rinse fluids were thawed and plated on Chocolate, MacConkey, and blood agar.

2.4 Sample Processing

Each collected specimen was processed to identify the bacteria in the sample. The following processing techniques were employed.

- Culture
- Gram staining
- Biochemical test

- **Culture Technique**

  Each door handle rinse fluid was aseptically inoculated into the well prepared media namely, Chocolate, MacConkey and Blood agar. The normal saline in which the door handle swabs were rinsed into, were gently shaken, and striked on the media plates. The plates were inoculated overnight at 37°C and examined

- **Gram staining Technique**

  .A clean grease free slide was used to make a smear by using a sterile wire loop to transfer an isolated colony from the culture plates to a grease free slide with a drop of normal saline, it was then spread an area the size of a dime and the slides were allowed to dry thoroughly. Each sample inoculated was gram stained to differentiate between the gram positive bacteria and gram negative bacteria

- **Biochemical test Technique**

The following biochemical test was done to identify the exact organism grown on the media

- Catalase test
- Coagulase
- Indole
- Urease

Catalase test:

It aims to differentiate between staphylococcus species from streptococcus species

Procedures

- Using a sterile inoculating loop or wooden stick, a small amount of the bacterial colony was collected from the agar plate. Ensure the colony is not too wet or too dry.
- bacterial sample was placed onto a clean glass slide.
- 1-2 drops of 3% hydrogen peroxide solution was added directly onto the bacterial sample.
- Immediately I observe the bacterial sample for the presence of bubbles.
- **Positive Result**: Rapid bubbling or effervescence indicates the presence of catalase enzyme, which breaks down hydrogen peroxide into water and oxygen gas.
- **Negative Result**: No bubbling indicates the absence of catalase enzyme

Control_????

Coagulase test

It aims to differentiate between staphylococcus aureus from other staphylococcus species

Procedures

- A small drop of saline was placed on both end clean glass slide.
- Using a sterile stick, emulsified a small colony of the test organism in each drop to make a smooth suspension.
- To one of the suspensions, a drop of plasma was added
- Mixed gently with a sterile stick.
- Observed for visible clumping within 10-30 seconds.

- **Positive Result**: Clumping or agglutination indicates the presence of bound coagulase.
- **Negative Result**: No clumping indicates the absence of bound coagulase.

Control- ???

Indole Test

This test aims to detect between indole positive and indole negative by the ability of bacteria to produce tryptophanase enzyme, which converts tryptophan into indole

Procedures

- Inoculate the bacteria culture into the tryptophan broth (peptone water)
- Incubate the tubes at 37 degreecelsus for 24 hours
- Add 3 drops of kovac's reagent to the broth
- Observed for a colour change

Positive result: A red colourdevelops within 1-2 minutes indicating indole positive

Negative result: No colour change occurs

Control???????

UREASE TEST

This test aims to detect between urease positive and urease negative by the ability of the bacteria to produce urease enzyme, which breaks down urea into ammonia and carbon dioxide

Procedures

- Inoculate the bacteria culture into the urease test broth

And incubate the tubes at 37 degreecelsus for 24 hours

- Observed for a colour change

Positive result: The medium turns red due to the production of ammonia which raises the pH and changes the colour of the phenol red indicator

Negative result: The medium remains yellow or orange, indicating no urease production

Control- ???????

2.5 Statistical Analysis

Data obtain from this study were analyzed using Statistical Package for Social Science (SPSS) version 20.0 for windows 7. The results were expressed as mean Standard deviation. Paired t-test which was used to compare mean ± and values were considered significant at $p<0.05$ and non-significant at $p>0.05$

Chi-square Test

This test is used to determine whether there is a significant association between two categorical variables.

Formula:

$\chi 2=\sum(Oij-Eij)2$

Where:

- $\chi 2$ is the chi-square test statistic.
- Oij is the observed frequency count in the ith row and jth column of the contingency table.
- Eij is the expected frequency count in the ith row and jth column under the assumption of independence

RESULT

Table 1: Total number of samples collected from door handles before and after sterilizing.

This shows the number of samples collected from each door handles from several offices before sterilizing and after sterilizing. A total of 12 samples were collected from Medlab offices with 6 of them collected before sterilization, while the other 6 after sterilization. Blue and white building had a total of 10 samples collected with 5 before sterilization, and 5 after sterilization. Student affairs was 4 samples, 2 before sterilization, and 2 after sterilization. Science hall was 4 samples. 2 before sterilization, and 2 after sterilization.

Table1: Totalnumberofsamplescollectedfromdoorhandlesbeforeandaftersterilizing.

Door handles	No. of samples	Before sterilizing	After sterilizing
Medical laboratory offices	12(40.0)	6(40.0)	6(40.0)
Blue and white offices	10(33.4)	5(33.4)	5(33.4)
Student affairs office	4(13.3)	2(13.3)	2(13.3)
Science hall	4(13.3)	2(13.3)	2(13.3)
Total	**30(100)**	**15(100)**	**15(100)**

Table 2: Gram reactions from door handle samples taken from different locations.

This shows the Gram reaction from door handles before sterilization. The table shows science hall to have a 100% Gram negative rods organism with zero (0) Gram positive organisms. Students affair also had a 100% Gram negative with 0% Gram positive organisms, indicating that student affairs and science hall had the highest gram negative organisms infection. Medical Laboratory offices had a 50% Gram positive reaction and 50% Gram negative reaction. Meanwhile the Blue and White administrative building offices had a 40% Gram negative reaction and a 60 % Gram positive reaction.

Table2: Gramreactionsfromdoorhandlesamplestakenfromdifferentlocations.

Gram Reaction	Blue and white office		Med lab sci offices		Science hall		Student's affairs		X^2	p-value
	N	%	N	%	N	%	N	%		
Gram-negative rods	2	40.0%	3	50.0%	2	100.0%	2	100.0%	3.750	0.290
Gram positive cocci	3	60.0%	3	50.0%	0	0.0%	0	0.0%		
Total	5	100.0%	6	100.0%	2	100.0%	2	100.0%		

Table 3: Biochemical test of isolated bacteria from door handles in different locations.

This shows the biochemical test carried out with the different suspected organisms found. The blue and white administrative building had a 20% catalase positive test, and a 20% indole positive test, but a 0% urease positive test. The Medlab science building had a 50% catalase positive test, 16.7% indole positive test and a 16.7% urease positive test. Science hall building had a 0% catalase test, 0% indole test and a 0% urease test.

Table3: Biochemicaltestofisolatedbacteriafromdoorhandlesindifferentlocations.

Biochemical Test	Blue and white office		Med lab sci offices		Sci hall		X^2	p value
	N	%	N	%	N	%		
catalase negative	2	40.0%	0	0.0%	0	0.0%	17.625	0.128
catalase positive	1	20.0%	3	50.0%	0	0.0%		
indole positive	1	20.0%	1	16.7%	0	0.0%		
urease negative	1	20.0%	1	16.7%	2	100.0%		
urease positive	0	0.0%	1	16.7%	0	0.0%		
Total	5	100.0%	6	100.0%	2	100.0%		

Table 4: shows the isolated bacteria from the various door handles before sterilization. The table shows *Staphylococcus saprophyticus* and *klebsiella pneumonia* as the highest prevailing organism, with a percentage of 40% respectively for the blue and white administrative building. Medlabscienece building had *Staphylococcus aureus* as the highest prevailing organism with a percentage of 50%, *klebsiella pneumoniae* 33.3% and *Echerichia coli* with 16.7%. science hall had a 100% prevalence of *Klebsiella pneumoniae,* while student affairs had *Echerichia coli* as the highest prevailing organism with 100%

Table4: Isolatedbacteriafromthevariousdoorhandlesbeforesterilization.

Organisms	Blue and white office		Med lab sci offices		sci hall		student affairs		X^2	p value
	N	%	N	%	N	%	N	%		
Echerichia coli	0	0.0%	1	16.7%	0	0.0%	2	100.0%	38.333	0.003
klebsiella pneumonia	2	40.0%	0	0.0%	0	0.0%	0	0.0%		
klebsiella pneumoniae	0	0.0%	2	33.3%	0	0.0%	0	0.0%		
Klebsiella pneumoniae	0	0.0%	0	0.0%	2	100.0%	0	0.0%		
staphylococcus aureus	1	20.0%	0	0.0%	0	0.0%	0	0.0%		
Staphylococcus aureus	0	0.0%	3	50.0%	0	0.0%	0	0.0%		
Staphylococcus saprophyticus	2	40.0%	0	0.0%	0	0.0%	0	0.0%		
Total	5	100.0%	6	100.0%	2	100.0%	2	100.0%		

Table 5 Overall bacteria isolation from swap samples from door handles before and after sterilization with 3% alcohol

This shows the bacteria isolation from swap samples from door handles before and after sterilization. The result shows there was an overall 100% growth on swap samples without sterization, whereas, there was a 53.3% scanty growth on the swap after sterilization with 3% alcohol and a 46.7% no growth after sterilization, indicating that even after sterilization, there could still be growth, highlighting that 3% alcohol may not be a good disinfectant

Table5:

Overallbacteriaisolationfromswapsamplesfromdoorhandlesbeforeandaftersterilizationwith3%alcohol

Growth in culture medium	Before sterilization	**With 3% alcohol**	**X^2**	**p-value**
	N(%)			
Bacteria growth	15(100.0%)	0(0.0%)	30.000	0.01
no growth	0(0.0%)	7(46.7%)		
scanty growth	0(0.0%)	8(53.3%)		

Significant at p<0.05

Table 6 shows the organisms isolated from the swap sample after sterilization.

This shows the percentage of organisms growth after sterilization. Blue and white building had a 20%, science hall had 1.9% and Medlab building had 5% growth on *staphylococcus aureus*. *klebsiella pneumonia* was 15%, 4%, and 2% respectively. *Echerichia coli* had 1%, 1% and 3% respectively.

Table6: Organismsisolatedfromtheswapsampleaftersterilization.

Organisms	**Blue and white building**	**Science hall**	**Medlab sci building**
Staphylococcus aureus	20.4%	1.9%	5%
klebsiella pneumonia	15%	4%	2%
Echerichia coli	1%	1%	3%
Total	53.3	?	?

4.1 Discussion

Microorganisms can be found everywhere, bacteria and fungi contaminate human body, houses, workplaces, and environment. Fortunately, among many billions of bacteria, only 1500 can be dangerous for health, causing different disease such as pneumonia or skin infection *(*5*)*. In the university environment, students have access to service offices regularly for different purposes. Given that the door handles are not routinely disinfected, the opportunity for the transmission of contaminating microorganisms is great. This study was carried out to evaluate the bacteria on door handles in Madonna University, Nigeria. The result of the study shows student affairs had *Echerichia coli* as the highest prevailing organism with 100%. Medlabscience building had *Staphylococcus aureus* as the highest prevailing organism with a percentage of 50% *klebsiella pneumoniae* with 33.3% and *Echerichia coli* with 16.7%. meanwhile, the blue and white administrative building had *Staphylococcus saprophyticus* and *klebsiella pneumonia* as the highest prevailing organism, with a percentage of 40% respectively. Science hall had a 100% prevalence of *Klebsiella pneumoniae*. This is contrary with the work of Nwori*et al.,(*12), who reported the most prevalent bacteria in their study to be Staphylococcus aureus (30.1%), Klebsiella pneumonia (25.7%), Escherichia coli (15.6%), Enterobacter spp.(11.2%), Citrobacter spp., (7.1%),Pseudomonas aeruginosa (5.9%), while Proteus species had the least prevalence,(4.5%) (12). Additionally, the study also revealed the various percentage of gram reactions with gram negative having a higher percentage of reactions that the Gram positive. This is also contrary to the work of (2), who reported the ratio of Gram reactions from their study with Gram-positive to Gram-negative organisms having a ratio of 1.2 to 1.1 respectively. This could be due to the higher prevalence of *E. coli* across the

study. Microbial contamination of doorknobs or handles are well documented, and this could serve as vehicles for cross infections and re-contamination of washed hands (10).*S.aureus* was the second most prevailing organism isolated from the study, and this could be since *Staphylococcus spp* 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. (15). The result also shows the bacteria isolation from swap samples from door handles before and after sterilization. The result shows there was an overall 100% growth on swap samples without sterilization, whereas, there was a 53.3% scanty growth on the swap after sterilization with 3% alcohol and a 46.7% no growth after sterilization, indicating that even after sterilization, there could still be growth, highlighting that 3% alcohol may not be a good disinfectant. This is similar with the work of (16) who demonstrated that treatment of door handles with 3% acid alcohol significantly reduced microbial contamination, including bacteria and viruses, thereby potentially reducing the risk of transmission in hospital environments (16).

The result shows the percentage of organisms growth after sterilization. Blue and white building had a 20%, growth, science hall had 1.9% and Medlab building had 5% growth on *staphylococcus aureus*. *klebsiella pneumonia* was 15%, 4%, and 2% respectively. *Echerichia coli* had 1%, 1% and 3% respectively, indicating some of the organisms that can still grow even after sterilization, supporting the earlier report of (16).Sterilization of environmental surfaces, such as door handles, is crucial in preventing the transmission of pathogens in various settings, including healthcare facilities and public spaces. The use of 3% acid alcohol solution has been proposed as an effective method for reducing microbial contamination on surfaces. (16) demonstrated that treatment of door handles with 3% acid alcohol significantly reduced microbial contamination, including bacteria and viruses, thereby potentially reducing the risk of

transmission in hospital environments. (6) found that routine disinfection of door handles with 3% acid alcohol was effective in maintaining low levels of microbial contamination over time, supporting its use as a practical sterilization method. In a review by White *et al.* (16), the effectiveness of various disinfectants, including 3% acid alcohol, was evaluated for their ability to control nosocomial infections through environmental surface disinfection, highlighting its role in reducing healthcare-associated infections.

5.2 Conclusion

Microorganisms, including bacteria and fungi, are ubiquitous in human environments, ranging from the human body to various indoor and outdoor spaces. Despite their abundance, only a fraction of these microorganisms pose a significant threat to human health, capable of causing diseases such as pneumonia and skin infections. The study underscores the potential for door handles to act as reservoirs and vectors for microbial transmission due to insufficient disinfection practices. This observation aligns with established literature emphasizing the role of environmental surfaces in spreading infections. Particularly noteworthy was the prevalence of *Staphylococcus aureus*, attributed to its presence in human skin and nasal flora, facilitating its easy dissemination through human contact.

In light of these findings, it was therefore concluded that effective sterilization practices are crucial for mitigating the transmission of pathogens in public spaces. The use of 3% acid alcohol solution has been identified as an effective method for reducing bacteria on door handles, These studies advocate for routine disinfection protocols to minimize the risk of healthcare-associated infections and improve overall hygiene standards in communal environment.

5.3 Recommendation

Since there are various forms of microorganisms found in the various door handles of these offices, it therefore, recommended that a proper sanitization be carried out from time to time, to ensure complete disinfection of these handles in other to limit or reduce the spread of these microorganisms and hand hygienic practice should be taken seriously.

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