**CHAPTER ONE**

**1.1. INTRODUCTION**

Fomite is a non living object that infectious microorganisms can be deported on. Fomites when in constant contact with humans or natural habitats of pathogenic organism constitute a major source of spread of infectious diseases (Osterholm *et al.,* 1995). The fomites include door handle of conveniences, showers, toilet, hand lockers especially those found in public offices, hospitals, hotels, restaurants and restrooms (Bright *et al.,* 2010). Beside the day to day interaction of people, which constitute one way of spreading disease, the major source of spread of community acquired infections are fomites (Presscott *et al.,* 1993). Microorganisms are found everywhere, bacteria and fungi contaminate out body, our houses, work places, and whole environment .Fortunately among many billion of bacteria, only 1500 can be dangerous for our health, causing different disease such as pneumonia, otitis media, sore throat, gastroenteritis and skin infections (Eltablawy and Elhinfnawi, 2009). Microorganisms constitute a major part of every ecosystem. In these environments, they live either freely or as parasites (Sleigh and Timbury, 1998). The 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 from microorganisms, the presence of pathogenic bacteria may lead to chronic or acute illness (Oranusi *et al.,* 2013). Human hands usually harbor microorganisms both as part of body normal flora as well as transient microbes contacted from the environment (Lindberg *et al.,* 2004). 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 (Scott *et al.,* 1982). 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 (Nworie *et al.,* 2012).

People believe that microbes are only present in research laboratories or in hospitals and clinics and thus they have a misleading feeling of security in other places. This is due to the lack of knowledge about where bacteria cause the health problem. Researchers considered that 80% of infections are spread through hands contact with hands or other objects (Al-Ghamdi *et al.,* 2011). The main reasons are difficulties to prevent the transfer of microbes that are already present in human bodies (Lues and Tonder, 2007). 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 (Chinakwe *et al.,* 2012). 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 food borne illness (Lambrechts *et al.,* 2014). Door handles of offices in Abuja metropolis were investigated for bacterial contamination. The researchers found that 86.7 % were positive (Nworie *et al.,* 2012).

**1.2. AIM**

This study was designed to determine the level of bacterial contamination of public restrooms in Godfrey Okoye University.

**1.3. OBJECTIVES**

1. To isolate bacterial from the formites using routine culture media.

2. To identify the isolate as much as possible, to compare the male, female and staff restrooms.

 **CHAPTER TWO**

**2.0. LITERATURE REVIEW**

**2.1. Bacterial contamination of fomites**

It is generally acknowledged that inanimate objects can carry microorganisms originating from the surrounding environment. These deposited microorganism posses bio-transfer potential, i.e. the ability to be transferred to another substratum where growth is possible — for example on food, or on the human body (Joanna Verra, 2012). The spread of infectious diseases through hand contact has been an area of major concern. Itah and Ben. (2004) states that Enteric bacteria such as *Escherichia coli,* *Klebsiella* spp*, Citrobacter* spp, were found to contaminate various contact surfaces including door handles and many other common house hold fixtures. Fomites consist of either porous or non porous surfaces or inanimate objects that when contaminated with pathogenic microorganism can be transferred to a new host thereby serving as vehicles in transmission (Greene, 2009). Fomites when in constant contact with humans or natural habitats of pathogenic organism which represent a major source of spread of infection diseases (Osterholm *et al.,* 1995). Such fomites include door handles of conveniences, showers, toilet seats and sinks, lockers, chairs, tables especially those found in public offices, hospitals, hotels, restaurants and restrooms (Bright *et al.,* 2010). Microorganism that cause infections can be found in any environment include soil, air, water and food as well as environmental surfaces or objects (Neely and Sittig*,* 2002). Most of the bacteria found by researchers are normal flora of the skin, mouth and nasal passages that can pass to our hands. Although many of these bacteria won´t hurt unless the immune system becomes weak because of illness (oluduro *et al.,* 2011).

A survey of environmental surfaces in two Atlanta areas, day care centers was conducted to determine the prevalence of fecal coliform bacteria, considered a marker for the presence of fecal contamination which might contain pathogenic parasites, bacteria, or viruses. Fecal coliforms were found in 17 (4.3%) of 398 representative samples of building surfaces, furniture, and other objects. These surfaces may be involved in the chain of transmission of enteric diseases among children. Therefore, disinfection of inanimate objects, in addition to good hand washing, may be important in controlling the spread of enteric diseases in day care centers. There were 10 (5.0%) positive plates from one center, and 7 (3.5%) from the other. Positive specimens were obtained from toilets, diapering items; floors, furniture, and a refrigerator handle (Weniger *et al.,* 1983). Omololu-Aso *et al*. (2011) investigated two hundred swabs from doctors’ stethoscope diaphragm, cell phones of Health Care Workers (HCWS), patients’ bed linen, pillows and door knobs at the Obafemi Awolowo University Teaching Hospitals Complex (OAUTHC). Cultures from the swabs were screened for Staphylococcus aureus. The results showed that 18.70% of the doctors’ stethoscopes, 20.33% of the doctors’ cell phones, 20.33% of the doorknobs were contaminated with *S. aureus* Oranusi *et al.,* (2013) collected 130 sample consisting of 40 hand swabs; 20 each of food sample and food contact surfaces; 10 each of swabs from banisters table top, door handles, taps handles and toilet flushers were collected from different location of the university campus. They found that about 98% of hand swabs; food contact and the easy contact surfaces were contaminated with organism. Hand swab from the halls of residence and library had higher level of contaminations 2.1×105 and 1.9×105 cfu respectively. Toilet flushers and Banisters had 8.3×106. Microorganism isolated by their study include *Bacillus spp; Staphylococcus spp; Streptococcus spp;* *Escherichia coli; Salmonella spp and Klebsiella spp.* Baadhaim *et al.,* (2011) indicated that the door handles may aid in the spread of microbes between individuals and that they may be a reservoir of microbial contamination. In their experiments, they assessed the prevalence of Gram negative bacteria that were found on door handles of Olin Hall. It was hypothesized that during times where the building was near its peak usage, a larger percentage of the bacteria sampled from the door handles of Olin Hall would be Gram negative. The results showed that of total microbial colonies observed as 49% were Gram negative bacteria.

Nworie *et al.,* (2012) recognized that the increase incidence of outbreaks of certain diseases and its rate of spread from one community to the other become a major health concern. The sample collected from the Door handles/knobs of public conveniences of selected public offices, motor parks, and markets in Abuja metropolis were investigated for bacterial contamination. Total of 180 swab samples cultured 156 (86.7%) were positive. The most positive samples from female toilet handles/knobs (41.7%) and bathroom door handles/knobs than males (11.5%). The study also found that toilet door handles/knobs in markets, motor parks and restaurants had higher rate of contamination compared to Government offices, and banks. Contamination was also higher in toilet door handles/knobs (87.2%) than in bathroom door handles/knobs (85%). Most of the bacteria contaminants were Coliforms. The isolated bacterial contaminants were Staphylococcus aureus (30.1%), *Klebsiella pneumoniae* (25.7%), *Escherichia coli* (1%), *Enterobacter* species (11.2%), *Citrobacter* species (7.1%), *Pseudomonas* *aeruginosa* (5.9%), and *Proteus* species (4.5%). This shows that the city’s convenient places harbor highly pathogenic bacteria which have the potentials of causing epidemics in the near future. The prevalence of bacterial organisms on toilet door handles in secondary schools in Bokkos Local Government; Jos Plateau State, Nigeria was evaluated by Maori *et al.,* (2011). A total of 120 samples were collected and cultured, 40 from each of the schools (Government Secondary School Bokkos (G. S. S.B), All Nation Academy and Government secondary School Mushere). Out of the 120 samples that were collected 60(50%) yielded growth and 60 showed no growth at all. The following organisms were isolated Staphylococcus species (43.3%), *Candida* species (10%), *Escherichia* coli (16.7%), *Citrobacter* species (1.7%), *Klebsiella* species (20%), *Proteus* species (6.7%) and *Salmonella* species (1.7%). The result showed that G. S. S. B has the highest contamination (48.3%) followed by All Nations Academy (30%) and then G. S. S. M (21%). Scott et al., (1982) carried out an investigation about the bacterial flora in over 200 homes. 60 samples collected from bathroom, toilet and kitchen. 9 sample from living room. The result of bacterial contamination as percentage occurring in 200 homes was as following ; E. coli 64.5%, *Klebsella* *Pneumoniae* 29.5%, *Klebsiella* spp, 6%, *Proteus* *mirabilis* 4%, *Salmonella* spp. 1.5%, *Citrobacter* *freundii* 42%, *Citrobacter* spp. 29%, *Enterobacter* cloacae 26%, *Enterobacter* agglomerans 7.5%; *Pseudomonus* *aeruginosa* 4%, *Staphylococcus* *aureus* 31.5%, *Streptococcus* spp. 16%,the majority of homes were contaminated with enterobacteria species and *Pseudomonus* species, many of which are potentially pathogenic. Other potential Pathogens included *Staphylococcus* *aureus* and *Streptococcus* species.

A study was carried out by Sabra, (2013) on public female restrooms at Taif, Kingdom of Saudi Arabia; Restrooms (RR) from different buildings, in order to characterize the locality of contamination and bacterial loads. 260 sample collected from different rest room (RR) like (RR Door, RR Handle; RR sink; RR Toilet door; RR Toilet handle). Incidence of bacterial growth or positive culture was 187/260 (71.9%). The predominant positive was from RR Toilet Handle in 73/80 (91.3%), then followed by RR Toilet Door in 59/80 (73.8%), RR Sink in 38/60 (63.3%), RR Handle in 10/20 (50%), finally less positive from RR Door in 7/20 (35%). Different isolated bacteria arranged according to their percentage as *Staphylococcus* *aureus* 76/187 (40.6%), *Escherichia* *coli* 42/187 (22.5%), *Bacillus* spp. 40/187 (21.4%), *Klebsiella* *pneumoniae* 25/187 (13.4%), *Enterococcus* *faecalis* 18/187 (9.6%), *Citrobacter* spp. 16/187 (8.6%), *Pseudomonas* *aeruginosa* 13/187 (7%) and *Proteus* *mirablilis* 10 /187 (5.3%). As well known that harmful microorganisms can be transferred to hands from contaminated surfaces. These Contaminated hands can transmit disease to own self as well as to others according to a study that done to determine to which extent the hand hygiene practices and toilet door knobs contribute to the bacterial load of hands of toilet users in a medical school. Swabs were taken from a randomly selected sample of 60 medical students for bacterial count from both hands before and after toilet use and from door knobs of six toilets. Only 40 (66.7%) claimed washed their hands with soap. Significantly more females (83%) used soap to wash hands compared to males (50%). Bacterial load in the hands of both males and females showed an increase after toilet use. The increase was significant among male students. The dominant hand had a significantly higher bacterial load than the other. The mean bacterial loads of male toilet door knobs (12 CFU/cm2) were significantly higher than of female toilet door knobs (2.5 CFU/cm2). *Staphylococcus* *aureus* was isolated from the hands of 21 students (De Alwis *et al.,* 2012). Fomites are inanimate objects that can serve as vehicles for pathogens transfer. Maryam *et al.,* (2014) conducted a study to determine the pathogenic bacteria isolated from fomites in a teaching hospital in Nigeria. Exactly 35 samples were used. Twenty three (65.7%) isolates were obtained; the ratio of Gram positive to Gram negative organisms was 12:11. The bacteria isolated were *Staphylococcus* *aureus* (21.7%), *Staphylococcus* *epidermidis* (8.7%), *Streptococcus* spp. (8.7%), *Bacillus* spp. (13.0%), *Escherichia* *coli* (26.1%), *Pseudomonas* spp. (8.7%) and *Klebsiella* spp. (13.0%). Other a study was conducted to determine the prevalence of some pathogenic bacteria and the general hygienic status on the interior surfaces of some domestic refrigerators (n = 150). Campylobacter spp., and *Salmonella* spp. were not recovered from any refrigerators, but Staphylococcus aureus was recovered from 9.54%, Listeria. monocytogenes 3.8%, *Escherichia* coli from 2.1% from 1.6% of examined refrigerators. That indicated very poor standards of consumer refrigerator management and hygiene, and posing risks to consumer health (Abdulla *et al.*, 2008).

The occurrence of enteric bacteria in kitchen sponges and dish cloths suggests that they can play a role or lead to the cross-contamination of foods, fomites and hands by food borne pathogens. Koenig, (2014) investigated the occurrence of bacteria in kitchen towels often used to dry dishes, hands and other surfaces in the domestic kitchen. A total of 82 kitchen hand towels samples were collected from households in five major cities in the United States and Canada and the numbers of heterotrophic bacteria, coliform bacteria, and *Escherichia* *coli* in each towel were determined. Coliform bacteria were detected in 89.0% of the samples and E. coli in 25.6% of total coliform bacteria isolated from towels.

 **CHAPTER THREE**

**3.0. MATERIALS & METHOD**

3.1. S**tudy area**

This study was conducted at Godfrey okoye university laboratory, Enugu. The required analysis and tests were all carried out.

**3.2. SAMPLE COLLECTION**

The samples were collected from each toilet in the following surfaces: toilet seats and door handles by means of sterile cotton swabs moistened in normal saline. The swab was wiped firmly on the entire surface of the seats and door handles. Each swab was placed in small tube, labeled and was immediately transported to the laboratory.

**3.2.1.** **Bacterial isolation and identification**

Each sample was inoculated onto nutrient and MacConkey agar plates. Here, using the swab stick, a primary streak was made while secondary and tertiary streaks were made from the primary streak in parallel pattern with the aid of a sterilized wire loop to make a four-way streak plate- technique. All the plates were incubated invertedly for 24 hours at 370C. After the overnight incubation, the plates were removed from the incubator and presumptively observed for colony characteristics. Isolated colonies were then sub-cultured onto fresh nutrient agar and macConkey agar plates for proper preliminary identification (Chesebrough, 2000). Different morphological features of the yielded colonies including colour, size, elevation and pigmentation were recorded. Single isolated colonies from these plates were subjected to Gram’s staining, and standard biochemical tests (catalase, coagulase, oxidase, IMViC- indole, methyl red, voges-proskauer and citrate utilization tests).

**3.2.2. Gram staining**

* Place slide with heat fixed smear on staining tray or rack
* Gently flood the smear with crystal violet and let stand for 1 minute
* Tilt the slide slightly and gently rinse with slow running water or distilled water using a wash bottle.
* Flood the smear with gram’s iodine and let stand for 1 minute
* Gently rinse with slow running water or distilled water using a wash bottle. The smear will appear as a purple circle in the slide.
* Decolorize using 95% ethyl alcohol or acetone. Tilt the slide slightly and apply the alcohol drop by drop for 5-10 seconds until the alcohol runs almost clear. Do not over decolorize.
* Then immediately since with water.
* Gently flood with safranin to counter stain and let stand for 45 seconds.
* Gently rinse with tap water or distilled water using a water bottle.
* Gently use cotton wool to clean the back of the slide and keep in a draining rack to air dry.
* View the smear using light microscope under oil immersion.

**3.2.3. Catalase test**

* Drop a small amount of bacterial colony to a surface of clean dry glass slide using a loop or sterile wood stick.
* Place a drop of 3% H2O2 on to the slide and mix.
* If positive: Evolution of oxygen (within 5-10 seconds) as evidence by bubbling.
* If negative: no bubbles or few scattered bubbles

**3.2.4. Coagulase test**

* Place a drop of normal saline on each end of the slide or on two separate slides.
* With the loop, emulsify a portion of the isolated colony in each drop to make two thick suspensions.
* Add a drop of human plasma to one of the suspension and mix gently.
* Look for dumping of the organisms within 10 seconds.
* No plasma is added to the second suspension to differentiate any granular appearance of the organism from true coagulase dumping.

**3.2.5. Citrate test**

* Inoculate Simmons citrate agar lightly on the slant by touching the top of a needle to a colony that is 18 to 24 hours old.
* Incubate at 35oc to 37oc for 18 24 hours. Some organisms may require up to70 days of incubation due to their limited rate of growth on citrate medium.
* Observe the development of blue colour denoting akalimization.
* If positive: colour change blue{ Prussian }
* If negative: no colour change

**3.2.6. Indole test**

* Take sterilized test tubes containing 4mls of tryptophan broth.
* Inoculate the tubes aseptically by taking the growth from 18 -24 hours culture.
* Incubate the tube at 37oc for 24-28 hours.
* Add 0.5ml of kovac’s reagent to the broth culture
* Observe for the presence or absence of ring.
* If positive: formation of pink or red colour (cherry-red ring).
* If negative: No colour change.

**3.2.7. Oxidase test**

* Strip of whatman’s filter paper are soaked in a freshly prepared 1% solution of tetramethyl-p-phenylene-diamine dihydrochloride.
* After draining about 30 seconds, the strips are freeze dried and stored in a dark bottle tightly sealed with a screw cap.
* For use, a strip is removed, laid in a petric dish and moistened with distilled water.
* The colony to be tested is picked up with platinum loop and smeared over the moist area.
* If positive: Deep-blue hue appearing within 5-10 seconds.
* If negative: No colour change.

**3.2.8. Voges prauskeur test**

* Inoculate the test organism into the vp medium.
* Incubate aerobically at 37oc for 24hours.
* In the process of the incubation, aliquot 2mls of the broth to a clean test tube.
* Reincubate the remaining broth of an additional 24hours.
* Add 6 drops of 5% alpha naphtol and mix well to acerate.
* Add 2 drops of 40%KOH, and mix well to aerate.
* If positive: Pink red coloration surface within 30minutes (shake the tubes vigorously during the 30 minutes period)
* If negative: No colour change.

**3.2.9. Methyl-red-test**

* Inoculate two test tube containing vp-MR broths with a pure culture of the organism under investigation.
* Incubate at 37oc for 4days.
* Add 5 drops of MR indicate solution to the first tube (for vp test Barrit’s reagent to another tube)
* If positive: Red coloration.
* If negative: No colour change.

 **CHAPTER FOUR**

**4.1. RESULT**

A total number of 24 samples were collected from different toilets including the toilet seat and door handles (female toilet, male toilet and staff toilet).

1-DH

2-TS

3-DH

4-TS

5-DH

6-TS

7-DH

8-TS Female toilets

9-DH

10-TS

11-DH

12-TS

13-DH

14-TS

15-DH

16-TS Male toilets

17-DH

18-TS

19-DH

20-TS

21-DH

22-TS

23-DH

24-TS Staff toilets both male and female

Table 1: Total number of samples collected and the number of positive isolates gotten from different restrooms.

|  |  |  |
| --- | --- | --- |
| Site of sample collection | Total number of samples collected | Total number of positive isolates |
| Female toilet door handles |  4 |  3 |
| Female toilet seat |  4 | 4 |
| Male toilet door handles |  4 | 2 |
| Male toilet seat |  4 | 3 |
| Male staff toilet door handles |  2 | 1 |
| Male staff toilet seatFemale staff toilet door handleFemale staff toilet seat |  2 2 2 | 212 |
| Total  |  24 | 18 |

Note: The percentage of the positive isolate is 75%

Table 2a: Colonial morphology of the isolates on nutrient agar after 24 hours of aerobic incubation

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Isolates  | Colour  | Shape  | Size  | Elevation  | Consistency  | NoofColonies  |
| 1-DH | White | Irregular  | 0.1mm | Flat | No  | No colony |
| 2-TS | Milkyyellow | IrregularCircular  | 0.1mm0.1mm | Fla tFlat  | Yes Yes  | Colonies |
| 3-DH | YellowWhite Milky  | Circular Circular Irregular | 0.2mm0.001mm0.2mm | Flat Raised Raised  | Yes No No  | Colonies |
| 4-TS | Golden  | Circular  | 0.1mm | Flat  |  Yes  | No colony  |
| 5-DH | WhiteYellow  | Irregular  Irregular  | 0.5mm0.1mm | Raised Flat  | Yes No  | Colonies  |
| 6-TS | Milky  | Circular  | 0.1mm | Flat  | No  | No colony |
| 7-DH | Yellow  | Circular  | 0.1mm | Flat  | Yes  | No colony  |
| 8-TS | White  | Circular  | 0.1mm | Flat | No  | No colony |
| 9-DH | Milky  | Irregular  | 1.0mm | Raised  | No  | No colony |
| 10-TS | Golden MilkyYellow | Irregular Circular Circular  | 0.01mm0.1mm0.1mm | Raised flat flat  | Yes No yes  | Colonies |
| 11-DH | Milky  | Irregular  | 1.0mm | Raised  | No  | No colony  |
| 12-TS | Milky  | Circular  | 0.2mm | Flat  | Yes | No colony  |
| 13-DH | Yellow | Irregular  | 1.5mm | Raised  | Yes  | No colony |
| 14-TS | Golden | Circular  | 0.2mm | Flat  | Yes  | No colony |
| 15-DH | Yellow  | Irregular  | 0.3mm | Flat  | Yes  | No colony  |
| 16-TS | Milky Yellow | Irregular Circular  | 0.1mm0.001mm | Flat Flat  | No Yes  | Colonies  |
| 17-DH | White  | Circular  | 0.01mm | Flat  | No  | No colonies  |
| 18-TS | YellowMilky  | CircularCircular  | 0.3mm0.2mm | Flat Flat  | Yes No  | Colonies  |
| 19-DH | White  | Circular  | 0.1mm | Flat  | No  | No colony |
| 20-TS | White  | Irregular | 0.2mm | ­­Raised  | No  | No colony  |
| 21-DH | MilkYellow  | IrregularIrregular  | 0.2mm0.1mm | Flat Raised  | Yes Yes  | Colonies  |
| 22-TS | Yellow | Irregular  | 0.01mm | Flat  | No  | No colony |
| 23-DH24-TS | MilkyYellow Golden  | Circular Irregular Circular  | 0.1mm0.1mm0.1mm  | FlatRaisedFlat  | Yes Yesyes  | Colonies No colony |

Table 2b: Colonial morphology of the isolates on MacConkey agar after 24 hours of aerobic incubation.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Isolates  | Colour  | Shape  | Size  | Elevation  | Lactose fermenter  | No of Colonies  |
| 2-TS | Pink  | Irregular  | 0.01mm | Flat  | Yes  | No colony |
| 4-TS | Milky | Circular  | 0.1mm | Flat | No  | No colony |
| 6-TS | Pink  | Circular | 0.1mm | Flat | Yes  | No colony  |
| 8-TS | Pink | Circular | 0.2mm | Raised  | Yes  |  Colonies  |
| 21-DH | Pink  | Circular | 0.2mm | Flat  | Yes  | No colony |
| 22-TS | Milky Pink  | CircularCircular | 0.2mm0.1mm | Raised Raised  | No Yes  | Colonies  |

Table 3: Microscopic view of subcultered samples

|  |  |
| --- | --- |
| Isolates  | Gram’s reaction |
| 12-TS | Gram positive cocci |
| 6 -TS | Gram positive cocci |
| 2 -TS | Gram positive cocci |
| 3 -DH | Gram positive cocci |
| 5 -DH | Gram negative cocci |
| 21-DH | Gram negative cocci |
| 20-TS | Gram positive cocci  |
| 10-TS | Gram positive cocci  |
| 4 -TS | Gram positive cocci |
| 22-TS | Gram negative cocci |
| 1 -DH | Gram positive cocci |
| 7 -DH | Gram negative cocci  |
| 8 -TS | Gram positive bacilli |
| 15-DH | Gram negative cocci |
| 17-DH | Gram positive bacilli |
| 23-DH | Gram negative cocci |
| 24-TS | Gram positive cocci |

Table 4: Biochemical analysis for identification of bacteria found on door handles and toilet seats.

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Gram reaction  | Catalase  | Coagulase  | Indole  | MR | VP | Citrate  | Oxidase  | Motility  | Probable organism |
| + | + | + | - | + | + | + | - | Non motile  | *Staphylococcus aureus*  |
| - | + | - | + | + | - | - | - | Non Motile  | *E.coli* |
| + | + | - | - | - | + | + | - | Motile  | *Bacillus* sp |
| - | + | - | - | + | - | + | - | Motile  | *Proteus* sp |
| -- | ++ | -- | -- | -- | +- | ++ | -+ | Non MotileMotile   | *Klebsiella* sp*Pseudomonas* sp |

**CHAPTER FIVE**

**5.1. DISCUSSION**

This study aimed in isolation and identification of bacteria from fomite in Godfrey okoye university restrooms. The contaminated surfaces such as door handles are commonly touched with hands, which may act as a source of hand transfer of disease. The study has isolated and identified the following bacteria from the different restrooms *Stapylococcus aureus, E.coli, Bacillus* sp, *proteus* sp, *klebsiella* sp, *pseudomonas* sp . The result of this study showed that the restroom seats and door handles had a lot of bacteria present. Baadhaim *et al.,* (2011) indicated that the door handles may aid in the spread of microbes between individuals and that they may be a reservoir of microbial contamination. In their experiments, they assessed the prevalence of Gram negative bacteria that were found on door handles of Olin Hall. It was hypothesized that during times where the building was near its peak usage, a larger percentage of the bacteria sampled from the door handles of Olin Hall would be Gram negative. The results showed that of total microbial colonies observed as 49% were Gram negative bacteria.

The isolated bacterial contaminants were *Staphylococcus aureus* (30.1%), *Klebsiella pneumoniae* (25.7%), *Escherichia* coli (1%), *Enterobacter* species (11.2%), *Citrobacter* species (7.1%), *Pseudomonas aeruginosa* (5.9%), and *Proteus* species (4.5%). This shows that the city’s convenient places harbor highly pathogenic bacteria which have the potentials of causing epidemics in the near future. The prevalence of bacterial organisms on toilet door handles in secondary schools in Bokkos Local Government; Jos Plateau State, Nigeria was evaluated by Maori *et al.,* (2011).

A study carried out by Sabra, (2013) on public female restrooms at Taif, Kingdom of Saudi Arabia; Restrooms (RR) from different buildings. He’s findings were in accordance with my own findings. He isolated different bacteria and arranged them according to their percentage as *Staphylococcus* *aureus* 76/187 (40.6%), *Escherichia* *coli* 42/187 (22.5%), *Bacillus* spp. 40/187 (21.4%), *Klebsiella* *pneumoniae* 25/187 (13.4%), *Enterococcus* *faecalis* 18/187 (9.6%), *Citrobacter* spp. 16/187 (8.6%), *Pseudomonas* *aeruginosa* 13/187 (7%) and *Proteus* *mirablilis* 10 /187 (5.3%). Microorganisms constitute a major part of every ecosystem and it can be deported on fomite. The hand serves a medium for the propagation of microorganisms from place to place and from person to person. To better protect the university restrooms, it is important to highlight the need for disinfectants.

**5.2. CONCLUSION**

In this study it is noted that so many types of bacteria are present in toilet seat and door handles*.* The door handle can serve as a medium for infections transfer. The study shows that there were pathogenic bacteria present in the restrooms. It is advised to properly wash the hands with soap each time we make use of the toilet to help reduce the possibility of bacteria that can be transferred through the hands. Continuous cleaning of the toilet with disinfectant is required.

**REFERENCES**

Abdulla, M. A., Siham, E. S., Alian Y. Y. H. A. and Amel, O. B. (2008). “A study of the microbial

content of the domestic refrigerators in Khartoum area (Khartoum North). *Sud J.Vet.Sci.Anim.Husb.*47(1&2)

Al-Ghamdi A. K., Abdelmalek S. M. A., Ashshi A. M., Faidah, Shukri H. and Jiman-Fatani A.

 A. (2011). *Bacterial contamination of computer keyboard and mice.* J Bio; 3(18):2224-3208.

Alice N. Neely, P and Dean F. Sitting, (2002). “Basic microbiology and infection control

information to reduce the potential transmission of pathogens to patient via computer

hardware” J. *Am Med Info Assoc.* 9(7):500-508.

 Bright K. R., Boone S. A. and Gerba C. P. (2010). Occurrence of bacteria and viruses on

elementary classroom surfaces and the potential role of elementary classroom hygiene in

the spread of infectious diseases. *J School Nursing;* 26 (1):33-41.

 Baadhaim M., Kusner, D., and Ahmed H. (2011). “Distribution and Prevalence of Bacteria Found on

 the Door Handles of Olin Hall, Drake University”. *Conference Poster.*

Cheesbrough M. (2006). *District Laboratory Practice in Tropical Countries, Part 2,*

*Cambridge University Press, United Kingdom, PP*. 60-64.

Chinakwe E. C., Nwogwugwu N. U., Nwachukwu I. N., Okorondu S. I., Onyemekara N. N. and

Ndubuisi-Nnaji, U. (2012). Microbial quality and public health implication of hand-wash

Water samples of public adults in Owerri, South-East Nigeria. *Inter Res J Microbiol*.

3(4):144-146.

De Alwis, W. R., Pakirisamy, P., Wai San, L., and Xiaofen, E. C. (2012). A Study on Hand

Contamination and Hand Washing Practices among Medical Students. *ISRN Public*

*Health.*3:1-5.

Eltablawy S. Y. and Elhinfnawi H.N. (2009). Microbial contamination of some computer

keyboards and mice in National center for Radiation Research and Technology. *J World*

*Appl Sci.*6(4):162-7.

Greene A. (2009). Fomites, Available from: http;//www.drgreene.com/articles/

fomites/.Reviewed by Le-Bucklin K-V,Hicks R january 12,2009accessed 4 nov 2014.

Itah B., and Ben A. E. (2004). Incidence of Enteric Bacteria and *Staphylococcus aureus* in Day

Care Centers in AkwaIbom State, Nigeria. *J South E Asi J. Trop Med & Pub*

*Health.*35(1):202-9.

Joanna V. (2012). School of Healthcare Science, Manchester Metropolitan University,

Mancheste, the Microbial Contamination of Mobile CommunicationDevices. *J*

*Microbiol Biol Educ.*13(1): 59–61.

Koenig, D. W. (2014). Occurrence in Kitchen Hand Towels. *Food Protection Trends.*34(5):312-

317.

Lambrechts A., Human I. S., Doughari J. H. and Lues J. F. R. (2014). Bacterial contamination of

the hands of food handlers as indicator of hand washing efficacy in some convenient food

industries in South Africa. *Pak jMed Sci.*30 (4): 755-758.

Lindberg E., Adlerberth B., Hesselmar R., Saalman I., Strannegared N. and Aberg I.(2004). A

High rate of transfer of *Staphylococcus aureus* from parental skin to infant gut flora*. J*

*Clini Microbiol.*42(2): 530-534.

Lues J. F. R ,van Tonder .I (2007). The occurrence of indicator bacteria on hands and aprons of

food handlers in the delicatessen section of a retail group, *Food* *control1.*8(18):326-332.

Maryam, A., Hadiza, U. S., and Aminu, U. M. (2014). Characterization and determination of

antibiotic susceptibility pattern of bacteria isolated from some fomites in a teaching

hospital in northern Nigeria”. *J Afri Micro Res*.8(8): 814-818.

Maori, L., Agbor, V. O., and Ahmed, W. A. (2011). “The prevalence of bacterial organisms on

toilet door handles in Secondary Schools in Bokkos LGA, Jos, Plateau Sate, Nigeria.

*IOSR J Pharm Biological sci.*8 (4); 85-91.

 Neely A. and Sittig D. F. (2002). Basic microbiologic and infection controlinformation to

reduce the potential transmission of pathogens to patients via computerhardware. *J. Am*

*Med Info Assoc.*9(5):500-508.

Nworie. A., Ayeni. J. A., Eze U. A., and Azi. S. O. (2012). Bacterial contaminationof door

handles/knobs in selected public conveniences in abuja metropolis, nigeria; apublic

health threat. *Continental J Med Res*.6(1): 7-11.

Oluduro, A. O, Ubani, E. K. and Ofoezie , I .E, (2011). “Bacterial assessment of electronic

hardware user in interface in Ile-Ife, Nigeria” J. *Bas Appl.pharmaSci.*32(3):323-334.

Oranusi S.U., Dahunsi S.O. ,Owoso O. O. and Olatile T. (2013).“Microbial profile of hands,

food, easy contact surfaces and food surfaces: *A case study in a University* *Campus” J*

*Nov Inter Biotech & Biosci.*2(1):30-38.

Osterholm M. T., Hederg C. W. and MacDonald K. l. (1995). *Epidemiology of infectious*

*diseases.* In: Mandell, Douglas and Bennett’s principles and practice ofinfectious

diseases. Vol.1, 4th edition, Churchill-Livingstone, NewYork, p-165.

Omololu-Aso, J., Kolawole, D. O., Omololu-Aso, O. O., and Ajisebutu, S .O.(2011).

“Antibiotics sensitivity pattern of staphylococcus aureus from fomites in the

Obafemi Awolowo University Teaching Hospital Complex (OAUTHC) Nigeria” .*Inter J Medi & Medic Sci.*3(2): 32-36.

Prescott L. M., Harvey J. P. and Klein D. A. (1993). *Microbiology, 2nd edition.*W.M.C. Brown,

England.Pp.706-707,805.

Sabra, S. M. (2013). Bacterial public Health Hazard in the public Female Restroomsat Taif,

KSA, Middle-East J Scientific Res.14(1):63-68.

Scott, E., Bloomfield S. F. and Barlow C. G. (1982). An investigation of microbial

contamination in the home . *J Hyg.* 89(2):279-293.

Sleigh D. J. and Timbury M. C. (1998). *Note on Medical Microbiology,5th edition*.Churchill-

Livingstone, New York. p173.

Van Tonder I and Lues J. F. R. (2007). the occurrence of indicator bacteria on hands and

aprons of food handlers in the delicatessen section of a retail group.*Food control.*18 (8):

326- 332.

Weniger, B. G., Ruttenber, A. J., Goodman, R. A., Juranek, D. D., Wahlquist, S. P., & Smith, J.

D. (1983).“ Fecal coliforms on environmental surfaces in two day care centers”. *Applied*

*and environmental microbiology.* 45(2):733-735.