Global Scientific JOURNALS

GSJ: Volume 6, Issue 1, January 2018, Online: ISSN 2320-9186
www.globalscientificjournal.com

EFFECTS OF HAND HYGIENE PRACTICES ON HANDBORNE BACTERIA INFECTIONS

[1]A.A. ONOJA*, [2]T.O. MOSES
[1]Pan African University, Institute for Basic Sciences, Technology and Innovation, Nairobi, donmaston09@gmail.com, P.O.Box 62000-00200, Nairobi-Kenya
[2]University of Jos, Nigeria, tinamoses522@gmail.com

ABSTRACT

In order to understand the prevalence spread of Handborne bacteria among University of Jos Students, there is every need to examine the effects of hand washing hygiene practices and spread of handborne bacterial infections. Twenty samples (ten from Microbiology students and ten from Non-Microbiology students) were obtained from hands of the students and analyzed for Total Plate Count (TPC), Total Coliform Count (TCC) and Staphylococcus aureus Count (SC) respectively. The isolates were identified using Standard Bacteriological Methods. Structured Questionnaires were administered to access the students' knowledge and compliance to hand hygiene practices. The results of the lab analyses showed that many of the students had very high bacterial flora in their hands especially the Non-Microbiology students. Also, the right hands of the students have more bacteria growth than the left hand of the students. The hypothesis of the study was validated using Pearson Chi-Square Statistics which showed that there is significant relationship between Handwashing hygiene practices and spread of Handborne bacterial infection among the students at the 5% level of significance.

Keywords:

Handborne Bacteria, Hand washing practices, Total Plate Count (TPC), Total Coliform Count (TCC),Staphylococcus aureus Count (SC)

1. Introduction

Over the years many high profile campaigns have been launched to promote the message: "wash your hands" especially after the Ebola outbreak in most West African countries. A primary aim of these campaigns is the prevention of the spread of infections such as *Clostridium difficile* and norovirus in hospitals and other healthcare settings. Promotion of handwashing is also a key part of public health campaigns to reduce the incidence of food poisoning arising in our society, where hand hygiene plays a crucial role. A review of hand hygiene by the World Health Organization (WHO) in 2007 concluded that a significant reduction in the infectious disease burden could be achieved by giving greater attention to good hand hygiene in the home and community. Hand-borne bacteria refer to those bacteria commonly transmitted through hand means such as fluid, finger nails, etc. Hand-borne bacteria comprise a broad group of bacteria caused by microbial pathogens, viral, chemical contaminants and biotoxins. The burden of hand-borne bacteria infections can be defined as the incidence and prevalence of morbidity, disability, and mortality associated with acute and chronic manifestations of diseases. The Centres for Disease Control and Prevention has identified more than 400 handborne-related illnesses about two thirds of all outbreaks involve bacteria. The illnesses are caused either by the microorganisms themselves or by the toxins they release. The consumption of foods contaminated by hand-borne pathogenic microorganisms and toxins produced by them cause deaths, illnesses, hospitalization, and economic losses. Due to their widespread nature, handborne bacteria, in particular causes gastro-intestinal infections and these represent a very large group of pathologies with a strong negative impact on public health. Many hand-borne bacteria incidents are reported every year in Africa. Numerous factors, contribute to this high number of incidents. However, it is extremely important to note that most cases of hand-borne bacteria infection in the region are not reported, so the true extent of the problem is unknown. Several hand-borne bacterial infection outbreaks are associated with poor personal hygiene practices of people handling foodstuffs. National Agency for Food and Drug Administration and Control (NAFDAC) reported that approximately 20% of hand-borne-related bacterial infections from 2010 – 2014 are due to food handlers. Due to the recent outbreak of so many pandemic cases of handborne bacterial infections and other viral infections transmitted through body fluids, contaminated food and other toxic materials, the University of Jos, Plateau State Nigeria, have put some measures like the use of hand sanitizers in strategic places to checkmate the outbreak of deadly diseases outbreaks like Ebola, Lassa fever, monkey pox, etc. among Students of the University. Unfortunately these measures were neglected by so many Students due to lack of proper awareness about handborne bacterial infection and hand washing hygiene practices. Contaminated food and other toxic products can causes a lots of set back to the students of the University due to varieties of illness they suffered from especially during their tedious period of the semester like examination. Many Students normally fall ill and some died from unreported cases of gastro-intestinal bacterial infections gotten from contaminated food and water. Some of these cases reported were as results of poor sanitation, poor hand washing hygiene practices, and other health wise related negligence that may cause by the victim's life. This study therefore, aimed at establishing insight to the following research questions:

- How many Students are aware of Handborne bacterial infection?
- Is there neglect towards hand hygiene practices among the Students?
- Is there any relationship between Handborne bacterial infection and hand hygiene practices?

This study is very crucial since it will help to shed more insight to consequences of neglect towards poor hand hygiene practices. Also, it will contribute to previous literature on handborne bacterial infection by other scholars so as to pave way for future researchers who will investigate this issue. It will also help health workers to observe certain hand hygiene practices in order to minimize hand-borne bacteria infection reported cases in school, clinics and Hospitals.
Therefore, the overall aim of this study is to ascertain the effects of hand hygiene practices and spread of hand borne bacteria infections among Students.
This will be active with the specific objectives:

- To capture the various handwashing practices common among students

- To ascertain the kind of hand-borne bacteria infections prevalent among students
- To establish a relationship between hand-borne bacterial infection and poor hand hygienic practices.

- **Hypothesis setup**

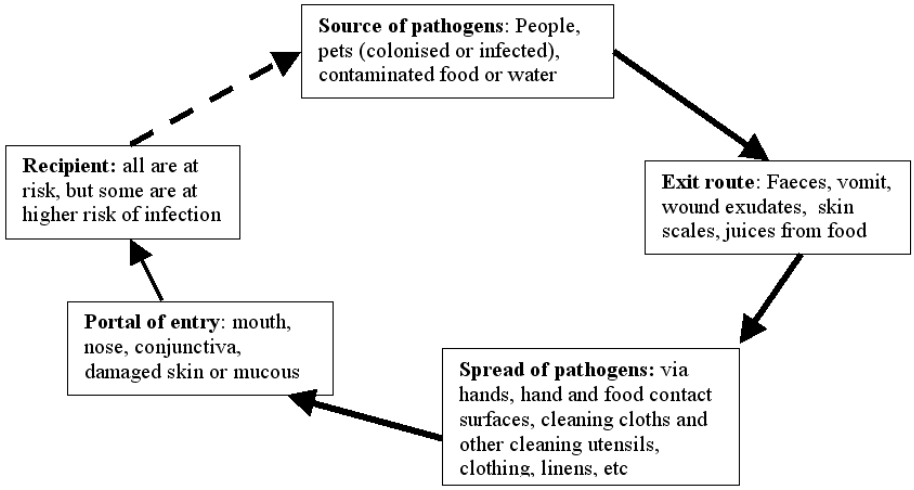
In order to achieve the aims and objectives of the study, there is every need to define scientifically; the hypothesis for the study which was stated in its null form:

H_0: There no significant relationship between hand hygiene practices and spread of handborne bacterial infections

2. Review Literature

The provision of healthcare worldwide is always associated with a potential range of safety problems. Yet, despite advances in healthcare systems, Students at all levels of learning, the general public remain vulnerable to unintentional harm in their related environment (Al-Busaidi, 2013). (Fakhri, Nguyen, & Case, n.d.) states that handborne bacteria arethose bacteria commonly transmitted through hand means such as fluid, finger nails, etc. Hand-borne bacteria comprise a broad group of bacteria caused by microbial pathogens, viral, chemical contaminants and biotoxins. The burden of hand-borne bacteria infections can be defined as the incidence and prevalence of morbidity, disability, and mortality associated with acute and chronic manifestations of diseases. Handwashing with soap and water has been considered a measure of personal hygiene for centuries. Handwashing and the spread of disease were established only two centuries ago, although this can be considered as relatively early with respect to the discoveries of Pastuer and Lister that occurred decades later. In 1938 Price established that bacteria recovered from the hands could be divided into two categories, namely resident or transient. The resident flora (resident microbiota) consists of microorganisms residing under the superficial cells of the *stratum corneum* and can also be found on the surface of the skin. *Staphylococcus epidermidis* is the dominant species, and oxacillin resistance is extraordinarily high, particularly among those that poorly observed hand hygiene. Other resident bacteria include *S. Hominis* and other coagulase-negative staphylococci, followed by coryneform bacteria (*propionibacteria*, *corynebacteria*, dermobacteria, and micrococci). Among fungi found in the hands the most common among them is genus of the resident skin flora, when present, is *Pityrosporum*(*Malassezia*) spp. protective functions: microbial antagonism and the competition for nutrients in the ecosystem. In general, resident flora is less likely to be associated with infections, but may cause infections in sterile body cavities, the eyes, or on non-intact skin in the mid-1800s, studies by Ignaz Semmelweis in Vienna, Austria, and Oliver Wendell Holmes in Boston, USA, established that hospital-acquired diseases were transmitted via the hands through the handborne bacteria. In 1847, Semmelweiss was appointed as a house officer in one of the two obstetric clinics at the University of Vienna Allgemeine Krankenhaus (General Hospital). He observed that maternal mortality rates, mostly attributable to puerperal fever, were substantially higher in one clinic compared with the other (16% versus 7*%).* He also noted that doctors and medical students often went directly to the delivery suite after performing autopsies and had a disagreeable odour on their hands despite handwashing with soap and water before entering the clinic. He hypothesized therefore that " cadaverous particles" were transmitted via the hands of doctors and students from the autopsy room to the delivery theatre and caused the puerperal fever. As a consequence, Semmelweis recommended that hands be scrubbed in a chlorinated lime solution before every patient contact and particularly after leaving the autopsy room. Following the implementation of this measure, the mortality rate fell dramatically to 3% in the clinic most affected and remained low thereafter. Targeted hygiene begins with the principle that pathogenic species (germs) are introduced continually into the school environment by primarily students and staff, foodsellers, non-teaching staff and other people entering the system. Sites where stagnant water accumulates (e.g. sinks, U-bends, toilets, cleaning cloths,

facecloths, dilapidated classrooms, white board dusters, lab utensils etc) readily support microbial growth and can also become a primary reservoir of infection (Esverdeamento, Batata, & Rodrigues, 2005). Within the school there is a chain of events that has 5 links, all of which have to be in place for an infection to pass from its original source to a recipient (Figure 1). Showing Critical control points in the chain of infection



Source: ("Kitchen hygiene in the home," 2008)

Surprisingly, the basic principle that one cannot get infected unless pathogens are present in the school environment, and that if one or more links in the chain of infection are broken an infection cannot take hold, is often not appreciated. Breaking the chain of infection can be achieved by good hygiene, which includes adherence to hand hygiene recommendations, and cleaning and disinfecting contaminated environmental surfaces, particularly high frequency touch surfaces, and surfaces which come into contact with food. The risk assessment approach is applicable to all types of infections, including gastrointestinal, respiratory and skin and eye infections, and shows us that the major target sites for preventing the spread of all these infections in the school are the hands, hand contact surfaces, food contact surfaces, and cleaning cloths and lab utensils ("Kitchen hygiene in the home," 2008).

- **The role of hands and hand hygiene practices in school**

As a vector for transmission of infectious disease the hands are probably the single most important transmission route for all types of infection. They come into direct contact with the known portals of entry for pathogens (the mouth, nose and conjunctiva of the eyes) and are thus the last line of defence. Breaking the chain of infection is not just about targeting critical surfaces such as the hands; it is also about doing it at the right time. In some cases it is obvious (e.g. after toilet visits) but in others it is not (e.g. after touching door, sitting on the desk, tap and toilet flush handles). Handwashing using soap or detergent and water mechanically dislodges organisms. To be fully effective, however, it must be applied using a rubbing process that maximises release of microbes from the skin and a rinsing process that washes away the dislodged organisms (Fakhri et al., n.d.).

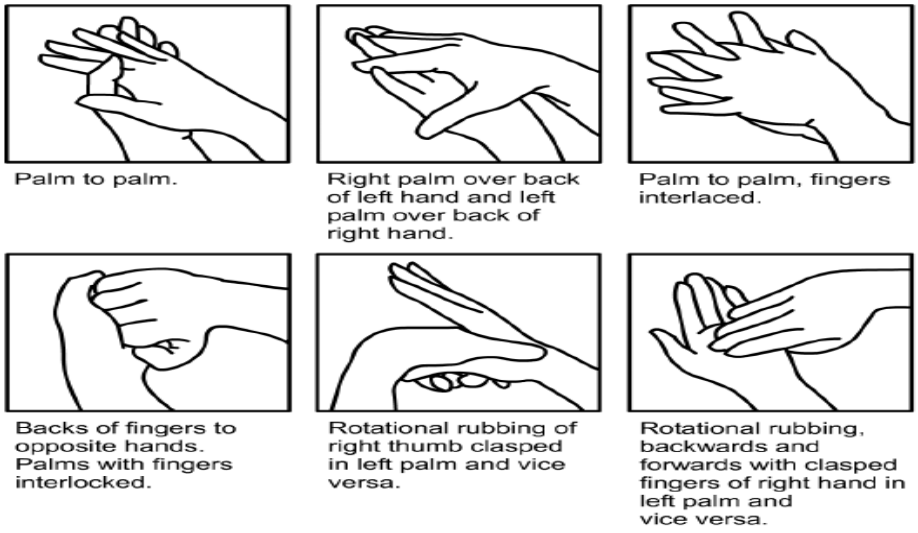
- **Hand washing with soap**

The accepted procedure for handwashing with soap is as follows:

- Ensure a supply of liquid soap, warm running water, clean hand towel/disposable paper towels and a foot-operated pedal bin
- Always wash hands under warm running water
- Apply soap

- Rub hands together for 15–30 seconds, paying particular attention to fingertips, thumbs and between the fingers (see Figure 2)
- Rinse well and dry thoroughly.

Figure2: shows correct procedures for hand washing practices



Source: ("Kitchen hygiene in the home," 2008)

3. Materials and Methods

- **Study Area and Period**

The study was conducted at the Faculty of Natural Sciences, University of Jos Main Campus, Jos Plateau State capital, located at 355 km southwest of Bauchi and Gombe States from February 2016 to April 2016. Its Geographical coordinates are 08°40' Latitude and 45°20' Longitude, at an altitude of 1800-2000m above sea level("Location Maps - Kigom, Jos Plateau, Plateau State, Nigeria," n.d.). Faculty of Natural Sciences, University of Jos is organized into eight Departments; all of them are located in the University of Jos main campus. Around 2000 students are currently registered in the Faculty of Natural Sciences, University of Jos Main Campus. There are about 500 registered Microbiology and other Medical Lab related courses (Non-microbiology students).

- **Sample Size and Data Collection**

Sample size (n) was determined using a formula to estimate single population proportion. Taking 50% prevalence of hand-borne bacterial infection (p=0.5), 95% confidence interval (z=1.96) and 20% marginal error (d=0.20) the initial sample size was:

$$n = \frac{\left(Z\alpha_{/2}\right)^2 \times p(1-p)}{d^2} = \frac{(1.96)^2 \times (0.5)^2}{(0.20)^2} = \frac{0.9604}{0.04} = 24.01 \cong 24 \qquad (1)$$

P: Bacterial hand contamination rate z: the z-statistics value that corresponds to 97.5 percentile cut-off point in the standard normal distribution d: Margin of error; since the population been considered is small the margin error is large. Note that the total number of the source population is 120 (Using the Information at hand obtained from the Natural Science Students (NASSA) Session Dues receipts), correction formula was used to adjust the sample size to the population size and the sample size was calculated to further as

$$n_{corrected} = \frac{n}{1+\frac{n}{N}} = \frac{24}{1+\frac{24}{120}} = \frac{24}{1.20} = 20.0 \qquad (2)$$

A total of twenty samples were collected from the hands of different categories of Natural Sciences students (Microbiology students (Mcbs) and Non-Microbiology students (Nmcbs))

aseptically using quantitative culture technique involving dipping hands in a glove containing sterile water for thirty seconds (Fakhri et al., n.d.). The samples were aseptically pipetted into sterile bottles and transported to the Microbiology laboratory of the University of Jos for analysis.

- **Sample Collection**

The Samples were collected using:

- Materials:
  Wire loop, spirit lamp, hand gloves, foil paper, cotton wool, masking tape, wash bottle, Petri dish.
- Glass wears: Glass slide, 1ml Pipette, 250ml conical flask, 10ml measuring cylinder, 500ml measuring cylinder and a beaker, test tube, Sample bottle.
- Equipment used: Autoclave, Incubator, Oven, Hot plate, Refrigerator, Weighing balance, Electrical Microscope.
- Reagents used: Crystal violet, Distilled water, Lugos Iodine, Acetone, Safaranine, Acid alcohol, Oxidase reagent, Kovacs reagents and Hydrogen peroxide.
- Media: Nutrients agar (NA), Salmonella Sheigella Agar (SSA).

20 samples was collected aseptically using a quantitative culture technique involving given a powder free gloves to the respondents to wear in the hands and 60ml each of the sterile water was poured in each hand and it was gently washed and turn back into the bottle and was then taken to the lab using the approach of Brian *et al*, (1982).

- 10 samples were collected from the hands of Microbiology students (Mcbs) and was taken to the Microbiology lab.
- 10 samples were collected from the hands of Non-microbiology students (Nmcbs) and was taken to the Microbiology lab.
- Serial of dilution was carried out using about
- Samples are cultured on Nutrient Agar and Salmonella Sheigella agar
- Growths on the agar were counted and compared with the control
- Morphological characteristics of growth were examined

Gram staining and other biochemical tests are performed according to methods described by (Fakhri et al., n.d.)

- **Sampling Techniques**

The use of Simple random sampling technique was adopted in the administering the cross-sectional descriptive questionnaire to the 20 sampled Natural Science students. Study participants were selected by the tossing of a fair coin method from the roster lists of 10 Microbiology students and 10 Non-microbiology students in the Faculty of Natural Sciences University of Jos, Nigeria.

- **Variables of the Study**

Dependent variables
Hand-borne Bacterial infections

Independent Variables
Socio-demographic factors
Hand washing habit
Fingernail status
Presence of jewellers on fingers
Regular medical checkup

- **Studies on Compliance to Hand Hygiene**

Copies of structured questionnaires were administered to the Students (Microbiology Mcs) and Non-microbiology Nmcs) to assess their compliance to hand washing practices in terms of adherence to standard handwashing routines, use of soap and water and or antiseptics and hand washing facilities.

- **Validity and Reliability of Instruments**

The Cronbach's alpha was used to check the internal consistency and variability of the sample descriptive questionnaire options and as well validate some of the laboratory apparatus and reagents used if they meet the international World Health Organizational Standards. The formula for Standardized Cronbach's alpha is given by:

$$\alpha = \frac{N.\bar{c}}{\bar{v} + (N-1).\bar{c}} \qquad (3)$$

Note: the lower the Inter-correlation Item matrix decreases; the lower the Cronbach alpha and vice versa (Strode & Brokaw, 2015).

- **Pearson's chi-square (χ^2) test**

This is used to establish the relationship between the dependent (Handborne bacterial contaminant) against the independent variable(s). Given the observed frequency distribution (o_i) the theoretical expected frequency distribution (e_i) is obtained from the table rows and column totals. The χ^2 calculated is found by using the formula

$$\chi^2_{cal} = \sum_{i=1}^{n} \frac{(o_i - e_i)^2}{e_i} \qquad (4)$$

The tabulated χ^2 is found from the statistical table and a decision is made using the χ^2 calculated and χ^2 tabulated with the number of degrees of freedom, v for a given h >1 and k >1 by: $v = (h-1)(k-1)$.that is when k is categorized,

$$\chi^2_{cal} = \sum_{i=1}^{k} \frac{(o_i - e_i)^2}{e_i}$$

With $v = (h-1)(k-1) - m$ degrees of freedom, and an appropriate level of significance(α), usually,$\alpha = 0.05$, test whether to reject or accept the null hypothesis based on the decision rule as stated in (John H. Mc.Donald, 2008):

- If $\chi^2{}_{cal} > \chi^2{}_{tab}$, reject the null hypothesis (H_o)
- If $\chi^2{}_{cal} < \chi^2{}_{tab}$, do not reject the null hypothesis (H_o)

4. Results

The researcher's supplies analysis of data collected through laboratory tests and of questionnaires to collect samples from both right and left hand ten Microbiology and ten Non-Microbiology Students. Gram reaction, Morphological characterization and biochemical tests such as Catalyst, Coagula, Indole, Citrate, Urease, Oxidase, motility were carried out. Table1 means Bacterial loads on hands of students of the University of Jos, Nigeria.

No.	Samples	Left hand	Samples	Right hand

1	Mcs	0.28 x102	Nmcs	0.54 x102
2	Mcs	0.11 x102	Nmcs	0.11 x102
3	Mcs	0.06 x102	Nmcs	0.11 x102
4	Mcs	6.32 x102	Nmcs	2.45 x102
5	Mcs	0.13 x102	Nmcs	6.40 x102
6	Mcs	0.83 x102	Nmcs	1.98 x102
7	Mcs	0.10 x102	Nmcs	1.03 x102
8	Mcs	4.0 x102	Nmcs	4.60 x102
9	Mcs	0.22 x102	Nmcs	0.14 x102
10	Mcs	1.69 x102	Nmcs	0.23 x102

Total Plate Count x 10^2(cfu/ml) SSA count (x10^2cfu/ml)
Mcs = Mean = 13.74 x10^2 NMcs = Mean = 17.59 x10^2
Grand Mean = 15.67

Key
SSA = Salmonella Sheigilla Agar
Mcs = Microbiology student
Nmcs = Non Microbiology Student
TPC = Total plate count

Table 2: frequency of occurrence of bacterial isolated in the hand of students

Organism	Mcs	Nmcs
e. coli	10	0
Protusspp	70	90
Kilebsiellaspp	80	60

Table 3: compliance to hand washing practices by students of University of Jos

Parameter	Mcs	Nmcs
Use of water only	3	8
Use of soap water	7	2
Use of hand drying material		
a. Hand dryer	6	3
b. Paper towel	2	4
c. Non of the above	2	3

Table 4: responses from students on compliance to various stages of hand washing

Mcs/nmcs	Yes	No
Before meal	13	7
After meal	15	5
After touching dirty	13	7
After hair, face, body and handshake	11	9
After touching garbage	14	6
After restroom	8	12
After sneezing	11	9

Table 5: Rating of compliance to hand washing

	Mcs		**Nmcs**	
Rating	Number	Percentage	Number	Percentage
$\frac{1}{7}$	5	71%	3	43%
$\frac{2}{7}$	7	100%	2	29%
$\frac{3}{7}$	4	57%	5	71%
$\frac{4}{7}$	4	57%	6	85%
$\frac{5}{7}$	6	85%	2	29%
$\frac{6}{7}$	3	43%	4	57%
$\frac{7}{7}$	2	29%	7	100%
$\frac{8}{7}$	1	14%	3	43%
$\frac{9}{7}$	7	100%	3	43%
$\frac{10}{7}$	6	85%	4	57%

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.808	.833	4

Inter-Item Correlation Matrix

	Do you wash your hands before touching dirty materials	Do you wash your hands before eating	Do you carryout regular medical checkup on your hands	Do Do you wear ring in any of your fingers
Do you wash your hands before touching dirty materials	1.000	.555	.320	1.000
Do you wash your hands before eating	.555	1.000	.577	.555
Do you carryout regular medical checkup on your hands	.320	.577	1.000	.320
Do Do you wear ring in any of your fingers	1.000	.555	.320	1.000

Pearson Chi-Square Tests

		Handborne Bacteria
Hand hygiene Practices	Chi-square	125.859
	df	76
	Sig.	.000[*.b.c]

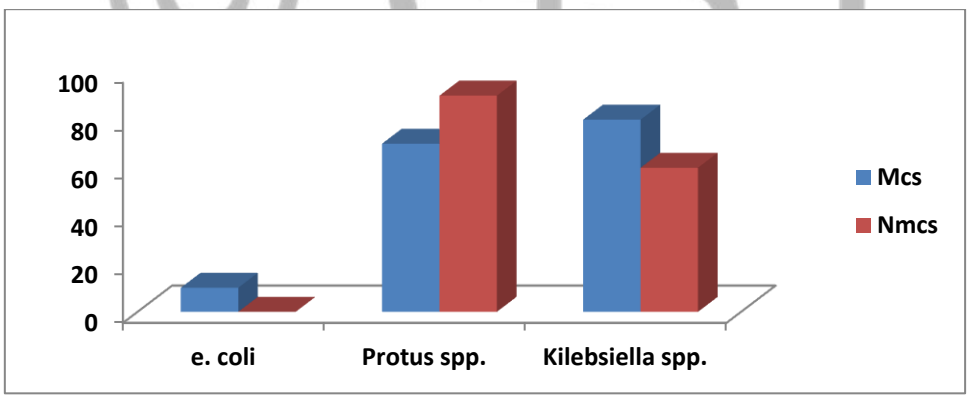
Results are based on nonempty rows and columns in each innermost subtable.

*. The Chi-square statistic is significant at the .05 level.

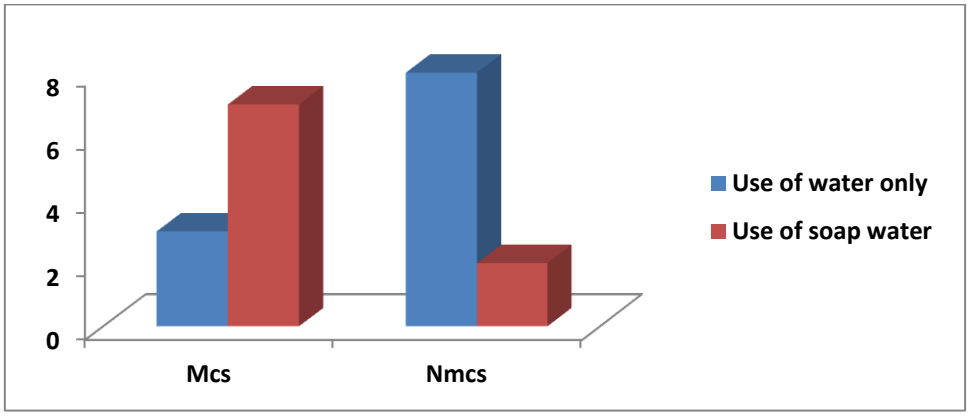
b. More than 20% of cells in this subtable have expected cell counts less than 5. Chi-square results may be invalid.

c. The minimum expected cell count in this subtable is less than one. Chi-square results may be invalid.

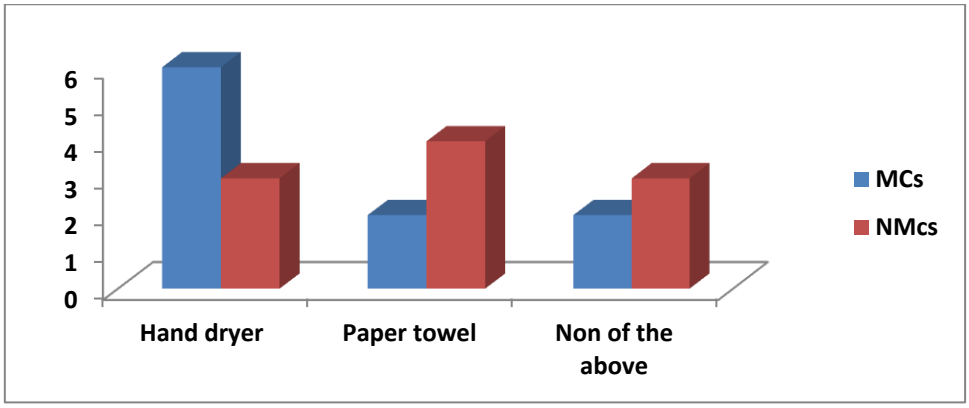
A multiple bar chart showing frequency of occurrence of bacterial isolated in the hand of students



A Multiple bar Chart showing compliance to hand washing practices by students of University of Jos



A Multiple bar Chart showing compliance to Use of Hand washing Materials by University of Jos Students



5. Interpretations and Discussion of Results

Consider the table for Bacterial loads of students hands; it can be seen that the Mean for Mcbs students is 13.74×10^2, with a Grand Mean of 15.67 whilst; the Mean of Non-Mcbs students is 17.59×10^2. This shows that there is high Bacterial load count in the Hands of Non-Mcbs students (3.85×10^2) than that of Mcbs students. From Table 2.1 (Morphological and Microscopic Features of Biochemical Test); it can be seen that there are more Lobat Margin in the bacteria than an Entire Margin, Also only Sample *L1* shows Negative Gram reaction, all the other Samples shows positive Gram reaction. More so; five of the Bacterial arrangement shows they are scattered, two are in clustered form and other two are in chained form, only one is in Paired form. The bacterial colours showed that there three Milky (Sample *L1, L4* and *L8*), four Pinkish (*L2, L3, L5* and *L7*), there are other three Dark Black (*L6, L9* and *L10*). All the bacterial showed positive Citrate Test and Catalyst Test, Sample (*L1* and *L6*) tested negative for Urease Test, only Sample *L7* tested negative for Coagulase Test, Motility test, Indole Test, and Oxidase Test all showed negative. There are seven suspected *Streplococci sp*. in the Sample isolated from the left hands of Microbiology students; there are only two *Staphyloccoci spp*, and one *Strepbacillussp*. There are more Rod shaped bacteria than Cocci shaped bacteria.

Table 2.2 showed the Morphological and Microscopic Features of Biochemical Test in the Rignt hands of the Non-Mcbs students. it can be seen that there four Dark black colours in Sample(*R2, R4, R5, R7* and *R10*), there are two Yellow colours (*R1* and *R8)*, two Pinkish colours (*R3* and *R9*) and one Milky colour in Sample *R6* . Also there are equal number of Lobat Margin in the bacteria and Entire Margin. Also all the ten Samples showed positive Gram reaction. More so; seven of the Bacterial arrangement showed scattered arrangement, two are in chained form and only one is in Paired form. Four of the sample tested positive Citrate Test and the other six samples showed negative. The entire sample tested Positive for Catalyst and Urease Test, Sample (*R6, R7, R9* and *R10*) tested negative for Coagulase Test the others showed positive, Motility test, Indole Test, and Oxidase Test all showed negative. There are seven suspected *Streplococci sp*. in the Sample isolated from the right hands of Microbiology students; there are only two *Staphyloccoci spp*, and one *Strepbacillussp*. There are more Cocci shaped bacteria than Rod shaped bacteria. From Table 3 above (Frequency of occurrence of bacterial isolated in the hands of the students; it can be seen that there are ten e.coli bacterial found in the hands of Mcbs and zero found in the hands of Non-Mcbs. Also there are seventy Protus spp in Mcbs and ninety in Hands of Non-Mcbs, there are eighty Kilebsiella spp isolated from Mcbs and sixty isolated from Non-Mcbs. From Table 4 above it can be seen that three of the Mcbs students washed their hands with water only while eight of the Non-Mcbs students do same but seven of the Mcbs students sampled all used soap and water in washing their hands, only two of the Non-Mcbs students do this practice. Six of the Mcbs students uses Hand dryer after washing of hands but only three do this among the Non-Mcbs students. Two of the Mcbs students agreed that they used Paper towel instead of hand dryer, four Non-Mcbs students do this. Other Two Mcbs students do none of the

practices mentioned same vein other three Non-Mcbs students as well. A Simple Multiple bar chart was used to further elicit this information. Table 5 showed the various responses from Students with respect to compliance to various stages of hand washing. Thirteen of the Mcbs students complied to washing of hands before meal, Seven Non-Mcbs students abide by this rule. Fifteen of the Mcbs students wash their hands after meal, only five Non-Mcbs complied to this, thirteen Mcbs wash their hands after touching dirty materials, only seven Non-Mcbs keep to this practice. Eleven Mcbs wash their hands after having contact with hair, face, body and handshake whilst, only nine Non-Mcbs keep to this practice. Fourteen Mcbs wash their hands after touching or disposing garbage, only six Non-Mcbs do same. Also; only eight Mcbs was their hands after restroom, whilst twelve Non-Mcbs do same. Eleven Mcbs wash their hands after sneezing; only nine Non-Mcbs do same. Table 6 shows the Rating of compliance to hand washing practice by both Mcbs and Non-Mcbs with respect to the WHO hand washing standard. The Rating is done from 1 – 7. The percentages are gotten by dividing Number column with 7 and multiply it by 100. From the percentage column it can be observed that Mcbs has one of its least percentage 14% when it was Rated 1 and 29% when it was Rated 2, whilst; Non-Mcbs has its least percentage 29% when it was Rated 2.

Twenty descriptive sample questionnaires were issued to the respondents from which there were eleven Male and nine Female. Their age limit was mostly distributed between 21 – 30years and little of them were less than or equal to the age of 20years. Sixteen of the Students were single, only four were married. Eight of the students practice Orthodox (Catholic, Methodist, EWCA, Cocin, etc), six of the students were Protestant (New Pentecostal Churches, etc) the remaining other six students were as well Muslim. There were ten Microbiology Students (Mcbs) and ten Non-Microbiology Students (Nmcbs). The Reliability test was performed to know if the variability in the actually responses are true or as a result of chance. From the Reliability Statistics Table, the Cronbach's Alpha is estimated which means that 80.8% of variability in a composite descriptive sample questionnaire have 80.8% of its variance considered to be true variance or internally consistent reliable variance. While the Cronbach's Alpha based on Standardized Items is this varies from the Ordinary Cronbach's alpha because it calculate the Cronbach's alpha under the pretence that the variance are all same. The Inter-Item Correlation Matrix Table shows the level of Correlation or relationship between the Items in the descriptive sample questionnaire. From the table it can be seen that washing hands before touching dirty materials and washing of hands before eating have a positive correlation of 0.555 whilst, washing of hands before touching dirty materials and regular medical checkup have a positive correlation of 0.320. All the correlation coefficient is positive this demonstrates a positive relationship between hand washing habits and Handborne bacterial Contaminants. From the frequency table for Handborne bacteria awareness among the students, it can be seen that twelve of the students have heard of Escherichia coli, eighteen of them have heard of Staphylococcus aureus, twenty of the students have heard of *Enterobacter*sp. And eighteen of the students have heard of Proteus sp. From the Pearson Chi-square Tests to validate the hypothesis stated earlier; it can be seen that the calculated Chi-square Statistic has a value of with a *p*-value. Thus; reject the true null hypothesis since *p*-value calculated is less than the p-value tabulated and concluded at the 5% level of significance that there is a strong positive relationship between Handborne Bacteria and Hand Hygiene practices.

6. Conclusion and Recommendation

From the results of the Cronbach's alpha; one can conclude that there was little variability in the internal consistency of the responses given by the students this also help to build a strong positive Inter-correlation matrix items in the questionnaire. More so; Judging by the results from the Pearson's chi-square calculated, the null hypothesis was rejected at the 5% level of significance. In conclusion, the findings showed that, even though many of the Students in the University of Jos are aware of handborne bacterial infections, they are still kept in the dark on how this affects their internal wellbeing. This is because many of the students do not comply with the standard hand hygienic practices as reflected by non-compliance indices of 33% of those who do not wash their hands regularly with soap and water. Hand hygiene campaign and provision of hand washing facilities in the University are strongly recommended to improve the hand hygiene practices among the students of the University.

References

Al-Busaidi, S. (2013). Healthcare workers and hand hygiene practice a literature review diffusion. *UCLan Journal of Undergraduate Research*, *6*(1), 1–13.

Esverdeamento, A. De, Batata, P. D. T. De, & Rodrigues, R. (2005). Boletim de Pesquisa e Desenvolvimento. https://doi.org/1980-6841

Fakhri, H., Nguyen, M., & Case, C. (n.d.). Investigation of Antimicrobial Activity of Cortaderia selloana , Pampas Grass, 30.

John H. Mc.Donald. (2008). H Andbook of B Iological. *Sokal & Rohlf (1981)*, 41–58. https://doi.org/10.1017/CBO9781107415324.004

Kitchen hygiene in the home. (2008), (October).

Location Maps - Kigom, Jos Plateau, Plateau State, Nigeria. (n.d.).

Strode, P., & Brokaw, A. (2015). Using BioInteractive Resources to Teach Mathematics and Statistics in Biology, (January), 1–41.