The scale **Journal Website: https://thescalejournal.com.ng/**
An Interdisciplinary Journal of
The ACADEMIC STAFF UNION OF POLYTECHNICS - ZONE D
ISSN: 2992-3727 Published 25th May, 2025

PREVALENCE AND ANTIBIOTIC SUSCEPTIBILITY PATTERN OF PATHOGENIC BACTERIA FROM FOMITES IN IMO STATE POLYTECHNIC, OMUMA

Ochuba, Emmanuel Emeka.[1*], Opara, Nnaemeka Kelechi[2], Onyema, Clifford Tobechi[3], Umejiego, Ikenna. Bruno[4], Ugagu Gerald Mmaduabuchi[5] and Nzeagwu Maximus Obinna[6]

[1-6] Department of Science Laboratory Technology, School of Science, Imo State Polytechnic Omuma, Imo State, Nigeria.

***Corresponding author's e-mail:** emmanuelochuba33@gmail.com

Abstract

The transmission of infection through fomites constitutes a major threat to public health especially in the developing countries. This study was carried out to isolate and identify potential bacteria reservoirs that may be responsible for infection in Imo State Polytechnic Omuma. A total of 100 swabs were taken from computer keyboards, work benches, door handle, file folders and mobile phones. Bacteria were isolated from these fomites using conventional microbiological techniques. The isolates obtained were examined and identified by colonial morphology, Gram reaction and biochemical characteristics. Antimicrobial susceptibility was performed on the isolates by paper disc diffusion method. A total of 153 bacteria were isolated. *Staphylococcus aureus* was the most predominant bacteria 72 (47.1 %) followed by *Escherichia coli* 31(20.3 %) and the least *Pseudomonas aeruginosa* 5 (3.3 %). Mobile phone was more contaminated 38 (24.8 %) followed by work benches 34 (22.2 %) and the least file folders 22 (14.4 %) Ciprofloxacin was highly effective in both Gram negative and Gram-positive bacteria. The presence of these bacteria of public health importance on the sampled fomites may probably pose a significant public health risk to the school community and its surrounding. Proper hand hygiene and disinfection of the school environment is recommended.

Keywords: Prevalence, Pathogenic bacteria, Fomites, Antibiotic and Imo State poly

Introduction

Fomites are inanimate objects which become contaminated and can spread infection from one individual to another (Nwankwo *et al.,* 2012). Fomites can become contaminated with pathogenic bacteria by direct contact with body secretions, fluids, contact with soiled hands, aerosol droplet generated through sneezing, talking, coughing or vomiting or contact with air borne bacteria (Aakriti, 2024). Once a fomite is infected, the spread of infectious bacteria may easily occur between inanimate objects or vice versa and between separate fomites if brought together. Also, fomites accumulate bacteria easily due to frequent and high volume use by different persons and show different abilities to allow bacteria grow from a few hours to days, even months (Micheal, 2011). Bacteria that contaminate fomites are also known to remain on fomites for a longer period of time with studies showing that they can be recovered even after routine normal cleaning of the fomites (Aakriti, 2024). According to Kramme *et al.* (2006) pathogenic bacteria may remain on fomites for weeks, even after the contaminating effect. This he also attributed to different environmental conditions of the fomites. In humid environments, bacteria develop greater ability to stick to surfaces making what could have been a passive reservoir to turn to an active one (Aakriti, 2024). In general, the greater the concentration of bacteria on a surface, the longer they last on such a surface and the greater the risk that they will be picked up by somebody. The survival of Pathogenic bacteria and other harmful organisms on fomites is influenced by a range of environmental, physical and biological factors. The factors include type of surface material, humidity, temperature, presence (of organic matter and frequency of use. These factors have been reported to affect their viability on surfaces and their ability to infect new hosts (Kampf, 2018; Aakriti, 2024). So many fomites

have been reported contaminated by bacteria, they include money, mobile phone, Kitchen sinks, Door handles, office desks, automated machine etc (Nworie *et al.*, 2017).

The transmission of infection through fomites poses a major threat to public health especially in the developing countries. Different species of bacteria have been isolated from fomites in the world especially developing countries. Bacterial pathogens that have been isolated include *Staphylococcus aureus*, coagulase negative staphylococcus*, Escherichia coli*, *Klebsiella* species, *Streptococci* species, *Pseudomonas aeruginosa Bacillus* species, *Corynebacterium* species, *Clostridium perfringes* and *Enterococcus*, species, antibiotic resistant strains of bacteria such as vancomycin-resistant *Enterococci, Staphylococcus aureus*, and methicillin - resistant *Staphylococcus aureus* have also been isolated (Nwankwo *et al.,* 2012; Nworie *et al.*, 2017). Although it has been acknowledged that bacteria pathogens in fomite could be a possible risk factor in transfer of bacterial infection, there is no study to confirm the presence in this locality. This is the focus of the present study.

Materials and Method

Study Area

The study was carried out in Imo State Polytechnic, Omuma. Omuma is one of the oldest towns in Imo State. Omuma is located at latitude 5.560° N and longitude 6.972° E. Its boundary to the west is Mgbidi, to the east by Akatta, to the north by Nempi and to the south by Amiri and Otulu. Omuma has four communities: Abia-Omuma, Ozuh-Omuma, Umuhu-Omuma, and Etiti-Omuma. The climate of the Omuma town is typically tropical. There are two seasons within this zone; the dry seasons that last for about four months and rainy season that last for about eight months. It is hot and warm during dry season and cold/warm during rainy season.

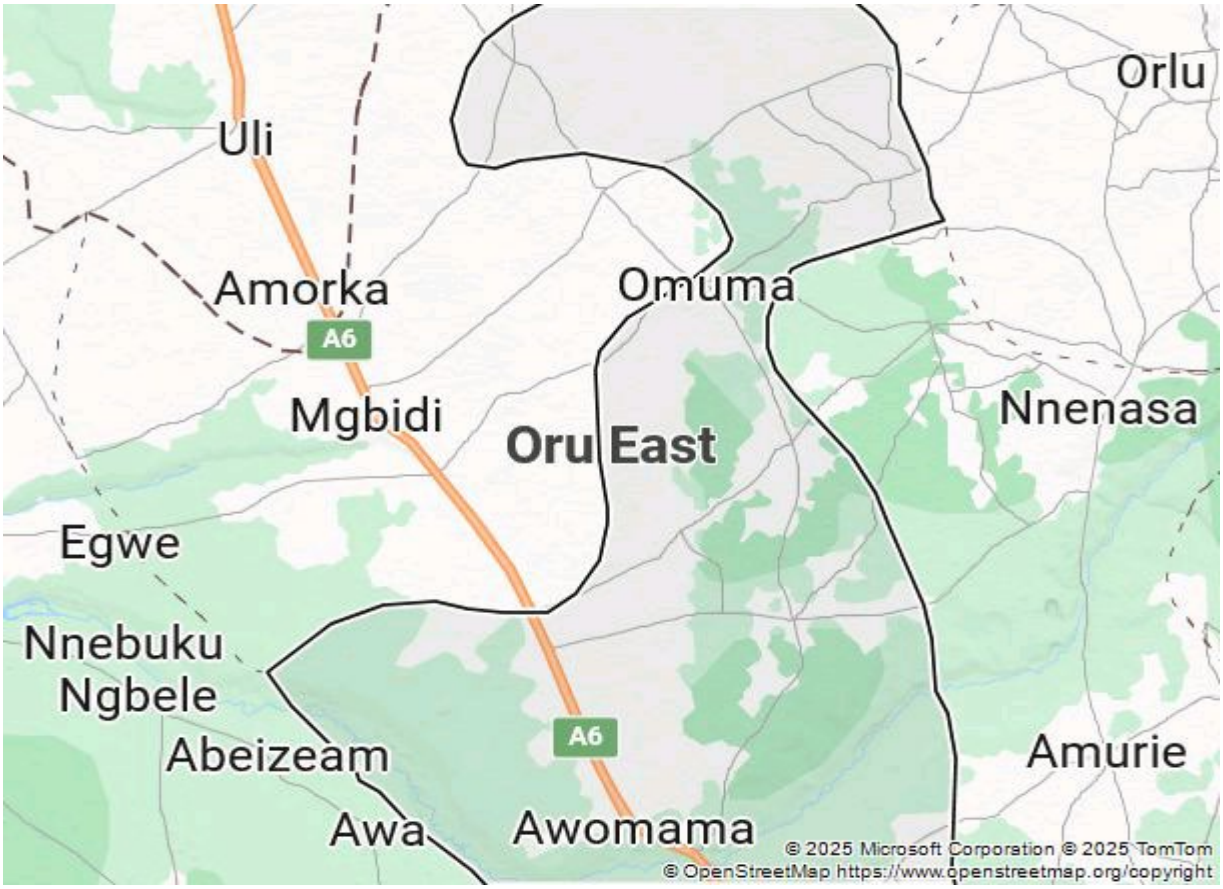


Fig 1: Map of Oru East local government showing Omuma.

Informed Consent and Permission to Carry out Study

Prior to the study, advocacy visits to the students and staff. Proper explanation of the project intent was used to obtain permission to carry out the study in the school. Oral consent was obtained from all participants involved in sample collection

Sample Collection and Procession

The samples were collected from May 2024 to August 2024. One hundred samples were collected. (20 each from file folder, computer keyboards, work benches, door handles and mobile phones). The samples were collected using sterile cotton swab sticks. The swab sticks were placed back into the casing to avoid contamination and was labeled appropriately. All the samples collected were transported within an hour for a culturing and treated according to standard method. The samples were aseptically inoculated into nutrient broth (10 mls) shaken and incubated over night at 37^0C. Loopful of the inoculated nutrient broth were then cultured by successive streaking on Manitol salt agar, MacConkey agar media and salmonella-shigella agar. The suspected bacteria isolates were further characterized using conventional/standard microbiology techniques such as colony morphology, Gram-staining, catalase test and other biochemical tests which include oxidase test, indole test, citrate utilization test, H2S production test, Voges-Proskauer test, methyl red test, urease test and sugar fermentation test (Nworie *et al.*, 2017). All laboratory work was undertaken in the Science laboratory complex of Imo State Polytechnic Omuma.

Antibiotics susceptibility testing

The antimicrobial patterns of the isolates were determined using the disk diffusion method of Mueller - Hinton agar. The bacteria isolates were emulsified in sterile Nacl (normal saline). The turbidity formed were compared to 0.5 MacFarland standards and then inoculated on Mueller Hinton agar (MHA) using sterile swab sticks according to the modified Kirby-Bauer - diffusion method. The antibiotic paper discs were placed aseptically on the surfaces of Mueller Hinton agar with the aid of sterile forceps. The plates were inverted and placed in an incubator set to 37^0C within 15 minutes after the discs are applied. The antibiotics that were used include discs for Gram positive bacteria containing Ciprofloxacin (5 μg), Gentamicin (10 μg). Amoxicillin (20 μg), Streptomycin (30 μg), Rifampcin (20 μg), Erythromicin (30 μg), Ceftazidime (30 μg), Cefuroxime (30 μg), Azithromycin (10 μg) and Levofloxacin (5 μg). Discs for Gram negative bacteria contains Ofloxacin (10 μg), Peflacine (10 μg) Ciprofloxacin (5 μg), Amoxicillin clavulanic acid (30 μg), Gentamicin (10 μg), Streptomycin (30μg), Ceftazidime (30 μg), Cephalexin (30 μg), Ceftriaxone (30 μg) and cefuroxime (30 μg). (Optum Lab Nig.), were placed on the inoculated plates using sterile forceps. The plates were incubated at 37°C for 24 h after which the zones of inhibition around each disc were measured to the nearest mm with a metre rule, recorded and interpreted according to the CLSI (2016) guidelines was carried out in order to get microbial population of 10^5 colony forming unit per milliliter/ (CFU/ml) by comparing it with 0.5 McFarland turbidity standards (Nworie *et al.,* 2017).

Data Analysis and Interpretation:

Statistical software package (SPSS) (version 20) was used to analyze the data collected. Findings from the study were explained in words and summary analysis was performed using the analysis of variance (ANOVA). P values less than 0.05 was regarded as statistically significant in all the cases, which implies rejection of the null hypothesis as the case may be.

RESULTS

Frequency of Pathogenic bacterial Isolates Obtained from Fomites in Imo State Polytechnic Omuma.

The result presented in table 1 revealed that a total of 153 bacteria were isolated, *Staphylococcus aureus* had the highest prevalence of 72 followed by *Escherichia coli* 31 and the least *Pseudomonas aeruginosa*

Table 1: Frequency of Pathogenic bacterial Isolates Obtained from Fomites in Imo State Polytechnic Omuma

Bacterial Isolates	Frequency	Percentage Frequency (%)

Gram positive Bacteria		
Staphylococcus aureus	72	47.1
Gram Negative Bacteria		
Salmonella species	24	15.7
Pseudomonas aeruginosa	5	3.3
Escherichia coli	31	20.3
Klebsiella species	8	5.2
Shigella species	13	8.5
Total	**153**	**100**

Frequency Distribution of Pathogenic Bacteria Isolates obtained from Fomites in Imo State Polytechnic Omuma

The result presented in table 2 revealed that mobile phone was more contaminated 38 (24.5%) followed by Work benches 34 (22.2%) and the least file folder 22 (14.4%)

Table 2: Frequency Distribution of Pathogenic Bacteria Isolates obtained from Fomites in Imo State Polytechnic Omuma

Fomites Bacteria	DH	WB	FF	KB	MP	**Total**
S aureus	15	18	12	12	15	**72**
E coli	8	6	5	4	8	**31**
P aeruginosa	0	1	0	3	1	**5**
Klebsiella spp	2	1	0	2	3	**8**
Shigella spp	3	2	2	3	3	**13**
Salmonella spp	5	6	3	2	8	**24**
Total	**33**	**34**	**22**	**26**	**38**	**153**

KEY DH-Door handle, WB-Work benches, FF-File folder, KB-Keyboard, MP-Mobile Phone.

Antibiotic Susceptibility Pattern of Gram- negative bacteria isolates from Fomites in Imo State Polytechnic Omuma

The result presented in table 3, revealed that The Gram-negative bacterial isolates were mostly susceptible to ciprofloxacin (92.5%), peflaxacin (82.7 %) and ofloxacin (65.4%), but highly resistant to ceftzdime (92.5%), ceftriaxone (92.5%) and cefuroxime (86.8%).

Antibiotic Susceptibility Pattern of Gram-positive Bacteria from Fomites in Imo State Polytechnic Omuma

The result presented in table 4 revealed that *S aureus* showed high sensitivity to ciprofloxacin (100 %), levofloxacin (91.2%), Erythromicin (91.2%), azitromycin (90.3%) and Gentamicin (83.3%) but highly resistant to rifampcin and amoxil at 100% each.

Table 2: Antibiotic Susceptibility Pattern of Gram Negative Bacterial Isolates from Fomites in Imo State Polytechnic Omuma

Isolates	No. Tested	Observation	Number and proportion of isolates susceptible to (%) S	CTZ	CEP	OFX	CEF	PEF	CN	AU	CPX	TRX
E coli	31	S	14(45.1)	0(0)	0(0)	18(58.1)	0(0.0)	29(93.5)	0(0)	18(58.1)	31(100)	0(0)
		R	17(54.8)	31(100.)	31(100)	13(41.9)	31(100)	2(6.5)	31(100)	13(41.9)	0(0)	31(100)
Klebsilella species	8	S	8(100)	4(50.0)	4(50)	8(100)	4(50.0)	8(100)	8(100)	8(100)	8(100)	4(50)
		R	0(0)	4(50.0)	4(50)	0(0)	4(50.0)	0(0)	0(0)	0(0)	0(0)	4(50.0)
P aeruginosa	5	S	4(80.0)	0(0)	3(60.0)	5(100)	5(100)	5(100)	0(0)	5(100)	5(100)	0(0)
		R	1(100)	5(100)	2(40.0)	0(0)	0(0)	0(0)	5(100)	0(0)	0(0)	5(100)
Shigella species	13	S	0(0)	0(0)	0(0)	8(61.5)	0(0)	13(100)	8(61.5)	0(0)	13(100)	0(0.0)
		R	13(100)	13(100)	13(100)	5(38.6)	13(100)	0(0)	5(38.6)	13(100)	0(0)	13(100)
Salmonella species	24	S	12(50.0)	0(0)	0(0)	14(58.3)	0(0)	12(50.0)	13(54.2)	0(0)	20(83.3)	0(0)
		R	12(50.0)	24(100)	24(100)	10(41.7)	24(100)	12(50.0)	11(45.2)	24(100)	4(16.7)	24(100)
Total	81	S	38(46.9)	4(7.5)	17(20.9)	53(65.4)	9(13.2)	67(82.7)	29(35.8)	31(38.3)	77(92.5)	4(7.5)
		R	43(53.1)	77(92.5)	64(79.1)	28(34.6)	72(86.8)	14(17.3)	52(64.2)	50(61.7)	4(7.5)	77(92.5)

Source: Researcher's Experimental Survey, 2024.

Key: S: Streptomycin; CTZ: Ceftzidime; CEP: Cephalexin; OFX; Ofloxacin; PEF: Peflacine ; CN: Gentamicin; AU: Amoxicillin clavulanic acid; CEF: Cefuroxime ; CPX: Ciprofloxacin; TRX : Ceftriaxone. S: susceptible; R: Resistance.

Table 3: Antibiotic Susceptibility Pattern of Gram Positive from Fomites in Imo State polytechnic Omuma

Isolates	No. Tested	Observation	Number and proportion of isolates susceptible to (%) S	RD	CTZ	CPX	E	LEV	CN	CEF	AZM	AMX
S. aureus	72	S	65(90.3)	0(0.0)	40(56.0)	72(100)	70(91.2)	70(91.2)	60(83.3)	0(0.0)	65(90.3)	0(0.0)
		R	7(9.7)	72(100)	32(44.0)	0(0.0)	2(2.8)	2(2.8)	12(16.7)	75(100)	7(9.7)	72(100)

Source: Researcher's Experimental Survey, 2024.

S: Streptomycin; CEF: Cefuroxime; CTZ: Ceftazidime; CPX: Ciprofloxacin; E: Erythromicin; Lev: Levofloxacin; CN: Gentamicin; AMX: Amoxil; RD: Rifampcin; AZM: Azitromycin; S: susceptible; R: Resistance

Discussion

Results from this study revealed that various fomites sampled in Imo State Polytechnic Omuma were contaminated with known bacteria pathogens although the rate of contamination varied ($p<0.05$) The isolation of *Staphylococcus aureus*, *Pseudomonas aeruginosa*, *Escherichia coli*, *Klebsiella* species and *Shigella* species which are bacteria of public health importance present a serious concern for transmission of infections (Badger-Emeka *et al* ., 2015) The bacteria isolated in our study are similar to those that have been isolated from surfaces and objects by Nwankwo (2012) and Nworie *et al.* (2017).

Six genera of bacteria totaling 153 isolates were isolated. Gram negative bacteria isolates were more prevalent (n = 81, 52.9 %) than Gram positive bacteria (n = 72, 47.1 %). This in agreement to the result obtained by Nworie *et al.* (2017) who isolated 62.3 % and 37.6 % in Nigeria, but contrary to the result of Agresew *et al.* (2015) who had 39.5 and 60.5% in Ethiopia. Among the bacterial isolates and over all the isolates, *S. aureus* was the most prevalent, this is similar to the results of Nworie *et al.* (2017) where *S aureus* showed the highest prevalence but contrary to the work of Nwankwo (2012), where coagulase negative staphylococci was the highest. *Staphlococcus aureus* is one of the major bacteria found in the skin and nostrils. This probably supports the high prevalence as seen in this study and the report that they can be discharged through contact with skin, talking and sneezing (Syt *et al.,* 2015). *Staphylococcus aureus* is also reported as one of the most common causes of both community and hospital acquired infections (Ibanga *et al*., 2020) and is also known to be the causative pathogen in a range of diseases: impetigo, folliculitis, septic arthritis, osteomyelitis, septicemia, pneumonia and meningitis (Lesley *et al*., 2018). Among the Gram-negative bacterial isolates, *E. coli* showed the highest prevalence (n = 31, 20.3 %). In terms of overall contamination as seen in this study, it ranked second. This is contrary to the result obtained by Nworie *et al.* (2017) who had lower prevalence of the organism from fomites. The presence of *E. coli* indicates fecal contamination and may reflect the extent of personal and environmental hygiene of the school community. The isolation of other Gram-negative bacterial isolates like *Klebsiella* species, *Shigella* species and *P aeruginosa* in our study is also of public health risk as they have been reported to possess the potential to cause infections especially in a school and hospital environment (Ameya *et al*. 2018).

Our study revealed that mobile phones were the most contaminated than other fomites sampled this might due to frequent use by the owners. Contamination of other fomites, file folder, work benches and door handle in this study is a clear indication that proper sterilization and hygienic method was not employed by the students and workers. (Badger-Emeka *et al*., 2015).

The antibiotic susceptibility profile of Gram-positive bacteria revealed that *S aureus* showed high sensitivity to ciprofloxacin, levofloxacin and gentamicin with ciprofloxacin being the most sensitive. This is similar to the result of Nworie *et al.* (2017) but contrary to Tula and Iyoha, in 2014. The differences in pattern of sensitivity may be due to genetic nature of the organisms, environmental conditions, geographical locations and improper use of antibiotics within the locality. The antibiotic susceptibility profile of Gram negative bacterial in our study revealed that they were mostly susceptible to ciprofloxacin (100%), Amoxicillin clavulanic acid (79.2%), Peflaxacin (79.2 %) and Ofloxacin (66.4%). In this study also, ciprofloxacin was highly effective in both Gram negative and Gram-positive bacteria. This suggest that it will be effective in the treatment of infections caused by the isolated bacteria in this locality.

Conclusion

This study revealed bacteria contamination of sampled fomites in Imo State Polytechnic, Omuma. The bacteria isolates, *S aureus*, *E. coli*, *P aeruginosnna*, *Klebsiella* species and *Shigella* species, were found to be resistant to some commonly used antibiotics. The presence of these bacteria which are microorganisms of public health

importance may be reservoir for bacteria disease spread in the school and its environs. Frequent hand washing should be encouraged among staff, students and the entire school community, also periodic monitoring of antimicrobial susceptibility both in the community and the hospital environment. Further research should be carried out on other fomites not included in the study.

Acknowledgements
We appreciate the HOD Science laboratory technology and head of Laboratory, Science laboratory technology department, Imo State Polytechnic, Omuma, for allowing us to carry out the study in the Laboratory.

Declarations

Authors Contributions

OEE, OCT and NMO Conceptualize the study, OEE, ONK, UGM and UIB designed the study. OEE, OCT, UGM, ONK, NMO and UIB participated in the laboratory work. OEE, UGM and ONK Performed the data analysis, OEE, UGM, UIB, interpreted the data. OEE prepared the first manuscript, reviewed by UGM, ONK, UIB, OCT and NMO. All authors contributed to the development of the final manuscript and approved its submission

Ethics Approval and Informed Consent

The study did not involve either human or animal subjects, therefore ethical consideration were not applicable. Oral consent was obtained from all participants involved in sample collection

Conflict of interest

The authors declared that there is no conflict of interest exists

Funding

The study did not receive any external funding

References

Aakriti, G. (2024). Spread of infectious diseases by microorganisms present in fomites. *World Journal of Advanced Research and Reviews*, 24(01), 1589–1601

Agersew, A., Degisew, M. and Yitayih, W. (2015). Bacterial Profile and their Antimicrobial Susceptibility Pattern of Computer Keyboards and Mice at Gonder University Hospital, Northwest Ethiopia. *Biomedcine and Biotechnology,* **3** (1): 1-7

Ameya, G., Tsalla, T., Getu, F. and Getu, E. (2018). Antimicrobial Susceptibility Pattern, and Associated Factors of *Salmonella* and *Shigella* Infections among Under Five Children in Arba Minch, South Ethiopia. *Annals of Clinical Microbiology and Antimicrobials,* **17** (1):1.

Anderson, G. and Palombo, E. A. (2009). Microbial Contamination of Computer Keyboards in a University Setting. *American Journal of infection and Control,* **37**:507-509...

Badger-Emeka, L. I., Al-Sultan, A. A., Al-Dehailan, H. S., Al-Humini, N. K., Al-Najja, F. A. and Al-Farhan, H. M. (2015). Potential Pathogenic Bacterial Contaminants of Shared Utility Devices in a University Setting at Al-Hofuf, Saudi Arabia. *African Journal of Microbiology Research*, **9** (41):2139-2144.

Brady, R. R. W., Kalima, P., Damani, N. N., Wilson, R. G. and Dunlop, M. G. (2007). Bacterial Contamination of Hospital Bed-Control Handsets in a Surgical Setting: A Potential Marker of Contamination of the Healthcare Environment. *Annals of the Royal College of Surgeons of England,* **89**(7): 656-660.

Clinical and Laboratory Standards Institute. (2017). Performance Standards for Antimicrobial Susceptibility Testing. 27th ed. CLSI Supplement M100. Wayne, PA: Clinical and Laboratory Standards Institute. (On-line:https://doi.org/ 10.1039/ C4DT01694G).

.

Eltablawy, S. Y. and Elhifnawi, H. N. (2009). Microbial Contamination of Some Computer Keyboards and Mice in National Centre for Radiation Research and Technology. *World Applied Science Journal,* **6**(2): 162-167.

Famurewa, O. and David, O. M. (2009). Cell Phone: a Medium of Transmission of Bacterial Pathogens. *World Rural Observation,* **1** (2): 69-72.

Hardy, K. J., Oppenheim, B. A., Gossain, S., Gao, F. and Hawkey, P. M. (2006). Study of the Relationship between Environmental Contamination with Methicillin Resistant *Stophylococcus aureus* (MRSA) and Patients Acquisition of MRSA. *Infection Control Hospital Epidemiologyl,* **27** (2): 127-132.

Ibanga, I. A., Akan, O. D., Uyanga, F. Z., Mantu, E. C. and Asuquo, M. (2020). Multi-Drug Resistance Pattern of *Staphylococcus aureus* from Paediatric Ward, General Hospital, Ikot-Ekpaw, MkpatEnin LGA, Akwa-Ibom State, Nigeria. *Archives of Clinical Microbiology,* **11** (1):105

Kampf, G. (2018). Efficacy of ethanol against viruses in hand disinfection. *The Journal of Hospital Infection, 98(4), 331-338.*

-

Michael, H. (2011). How Long Do Bacteria Live On Surfaces? (On-line: Http://wwweho w.com/M/About).

Mike, A. and Bruce, A. (2013). Health Soil Microbes, Health People. The Atlantic Monthly Group. (On-line: www.Healthatlantic.Come/Health).

Nwankwo, E. (2012). Isolation of Pathogenic Bacteria from Fomites in the Operating Rooms of a Specialist Hospital in Kano, North-Western Nigeria. *The Pan African Medical Journal,* **12**:90.

Nworie, O., Ochuba, E., Okonkwo, E., Ukpabi, N., Agwu, C., Onu, E. and Obasi, E, (2017).Bacterial Profile and Their Antibiogram on Computer Key Boards and Other FomitesUsed in Federal Teaching Hospital, Abakaliki Ebonyi State, Nigeria. *International Journal of Biology Pharmacy and Applied Sciences*, **6** (2): 389-412

Syt, J. S. D., Eichenberger, E., Holland T.L. and Fowler, V.G. (2015). *Staphylococcus aureu s*Infections: Epidemiology, Pathophysiology, Clinical Manifestations and Management. *Clinical Microbiology Review*, **28** (3):603–661

Tula, M. Y. and Iyoha., O. (2014). Distribution and Antibiotic Susceptibility Pattern of Bacterial Pathogens Causing Urinary Tract Infection in Mubi General Hospital, Yola-Nigeria. *British Journal of Medicine & Medical Research,* **4**19:359103602.