International Journal of Microbiology and Applied Sciences
ISSN 1115-4004 Volume 4 issue 3 Sept, 2025 Research Article

Pathogenic Bacteria Associated with Fomite within Laboratories in an Educational Institution in Nigeria

Emecheta, Rose. O[1*], Ndukwe, Ken. O[1] and Ekaiko, Marshall.U[2]
[1]Department of Microbiology, Dr. Ogbonnaya Onu Polytechnic, Aba, Abia State, Nigeria.
[2]Department of Science and Laboratory Technology, Federal Polytechnic Ngodo-Isuochi, Umunneochi, Abia State.
***Corresponding Author:** *obirose444@gmail.com*

ABSTRACT

Fomite mediated transmission can be an important pathway causing significant disease transmission in a number of settings such as schools, daycare centers, and long-term care facilities. The occurrence of pathogenic bacteria within Dr. Ogbonnaya Onu Polytechnic laboratories was investigated. Samples were randomly collected from different surfaces using sterile swab sticks and analyzed for total aerobic heterotrophic bacteria count (TABC) and total coliform count (TCC) and for potential pathogenic bacteria using standard microbiological procedures. Results obtained showed the total bacterial count ranging from, tables (2.8×10^4), Laboratory bench (3.7×10^4) and reagent shelves (4.0×10^4) respectively for total bacterial count. The coliform count ranged from 2.1×10^4, 1.1×10^4 and 3.1×10^4 respectively for the different surfaces. A total of eight (8) potential pathogenic bacteria were isolated which included; *Bacillus* species, *Staphylococcus aureus, Micrococcus* species, *Streptococcus* species, *Escherichia coli, Enterobacter*, *Serratia* sp and *Pseudomonas* sp. The isolates and their frequency were *Staphylococcus* (100%) as the highest isolate, followed by *Bacillus* and *Enterobacter* (71.4%), *Serratia* (57.1%), *Pseudomonas*, *Streptococcus* and *Micrococcus* (42.8%) and *Escherichia coli* (28.5%) as the least. Appropriate hygienic measures to suppress any potential microbial cross-contamination are therefore needed to safeguard public health. It is also imperative to conduct regular testing to check for bacterial contamination and increase community awareness and education on sanitary and hygienic standards in the laboratory.

Keyword: Educational Institution, Laboratories, Fomites, Bacteria, Multidrug Resistance, Disease Transmission.

Introduction

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 such as door handles, clothes, utensils and furniture. Microorganisms constitute a major part of every ecosystem. In these environments, they live either freely or as parasites (Prescott *et al.,* 1999). The hand serves as a medium for the propagation of microorganisms from one surface to another and from person to person. Given that most laboratory surfaces are not routinely disinfected; the opportunity for the transmission of contaminating microorganisms is great. Rhinovirus has been shown to be transmitted through contaminated surfaces (Molinari *et al.,* 1997). The increasing incidence of epidemic outbreaks of certain diseases and its rate of spread from one person to the other has become a major public health concern (Rutala *et al.,* 2006).

Guidance on appropriate non-pharmaceutical interventions (e.g., masks, hand hygiene, and surface decontamination) depends on the dominant model of transmission.

Several factors have been identified to affect the transfer rate of bacteria from one surface to another surface. These include bacteria type, source and destination surfaces, time post inoculation and moisture level (Mackintosh and Hoffman 1984). Rusin *et al*. (2002) and Montville *et al*. (2001) investigated bacterial transfer rates from food to hands and from hands to food with or without a glove and stated that glove barrier can decelerate the transfer rate of microorganisms from food to hands and vice versa. Findings also showed that the transfer rate is dependent on the activity, inoculums size and types of surfaces. Several hygienic measures were reported to prevent cross contamination from surface to another surface.

Citation: Emecheta *et al.* (2025). Pathogenic bacteria associated with fomite within laboratories in an educational institution in Nigeria. *International Journal of Microbiology and Applied Sciences*. *4(3)*: 281 – 285.

The present study aimed at isolating and identifying potential pathogenic microorganisms associated with different surfaces within the laboratories in Dr. Ogbonnaya Onu Polytechnic, Aba.

Materials and Methods

Collection of Samples

A total of 14 duplicate samples were collected from different surfaces within the laboratory. The specimens were collected from, reagent bottles, wooden laboratory benches, reagent shelves and technologist's tables by means of sterile cotton swabs moistened in sterile nutrient broth. The swab was wiped firmly on the surfaces measuring about 100mm by 100mm of each surfaces and was soaked with Normal Saline after swapping. Each swab was replaced back in its tube and labeled, before being placed in sterile polythene bag and transported to the microbiology laboratory in Dr. Ogbonnaya Onu Polytechnic, Aba

Examination of the Samples

The swabs were inoculated aseptically after serial dilution using pour plate method on Nutrient agar, Chocolate agar, and MacConkey agar plates and the plates were incubated aerobically at 37°C (Unicon GE-172, India). Bacterial growth was checked after 24-48 hours of incubation after which the colonies which developed were examined. Each colony represented a different organism and was picked up for characterization and identification.

Results

The results of the Mean values of the Total aerobic heterotrophic bacteria count and Total coliform count the on the surfaces of fomites in the Laboratory are presented in Table 1.

Table 1: Mean values of microbial counts on fomites in the Laboratory

Fomite	Total aerobic heterotrophic bacteria count	Total coliform count
Tables	2.8×10^4	2.1×10^4
Lab. bench	1.1×10^4	1.1×10^4
Lab. bench	3.7×10^4	-
Reagent shelves	1.0×10^4	-
Reagent shelves	2.4×10^4	1.0×10^4
Reagent shelves	4.0×10^4	2.0×10^4
Reagent bottles	2.1×10^4	3.1×10^4

Results of the microscopic and biochemical profiles of bacterial isolates are presented in Table 2. On the other hand, results of the incidence of potential pathogenic bacteria on fomite surfaces are presented in Table 3.

The level of or incidence (%) of bacterial contamination in relation to different fomite surfaces is presented in Figure 1 while the prevalence (% occurrence) of bacterial isolates on different fomite surfaces is presented in Figure 2.

Table 2: Microscopic and biochemical profile of bacterial isolates

Isolate Code	Gram reaction	Catalase text	Coagulase	Methyl red	Voges proskaeur	Citrate utilization	Oxidase text	Indole	Urease text	Glucose	Lasctose	Sucrose	Most probable organism
A	+	+	-	+	+	+	+	+	+	A	A	A	*Bacillus* sp.
B	+	+	+	-	+	+	-	-	-	A/G	A	A	*Staphylococcus aureus*
C	-	+	-	-	-	-	+	+	-	A	A	A	*Escherichia coli*
D	+	-	-	-	+	+		-	-	A	-	A	*Micrococcus* sp.
E	+	-		+	+	-	-		+	A	-/-	-/-	*Streptococcus* sp.
F	-	-	-	-	+	-	-	+	+	A	-	-	*Pseudomonas* sp.
G	-	+	-	-	-	-	+	-	-	AG	AG	A	*Enterobacter* sp.
H	-	-	-	-	+	+	-	+	-	-/-	A/-	A/-	*Serratia* sp.

Note: + = Positive, - = Negative, A = Acid production, A/G = Acid and Gas production.

Citation: Emecheta *et al.* (2025). Pathogenic bacteria associated with fomite within laboratories in an educational institution in Nigeria. *International Journal of Microbiology and Applied Sciences*. *4(3)*: 281 – 285.

Table 3: Incidence of potential pathogenic bacteria on fomite surfaces

Fomite Sample	Incidence of potential pathogenic bacteria								
	Bacillus species	*Staph aureus*	*Escherichia coli*	*Micrococcus*	*Streptococcus*	*Pseudomonas sp*	*Enterobacter sp*	*Serratia sp*	Incidence of all the isolates %
Tables	+	+	-	+	-	+	+	+	75.0
Lab. bench	-	+	-	+	+	-	+	+	62.5
Lab. bench	+	+	+	-	-	+	-	-	50.0
Reagent shelves	+	+	-	-	-	-	+	-	37.5
Reagent shelves	-	+	-	-	+	-	+	+	50.0
Reagent shelves	+	+	-	+	+	-	+	+	75.0
Reagent bottles	+	+	+	-	-	+	-	-	50.0
% Occurrences	71.4	100	28.5	42.8	42.8	42.8	71.4	57.1	

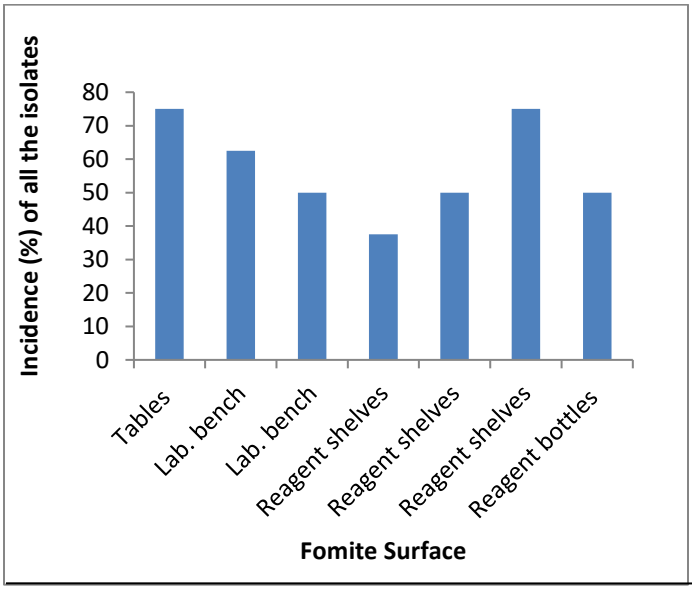

Fig.1: Level of bacterial contamination in relation to different fomite surfaces

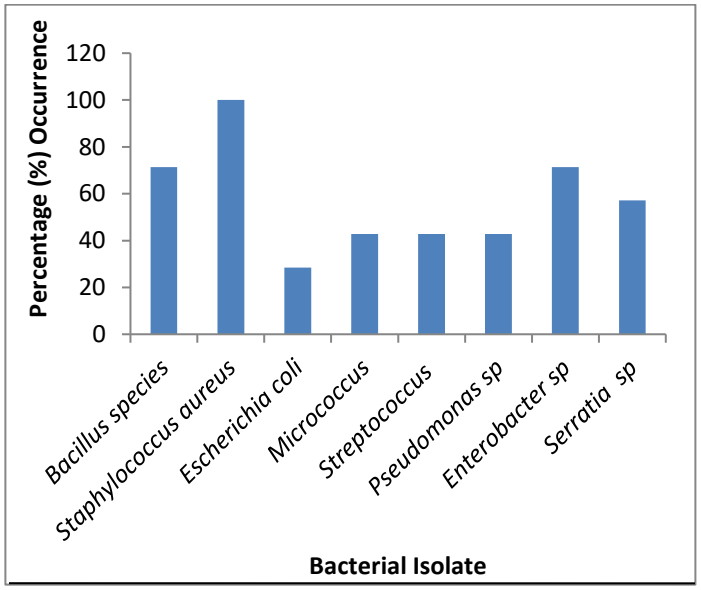

Fig. 2: Prevalence of bacterial isolates on different fomite surfaces

Discussion

Fomite mediated transmission can be an important pathway causing significant disease transmission in number of settings such as schools, daycare centers, and long-term care facilities. The importance of these pathways relative to other transmission pathways such as direct person-person or airborne will depend on the characteristics of the particular pathogen and the venue in which transmission occurs (Osterholm *et al.,* 1995).

The present study investigation has revealed the population of total aerobic bacteria and total coliforms and the incidence of pathogenic bacteria on fomites surfaces within the school laboratory. The level of contamination varies with fomite surface ranging from 2.8×10^4, 3.7×10^4 to 4.0×10^4 respectively for Tables, Laboratory bench and Reagent shelves while the coliform count ranged from 2.1×10^4, 1.1×10^4 and 3.1×10^4 respectively for the different surfaces.

Citation: Emecheta *et al.* (2025). Pathogenic bacteria associated with fomite within laboratories in an educational institution in Nigeria. *International Journal of Microbiology and Applied Sciences*. *4(3)*: 281 – 285.

The findings as seen in the present study is similar to that reported by other authors Rusin *et al.* (2002), Kennedy *et al.* (2005) and Bright *et al.* (2010) who reported similar findings in their study. According to Kennedy *et al.* (2005), high traffic environment such as educational institutions, restrooms, airports and bus terminals are always very contaminated and serve as route for the transmission of disease causing organisms. They also stated that such environments lack cleaners and a few that are available are neither trained nor have the equipments and disinfectants to do their job resulting to high level of contamination in these places. Previous works have shown that frequently or heavily used formites are most likely contaminated and therefore carry higher heterotrophic bacterial loads (Bright *et al.,* 2010).

The results of the study also showed that the fomites surfaces were contaminated with different bacterial species which include *Bacillus* species, *Staphylococcus aureus, Micrococcus* species, *Streptococcus* species, *Escherichia coli, Enterobacter*, *Serratia* sp and *Pseudomonas* sp. The bacterial pathogen and their frequency were *Staphylococcus* (100%) as the highest isolate, followed by *Bacillus* and *Enterobacter* (71.4%), *Serratia* (57.1%), *Pseudomonas*, *Streptococcus* and *Micrococcus* (42.8%) and *Escherichia coli* (28.5%) as the least. Results showed that each surface was contaminated with more than one bacterial species. Kennedy *et al.* (2005) and Rusin *et al.* (2002) also reported *Staphylococcus* as the most prevalence bacteria on different surfaces. Also, the finding of *Staphylococcus aureus* as the most frequent bacterial contaminant in the study is in accordance with previous works in Nigeria that reported *Staphylococcus aureus* as the most prevalent contaminants of door handles (Onwubiko and Chinyeaka, 2015). They stated that environmental factors such as relatively high humidity and moisture content can play crucial role in influencing microbial transfer rates on fomites or hands.

Coliforms such as *Escherichia coli* and *Enterobacter* sp isolated in the study are of great public health concern. Apart from the fact that they are major indicators of fecal contamination and poor hygiene;

Coliforms such as *Escherichia coli* and *Enterobacter* sp possess diverse strains with potent virulence and toxic factors and are responsible for urinary tract diseases such as, gastrointestinal and urogenital ailments of humans (Al-Ghamdi *et al*., 2011).

Transmission of pathogens takes place by either direct or indirect pathways. Direct pathways include human-to-human transmissions, such as hand-shaking. Different microorganisms were detected on different fomites. These microorganisms could transfer from contaminated surfaces to hands via surface-surface cross contamination or any sort of direct pathways. Subsequently, these microorganisms could be ingested or inhaled if adequate hygiene practices are not applied. Indirect transmission occurs when a non-living agent is involved in the transfer of the pathogen to a susceptible individual such as through air, food, water and inanimate objects known as fomites. It was previously reported that bacteria can adhere to particles of grain dust, which are considered an effective infectious aerosol because its organic materials offer necessary nutrients for airborne microorganism's adherent to their surfaces.

The fact that these contaminants were at high level in the laboratory environments is of great concern, especially with immuno-compromised students/ individual and in the light of the fact that some of the isolated bacteria have been reported to demonstrate multi-drug resistance to currently available chemotherapeutic agents.

Conclusion

Bacterial contamination of fomites is a major health care problem in the study area and fomite-mediated transmission introduces both challenges and opportunities for infection control due to interactions between the properties of pathogens and venues.

Therefore, there is need to implement proper handling of fomites to reduce contamination and the spread of pathogenic bacteria. Appropriate hygienic measures among laboratory and teaching staff and students to suppress any potential microbial cross-contamination are also needed.

Citation: Emecheta *et al.* (2025). Pathogenic bacteria associated with fomite within laboratories in an educational institution in Nigeria. *International Journal of Microbiology and Applied Sciences*. *4(3)*: 281 – 285.

References

Al-Ghamdi, A. K., Abdelmalek, S. M. A., Bamaga, M. S., Azhar, E. I., Wakid, M. H. & Alsaied, Z. (2011). Bacterial Contamination of Saudi"ONE"Riyal paper notes. *Southeast Asian J Trop Med Public Health, 42(3),* 711-716.

Bright, K.R., Boone, S.A. & 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. *The Journal of School Nursing*, *26 (1)*, 33-41.

Bures, S., Fishbain, J.T. & Uyehara, C.F. (2000). Computer keyboards and faucet handles as reservoirs of nosocomial Pathogens in the Intensive Care Unit. *Am J Infect Cont*, *28(6),* 465–471.

Kennedy, D.I., Enriquez, C.E. & Gerba, C.P. (2005). Enteric bacterial contamination of public restrooms. Cleaning Industry Research Institute. *www. ciriscience.org* (Accessed 20/12/2010).

Mackintosh, C. A. & P. N. Hoffman. (1984). An extended model for transfer of micro-organisms via the hands: differences between organisms and the effect of alcohol disinfection. *J. Hyg. Camb*, *92*, 345-355.

Molinari, N.A.M., Ortega-Sanchez, I.R., Messonnier, M.L., Thompson, W.W., Wortley, P.M., Weintraub, E. & Bridges, C.B. (2007). The annual impact of seasonal influenza in the US: Measuring disease burden and costs. *Vaccine*, *25(27),* 5086–96.

Montville, R., Chen, Y. & Schaffner, D.W. (2001). Glove barriers to bacterial cross-contamination between hands to food. *J. Food Prot*, *64*, 845-849.

Onwubiko, N. E. & Chinyeaka, A. H. (2015). Isolation and identification of bacterial contaminants from door handles in a Tertiary Institution of Umuahia, Abia state, Nigeria. *Nigerian journal of microbiology*; *29*, 3139-3147.

Osterholm, M.T., Hederg, C.W. & MacDonald, K.L. (1995). Epidemiology of infectious diseases. *In: Mandell, Douglas and Bennett's principles and Practice of Infectious diseases vol. I, 4th edition. Churchill-Livingstone, New York*. P. 165.

Prescott, L.M.S., Harley, J.P. & Lein, D.A.(1999) . *Microbiology*. MacGraw-Hill Publisher, New York, 4th edition. Pp 916-919.

Rusin, P., Maxwell, S. & Gerba, C. (2002). Comparative surface-to-hand and finger tip-to-mouth transfer efficiency of gram-positive bacteria, gram-negative bacteria, and phage. *J. Appl. Microbiol*., *93 (2),* 585-592.

Rutala, W.A., White, M.S. & Gergen, M.F. (2006). Bacterial contamination of keyboards: Efficacy and functional impact of disinfectants. *Inf Cont Hosp Epidem*, *27(4),* 372–377.

Citation: Emecheta *et al.* (2025). Pathogenic bacteria associated with fomite within laboratories in an educational institution in Nigeria. *International Journal of Microbiology and Applied Sciences*. *4(3)*: 281 – 285.