

Research Article

Bacterial Contamination of Door Handles/Knobs in Gombe State University, Nigeria

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Abstract

Public contacted surfaces such as door knobs/handles frequently touched with hands could serve as vehicles for disease transmission. This study was aimed at isolating, identifying, and evaluating the presence/absence of bacterial contaminants present on the knobs/handles of some selected departments of Gombe State University, Nigeria. During this investigation, door knobs/handles from the selected departments' namely Biological sciences, Biochemistry and Microbiology department were selected for sample collections. A total number of one-hundred and thirty-five (135) samples were analyzed using the swab-rinse method. Samples collected were cultured and incubated at 37 °C for 24 hours. Isolation and identification of bacteria was done using standard microbiological procedures. A total of one hundred and fifteen (115) colonies were isolated in this study based on cultural, morphological and biochemical characteristics. Frequency distribution of the isolates showed that *Staphylococcus aureus* were 26(22.0%), *Staphylococcus epidermidis* 14(12.6%), *Escherichia coli* 21(18%), *Klebsiella* spp. 15(13%), *Proteus mirabilis* 15(13%) and *Salmonella* spp. 13(11%), and *Pseudomonas aeruginosa* 11(9.6%). The level of contamination varies depending on the traffic exposure and the environment. This means that it is necessary to practice good personal hygiene through hand washing and use of hand sanitizer as well as daily washing.

Keywords: Door handles/knobs; Bacterial contamination; Environmental hygiene; Surface.

Introduction

Door handles are attached objects or mechanisms used to manually open or close a door, it also can be categorized as fomites as it can transfer infectious organisms from one person to another. These handles/knobs are often touched whenever doors are used globally, this process thus transfers microbes from either hands to door handles or from door handles to hands vice versa. Basically some of the organisms associated with the door handles are often transferred to hands and as individuals shake hands, exchange of microorganisms occurs. Similarly, several factors have been revealed to influence bacterial transmissions between surfaces, including the source and destination surfaces, features, bacterial species involved, moisture levels, pressure and friction between the contact surfaces and inoculum size on surfaces [1,30,44].

Furthermore, the day-to-day interaction of people, which constitutes one way of spreading bacteria, the major source of and spread of community-acquired infections are fomites [41,43]. Fomites when in constant contact with humans or natural habitats of pathogenic organisms constitute a major source of spread of infectious diseases. Such fomites which include door handles of offices, showers, toilet seats and faucets, sinks, lockers, chairs, and tables, especially those found in public offices, hospitals, hotels, restaurants and restrooms [36]. One of the most implicated probable sources of infections is door handles of offices, toilets and bathrooms [16,27]. Public offices have large traffic of users who throng in with their own microbial flora and other organisms they have picked elsewhere and deposit them on door handles/knobs while going into the convenience and on their way out [39]. Unfortunately, adequate water supply is lacking in most of the

institution toilets and conveniences, whiles, those Universities with water systems lack availability of water supply, consequently, users barely wash their hands after usage, thus carrying contaminants from such conveniences. This may result to community-associated epidemic.

The present study was therefore, aimed at isolating, identifying, and evaluating the presence/absence of bacterial contaminant present on the knobs/handles of some selected departments of Gombe State University, Nigeria, so as to provide systematic information that would have policy significance, and will aid the hand washing programs in Nigerian universities.

Materials and methods

Sample sites and collection

A bacteriological investigation was conducted in (3) selected departments namely; Biochemistry, Biological science and Microbiology within Gombe State University. A total of 135 door handles/knobs contact surfaces were swab. The samples were collected at different time interval within early hours of the day, noon and evening hours after closure from daily works when people made use of these doors to maximize the chances of isolation. The moistened sterile cotton swabs sticks were used to vigorously swab the door handles of toilets, offices and laboratories, which are hand-related public surfaces. The cotton end was cut off, soaked in peptone water, the collected samples were immediately transported to Microbiology laboratory of the Department of Microbiology, Gombe State University, in an ice-cooled pack and incubated overnight. This was to ensure that any microorganisms present in the cotton swab diffused into the broth and for further bacteriological analysis [34,39].

Sample processing

Collected samples from overnight broth culture were inoculated from serial dilutions using the pair plate method onto Nutrient agar, Mannitol Salt Agar and MacConkey agar plates and were incubated inverted for 24-48 h at 37°C. After the overnight incubation, the plates were observed for colony characteristics. Isolated colonies were then sub-cultured onto fresh Nutrient agar, Eosin-methylene blue and Salmonella-Shigella agar plates for proper preliminary identification

[39]. Single isolated colonies from these plates were subjected to Gram's staining, spore staining and standard biochemical tests (catalase, coagulase, IMViC- indole, methyl red, Urease, TSIA, voges-proskauer and citrate utilization tests).

Viable bacterial count

After overnight incubation, growths on plates were counted using the colony counter. Bacterial counts were expressed as the log of colony forming units per ml.

Result and discussion

Door handles/knobs are touched whenever doors are used globally, this process thus transfers microbes from either hands to door handle or from door handles to hand vice-versa. This study was aimed at isolation and identification of bacteria from door handles/knob of staff offices in some selected departments, namely Biological sciences, Biochemistry and Microbiology department of faculty of science, Gombe State University. The results of the bacterial isolates from door/knob handles of some selected departments of the faculty of science presented in table 1.

Table 2 shows the result of the total bacterial plate count across the various selected departments revealed the highest number of bacteria in Biological sciences (7.05×10^6 cfu/ml), followed by Microbiology with (5.33×10^6 cfu/ml), while biochemistry showed the least with (2.74×10^6 cfu/ml), as shown in table 1. The highest bacterial count observed in biological sciences might be attributed to high population of staffs and students in the department that uses these offices and conveniences. Interestingly, this study is in agreement to that of Kennedy *et al.* [27], who also reported that levels of contamination of conveniences vary depending on traffic, exposure and environment.

Table 3 shows the results of the frequency of occurrence of different bacterial isolates across the selected department. From the result *Staphylococcus aureus* shows the high incidence with 26 (22.6%), followed by *Escherichia coli* with 21 (18.3%), while, *Proteus spp.* 15(13.0%), *Klebsiella spp.* 15(13.0%), *Salmonella spp.* 13(11.3%), *Staphylococcus epidermidis* 14(12.2%) and *Pseudomonas spp.* 11(9.6%) showed the least.

Table 1. Morphology and biochemical characteristics of bacteria isolated from various departments

Colony morphology	Gram reaction	Microscopic morphology	Cat	Co	Ox	Ci	Ind	TSIA				Possible Organisms
								Slot	But	H ₂ S	Gas	
Yellow colony on MSA while smooth, circular and milky on NA	+	Cocci in clusters	+	+	-	-	-	-	-	-	-	<i>Staphylococcus aureus</i>
Mucoid, pink colonies on MA	-	Short rod in single	-	-	-	-	+	Y	Y	-	+	<i>Escherichia coli</i>
Mucoid, moist and sticky, pink colonies on MA	-	long rod in single	-	-	-	+	+	Y	Y	-	+	<i>Klebsiella spp</i>
Pale colonies on MA, Mucoid with green Pigmentation on NA	-	long rod in cluster	-	-	+	+	-	R	R	-	-	<i>Pseudomonas spp</i>
Mucoid and milky on NA, pale colonies On MA	-	short rod	+	-	-	+	-	R	Y	+ ²	+	<i>Salmonella spp.</i>
On MSA whitish Colonies (no colour change)	+	cocci in chains	+	-	-	-	-	Y	Y	-	+	<i>Staph.epidermidis</i>
pale colonies on MA, mucoid on NA	-	short rod in single	+	-	-	+	-	R	Y	-	+	<i>Proteus mirabilis</i>

NOTE: MA=MacConkey agar, NA=Nutrient agar, MSA=Mannitol Salt Agar, Cat= Catalase, Cit= Citrate, Co= Coagulase, Ind= Indole, Ox= Oxidase, TSIA=Triple Sugar Iron Agar, Y= Yellow (Acid reaction), R= Red (Alkaline reaction)

The results of this study also showed that *Staphylococcus aureus*, *Staphylococcus epidermidis*, *Escherichia coli*, *Klebsiella spp*, *Proteus mirabilis*, *Salmonella spp* and *Pseudomonas spp* are the main bacterial isolates frequently associated with the door handles as shown in the (Table 3). These organisms may probably have their way to the door handles through the skin and hand-to-hand contacts. Furthermore, in this study *Staphylococcus aureus* 26(22.6%), was the most frequently isolated bacterium as shown in Table 2. This is may be due to the fact that they are the major components of the normal flora of the skin and nose, which probably explains its high prevalence as contaminant as it can easily be discharged by several human activities. This observation is in conformity with the finding of Nworie et al. [5,32]. *Staphylococcus aureus* is the most important potential pathogen that cause boils, abscesses, wound infections toxic shock syndrome and pimples. Also, the result of this study is also in agreement to that of Bloomfield et al. [37], who also recorded 32% *Staphylococcus* from toilet and bathroom handles whereas in contrast with the work Wasa et al. [25] that observed high number of *E.coli* 67% on door handles.

Table 2. The mean total bacteria plate Count across the various selected departments of faculty of Science

Department	Mean Total Bacterial plate Count (cfu/ml)
Biological Sciences	7.05×10^6
Biochemistry	2.74×10^6
Microbiology	5.33×10^6

Table 3. The frequency of occurrence of different bacteria isolated from the various department

Isolates	Frequency	Frequency, %
<i>Staphylococcus aureus</i>	26	22.6
<i>Staphylococcus epidermidis</i>	14	12.2
<i>Escherichia coli</i>	25	18.3
<i>Klebsiella spp.</i>	15	13.0
<i>Proteus mirabilis</i>	15	13.0
<i>Salmonella spp</i>	13	11.3
<i>Pseudomonas spp</i>	11	9.6
Total	115	100

Table 4 shows the distribution of isolates based on Grams reaction, from the results it can be deduce that Gram negative bacterial have the highest incidences on door handles and knobs with 65.23% whereas Gram positive showed the least with 34.78%. The results of this study showed high incidence of bacterial contaminants on door handles which were contaminated with considerable number of pathogenic bacteria most of which are Gram-negative bacteria 75(65.23%) as shown in Table 3. The high incidence observed may be attributed to poor sanitary and hygienic practices. The bacteria may have found their way onto the surfaces through cross contamination, poor personal hygiene of the users [2,25]. The presence of the gram-negative bacteria which are member of the coliforms indicates the possibility of the presence of faecal contamination on these public conveniences. The results of this study suggest that commonly handled objects that are microbial contaminated can serve as reservoirs of bacteria and that can easily transfer to the hands through direct contact and can give rise to food borne infections and gastroenteritis [30].

Table 4. Distribution of isolates according to grams reaction

Isolates	Number of Isolates	Percentage
Gram Positives	40	34.78
Gram Negatives	75	65.22

Table 5 shows the results of mean total bacterial plate count from various sample sites, namely Toilet, Offices and Laboratories door handles/knobs. The results revealed highest number of bacteria in Toilet door handles (6.24×10^6 cfu/ml), followed by Offices with (5.28×10^6 cfu/ml), while Laboratories door handles showed the least with (3.60×10^6 cfu/ml). The result of the total bacterial plate count across the various selected departments revealed highest number of bacteria in Biological sciences (7.05×10^6 cfu/ml), followed by Microbiology with (5.33×10^6 cfu/ml), while biochemistry showed the least with (2.74×10^6 cfu/ml), as shown in table 1. The highest bacterial count observed in biological sciences might be attributed to high population of staffs and students in the department that uses these offices and conveniences, Interestingly, this study is in agreement to that of Kennedy et al. [27], who also reported that levels of contamination of conveniences vary depending

on traffic, exposure and environment. These organisms probably have found their entry on the handles/knob through the skin and hand to hand mechanism, as this *Staphylococcus aureus* are subset of the normal microbiota of the skin [30,44]. Similarly, frequent handling by many users of different hygiene profile having regular skin contact with the handles/knob may have resulted in the frequency and the degree of population of the isolates.

Table 5. The mean total bacteria plate count from various samples sites

Sample Sites	Mean Total Bacterial plate Count (cfu/ml)
Laboratories	3.60x10 ⁶
Offices	5.28x10 ⁶
Toilet	5.28x10 ⁶

The mean total bacterial plate count from various sample sites revealed highest number of bacteria in toilet door handles (6.24x10⁶ cfu/ml), followed by Offices with (5.28x10⁶ cfu/ml), while Laboratories door handles showed the least with (3.60x10⁶ cfu/ml). The highest occurrence of bacterial isolates observed in toilet door handles might be attributed to high population and frequently used of the toilet by different individual. This is similar to the report of Kennedy *et al.*, [27] who reported that there was more contamination in restrooms such as educational institutions because they lack cleaners and a few that are available are neither trained nor have the equipment and disinfectants to do their job resulting to high level of contamination in these places. This is also in agreement with Boone *et al.* [7,35], who attested that the frequently or heavily used fomites are most likely contaminated and therefore carry higher heterotrophic bacterial loads and also Sanitary conditions in public places have always been a major problem, especially in the toilet and laboratories since some organisms are able to survive for weeks and months in dry areas. The fact that these contaminants were at high level in these environments is of great concern, especially with the increasing number of immuno-compromised individual [44].

Conclusions

Staphylococcus aureus, *Staphylococcus epidermidis*, *Escherichia coli*, *Klebsiella spp*, *Proteus mirabilis*, *Salmonella spp* and *Pseudomonas spp* were the main bacteria

isolated in this research study so far. The results of the present study demonstrated that public contact surfaces such as door handles are often colonized by several bacteria and serve as a potential source of infections. Contaminated and improperly washed hands contaminate door handles, that is to say there is a high level of bacterial contamination which may lead to high level prevalence of the bacterial infectious disease due to contaminants. The isolation of pathogenic bacteria from the toilets door handles in this study indicates that they could be vehicle of disease transmission as microbial contamination of toilet door handles surfaces may be a common means of transfer of potentially pathogenic bacteria among users. On the basis of the above findings, it is therefore recommended that the university management should at least provide hand sanitizers to the users or spray disinfectants with regular cleaning of the toilets to ensure reduction in microbial load, more cleaners should be employed especially in male student hostel in considering the higher level of bacterial contamination in this site, Individuals both adult and young should adopt the habit of hand washing practice after using the toilets and routine surface disinfection of the toilets door handles, this can prevent cross contamination, Besides the encouraging for general good hygiene practice by all (staffs, students and visitors), there is a need for the university management to build more toilets so as to make it less busy, considering factors like the number of sites, the number of samples collected, conditions under which the research work was carried out, further research should be carried out particularly on the risk of fungal contamination.

Conflict of interest

Further studies should be conducted on susceptibility of both antibiotics and also disinfectants towards these organisms which this study wasn't able to cover due to lack of resources.

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