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Incidence and antibiotic susceptibility profile of bacteria from door handles in Faculty of Science complex, Sokoto State University Sokoto

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The incidence and antibiotic susceptibility profile of bacteria from door handles were studied to X-ray the public health implication of bacterial infections in the complex. Eleven genera were identified: *Staphylococcus aureus*, *Staphylococcus intermidis*, *Streptococcus pneumonia, Listeria monocytogenes, Staphylococcus cohinii,* and *Streptococcus pyogenes, Staphylococcus epidermidis, Staphylococcus chromogenes, Staphylococcus capitis, Escherichia coli, Pseudomonas aeruginosa.* The antibiotic susceptibility pattern revealed that Gentamycin exhibited the highest zone of inhibition to all isolates, followed by ciprofloxacin, oflaxacin, nitrofurantoin and Ampicillin. The frequency of bacterial isolates showed that *Staphylococcus aureus* had the highest percentage of 30%, followed by *Escherichia coli* (12.5%), *Streptococcus pyogenes* (10.0%). *Streptococcus pneumonia*, *Staphylococcus cohinii*, and *Staphylococcus capitis* each had (7.5%); the least was *Listeria monocytogenes* and *Staphylococcus intermidis* (2.5%). Finally, the public health implications of the isolates were discussed.

Keywords: Antibacterial, Door handles, Fomites, Incidence, Profile.

1. Introduction

The increasing incidence of epidemic outbreaks of certain diseases and their rate of spread from one community to the other has become a significant public health concern (Nworrie *et al*., 2012). In developing countries, including Nigeria, many people have neglected the need to wash their hands with disinfectant after visiting the restroom. Many infected infants shed large concentrations of bacteria in their waste, such as stool, due to improperly cleaned hands which can readily transmit to others (Dancer, and Robertson, 2007). Enteric bacteria contaminate household fixtures and door handles, including *Escherichia coli, Klebsiella spp*. and *Citrobacter spp.* (Itah and Ben, 2004). Disease agent is carried from a reservoir to environmental surfaces by air spread, animate and inanimate intermediaries (CDC, 2012).

Some microorganisms possess virulence factors determining their intensity and contribution to their pathogenicity (Prescott *et al*., 2008; Kome and Nneoma, 2021). These virulence factors, such as toxins, cell surface protein and hydrolytic enzymes, are frequently involved in the direct interaction with the host tissues or in concealing the bacterial surface from the host's defence mechanism (Whitehead and Cotta, 1995; Prescott *et al.*, 2008). The fundamental precautionary measure to protect against the spread of infectious diseases can be achieved through hand washing and is one of the most public health practices to reduce person-person or person-to-food contact surfaces (Chinakwe *et al*., 2012). The present study was designed to isolate and investigate the bacterial load door handles in the Faculty of Science at Sokoto state university, Sokoto and determine the antibiotic susceptibility profile of the isolated bacterial species.

Staphylococcus epidermidis and other coagulase-negative staphylococci that reside in the outer layers of the skin appear to account for some 90 per cent of the skin aerobes (Rechard et al., 2013). *Staphylococcus aureus* is the most important potential pathogen that causes boils, abscesses, wound infections, toxic shock syndrome and pimples (Brooks *et al*., 2007;

Nworie *et al.*, 2012). The present study was designed to investigate the incidence of bacterial load on door handles in the Faculty of Science at Sokoto state university, Sokoto and determine the antibiotic susceptibility profile of the isolated bacterial species.

2. Materials and Methods

2.1 Sample Collection and Sample Processing

In this study, twenty (20) samples were collected from office door handles at the faculty of science complex, Sokoto State University using the swab-rinse method of the American public health association as described by (Reynolds and Hurst, 2005). Door handles were swabbed with sterile cotton-tipped applicators (swab stick) and moistened with sterile peptone water. These were introduced into a sterile test tube containing sterile peptone water shaken and loosely capped. The test tube was covered with cellophane and transported to the Microbiology laboratory. The samples were incubated for 24 Hours. The rinsed fluid was plated on nutrient agar. Each sample was processed to identify the bacteria present.

2.2 Isolation of bacterial from door handles

Each sample of the door handle was swabbed using a stick rinsed in peptone water and was aseptically inoculated into a nutrient agar plate. The door handle swabs were rinsed into peptone water, gently shaken and inoculated into a nutrient agar plate using poured plate technique and were spread evenly over the entire surface of the media using a spreader (a sterile bent-glass rod). This allows the complete recovery of all the organisms picked up in the swab. The plates were incubated for 24 hours at 37^0C and examined. The colonial characterizations of bacterial isolates grown were observed by macroscopic and microscopic examination of each colony. The colonies were differentiated based on size, colour, and texture (Vandepitte *et al.,* 2003; Cheesebrough, 2006).

2.3 Antimicrobial susceptibility Test

A broth suspension of the organism to be tested was prepared to a turbidity equivalent to a 0.5 McFarland standard. The plates were labelled correctly within 15 minutes of turbidity adjustment, and the swab was used to inoculate the agar surface evenly. The rings were aseptically placed on the inoculated surface and pressed gently to ensure complete contact with the agar surface. Next, the plates were incubated for about 24 hours, after which the inhibition zones were measured using a ruler (Bauer *et. al*, 1996).

3. Results and Discussion

The result of the bacterial load of samples collected from door handles in the faculty of science complex, Sokoto State University Sokoto, was presented in table 1. The highest count was 1.05 X 10^6 cfu/mL colonies in sample DH12, while the lowest was 2.5 X 10^5 CFU/mL colonies in each sample DH7 & DH19. The study's finding answered the proposed research question that increased use of door handles might increase a load of bacterial species on the surfaces of the door knob.

The bacterial species isolated in this experiment were identified based on morphology and biochemical characteristics. Bacterial species identified are *Staphylococcus aureus, Staphylococcus intermidis, Streptococcus pneumonia, Listeria monocytogenes, Staphylococcus cohinii, Streptococcus pyogenes, Staphylococcus epidermidis, Staphylococcus chromogenes, Staphylococcus capitis, Escherichia coli, Pseudomonas aeruginosa*. The findings of this study are in agreement with the finding of Akinjogunla & Divine-Anthony (2017**),** who reported *S. aureus*, *Streptococcus* sp., *Bacillus sp*., *E. coli*, *Proteus sp*., *E. faecalis*, *K. pneumoniae* and *P. aeruginosa* as the door handles microorganisms isolated from the Tertiary Institutions in Uyo, Akwa Ibom State. Similarly, the study conducted by Bashir *et al.* (2016) supports this study's findings, which reported *Staphylococcus aureus*, *Bacillus sp*., *Micrococcus sp*., *Escherichia coli*, *Salmonella sp*. and *Klebsiella* sp. are the primary bacterial isolates frequently associated with the toilet door handles.

Table 1: Bacterial load on the Door handle Samples

Sample code	Colony count in cfu/ml	Sample code	Colony count in cfu/ml
DH1	7.0 X 10^5	DH11	6.0 X 10^5
DH2	5.5 X 10^5	DH12	1.05 X 10^6
DH3	8.0 X 10^5	DH13	8.0 X 10^5
DH4	7.5 X 10^5	DH14	5.5 X 10^5
DH5	6.0 X 10^5	DH15	7.0 X 10^5
DH6	9.5 X 10^5	DH16	5.0 X 10^5
DH7	2.5 X 10^5	DH17	8.0 X 10^5
DH8	6.5 X 10^5	DH18	5.0 X 10^5
DH9	8.0 X 10^5	DH19	2.5 X 10^5
DH10	6.0 X 10^5	DH20	9.0 X 10^5

This study's results revealed that door handles of some offices of the faculty of science complex, Sokoto State University, were contaminated with different groups of bacteria. The presence of these organisms indicates the poor sanitary condition. Nworie *et al*. (2012) isolated *S. aureus*, *K. pneumonia*, and *P. aeruginosa* from door

handle/knobs in selected public conveniences in Abuja Metropolis, Nigeria. The contamination of door handles might be due to direct contact with contaminants that can transmit bacterial species, most of which are bacteria of medical importance. Bacteria can be transmitted to surfaces of inanimate objects such as fomites and door handles due to personal contact and by mechanical vectors such as flies and fleas that carry disease agents in the gut and on appendages deposited on environmental surfaces. Bashir *et al.* (2016) reported that poor personal hygiene increased the level of contaminant. A high level of contamination of door handles by bacterial contaminants might be attributed to the fact that there is evidence of high contact of door handles by many users. The study agrees with the finding of Bashir *et al*. (2016).

The result of the occurrence of bacterial species was presented in table 2. *S aureus* has the highest frequency of occurrence of 12 (30%), followed by *E coli* with 5 (12.5%), *S. pyogenes* 4 (10%), *S. pneumonia* 3 (7.5%), *S. epidermidis* 3 (7.5%), *S. cohinii* 3 (7.5%), *S. capitis* 3 (7.5%), *S. chromogenes* 2 (5%). In comparison, the species with the lowest frequency are *L. monocytogenes* and *S. intermedis*, which have 1 (2.5%). The Presence of L. *monocytogenes* which is food pathogens, would result from contacting the remaining food left overnight in the some offices by cookers that wash dishes and directly convey the food to the staff. Contaminant levels may vary due to some factors such as exposure and environment (Nworrie *et al*., 2012).

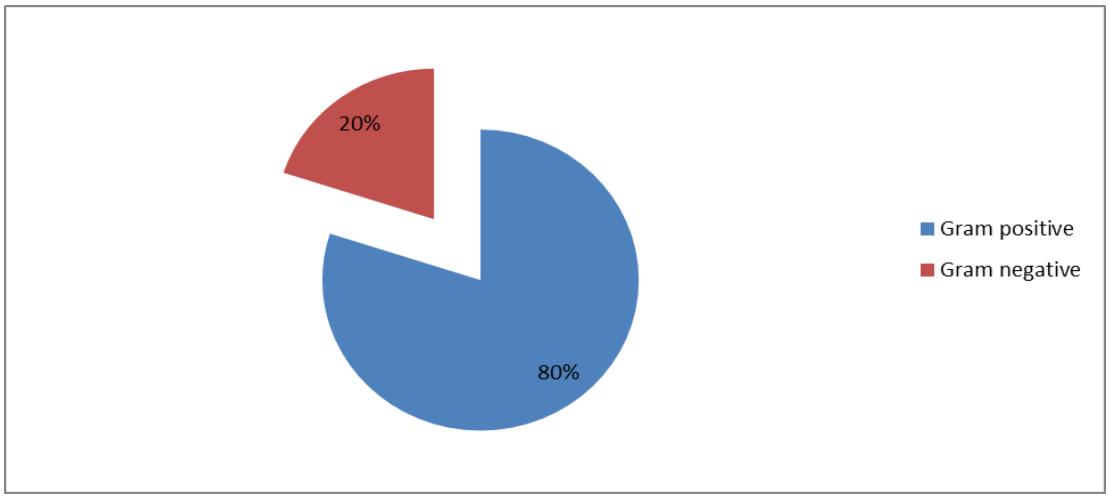
The contamination of door handles is possible because students and staff are busy going in and out of some offices at the faculty of science complex. Some students work in the laboratory for their practical experiments with bare hands. They may usually come to some of these offices and contaminate the door handles. While some students and staff visit toilets, some may not wash their hands properly with disinfectants and antiseptic chemicals and directly contact some of these offices, which might contaminate the door handles. Itah and Ben (2004), in the study conducted, reported that *E.coli, Klebsiella sp.* and *Citrobacter sp*. are the predominant bacterial contaminant on surfaces such as door handles.

Table 2: Frequency of occurrences of bacterial species

	Bacteria isolates	Frequency	Percentages (%)
Gram positive	*Staphylococcus aureus*	12	30
	Staphylococcus intermedius	1	2.5
	Streptococcus pneumonia	3	7.5
	Listeria monocytogenes	1	2.5
	Staphylococcus cohinii	3	7.5
	Streptococcus pyogenes	4	10
	Staphylococcus epidermidis	3	7.5
	Staphylococcus chromogenes	2	5.0
	Staphylococcus capitis	3	7.5
Gram negative	*Escherichia coli*	5	12.5
	Pseudomonas aeruginosa	3	7.5

The study also agrees with Maryam *et al.* (2014), who found *S. aureus* and *E.coli* on door handles with the highest percentages compared to species of *Streptococcus, Pseudomonas,* and *Klebsiella* found on fomites which have a minor occurrence and portions. In addition, Alonge *et al.* (2018) reported bacterial contamination of on toilet door handles on Baze University, Nigeria. The study's results confirmed that continuously used door handles would increase the risk of contracting microbes and, more importantly, bacteria.

The study revealed that most bacteria found on the door handles are gram-positive bacteria, with 80% (Fig 1). Contamination of door handles is not surprising as contaminants can quickly transfer to environmental surfaces such as door handles of service offices due to frequent contact by students, staff and cleaners during working hours. Omololu-Aso *et al*. (2011) investigated 200 samples of swabs from doctors' stethoscope diaphragms, cell phones of Health Care Workers (HCWS), patients' bed linen, pillows and door knobs at the Obafemi Awolowo University Teaching Hospitals Complex (OAUTHC). The results revealed that 20.33% of the doorknobs were contaminated with *S. aureus*. Maryam *et al.* (2014) reported that gram positives organisms accounted for a percentage (52.2%) as compared to the gram-negative (47.8%) in fomites.



Source: Field work, 2017.

Fig 1: Distribution of Isolates According to Gram's Reaction

Most species of *Staphylococcus* are harmless and are usually found on the skin and mucous membranes. However, Oje and Kamiya (1996) reported that many species of *Staphylococcus* could survive on dry surfaces for weeks and months, so transferring those species from door handles is very real. Therefore, contacting them can cause a severe problem that may lead to illness. On the other hand, many species of Streptococcus are known to cause meningitis, pneumonia, and some flesh-eating infection.

Akinjogunla & Divine-Anthony (2017) isolated 140 bacterial species comprising 64 Gram-positive and 76 Gram-negative bacteria in the genera *Staphylococcus*, *Enterococcus*, *Streptococcus, Escherichia*, *Bacillus*, *Proteus*, *Klebsiella* and *Pseudomonas* which were isolated from the door handle swab samples obtained from offices, toilets, hostels, classrooms and laboratories. The growth percentage of bacteria obtained was lower than the 99% obtained in a previous study in Nigeria (Ikeh and Isamade, 2011). However, other pathogens like *E. coli* were also isolated. This indicates faecal contamination which leads to diseases like gastroenteritis and diarrhoea. This is in line with the result of Maori *et al*. (2013), who reported that *E. coli* are a significant cause of infection by enterobacteria.

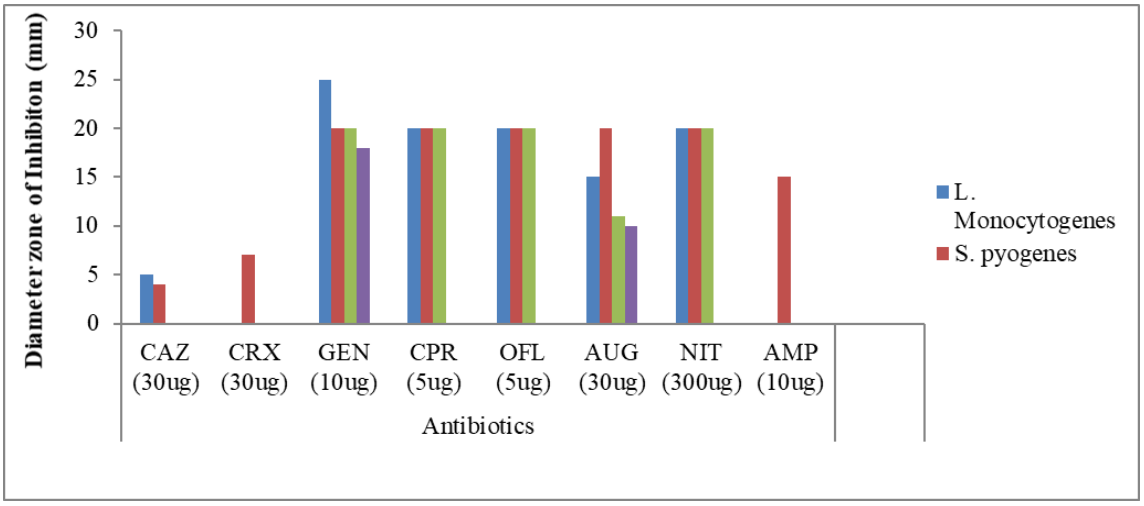


Fig 2: Antibiotic sensitivity pattern for Gram Positive bacterial isolates.

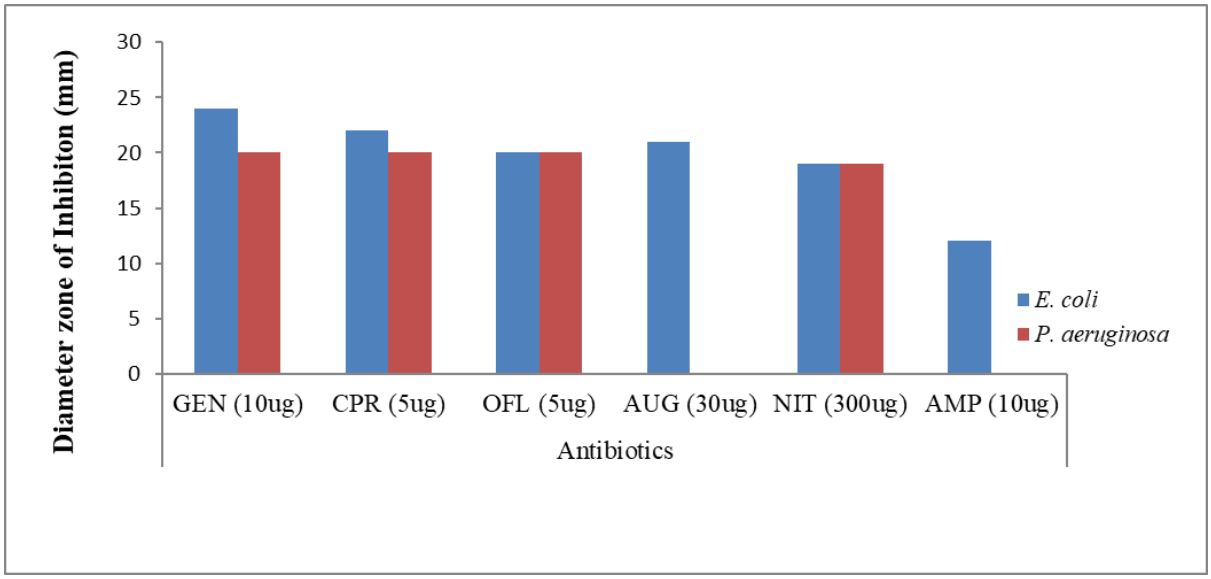


Fig 3: Antibiotic sensitivity pattern for Gram negative bacterial isolates.

Keys: CAZ= Ceftazidime, CRX=Cefuroxime, GEN=Gentamicin, CPR=Ciprofloxacin, OFL=Ofloxacin, AUG= Amoxicillin/Clavulanate, NIT=Nitrofurantoin, AMP=Ampicillinug= Microgram 0-9= Resistance 12-20= Susceptible (Bauer *et al*., 1996).

The results of the antibiotic susceptibility profile on bacterial isolates revealed that the antibiotic Gentamycin exhibited the highest zone of inhibition in all the isolates, followed by Ciprofloxacin, Nitrofurantoin and Ampicillin. The possible explanation for this is Gentamycin could be a drug of choice in treating diseases caused by those bacteria. The ability of Gentamycin to have such an effect is the fact that the Gentamycin have broad activity on bacterial isolated and its ability to destroy the cell wall of the vegetative cell of the spore-forming bacterial isolates (Abraham and chain, 2000). The study agrees with the finding of Maryam *et al.* (2012) that *E. coli, Pseudomonas spp*. and *Klebsiella spp*. were susceptible to Gentamycin. However, the bacterial species were resistant to Ceftazidime; this means that the antibiotic could not cure any infection caused by the bacteria isolated in this study. Similarly, the antibiotic sensitivity pattern of gram-negative bacteria indicated the species of *E. coli* and *P. aeruginosa* isolated in this study were susceptible to Gentamicin, Ciprofloxacin, Ofloxacin, Amoxicillin, and Nitrofurantoin. Still, the exception is in Ampicillin, where only *E. coli* was sensitive to it.

Ciprofloxacin, Ofloxacin, Nitrofurantoin and Ampicillin did not affect the bacterium *S. capitis.* Although Ampicillin affected only *S. pyogenes* and *S. epidermidis,* the other isolate had no impact. The resistance by *Staphylococcus* might be due to differences in the genus with *L. monocytogenes*. Also, Ampicillin having activity on only two bacterial isolates conforms with the work of Cox (1994), which showed that Ampicillin had little or no action on bacteria-associated soil.

4. Conclusion

The study revealed a high load of bacterial contaminants on door handles, which are pathogenic to humans. This study indicates that environmental surfaces such as door handles serve as media that can transmit infectious agents. We, therefore, recommend long-term monitoring of the door handles in the entire university buildings to determine the prevalence and pathogenic bacteria on the campuses. Increasing personal hygiene and using protective measures could be the best precautionary measure to reduce the burden of disease transmission among the human population.

Conflict of Interest

The author declares that there is no conflict of interest.

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