BSP Advances in Science, Engineering and Technology
www.iahiservices.com

Bacteriological Contamination of Car Door Handle in Ellen Gaf School of Health and Technology, Ajide Ekeh, Benue State.

Abah Emmanuel A[1]*, Attah Moses O.[2], Obera Matthew[3] Ameh Peter O[4].
[1,3]*Department of Medical Laboratory Technician, Ellen Gaf School of Health Science and Technology, Ajide Ekeh*
[2,4]*Department of Science Laboratory, Benue State Polytechnic, Ugbokolo*
**Corresponding Author Email: emmaabah65@gmail.com*

Abstract

This study investigated the bacteriological contamination of car door handles and steering wheels within the Ellen Gaf School of Health and Technology, Ajide Ekeh, Benue State, Nigeria. A total of 60 swab samples were collected from vehicles at two high-traffic locations: the Market Bus Stop and the School Gate Bus Stop. Samples were processed using standard microbiological techniques, including culture on selective media and biochemical identification. The results revealed that 60% of the samples were contaminated with bacteria. The most frequently isolated organism was *Staphylococcus aureus* (72.2%), followed by *Escherichia coli* (19.4%) and *Salmonella* spp. (8.3%). The equal contamination rate observed at both sampling sites indicates a consistent risk of microbial transmission through shared vehicle surfaces. The detection of both skin and fecal bacteria highlights inadequate hand hygiene and a lack of surface sanitation practices. These findings emphasize the role of vehicle interiors as potential fomites and underscore the need for routine disinfection, enhanced hygiene awareness, and public health interventions to reduce the risk of infection transmission in academic and public environments.

Keywords: Bacterial contamination, Fomites, *Staphylococcus aureus*, *Escherichia coli*, *Salmonella* spp., Vehicle surfaces, Hand hygiene, Public health, Infection control

1.0 Introduction

Human hands serve as a significant reservoir for microbial colonization, harboring both resident flora—such as *Staphylococcus aureus*, *Corynebacterium* spp., and *Micrococcus* spp.—and transient pathogens acquired from the environment, including *Escherichia coli*, *Salmonella* spp., *Shigella* spp., *Clostridium perfringens*, *Giardia lamblia*, Norwalk virus, and Hepatitis A virus [1–3]. This dual role of hands as vectors for pathogen transmission has critical implications, especially in shared environments where frequent contact with surfaces may facilitate cross-contamination. The survival of these organisms on surfaces

varies, influencing the likelihood of subsequent transfer to individuals [4]. Within healthcare settings, environmental surfaces have long been recognized as major contributors to nosocomial infections (NIs), with resistant microorganisms frequently isolated from hospital equipment and surfaces [5].

Beyond healthcare facilities, public and private transport vehicles present another overlooked yet potentially significant source of microbial exposure. In the field of automotive aerodynamics, concerns about surface contamination have historically focused on visibility and safety—such as the development of windscreen wipers to combat rain [6–8]. However, modern understanding emphasizes the complex interactions between vehicles and environmental contaminants, including road spray, brake dust, soot, and cleaning agents. These contaminants accumulate on vehicle surfaces, including door handles and steering wheels—high-touch areas that may serve as vectors for microbial transmission.

Despite the potential public health implications, there remains limited data on microbial contamination in non-clinical settings such as automobiles, particularly within academic institutions. Misconceptions persist among the general population that bacteria are confined to hospitals or laboratories, which may result in lax hygiene practices in everyday environments. Previous studies have identified microbial contamination on vehicle surfaces [9-10], yet, to our knowledge, no investigations have been conducted on the car door handles and steering wheels of vehicles within the Ellen Gaf School of Health and Technology, Ajide Ekeh, Benue State.

This study aims to bridge that gap by assessing bacterial contamination on commonly touched surfaces of cars within the institution. Specifically, the objectives are to: (1) determine the presence of bacterial contamination on car door handles and steering wheels, (2) quantify the bacterial load, and (3) identify the bacterial species present. The findings are expected to raise awareness about the role of vehicular surfaces in microbial transmission and underscore the importance of routine disinfection and hand hygiene—particularly among healthcare workers—to mitigate the spread of infection.

2.0 Literature Review

2.1 Surface Contamination and Disease Transmission

Microorganisms can persist on inanimate surfaces for extended periods, making such surfaces potential vehicles for disease transmission [11]. Fomites—including mobile phones, computer keyboards, and door handles—have been extensively studied for their role in spreading infectious agents in both hospital and community settings [1, 3, 12]. These surfaces, especially when frequently touched, contribute to cross-contamination, which can lead to outbreaks of nosocomial and community-acquired infections [5, 6].

2.2 Bacterial Flora of the Human Hand and its Role in Contamination

The human hand plays a central role in microbial transfer. Normal skin flora such as *Staphylococcus aureus*, *Micrococcus spp.*, and *Corynebacterium spp.* are often found alongside transient pathogens acquired from the environment, such as *Escherichia coli*, *Salmonella spp.*, and *Shigella spp.* [1–3]. These transient microbes are especially problematic because they are more likely to be pathogenic and capable of spreading from surface to surface via human contact [4].

2.3 Microbial Contamination in Vehicles

Vehicles are often neglected as potential sources of microbial transmission, despite being high-touch environments. Door handles and steering wheels, in particular, are repeatedly contacted and rarely disinfected, making them likely carriers of pathogens. While studies have investigated microbial contamination on phones and hospital equipment, few have focused on automobile interiors [10]. These surfaces may accumulate contaminants from various sources, including hands, road grime, and airborne particles, raising public health concerns, especially in shared vehicles.

2.4 Pathogens of Concern on Environmental Surfaces

Common pathogens isolated from surfaces include *S. aureus*, *E. coli*, *Klebsiella pneumoniae*, and *Pseudomonas aeruginosa*, all of which are capable of surviving harsh conditions and causing severe infections [5, 10, 12]. *S. aureus*, for instance, is not only a natural part of the human microbiota but also a frequent contaminant in environmental settings, known for its ability to survive on dry surfaces for days or even weeks [8].

2.5 Misconceptions about Microbial Distribution

Many people believe that bacteria are primarily found in hospitals or laboratories. This misconception leads to poor hygiene practices in community and private settings. Research shows that enteric bacteria such as *E. coli* and *Salmonella spp.* can be present on common items like money, tools, and door handles, highlighting the risk of contamination even in seemingly clean environments [3, 9].

2.6 Importance of Hand Hygiene and Surface Disinfection

Hand hygiene remains one of the most effective strategies to prevent the spread of infections. Studies estimate that up to 80% of infections are transmitted via hand contact with surfaces or other people [2]. Regular handwashing and surface disinfection can drastically reduce microbial load, limiting the potential for disease transmission [1, 9]. In healthcare and educational institutions, reinforcing these practices is essential for preventing outbreaks.

3.0 Materials and Methods

3.1 Study Area

This study was conducted at Ellen Gaf School of Health and Technology, Ajide Ekeh, located in Obi Local Government Area of Benue State, Nigeria. The institution is a private health training school that attracts a significant number of staff, students, and visitors on

a daily basis. Vehicles frequently enter and leave the premises, creating a shared environment where microbial contamination of commonly touched surfaces is likely.

3.2 Sample Collection

A total of 60 samples were collected from the surfaces of car door handles and steering wheels. Sampling was carried out using sterile swab sticks moistened with normal saline. Swabs were taken from both the interior (steering wheels) and exterior (door handles) surfaces of the vehicles. Each swab was immediately transferred into a sterile, labeled test tube containing 5 mL of sterile normal saline and transported to the microbiology laboratory for analysis within two hours of collection.

3.3 Culture Media and Microbial Isolation

Upon arrival at the laboratory, the samples were vortexed and inoculated onto freshly prepared culture media: Nutrient Agar (NA), MacConkey Agar (MAC), and Mannitol Salt Agar (MSA). The inoculated plates were incubated aerobically at 37°C for 24 hours. After incubation, plates were examined for bacterial growth, and colony morphology was recorded.

3.4 Enumeration of Bacterial Load

Bacterial load was estimated using the pour plate method. Ten-fold serial dilutions of each sample were prepared up to 10^{-5}. One milliliter of each dilution was inoculated into sterile Petri dishes and overlaid with molten Nutrient Agar. The plates were incubated at 37°C for 24 hours, after which colony-forming units (CFU/mL) were counted. Only plates with colony counts between 30 and 300 were considered for enumeration.

3.5 Identification of Bacterial Isolates

Colonies with distinct morphologies were subcultured to obtain pure isolates. Identification of bacterial species was based on colonial characteristics, Gram staining, and standard biochemical tests, including catalase, coagulase, indole, citrate, urease, oxidase, and triple sugar iron (TSI) tests. The identities of isolates were confirmed using established identification keys.

4.0 Results and Discussion

4.1 Surface Contamination Rates of Vehicle Touchpoints

A total of 60 surface swab samples were collected from vehicle door handles and steering wheels across two locations: Market Bus Stop and School Gate Bus Stop. Bacterial growth was observed in 36 samples, indicating an overall contamination rate of 60.0%. The prevalence was identical across both sites, with 15 of 25 (60.0%) samples from the Market Bus Stop and 21 of 35 (60.0%) samples from the School Gate Bus Stop testing positive (Table 1 and Figure1).

Table 1: Frequency and Percentage of Positive Samples by Location

Location	No. of Samples	No. Positive (%)
Market Bus Stop	25	15 (60.0%)
School Gate Bus Stop	35	21 (60.0%)
Total	**60**	**36 (60.0%)**

This finding highlights the uniform distribution of bacterial contamination across different public-use environments, supporting existing literature that high-touch fomites in public areas—regardless of setting—can act as consistent microbial reservoirs [1, 4]. The equally high contamination levels underscore the need for improved hygiene awareness, especially in healthcare-adjacent institutions.

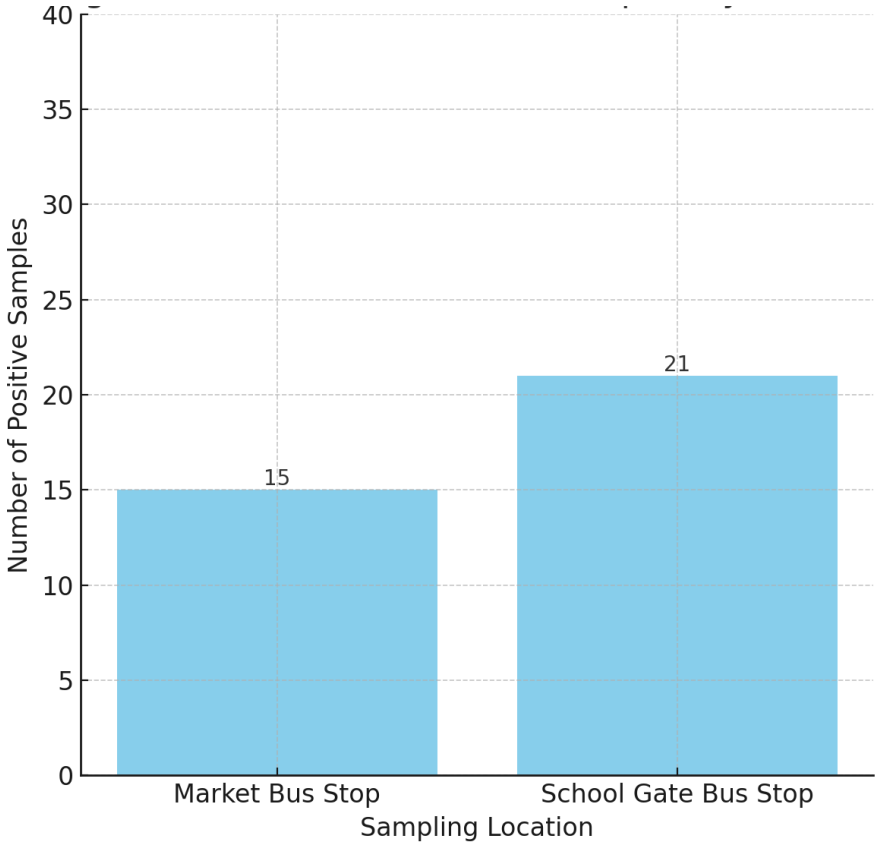

Fig 1: Positive Samples by Location

4.2 Identification of Bacterial Isolates via Biochemical Testing

Biochemical characterization of the isolates revealed the presence of three bacterial species: *Staphylococcus aureus*, *Escherichia coli*, and *Salmonella* spp. These were identified using catalase, coagulase, indole, and Gram staining techniques. *S. aureus* tested positive

for catalase and coagulase but negative for indole, whereas *E. coli* tested positive for catalase and indole but was Gram-negative. *Salmonella* spp. showed positive catalase activity but negative reactions to coagulase and indole, and was also Gram-negative (Table 2).

The dominance of *S. aureus* aligns with its status as a skin commensal often found on human hands, making it a common contaminant on high-contact surfaces. The isolation of *E. coli* and *Salmonella* spp., however, indicates fecal contamination, likely due to inadequate hand hygiene practices.

Table 2: Biochemical Characteristics of Isolated Organisms

Organism Identified	Catalase	Coagulase	Indole	Gram Stain
Staphylococcus aureus	+	+	–	+
Escherichia coli	+	–	+	–
Salmonella spp.	+	–	–	–

The presence of enteric pathogens in these samples is a red flag. These organisms have the potential to cause serious gastrointestinal infections, particularly in vulnerable populations such as the elderly, children, and immunocompromised individuals.

4.3 Distribution and Prevalence of Isolates by Location

Further breakdown of the microbial distribution revealed that *S. aureus* accounted for the majority of isolates at both locations—72.7% at the Market Bus Stop and 71.4% at the School Gate Bus Stop. *E. coli* and *Salmonella* spp. were detected in 18.2% and 9.1% of Market Bus Stop samples, and in 21.4% and 7.1% of School Gate Bus Stop samples, respectively (Table 3).

This consistent prevalence of *S. aureus* across both sites reiterates its widespread presence and ease of transmission through hand contact. Conversely, the detection of fecal-origin bacteria like *E. coli* and *Salmonella* spp. implicates direct contamination from poor hygiene practices, likely involving inadequate handwashing after defecation or contact with contaminated materials.

Table 3: Prevalence of Bacterial Isolates by Location

Organism Identified	Market Bus Stop n (%)	School Gate Bus Stop n (%)	Total n (%)
Staphylococcus aureus	16 (72.7%)	10 (71.4%)	26 (72.2%)
Escherichia coli	4 (18.2%)	3 (21.4%)	7 (19.4%)
Salmonella spp.	2 (9.1%)	1 (7.1%)	3 (8.3%)
Total Isolates	**22 (100%)**	**14 (100%)**	**36 (100%)**

These findings are congruent with previous studies that have reported similar bacterial compositions on fomites in public settings, especially those frequently touched by

multiple individuals [5, 6, 9]. The high prevalence of *S. aureus*, a known pathogen responsible for skin infections and hospital-acquired infections, highlights a pressing need for sanitation protocols targeting shared vehicle surfaces.

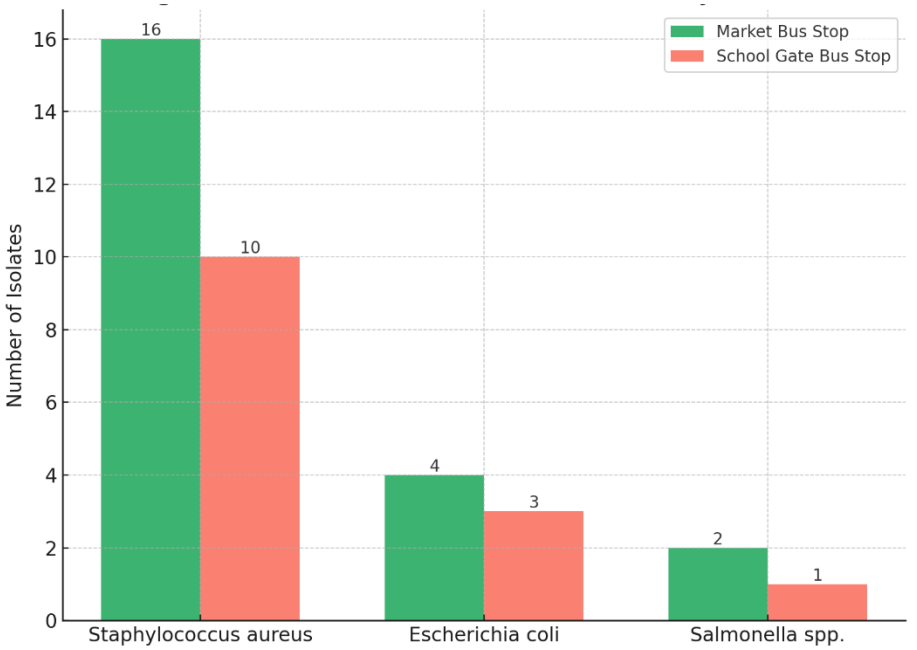

Figure 2: Distribution of Bacterial Isolates by Location

4.4 Public Health Implications

The detection of both skin and fecal bacteria on car door handles and steering wheels at a health-focused institution raises concerns about potential nosocomial and community-acquired infections. These surfaces, acting as fomites, could facilitate indirect transmission of pathogens among users—especially in settings where people commute between hospitals, schools, and markets.

This is particularly critical considering that *S. aureus* is capable of causing opportunistic infections and can harbor antibiotic resistance genes such as those conferring methicillin resistance (MRSA). The presence of enteric pathogens like *E. coli* and *Salmonella* spp. also points to potential risks for outbreaks of gastrointestinal illness.

5.0 Conclusion and Recommendations

5.1 Conclusion

This study provides compelling evidence that vehicle door handles and steering wheels in high-traffic public locations within Ellen Gaf School of Health and Technology, Ajide Ekeh, Benue State, serve as significant reservoirs of bacterial contamination. With a 60%

overall contamination rate, the prevalence of Staphylococcus aureus**,** Escherichia coli, and Salmonella spp**.** demonstrates both skin and fecal contamination, indicating poor hygiene practices and environmental neglect. The predominance of *S. aureus* further emphasizes the role of human contact in the dissemination of potentially pathogenic microorganisms across commonly shared surfaces.

These findings have important public health implications, especially in educational and healthcare-adjacent settings where the risk of cross-infection is elevated. The presence of enteric bacteria also suggests the potential for gastrointestinal illness transmission, particularly among immunocompromised individuals. The study underscores the need for strategic hygiene and sanitation interventions to curb microbial transmission and safeguard public health.

5.2 Recommendations

i Implement Routine Disinfection Protocols: It is recommended that vehicle door handles and steering wheels, particularly those in public or institutional use, be subjected to regular cleaning and disinfection. This measure will significantly reduce microbial contamination and lower the risk of pathogen transmission among users.

ii Promote Hand Hygiene Awareness: Educational initiatives should be established to promote effective hand hygiene practices. In particular, health training institutions must ensure that students and staff are regularly sensitized on the importance of proper handwashing, especially before and after touching communal surfaces such as vehicle interiors.

iii Develop Institutional Hygiene Policies: Institutions such as schools, hospitals, and transport services should develop and enforce hygiene policies. These should mandate routine sanitation procedures for shared vehicles and promote accountability among users regarding cleanliness and hygiene practices.

iv Conduct Surveillance and Resistance Testing: Future studies should be expanded to include antimicrobial susceptibility testing of the bacterial isolates. This will help identify resistant strains, assess their clinical relevance, and inform appropriate infection prevention and control strategies.

v Encourage Design Innovations in Automobiles: Automobile manufacturers should be encouraged to incorporate antimicrobial surfaces in high-contact areas like door handles and steering wheels. This innovation would add an extra layer of protection and contribute to reducing the microbial burden in commonly used vehicles.

By implementing these measures, institutions and public health authorities can mitigate the spread of infectious diseases through environmental surfaces, especially in vulnerable and high-exposure settings.

References

[1] *Bright, K. R., Boone, S. A., and Gerba, C. P. (2010). Occurrence of bacteria and viruses on elementary classroom surfaces and the potential role of classroom hygiene in the spread of infectious diseases.* Journal of School Nursing, *26(1), 33–41.*

[2] *Goldblatt, J. G., Krief, I., Klonsky, T., Haller, D., Milioul, V., Sixsmith, D. M., Srugo, I., and Potasman, I. (2007). Use of cellular telephones and transmission of pathogens by medical staff in New York and Israel.* Infection Control and Hospital Epidemiology, *28, 500–503.*

[3] *Gosa, G., and Tsige, K. K. B. (2014). Microbial load and safety of paper currencies from some food vendors in Jimma Town, Southwest Ethiopia.* BMC Research Notes, *7, 843.*

[4] *Angadi, K. M., Misra, R., Gupta, U., Jadhav, S., and Sardar, M. (2014). Study of the role of mobile phones in the transmission of hospital acquired infections.* Medical Journal of D.Y. Patil University, *7(4), 435–438.*

[5] *Borer, A., Gilad, J., Smolyakov, R., Eskira, S., Peled, N., Porat, N., Hyam, E., Trefler, R., Riesenberg, K., and Schlaeffer, F. (2005). Cell phones and* Acinetobacter *transmission.* Emerging Infectious Diseases, *11, 1160–1161.*

[6] *Elsevier Health Sciences. (2011). Dangerous bacteria found on cell phones of hospital patients.* Science Daily. *FSH (Food Safety and Hygiene), February 2000. A bulletin for the Australian Food Industry, Money handling in food science operations.*

[7] *Kilic, I. H., Ozaslan, M., Karagoz, I. D., Zer, Y., and Davutoglu, V. (2009). The microbial colonization of mobile phones used by healthcare staff.* Pakistan Journal of Biological Sciences, *12(11), 882–884.*

[8] *Axel, K., Ingeborg, S., and Gubter, K. (2006). How long do nosocomial pathogens persist on inanimate surfaces? A systematic review.* BMC Infectious Diseases, *6, 130.*

[9] *Burton, M., Emma, C., Peter, D., Gaby, J., Val, C., and Wolf-Peter, S. (2011). The effect of hand washing with water or soap on bacterial contamination of hands.* International Journal of Environmental Research and Public Health, *8(1), 97–104.*

[10] *Ekanem, E. E., Dupot, H. L., Pickering, L. K., Selwyn, B. J., and Hawkins, C. M. (1983). Transmission dynamics of enteric bacteria in day-care centers.* American Journal of Epidemiology, *118, 562–572.*

[11] *Cheesebrough, M. (2006).* District Laboratory Practice in Tropical Countries *(2nd ed.). Cambridge University Press, Cambridge, UK, p. 387.*

[12] *Bures, S., Fishbain, J. T., and Uyenha, C. F. T. (2000). Computer keyboards and faucet handles as reservoirs of nosocomial pathogens in the intensive care unit.* American Journal of Infection Control, *28, 465–470.*

