# MICROBIOLOGICAL ASSESSMENT OF MICROPHONES USED IN CHURCHES IN CALABAR, NIGERIA

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**Received:** 24th June, 2022 **Accepted:** 28th June, 2022 **Published:** 30th June, 2022

## ABSTRACT

**Background:** Bacteria can survive on the surface of the microscopic grooves and cracks and will go unnoticed, hence the presence of pathogenic microorganisms on the user interface of handheld microphone poses a potential public health risk.

**Aim:** The aim of this study was to isolate and identify potential pathogenic micro-organisms associated with used microphones, between April to August, 2021 in Calabar, Nigeria.

**Methodology:** One hundred and fifty samples were collected (75 each) from the mouthpiece (head) and handles of the various microphones from different churches in Calabar using sterile cotton wool swab moistened with sterile peptone water. Samples were inoculated on Blood agar, Cysteine Lactose Electrolyte Deficient agar and incubated at 37$^{o}$C for 24 - 48 hours and also on Sabouraud's Dextrose agar at room temperature for 2 - 7 days. Isolates were characterized macroscopically, microscopically and biochemically.

**Results:** Overall, 96(64.0%) of the 150 samples from microphones studied yielded growth of microbes with the mouthpiece being more significantly contaminated 57(76.0%) than the handles 39(52.0%) ($X^2$=9.375, p=0.0022). The number of microphones colonized with bacteria were significantly more 62(41.3%) than those carrying fungi 34(22.7%) ($X^2$=7.45, p=0.0063). *Staphylococcus aureus* ranked highest (53.2%) among the bacterial isolates followed by *Bacillus* species (29.0%) and *Escherichia coli* (17.7%) while in the case of those colonized by fungi, *Candida* species ranked higher (91.2%) than *Aspergillus flavus* (8.8%). The distribution of microbes by church group was statistically insignificant ($X^2$=0.508, p=0.1969).

**Conclusion:** This study has shown that used microphones carry various microbes including potential bacterial and fungal pathogens, hence can play reservoir role in microbial infection transmission. Frequent cleaning and creation of awareness on the health hazards associated with improper use and maintenance of microphones is recommended.

**Keywords:** Microphone, Bacteria, Fungi, Infection, Reservoir

## INTRODUCTION

Mankind is in the complex ecosystem where there is interaction between microorganisms and the body. Sometimes this relationship can be dangerous or beneficial. A microphone is a device that converts sound into an electric signal (Zimmer and Ben, 2010). There are moving coils and a thin metallic sheet named diaphragm in the microphone, which vibrates by the sound wave when a person speaks through it. Microphones are used for amplification of sound, the appropriate length for the most common microphone is 6-12 inches away from the mouth.

Types of microphone include the hand-held microphone and the headset microphone.

Microorganisms exist everywhere in the environment and are able to persist or grow on any surfaces (Kramer and Schewebke, 2006). Bacteria can survive in the microscopic grooves and cracks on surfaces and will go unnoticed. Oils in the skin, dust, grime moisture provide an ideal environment for them to accumulate. Bacteria, such as *Escherichia coli,* can survive on dry air or sunlight (Ashgar and El-said, 2012). Bacteria that can cause gastroenteritis have been found on frequently touched surface (Chandra *et al.,* 2014). The presence of viable pathogenic bacteria in inanimate objects has been reported by earlier investigators (Oluduro *et al*., 2011). Infectious doses of pathogen may be transferred to the mouth after handling an everyday environmental fomite (Rusin *et al.,* 2002).

Various organisms (Gram positive and Gram-negative bacteria) have been isolated from daily used gadgets like mobile phone, microphone, computer, stethoscopes (Chandra *et al*.,2014) computer keyboard, mice, elevator buttons and shopping cart (Al-Ghamdi *et al*., 2011). Bacterial agents can affect the survival of other pathogens on the same surfaces (Tagoe and Gyande, 2011). Once deposited on surfaces, many infections can survive for extended period of time unless they are eliminated by disinfection or sterilization procedure (Neff and Rosenthal, 1957). It has been shown that hard non porous surface has the highest bacteria transfer rate to hands (Rusin *et al.,* 2002).

Fomite such as microphone may likely to be contaminated with different kinds of microorganism including potential pathogens due to their vast usage and direct contact by different peoples especially in public gathering (Subathra *et al*., 2020). Microphone can cause health hazard if not properly used or poorly maintained, it can cause public health risk to the users especially in this era of covid-19 pandemic were people are expected to keep social distancing and observe other health measures put in place by Nigeria Centres For Disease Control (NCDC).

Transmission of microorganism may occur through direct, indirect or close contact with an infected person, through infected secretions such as saliva and respiratory droplets, which are expelled in air (Hamner *et al.,* 2020). The presence of pathogenic bacteria on the user's interface of microphone possess a potential risk to vulnerable, immune compromised individuals. Microphones are commonly used in churches, schools, seminars, ceremonies and public gathering. Therefore, there is need to investigate used microphones, to determine their role in the transmission and spread of microbial infections.

## MATERIALS AND METHODS

### Study area

This study was carried out in Calabar Metropolis between May and August, 2021. Calabar is the capital of Cross River State in the south eastern Nigeria. The city is divided into Calabar South and Calabar Municipal Local Government Areas with an area of 406 square kilometers and a population of 371,022 as at 2006 census (Ottong *et al.,* 2010). It is a large urban city with several hotels, good road network, hospitals, schools, many churches and other establishments. The main occupation of the residents of Calabar is farming and trading but many are civil servants who combine work with either farming or trading. The annual Calabar carnival attracts thousands of tourists within and beyond Nigeria into the city.

### Study design

This study was a cross- sectional study where a random sampling technique was used to obtain samples from 30 churches in Calabar metropolis.

### Informed consent

Unannounced visits were made to the churches in Calabar Metropolis.

Consent was sought and obtained verbally from the church authority and with the letter of introduction from the Department of medical Laboratory Science, University of Calabar.

**Sample collection**

A total of 150 samples were collected from church microphones (75 for handle and 75 for mouthpiece) in Calabar metropolis with the consent of the church authority. Two samples were obtained from each microphone, one from microphone handle and one from mouthpiece. A sterile cotton wool swab moistened in sterile peptone water was used to swab the microphone handle and the mouthpiece surface. The swab samples were transported to the laboratory within an hour for processing.

**Laboratory processing of the samples**

The swab stick containing the swabbed sample were rolled gently on a clean sterile glass slide making a thin smear and allowed to air dry. The smear was stained by Gram's method and examined microscopically for its Gram reactions (Cheesbrough *et al*., 2009).

**Cultural and isolation procedures**

Each swab was inoculated into 5mls of sterile peptone water and incubated at 37˚C for 3 hours for recovering of organisms. Each recovered sample suspension was cultured on the following culture media, prepared according to the manufacturer`s instruction: Blood agar, Cysteine Lactose Electrolyte Deficient agar and two Sabouraud's Dextrose agar (for fungi).

With a sterile wire loop, sample suspension was inoculated unto the culture media mentioned above and was properly streaked out to obtain distinct colonies. The culture plates were incubated aerobically at 37˚C for 24 - 48 hours and one Sabouraud's Dextrose agar plate at room temperature for 2-7 days for fungi growth (Cheesbrough *et al*., 2009).

**Identification and characterization of isolates**

*Identification of bacteria*

At the end of incubation period, bacterial colonies were identified macroscopically based on their colonial morphology. They were also identified microscopically using Gram staining method and motility test. The bacterial organisms were further identified using standard biochemical tests for catalase, coagulase, indole, urease, oxidase, carbohydrates fermentation and citrate utilization (Cheesbrough *et al*., 2009).

*Identification of fungal isolates*

This was done based on colonial and microscopic morphology of the isolates.

*Lacto-phenol cotton blue mount*

Two drops of lacto-phenol blue was placed on a clean slide. A sterile wire loop was used to transfer a portion of colony growth from the Sabauraud's Dextrose agar plate to the slide with the lactophenol blue and emulsified. The preparation was covered with a cover slip and examined with a microscope using X10 and X40 objective lens for fungal elements (Cheesbrough, 2009).

*Germ tube test for Candida species*

A colony of yeast was emulsified in 0.5 ml of human serum in a small test tube and the tube was incubated at 37˚Cfor 2-4 hours. A drop of the suspension was transferred to a glass slide and covered with a coverslip for microscopic examination (Cheesbrough, 2009).

**Statistical analysis**

Statistical analysis was carried out by the use of the Statistical Package for Social Science (SPSS) version 21.0. Proportions were compared using Chi-square test. P-value < 0.05 was considered statistically significant at 95% confidence interval.

## RESULTS

Distribution of bacteria and fungi on microphones indicated that the microphones were more significantly contaminated with bacteria 62(41.3%) than fungi 34(22.7%) ($X^2$=7.45, $p$=0.0063). Microphone handles carried more bacteria 29(38.7%) than fungi 10(13.3%), the difference was statistically significant ($X^2$=12.508, $p$=0.00405).

Likewise, mouthpiece carried more bacteria 33(44.0%) than fungi 24(32.0%) but the difference was statistically insignificant ($X^2$=2.292, *p*=0.130041) (Fig. 1).

Occurrence of bacteria and fungi on microphones based on church grouping. Church group K-N microphones scored the highest occurrence of microbial contaminants 29(69.0%) followed by group A-E 34(65.4%) and group F-J 35(62.5%). The differences in occurrence of microbes by church group was not statistically significant ($X^2$ = 0.5088, *p*=0.91 69) (Table 1).

Table 2 displays the occurrence of bacteria and fungi species on microphone handles and mouth -piece. *Staphylococcus aureus* ranked, highest among the bacterial isolates (53.2%) followed by *Bacillus* species (29.0%) and *Escherichia coli* (17.7%) while *Candida* species scored higher (91.2%) than *Aspergillus flavus* (8.8%) among the fungal isolates. The microphone handle and mouthpiece carried more of *Staphylococcus aureus* (55.2%) and (51.5%), respectively while *Candida* species dominated in the handle (70.0%) and the mouthpiece (100%).

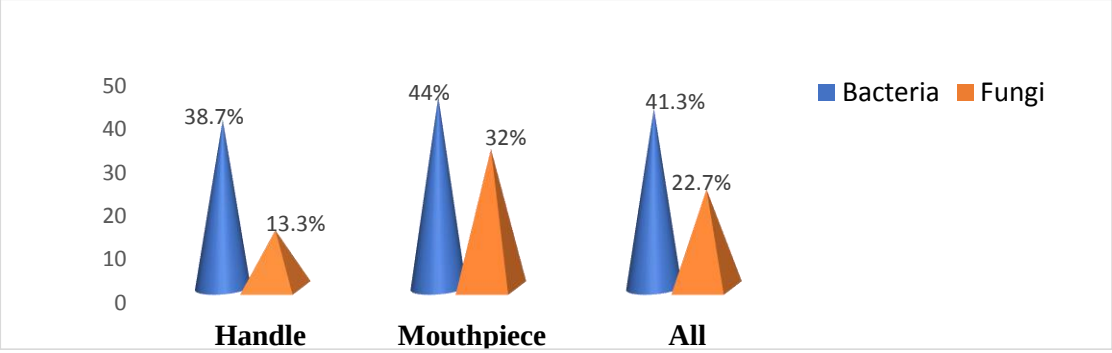


**Fig. 1: Distribution of bacteria and fungi on microphones**

**Table 1: The occurrence of bacteria and fungi on microphone based on church grouping**

| Church Group | No. Examined | No. (%) with | | |
|---|---|---|---|---|
| | | Bacteria | Fungi | All |
| A-E | 52 | 22(42.3) | 12(23.1) | 34(62.5) |
| F-J | 56 | 23(41.0) | 12(21.4) | 35(62.5) |
| K-N | 52 | 19(45.2) | 10(23.8) | 29(69.0) |
| Total | 150 | 62(41.3) | 34(22.7) | 96(64.0) |

**Table 2: Occurrence of bacteria and fungi species on microphone handles and mouthpiece**

| Organism | No. (%) present on | | All |
|---|---|---|---|
| | Handle | Mouthpiece | |
| **Bacteria** | | | |
| *Staphylococcus aureus* | 16(55.2) | 17(51.5) | 33(53.2) |
| *Escherichia coli* | 6(20.7) | 5(15.2) | 11(17.7) |
| *Bacillus* species | 7(24.1) | 11(33.3) | 18(29.0) |
| **Total** | **29(46.8)** | **33(53.2)** | **62(100)** |
| **Fungi** | | | |
| *Candida*spp | 7(70.0) | 24(100) | 31(91.2) |
| *Aspergillus favus* | 3(30.0) | 0(0.0) | 3(8.8) |
| **Total** | **10(29.4)** | **24(70.6)** | **34(100)** |

## DISCUSSION

In this study, the microphones examined were contaminated with a considerable rate of Gram positive and Gram-negative bacteria species and this is in agreement with the research findings of Adamu *et al*. (2012) and Catano *et al*. (2012) who obtained Gram positive and Gram-negative bacteria from surfaces of currency banknotes, computer keyboards, curtains, cell phones, white coats and ties, respectively.

Findings from this study revealed *Staphylococcus aureus* as the most frequently occurring isolate with the percentage occurrence 53.2% which is higher than 35.8% recorded by Oluduro *et al*., 2011 who reported *Staphylococcus aureus* as the most frequent bacterial contaminant of electronic hardware in Ile-Ife. *Staphylococcus aureus* being a major component of normal flora of the human skin and nostrils can be easily discharged by several human activities (Cole *et al*., 2001) including sneezing, talking, coughing, nose picking and contact with moist skin (Itah and Ben, 2004). This probably explains its high frequency on the handlesand mouthpiece of the microphones. It has also been associated with numerous infectious disease conditions and nosocomial infections. It follows that since users constantly touch the microphone interface and often sneeze, there is every chance of introducing *Staphylococcus aureus* on to the interface in use and transferring it to subsequent users. Also, airborne organisms can be transported from users to passerby.

*Escherichia coli* is a normal flora of the gastrointestinal tract and a fecal contaminant which can be picked up easily from toilet door handles. In a society of low hygiene, this probably explains its preponderance as a bacterial contaminant of surfaces. Its presence in this study could be attributed to fecal contamination and poor hygiene. Ithas also been associated with various opportunistic infections including food poisoning, urinary tract and nosocomial infections. Since microphone users constantly touch interfaces, there is every chance of introducing *Escherichia coli* onto the interface in use.

*Bacillus* spp and their presence in this present study could be linked to their ubiquitous nature with their spores able to resist environmental changes, withstand dry heat and certain chemical disinfectants for moderate period. This finding is in agreement with the findings of Datta *et al*. (2009), who reported a large number of *Bacillus* spp transferred from fingertips or hands touching inanimate surfaces.

*Candida albicans***,** the most common fungal isolate in this work, is an opportunistic pathogen that resides as a normal flora of the female genital area, mouth and other body sites. When the ratio of *Candida albicans* is higher than those of the bacteria co-existing in these sites, oral or virginal thrush occurs. Its presence on the microphones suggests their coming in contact with secretions from any of these sites or the skin of infected persons.

The pathogenicity of *Aspergillus flavus*is dependent on the host's immune status. When the host immunity is weak, the conidia thrive in the lungs, swell and germinate to producehyphae that have the tendency to invade pre-existing cavities of the lungs or blood vessels resulting in aspergillosis.

## CONCLUSION

The findings of this study showed that microphones used in churches in Calabar, especially the mouthpiece, carry potential pathogenic bacteria 41.3% and fungi 22.7%,hence, can aid in the spread of microbial infections/diseases between individuals and among groups at large. Therefore, cleaning and disinfecting of hands and microphones (mouthpiece and handle) will help in the removal and interruption of the growth of these organisms thus reducing the rate of contamination and disease transmission.

## CONFLICT OF INTEREST

None declared.

## REFERENCES


Adamu, J. Y., Jairus, Y. and Ameh, J. A. (2012). "Bacterial contaminants of Nigerian currency notes and associated risk factors". *Research Journal of Medical Sciences*,**6**(1)**:**1-6. DOI:10.3923/rjmsci.2012.1.6

Al-Ghamdi, A.K., Ashshi, S.M., Faidah, H.S., Shukri, H.A. and Jiman-Fatani, A.A. (2011). "Bacterial contamination of computer keyboards and mice, elevator buttons and shopping carts". *African Journal of Microbiology Research*,**5**(23):3998-4003. DOI: 10.5897/AJMR11.770

Ashgar, S. S. and El-Said, H. M. (2012). Pathogenic bacteria associated with different public environmental sites in Meca City. *Open Journal of Medical Microbiology*,**2**:133-137. DOI: 10.4236/ojmm.2012.24020

Catano, J. C., Echeverri, L. M. and Szela, C. (2012). Bacterial contamination of cloths and environmental items in a third level Hospital in Colombia. *Interdisciplinary Perspectives on Infectious Diseases*, **507640**:1-5. doi: 10.1155/2012/507640

Chandra, J., Sowndarya, A., Sirisha, I. and Sharma, Y. V. (2014). How Safe Ladies' Handbags are: A Microbiological View. *Biology and Medicine*,**6**(3):1-2. doi: 10.4172/0974-8369.1000212

Cheesbrough, M. (2009). District Laboratory Practice in Tropical Countries Part 2. Cambridge: Cambridge University Press, Pp.65-67.

Cole, A. M., Tahk, S., Oren, A., Yoshioka, D., Kim, Y. H., Park, A. and Ganz, T. (2001). Determinants of *Staphylococcus aureus* Nasal Carriage. *Clinical and DiagnosticLaboratoryImmunology*, **8**(6):1064-1069. DOI:10.1128/CDLI.8.6.1064-1069.2001

Datta, P., Rami, H., Chander, J. and Gupta, V. (2009). Bacterial contamination of mobile phones of healthcare workers.*Indian Journal of Medical Microbiology*,**27**(3):279-281. doi:10.4103/0255-0857.53222

Hamner, L., Dubbel, P., Capron, I., Ross, A., Jordan, A., Lee, J., Lynn, J., Ball, A., Narwal, S. Russell, S., Patrick, D. and Leibrand, H. (2020). High SARS-CoV-2 Attack Rate Following Exposure at a Choir Practice - Skagit County, Washington, March 2020. *Morbidity and Mortality Weekly Report*, **69**(19), 606–610. https://doi.org/10.15585/mmwr.mm6919e6

Itah, A. Y. and Ben, A. E. (2004). Incidence of enteric bacteria and *Staphylococcus aureus* in day care centers in Akwa Ibom State, Nigeria. *South EastAsian Journal of Tropical Medicine and Public Health*, **35**:202-209.

Kramer, A., Schwebke, I. and Kampf, G. (2006). How long do nosocomial pathogens persist on inanimate surfaces? A systematic review.*BMC Infectious Diseases*, **6**:130:1-8. https://doi.org/10.1186/1471-2334-6-130

Neff, J.H. and Rosenthal, S. L. (1957). A Possible Means of Inadvertent Transmission of infection to Dental Patients. *Journal of Dental Research*, **36**:932-934. DOI:10.1177/00220345570360061901

Oluduro, A.O., Ubani, E.K. and Ofoezie, I.E. (2011). Bacterial assessment of electronic hardware user interfaces in Ile-Ife, Nigeria. *Journal of Basic and Applied Sciences*. **32**(3):323-334.

Ottong, J.G., Ering, S.O. and Akpan, F.U. (2010). The population situation in Cross River State, Nigeria and its implications for socio-economic development: Observations from the 1991 & 2006 censuses. *Journal of Emerging Trends in Educational Research and Policy Studies*, **1**(1):36-42.

Rusin, P., Maxwell, S. and Gerba, C. (2002). Comparative surface-to-hand and fingertip-to-mouth transfer efficiency of gram-positive bacteria, gram-negative bacteria, and phage. *Journal of Applied Microbiology*, **93**(4):585–592. https://doi.org/10.1046/j.1365-2672.2002.01734.x

Subathra, P., Vijayan, D. S., Abirami, R. N., Kharsati, M., Soshang, G. and Das, D. K. (2020). Experimental investigation on concrete with marble dust and steel fiber. AIP Conference Proceedings, **2271**(1):030016. DOI: 10.1063/5.0024779.

Tagoe, D.N., Gyande, V.K. and Ansah, E.O. (2011). Bacterial Contamination of Mobile Phones: When Your Mobile Phone Could Transmit More Than Just a Call.*WebmedCentralMicrobiology*,**2** (10): WMC002294.

Zimmer, B. (2010). How should 'Microphone' be Abbreviated? The New York Times. Retrieved 10 June 2022.