



POSSIBLE ROUTES FOR BACTERIAL INFECTION; A CASE STUDY OF MOBILE PHONES OF SELECTED UNDERGRADUATE STUDENTS

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ABSTRACT

Different brands of mobile phones from undergraduate students were examined as a possible route of bacterial infections. The study reveals that the total plate count of analyzed android mobile phones was within the range of 3.2×10^7 - 1.92×10^7 where as that of button phones range from $1.1.2 \times 10^7$ - 2.24×10^7 . The result of morphological and biochemical characteristics of bacteria isolates from the samples shows that a total of three isolates were identified and they includes; *Staphylococcus auerus* and *Escherichia coli* and *Klebsiella pneumonia* with The result revealing that 50% of the isolates was *Eschericia coli* showing that it was frequently isolated from the phones closely followed by S.aureus that made up 44% of the isolates from the

mobile phones. The isolates were susceptible to majorly four out of the seven antibiotics used. The three isolates were susceptible to Vancomycin especially *K. pneumonia* that was 100% susceptible to vancomycin. This has indeed revealed the possibility of our personal item being a source of bacterial infection if not properly guarded.

KEYWORDS: Mobile phones, Contamination, Infectious disease transmission, Aerosol.

INTRODUCTION

Fomites, a non-living object such as tables, rails, bedding, towels, toys and barbed wire that can harbor disease-causing organisms (Free Dictionary, 2018). Mobile phones are Fomites,

inanimate objects which, when contaminated, can serve as a route to transfer pathogenic microorganisms from one person to another. These objects can become contaminated from person's hands, body fluids and secretions or respiratory droplets settling on their surfaces (Sehgal et al., 2020). For instance Fomites in hospital environment which involves different objects that normally comes in contact with the patient, such as toilet seats, door handles and shared equipment; other, less commonly mentioned objects include hair, clothing, bedding, and eating and drinking utensils. This means of transmission depends on the ability of the microorganism to survive outside the human body. Infection is known to spread through the following procedures; Escape from the host or primary reservoir of the infectious agent, and then it moves onto the new host, Entry to the new host, leaves from the new host (Rouse and sehrawat, 2010; Rencare, 2012). Different pathogens have different modes of transmission, either via respiratory pathogens which are usually airborne and intestinal pathogens are normally regularly consumed in water as well as food. The main routes of transmission are Person-to-person direct or indirect contact touch as observed in cold or flu and some communicable diseases, Air with infective spores of microorganism trapped in it which can be inhaled to cause diseases(Ryan and Ray, 2004). Microbes need nutrients to multiply so they can get into our food at any point, either from the raw material to finished product. Therefore a lot of caution must be taken in food production, **water** is equally another route of disease transmission. Insects are not left out here they can equally cause and transmit diseases. A study [Rencare, 2012], which investigated toilets, floors and high touch surfaces, reported that 15 out of 25 were contaminated and that the highest contamination was found on toilets (Weaver et al., 2022). They found viral RNA on surfaces in three out of five patient rooms, while no contamination was found on floors. Similar findings were obtained in another study [Brent et al., 2019] which sampled common room surfaces, toilets, and personal items. A total of 134 samples tested, 114 (85%) were found to be contaminated with SARS-CoV-2 RNA. These included floors under beds, bedside tables or bed rails, toilets, personal phones and remote controls. In one study [Robert and Fred, 2009], where samples were collected from high touch surfaces including bed rails, sinks, computer keyboards, clinical equipment, ward telephones and other surfaces, a total of 114/218 (52.3%) surfaces were found to be contaminated with SARS-CoV-2 RNA.

Transmission from fomites involves microbial deposition on surfaces that have been in contact with contaminated secretions from disease victims, this appears common and has been linked to many cases of transmission(Ananta et al., 2023) The infection usually moves

via contact with infected humans or animals or occasionally from environmental sources (e.g., soil). Fomites also can play a significant role whereby some diseases are more easily spread through fomites than others (Trent, 2005; Seventer and Hochberg 2016). However, several factors can be a pointer as whether bacteria on a fomite can successfully transmit to a human (Study blue 2016; Torgesen et al., 2015). These factors include: the type of bacteria or virus on the fomite, how much bacteria or virus can lead to infection, the temperature of the room, the humidity of the room, the porosity of the fomite. Sneezing and coughing can spread germs onto surfaces either through the droplets released from the sneeze or cough itself or through germs from the sneeze or cough getting onto the hands, which then come into contact with fomites (Torgesen et al., 2015).

Flushing the toilet can spread urine and fecal-associated pathogens through the air and onto other surfaces, including faucets, textiles such as towels or face cloths, or toothbrushes. Hand driers in public bathrooms can also spread pathogens through the air (NIH, 2019; Michelle et al., 2004). Transmission via the hands is the most common type of disease spread. It leads to other fomites being infected through direct contact, which is why hand washing is so important in the fight against the spread of infectious disease. It was only in the 1980s that the role of a person's environment and the objects or fomites within it was properly studied concerning the spread of disease. Practicing good hygiene such as washing hands after sneezing, coughing, or using the toilet, remains one of the most effective ways of reducing the risk of fomite transmitted diseases, as well as the use of appropriate disinfectants. As at the 1500s, fomites (or *fomes*) were first thought of as "seeds of disease," found in the clothing of infected individuals that spread contagious materials even in long distances by indirect human contact [Garcia, 2009]. Today, fomites are generally considered as any inanimate object that, when contaminated with infectious organisms, can serve as a means of transferring disease-causing agents to a new human host. Because people in industrialized countries spend approximately 90% of their time indoors [Margret et al., 2002], the most important fomites for contamination and transmission tend to be those found in the built environment and those that humans frequently come into direct contact with, such as doorknobs, countertops, medical equipment, handrails, clothing, and mobile phones. As our understanding of microbes in the built environment has greatly expanded in the last decade, so has our understanding of fomites and their role in the transmission of infectious agents and other microbial matter to and from humans. Inanimate objects which become contaminated with pathogenic bacteria and then spread infection to others are often referred to as fomites.

Most outbreaks of infection associated with inanimate objects are caused by items like mobile phones, that should be sterile but have been contaminated [Philip *et al.*, 2017].

In another related study [Ananta *et al.*, 2023] in trying to assess the relationship between organism on environmental surface and nosocomial infection, they virtually ruled out the environment as a significant vector for nosocomial infections. Although it has always been acknowledged that bacterial pathogens in fomites could be a possible risk factor in nosocomial infection, there is no study to confirm the presence of such pathogens in this locality. In another study carried out in Kano state, Nigeria, weekly before surgery for 30 weeks at the Murtala Mohammed Specialist Hospital MMSH, Kano between January and August 2009. Exactly 1,620 samples were collected from 27 sources in the three operating rooms namely; Operating Lamp (OPL), Floor (FL), Wall (WL), Sink (SK), Suction tube (ST), Forceps (FC), Scissors (SC), Trolley (TR) and Anesthetic machine (ANM), one hundred and eighty (180) samples were obtained from three operation beds by sweep plate method. The theatre rooms screened were Main, Gynecology and Maternity. A lot of discoveries were made that further buttresses the possibility of fomites being a route of transmission where they harbor numerous infectious materials.

MATERIAL AND METHODS

Materials

Equipment and instruments

The following equipment/instrument were used: forceps, wire loop, Bunsen burner, autoclave (Olympic), oven, incubator, weighing balance, spatula, masking tape, cotton wool, nose mask, syringe, hand glove and aluminum foil. The following glass wares were used in this study: pipette, petri dish, beakers, conical flasks, slides, test tubes, glass rod, measuring cylinder.

Chemicals and Reagents

The following reagents and chemicals that were used in this study includes: sterile water, Dimethyl Sulphur Oxide, normal saline.

Media

The following media were used for this research work., Nutrient broth, Nutrient agar and Muller Hinton agar, Eosin methylene Blue agar, mannitol salt, Macconkey agar, salmonella-

shigella agar. All media were prepared aseptically according to the manufacturers' instruction.

Antibiotics

The following antibiotics were used, Oxacillin, Amikacin, Imipenem, Erythromycin, Vancomycin, Ciprofloxacin, Gentamicin.

Study Area

The study area is Abakaliki town in Ebonyi State located in south eastern part of Nigeria. It is located at 64 kilometers southeast of Enugu. Abakaliki is situated on latitude 6⁰20'N and longitude 8⁰06E.

Sample Collection

Exactly 20 different brands of mobile phones used by undergraduate students (being active users of mobile phones) were collected and examined for this research work. The swabs from the samples were transported to the microbiology laboratory of EBSU, Abakaliki where they were analyzed following standard techniques in Microbiology (Anie et al., 2017).

Analysis of Samples

Sterile cotton wool swab sticks were prepared by making the cotton wool end wet with physiological saline. These were used to swab various parts of the mobile phones (AOAC, 1995).

Determination of Plate Count

Standard plate count method proposed by AOAC, (2004) was used to determine the total aerobic colony count of the samples. Only plates with moderate growth were counted. The average microbial loads of the samples obtained from the different samples were expressed as colony forming units per Milliliter (Cfu/ml).

Isolation and Identification of Bacteria Isolated from mobile phone Samples

Mac Conkey agar, Eosin methylene Blue agar, mannitol salt and salmonella – shigella agar were employed for the isolation of bacteria for the purpose of identification. Mac Conkey agar was used to isolate lactose fermenting gram negative bacteria, Eosin methylene Blue agar was used for the selective isolation of enteric coliforms, mannitol salt agar was used for the selective isolation of salt-tolerant bacteria and salmonella – shigella agar was used for the isolation of enteric bacilli particularly *Salmonella* and *Shigella* species. All plates were

incubated at 37⁰C for 24 hours. Identification of bacteria isolates was based on the standard culture, morphological and biochemical methods (CLSI, 2015).

RESULTS

The total plate count of the analyzed android mobile phones was within the range of 3.2×10^5 to $1.1.2 \times 10^5$ with RD phone having the highest bacterial count of 112. This result is as shown in Table 1 below.

Table 1: Total Bacterial count of isolates from mobile phones.

Sample code	Bacterial count	Colony forming unit
TC	16	3.2×10^5
IN	48	9.6×10^5
IP	56	1.12×10^5
IT	104	2.08×10^5
TS1	80	1.6×10^5
TS2	56	1.12×10^5
IN5	68	1.12×10^5
RD	112	2.24×10^5
SM	88	1.76×10^5
NT	92	1.84×10^5
IPX	96	1.92×10^5
IPX2	18	3.6×10^4
IPX3	56	1.12×10^5
1P13	101	2.02×10^5
1P132	85	1.7×10^5
IP11	72	1.44×10^5
TC2	107	2.14×10^5
TC3	69	1.38×10^5
RD	29	5.8×10^5
RD3	53	1.06×10^5

The result equally revealed that 50% of the isolates was *Eschericia coli* showing that it was frequently isolated from the phones. This is closely followed by *S. aureus* with 44%, this result is as shown in Table 2 below.

Table 2: Percentage Frequency Distribution Of Isolates.

S/No	ISOLATES FROM MOBILE PHONES	PERCENTAGE DISTRIBUTION
1	<i>S. aureus</i>	8(44)
2	<i>Klebsiella pneumonia</i>	1(6)
3	<i>Eschericia coli</i>	9(50)
	TOTAL : 18	

The percentage susceptibility of isolates against different antibiotics is as shown below in Table 3. The isolates were susceptible to majorly four out of the seven antibiotics used. The three isolates were susceptible to vancomycin especially *K. pneumonia* that was 100% susceptible to vancomycin.

Table 3: Percentage Susceptibility Of Isolates Against Different Antibiotics.

Sample isolates	Nos of isolates	OX	IM	VA	CIP	AK	CN	E
<i>S. aureus</i>	8	0	0	3(37.5)	5(62.5)	0	0	0
<i>E. coli</i>	9	0	0	2(22.2)	2(22.2)	0	2(22.2)	3(33.3)
<i>K. Pneumoniae</i>	1	0	0	100	0	0	0	0

OX= Oxacillin; IM= imipenem; VA= vancomycin; CIP= ciprofloxacin; AK= Amikacin; CN= gentamicin; E= erythromycin

DISCUSSION

This review summarizes our understanding of fomite (mobile phones) contamination and possible risk of associated human health risks in the environment from fomites. A total of 20 mobile phones were swabbed aseptically and all had visible growths after incubation. A total of three bacteria genera were observed.

Different brands of mobile phones from undergraduate students were examined as a possible route of bacterial infections. The study reveals that the total aerobic plate count of analyzed android mobile phones was within the range of 3.2×10^7 to $1.1.2 \times 10^7$. The result of morphological and biochemical characteristics of bacteria isolates from the samples shows that a total of four isolates were identified and they includes; *Staphylococcus auerus*, and *Escherichia coli*. *Klebsiella pneumonia* with *Staphylococcus aureus* being most frequently isolated bacteria. This result is in line with the findings of Tong et al., (2015) that isolated a total of eight bacteria genera and four fungal species were observed. The following bacterial pathogens were isolated; *Escherichia coli*, *Proteus Mirabilis*, *Proteus vulgaris*, *Pseudomonas aeruginosa*, *Staphylococcus aureus*, *Streptococcus spp*, *E. faecalis*, Coagulase negative staph and *Salmonella choleraesius*. The percentage susceptibility of isolates against different antibiotics shows that the isolates were susceptible to majorly four(erythromycin, vancomycin, ciprofloxacin and gentamicin) out of the seven antibiotics used. The three isolates were susceptible to mostly vancomycin especially *K. pneumonia* that was 100% susceptible to vancomycin. This result was equally in line with Brent et al., (2019) that used similar antibiotics on the isolates from different type of fomite which revealed the antibiotic

sensitivity pattern of bacterial pathogens isolated from fomites in the operating room theatre. The quinolone (Ofloxacin) and the cephalosporin (Ceftriaxone) showed encouraging results. The tetracycline and cotrimoxazole show no sensitivity against the bacterial organism. The result equally revealed that 50% of the isolates were *Eschericia coli* showing that it was frequently isolated from the phones. This is closely followed by *S. aureus* with 44%, this might be due to unhygienic practices of some students that can lead to high percentage of *Eschericia coli* from the phone samples. This result was in line with Brent et al., (2019). That reported that out of 900 samples screened for bacteria, 210(23.3%) yielded growth, while 120(57.1%) were recognized clinical pathogens.

CONCLUSION

Fomites should be regarded as a possible source of nosocomial infection since bacteria from them can be carried from the hands of handlers to the unsuspecting individuals within their contacts.

REFERENCE

1. Ananta Khurana, Kimberlin David Aastha Agarwal(2023). In Principles and Practice of Pediatric Infectious Diseases (Sixth Edition), Elsevier Inc, Pp 8-21.
2. Association of Official Analytical Chemists (AOAC), (2004). Official methods of analysis of the association, 7(8): 31-33.
3. Brent Stephens, Parham Azimi, Megan S. Thoemmes, Mohammad Heidarinejad, Joseph G. Allen, and Jack A. Gilbert (2019) microbial Exchange via Fomites and Implications for Human Health, 198-213.
4. Clinical and Laboratory Standard Institute (CLSI), (2015). Performance standards for antimicrobial disk susceptibility tests; Approved standard- 12th ed CLSI document M02-A12. Wayne, PA: Clinical and Laboratory Standards Institute, Pp 31-37.
5. García-Sastre A (2009). In Encyclopedia of Microbiology (Third Edition), Academic press, Pp 312-321.
6. Margaret L. Delano, Scott A Mischler., Wendy J. Underwood, (2002). In Laboratory Animal Medicine (Second Edition), Pp198-199.
7. Michelle R Salvaggio MD, John W Baddley MD (2004). In Dermatologic Clinics, 22(3): 291-302.

8. National Institutes of Health. (2019). Current Pollution Reports, 5(4): 198–213. Published online, 2019 Aug 31. doi: 10.1007/s40726-019-00123-6 PMID: PMC7149182 PMID: 34171005.
9. Philip Lawrence, Danet N., Reynard V., Viktor Volchkov (2017). In Current Opinion in Virology. science direct, 22: 51-58.
10. Rencare "Infection". Archived from the original on March 5, 2012. Retrieved 4 July 2013.
11. Robert N. Golden, and Fred Peterson (2009). The Truth About Illness and Disease. Infobase Publishing. p. 181. ISBN 978-1438126371.
12. Rouse BT, Sehrawat S (2010). "Immunity and immunopathology to viruses: what decides the outcome?". Nature Reviews Immunology, 10(7): 514–526. doi:10.1038/nri2802. ISSN 1474-1741. PMC 3899649. PMID 20577268.
13. Ryan KJ, Ray CG, eds. (2004). Sherris Medical Microbiology (4th ed.). McGraw Hill. ISBN 978-0-8385-8529-0.
14. Sehgal M, Ladd HJ, Totapally B (2020). "Trends in Epidemiology and Microbiology of Severe Sepsis and Septic Shock in Children". Hospital Pediatrics, 10(12): 1021–1030. doi:10.1542/hpeds.2020-0174. ISSN 2154-1663. PMID 33208389. S2CID 227067133. Archived from the original on 2021-04-13. Retrieved 2021-03-26.
15. Seventer JM, Hochberg NS (2016). "Principles of Infectious Diseases: Transmission, Diagnosis, Prevention, and Control". International Encyclopedia of Public Health: 22–39. doi:10.1016/B978-0-12-803678-5.00516-6. ISBN 9780128037089. PMC 7150340.
16. StudyBlue. St. Louis(2016). "Bacterial Pathogenesis at Washington University". . Archived from the original on 2016-12-03. Retrieved 2016-12-02.
17. The Free Dictionary (2018) "infection". Archived from the original on 2018-07-19, retrieved 2023-11-17.
18. Tong SY, Davis JS, Eichenberger E, Holland TL, Fowler VG (2015). "Staphylococcus aureus Infections: Epidemiology, Pathophysiology, Clinical Manifestations, and Management". Clinical Microbiology Reviews, 28(3): 603–661. doi:10.1128/CMR.00134-14. ISSN 0893-8512. PMC 4451395. PMID 26016486.
19. The Free Dictionary (2022). Antiprotozoal Drugs. Retrieved 2022-04-22.
20. Torgerson PR, Devleeschauwer B, Praet N, Speybroeck N, Willingham AL, Kasuga F, Rokni MB, Zhou XN, Fèvre EM, Sripa B, Gargouri N (2015). "World Health Organization Estimates of the Global and Regional Disease Burden of 11 Foodborne Parasitic Diseases, A Data Synthesis". PLOS Medicine, 12(12):

e1001920. doi:10.1371/journal.pmed.1001920. ISSN 1549-1277. PMC 4668834. PMID 26633705.

21. Trent RJ (2005). "Infectious Diseases". *Molecular Medicine*: 193–220. doi:10.1016/B978-012699057-7/50008-. ISBN 9780126990577. PMC 7149788.
22. Vazquez-Pertejo MT (2022). "Diagnosis of Infectious Disease - Infections". Merck Manuals Consumer Version. Archived from the original on 2024-01-02.
23. Weaver JS, Omar IM, Mar WA, Klauser AS, Winegar BA, Mlady GW, McCurdy WE, Taljanovic MS (2022). "Magnetic resonance imaging of musculoskeletal infections". *Polish Journal of Radiology*, 87: e141–e162. doi:10.5114/pjr.2022.113825. ISSN 1733-134X. PMC 9047866. PMID 35505859.