Bacterial Contamination of Mobile Phones: When Your Mobile Phone Could Transmit More Than Just a Call

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**Article ID:** WMC002294
**Article Type:** Research articles
**Submitted on:** 04-Oct-2011, 03:10:51 PM GMT   **Published on:** 05-Oct-2011, 12:46:57 PM GMT
**Article URL:** [http://www.webmedcentral.com/article_view/2294](http://www.webmedcentral.com/article_view/2294)
**Subject Categories:** MICROBIOLOGY
**Keywords:** Contamination, Bacillus species, Coagulase Negative Staphylococci, Mobile Phone, Gentamicin, Ampicillin

**How to cite the article:** Tagoe D N, Gyande V K, Ansah E O. Bacterial Contamination of Mobile Phones: When Your Mobile Phone Could Transmit More Than Just a Call. WebmedCentral MICROBIOLOGY 2011;2(10):WMC002294

**Source(s) of Funding:**
None

**Competing Interests:**
None
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Abstract

Background: Mobile phones have become one of the most indispensable accessories of professional and social life. However, several researches have indicated the potential colonization of surfaces and their ability to transmit diseases (fomites) of which the mobile phone is no exception. Thus this present study investigates bacterial contamination of mobile phones and their antibiotic susceptibility patterns.

Methodology: Surfaces of 100 mobile phones of randomly selected university students were aseptically swabbed. Serial dilution was used in quantification of bacterial with blood and MacConkey agars used in bacterial isolation. Gram reaction and biochemical reactions were applied in identification and the Kirby Buaer method employed in Antibiotic Sensitivity Testing.

Results: There was 100% contamination of all the mobile phones surfaces with a mean bacterial count of 9.915x10^7cfu/ml with a total of 11 bacteria spp. isolated. The higher isolates include Bacillus cereus (23%) and Proteus mirabilis (19%), whilst the least isolate were Salmonella spp. (3%) and Shigella. spp. (2%). Pathogenic isolates made up 81.8% of all isolates 18.2%. Salmonella spp. and Shigella spp. showed the most resistance to the antibiotics (87.5%) each whilst Escherichia coli was the most susceptible bacteria to the antibiotics (75%). Amikacin (71.4%) and Gentamicin (63.6%) were the most effective antibiotics whilst Ampicillin, Penicillin, Cloxacillin showed the least effectiveness with 100% bacteria resistance.

Conclusion: Thus mobile phones can be heavily colonized by high quantities of pathogenic bacteria and thus potential sources of disease transmission requiring application of sound personal hygiene as preventive methods.

Introduction

The global system for mobile telecommunication (GSM) was established in 1982 in Europe with a view of providing and improving communication network.
Materials and Methods

Study Area and Design: The study was conducted on the campus of University of Cape Coast where mobile phones were randomly sampled from students between December, 2010 to May, 2011.

Sampling: A total of 100 mobile phones were randomly sampled from students both in the halls as well as in the faculties aseptically swabbing the entire phone using a dry sterile cotton.

Laboratory Methods and Procedures:

Laboratory analysis were undertaken in the laboratories of the Department of Laboratory Technology of the University, Cape Coast, Ghana.

Inoculation: The cotton end was cut off and soaked in 10ml peptone water and incubated aerobically overnight at 37°C.

Quantification of Bacteria: Serial dilutions from the resulting growth from the peptone water medium were pour-plated on count agar (PCA) and incubated for 24hrs at 37°C under aerobic condition. The number of estimated Colony Forming Units (CFU) for each sample was then counted using the Quebec colony counter (Reichert, USA).

Isolation of Organisms: All pure isolated colonies were sub-cultured onto blood agar plates (for growth of heterotrophic bacteria) and MacConkey agar plates (for coliforms) for 24hrs at 37°C for colony isolation and morphological identification.

Identification of Organisms: Pure isolated colonies were Gram differentiated and then biochemically identified using Indole, Catalase, Citrate, Oxidase, Coagulase, and Urease test.

Antibiotic Susceptibility Test (AST): Antibiotic susceptibility were determined by the agar diffusion technique on Mueller-Hinton agar (Kirby-Bauer NCCLS modified disc diffusion technique) using 8 antibiotic discs (Biotec Lab. UK) corresponding to the drugs most commonly used in the treatment of human and animal infections caused by bacteria; Ampicillin (Amp) (10?g), Tetracycline (Tet) (10?g), Gentamicin (Gen) (10?g), Cotrimoxazole (Cot) (25?g), Cefuroxime (Crx) (30?g), Cefixime (Cxm) (30?g), Cefotaxime (Ctx) (30?g), Penicillin (Pen) (10IU), Cloxacillin (Cxc) (5?g), and Erythromycin (Ery) (5?g), Amikacin (Amk) (30?g).

Statistical Analysis: Data from this study was analyzed descriptively using Minitab 15 software. One-way analysis of variance (ANOVA) was used to determine significant difference where (P?0.05) is significant and (P>0.05) is not significant.

Results

All 100 mobile phones sampled were contaminated with varied numbers of bacteria (Mean 9.915×105 CFU/phone). Nine (9%) had a single bacteria contamination whilst 65% had >3 bacterial contamination (Figure I). Bacteria isolates include Klebsiella pneumonia (10%), Citrobacter spp. (2%), Staphylococcus aureus (4%), Coagulase Negative Staphylococci (CNS) (15%), Pseudomonas aeruginosa (4%), Salmonella spp. (3%), Shigella spp. (2%), Proteus mirabilis (19%), Escherichia coli (8%), Bacillus cereus (23%), Streptococcus pneumonia (10%), Salmonella spp. (3%) and Shigella spp. (2%) with Bacillus cereus being the highest (23%) followed by Proteus mirabilis (19%), Coagulase Negative Staphylococci (15%). The least organisms sampled were Citrobacter spp. and Shigella spp. (2%) (Figure II). Antimicrobial susceptibility testing showed that isolated bacteria were 100% resistant to Ampicillin, Penicillin, Cloxacillin and Cefuroxime whilst the more effective antibiotics include Gentamicin (27.3%), Cotrimoxazole (27.3%), and Amikacin (14.3%) resistance (Figure III).

Discussions

Mobile phones due to their personal nature and proximity to sensitive part of our bodies in usage such as faces, ears, lips and hands of users could become veritable reservoirs of pathogens that could result in infections.

Results from this study showed high levels of bacterial contamination of mobile phones used by students in the University of Cape Coast with an overall mean viable bacteria count of 9.915×105 CFU/phone. This conforms work by [2] who found that One-fifth of the cellular telephones examined in New York harbour pathogenic microorganisms. Depending on environmental conditions, pathogens may remain infectious on surfaces for weeks after being contaminated. In humid conditions, pathogens may actively colonize surfaces, transforming a passive reservoir into an active one. Furthermore, formation of biofilm by one bacterial agent can affect the survival of other pathogens on the same surface [7]. In general; the greater the concentration of the microbe, the longer it survives and survival can range from minutes to months. This is a cause for concern since these pathogenic isolates are capable of causing diseases in anyone who gets contaminated whilst using the mobile phone.
Bacteria isolates include Bacillus cereus (23.0%), which was the dominant isolate, followed by Proteus mirabilis (19.0%), Coagulase Negative Staphylococci (15.0%), Klebsiella pneumoniae (10.0%), Streptococcus pneumoniae (10.0%), Escherichia coli (8.0%), Pseudomonas aeruginosa (4.0%) and Salmonella spp (3.0%), Shigella spp (2.0%) and Citrobacter spp (2.0%). The broad spectra of bacteria isolated here is indicative of the potential of the mobile phone to act as a fomite, which is similar to other fomites such as paper currency, which has been extensively researched on [8,9,10,11]. The frequent handling of both the mobile phone and the money makes for easy transfer of bacterial and thus cross contamination. The high isolation of Bacillus cereus confirms the ubiquitous nature of the Bacillus spp. giving it greater colonization ability as well as the ability of its spores to resist environmental changes, withstand dry heat and certain chemical disinfectants for moderate periods [12]. The presence of E. coli and Salmonella spp. suggests faecal contamination of these phones, which can result in community-acquired infections and disease outbreaks.

Antibiotic Susceptibility Testing (AST) indicates marked resistances of bacterial isolates to commonly used antibiotics such that only 41.67% of the tested antibiotics had susceptibility 50% or less. As much as 33.33% of the antibiotics i.e. Ampicillin, Penicillin, Cloxacillin and Cefuroxime were 100% infective on the isolated bacteria. These findings were similar to resistant pattern of bacterial isolates in sachet water sold in the streets of Cape Coast [13]. Resistances (100%) of isolates to Ampicillin, Cloxacillin, Penicillin and Cefuroxime commonly used antibiotics have been observed in previous studies presenting a public health problem [13,14]. The observed high antibiotic resistances could be attributed to the abuse of antibiotics as observed in a study in Cape Coast on antibiotic use which showed that majority of the populace sampled purchases antibiotics in the open market without any medical prescription and use them for the wrong diseases and infections [15].

Conclusions

All sampled mobile phones were highly contaminated with various types of bacteria with high resistances to commonly used antibiotics. This suggests the potential of the mobile phone as a fomite, which can result in community-acquired infections with possible public health implications. Periodic cleaning of mobile phones with disinfectants or hand cleaning detergents as well as frequent hand-washing should be encouraged as a means of curtailing any potential disease transmission.

Acknowledgement

The authors acknowledge the profound contributions of Mr. Emmanuel Birikornag and Mr. Yarquah (Laboratory Assistants) of the Department of Laboratory Technology, University of Cape Coast, Ghana in setting up the laboratory for this research work.

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Illustrations

Illustration 1

Figure I: A Chart showing the percentage of phones with different Bacteria colonies
Illustration 2

Figure II: A Graph showing the Percentage of Phones colonized by the isolated Bacteria
Illustration 3

Figure III: A graph showing the Antibiotic Resistance Pattern of the Isolated Bacteria
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