Original Article

Isolation and identification of microbes associated with mobile phones in Dammam in eastern Saudi Arabia

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ABSTRACT

Objective: This study was conducted to determine microbial contamination of mobile phones in the city of Dammam, in the eastern region of Saudi Arabia, and identify the most important microbial species associated with these phones in order to take the necessary remedial measures. **Materials and Methods:** The analysis of a total of 202 samples was done to identify fungal and pathogenic bacteria isolates. Sterile swabs were firmly passed on the handset, the buttons and the screens of mobile phones, then inoculated into media of bacteria and fungi. Frequency distribution of isolates were calculated. **Results:** There were 737 isolated of the following bacteria: *Staphylococcus aureus, Staphylococcus epidermidis, Pseudomonas aeruginosa, Neisseria sicca, Micrococcus luteus, Proteus mirabilis, Bacillus subtilis,* and *Enterobacter aerogenes* at the rate of 56.58, 13.57, 8.01, 7.73, 6.51, 3.66, 2.85 and 1.09% respectively. There were fungal isolates as follows: *Alternaria alternata, Aspergillus niger, Cladosporium sp., Penicillium spp., Aspergillus flavus, Aspergillus fumigatus, Rhizopus stolonifer, Aspergillus ochraceus* at the rate of 29.07, 26.74, 20.93, 10.47, 6.98, 2.33, 2.33, 1.16%, respectively. **Conclusions:** The study showed that all mobile phones under consideration were infected by several microbes, most of which belonged to the natural flora of the human body as well as airborne fungi and soil. This means that it is necessary to sterilize hands after contact with a phone since it is a source of disease transmission.

Key words: Microbial of mobile phones, pathogenic bacteria, *Pseudomonas, Staphylococcus*

INTRODUCTION

A mobile or cellular telephone is a long-range, portable electronic device for personal telecommunication. The vast majority of mobile phones are hand-held. In less than 20 years, mobile phones have gone from being rare and expensive pieces of equipment used primarily by the business elite, to a common low-cost personal item. In many countries, mobile phones outnumber landline telephones since most adults and many children now own mobile phones. At present, Asia has the fastest growth rate of cellular phone subscribers in the world.

Because of the achievements and benefits of the mobile phone, it is easy to overlook its hazard to health; this is against the background that many users may have no regard for personal hygiene, and the number of people who may use the same phone. This constant handling of the phone by different users exposes it to an array of microorganisms, and makes it a good carrier for microbes, especially those associated with the skin

resulting in the spread of different microorganisms from user to user. Our research has shown that the mobile phone could be a health hazard with tens of thousands of microbes living on each square inch of the phone.[1] Microbiologists say that the combination of constant handling with the heat generated by the phones creates a prime breeding ground for many microorganisms that are normally found on the skin. Staphylococci, particularly *S. epidermidis* are members of the normal flora of the human skin, respiratory and gastrointestinal tracts. Nasal carriage of *S. aureus* occurs in 20-50% of human beings. Staphylococci are also found regularly on clothes, bed linen, and other human environments.[2] *Staphylococcus aureus,* a common bacterium found on the skin and in the noses of up to 25% of healthy people and animals can cause illnesses from pimples and boils to pneumonia and meningitis, and is a close relative of methicillin Resistant *Staphylococcus aureus* (MRSA). The main reservoir of *S. aureus* is the hand from where it is introduced into food during preparation.[3] The hand serves as a major vehicle of transmission of various

microbes including the enteric species.[4] *Proteus mirabilis* is one of the most common Gram-negative pathogens encountered in clinical specimens. It can cause a variety of community- or hospital-acquired infections, including those of the urinary tract, respiratory tract, wounds and burns, bacteraemia, neonatal meningoencephalitis, empyema and osteomyelitis.[5] After *Escherichia coli*, *P. mirabilis* is the member of the Enterobacteriaceae most often isolated in European clinical microbiology laboratories,[6] accounting for ∼3% of nosocomial infections in the United States.[7] *Pseudomonas aeruginosa* is a metabolically versatile γ-Proteobacterium, which inhabits terrestrial, aquatic, animal-, human-, and plant-host-associated environments.[8]

Our study aimed at investigating bacterial contamination of the mobile phone to identify the microbes regularly associated with mobile phones and their pathogenicity. Suggestions for the improvement of handling are proposed.

MATERIALS AND METHODS

The samples were collected from the mobile phones of 202 devices during a three-week period from December 20, 2008 and January 11, 2009 in Dammam city, Eastern Saudi Arabia with sterile cotton swab sticks. Each swab was immediately streaked on three plates of Nutrient agar and Sabouraud Dextrose agar, and Glucose yeast agar. The plates were incubated at 34-37°C for 48 hours and observed for growth and colonial description of the isolates.

Characterization and identification of isolates

Morphological description of colonies, gram stain,[1,8] mobility tests and identification keys[9,10] were used for bacterial identification.

Biochemical reactions

Physiological and biochemical reactions of each bacterial isolate were verified using the standard kits API identification system (Biomerieux, Marcy L'etoil, France) for the identification of both gram positive and negative bacteria.

RESULTS AND DISCUSSIONS

Microbiological standards in hygiene are necessary for a healthy life. It is not uncommon, however, to observe practices that deviate from normal standards of hygiene in both the developing and the developed world. This investigation confirms such a deviation, as a variety of microbes were found on mobile phones.

The research findings indicate that *Staphylococcus aureus,*

Table 1: Bacteria isolated from mobile pohones in Dammam

Bacterial isolates	No. (%)
Staphylococcus aureus	417 (56.6)
Staphylococcus epidermidis	100 (13.6)
Pseudomonas aeruginosa	59 (8.0)
Neisseria sicca	57 (7.7)
Micrococcus luteus	48 (6.5)
Proteus mirabilis	27 (3.7)
Bacillus subtilis	21 (2.9)
Enterobacter aerogenes	8 (1.1)

Staphylococcus epidermidis, Pseudomonas aeruginosa, *Neisseria sicca*, *Micrococcus luteus*, *Proteus mirabilis, Bacillus subtilis* and *Enterobacter aerogenes* are the main bacterial isolates frequently associated with mobile phones as shown in Table 1. These organisms may probably have found their way into the phone through the skin and from hand to hand. This is because the isolated bacteria are a subset of the normal microbiota of the skin as advanced by earlier researchers.[11] Frequent handling by many users with different hygiene profiles producing regular skin contact with the phones may have resulted in the frequency and the degree of population of the isolates. This has many health implications. *Staphylococcus aureus* is known to cause illnesses ranging from pimples and boils to pneumonia and meningitis, a scenario supported by the high population of colony isolates.

The presence of the gram-negative rod, *Enterobacter aerogenes,* a member of the coliforms, indicates the possibility of the presence of faecal contamination on the mobile phone. Gram-negative sepsis is most commonly caused by *E coli, Klebsiella* spp, *Enterobacter* spp and *Pseudomonas aeruginosa*.[12] It has also been advanced that the endotoxin or lipopolysaccharide (LPS) produced by members of this group has been implicated as a primary initiator of the pathogenesis of septic shock. *Bacillus subtilis* with a 100% frequency of occurrence has been identified as an important organism in food spoilage.[13] This undoubtedly contributes a great deal to food spoilage and the contamination of food if food is prepared or eaten with infected hands.

Alternaria alternata (29.07%), *Aspergillus Niger* (26.74%), *Cladosporium sp* (20.93%)*, Penicillium spp.* (10.47%), *Aspergillus flavus* (6.98%), Rhizopus *stolonifer* and *Aspergillus fumigates* (2.33%) were isolated and tabulated in Table 2 based on mycelia, colour and spores. These isolates can significantly influence food spoilage and food infection through the production of toxins.

The overall implication of these results is that mobile phones which make communication easy and accessible

Table 2: Fungi isolated from mobile phones in Dammam	
Fungal isolates	No. (%)
Alternaria alternata	25 (29.1)
Aspergillus niger	23 (26.7)
Cladosporium sp.	18 (20.9)
Penicillium spp.	9 (10.5)
Aspergillus flavus	6 (7.0)
Rhizopus stolonifer	2 (2.3)
Aspergillus fumigatus	2 (2.3)
Aspergillus ochraceus	1 (1.2)

also form good carriers of pathogenic agents of disease transmission. If care is not taken, they could be vehicles for the transmission of biological weapons.

Karabay *et al*[14] reported that mobile phones may get contaminated with such bacteria as *Escherichia coli*, *Pseudomonas aeruginosa* and *Klebsiella pneumoniae*, which cause hospital infections, and may serve as a vehicle for the spread of nosocomial pathogens. Users of mobile phones are found everywhere: in the market, the home, hospitals, and schools. They could therefore, be the cause of the spread of the infection in the community. Our results indicate that isolates were associated with various strata of society. Today, mobile phones are important equipment for physicians and other health workers. Since restrictions on the use of mobile phones by HP is not a practical solution, many researchers suggest that adherence to such infection control precautions as hand hygiene should be strict. In addition, people should be informed that these devices may be a source for transmission of hospital-acquired infections to and from the community. Further studies for the possible means of decontamination of mobile phones, such as the use of alcohol and/or disinfection tissues, should be found and employed in hospitals that have large bed capacities and Intensive Care Units. The hospital environment plays a critical role in the transmission of organisms associated with nosocomial infections. Micro-organisms can be transferred from person to person or from inanimate objects (such as stethoscopes, bronchoscopes, pagers, ballpoint pens, hospital charts, computer keyboards, mobile phones and fixed telephones) to hands and vice versa.[15-18]

Karabay *et al* (2007)[14] found that most of the organisms isolated were skin flora. However, 16.7% of the samples were positive for pathogens known to be associated with nosocomial transmission, such as *Enterococci* spp, *S. aureus* and *K. pneumonia*. Vancomycin-Resistant Enterococci (VRE) and Methicillin-Resistant *S. aureus* (MRSA) were not isolated. Other investigators reported that telephones, intercoms, dictaphones and bedpan flusher handles may be contaminated with potentially pathogenic bacteria.[17,19-21] Jeske *et al*[22] also reported that bacterial contamination of

anesthetists' hands by personal mobile phones occurred, (38/40 physicians, 4/40 with human pathogen bacteria) in the operating theatre. The use of mobile phones by HCWs in the Intensive Care Unit, burn wards and operative rooms may have more serious hygiene consequences, because unlike fixed phones, mobile phones are often used close to patients. Intensive Care Unit patients and burn patients are very vulnerable to infectious diseases, so the risk of transmission of organisms associated with nosocomial infections is increased.[21-23] More than half of the British population own mobile phones, and increasing technological applications have led to increased use of these devices to provide better communication between healthcare workers (HCWs) and patients.[24] Innovations in mobile communication have led to better patient control of diseases; however, the increased use of mobile phones is seen against a background rise in the rate of nosocomial infections.[17,18]

Since the restriction of the use of mobile phones by HCWs is not effective for the prevention of the spread of nosocomial infections it is necessary to develop effective preventive strategies that will include environmental decontamination, hand hygiene, surveillance, and contact isolation for the prevention of these nosocomial infections. [25,26] Simple cleaning of computers and telephones with 70% isopropyl alcohol may decrease the bacterial load.[26,27]

Control measures are quite simple and can include engineering modifications, such as the use of hands-free mobile phones, surfaces that are easy to clean and disinfect, hand washing, and the wearing of gloves by the appropriate personnel.[20,27] In general, resident infection control staff of the medical facility can advise on the routine control practices for medical devices. Observance of these simple control procedures can decrease morbidity and mortality and thereby reduce medical care costs for hospitals and other care providers.[27]

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