

## Is Cellular Phone a Source of Infection?—A Hospital Based Study among Dentists in Ajman and Sharjah, UAE.

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## Research Article

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**ABSTRACT**

This study was carried out to know the different micro-organisms harboring the cell phones of health care persons working in the dental centre of our hospital and to determine what are the potential pathogenic organisms transmitted via mobile phones. An interviewer-administered questionnaire was used for data collection. Two samples were collected by rotating the swabs over all the surfaces of cell phones; one without any sterilization and second sample after decontaminating the cell phone using isopropyl alcohol in the morning. The swabs were inoculated and streaked onto five per cent sheep blood agar, Mac-Conkey agar and chocolate agar. Isolated organisms were processed according to colony morphology and gram stain. Tests for identification of gram positive cocci included catalase, Oxidative/ Fermentative test, anaerobic mannitol fermentation and coagulase production. Tests for identification of gram negative bacilli included catalase, oxidase and other relevant biochemical tests (API 20E). In the samples taken without prior decontamination, 40% of the samples did not show any growth. Staphylococcus species dominated the growth in the remaining specimens. Gram positive bacilli, Pantoe species and Enterobacter Cloacae were also found. In the samples taken with prior decontamination at the beginning of the day, 36% of the samples did not show any growth. Staphylococcus species dominated the growth in the remaining specimens. Gram positive bacilli, Micrococci and Citrobacter Freundii were also found. Since dental aerosols are proven risk factor; any method of reducing aerosols and airborne contamination should be employed along with regular decontamination of cell phones.

**INTRODUCTION**

A mobile or cellular phone is a long-range, electronic device for personal telecommunications which can be carried easily. Mobile phones are no longer rare and expensive pieces of equipment used primarily by the elite. In fewer than two decades, they have become pervasive low cost personal item. With high level of mobile phone penetration, a mobile culture has evolved, where the phone has become a key social tool. Evolving technologies has converted a cell phone to a hand held camera and a hand held personal computer along with the option of internet browsing which has only increased its usage [1].

Dental clinics are common place for the bacterial aerosols generated by high speed dental hand pieces with water supplies which has the capacity to settle over long distance [2]. Aerosols and spatter produced during many dental procedures are a potential source of transmission of various diseases [3, 4, 5, 6]. Since mobile phones have become an unavoidable means of communication, there are chances dentists might make or receive phone calls while in the clinical setup.

In a study done in Manchester University, it was discovered the average cell phone is dirtier than a toilet seat and the bottom of our shoe. The phones contained more bacteria than any other object. This type of bacteria tend to multiply in high temperatures and mobile phones are perfect for breeding these germs as they're kept warm and cozy in our pockets, handbags and brief cases. These bacteria can cause infections if they have the opportunity to enter the body [7]. A study in Amravati has found that there was a very high prevalence of MRSA (Methicillin resistant staphylococcus aureus) in doctors' mobile phones which is a known agent for nosocomial infections [8]. Another study in Nigeria determined the potential role of mobile phones in the dissemination of diseases [9]. A study in Iran has confirmed the fact that the use of cell phones by health care personnel may serve as vehicles for the spread of nosocomial pathogens [10].

White coats, neckties, stethoscopes, cell phones, and nurse's clothing have been shown to carry bacteria, including Methicillin resistant staphylococcus aureus and other Gram-negative bacilli which can cause disease. These items are often not decontaminated in routine cleaning schedules, but they should be. In fact, because data shows that these items are likely be "contaminated with pathogens"; CDC says they should be cleaned more frequently than other surfaces [11]. A study in Amritsar found 98% efficacy of decontamination of cell phones with 70% isopropyl alcohol [12].

Micik and colleagues, referred to by several authors, define aerosols as solid or liquid particles suspended in a gas with a diameter of less than 50 micrometers; airborne particles larger than 50 micrometer in diameter are defined as spatter [2, 13].

Aerosols and spatter are generated through several dental procedures, including the use of hand pieces and drills, ultrasonic scalers, and air and water sprays. Dental clinic is a place where cavity preparations, root canal treatments and scaling are a day to day procedure, where saliva, blood and pus mixed aerosol splatter is going to settle around in the clinic that can reach dentists' cell phones which are kept very close to the body. They might also settle on it when used in hand to attend/make a call. The mobile phones of health care workers harbor many harmful pathogens which serve as a reservoir for nosocomial infections [2, 14]. This phone acts as a fomite when shared with friends and family. Dentists, not aware of the seriousness of the situation, are not disinfecting their mobile phones often which could result in hospital cross infection.

According to CDC guideline for hand hygiene, wearing gloves does not replace the need for hand hygiene. Rationale behind hand hygiene is to avoid:

- Potential risks of transmission of microorganisms to patients
- Potential risks of health-care worker colonization or infection caused by organisms acquired from the patient
- Morbidity and mortality associated with health-care-associated infection [15].

However, no study has been conducted out in this part. Our study was carried out to determine different pathogens harboring the cell phones of health care persons working in the dental centre of our hospital which makes mobile a source of infection and to determine what are the potential pathogenic organisms transmitted via mobile phones. This should eventually result in creating awareness among dentists and associated health care workers and preventing the spread of dreadful pathogens and diseases.

### Conceptual/Operational Definitions

**Aerobic:** Grows in the presence of molecular oxygen [16].

**Anaerobic:** Grows in the absence of molecular oxygen or in the presence of increased carbon dioxide levels [16].

**Fomites:** Inanimate objects which may be contaminated by a pathogen from one person and act as a vehicle for its transmission to another [17].

### MATERIALS AND METHODS

This study was conducted by College of Dentistry in collaboration with Central Laboratory of GMCHRC (Gulf Medical College Hospital and Research Centre) and Gulf Dental Centre, Ajman and Sharjah, UAE. This hospital based study employed a descriptive design involving students and staff of Gulf Dental Centre (GDC), which is a multi specialty private Dental centre located Ajman and Sharjah, UAE. Those who are present in the dental clinic as assistants or observers (students) during the treatment procedures and were willing to participate in the study were included. The duration of the study was 6 months.

Approval was sought from the Ethics and Research Committees of Gulf Medical University before the commencement of the study. A standard written consent procedure was followed. The investigator ensured to give adequate verbal and written information

about the purpose, procedure and benefit of the study conducted. The investigator obtained written consent from the participants before collecting the samples. Any information revealing the identity of the participant was not collected.

In our study, an interviewer-administered questionnaire was designed and used for data collection. Items in the questionnaire were carefully selected from relevant previously published articles. The questionnaire had both open ended and closed ended questions. The questionnaire had questions related to time spent in the clinic, average number of patients attended by personnel per day, whether they use mobile phones between patients or during the procedure, usage of phones with gloved hands, hand hygiene procedures and whether routine cleaning of phones was done using alcohol, commercially available products to clean cell phones or by any other method. Content and face validity of the study tool was assessed by submitting the questionnaire to two subject experts. Their suggestions were incorporated before piloting the tool. A pilot run was conducted among five subjects and then this tool was finalized.

**Methodology**

After obtaining consent from the participants, an interviewer administered questionnaire was used for data collection. Out of 25 study subjects, 10 were male and 15 were females. Among 25 Dental practitioners, there were 7 specialists, 12 assistants, 1 dental hygienist and 5 General Practitioners. Two samples were collected aseptically at the end of the day, using sterile disposable swabs. One sample was collected without any sterilization in the morning and the second one was collected after decontaminating the cell phone in the morning. Study participants were requested to allow the investigator to decontaminate the phones using 70% isopropyl alcohol<sup>12</sup> as soon as they enter the clinics. This is to make sure the isolates are not from an outside source. Samples were collected by rotating the swabs over all the surfaces of cell phones including the mouthpiece, earpiece, keypad, sides and the back, and from Bluetooth, hands free, and external cover of the mobile if they are using them. This was immediately transferred to a test tube of nutrient broth and carried to the laboratory for further investigations. Samples were collected from the subjects and were coded and numbered. The Laboratory investigations up till the reading were carried out in the Central Laboratory.

The swabs were inoculated and streaked onto five per cent sheep blood agar, Mac-Conkey agar and chocolate agar. Sheep blood agar and Mac-Conkey agar plates were incubated aerobically at 37°C for 24 hours. Isolated organisms were processed according to colony morphology and gram stain. Bacteria were identified according to standard protocol (Mackie and McCartney)<sup>[18]</sup>. Tests for identification of gram positive cocci included catalase, Oxidative/ Fermentative test, anaerobic mannitol fermentation and coagulase production. Tests for identification of gram negative bacilli included catalase, oxidase and other relevant biochemical tests (API 20E)<sup>[19]</sup>.

The collected data was coded and fed into Excel spread sheet and analysis was performed on SPSS 19 version. Socio-demographic and clinical details were shown by means and standard deviation. The association between clinical parameter and the presence of pathogens were based on chi square test.

**RESULTS**

The culture report shows that in the samples taken without prior decontamination, 10 samples did not show any growth. Staphylococcus species dominated the growth in the remaining specimens (10 mobile phones, which included light growth of Staphylococcus citreus in 8, and moderate growth of Staphylococcus species in 2 cell phones). 3 of them showed light and moderate growth of Gram positive bacilli. Pantoea species was found in 1 cell phone and Enterobacter Cloacae was found in 1. The details are given in table 1.

Table 1: Culture report of the Sample collected without prior decontamination

Culture report	No.	%
No Growth	10	40.0
Staphylococcus citrus- light growth	8	32.0
Pantoea Species - light growth	1	4.0
Staphylococcus species-moderate growth	2	8.0
Gram +ve Bacilli - light growth	1	4.0
Gram +ve Bacilli -moderate growth	1	4.0
Gram +ve Bacilli - light growth and Staphylococcus Species- light growth	1	4.0
Enterobacter Cloacae	1	4.0
Total	25	100.0

The culture report shows that nine of the samples taken with prior decontamination at the beginning of the day did not show any growth. Staphylococcus species dominated the growth in the remaining specimens similar to the other sample taken without prior decontamination (8 cell phones which included light growth of Staphylococcus species in 2, and moderate growth of Staphylococcus

epidermidis in 8 cell phones). 12 cell phones showed light and moderate growth of Gram positive bacilli. Micrococci were seen in one sample and light growth of *Citrobacter Freundii* was found in one sample. The details are given in table 2.

Table 2: Culture report of the Sample collected with prior decontamination

Culture report	No.	%
NO GROWTH	9	36.0
Gram +ve Bacilli – light growth	3	12.0
Gram +ve Bacilli –moderate growth	3	12.0
Gram +ve Bacilli – light growth and <i>Staphylococcus</i> Species– light growth	2	8.0
<i>Staphylococcus epidermidis</i> – light growth and gram + bacilli –light growth	4	16.0
<i>Citrobacter freundii</i> –light growth	1	4.0
Micrococci– light growth	1	4.0
Micrococci– moderate growth and <i>staphylococcus epidermidis</i> – light growth	1	4.0
<i>Staphylococcus epidermidis</i> – light growth	1	4.0
Total	25	100.0

**DISCUSSION**

In the samples taken without prior decontamination, 40% of the samples did not show any microbial growth and in the samples taken with prior decontamination at the beginning of the day, 36% of the samples did not show any microbial growth. The reason for this could be firstly these health care workers were aware of cellular phone being a source of infection and they regularly decontaminated their cell phones using either spirit or commercially available solutions to clean cell phone surfaces and secondly except for one study subject, all of them practiced hand hygiene measures, which proves the importance of hand hygiene in prevention of spread of infection.

The combination of the heat generated by the phones and constant handling creates an optimum breeding condition for all sorts of microorganisms that are normally found on our skin. The skin is constantly in contact with the microorganisms present in the environment and become colonized by certain microbial species. The normal flora of the skin includes: *Staphylococci*, *Streptococci*, *Bacillus* species, *Diphtheroids*, and *Candida* species. Occasionally *Mycobacterium* species, *pseudomonas* and *Enterobacteriaceae* can be found. The normal flora of the skin is harmless and may be beneficial in their normal location in the host but they can produce disease condition if introduced into foreign locations [20].

The mouth harbors numerous micro-organisms originating from the nose, throat and respiratory tract since it is a part of oronasal pharynx. Dental procedures that can produce aerosols would result in airborne contamination with organisms from any of these sources. Ultrasonic scalers, dental hand pieces and polishing cups produce aerosols by the action of water sprays and compressed air. The composition of aerosols might vary depending on the patient and operative site. Recent surge in the usage of ultrasonic scalers and turbine hand pieces has caused increased aerosol contamination and decreased air quality in the dental office. The composition of dental aerosols could include blood and saliva, nasal and pharyngeal secretions, plaque and calculus, enamel, dentin or any other tooth component and any material used in the dental procedure E.g., abrasives used for polishing. According to a study, microorganisms isolated in dental aerosols have been responsible for diseases such as tuberculosis, staphylococcal infections, conjunctivitis, viral infections and other skin infections [21]. Our study proves the same and the organisms isolated from the samples varied from non-pathogenic strains to opportunistic bacteria to highly pathogenic species. We have discussed the organisms found in our study and the disease states they could result in.

*Staphylococcus* species showed a predominant growth in both the samples taken with prior decontamination at the beginning of the day and in the samples taken without any prior decontamination.

*Staphylococcus aureus* is capable of infecting almost any organ system. Skin infections being the most common can lead to cellulitis, folliculitis, or impetigo. Bacteremia of this organism can abscesses, osteomyelitis, endocarditis, and pneumonia which can be life threatening. *S. aureus* strains also produce enzymes and exotoxins that might result in food poisoning, septic shock, toxic shock syndrome, and scalded skin syndrome [22, 23, 24, 25, 26].

*Staphylococcus epidermidis* is gram-positive, coagulase-negative coccus that is a part of our normal flora. *S. Epidermidis* is an opportunistic pathogen known to cause CNS infections, septicemia and endocarditis. Their symptoms can vary from fever, headache, and fatigue to anorexia and dyspnea [22, 23, 24, 25].

*Staphylococcus Citreus* which was found in some of the samples though is a non pathogenic organism [23].

Gram positive bacilli which includes: *Bacillus anthracis* and *cereus*, *Corynebacterium diphtheria* and *Listeria monocytogenes*. *Bacillus anthracis* results in cutaneous, inhalation and intestinal anthrax in humans who come in contact with the diseased animal, mainly due to their occupation. *B. cereus* is a primary pathogen for Eye infections. *B. cereus* produces enterotoxins responsible for food-poisoning syndromes. The reason *B. cereus* is resistant to penicillin and other  $\beta$ -lactam antibiotics, including cephalosporins is a matter of concern. *Corynebacterium diphtheria* causes diphtheria and *Listeria monocytogenes* is the cause of listeriosis, a serious and often fatal infection [23, 26].

*Enterobacter cloacae* are gram-negative bacilli which belong to the Enterobacteriaceae family. *Enterobacter cloacae* are known nosocomial bacteria that can cause a wide range of infections such as skin and soft tissue infections, bacteremia, endocarditis, septic arthritis, osteomyelitis, intra-abdominal infections, lower respiratory tract infection, urinary tract infections, and ophthalmic infections. Management of this bacterial infection is complicated by the organism's multiple antibody resistance [23, 27].

*Pantoea* bacteria also happen to belong to the large group of organisms of Enterobacteriaceae family. They are also known nosocomial bacteria similar to *Enterobacter cloacae*. They are associated with various diseases. The most common are eye and skin infections and others include abscesses, GI tract infections, meningitis, septicemia, pneumonia, urinary tract infections, and wound infections [23, 28].

Micrococci are seen as normal flora of the skin. *Micrococcus* species are usually seen in immunocompromised patients and can cause intracranial abscess, meningitis, arthritis, endocarditis and pneumonia [3, 29].

*Citrobacter freundii* represents about 29% of all opportunistic infections. They are aerobic gram-negative bacilli and most commonly cause Urinary tract infections. Neonatal meningitis associated with *C. freundii* is a fatal disease. Clinical signs and symptoms include seizures, high grade fever and projectile vomiting. Peritonitis, inflammatory changes in the intestine and tunnel infection have also been reported [23, 30, 31, 32, 33].

## CONCLUSION

Nearly 40% of our samples did not show any pathogenic organisms, due to the cell phones being kept away on a table or inside the bags rather than close to the patient chair and because most of the professionals used some kind of decontamination procedure at the end of the day or at least once in a week. Except one study subject, all others followed strict hand hygiene.

Since dental aerosols are proven risk factor; any method of reducing aerosols and airborne contamination should be employed along with regular decontamination of cell phones. The health professionals should be aware of importance of hand hygiene and the updates on hand hygiene measures must be followed.

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