Bacteriological evaluation of disinfection potential of Titanium dioxide Nanospray on Mobilephones of dentists in Greater Noida

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Abstract: AIM: Bacteriological evaluation of disinfection potential of TiO₂ Nanospray on mobile phones of dentists in Greater Noida
MATERIALS AND METHODS: Sterile cotton swabs were moistened with sterile normal saline to collect samples from mobile phones of a total of 60 Dental practitioners. Samples were taken before, 10 minutes, and 1 week after spraying the nanoparticles. Bacterial isolates were identified by culturing the samples on blood agar.
RESULTS: All mobile phones were contaminated with bacteria i.e. they were culture positive. Disinfection with Nanospray resulted in significant reduction of mean colony forming units (p<0.001).
CONCLUSION: Titanium dioxide Nanospray can be used as an effective disinfection.
CLINICAL RELEVANCE: Dental professionals can use TiO₂ Nanospray to disinfect their mobile phones routinely.

Key Words: Disinfection, Titanium dioxide Nanospray, Dentist, Nosocomial pathogen, Bacterial contamination

Introduction
Cell phones that are used by dental professionals harbor various potential pathogens and become an exogenous source of nosocomial infections. Source of infection may be exogenous or endogenous. Exogenous may be from the air, dental equipment, hands of dental surgeons, and other staff, while the bacterial flora in the operative site is considered as endogenous. Streptococcus spp., Acinetobacter spp., Enterococcus, Pseudomonas aeruginosa (P. aeruginosa), coagulase-negative staphyloccoci (CoNS), Staphylococcus aureus (S. aureus), Legionella and Enterobacteriaceae, Escherichia coli (E. coli) are the organisms that are involved in hospital acquired infections (HAIs). At present in India, there are no sterilization rules for cell phones of health-care professionals that meet emergency clinic benchmarks, nor are there any guidelines confining dental experts and other staff from conveying these things into the operatory. Since the danger of nosocomial contaminations included utilizing cell phones in dental medical clinics has not however been resolved, this investigation tried to address this issue by screening the cell phones of dental specialist for microbial pathogens and to survey the convenience of titanium dioxide Nanospray (TiO₂ NS) for disinfecting.

Aims and Objectives
The aim of the study was to determine the bacterial contamination of mobile phones of dentist and to determine effect of Titanium dioxide Nanospray in disinfection of mobile phones.

Materials and Methods
The Study was conducted at School of Dental Sciences, Greater Noida, UP, India. A total of 60 dentists were included in the study. The criteria for participant selection included those dentists who were involved in-direct patient care, and possessed a mobile phone for not less than 3 months. Informed consent was obtained from all participants.
The samples were collected from all mobile phones of the participants by rolling sterile cotton swabs moistened with sterile normal saline. All exposed external surfaces of mobile phones (back or flip covers) were swabbed (fig.1). The external surfaces of mobile phones were cleaned with sterile gauze & sprayed...
with TiO2 NS from a distance of 2 feet (fig.2). Spray droplets were wiped with sterile gauze & allowed to dry for 10 min. A repeat swab was taken. Collected samples were sent within 1 hour to the Department of Microbiology. Swabs were streaked onto blood agar and incubated at 37°C for 24 h. Mean number of colony-forming units (CFUs) was measured. Identification of isolated bacteria was done using Gram stain, morphology, catalase, and oxidase reaction. On Mueller-Hinton agar, antibiotic sensitivity was done using the Kirby–Bauer disc diffusion method. Slide coagulase test was used to differentiate Staphylococcal isolates into *S. aureus* and CoNS. Methicillin-resistant *S. aureus* (MRSA) was confirmed by testing with Cefoxitin disc diffusion test on Mueller-Hinton agar with 4% sodium chloride and incubated at 35°C for 24 hours.

**STATISTICAL ANALYSIS**
The data were analyzed using SPSS software (version 21). ANOVA test and unpaired *t*-test were applied. The association between two variables were done using Fisher’s exact test.

**RESULTS**
Out of 60 mobile phones, CoNS were present on 57 mobile phones, i.e. they were present in majority. *Bacillus* species were found on 36 mobile phones. *MSSA* and Diptheriods were found in 13 and 10 samples respectively. *Acinetobacter* were found on 7 mobiles, *Micrococcus* on 6, while *Pseudomonas* on 5 mobile phones. MRSA were found in 3 samples and *Staphylococcus* was present in only 2 samples. (Table 1, Graph 1)

<table>
<thead>
<tr>
<th><strong>BACTERIA</strong></th>
<th><strong>n=60</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Acinetobacter</td>
<td>7</td>
</tr>
<tr>
<td><em>Bacillus</em> species</td>
<td>36</td>
</tr>
<tr>
<td>CoNS</td>
<td>57</td>
</tr>
<tr>
<td>Diptheriods</td>
<td>10</td>
</tr>
<tr>
<td>Micrococcus</td>
<td>6</td>
</tr>
<tr>
<td>MRSA</td>
<td>3</td>
</tr>
<tr>
<td>MSSA</td>
<td>13</td>
</tr>
<tr>
<td>Pseudomonas</td>
<td>5</td>
</tr>
<tr>
<td><em>Staphylococcus</em> aureus</td>
<td>2</td>
</tr>
</tbody>
</table>

Graph 1
Mean colony forming units were 238.09 before spraying. This reduced to 19.74, ten minutes after spraying and was around 61.94 after one week (Table 2, Graph 2).

### Table 2

<table>
<thead>
<tr>
<th>Time</th>
<th>CFU</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before Spraying</td>
<td>238.09</td>
</tr>
<tr>
<td>10 Minutes After Spraying</td>
<td>19.74</td>
</tr>
<tr>
<td>1 Week After Spraying</td>
<td>61.94</td>
</tr>
<tr>
<td>P</td>
<td>&lt; 0.0001</td>
</tr>
</tbody>
</table>

### Graph 2

DISCUSSION

Cell phones have turned into a basic part of our day-to-day lives. Each individual is in the ownership of a cell phone at some random purpose of time. In this way, it is additionally essential to concentrate on the likelihood of mobile phones going about as potential stores for pathogens. With the appearance of touchscreen phones, the phone contacted with fingertips is placed against face and mouth, along these lines increasing the odds of disease. In this manner, patients as well as specialists are at the danger of nosocomial diseases. The likelihood of electronic gadgets to transmit nosocomial pathogens by their utilization in the emergency clinics has been accounted for by Ulger et al. So far, every one of the examinations that had been performed were constrained to therapeutic faculty and health-care specialists.

On-going endeavours to measure the natural dangers caused have demonstrated the earnestness of potential cross-contamination. Dental operatory fundamentally is a reason for pollution in light of the vaporizers created amid dental operatory procedures. Hence, not just the hands of a dental specialist as announced by Brady et al. yet additionally the aerosol helps in contaminating cell phones. Drawn out use, just as the items, for example, disinfectants, composite units, and alcohol, may raise the permeability of the gloves. An inappropriate adherence to hand cleanliness convention may likewise help in cell phone defilement. The vast majority of the cell phones of the members in the dental operatory demonstrated a high rate of bacterial growth. Numerous examples additionally demonstrated contamination with nosocomial pathogens (Acinetobacter, MRSA, Pseudomonas, S. aureus, and S. citreus). A cell phone is the perfect reproducing ground for microorganisms. S. aureus and Acinetobacter which are impervious to drying, make due for weeks. In this examination, MRSA was separated from three cell phones, which speak to a noteworthy nosocomial pathogen worldwide. MRSA has been accounted for causing necrotizing pneumonia, necrotizing fascitis, pyomyositis, harmful stun disorder, and Waterhouse–Friderichsen syndrome. Acinetobacter species were confined from seven mobiles. Distinctive phrasings with different definitions, for example, multidrug-resistant (MDR), broad medication safe, and pan-drug safe have been utilized to portray their medication opposition. These microscopic organisms are in charge of nosocomial-acquired pneumonia, bacteraemia, meningitis, peritonitis, ophthalmitis, endocarditis, and urinary tract infections. Studies have demonstrated that Acinetobacter spp. is related with 30% of nosocomial diseases in the Intensive Care Units (ICUs). Following a comparable study in Israel, the utilization of PDAs in patient consideration territory have been prohibited in the concerned clinic, which had recognized MDR...
Acinetobacter baumannii on the hands, PDAs of health-care specialists, and patients admitted to the ICU.\[13\]Diptheriods, which were confined from 10 cell phones are overwhelmingly nosocomial pathogens. They make due as biofilms and in charge of MDR endogenous infections.\[14\] Manufactures of different brands of cell phones don’t give any purification particular to these contraptions. In this investigation, the photo catalytic property of TiO2 NS diminished the bacterial burden. At whatever point a TiO2 NS-coated surface gets illuminated, the microscopic organisms gets photo killed by TiO2 nanoparticles by a three-step instrument (a) responsive oxygen species assault cell divider; (b) scattering the inward cytoplasmic layer; and (c) slaughtering and deteriorating the harmful elements of bacteria.\[15\] It was seen in the investigation that TiO2 NS not just gave phenomenal outcomes 10 minutes after its utilization yet additionally powerful even following a week.

CONCLUSION
Mobile phones are one of the sources of nosocomial infections in dental operatory. This study shows that after using of TiO2 NS on mobile phones microbial contamination can be reduced even up to one week. It can be concluded that TiO2 NS can be used to disinfect the mobile phones.

REFERENCES