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## SHORT COMMUNICATION

# Prevalence of antibacterial resistant bacterial contaminants from mobile phones of hospital inpatients

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Mobile phones contaminated with bacteria may act as fomites. Antibiotic resistant bacterial contamination of mobile phones of inpatients was studied. One hundred and six samples were collected from mobile phones of patients admitted in various hospitals in Jazan province of Saudi Arabia. Eighty-nine (83.9%) out of 106 mobile phones were found to be contaminated with bacteria. Fifty-two (49.0%) coagulase-negative *Staphylococcus*, 12 (11.3%) *Staphylococcus aureus*, 7 (6.6%) *Enterobacter cloacae*, 3 (2.83%) *Pseudomonas stutzeri*, 3 (2.83%) *Sphingomonas paucimobilis*, 2 (1.8%) *Enterococcus faecalis* and 10 (9.4%) aerobic spore bearers were isolated. All the isolated bacteria were found to be resistant to various antibiotics. Hence, regular disinfection of mobile phones of hospital inpatients is advised.

Keywords: mobile phones; bacterial contaminants; Antibacterial resistant

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Health care-associated infections have increased significantly during the last decade. These infections remain a major cause of morbidity and mortality, which in turn lead to an increase in the cost of health care and also to new health care hazards for the community (1). Earle H Spaulding has categorized patient care items and instruments as critical, semi-critical and non-critical according to the degree of risk involved in use of the items (2). Non-critical items are further divided in to non-critical patient care items and non-critical environmental surfaces (3). Bedpans, blood pressure cuffs, crutches and computers are classified under non-critical patient care items. Bed rails, some food utensils, bedside tables, patient furniture and floors come under non-critical environmental surfaces. Surfaces of medical equipment such as x-ray machines, haemodialysis machines, stethoscopes and blood pressure cuffs can become contaminated with pathogens and lead to the spread of nosocomial infections (2).

Health care workers and patients admitted in various hospitals use mobile phones for communication. As per the classification of Earle H Spaulding (2), a mobile

phone comes under non-critical items because it will not contact mucous membranes and/or non-intact skin. Mobile phones of health care workers provide a reservoir of bacteria known to cause nosocomial infection but the contamination of mobile phones of inpatients and their cross contamination is currently unknown (4) and to date, there is no report on antimicrobial resistant bacterial contamination of mobile phones of inpatients. Hence, the present study was carried out to determine contamination of antimicrobial resistant bacteria on mobile phones of patients admitted in various hospitals.

## Materials and methods

One hundred and six samples were collected from mobile phones of patients admitted in various hospitals in Jazan province Saudi Arabia. Each sterile swab was moistened with sterile saline and then the swab was rotated on the key of mobile phones and sides of mobile phones. After collection, swabs were immediately inoculated into brain heart infusion broth and incubated aerobically at 37°C for 24 hours (4). After 24 hours of incubation in brain heart infusion broth, growth was noted and further sub-cultured

on MacConkey agar, blood agar and chocolate agar and incubated at 37°C for 24 hours. All agar plates were observed for growth, colony morphology and Gram reaction. Depending on colony characters and Gram reactions, all isolates were subjected to identification and antibiotic sensitivity test using VITEK2 (Biomerieux, France) with advanced expert system. Condensed plastic reagent cards (microquantities of antibiotics and media present in wells) are used in VITEK2 system. The VITEK2 system automatically checks for bacterial growth during an incubation period. VITEK 2 follows Clinical and Laboratory Standards Institute (CLSI) guidelines (5). For identification of bacteria, both Gram positive (GP ID card) and Gram negative (GN ID card) cards (Biomerieux, France) were used and for antibiotic susceptibility test both Gram positive and Gram negative susceptibility test cards (AST-P580; AST-N117; Biomerieux, France) were used.

## Results

Eighty-nine (83.9%) out of 106 mobile phones of patients admitted in various hospital were contaminated with bacteria. Fifty-two (49.0%) coagulase-negative *Staphylococcus*, 12 (11.3%) *Staphylococcus aureus*, 7 (6.6%) *Enterobacter cloacae*, 3 (2.83%) *Pseudomonas stutzeri*, 3 (2.83%) *Sphingomonas paucimobilis*, 2 (1.8%) *Enterococcus faecalis* and 10 (9.4%) aerobic spore bearers were found (Table 1).

Results of antibiotic resistance of Gram positive and Gram negative bacterial isolates are listed in Tables 2 and 3, respectively.

Coagulase-negative *Staphylococcus* strains were resistant to benzylpenicillin (100%), rifampicin (100%), fusidic acid (96%), fosfomycin (79.2%), tobramycin (70.8%), erythromycin (62.5%), gentamicin (53.8%), clindamycin (40.5%), levofloxacin (32.7%), moxifloxacin (18%) and teicoplanin (13%). *S. aureus* strains were resistant to benzylpenicillin (100%) and erythromycin (83.3%).

*E. cloacae* complex strains were resistant to ampicillin (100%), piperacillin/tazobactam (100%), cefuroxime axetil (100%), ceftazidime (100%) and cefuroxime (85.7%). *P. stutzeri* strains were resistant to cefalothin (66.6%),

cefotaxime (66.6%), cefuroxime axetil (66.6%), ceftazidime (66.6%), cefepime (66.6%), nitrofurantoin (66.6%) and trimethoprim/sulfamethoxazole (33.3%). *S. paucimobilis* strains were resistant to ampicillin (33.3%), cefalothin (33.3%), cefotaxime (33.3%), cefuroxime axetil (33.3%), gentamicin (33.3%) and nitrofurantoin (33.3%).

## Discussion

Bacterial contamination of mobile phones of hospital inpatients was reported in the United Kingdom (UK). Brady (4) found 86 (84.3%) out of 102 mobile phones of patients admitted in hospital to be contaminated with bacteria (2) whereas in the present study, 89 (83.9%) out of 106 mobile phones of patients admitted in various hospitals were found to be contaminated with bacteria.

All isolated bacteria in the present study were identified up to species level such as coagulase-negative *Staphylococcus*, *S. aureus*, *E. cloacae*, *P. stutzeri*, *S. paucimobilis*, *E. faecalis* and aerobic spore bearers whereas Brady (4) reported coagulase-negative staphylococci, *S. aureus*, *Corynebacterium* (*jeikeium*, *pseudodiphtheriticum*, *urealyticum*), *Streptococcus* species (*constellatus*, *parva*, *anginosus*), *S. paucimobilis*, *Enterococcus faecium*, *Rhizobium* species, *Acinetobacter ursingii*, *E. cloacae*, *Moraxella* species, *Micrococcus* species, *Burkholderia cepacia*, *Dermacoccus* species, *Kocuria* species, *Lactococcus* species, *Gemella* species, *Bacillus* species, unidentified Gram positive bacillus, unidentified alpha-haemolytic streptococcus and *Candida albicans* from mobile phones of hospital inpatients (2).

No risk has been reported for the transmission of pathogens to patients through non-critical items (6) such as mobile phones which do not contact mucous membranes and /or non-intact skin (2). However, isolated organisms such as coagulase-negative staphylococci have emerged as a major pathogen in implant users and severely debilitated patients in hospitals; *S. aureus* is a known pathogen, *P. stutzeri* is an opportunistic pathogen (1) and *S. paucimobilis* were reported to cause nosocomial infection (7). Since *E. faecalis* and *E. cloacae* are part of human intestinal microbial flora (8), isolation of *E. faecalis* and

**Table 1.** Various types of bacteria isolated from mobile phones of patients

S. No	Name of the bacteria isolated from mobile phones	Number of bacteria isolated from mobile phones	Percentage of bacteria isolated from mobile phones
1	Coagulase-negative <i>Staphylococcus</i>	52	49.06
2	<i>Staphylococcus aureus</i>	12	11.32
3	<i>Enterobacter cloacae</i> complex	7	6.6
4	<i>Pseudomonas stutzeri</i>	3	2.83
5	<i>Sphingomonas paucimobilis</i>	3	2.83
6	<i>Enterococcus faecalis</i>	2	1.8
7	Aerobic spore bearers	10	9.4

**Table 2.** Antibiotic resistance of various Gram positive bacterial isolates from mobile phones of patients

Name of antibiotic	Percentage of resistance	
	Coagulase-negative Staphylococci (52)*	<i>Staphylococcus aureus</i> (12)*
Benzylpenicillin	100	100
Gentamicin	53.8	0
Tobramycin	70.8	0
Levofloxacin	32.7	0
Moxifloxacin	18	0
Erythromycin	62.5	83.3
Clindamycin	40.5	0
Linezolid	0	0
Teicoplanin	13	0
Vancomycin	0	0
Tetracycline	32	0
Tigecycline	0	0
Fosfomycin	79.2	0
Nitrofurantoin	0	0
Fusidic acid	96	0
Mupirocin	0	0
Rifampicin	100	0

\*Total number of bacterial isolates in parenthesis.

*E. cloacae* from mobile phones may indicate that such mobile phones may be contaminated with intestinal flora. Several studies have also reported antibiotic resistant hospital strains such as *Staphylococcus epidermidis*, *S. aureus*, *Enterococcus*, and *Pseudomonas* species, etc. which are common health care-associated pathogens (2).

In the present study, MRSA were not isolated among isolates of *S. aureus* and ESBL were not isolated among isolates of *E. cloacae*, *P. stutzeri* and *S. paucimobilis*. All bacterial isolates from mobile phones are aerobes or facultative anaerobes. The possibility of other microorganisms like obligate anaerobes and fungi being found on contaminated mobile phones has not been excluded.

Educating patients about infection control and stressing individual responsibility of infection control is an important aspect of controlling nosocomial infections (9). Contaminated mobile phones may act as fomites because most people carry mobile phones along with them to places such as hospitals, toilets and kitchens where microorganisms thrive (10).

This study indicates that unreported antibiotic resistant bacterial contaminants of mobile phones of patients may be a matter of great concern. Hence, it is recommended that all patients admitted in hospitals be educated about guidelines of using mobile phones, regular disinfection of their mobile phones, hand hygiene and be advised not

**Table 3.** Antibiotic resistance of various Gram negative bacterial isolates from mobile phones of patients

Name of antibiotic	Percentage of resistance		
	<i>Enterobacter cloacae</i> complex (7)*	<i>Pseudomonas stutzeri</i> (3)*	<i>Sphingomonas paucimobilis</i> (3)*
Ampicillin	100	0	33.33
Amoxicillin/clavulanic acid	0	0	0
Piperacillin/sulbactam	0	0	0
Piperacillin/tazobactam	100	0	0
Cefalothin	0	66.6	33.3
Cefuroxime	85.7	66.6	33.3
Cefuroxime axetil	100	66.6	33.3
Cefoxitin	100	66.6	0
Cefpodoxime	0	66.6	0
Cefotaxime	0	0	0
Ceftazidime	0	0	0
Imipenem	0	0	0
Meropenem	0	0	0
Amikacin	0	0	0
Gentamicin	0	0	33.3
Tobramycin	0	0	0
Ciprofloxacin	0	0	0
Norfloxacin	0	0	0
Tetracycline	0	0	0
Nitrofurantoin	0	66.6	33.3
Trimethoprim/sulfamethoxazole	0	33.3	0

\*Total number of bacterial isolates in parenthesis.

to share mobile phones with other people so that role of contaminated mobile phones in the spread of nosocomial infections can be prevented to some extent.

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## Conflict of interest and funding

Authors declare that they have no conflict of interest.

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