

# The Possible Role of Mobile Phones in Spreading Microorganisms in Hospitals

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## Abstract

Mobile phones belonging to healthcare workers and inpatients represent a potential source of microorganisms, some being well-known sources of hospital infections. The aim of this study was to determine the extent of contamination of the hands and mobile phones of healthcare workers and inpatients. The study comprised 200 healthcare workers and 100 inpatients of the University Hospital in Messina (Italy) between April 1 and June 31, 2013. Bacterial contamination was detected on 230 mobile phones (76.6%) and on 250 hands (83.3%). The most frequently isolated bacteria belonged to the *Staphylococcus* genus. For hospital staff, 78% of mobile phones and 86% of hands were found to be contaminated. Similar results were obtained for inpatients whose mobile phones tested positive in 74% of cases, while for hands the rate was 78%. These findings are in line with international literature and demonstrate that routine everyday use of mobile phones by healthcare workers and inpatients represents an important vehicle of contamination since potentially pathogenic agents, capable of causing nosocomial infections, can pass from the telephone to the hands and vice versa.

**Keywords:** Mobile phone; Hands; Healthcare workers; Inpatients; Nosocomial infections

## Introduction

Hospital infections still represent one of the main public health problems today. The importance of inanimate surfaces as a source of nosocomial pathogens has long been known [1-3]. In recent years much importance has been attributed to contaminated mobile phones belonging to healthcare workers as a source of these infections. A number of studies have reported 5-21% of mobile phones belonging to healthcare workers to be contaminated, and therefore to be a significant source of the microorganisms responsible for nosocomial infections [4-10].

There are reports of cross contamination of Methicillin-Resistant *Staphylococcus aureus* (MRSA) occurring between the hands of healthcare workers and their mobile phones [8,9]. Other findings report that the hands of healthcare workers previously decolonized can be recontaminated following the use of this device [7]. It has also been shown that a range of pathogenic microorganisms, including *Staphylococci* (MRSA), Vancomycin-Resistant Faecal Enterococci (VRE) and *Acinetobacter* spp. are able to survive for periods of 4-5 months on dry surfaces under certain conditions [11] and that the minimal infective dose is extremely low for many of these. In fact, the concentration of nosocomial pathogens on surfaces is, generally, in the range of 1 to 100 CFUs/cm<sup>2</sup> and broth enrichment is often necessary to detect them. Therefore, the presence of a pathogen on a surface at any concentration may be a risk for transmission, and this is reflected in proposed guidelines for microbiological hygiene standards [1]. In recent years, some studies have been conducted on the potential role played by hands and the mobile phones belonging to inpatients in the transmission of important nosocomial pathogens [12,13]. The aim of this study was therefore to assess the extent of contamination of mobile phones and hands, not only of healthcare workers, but also those of patients hospitalized in different wards of Messina University Hospital (A.O.U. Policlinico "G. Martino") in Messina, Italy.

## Materials and Methods

The present investigation was conducted between April 1 and

June 31, 2013. The study involved 200 healthcare workers and 100 inpatients of Messina University Hospital. Samples were collected in the following departments: General Surgery, Thoracic Surgery, Vascular Surgery, Gynaecology and Obstetrics, Internal Medicine and Infectious Diseases. Sterile cotton swabs were used to collect samples from the hands and mobile phones of healthcare workers and inpatients. The mobile phones used were "touch screen" type. In order to collect samples from mobile phones, the swabs were wet with brain-heart infusion broth and swiped, for 4-5 seconds, to the surface coming into contact with the palm of the hands. To collect samples from hands, the wet swabs were swiped, for the same time, directly onto the palm of the dominant hand. The swabs were taken to the laboratory without delay and were left to culture in a brain-heart infusion broth and incubated at 37°C for 24-48 h. Positive samples were prepared for further culture on different growth media: Mannitol salt-agar (Oxoid) to isolate *Staphylococci*, MacConkey-agar (Biomèrieux) to isolate Gram-negative bacteria and Enterococcosel-agar (Biomèrieux) to isolate faecal enterococci. The isolated microorganisms were then identified by the API Identification System (Biomèrieux): API STAPH for *Staphylococcus* spp, API 20 NE for non-*Enterobacteriaceae* Gram-negative and API 20 E for *Enterobacteriaceae*.

## Results

Bacterial contamination was found on 230/300 mobile phones (76.6%) and on 250/300 hands (83.3%) while 23.4% of mobile phones and 16.7% of the hands were sterile. The most frequently isolated

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bacteria were those belonging to the *Staphylococcus* genus (Tables 1 and 2).

### Healthcare workers

78% of mobile phones and 86% of hands of healthcare staff were found to be contaminated. On cultures testing positive, mobile phones were found to be colonised as follows: 64.1% by *Staphylococcus aureus*, 33.3% by Coagulase-negative *Staphylococci*, 2.5% by *Enterobacter* (*Serratia* spp.) and 15.3% by *Enterococci faecalis*. The overall contamination rate for hands was 86% where the following microorganisms were isolated: *Staphylococcus aureus* in 67.4% of cases, Coagulase-negative *Staphylococcus aureus* (CONS) in 32.5%, *Pseudomonas* spp. in 2.3% and *Enterococcus faecalis* in 13.9%. The copresence of *Staphylococcus* spp. and *Enterococcus faecalis* was detected on 6.0% of mobile phones and 7.0 % of hands.

### Inpatients

A similar percentage (74%) of mobile phones of inpatients tested positive. The following rates of microorganisms were detected: *Staphylococcus aureus* 62.1%, CONS 51.3%, *Pseudomonas* spp. 2.7% and *Enterococcus faecalis* 13.5%.

As regards patients' hands, 78.0% tested positive. The microorganisms isolated were: *Staphylococcus aureus* in 58.9% of cases CONS in 46.1%, *Pseudomonas* spp. in 2.5% and *Enterococcus faecalis* in

Microrganisms	Phones N=200 (%)	Hands N=200 (%)
Positive Cultures	156 (78)	172 (86)
<i>S. aureus</i>	100 (64,1)	116 (67,4)
<i>Faecal enterococci</i>	24 (15,3)	24 (13,9)
<i>Pseudomonas</i> spp.	0	4 (2,3)
<i>Enterobacteria</i>	4 (2,5)	0
CONS (normal bacterial flora)	52 (33,3)	56 (32,5)
CONS, coagulase-negative-staphylococci		

Table 1: Percentage of positivity of healthcare workers' phones and hands.

Microrganisms	Phones N=100 (%)	Hands N=100 (%)
Positive Cultures	74 (74)	78 (78)
<i>S. aureus</i>	46 (62,1)	46 (58,9)
<i>Faecal enterococci</i>	10 (13,5)	12 (15,3)
<i>Pseudomonas</i> spp.	2 (2,7)	2 (2,5)
<i>Enterobacteria</i>	0	2 (2,5)
CONS (normal bacterial flora)	38 (51,3)	36 (46,1)
CONS, coagulase-negative-staphylococci		

Table 2: Percentage of positivity of inpatients' phones and hands.

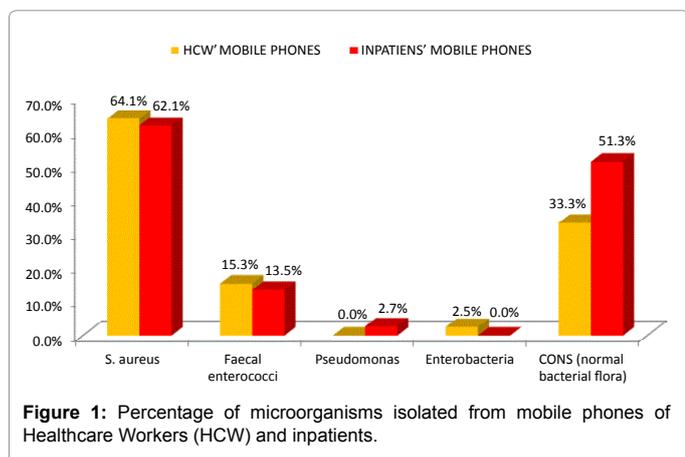


Figure 1: Percentage of microorganisms isolated from mobile phones of Healthcare Workers (HCW) and inpatients.

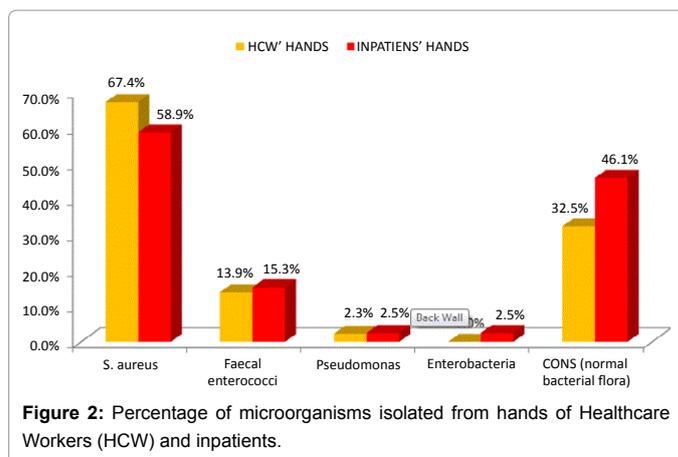


Figure 2: Percentage of microorganisms isolated from hands of Healthcare Workers (HCW) and inpatients.

15.3%. Two cases of *Enterobacter cloacae* (2.5%) were found. Moreover, *Staphylococcus* spp. and *Enterococcus faecalis* were both found on 7% of patients' mobile phones and 9% of their hands.

### Discussion

Mobile phones are very frequently used on wards by both healthcare workers and inpatients as they are an effective means of communication for both categories. However, scant attention is paid to rules of hygiene and/or the disinfection of mobile phones, not only by healthcare workers but also by inpatients. Several studies have shown how mobile phones belonging to healthcare workers constitute a device on which various microorganisms linked to nosocomial infections can congregate [5,6]. Our results confirm the high correspondence between the rates of positive tests regarding the colonization of hands and mobile phones, detected for all the microorganisms identified.

On comparing the rates and the type of microorganisms isolated, there emerged a higher rate of CONS on the phones and hands of patients than on healthcare workers. Surprisingly, a higher positive rate of *S. aureus* was found on the hands of healthcare staff than on those of patients while the percentages relating to other microbial species were similar. This made us think that a probable colonization of the healthcare workers by *Staphylococcus aureus*. Moreover, a higher rate of contamination was found in patients for hands compared to phones in the total bacterial load, while a higher rate of contamination was found on mobile phones for *Staphylococcus* spp. (Figures 1 and 2).

Our results are consistent with international literature [10-12], demonstrating that mobile phones used routinely by healthcare workers represent an important vehicle of contamination since potential pathogens capable of causing nosocomial infections pass from the telephone to the hands and vice versa. It is therefore essential to adopt precautionary measures to prevent hospital infections and to avoid the risk of cross contamination. These measures, i.e. careful hand washing (WHO five moments) and disinfecting hands with alcohol-based products, should be adopted by healthcare workers after the use of the mobile phone and just before they come into contact with patients [13-15]. However, re-contamination of hands from mobile phones is very rapid for the frequent use of these devices by HCW for many aims, i.e. to take pulse or blood pressure or to search, on web, drugs and therapies [16]. Nevertheless, it is more difficult to sanitize mobile phones as they are sensitive to liquids and high temperatures and therefore cannot be disinfected as frequently as hands. Hence, the use of silicone cases would be useful as this would allow the phones to be disinfected using chemical products without damaging the phone

itself [12]. In our study we previously contaminated the silicone cases with *S. aureus*. Then we cleaned and disinfected the silicone cases. We evaluated sanitation using the same procedure as described in materials and methods and results were negative demonstrating correct sanitation.

As a further precaution, healthcare workers should be advised to limit their use of mobile phones in high risk areas and in wards [5,6,10,12]. The same precautions should also be adopted for mobile phones belonging to inpatients.

Despite repeated reminders advising healthcare workers to wash and disinfect hands frequently, high rates of potentially pathogenic microorganisms persist.

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