

Mobile phones: What Lies Beyond the Naked Eyes

ABSTRACT

Aims: To determine the type of microorganisms growing on mobile phones of health care workers and the possibility of mobile phones being vectors for transmission of hospital-acquired infections.

Methodology and Result: 50 random participants were chosen from health care workers from three orthopaedic wards of Sarawak General Hospital, Sarawak, Malaysia. Verbal consent was taken and a short questionnaire given. Subsequently, the mobile phones were swabbed with a cotton swab soaked in sterile normal saline over the front, sides and back aspect of the handphone.

Samples taken were stored in a Stuart medium using Bijou bottles prepared sterile. After that, the samples were then streaked on 2 separate plates-blood agar and Mac Conkey. Subsequently, they were examined for the growth of microorganisms and the identification was made on the basis of colony morphology, gram reaction, coagulase and catalase test and antibiotic sensitivity for five different antibiotics by Kirby Bauer disc diffusion method. 12 out of 50 had a positive culture. Among the types of bacteria cultured, 2 (17%) was gram negative but cultured fungal, and 10 (83%) was gram positive bacteria. From the 10, 1 was methicillin resistant staphylococcus aureus, 1 was staphylococcus species extended spectrum beta lactamase, 2 more were coagulase negative staphylococcus species resistant to methicillin and the remaining 6 were staphylococcus species methicillin sensitive.

Conclusion: In this study, we concluded that pathogenic bacteria that is notorious for nosocomial infection does harbour in the mobile phones of our health care workers and urgent guidelines or protocols should be established to circumvent it.

1. INTRODUCTION

Mobile phones have become indispensable in our everyday life. Popular Mechanics magazine in one of its poll had named the mobile phone as the number 1 gadget that has changed the world[1]. In 2017, the number of smartphone users in Malaysia is estimated to be 19.9 million[2]. In the healthcare setting, mobile phones are used as a means of communication between co-workers and for quick references. This has greatly enhanced the ease of communication and the transfer of data between the various interdepartmental disciplines.

Hospital acquired transmission of infection and multi-drug resistant organism is on the rise which cost the country millions of ringgit every year to combat and have now reached a worrying level in some hospitals. Among the exogenous sources which are possible reservoirs of infection includes patients themselves, healthcare workers (HCW's), inanimate objects like computer keyboards, stethoscopes, wrist watches, mobile phones, rings and other items present in the immediate vicinity of the patient.

In a recent study for Time Health Magazine, scientists at the University of Arizona have found that cell phones carry 10 times more bacteria than most toilet seats[3]. This begs the question, how clean are our handphones and are our handphones a source of these dreaded organisms? The possibility of mobile phones as vectors of infection hasn't been researched

before in Sarawak, Malaysia. This study's objective is to determine the type of organisms/pathogens isolated on the mobile phones of health care workers from a cross section of Orthopaedic Department, Sarawak General Hospital,

2. MATERIALS AND METHODS

50 participants who volunteered for this study were chosen from healthcare workers in the three orthopaedic wards (male orthopaedic, female orthopaedic and paediatric orthopaedic ward) of Sarawak General Hospital (SGH), Sarawak, Malaysia who had direct contact with patients care. Verbal consent was taken and a short questionnaire given to them without previous information about the study being provided to gauge the extent of usage, general awareness of disinfecting their phone and whether they perform hand hygiene. Participants were volunteers and answered anonymously and they all agreed that the mobile phones they used could be sampled for data purposes. Subsequently, the mobile phones were swabbed with a cotton swab soaked in sterile normal saline over the front, sides and back aspect of the handphone using the same cotton swab. For mobile phones with covers, the front cover will be swabbed instead. The entire procedure was performed by a clinical microbiologist using sterile gloves. This study took place in the month of February 2018. These were the distribution of samples taken from the participants -House

officer (36%), Nursing staff (30%), Specialist (14%) and medical officers(20%).

The study was approved by the ethics committee and the clinical research centre. Sample collection and processing was done by a clinical microbiologist to avoid bias. All the samples that were taken using a sterile cotton swab soaked in sterile saline over the mobile phones were stored in a Stuart medium using Bijou bottles prepared sterile by the microbiology lab of Sarawak General Hospital. All the samples taken from Sarawak General Hospital was then transported to the microbial lab in University Sarawak Malaysia (UNIMAS) for analysis. After that, the

samples were then streaked on 2 separate plates-blood agar and MacConkey reactions increases. These studies, were conducted by using assay techniques involving incubation times and temperatures of 24 h and 37°C, respectively. Subsequently, they were examined for the growth of microorganisms and the identification was made on the basis of colony morphology, gram reaction, coagulase and catalase test and antibiotic sensitivity for five different antibiotics namely Methicillin (MET5), Penicillin G (P10), Oxacillin (OX1), Chloramphenicol (C30) and Erythromycin (E15) for all staphylococcal isolates that was done by Kirby Bauer disc diffusion method.[4-5]

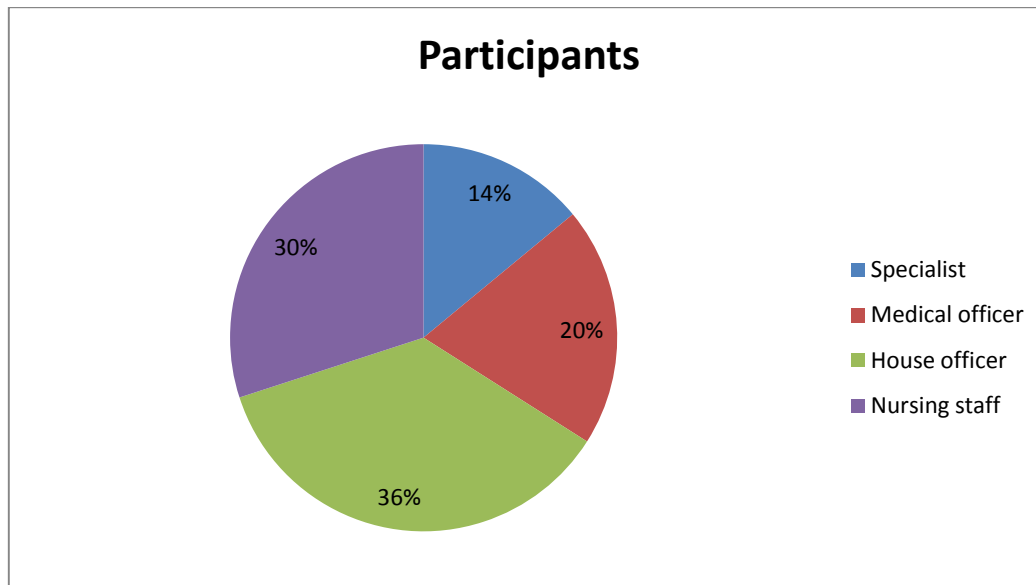


Fig. 1.



Map 1.

3. RESULTS

Out of the 50 mobile phones swabbed,there was 12 mobile phones that had growth of microorganism (24%).

From the 12 mobile phones,house officers had the highest rate of contamination (38%),followed by medical officers (30%), (14%) and (7%) respectively for nursing staff and specialist.

Among the types of bacteria cultured,2 (17%) was gram negative but cultured fungal, and 10(83%) was gram positive bacteria.From the 10, one was methicillin resistant staphylococcus aureus,one was staphylococcus species extended spectrum beta lactamase, 2 more were coagulase negative staphylococcus species resistant to methicillin and the remaining 6 were staphylococcus species methicilin sensitive .

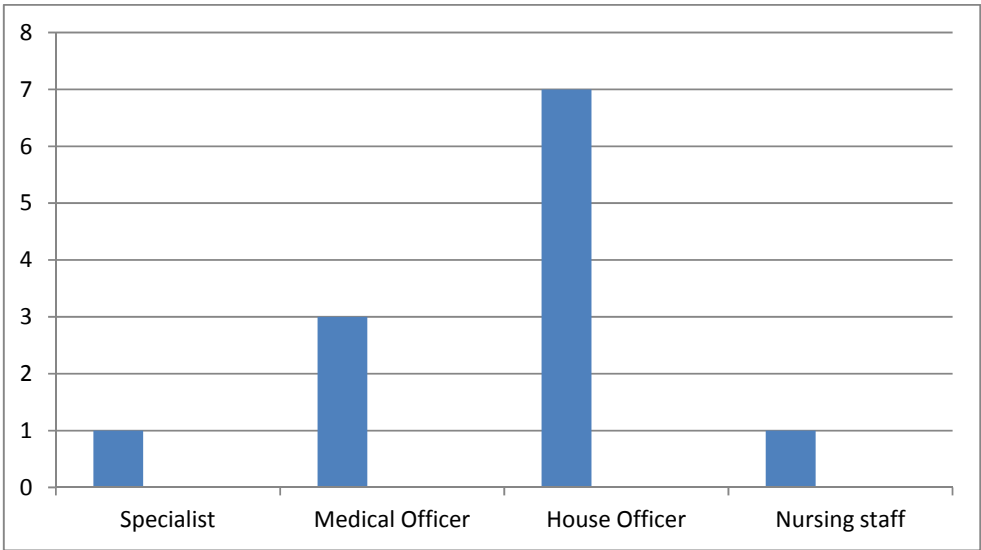


Fig. 2.

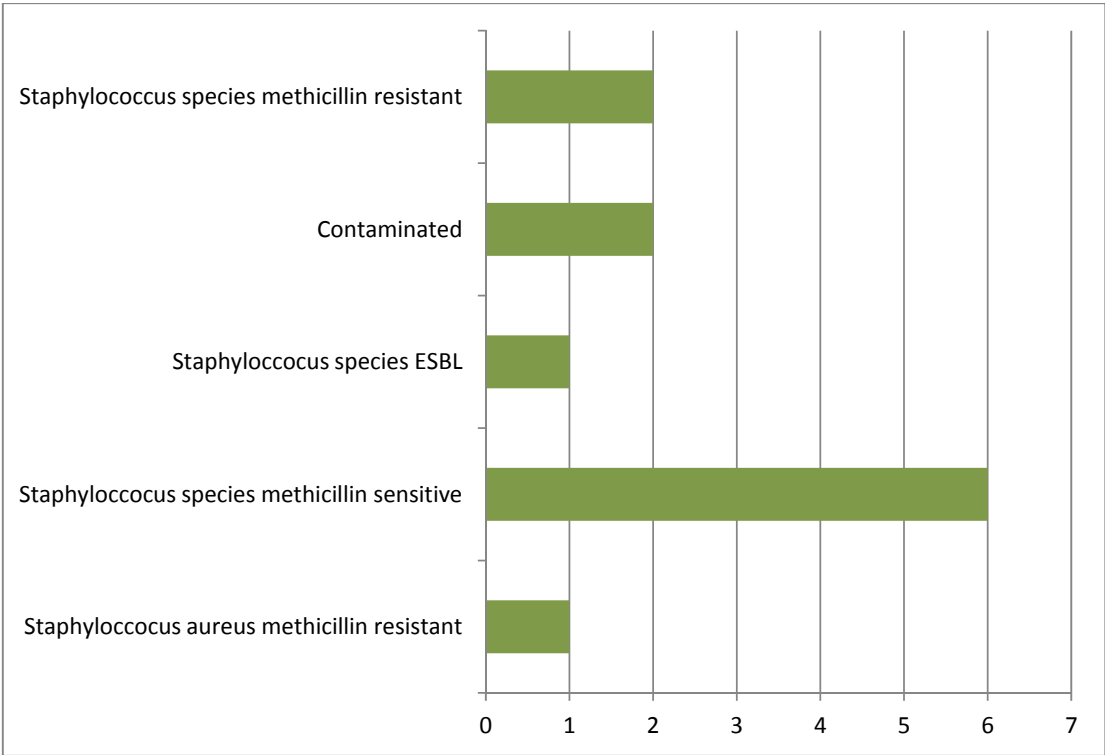


Fig. 3.



Fig. 4. Plate numbers that had growth of microorganism

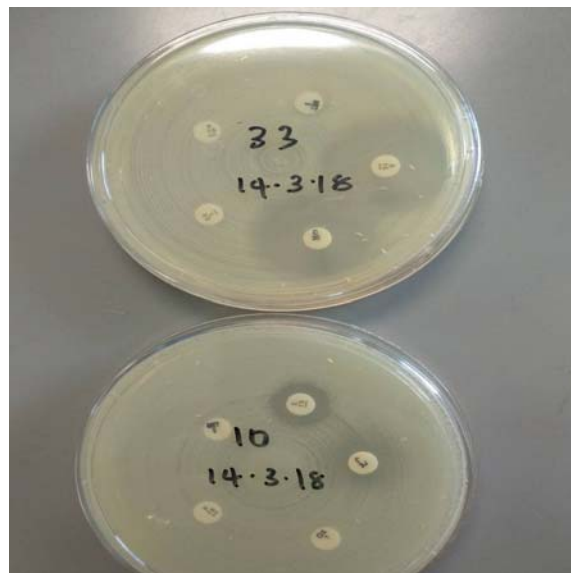


Fig. 5. Examples of antibiotic testing done using disc diffusion

From the questionnaire, the majority of participants were females 64% compared to male colleagues 36%. More than half of the participants (58%) do disinfect their mobile phones more than once per week compared to 10% who never do it. The most common practise is to clean it after hand hygiene 52% and the most common disinfectant used is alcohol swab (40%).

Besides that, 66% of the participants do hand hygiene before and after handling a patient. The majority of health care workers agree that regularly disinfecting their mobile phones is necessary and that cross contamination does decrease by regularly practising this habit of disinfecting the mobile phones.

Table 1. Result compilation out of 50 samples tested

Sample No.	Gram stain	Coagulase test	Catalase test	AST	Species
5	gram –ve bacilli	-	-		Fungal
6	gram –ve bacilli	-	-		Fungal
10	Gram +ve cocci	+ve	+ve	Resistant to all antibiotics	MRSA
13	Gram +ve cocci	+ve	+ve	Sensitive to all antibiotic	<i>Staphylococcus aureus</i>
14	Gram +ve cocci	-ve	+ve	Sensitive to all antibiotics	Staphylococcus spp.
15	Gram +ve cocci	-ve	+ve	Resistant to P10 & E15	Staphylococcus spp.
16	Gram +ve cocci	-ve	+ve	Methicillin resistant	Staphylococcus spp.
20	Gram +ve cocci	-ve	+ve	Erythromycin resistant, Methicillin intermediate	Staphylococcus spp.
26	Gram +ve cocci	-ve	+ve	Erythromycin resistant	Staphylococcus spp.
28	Gram +ve cocci	-ve	+ve	Methicillin resistant	Staphylococcus spp.
29	Gram +ve cocci	+ve	+ve	Sensitive to all antibiotics	<i>Staphylococcus aureus</i>
33	Gram +ve cocci	-ve	+ve	Resistant to MET5, P10 & OX1	ESBL

The rest of the questionnaire are as shown below in **Table 2**.

Table 2

Question 1	Current Grade?	Specialist	7	
		Medical Officer	10	
		Nursing staff	15	
		House officer	18	
Question 2	Years of service in the hospital?	Less than 2	22	44%
		2 to 5 years	6	12%
		6 to 10 years	13	26%
		More than 10 years	9	18%
Question 3	How recent is the age of your current mobile phone?	Less than 1 month	2	4%
		1 to 6 month	12	24%
		6 to 12 month	8	16%
		More than 12 month	28	56%
Question 4	What is your gender?	Male	18	36%
		Female	32	64%
Question 5	How often do you clean your mobile phone?	Never	5	10%
		Once a week	29	58%
		Once per day	5	10%
		More than once per day	3	6%
		Other answers-occasionally	8	16%
Question 6	When do you clean your mobile phone?	Never	9	18%
		Before hand hygiene	8	16%
		After hand hygiene	26	52%
		Not answered	1	2%
		Before and After	5	10%
		Other answers-Dirty	1	2%
Question 7	What type of disinfectant do you regularly use on your mobile phone?	Alcohol swab	20	40%
		Tissue with tap water	12	24%
		Clorhexidine	2	4%
		Never	4	8%
		Other answers AnB	8	16%
		AnC	3	6%
		BnC	1	2%
Question 8	When do you perform hand hygiene?	Never	-	
		After contact	12	24%
		Before contact	5	10%
		Other answers-BnC	33	66%
Question 9	What is the purpose of using your mobile phone in the ward?	Receiving calls/text	6	12%
		Search for medical info	1	2%
		Wound inspection pictures	2	4%
		Other answers AnB	6	12%
		Other answers AnC	1	2%
		Other answers A,B,C	33	66%
		Not answered	1	2%
Question 10	Do you wear any other equipment on your hand?	Yes	23	46%
		No	26	52%
		Not answered	1	2%
Question 11	In your opinion,do you think regularly disinfecting your phone is necessary?	Yes	48	96%
		No	1	2%
		Unsure	-	
		No answer	1	2%
Question 12	Do you think corss contamination and hospital acquired infection will decrease with regularly disinfecting your mobile phones?	Yes	40	80%
		No	1	2%
		Unsure	8	16%
		No answer	1	2%

4. DISCUSSION

Nosocomial infection has always been a burden to the health care setting in terms of hospital cost and duration of stay especially in the intensive care [6-7]. There are many possible ethiological sources as to how it was transmitted in the first place and we tried to deduce it from the mobile phone of healthcare workers.

In our study 24% of mobile phones of health care workers were contaminated which were similar to the study from Mangalore by Khivsera *et al* who has reported lesser contamination rate of the hands of HCWs (30%) [8]. Another study from Nigeria by Akinyemi *et al*. reported HCWs to be the least contaminated (15.3%) [9].

The most common organism expected would be the gram-positive *Staphylococcus* which is present on the skin surfaces of humans. This was already predicted as it is a normal skin flora present on the superficial layers of skin [10]. The isolates of *Staphylococcus* is known to multiply rapidly in warm environments like as mobile phones especially in a tropical climate as Malaysia.

From the 12 participants that had positive growth, we noticed that the more years of service a health personel has served, the less likely is the phone contaminated. This can be explained as the highest number of contamination was under the houseman group while the lowest was the nursing and specialist group who had at least more than 2 years in service. The duration of a mobile phone does not seem to correlate with the degree of contamination which was shown in our study whereby people who recently just used their mobile phone less than 1 month had a 25% chance for contamination in comparison to those that had their mobile phones more than 12 months had a similar contamination rate at 32%.

In terms of the best disinfectant, those that used the chlorhexidine swab had the highest rate of contamination on their mobile phones while the lowest were those that used alcohol wipes.

Besides that, of note is that the MRSA grew when the healthcare worker had never cleaned or disinfected the mobile phone before while the other methicillin resistant coagulase negative staphylococcus species grew even though they regularly disinfected their mobile phones. We can conclude that bacteria contamination can occur albeit frequently cleaning their phones.

5. CONCLUSION

We concluded that pathogenic bacteria that is notorious for nosocomial infection does harbour

in the mobile phones of our health care workers and urgent guidelines or protocols should be established to circumvent it. We can also deduce that while there are no proper guidelines had been issued by the infectious disease department of our hospital, the majority of health care workers in our hospital do disinfect their mobile phones on regular basis whereby around 80% of health care workers do clean their mobile phones while only 20% don't.

Mobile phones are here to stay due to its numerous benefits and concerted efforts should be implemented. Simple measures such as proper hand hygiene practices and regular decontamination of the mobile phones with alcohol wipes may reduce the risk of hospital acquired infection caused by these devices.[11]

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TRANSPARENCY DECLARATION

All authors report no conflicts of interest relevant to this article and did not receive any sponsorship from any particular party/organization.

Consent Disclaimer:

As per international standard or university standard written participant's consent has been collected and preserved by the author(s).

Ethical Disclaimer: NA

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APPENDIX

The investigator involved are :

Investigators Name	Roles	Site involved
PAUL TAN BOON KING	PRIMARY INVESTIGATOR	SARAWAK GENERAL HOSPITAL
LEONG WAN HEE	SUPERVISOR	SARAWAK GENERAL HOSPITAL
SITI FAIROUZ	MICROBIAL COORDINATOR	UNIVERSITY SARAWAK MALAYSIA

This is a descriptive pilot study of a cross section of the healthcare workers working in Sarawak General Hospital, Sarawak, Malaysia.