



Healthcare workers' beliefs, attitudes and compliance with mobile phone hygiene in a main operating theatre complex

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SUMMARY

Background: Phone hygiene is increasingly recognized in infection prevention. We aimed to explore the beliefs, attitudes and performance of phone hygiene amongst healthcare workers (HCWs) in the major operation theatre (MOT) complex of a Singapore tertiary acute care hospital. We also monitored the impact of phone hygiene stations, introduced to improve phone hygiene.

Methods: We sent two online anonymous surveys to the Departments of Anaesthesia and MOT Nurses one month before and after we set up phone hygiene stations. Four phone hygiene stations displaying visual phone hygiene reminders and Mikrozid® sensitive wipes were set up at MOT entrances.

Results: A total of 205 and 91 HCWs responded to the first and second surveys respectively. In the first survey, 11.5% cleaned their phones daily while 9.4% never cleaned their phones. These changed to 16.9% and 3.8% respectively after the introduction of phone hygiene stations. 80.0% in the first survey said they would clean their phones more often if there were a readily accessible disinfection method in the MOT. A majority believed phones are a source of healthcare associated infection. Common reasons for not cleaning phones were 'lack of available resources' and 'I don't think about it.' Senior doctors were the least compliant to phone hygiene.

Conclusion: Phone hygiene is easily overlooked during our busy workday. Besides increasing awareness of phone hygiene, having a readily available disinfection method in

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the MOT complex is important to improve phone hygiene. We suggest HCWs clean their phones before entering and/or after leaving the MOT daily.

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Introduction

With widespread use and increasing dependence on mobile phones, mobile phone hygiene in healthcare is increasingly recognized as an important part of infection prevention [1]. Healthcare workers' phones have been demonstrated to be carriers of healthcare-associated bacteria and pathogens; thus they are a potential cause of healthcare associated infections [2,3]. Some limited interventions, such as the use of disinfectant wipes, have been proven to be effective in reducing pathogen carriage of healthcare workers' phones [4]. However, there is no conclusion on what is the best intervention, nor the required frequency of mobile phone cleaning. There has also been no study done to explore the beliefs, attitudes and performance of mobile phone hygiene amongst healthcare workers in Singapore.

The aim of this study was to explore the beliefs and attitudes towards, and the performance of, mobile phone hygiene amongst healthcare workers (HCW) in the main operation theatre (MOT) complex of a major tertiary acute care hospital in Singapore. The survey was performed before and after the introduction of phone hygiene stations, intended to improve mobile phone hygiene.

Methods

Study design and participants

After obtaining our institution's Institutional Review Board waiver for our prospective study, we sent out two online anonymous surveys to all the healthcare workers (HCWs) working in the Singapore General Hospital's Departments of Anaesthesia and Major Operating Theatre (MOT) Nursing Staff. These two departments were selected as they were deemed to spend most of their work in the MOT, and have consistent patient contact. Each survey was open for a month, with a reminder to fill in the surveys mid-way. Four phone hygiene stations were set up at the MOT main entrances after the first survey was closed. The second survey was sent out a month after the introduction of the phone hygiene stations. The surveys were voluntary and could only be accessed via an email invitation link.

Surveys

The surveys (Appendix A) were developed and tested by our multidisciplinary research team (Anaesthesia, Infectious Disease, and Nursing) with the goal of determining the beliefs, attitudes and self-rated performance of mobile phone hygiene by HCWs. The short surveys were designed to be easily completed in a few minutes so as to encourage participation from the HCWs.

The HCWs were separated into four main categories for analysis: senior doctors (Associate Consultants and above);

junior doctors (Senior Residents and below); senior nurses (Nurse Clinicians and above); and junior nurses (Senior Staff Nurses, Senior Enrolled Nurses and below). Data on mobile phone usage at work and beliefs regarding mobile phone hygiene and the risk of nosocomial infection were collected. In terms of cleaning, we collected data on the frequency and timing of mobile phone hygiene, and factors that affect HCWs' phone hygiene habits.

The second survey had additional questions on whether the participant completed the prior survey (to allow for clearer data analysis); the awareness and usage of the phone hygiene stations and which station was utilized; reasons for overlooking the phone hygiene stations; and factors that resulted in omission of phone hygiene despite the availability of phone hygiene stations.

Phone hygiene station

Four phone hygiene stations were set up at the main entrances of the MOT: one station each at the two corridors of the changing rooms leading to the MOT, and one station each at the two exits of MOT leading to the hospital wards. These



Figure 1. Phone Hygiene Station.

stations displayed visual reminders of mobile phone hygiene together with Mikrozyd® sensitive wipes (Figure 1).

The Mikrozyd® sensitive wipes contain the following active ingredients: Alkyl(C12–C16) dimethylbenzyl ammonium chloride (ADBAC/BKC (C12–C16)); Didecylmethylammonium chloride (DDAC), Alkyl(C12–C14) ethylbenzylammonium chloride (ADEBAC (C12–C14)). Within 1 minute of use, they are bactericidal (including MRSA), levurocidal and virucidal against enveloped viruses. The product is suitable for the cleaning and disinfection of alcohol-sensitive surfaces and medical devices [5].

Statistical analysis

Results from the two surveys were collated. With the help of our biostatistician, we performed descriptive statistics as well as chi-squared tests to compare the responses amongst the different HCW groups as well as response differences between the two surveys. For clearer comparisons between the surveys, we only used responses where both surveys were done.

Results

Demographics

A total of 205 HCWs responded to the first survey and 91 HCWs responded to the second survey. 63 HCWs completed both surveys. The response rate for first and second surveys were 55% and 24% for doctors (95 and 42 out of 173 doctors), 29% and 13% for nurses (110 and 48 out of 382 nurses) respectively. Of the respondents, 46.3% and 49.2% were doctors in the first and second surveys respectively (Figure 2).

Behaviours

93.7% (192/205) and 97.8% (89/91) of the HCW respondents said they used a mobile phone regularly at work for the first and second surveys respectively. Amongst these HCWs, 11.5% cleaned their phones daily while 9.4% never cleaned their

phones in the first survey. These percentages were 16.9% and 3.8% respectively for the second survey.

Attitudes and beliefs

For the first survey, 80.0% of the respondents said they would clean their phones more often if there was a readily accessible disinfection method in the MOT changing room, whereas 6.3% did not think it would change their behaviour. These respondents were quite equally spread out amongst the staff categories (ranging from 76.1% to 84.3%).

A majority of the respondents (89.8% [184/205] and 95.2% [60/63] in the first and second surveys, respectively) believed that mobile phones are a source of healthcare associated infection. Of the respondents who did not believe so, most were junior nurses (15/24 respondents); the attitudes of junior nurses were significantly different to other HCW: $X=6.232$, $p=0.016$, $OR=0.35$, $95\% CI=0.15-0.82$.

In the first survey, the top 3 reasons that the respondents gave for not cleaning their phones daily were: 1. Lack of available resources to clean phones; 2. I don't think about it; 3. I am concerned that using disinfectant wipes will damage my phone (Figure 3). In the second survey, the top 3 reasons changed to: 1. Not applicable as I am already cleaning my phone daily; 2. I don't think about it; 3. I am concerned that using disinfectant wipes will damage my phone.

30.2% and 23.8% of respondents in the first and second surveys respectively were concerned that the wipes would damage their phones.

In both surveys, junior nurses were more likely than other HCWs to clean their phones daily ($X=8.093$, $p=0.004$, $OR=2.20$, $95\% CI=1.27-3.81$). They were also less likely to perceive a lack of resources to clean their phones ($X=4.856$, $p=0.029$, $OR=0.53$, $95\% CI=0.30-0.94$), and less likely to forget to clean their phones ($X=4.626$, $p=0.032$, $OR=0.55$, $95\% CI=0.32-0.95$). Compared to the other HCWs, senior doctors were less likely to clean their phones daily ($X=12.255$, $p<0.001$, $OR=0.24$, $95\% CI=0.11-0.56$) and more likely to forget to clean their phones ($X=5.519$, $p=0.019$, $OR=1.98$, $95\% CI=1.11-3.51$).

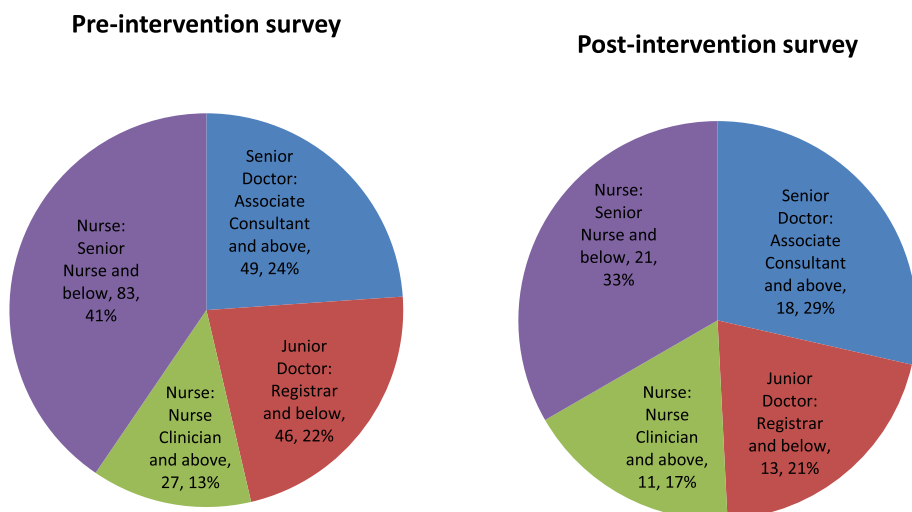


Figure 2. Distribution of staff category among respondents was similar for both surveys (Pearson Chi-square = 1.752, $p = 0.625$).

Phone hygiene station efficacy

Although statistically insignificant, comparing the first and second survey respectively, there were increased proportion of respondents cleaning their phones daily before they enter the MOT (12.7%–15.9%), after they leave the MOT (27.3%–36.5%) and daily (24.4%–34.9%). There was also a reduction in proportion of respondents who did not clean their phones at all from the first and second survey, before entering the MOT (23%–21%) and after leaving the MOT (10%–5%) (Figure 4).

With regard to disinfectant wipes as a method to clean HCW phones, 4.9% and 1.6% of first and second survey respondents respectively felt that they were not effective in reducing bacterial contamination; another 4.4% and 4.8% of first and second survey respondents felt that it took too much time.

62 of 91 (68.1%) of the second survey respondents were aware of the phone hygiene stations. Stratifying by HCW categories, senior nurses were significantly more likely to be aware of it ($X=5.254$, $p=0.031$, OR 8.17, 95% CI 1.02–65.48). Visual reminders of mobile phone hygiene were reported to be less helpful for junior doctors than other staff ($X = 13.275$, $p=0.001$, OR: 16.5, 95% CI 2.92–93.20). 24 staff (38.7%) who were aware of the intervention did not use the wipes.

Of the respondents who used wipes, 90% obtained them from the phone hygiene stations (Table I).

Out of the 29 respondents who did not notice the intervention, 69.0% felt it was because the intervention was not eye-catching enough; 24.1% reported they already used alcohol wipes available in the MOT for cleaning their phones; and the rest use other methods of cleaning their phones.

Discussion

With improving technology, mobile devices are becoming part of our daily lives. As demonstrated in our study, more than 90% of the HCW respondents use their mobile phones regularly at work, be it for personal or work-related use. However, phone hygiene is often overlooked during our busy lives: in first survey, 9.4% of HCWs who use their phones at work never cleaned their phones. This is also reflected in a study done amongst 117 HCWs in Barbados [6], where only 47% of mobile phone owners ever cleaned their phones and, of these, 75% cleaned them only one or two times a week.

Studies have consistently shown that prior to cleaning more than half of HCW's phones carry hospital-acquired bacteria [7–11], and that the contamination rate with bacteria known to cause healthcare-associated infections) is 9–25% [12]. Phone hygiene is believed to be particularly important in clinically sensitive areas [10] such as operating theatres [13], intensive care units, burns units and paediatric wards. Amongst our HCWs working in the MOT of our tertiary hospital, a majority believed that phone hygiene is a source of healthcare associated infections. However, two thirds of those who did not use wipes were junior nurses. Conversely, junior nurses were more likely than other staff groups to clean their phones regularly. Possibly this dichotomy is explained by a lack of understanding by junior nurses of routes of transmission of infection; this is a potential area for us to focus on in future work, especially around education.

While many studies have investigated bacterial colonization of HCW phones, few have explored the reasons why phone hygiene was poor amongst HCW. Many advocate improving

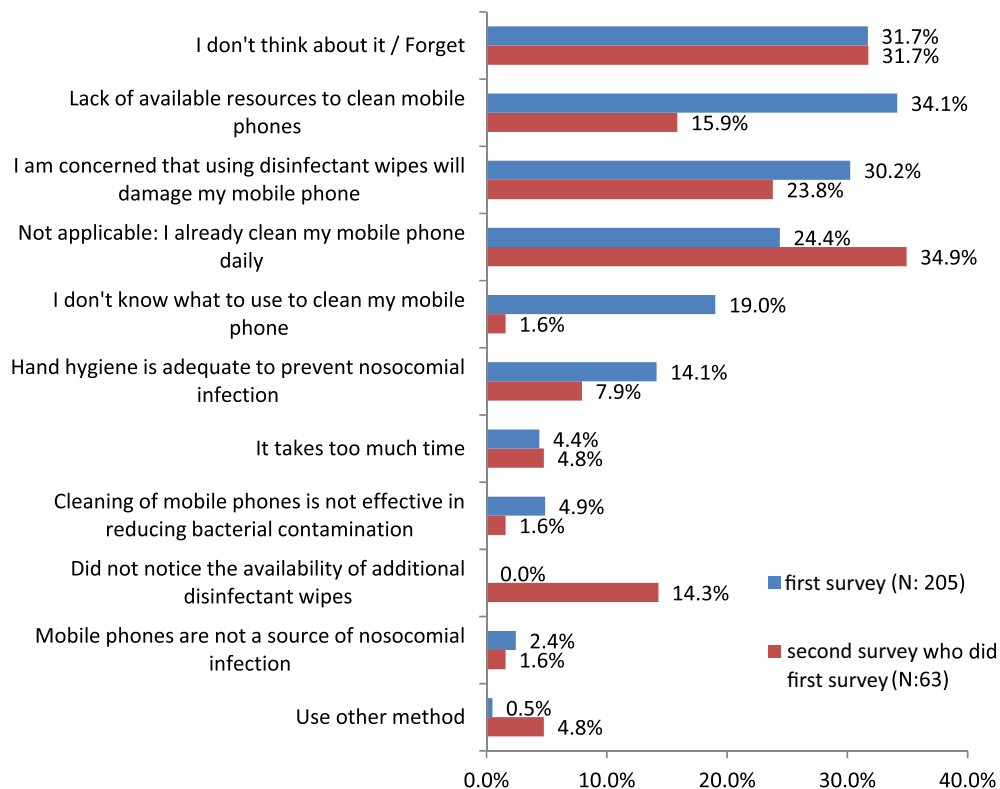
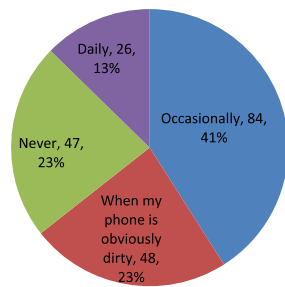


Figure 3. Reasons for not cleaning mobile phone: first vs second survey.

Before entering OT: No significant difference in response distribution pre- to post-survey ($\chi = 2.807, p = 0.422$)

I clean my mobile phone before entering the OT: pre-survey responses (N: 205)

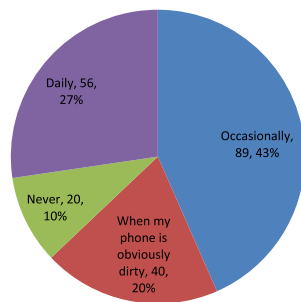


I clean my mobile phone before entering the OT: post-survey responses (N: 63)



After leaving OT: No significant difference in response distribution pre- to post-survey ($\chi = 3.513, p = 0.319$)

I clean my mobile phone after leaving the OT: pre-survey responses (N: 205)



I clean my mobile phone after leaving the OT: post-survey responses (N: 63)

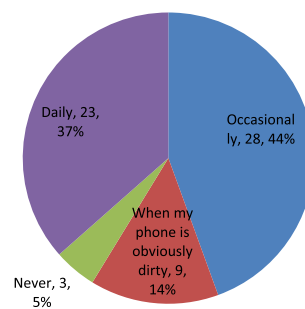


Figure 4. Frequencies of reported mobile phone cleaning before entering the operating theatre (OT).

awareness of phone and hand hygiene [2,6,12], assuming that the main reason for poor phone hygiene is due to lack of awareness. Only one study explored the beliefs amongst HCW regarding potential changes in their phone usage in light of evidence of bacterial colonization [9]. Interestingly, lack of awareness of phone hygiene was not the most common reason for poor phone hygiene in our study. In our first survey, 'lack of available resources to clean phones' was cited as the most common reason for HCWs not cleaning their phones daily (Figure 3). 80% of the first survey respondents reported that they would clean their phones more often if there was a readily accessible disinfection method in the MOT changing room. This would suggest that providing ready accessible phone hygiene stations should markedly improve phone hygiene amongst HCWs working in our MOT. This hypothesis is also supported by the fact that in the second survey (after the introduction of phone hygiene stations), this reason for poor phone hygiene dropped from the most common to the 4th place. However, it must be noted that comparisons between the first and second surveys are constrained by the different response rates, and that there was no significant difference in the numbers of respondents cleaning their phones daily between the two surveys.

While many studies investigated and proved the efficacy of disinfectant wipes on mobile devices [2–4], none of them were aimed to improve phone hygiene practically. With knowledge of phone hygiene barriers after our first survey, we introduced

a novel phone hygiene station concept integrating disinfectant wipes, phone hygiene educational and visual reminders to explore how we can improve phone hygiene amongst our HCWs. In the second survey after the introduction of these stations, there was a statistically insignificant trend towards an increased proportion of HCWs cleaning their phones daily and occasionally before entering and after leaving the MOT. Our results suggest that the phone hygiene station concept has promise, but further improvements are required to increase use of the facility.

Table I

Usage of disinfectant wipes at different locations in MOT complex

Location	Count	Percent
Operation Caps holding area at MOT Level 1	29	50.0%
MOT display area (near masks holding area at level 2)	16	27.6%
MOT reception areas	7	12.1%
Induction room	2	3.4%
PACU	1	1.7%
In OT as well	1	1.7%
Alcohol wipes in Anaesthetic trolley	1	1.7%
In NHCS OT display or reception area	1	1.7%
Total	58	100.0%

As a large proportion of our respondents either did not notice our phone hygiene stations or cited that they were not eye-catching enough, making the stations more prominent would serve to improve HCW awareness and its purpose as a visual reminder. This may be particularly important amongst the subgroup of senior doctors who forgot to clean their phones and have lower self-reported rates of phone hygiene. Additional reminders (e.g. periodic email reminders, or visual reminders on computer screensavers) targeted at senior doctors may be required.

The location of our phone hygiene stations appears to have been appropriate as they were the top 3 areas where the respondents reported using the disinfectant wipes. These locations were selected as they were the main areas where HCWs enter and leave the MOT complex.

Besides hand hygiene as a method to reduce healthcare associated carriage of phones [9], various types of wipes (e.g. alcohol-based, chlorhexidine, iodine, ammonia-based) have been studied and proven to be effective in significantly reducing bacterial carriage of phones [2,3,10]. Our team explored the use of ultraviolet (UV) phone sanitizers (e.g. PhoneSoap [14]), but they were too either too bulky to be installed, or the smaller versions take too long for phone disinfection (the time required would be at least 10mins), thus rendering them impractical for our busy HCWs. Other issues such as sizes of phones and phone covers not fitting the UV device, effectiveness of the UV devices etc. also contributed to the practical problems of using these devices for phone hygiene. In comparison, the Mikrozid® sensitive wipes [5] were alcohol-free and were readily available in our MOT as we used these wipes for our medical equipment. They are also versatile for different sized devices, and take only 1 minute to be effective. Therefore the wipes appear to be more practical for phone hygiene use.

So far, there have not been any reports in the literature citing phone damage due to such wipes. However, companies of most commonly used phones do not recommend the use of alcohol- or ammonia-based wipes on their surfaces; hence, we could not assure HCWs that no damage would be sustained with the frequent use of the Mikrozid® sensitive wipes. The use of screen protectors and phone cover protectors is prevalent and the majority of HCWs were not concerned about phone damage. Reassuring HCWs and encouraging the use of phone and screen protectors that are easily cleaned may improve phone hygiene.

There is also no recommendation on how frequent HCWs should clean their phones. A study by Shakir *et al.* published in 2015 involving 53 orthopedic doctors showed that 83% had pathogenic bacteria at initial testing, 8% had pathogenic bacteria after disinfection, and 75% had pathogenic bacteria one week later [3]. Another study by Foong *et al.* found that only daily cleaning of phones resulted in no growth of pathogenic bacteria [11]. In our survey, most of our respondents clean their phones after leaving the MOT compared to before entering MOT, and a majority of them clean their phones daily or occasionally. It appears that adhering to phone hygiene at least once daily would not be impractical or too inconvenient. Hence, we suggest all HCW to clean their phones before entering and/or after leaving the MOT daily to avoid healthcare associated contamination of their phones both to their own and the patients' benefit.

Conclusion

Healthcare workers' phones have been demonstrated by multiple studies to be carriers of nosocomial bacteria and pathogens, and may therefore potentially cause healthcare associated infections. Phone hygiene is easily overlooked during our busy workday, and increasing awareness is important to improve our phone hygiene. Besides advocating phone hygiene education and awareness, our study also showed that having a readily available disinfecting method could be an important component to improve phone hygiene compliance. However, more prominent phone hygiene stations and/or additional interventions are required to improve hygiene rates. Encouraging the use of phone and screen protectors that are easily cleaned may be useful. We suggest that HCWs clean their phones with disinfectant wipes before entering and/or after leaving the MOT daily to avoid healthcare associated contamination of their phones.

Authorship statement

Leong Xin Yu Adeline: literature review, research planning, development and execution of surveys, data collection, manuscript writing.

Chong Shin Yuet: research planning, development of surveys, manuscript editing.

Angel Koh Si En: data analysis, manuscript editing.

Yeo Bee Chin: implementation of study.

Tan Kwee Yuen: research planning, implementation of study.

Ling Moi Lin: research planning, mentorship.

Artwork.

None.

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Ethical considerations

None.

Conflicts of interest

None.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.infpip.2019.100031>.

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