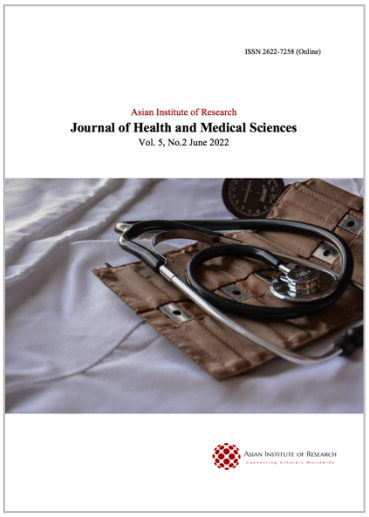

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Mobile Phones as a Source of Nosocomial Infection in the Radiology Department of a Teaching Hospital

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Abstract
Background: Mobile phones were first introduced in the United Kingdom and have become an important means of communication among doctors, other healthcare workers, patients and the general public. Objectives: This study was aimed at establishing that mobile phones are sources of nosocomial infections in the radiology department of our teaching hospital and also to determine the pathogens that are responsible for these infections. Methods: This was a prospective study that involved collection of swab samples from radiographers' mobile phones. Three different samples were collected from each mobile phone. Thirty (30) mobile phones were used for this investigation and ninety (90) samples were totally collected. Samples were collected on arrival of the radiographer to the department, after handling patients and after washing hands. Samples collected were sent to the microbiology department for culture analysis. Descriptive data analysis was performed and results presented in frequency tables. Results: On arrival at the department, samples collected revealed that 22 (73.3%) of the phones were contaminated before commencing work for the day while 8 (26.7%) were not contaminated. With direct patient contact, 27 (93.3%) were contaminated and after washing hands it was observed that 16 (53.3%) of the mobile phones were contaminated. The major cause of contamination was staphylococcus aureus especially noted in swabs obtained after direct patient contact. Pseudomonas aeruginosa and Escherichia coli were also identified as contaminants of the phones. Conclusion: Radiographers' mobile phones harbour bacteria and could act as a source of nosocomial infection in the radiology department.

Keywords: Mobile, Phone, Nosocomial, Infection, Radiographers, Radiology

1. Introduction

Mobile phones also known as global system for telecommunications (GSM) were introduced in Europe in 1982 and have helped to improve the communication network both in Europe and the entire universe. Mobile phones are readily available and affordable that people of all works of life use them for business connections and other purposes. They come in various sizes, can be easily handled, carried around and have helped in improving the

social and economic lives of individuals thereby making them indispensable accessories in modern times (Sowah,2008).
In the hospital, doctors and other health workers use them to effectively communicate among themselves and with their patients. There are infections associated with the hospital which can be contacted by both health workers and patients who visit the hospitals. These hospital infections are prevalent (Brady, et al, 2007), also known as nosocomial infections and can be transmitted from the patient to the health care provider or vice versa. There is a rise in this hospital acquired infections globally and this has been a source of worry (Palmore, et al, 2010; Allegranzi and Pittet, 2009; Razine et al, 2012). Previous study has shown that one third of all nosocomial infections may be preventable and are caused by organisms acquired within the hospital [Hugh, 1998]. Many of these organisms are becoming increasingly resistant to standard antimicrobial agents (Borkow and Monk, 2012). Hands of health care workers may play an important role in transmission of HAI. Mobile phones are repeatedly used by health workers while on duty and may not be cleaned thereby making them act as reservoirs as well as vehicles for transmission of nosocomial infection (Brady et al, 2007; Nyasulu et al, 2012; Datta et al, 2009). Handling of a single mobile phone between HCWs directly facilitates the spread of potential pathogenic bacteria to the community (Trivedi et al, 2011). In the past studies have demonstrated that health care equipment, (Shcabrun and Chip, 2006; Eze et al, 2012) and healthcare environments, (Otter et al, 2011; Tagoe et al, 2011) are a significant source of hospital acquired infections.

There are no existing guidelines or rules for the use and cleaning of mobile phones in the radiology department of our hospital. The radiographers move about with their mobile phones anywhere they go to within the radiology department and even the entire hospital and sometimes make and/or answer calls when attending to patients. With this behaviour, there is every likelihood that such phones may get contaminated. From observation, the use of disinfectant and hand sanitizers is not a common practice within the radiology department of our teaching hospital. It is noteworthy to state that some radiographers do wear gloves, but they have been seen to wear the same pair throughout the day and they answer their mobile phones without removing and replacing them. The potential role of mobile phones as vectors of nosocomial infection has been studied previously (Chawl et al, 2009; Akinyemi et al, 2009; Ulger et al, 2009; Bhatt et al, 2011). However, to the best of our knowledge, no formal study has previously been conducted in our institution. This study is aimed at establishing that mobile phones are sources of nosocomial infection in the radiology department of our teaching hospital and also determining the pathogens that are responsible for this infection.

2. Materials and methods

This was a prospective study that involved collection of swab samples from radiographers' mobile phones. Ethical approval to conduct this study was obtained from the faculty of health sciences and technology ethical committee, Nnamdi Azikiwe University, Nnewi campus. Three different samples were collected from each mobile phone. Thirty (30) mobile phones were used for this investigation and ninety (90) samples in - total were collected. The radiographers had no prior information about this study to avoid the bias that may result from such information. On arrival at the department, the radiographers' mobile phones were swabbed and samples collected to check for pathogens on the mobile phones from the radiographers' home. After this, they were allowed to work for three hours. The radiographers were then asked to touch their phones after having direct contact with the patients. Another swab sample was then collected from the phones. After this, the mobile phones were disinfected with alcohol based sanitizer to make sure that there was no pathogen retained on the phones. To further ensure that the phones were not contaminated, swab samples were taken after disinfection. The radiographers were then asked to properly wash their hands and then touch the phones. All collected samples were then sent to the microbiology department of the hospital for culture and isolation of microbes. The culture media (MacConkey and Blood agar) were prepared according to the manufacturer's instructions. The samples were prepared and put into the autoclave and heated for 15 minutes at a temperature of 121ºC to achieve sterilization of the culture medium. The medium was then poured into petri dishes. After allowing the medium to cool to 47 ºC, the culture plates were covered and allowed to set before inoculation of samples. After inoculation, culture plates were placed in an incubator and incubated for 24 hours at a temperature of 37 ºC in order to allow for growth of microorganisms. After incubation the culture plates were examined macroscopically under a bright light in order to identify the isolated microorganisms based on their colonial characteristics.

Data collected was analyzed descriptively and results presented in frequency tables and percentages.

3. Results

The result of this study shows that 30 swab samples were collected when the radiographers arrived to the hospital, 30 samples were collected after the radiographer had direct contact with some patients and another 30 samples after washing hands giving a total of 90 samples.

Table 2 depicts the type of bacteria isolated or detected on the mobile phones. Three bacteria were implicated for contaminating radiographers' mobile phones. They are staphylococcus aureus, pseudomonas aeruginosa and Escherichia coli. On arrival to the department, 13 (14.4%) were contaminated by staphylococcus aureus, 4 (4.4%) were contaminated by Pseudomonas aeruginosa, while Escherichia coli was responsible for 5 (5.6%). After direct contact with the patients, 21 (23.3%) of the mobile phones were contaminated with Staphylococcus aureus, Pseudomonas aeruginosa caused 2 (2.2%) of the contamination while 4 (4.4%) were due to Escherichia coli. After washing hands, 13 (14.4%) of the contamination was as a result of staphylococcus aureus, 1 (1.1%) was due to pseudomonas aeruginosa while 2 (2.2%) were due to Escherichia coli. Staphylococcus aureus was the major cause of infection and contributed to a total of 47 (52.2%), followed by Escherichia coli which was responsible for 11 (12.2%) of the infection. Pseudomonas aerginosa contributed to 7 (7.7%) of the infection.

Table 1: Presence of pathogens on the mobile phones of Radiographers in the radiology department

Samples	On arrival	After direct patient contact	After hand washing	Total
With growth	22 (73.3%)	27 (93.3%)	16 (53.3%)	65 (72.2%)
Without growth	8 (26.7%)	3 (6.7%)	14 (46.7%)	25 (27.8%)
Total	30	30	30	90 (100%)

Table 1 shows the presence of pathogens on radiographers' mobile phones. A total of 65 (72.2%) of the mobile phones were contaminated while 25 (27.8%) were free of the pathogens.

Table 2: Bacteria detected from the mobile phones

Bacteria	On arrival	After direct contact with patients	After washing hands	Total
Staphylococcus Aureus	13 (14.4%)	21 (23.3%)	13 (14.4%)	47 (52.2%)
Pseudomonas Aeruginosa	4 (4.4%)	2 (2.2%)	1 (1.1%)	7 (7.7%)
Escherichia Coli	5 (5.6%)	4 (4.4%)	2 (2.2%)	11 (12.2%)

Table 2 depicts the type of bacteria isolated or detected on the mobile phones. Three bacteria were implicated for contaminating radiographers' mobile phones. Staphylococcus aureus were responsible for most of the contamination (52.2%) while pseudomonas aeruginosa caused the least contamination of the phones (7.7%).

4. Discussion

This study investigated mobile phones as a source of nosocomial infection among practicing radiographers. The present study tested for the presence of bacteria on radiographers' mobile phones. Findings revealed that these phones harboured nosocomial pathogens (bacteria). Some of these pathogens were detected on arrival to the department before handling of patients by the radiographers. The implication of this is that radiographers could carry and spread infection in the hospitals from their homes. Majority of the bacteria were detected after direct contact with the patients. This observation may be because the radiographers make and receive calls while working in the department and as the number of patients handled increases there is also the possibility of increased rate of contamination of their phones because some of the patients may also transmit infection to the workers.

This study revealed the presence of bacteria even after hand washing in some of the mobile phones. This indicates that the mobile phones can be contaminated by the hand as reported by Vaibhavi et, al, (2015). It may be because their hands were not properly washed. The department does not regularly provide disinfectants or soap and because of this the radiographers who had not provided such for themselves washed their hands with ordinary water and this may have been the reason for detecting some pathogens even after hand washing.

A total of 72.2% of mobiles phones were contaminated in our study. (Grimma et al, 2014) reported a total of 71.2% in their study and this could be said to be the same with our findings. This finding is also in tandem with other previous studies (Nyasulu et al, 2012; Chawl et al, 2009). Some other studies reported values that are higher than our value (Ulger et al, 2009; Famurewa and David, 2009; Karabay et al, 2009). Lower bacteria contamination was reported by Sepheri et al, (2009) and Arora et al, (2009). This variation noted may be as a result of the participants studied. While most of the studies considered the mobile phones of healthcare workers generally, we considered only radiographers in the radiology department. Conducting this study on radiographers alone in the radiology department may have also affected the types of bacteria detected. The environment and equipment used can also be a contributing factor (Shcabrun and Chip, 2006). A previous study by Grimma et al, (2014) has demonstrated that the adherence to infection prevention, pattern of mobile phone use, mobile phone keeping habits and personal behaviour like nose picking may also affect the number of contaminated mobile phones.

The most predominant bacteria isolate in this study was staphylococcus aureus constituting about 72.3% of the total bacterial isolate. This is in agreement with other studies which also recorded staphylococcus as their most common isolate (Sadat et al, 2010; Raghavendra et, 2014; Tambleka et al, 2008). This finding however does not agree with other previous studies which stated that staphylococcus aureus was their second predominant isolate (Chawl et al, 2009; Grimma et al, 2014; Arora et al, 2009). Staphylococcus aureus can resist dryness and multiply rapidly in warm environments like the mobile phones.

Pseudomonas aeruginosa (11%) and Escherichia coli 11(17%) were also found on these mobile devices in concordance to a similar work done by Nwankwo et al, (2014). Escherichia coli are harmless but most times can cause diarrhea, cramps, vomiting (WHO 2002).

5. Conclusion

1. Nosocomial bacteria were found on the mobile phones of radiographers.
2. Radiographers' mobile phones are a source of nosocomial infection. Radiographers should properly wash their hands and their mobile phones should be disinfected regularly.
3. Most of the contamination was recorded after direct contact with patients. Staphylococcus aureus, pseudomonas aeruginosa, and Escherichia coli were the bacteria responsible for the contamination of the mobile phones.

6. Recommendations

Based on the results of this study, we recommend the following;

1. Proper hand hygiene should be practiced by scrubbing with soap and water or antiseptics after attending to a patient and before contact with mobile phone.
2. Radiographers should also imbibe the culture of proper hand washing with disinfectants at the close of work.
3. It is also necessary that radiographers should wash their hands after going to the rest room, after shaking hands, after lunch, after using a handrail, after traveling from one location to another, after using the phone etc.
4. There should be a guideline on how to use mobile phones in the department. Such guideline may include restricting the radiographers from handling their phones when they are on duty.
5. Radiographers' mobile phones should be covered. This cover could be such that it can be removed and cleaned after work.

7. Limitations of study

1. This study considered only the presence of bacterial pathogens on the mobile phones. The degree of bacterial contamination was not considered in this study.
2. The radiographers were instructed to touch their phones after working for three hours. This may have affected the rate of contamination of the mobile phones.
3. The radiographers were asked to touch their phones to ensure that there was contact with the phone before taking the swab. The number of times contact was made with the phones was not taken into consideration and therefore does not represent daily habits during a regular working day.

Conflict of interest.

The authors have no conflict of interest.

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