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Study on awareness of microbial contamination through mobile phones

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ABSTRACT

Mobile phones have become an essential accessory in our personal, social and professional life. Mobile phones can act as a reservoir of a wide variety of bacterial species, many of which have the potential to be pathogenic. Mobile phones were found to carry microorganisms because count of bacteria increases in high temperature and our phones are ideal breeding sites for these microbes as they are kept warm and snug in our pockets and handbags. The important factors of contamination are the personal hygiene level. Though mobile phone use are restricted in hospitals, the probability of the mobile phones of the patients, visitors and healthcare professionals being contaminated by bacteria and microbes in the hospital surrounding is high and may serve as a vehicle for the spread of nosocomial pathogens. The aim of the study is to conduct a survey to identify the level of awareness and to make people aware of transmission of diseases.

The method used in this survey is a set of questionnaire were prepared and given to 100 mobile phone users and were asked to answer them without any ambiguity. The data is then collected. Based on the data it was observed that the awareness among people on the presence of microbes on their gadgets were very less. The survey results was shared with the participants, explained them the causes of contamination and its adverse impact, and instigated them to awareness and suggested few preventive measures to avoid the habit of using mobile phones while being with infants, kids, dining and in washrooms. Use of an antimicrobial cleaning agent to clean the mobile phones whenever required is recommended.

Key words: Microbes, Bacteria, Anti microbial, Nosocomial pathogens, Mobile Phones.

Introduction

The global system for mobile telecommunication was established in 1982 in Europe with a view of providing an improved communications network.[1]In many countries, mobile phones outnumber landline telephones since most adults and many children now own mobile phones. At present, Asia has the fastest growth rate of mobile phone subscribers in the world. Today, mobile phones have become one of the most indispensable accessories of professional and social life [2]. With advancement in telecommunication, mobile phones are used for internet browsing, text messaging, ticket booking, listening music, GPS, and many applications. The vast majority of mobile phones are hand-held [3]. Because of the advancement and benefits of the mobile phone, the utility level became high and it is easy to overlook its hazard to health. This constant handling of the phone by different users exposes it to an array of microorganisms, and makes it a good carrier for microbes, especially those associated with the skin resulting in the spread of different microorganisms from user to user[4]. Although they are usually stored in bags or pockets, mobile phones are handled frequently and held very close to the mouth, and exposed frequently to the face. However, the mobile phones are used routinely all daylong but not cleaned properly [5]. All mobile phones under consideration were infected by several microbes, most of which belongs to natural flora of the human body[6] as well as airborne fungi. A study reported that many species of commonly found bacterias such as Staphylococcus aureus, Staphylococcus epidermidis,

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Pseudomonas aeruginosa, Neisseria sicca, Micrococcus luteus, Proteus mirabilis, Bacillus subtilis, and *Enterobacter aerogenes* were identified on mobile phone surface [9]. This indicates the necessity to maintain the mobile phones at adequate level of cleanliness. It was reported that a mobile phone can harbor more microorganisms than a man's lavatory seat, the sole of a shoe or the door handle [10].

Contamination of Mobile phones can be through sources such as human skin or handbag, phone pouch, bags, pockets, environment and food particles. These sources are links through which microorganisms colonize the phone, thus causing diseases that range from mild to chronic [4].

Although, microorganisms isolated so far by health researchers are mostly normal flora of the source of contamination, they may serve as mobile reservoirs for infections, allowing the transportation of the contaminated bacteria to many different clinical environments [11]. Further, sharing of mobile phones between people may directly facilitate the spread of potential pathogenic bacteria to the community. The potential of mobile phones as vectors to nosocomial infection has been studied before [10, 11, 12]

Mobile phones were found to carry microorganisms because count of bacteria increases at high temperature and our phones are ideal breeding sites for these microbes as they are kept warm and snug in our pockets and handbags. The important factors of contamination are the personal hygiene level, location, frequency of usage, duration of usage of the phone and possible number of users. Mobile phones may get contaminated by bacteria (such as Escherichia coli, *Pseudomonas aeruginosa* and *Klebsiella pneumoniae*), which cause hospital infections, and may serve as a vehicle for the spread of nosocomial pathogens [13]. Since the same phone is used both inside and outside of the hospital, the phone if contaminated plays a major role in the spread of hospital infection bacteria to the community at large[18, 19, 20].

Type of microorganism that occupies the hand phones the most according to studies are the Coagulase negative Staphylococcus, followed by *Staphylococcus aureus*, thirdly E.coli, and Enterococcus fecalis, followed by other microorganisms like Klebsiella pneumonia, Bacillus spp. and P.aeruginosa[1, 16].The frequent use of mobile phone can lead to nosocomial disease which is caused by bacteria like *Staphyllococcus aureus, Pseudomanas, Acineto bactor*[14].

There are various diseases associated with the mobile phone contamination. Some of the diseases are mobile phone dermatitis, in which people who spend longtime on their mobile phone develop an allergic reaction to the phone's nickel surface. The problem was identified in several published case reports [7] of patients with unexplained rashes on their face and ear. Closer investigation revealed that the reaction was caused by nickel in the mobile phone handsets [17], where it is often found in the casing or buttons, particularly in the most fashionable models. Beside this mobile phone affect sperm motility, which an experiment conducted to exposure of human sperm to a mobile phone for 5 minutes significantly decreased sperm motility [15]. Then in another study the exposure of mobile phone during pregnancy and after birth increased feotal and neonatal heart rate and decreased with increasing gestational age. Exposure to mobile phone on average 34 minutes per day was associated with decreased nocturnal concentration of hormone melatonin in adults. [4]

Methodology

In this study, a set of questions were prepared based on the articles and literature review. These questions were prepared to test the knowledge and increase the awareness of each individual who were interviewed. In recent years, the usage of mobile phones becomes unavoidable to individuals. Taking care of their health and the awareness of the possible infectious carriers with them are rare. The participants are public and college students around Penang, Perak and Kedah states in Malaysia.

Results & discussion

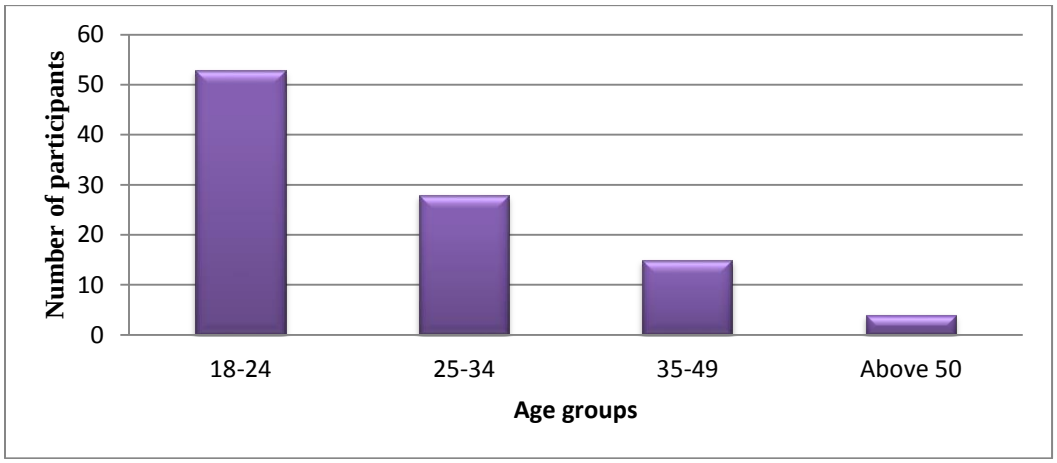

Fig 1: Percentage of mobile phone users related to age

Table 1: Percentage of mobile phone users related to age

Age groups	18-24	25-34	35-49	Above 50
No of participants	53	28	15	4

Based on the above survey it was evident that the highest mobile phone users are from the age group of 18-24 years. The advancement of technology has increased the younger generation to use their gadgets for social networking and gaming purposes mainly. They are addicted to social websites, online shopping and gaming etc and there is continuous usage of the gadgets. As the age group increases there is a decline in the number of participants. This can be attribute to numerous factors including the literacy rate, socio economic conditions and the awareness of the utility of the gadgets. In conclusion, the overall use of mobile phones is increasing across all age groups.

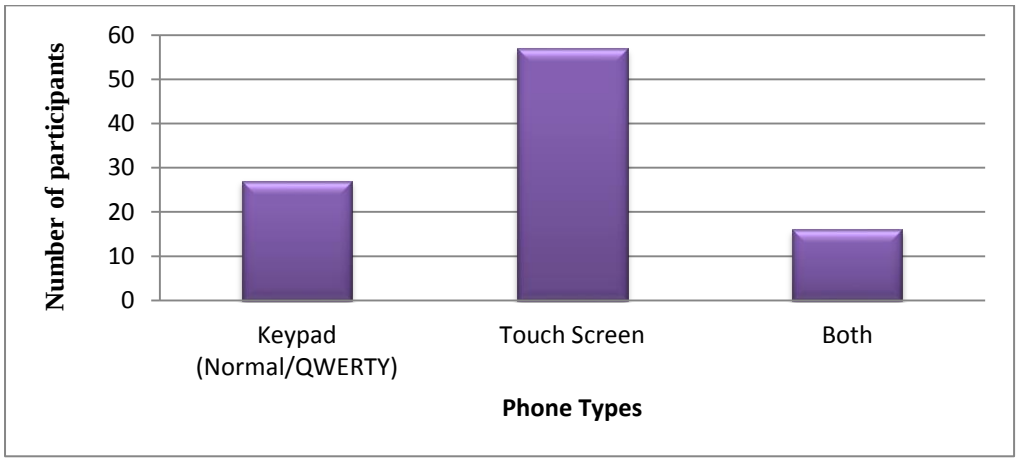

Fig 2: Percentage of types of mobile phone used

Table 2: Percentage of types of mobile phone used

Types of phones	Keypad (Normal/QWERTY)	Touch Screen	Both
No of participants	27	57	16

The type of phone used also has increases the chance of contamination and spread of microorganisms. In case of key pad, the rubber pads help the microorganism to adhere to the surface and at the nook and corners of the keypads and maintains a repository of microbes without the knowledge of the user. The touch screen on the other hand helps the exchange of microbial flora from human hands to the surface of phone. The contaminated phone when placed near to the ears and mouth during a call can easily transmit the microbes to the user. Both kinds of phones have the high risk of contamination.

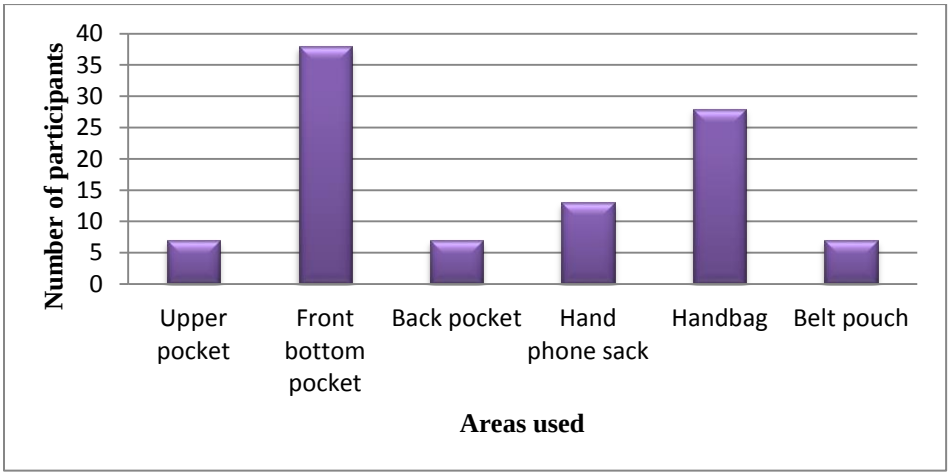

Fig 3: Percentage of various areas used to keep phones

Table 3: Percentage of various areas used to keep phones

Place for phones	Upper pocket	Front bottom pocket	Back pocket	Hand phone sack	Handbag	Belt pouch
No of participants	7	38	7	13	28	7

Mobile phones are usually stored in different location based on the utilitarian's need and accessibility. The mobile phone is not the only gadget that is kept in, it is usually placed along with other articles such as pens, spectacles, keys etc. It is very important where the phones are kept idle for long time when not in use. Males used to keep it in pant or shirt pockets whereas females used to keep inside handbags. The contamination level in front bottom pocket and handbag is higher since in front bottom pocket we tend to place more things, such as key, sweet wrappers, handkerchief etc, and also handbag for the women's, who used to keep cosmetics, combs, creams and tissues. Though they are cleaner, the chores of daily activities contaminate the places and prove to be a comfortable media for breed of microorganisms.

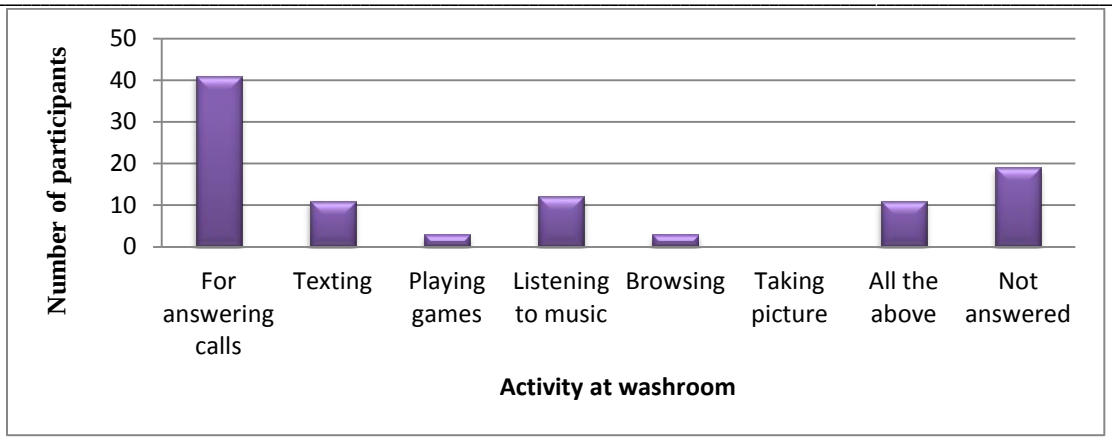

Fig 4: Percentage of people using phones at washroom

Table 4: Percentage of people using phones at washroom

Activity	For answering calls	Texting	Playing games	Listening to music	Browsing	Taking picture	All the above	Not answered
No of participants	41	11	3	12	3	0	11	19

Human dwelling places are preoccupied with different colonies of microbes, which are both useful and harmful to us. The microbial populations have to be controlled in-order to have a healthy balanced life. There are different microorganisms in the kitchen, dining table and toilets mainly E.coli, salmonella, yeast and mold, and listeria. Depending on the location, where the mobile phone is used frequently, there may be a high level of chances of contamination of those particular microbes with respect to the place. By knowing, the fact one can avoid the contamination by reducing the usage at particular areas.

From the survey, it is evident that use of mobile phones at washroom is higher. Personal hygiene is very important to avoid microbial contamination in rest rooms. The bacteria and microbes find their ways to the community through human vectors. The articles, which we use further in other places and location, transfer the infectious microbes to others. Hence, it is advisable to keep good hygienic practices and to avoid use of mobile phones in rest rooms.

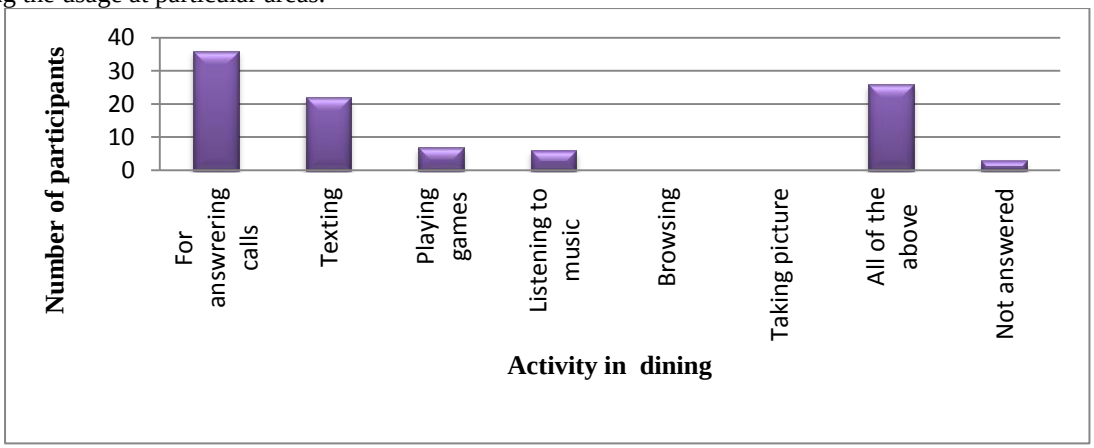

Fig 5: percentage of people using phones during dining

Table 5: percentage of people using phones during dining

Activity	For answering calls	Texting	Playing games	Listening to music	Browsing	Taking picture	All the above	Not answered
No of participants	36	22	7	6	0	0	26	3

Habituated to watch tv while eating is past scenario, the present is chatting with friends in social sites, or watching movie, playing games etc. In the survey usage of mobiles while dining, was found to be 97%. This vast majority people are using their mobiles while dining. Only 3% of people avoid phones while dining. Dining table is more suitable place for microorganism to grow faster, so use of mobile phones while dining increases the conamination levels as well as multiplication of microorganisms. Lesser activities with phones during dining decreases the level of contamination.

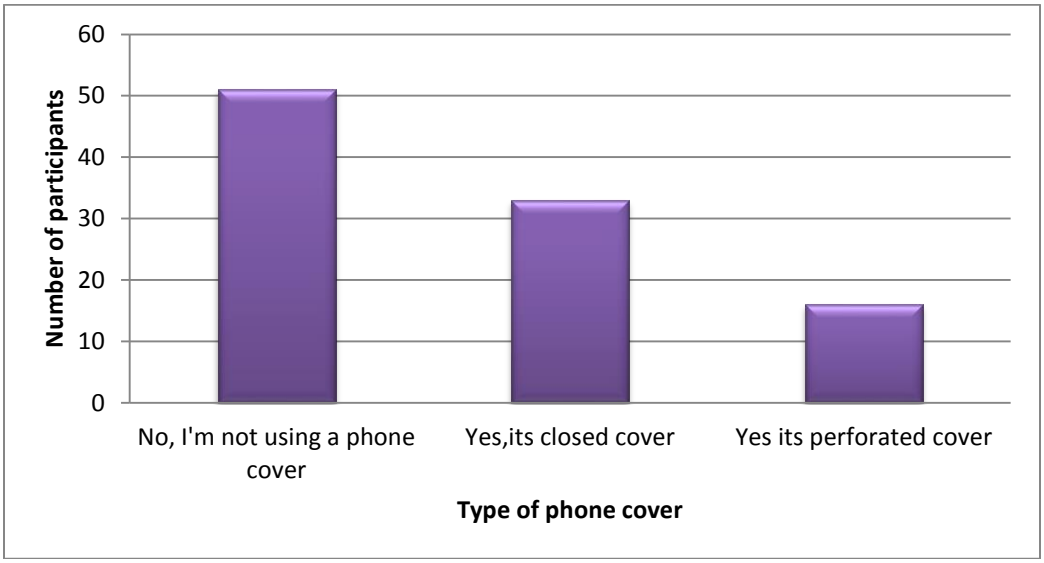

Fig 6: percentage of covered and uncovered phones

Table 6: percentage of covered and uncovered phones

Type of phone cover	No of participants
No, I'm not using a phone cover	51
Yes, its closed cover	33
Yes its perforated cover	16

Phone covers are good place for microorganism to adhere and grow. Nowadays, varieties of phone covers are available in market and it has rough or perforated surface this helps the microorganism to adhere and multiply. Handphone covers, which are perforated are more prone to microbial contamination. They protect them and provide a suitable environment to grow and breed. The pouches with perforations need to be cleaned regularly with anti-microbial agents or a basic cleaning agent to avoid microbial contamination.

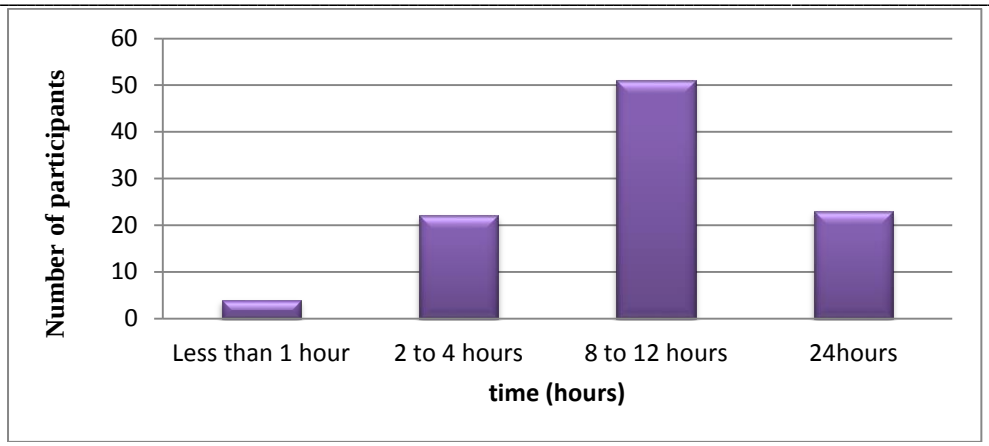

Fig 7: Percentage of duration of use of phones per day

Table 7: Percentage of duration of use of phones per day

Duration of use /day	Less than 1 hour	2 to 4 hours	8 to 12 hours	24hours
No of participants	4	22	51	23

Constant use of mobile phones increases the risk of contamination, multiplication and infection too. Most of the people in this survey use the phone for about 8 to 12 hours per day. It shows that the duration of using a handphone, increases the temperature of the phone surface, since moderate heat is sufficient for their growth, it provides a favorable surface for the growth and multiplication of microbes on the hand and is easily transmitted.

The levels of use are also a factor for multiplication and spread of microbes. Nowadays smart phones with increased applications keeps the user engaged with the mobile phones for over a period of time and increases the chances of contamination too.

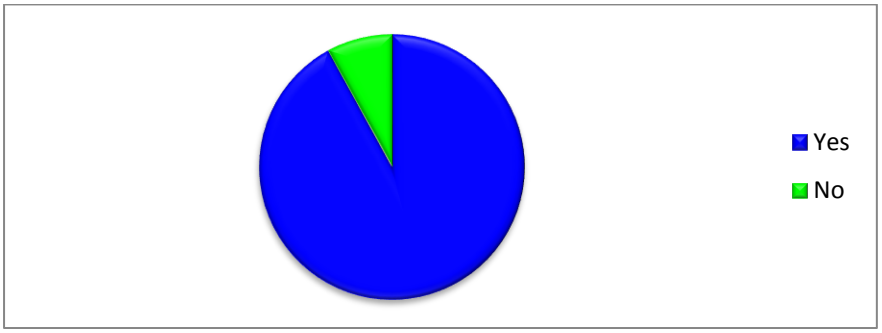

Fig 8: percentage of cleanliness of phone covers

Table 8: percentage of cleanliness of phone covers

Cleaning phone cover	Yes	No
No of participants	37	63

Cleaning is the way to reduce the microbial count on the surface of phone. Cleaning the phone covers are seldom done by users. Though the phone is serviced the body cover is not well sanitized and cleaned. Wiping of the mobile screen and body parts is performed by default on daily use but this activity does not sanitize the mobile

phone. Based on this survey, it is known that 37% of people do clean, change their pouch meanwhile 63% of them do not clean, or change their phone pouch regularly. Hence, most of them do not clean or change their phone pouch at regular time interval.

Fig 9: percentage of materials used to clean phones

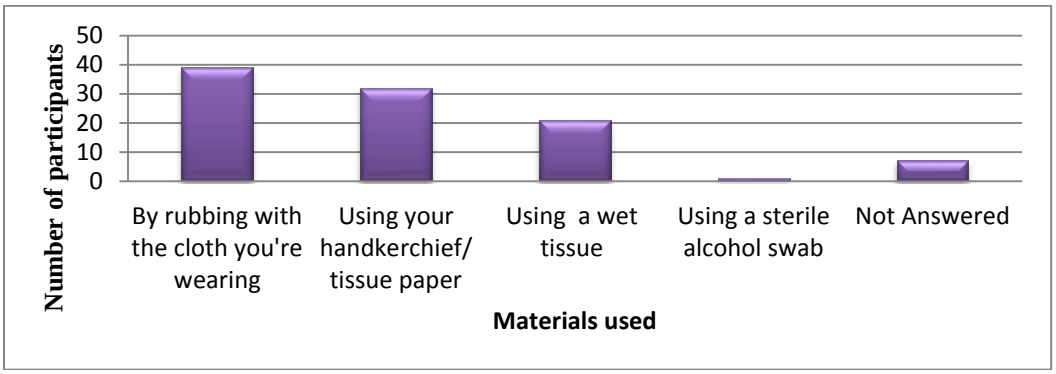

Table 9: percentage of materials used to clean phones

Materials used	By rubbing with the cloth you are wearing	Using your handkerchief/ tissue paper	Using a wet tissue	Using a sterile alcohol swab	Not Answered
No of participants	39	92	21	1	7

Cleaning methodology differs from person to person depending on their knowledge and lifestyles. So far there is no proper method developed for cleaning of mobile phone surface to avoid microbial contamination. Many people clean their phones by rubbing it on their clothes and some may use handkerchief or tissue paper to clean it rarely few use computer screen cleaning solutions to clean the mobile screens. From this survey, we came to know that mostly people clean their phones by using dry cloth, which is not a correct method to do and based on the survey we create an awareness to use anti-microbial solution to clean the surface of their mobile phones.

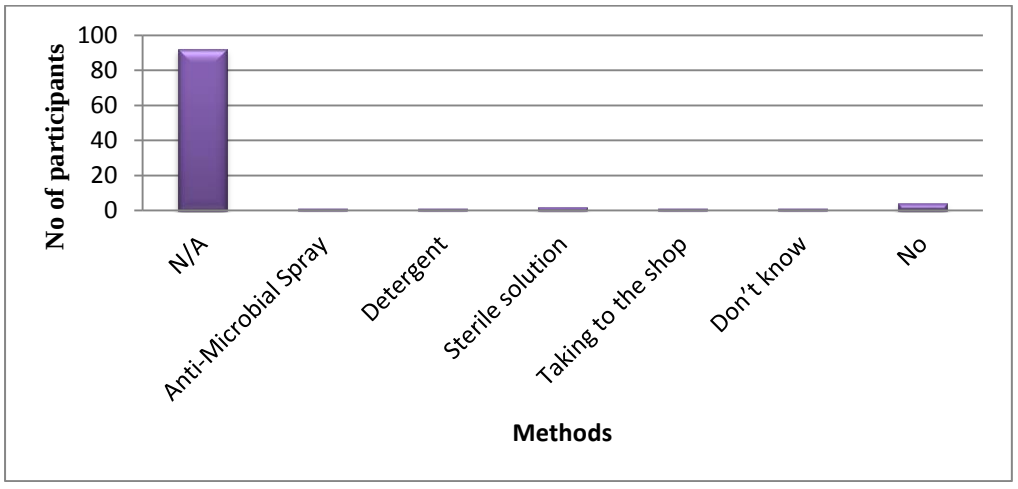

Fig 10: Proper method of cleaning phones

Table 10: Proper method of cleaning phones

Methods	Not applicable	Anti-microbial spray	Detergent	Sterile solution	Taking to the shop	Don't know	No
No of participants	92	1	1	2	1	1	4

During the survey, the interaction with the participants brought about numerous ideas and solutions for cleaning of mobile phones. Each individual participant had their own different opinions and ways of cleaning methods and procedures. There was no unique material and method to clean a hand phone. There were numerous ideas and the participants gave suggestions. Few people uses anti-microbial spray, detergents, sterile solution etc. but most of the participants don't have an idea of which is the proper method to clean hand phones and in market also no proper cleaning agent is available. The majority of the participants were unaware about the consequences the unclean phones they are handling. From this, it is conclusive that most people are unaware of any cleaning agent and procedure or methods to clean their phones and protect themselves from infections and rashes.

Fig 11: habit of keeping phone at bed during sleep

Table 11: habit of keeping phone at bed during sleep

Phone at bed while sleep	Yes	No
No of participants	72	28

The habit of handling phones on bed is inevitable. The need to do our daily day to day activities start right from the mobile phones from switching OFF the alarm in the morning to switching ON in the late night are inseparable from or needs. Easy access to information, reminders, mails and to communicate instantly has increased the use of phones especially at bedtime. This is harmful in various ways. The major cause can be infection, and the other is a close contact with the radiation signals emitted during phone usage. Many studies reveled that these radiations are potent to induce cancers. From the survey,72% of people keep their phone next to them while sleeping. About 28% of people don't keep their phones next to them while sleeping. From this data, it is understood that the awareness of mobile phone handling at bed time is very less among the growing population.

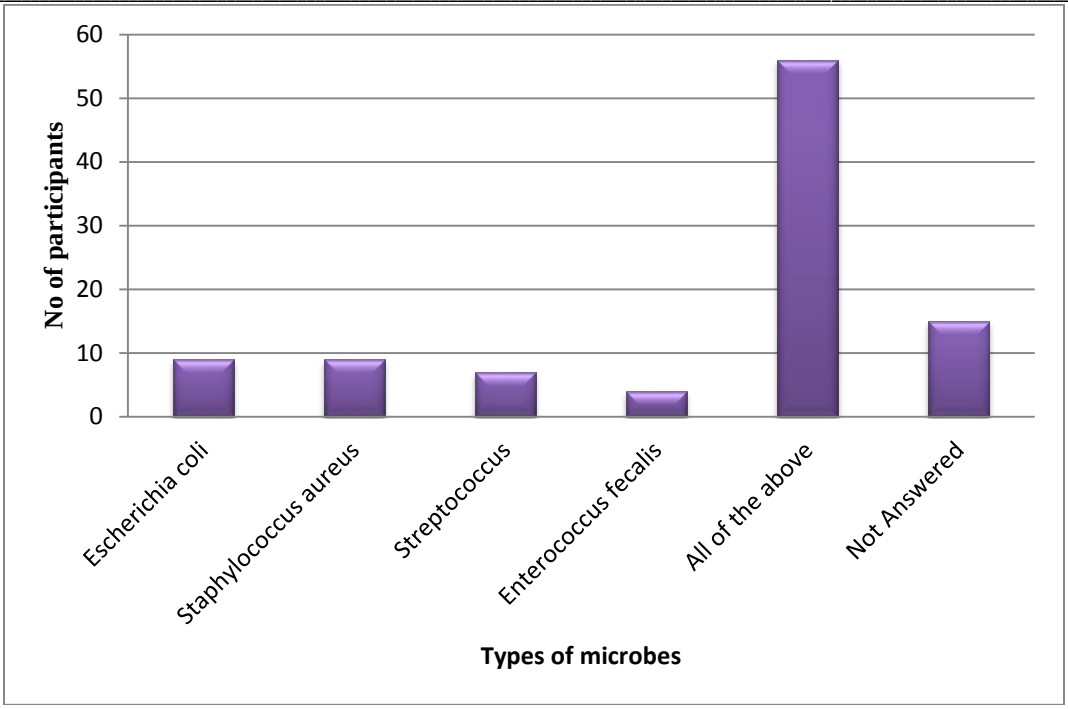

Fig 12: Expected type of microorganism in phone

Table 12: Expected type of microorganism in phone

Types of microbes	E.coli	S. aureus	Streptococcus	E. fecalis	All of the above	Not answered
No of participants	9	9	7	4	56	15

Generally, people know the names of the germs or microbes and the basic causative route and its implication at large. In depth, the basic knowledge of the microbes and microbial contamination and its prevention are often overviewed. Many are not aware of the different types of germs and microbes. Less than 50% of participants know few commonly contaminated microbes through air, water and food such as e.coli, s.aureus, etc. About56% of people answered all of the above while 15% of people did not answer for this question. From the literature survey, it is evident that various types of microorganisms contaminate the mobile phones. The literate population is aware of some of the common and known types of microorganisms so this may increase the awareness of people who had undergone this survey.

Conclusion

The objective of this survey was to find out how and to what extent the increasing populations of mobile phone users are aware of the microbial contamination through their electronic gadget. From the survey, we conclude that the participants were not much aware about the contamination in their own mobile phones. During the survey, most of the participants gave their unbiased and truthful information. They were less aware about the contamination through their mobile phones, which can affect their health. Majority of them do not know about the methods to keep their phones clean. Last but not least, this survey helps to increase the awareness among the people about the contamination through their mobile phones and it encouraged the participants to keep their mobiles clean for their well-being.

Reference

1. Maryam Mohammadi- Sichani, Vajiheh Karbasizadeh, Bacteial contamination of healthcare workers mobile phones and efficacy of surface decolonization techniques. African journal of microbiology research.2011; 5(30): 5415-5418. 16.
2. Rezk AY, Abdulqawi K, Mustafa RM, Abo El-Azm TM, Al-Inany H, Fetal and neonatal responses following maternal exposure to mobile phones, Saudi Med J. 2008; 29(2): 218-23.
3. Fatma Ulger, Saban Esen**,** Ahmet Dilek**,** Keramettin Yanik**,** Murat Gunaydin**,** Hakan Leblebicioglu**,** Are we aware how contaminated our mobile phones with nosocomial pathogens? Annals of clinical microbiology and antimicrobilas2009; 8:7
4. Dr.Mercola, NEW Urgent Warning to All Cell PhoneUsers.http://articles.mercola.com/sites/articles/archive/2012/06/16/emf-safety-tips.aspx
5. Abhinnay singh, et.al, Mobile phones in hospital settings. A serious threat to infection control practices. Occupational health & safety magazine.2012;Ohsonline.com/articles/…/mobilephones-in-hospital-settings.aspx.
6. Tagoe, DN, Gyande, VK, Ansah, EO., Bacterial Contamination of Mobile Phones: When Your Mobile Phone Could Transmit More Than Just a Call. Web med Central Microbiology.2011; 2(10): WMC002294.
7. Rutburg, et.al, Global mobile statistics, All quality mobile marketing research, 2012.
8. Koay hock eng, et.al, Hand Phone Users Survey. Malaysian communication and multimedia commission,2009.http://www.skmm.gov.my/skmmgovmy/files/attachments/HPUS-2009.pdf.
9. Kabir, O. Akinyemi, The Potential Role of Mobile Phones In The Spread of Bacterial Infections.The Journal of Infection in Developing Countries 09/2009; 3(8): 628-32. DOI: 10.3855/jidc.556.
10. Richard, R.W. Brady, et.al, TelemedJ E Health. 2012 ;18(4): 289-291.doi: 10.1089/tmj.2011.0147.
11. R.R. Brady, S.F. Fraser,M.G. Dunlop,S. Paterson-Brown,A.P. Gibb, Bacterial Contamination Of Mobile Communication Devices In The Operative Environment. The journal of hospital infection.2007;66(4):397-398
12. Karen M. Rafferty and Stephen J. Pancoast, Brief Report: Bacteriological Sampling of Telephones and Other Hospital Staff Hand-Contact Objects, Infection Control,1984; 5(11): 533-535.
13. Karabay O, Kocoglu E, Tahtaci M., The Role of mobile phones in the spread of bacteria associated with nosocomial infections. J. Infect. Dev. Countries2007; 1:72-73.
14. Joseph gil goldblatt, et.al, Infection Control And Hospital Epidemiology.28(4):500-503.
15. Sandro La Vignera, Rosita A. Condorelli, Enzo Vicari, Rosario D'Agata, Aldo E. Calogero, cellular phone and male infertility. Jopurnal of Andrology 2011; -014373.
16. Amira H. A. Al-Abdalall, Isolation and identification of microbes associated with mobile phones in Dammam in eastern Saudi Arabia. J family community med2010; 17(1): 11-14. doi: 10.4103/1319-1683.68783.
17. Mehmet Akın, Ozgun Yusuf Ozyılmaz, Tevfik Yavuz, Filiz Aykent, Faruk Ayhan Bascıftcı., Effect of different finishing techniques for restorative materials on surface roughness and bacterial adhesion. J Prosthet Dent2010; 103(4): 221-7.
18. Sweta singh, et.al, Mobile phone hygine: potential risks posed by use in the clinics of an indian dental school. Journal of Dental Education2010;74: 1153-1158.
19. Timothy Julian, et.al, Methicillin-resistant staphylococcal contamination of cellular phones of personnel in a veterinary teaching hospital. BioMed central.2012; 5: 193.
20. Tekerekoglu Ms., Infectious disease news. Am J Infect Control 2011;39: 379-381.

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