

CHAPTER ONE

1. INTRODUCTION AND OBJECTIVES

1.1. Introduction

The global system for mobile telecommunication was established in 1982 in Europe with a view of providing and improving communication network (Harish *et al.*, 2011). Today, mobile phones have become one of the most indispensable accessories of professional and social life (Kabir *et al.*, 2009). A mobile is along range, portable electronic device for personal telecommunication (Ekrakene and Igeleke., 2007). In addition to the standard voice function of a telephone, a mobile phone can support many additional services such as SMS for text messaging, email, clocks, organizers, reminders, calculators etc (Yashini *et al.*, 2013; Yusha'u., 2010).

Hands play a major role in the transmission of infection in healthcare institutions, in industrial settings and also in community and domestic settings. And the vast majority of mobile phones are hand held. The use of mobile phones by teachers and lectures may serve as a potential vehicle for the spread of pathogenic microorganisms (Ibrahim *et al.*, 2013).

Because of the achievement and benefits of the mobile phones, it is easy to overlook its hazard to health; this is against the background that many users may have to regard for personal hygiene, and the number of people who may use the same phones. This constant handling of the phone by different users exposes it to an array of microorganisms, and makes it good carrier for microbes living on each square inch of phone (Ibrahim *et al.*, 2013).

Microbiologist say that the combination of constant handling with the heat generated by the phones create a prime breeding ground for many microorganisms that are normally found on the skin The human surface tissue (skin) is constantly in contact with environmental microorganisms and becomes readily colonized by certain microbial species (Timothy *et al.*, 2012).

The use of mobile phone often occurs in hospitals, by patients, visitors, and healthcare workers, and this is one environment where hospital-associated infection is most prevalent, And nosocomial infection caused by multidrug resistant gram positive bacteria such as *Staphylococcus aureus*, and enterococcal species are growing problems in this hospitals (Oguz *et al.*, 2007).

Nosocomial are an increasing cause of morbidity and mortality in human and veterinary medicine. Concerns regarding bacterial associated with the use of mobile phone with in the hospital environment have been raised in human medicine, and studies of human healthcare worker mobile phone have reported contamination of 9_ 43% of mobile phone with bacteria known to cause hospital-associated infection (Timothy *et al.*, 2012).

A well practiced infection control plane that encompasses hand hygiene, environmental decontamination, and surveillance contact isolates is effective for prevention of such pathogenic organisms (Ibrahim *et al.*, 2013).

1.1. **Rationale**

In recent years there has been an increase in the use of mobile phones by academic and non-academic staff of educational institutions. And the use of mobile phones in the course of a working day has made mobile phones potential agents of microbial transmission the increase use of mobile phones is seen as responsible for rise in community infection rates reported by ecological findings (Ibrahim *et al.*, 2013).

Hand washing may not usually be performed often enough and many people may use personal mobile phone in the course of a working day, the potential act of mobile phones as a source of microbial transmission is considerable (Ibrahim *et al.*, 2013).

Mobile phones are continuously used all day long but never cleaned, and there are no guidelines for proper disinfection and decontamination of mobile phones, further keeping them in pockets, handbags, and snug pouches increase the possibility of bacterial proliferation due to warmth and ideal conditions. Also peoples are lives in low income area where portable water and good sanitation are limited are exposed to the risk of contracting infections (Kabir *et al.*, 2009).

There is no study about Gram-positive bacteria on mobile phone on Khartoum State, from these point of view the aim of this study focuses on determining the presence, quantum and type of Gram -positive bacteria that contaminate mobile phones.

1.3. Objectives

1.3.1. General objective

To assess the Gram-positive bacteria on mobile phones in Khartoum State community.

1.3.2. Specific objectives

- a) To isolate bacteria found on the surface of mobile phones.
- b) To determine bacterial load.
- c) To determine percentage of isolated Gram-positive bacteria.

CHAPTER TWO

2. LITERATURE REVIEW

2.1. Mobile phone

The global system for mobile telecommunication was established in 1982 in Europe with a view of providing and improving communication network. Today, mobile phones have become one of the most indispensable accessories of professional and social life (Kabir *et al.*, 2009; Mohammed *et al.*, 2014).

A mobile or cellular telephone is a long range, portable electronic device for personal telecommunication, the vast majority of mobile phones are hand held, in less than 20 years, Mobile phones have gone from being rare and expensive pieces of equipment used primarily by business elite, to a common low cost personal item. In many countries, mobile phones outnumber landline telephones since most adults and many children now own mobile phones (Ibrahim *et al.*, 2013).

At present, Africa has the largest growth rate of cellular subscribers in the world with African markets expanding nearly twice as fast as Asian markets. The availability of prepaid or pay as you go services, where the subscriber does not have to commit to a long term contract, has helped fuel this growth on a monumental scale, not only in Africa but on other continents as well (Yazhini *et al.*, 2013).

2.2. Uses of mobile phone

In recent years there has been an increase in the use of mobile phone by academic and non academic staff of educational institutions. Innovations in mobile phones have led to better

strategic life with good communication, In addition to the standard voice function of a telephone, a mobile phone can support many additional services such as short message service (SMS), email, pocket switching for access to the internet, MMS for sending and receiving photos and video, mobile phones also serve as clocks, organizers, reminders, calculators etc (Yazhini *et al.*, 2013).

Mobile phones have become part of health professionals, equipment and are used extensively for communication in a clinical setting (Mukhtar *et al.*, 2014).

innovation in mobile communication have lead to better patient control of diabetes and asthma and increase uptake of vaccination by travelers reminder by short message service(SMS), Mobile phones are increasingly becoming an important means of communication, being in expensive and conveniently small in size, they are used by doctors and other health care workers in hospital for immediate communication during emergencies, in rounds and even in operation theatres and intensive care units (Kiran *et al.*, 2009).

2.3. Sources of mobile phones contamination

Hands play a major role in transmission of the infection in health care institutions in industrial settings such as food industries and also in all community and domestic settings

Hands and instrument used by workers serve as vectors for the transmission of microorganisms, The use of mobile phones by teachers and lectures may serve as a potential vehicle for the spread of pathogenic microorganisms, also the use of mobile phones in the course of working day has made mobile phones potential agents of microbial transmission (Ibrahim *et al.*, 2013).

Hand washing may not usually be performed often enough and many people may use personal mobile phone in the course of a working day, the potential act of mobile phones as a source of microbial transmission is considerable (Ibrahim *et al.*, 2013).

Mobile phones, are seldom cleaned and are often touched during or after examination of patients and handling the specimens without proper hand washing (Mukhtar *et al.*, 2014;Usha *et al.*, 2009).

Further, sharing of cell phones between health care workers and non health care workers may directly facilitate the spread of potentially pathogenic bacteria to the community (Mukhtar *et al.*, 2014; Neha *et al.*, 2014; Lavanya *et al.*, 2013).

The constant handling of the phone by different users make it open for arrays of microorganisms, making it a harbor and a breeding ground for microbes especially those associated with the skin.

Research has shown that the mobile phone could constitute a major health hazard, with tens of thousands of microbes living on each square inch, they harbor more bacteria than a man's lavatory seat, The sole of shoe or door handle (Yazhini *et al.*, 2013; Muhammed *et al.*, 2014). Also the moisture and the optimum temperature of human body especially our palms, axillaries and other parts of the body play a significant role in contamination of these phones (Tagoe *et al.*, 2011).

Because of the achievements and benefits of the mobile phone, it easy to say over look it is hazard to health; this is against the background that many users may have to regard for personal hygiene, and the number of people who may use the same phone. This constant handling of the phone by different users exposes it to an array of microorganisms, and make it good carrier for microbes

living on each square inch of the phone, Previous studies of bacterial contamination of mobile phones had been conducted in a teaching hospital in Turkey and New York where one-fifth of cellular phones examined were found to harbor pathogenic microorganisms. In several areas of the world mobile usage has increased dramatically, and in such environments where the percentage presence of convenience. This could enhance pathogen transmission and intensified the difficulty of interrupting disease spread. With now growing evidence that contaminated fomites or surfaces play a key role in the spread of bacterial infections with antimicrobial resistance (Tago *et al.*, 2011).

Further more there are in close contact with mouth, nose, ears, hands and various clinical environments, and keeping them in pockets, handbags, and snug pouches increase possibility of bacterial proliferation due to warmth and ideal temperature conditions (Munish and Asha., 2009).

Microbiologists say that the combination of constant handling and the heat generated by the phones creates a prime breeding ground for all sorts of microorganisms that are normally found in our skin. The human surface tissue (skin) is constantly in contact with environmental microorganisms and become readily colonized by

certain microbial species, The adult human is covered with approximately 2m² of skin, with surface area supporting about 10¹² bacteria (Mnjula *et al.*, 2013).

On study done by (Usha Arora *et al.*, 2009): screened 160 mobile phones belonging to doctors and paramedical staff, out of total 160 phones, growth was obtained in 65 mobile phones, coagulase negative Staphylococcus was the most common isolated organism (Lavanya *et al.*, 2013).

The normal microbiota of the skin include among others; coagulase negative staphylococci, *Diphtheroids*, *Bacillus* sp, *Staphylococcus aureus*, streptococci (various species), *Mallassezia furfur* and *Candida* species. Others include *Mycobacterium* species (occasionally), *Pseudomonas* and Enterobacteriaceae (occasionally) (Yazhini *et al.*, 2013).

Sources of health associated infections can include medical staff, the patient's own flora, and inanimate hospital objects, hands of health care personnel are commonly contaminated with opportunistic pathogens and poor hand hygiene compliance is thought to be an important factor in the pathogenesis of health associated infections. Contaminated hands can result in direct

transfer of pathogens to patients, as well as contamination of inanimate objects. Any item that have frequent hand contact, especially in the absence of routine hand hygiene practices, are at high risk of becoming contaminated (Timothy *et al.*, 2012).

People are lives in low income countries where potable water and good sanitation are limited are exposed to the risk of contracting infections. Mobile phones are continuously used all day long but never cleaned. Further more there are no guidelines for proper disinfection and decontamination of mobile phones thus mobile phones act as resevoirs of infection which may proliferate from patient to patient in a hospital settings (Munish and Asha., 2009).

Colonization by potential pathogenic organisms on various objects such as duster, marker, pen, chalk, pagers, computer, keyboard, and mobile phones has been reported and this materials are implicated in transmission of pathogens (Gholamreza *et al.*, 2009).

A well practiced infection control plan that encompasses hand hygiene, environmental decontamination, and surveillance contact isolates is effective for prevention of such pathogenic organisms (Ibrahim *et al.*, 2013).

2.4. Role of mobile phone in spreading hospital acquired infection

Hospital acquired infection or nosocomial infection is an important problem in all modern hospitals. As early as 1861 Semmelweis demonstrated that bacteria were transmitted to the patients by the contaminated hands of health care workers (Jeske *et al.*, 2007).

hospital operating room (OR) and intensive care units (ICU) are the work places that need the highest hygiene standard, also the same requirements for the personnel working there and the equipment used by them (Fatma *et al.*, 2008).

These infections may spread through the hands of healthcare workers (HCW), thermometers, stethoscopes, and even toys in the paediatric intensive care units of hospitals as inanimate objects can be contaminated with different pathogens. HCW use mobile phones in hospital halls, laboratories, intensivecare units and operating rooms (Rawia *et al.*, 2012).

Some epidemiological studies have implicated environmental surfaces in the transmission of bacteria, few studies have been reported from India and Spain, that mobile phones may also involved in the transmission of infections in the health care systems

and threatening infection due to potential pathogens could be acquired from doctor's mobile phones in hospitals, which cause great concern to everyone (Tambekar *et al.*, 2008).

Mobile phones are widely used as non medical portable electronic devices and it is in close contact with the body. It is used for communication by health care workers in every location including OR and ICU. Studies do not include direct comparisons of transmission rates of bacteria from surfaces to hands. The risk of infection involved in using mobile phones in the OR and ICU has not yet been determined as there no cleaning guidelines available that meet hospital standards. However, the mobile phones are used routinely all day long but not cleaned properly, as health care workers' (HCW) may do not wash their hands as often as they should (Fatma *et al.*, 2008).

Nosocomial infections constitute a major problem globally with major social, economic, moral, and personal effects that increase morbidity and mortality of hospitalized patients (Neha *et al.*, 2014). It is estimated that between 5% and 10% of patients admitted to hospitals acquire HAI, but recent data suggest that this figure is on the rise. The extended duration of hospital admission and extra drugs or medical management may contribute to additional cost of

patient care. These factors increase the emotional stress of the patients and their families and may lead to severe disability and reduce the patients' quality of life. The emergence of antimicrobial resistance is an important issue associated with nosocomial infections and most nosocomial infections are often caused by antibiotic resistant organisms such as *staphylococcus aureus* and enterococcal species (Sweta *et al.*, 2010). Antibiotic resistance increases the morbidity and mortality associated with infections and contributes substantially to rising costs of care resulting from prolonged hospital stays and the need for more expensive drugs (Mukhtar *et al.*, 2014). These resistant organisms develop mainly due to antibiotic stress causing colonization and spread of resistant organisms by horizontal gene transfer majorly (Harika *et al.*, 2013).

The association between increased rates of antimicrobial use and resistance has been documented for nosocomial infections as well as for resistant community acquired infections (Tagoe *et al.*, 2011). Different studies in different parts of the world indicated aetiological agents of hospital infections may spread through the hands of HCWs, thermometer, stethoscope, and even toys in the pediatric ICUs of hospitals (Oguz *et al.*, 2007). Nosocomial infection

is a big problem in both developed and developing countries. It significantly increases the patients' length of stay in hospital resulting in higher hospital costs. Such infections can be prevented by health care workers taking proper precautions when caring for patients. Source of infection may be exogenous such as from the air, medical equipment, hands of surgeons and other staff or endogenous such as the skin flora in the operative site, or rarely from blood used in the surgery. With recent advances in the source of information, mobile phone use has become indispensable in hospitals. The use of cell phones often occurs in hospital halls, laboratories, and/or intensive care units when dealing with severe illnesses (Sham *et al.*, 2011).

Concerns regarding bacterial contamination associated with the use of cell phones (CP's) within the hospital environment have been raised in human medicine, and studies of human healthcare worker CPs have reported contamination of 9–43% of CPs with bacteria known to cause HAIs]. Comparable data are not available for veterinary medicine. Methicillin-resistant *S. aureus* (MRSA) is a critically important hospital-associated pathogen in humans, and has been found on 1.9–10% of CPs sampled in hospitals. It is also a significant concern in companion animals, both as a cause of HAI

and the potential for zoonotic transmission to veterinary personnel.

Of greater relevance from an animal health aspect is methicillin-resistant *S. pseudintermedius*, which has rapidly emerged as a leading cause of various opportunistic infections, including pyoderma and surgical site infection (Timothy *et al.*, 2012).

The potential of cell phones as vectors to nosocomial infection has been studied before.¹⁻³ These studies reported that the most commonly found bacterial isolate was Coagulase Negative *Staphylococcus* (CONS) as a part of normal skin flora. Potentially pathogenic bacteria found were methicillin sensitive *Staphylococcus aureus* (MSSA), coliforms, methicillin resistant *Staphylococcus aureus* (MRSA), *Corynebacterium* spp., *Enterococcus faecalis*, *Clostridium perfringens*, *Klebsiella* spp., *Enterobacter* spp, *Pseudomonas* spp., *Aeromonas* spp, *Acinetobacter* and *Stenotrophomonas maltophilia*. Although the contamination of cell phones of HCWs has been studied (Barhizgari *et al.*, 2012).

little information regarding the contamination of personal cell phones of people in the community exists. Bacterial flora on cell phones of HCWs may vary in composition, number and antibiotic

sensitivity, to that found on cell phones of non-HCWs (Kiran *et al.*, 2009).

2.5. Hand hygiene practices

Failure to apply hand hygiene before and afterwards can lead to contamination of operating theatre (OT) and hospitals implements, thus creating a reservoir for pathogens that can cross-infect the next patient. Such a route of microbial transmission has been well described for healthcare workers above, Contamination of OT implements with pathogens has repeatedly been demonstrated, for example, telephones, keyboards, anaesthesia machines, and i.v.stopcock sets. Operating theatre staff perform invasive procedures such as tracheal intubation, insertion of intravascular devices, and urinary catheters. This enables pathogens to bypass the normal patient defense barriers and can cause infections, for example, respiratory, urinary, and bloodstream. The overall incidence of anaesthesia-related infections within 7h after operation has been reported as 3.4%. Hand hygiene is considered the single most cost-effective public health measure in preventing HCAI. Limited data are available on adherence to hand-hygiene guidelines by OT staff, and its role in preventing OT-borne HCAI. In postal surveys among anaesthesiologists, 50% (range of 36–58%) of

respondents describe always washing their hands between OT cases. a total of 17% of anaesthesiologists report performing hand hygiene before anaesthesia, compared with 69% before lunch. Compliance of gloving guidelines is also reportedly low, with compliance rates never exceeding 50%. Observations on patient wards demonstrate that anaesthesiologists and surgeons have the lowest hand-hygiene compliance among physicians. In a controlled before-after study, the incidence of HCAI 30 days after operation was reduced from 17.2% to 3.8% after the frequency of hand hygiene in the OT had increased from 0.15–0.38 to 7.1–8.7 hand-hygiene applications per hour (Kredit *et al.*, 2011).

Recently, the Health Care Infection Control Practices Advisory Committee of the Centers for Disease Control and Prevention released new hand hygiene guidelines that promote increased use of alcohol based hand rubs (Khodavaisy *et al.*, 2011).

CHAPTER THREE

3. MATERIALS AND METHODS

3.1. Study design

3.1.1. Study type

This is a cross-sectional study.

3.1.2. Study area

This study was done on mobile phones sampled by sterile cotton swabs, that belong to the students of different universities distributed in Khartoum State.

3.1.3. Study duration

This study was carried during the period from April to August 2014.

3.2. Sampling method

Sterile cotton wool swabs moisten by sterile normal saline was used to swab the whole mobile phone surface and it was immersed in 2

ml sterile normal saline and resaved to the labratory within one hour.

3. 3. Bacteriological methods

3.3.1. Bacterial load count

Six test tubes containing nine ml of sterile normal saline were labeled 1-6. The initial dilution was made by transferring 1ml of bacterial susbention that was prepared by (immersed the swabs in two ml of sterile normal saline and mixed well using vortex) to the first tube, This was 1/10 dilution.

Immediately after 1/10 dilution has been shaken, uncapped it and transferred 1 ml to a second tube, this second represented 1/100 dilution of the original sample. The process was repeated 4 times more till having 1/1000000 dilution.

From tube 4 aseptically transferred 1 ml to petri plate and 1 ml to another petri plate, and also from tube 5 and 6. One nutrient agar pour tube removed from water bath and aseptically poured into the

petri plate that contains the bacterial suspension, the agar and sample are immediately mixed gently by moving the plate in circular motion while it rested on the tabletop, these process was repeated for the remaining five plates.

After the pour plates have cooled and agar has hardened, they inverted and incubated at 37°c for 24 hours. At the end of incubation period, all plates between 30-300 colonies was selected, and the colonies were counted on each plate, and the number of bacteria was calculated by dividing the number of colonies by the dilution factor multiplied by the amount of specimens added to liquefied agar,

number of colonies (CFUs) = NO of bacteria/ml (Jackie Reynolds ., 2011).

dilution X amount plated

3.3.2. Bacterial isolation

Bacteria that gave significant growth was sub cultured on macConkey agar and blood agar, and incubated over night aerobically at 37°c, the colonial morphology was studied and further identification was done.

3. 3.3. Gram stain

Smear was done by emulsified the colonies I pecked it from overnight growth obtained in sterile normal saline and fixed by flame, Then covered with crystal violet stain for 30-60 seconds, rapidly washed with clean water, Then covered with lugols iodine for 30-60 seconds, rapidly washed with clean water, then decolorized it rapidly with acetone alcohol for second, rapidly washed with clean water, finally covered by sufranine stain for 2 minutes and washed with clean water, the back of slide wiped and cleaned and placed the slide to air- dry and examined microscopically by oil immersion objective to report the bacteria and the reaction of gram stain (Cheesbrough., 1989).

3.3.4. Biochemical testes

Coagulase test

Coagulase produced by bacteria causes plasma to clot by converting fibrinogen to fibrin. I labeled three test tubes as control positive, control negative, and test, Then I was pipette 0.2 ml of plasma into each tube, and 0.8 ml of sterile normal saline was also added to the tubes, and I used sterile wire loop to pick tested organism and inoculate it on test tube, I inculcate colonies of *S.aureus* on control positive tube. After mixing gently the three

tubes I was incubate them at 37°c for 4 hours, formation of the clotting indicate the positive result (Cheesbrough., 1989).

Catalase test

Catalase produced by bacteria will breakdown the hydrogen peroxide into oxygen and water. I used sterile wood stick to remove several colonies of tested organism and I was immersed it in tube contain 2 ml of hydrogen peroxide, the appearance of immediate bubbling indicates the positive result (Cheesbrough., 1989).

DNA-ase test

DNA-ase produced by bacteria hydrolyzed deoxyribonucleic acid. I used sterile wire loop to inoculate the tested organism on DNA containing media and I was incubate it overnight at 37°c, after incubation end I was float the plate surface was by hydrochloric solution and the clear zone around the colonies indicate the positive result (Cheesbrough., 1989).

Mannitol salt agar (MSA) test

Bacteria ferment mannitol leading to PH change. By means of sterile wire loop I was inoculate the tested organism on (MSA) and I

was incubate it for overnight at 37°C, The growth of yellow colonies indicate positive result (Cheesbrough., 1989).

Sugar fermentation test

Bacteria ferment sugares leading to PH change. By means of sterile wire loop I was inoculate the tested organism on sugar contained tubes and I was incubate it for overnight at 37°C, the change into pink color indicate positive result (Collee *et al.*, 1996).

CHAPTER FOUR

4. RESULTS

This study was done on 203 specimens collected from mobile phones of universities students of Khartoum State. The bacterial growth was obtained from 34 (16.7%) specimens, while the remaining 169 (83.3%) specimens had no bacterial growth (Table 1 and 2), the bacterial load mean was 59×10^6 CFU/ml (Table 3). 26 (76.5%) coagulase-negative staphylococci were isolated. These were 17 (65.4%) *S. simulans*, 4 (15.4%) *S. lugdunensis*, 3 (11.5%) *S. warneri*, and 2 (7.7%) *S. hominis* (Table 4).

Table 1. Bacterial growth

Growth	Frequency	%
bacterial growth	34	16.7
No bacterial growth	169	83.3
Total	203	100

Table 2. Bacterial growth among the universities

University	No of the specimen s	Growth	No growt h
Sudan University of Science and Technology	49	7	42
Alzaeem Alazharei University	20	17	3
National Rebat University	15	8	7
Almogtarbeen University	18	2	16
University of Khartoum	18	0	18
Bahrey university	20	0	20
International Africa University	10	0	10
Alneelain University	24	0	24
University of Science and Technology	10	0	10
Omdurman Islamic University	10	0	10
University of Holly Quran and Islamic Science	9	0	9
Total	203	34	169

Table 3. Bacterial load mean on mobile phones according to university

University	Mean (CFU)
Sudan University of Science and Technology	24×10^6
Alzaeem Alazharei University	76×10^6
National Rebat University	30×10^7
Almogtarbeen University	46×10^4
Total	59×10^6

Table 4. Co-agulase negative staphylococci

Co-agulase negative Staphylococci	Frequency	%
<i>S. simulans</i>	17	65.4
<i>S. lugdunensis</i>	4	15.4
<i>S. warneri</i>	3	11.5
<i>S. hominis</i>	2	7.7
Total	26	100

CHAPTER FIVE

5. DISCUSSION

Mobile phones have become one of the most indispensable accessories of professional and social life, the vast majority of mobile phones are hand held and hands contain bacteria either as normal flora or pathogenic bacteria.

There are many studies were done to assess the presence of bacteria on mobile phone, but this is the first one in Sudan.

This study was carried out in Khartoum community represented by different universities randomly distributed. The specimens were swabs of mobile phones surfaces obtained during the routine day practices.

In this study out of 203 mobile phones, growth was obtained from 34 (16.7%) mobile phones, that means it is a low percentage of mobile phones contamination on communities compared with health care institutions as in study in India done by (Sham *et al.*, 2011) in which out of 204 mobile phones 202 had bacterial growth.

In this study bacterial load mean 59×10^6 CFU/ml, This is high bacterial load mean, the highest was obtained from National Rebat university 297×10^6 CFU/ml flowed by Alzaeem Alazharei university 76×10^6 CFU/ml, Sudan university of science and technology 24×10^6 CFU/ml and Almogtarbeen university 46×10^4 CFU/ml.

In this study the Coagulase- negative staphylococci represented 26 (76.5%) of this growth, these findings agreed with many studies such as study done by (Kabir *et al.*, 2009) in which they found Coagulase- negative staphylococci was the most prevalent bacterial agent isolated from mobile phones, study at Comibatore showing the isolation of Coagulase- negative staphylococci in 108 out of 229 bacterial isolate obtained, study done by (Usha *et al.*, 2009).

The study done by Brady *et al.*, (2006) had shown that the combination of constant handling and heat generated by phones creates a prime breeding ground for microorganisms that are normally found in our skin. This may be because these type of bacteria increase in optimum temperature and phones are perfect for breeding these germs as they are kept warm and easy to handle in pockets, handbags and brief-cases. These organisms may probably have found their entry to the phones through the skin and hand to hand mechanism, Also the poor hand hygiene played important role in this transmission.

Conclusions

Low bacterial contamination of mobile phones, High bacterial load, Coagulase-negative staphylococci were isolated.

Recommendations

1. hand washing and good hygiene practice among the users of mobile phones is advocated.
2. Mobile phones should not put on dirty surfaces.
3. .Further study can be done using more samples.

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APPENDIX

A) Preparation of reagents

1 Gram stain reagents

Suffranine stain

Safranin powder	0.5 g
Distilled water	100 ml

Lugol's iodine solution

Potassium iodide	20 g
Iodine	10 g
Distilled water	to 1 litre

Acetone - alcohol decolorizer

Acetone	500 ml
Ethanol or methanol , absolute	475 ml

Distilled water	25 ml
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Crystal violet Gram stain

Crystal violet	20 g
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Ammonium oxalate	9 g
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Ethanol or methanol , absolute	95 ml
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Distilled water	to 1 litre
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2 Physiological saline, 8.5 g/ l

Sodium chloride	8.5 g
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Distilled water	to 1 litre
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3 Hydrochloric acid, 1mol / l

Hydrochloric acid, concentrated	8.6 ml
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Distilled water	to 100 ml
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B) Preparation of culture media

1 DNase agar

This medium is best prepared from ready to use dehydrated powder , available from most suppliers of culture media .

The medium is usually used at a concentration of 3.9 g in every 100 ml distilled (concentration may vary depending on manufacturer) .

- 1 Prepare and sterilize as instructed by the manufacturer.
- 2 When the medium has cooled to 50 – 55 °C , mix well and dispense in sterile petri dishes Date the medium and give it a batch number .
- 3 Store the plates at 2-8°C in sealed plastic bags to prevent loss of moisture.

2 Mannitol salt agar

The medium is usually used at a concentration of 11.1g in every 100 ml distilled water.

- 1 Prepare and sterilize as instructed by the manufacturer.
- 2 When the medium has cooled to 50 – 55 °C , mix well and dispense in sterile petri dishes Date the medium and give it a batch number .
- 3 Store the plates at 2-8°C in sealed plastic bags to prevent loss of moisture

3 Nutrient agar

Nutrient agar is usually used at concentration of 2.8 g in every 100 ml distilled water.

- 1 Prepare and sterilize as instructed by the manufacturer.

2 When the medium has cooled to 50 – 55 °C , mix well and dispense in sterile petri dishes Date the medium and give it a batch number .

3 Store the plates at 2-8°C in sealed plastic bags to prevent loss of moisture

4 **peptone water sugares**

peptone	10 g
sodium chloride	5g
bromothymol blue	12.5g
disitilled water	1 liter

- 1 dissolve the peptone and salt in the water adjust the PH to 7.2-7.4
- 2 add the indicator solution
- 3 sterile by autoclaving
- 4 add sterile sugar solution to the sterile peptone water and mix well
- 5 dispense aseptically in 4 ml amounts in sterile Bijou bottles

containing an inverted Durham tube.

C) Bacterial count of Gram-positive bacteria among the universities

Sudan university for science and technology	
Specimen No	Bacterial count
1	200×10^4

2	78×10^4
3	116×10^6
4	115×10^4
5	70×10^6
Alzaeem Alazharei university	
Specimen No	Bacterial count
1	32×10^4
2	200×10^4
3	35×10^6
4	100×10^6
5	90×10^4
6	200×10^4
7	300×10^6
8	40×10^5
9	30×10^4
10	100×10^4
11	195×10^4
12	300×10^6
13	298×10^6
14	63×10^4
15	185×10^6
16	70×10^6
17	46×10^4

National Rebat university	
Specimen No	Bacteriazl count
1	300×10^6
2	295×10^6
Almogtarben university	
Specimen No	Bacterial count
1	38×10^4
2	54×10^4