REPUBLIC OF YEMEN
MINSTRY OF HIGHER EDUCTAION
& SCIENTIFIC RESCHERS
EMIRATES INTERNATIONAL UNIVERSITY
FACULTY OF MEDICINE & HEALTH SCIENCES

Mobile Phones of Health Care Professionals: A Silent Bacterial Threat

A Research Submitted for the Partial Fulfillment of B.S in Medical Laboratory

Submitted by

Elahm Abduallah Hassan Al- Shatter
Bushra Ahmed Ahmed Al-Razeqi
Samah Ahmed Abdulkareem Sakran
Falentina Mohammed Obaid Al-Athwari
Laila Aiman Mohammed Al-Bahlooli
Maram Mutahar Zaid Al-Mutahar
Nesma Masood Gaelan Al-Alawi
Nora Khalil Mohammed Al-Akhali

Supervised by

Assist.Prof. Dr/ Abdul-Basit Al-Ghoury

M.Sc,M.D (Head of Medical Laboratory Department, Faculty of Medicine and Health Sciences, Emirates International University)

Emirates International University

2017/ 2018

LIST OF TABLES

TABLE ***PAGE***

LIST OF FIGUERS

FIGUER ***PAGE***

Chapter one

Introduction

1. INTRODUCTION

1.1- Introduction:

Mobile phones are essential accessories that are being used in everyday life, both in its professional and private capacities. These devices are usually stored in handbags and/or in the pockets of their owners' clothing, therefore they are being touched by hands and come in close contact with human skin, not to mention that they are being placed on numerous surfaces countless number of time each and every day what causes the microorganisms to migrate from any other surface that the phone had contact with to a phone itself **(Akinyemi K, *et al.* 2009).**

Nowadays mobile phones have become an inevitable part of our lives. Their number per capita is often much larger than the population of a country **(Radicati S, 2014).** Despite the advances in modern medicine nosocomial infections still pose a risk of increased mortality and morbidity to the hospitalized patients. Hands of the Doctors and health care personnel play important role in transmission of hospital acquired infections (**Landman *et al* 2002**). Using mobile phones in hospitals can lead to improved quality of health care, especially in terms of faster communication in emergencies within hospital departments (**Jacobs M, Dagan R. 2004**). However, with all the benefits that mobile phones offer, their potential role in microorganism transmission has to be emphasized as well **(West DM, 2013).** While working with patients and touching their mobile phones, health care workers (HCW) can easily transmit microorganisms from patients to their mobile phones and vice versa. Combination of constant handling with the heat generated by the mobile phones can create a prime breeding ground for many microorganisms **(Al-Abdalall AHA, 2010)**. There are few reports on the role of mobile phones in the spread of nosocomial infections **(Karabay *et al.*, 2007; Borer *et al.*, 2005)** and even fewer in a tropical setting **(Jayalakshmi *et al.*, 2008).** Those infections are increasing day-by-day and are causing increased morbidity and mortality of hospitalized patients. Not only do they affect the general patients' health but they are also a huge financial burden **(Revelas A. Healthcare. 2012).** Many of personal instruments used daily by medical health care workers (HCW), such as stethoscope, cell phones and writing pens in the hospitals can act as carriers of the infection **(Neely, 2007).**

Presence of nosocomial microorganisms is one of the main problems in the intensive care unit (ICU) today as well. The ICU cares for patients whose vital functions are

risk, patients are connected to various tubes and the entry of pathogens is very pronounced and easily enabled. Due to their characteristics, such patients are extremely sensitive to be infected by microorganisms that can be transmitted, not only from any of the objects connected to the patient but also from mobile phones of HCWs **(Selim HS, Abaza AF. 2015).**

1.2- Aim of study:

The aim of this study was to investigate the rate of microbial contamination of mobile phones of health care workers (HCW) in ICUs, NCUs, Emergency care unit ECU and Burn CUs at Al-Jumhory Teaching Hospital, describe the microbiological profile of contaminated mobile phones and investigate the factors associated with mobile phone contamination.

Chapter tow

Literature Review

2. LITERATURE REVIEW

2.1- Historical review:

Mobile phones are essential accessories that have used in everyday life, both in its professional and private capacities. Because of the rapid progress of modern technology, this technology has contributed not only to medical fields, but also to the development of technologies for individual use. This technology includes personal computers, pagers, mobile hand-held devices (MHDs) (wireless tablets such as iPad, droids, etc.) and mobile phones (MPs), in which improvements have made at a staggering speed over the past 20 years (**Manning ML *et al.*, 2013**).

MPs and MHDs help accelerate in-hospital flow of medical information and information sharing and querying, and contribute to communications in the event of emergencies through their application and access to wireless media technology (**Ramesh J. *et al.*, 2008**). As technology in this area has evolved, MHDs that provide laboratory and imaging results, physicians are using patient data, and photographic images during bedside rounds to engage clinicians, residents, and students. Healthcare workers (HCWs) access pharmaceutical knowledge and literature by MPs and MHDs, which facilitates learning and clinical performance (**Visvanathan A. *et al.* 2011).**

However, the MP, which we often carry in our pocket and hold with clean or dirty hands, can lead to potential risks, such as noise, distractions, loss of concentration, data safety, disturbance of patient privacy, and transfer of microorganisms possibly leading to nosocomial infections (**Brady RR. *et al.*, 2009**).

Aronson *et al.* first suggested the infection potential of telephones in 1977 (**Aronson SH. 1977**). Then, in 1978, Cozanitis reported that telephones could pose a risk of transmitting infections within the intensive care unit (ICU) (**Cozanitis DA. *et al.*,**

1978). Early in the 1980s, White-Rafferty and Pancoast supported these reports with different studies (**Rafferty KM, Pancoast SJ 1984 & White DA. 1980**).

Borer performed the first study on MPs in 2005, and many articles have published since (**Borer A, *et al.*, 2005**).

2.2- Prevalence of Microorganisms on Mobile phones:

The use of MPs by healthcare workers increases the risk of repetitive cyclic contamination between the hands and face (e.g., nose, ears, and lips), and differences in personal hygiene and behaviors can further contribute to the risks (**Ulger. F. *et al.*, 2015**).

Research has shown that mobile phones could be contaminated through several sources such as human skin or hand, hunter bag, phone pouch, bags, pockets, environment and food particles, these sources are links through which microorganisms colonized the phone, which causing diseases that range from mild to chronic (**Soto *et al.*, 2006**). Although microorganisms have so far been isolated by several health researchers are mostly normal flora of the source of contamination, they can cause opportunistic infections (**Singh *et al.*, 1988**). It was revealed that there could be tens to thousands of bacteria live on each square inch of mobile phones (**Pugh, A. 2006**). In addition, it was found that the most commonly isolated bacterial pathogens are Methicillin-Sensitive *Staphylococcus aureus* (MSSA), Methicillin-Resistance *Staphylococcus aureus* (MRSA), *Micrococcus* species, *Bacillus* species, *Diphtheroids, Streptococcus viridians, Escherchia coli* and *P. aeruginosa.* (**Golblatt *et al.* 2007**), Also it was found the fungal species isolated from mobile phones include *Candida* species, *Rhizopus* species, *Aspergillus* species and *Mucor* species are known to cause human infections especially among the immuno-compromised individuals (**Yusha"u *et al.*, 2010**).

Furthermore, mobile phones and other commonly handled items have been concerned in cross-infection in the hospital environments. Nosocomial infection is an important problem in all modern hospitals. However, there are no guidelines for disinfection of mobile phones that meet hospital standards (**Trivedi, et *al.* 2011**).

It wasreported that mobile phones of healthcare workers were also contaminated with bacteria which include *Staphylococcus epidermidis, Staphylococcus aureus, Klebsiella pneumonia, E coli, Bacillus spp., Enterococci spp.,*

Acinetobacter spp. and *Pseudomonas spp.* in addition, mobiles phones had bacterial contaminations mostly with *S. epidermidis* (40%) and contamination with other nosocomial species was 13.97% (**Trivedi *et al.*, 2011**) **table 2-1**.

Table 2- 1: Relative occurrence and frequency of different isolates of bacteria isolated from mobile phones of healthcare workers (**Trivedi *et al.*, 2011**).

ed bacteria	isolates	iency (%)
ococcus epidermidis		
ococcus aureus		
la pneumonia		
spp.		
occi spp.		
bacter spp.		
nonas spp.		

Several studies indicated that most commonly microorganisms isolated from mobile phones of health care workers include *Klebsiella pneumonia, Enterobacter species, coagulase negative Staphylococcus, S. aureus, Bacillus anthracoid, Pseudomonas species, Neisseria species,* and *Acinetobacter species, Enterococcus feacalis, Escherichia coli, Serratia spp, Proteus vulgaris* which are antibiotic resistant organisms and responsible for nosocomial infections. (**WHO, 2002; Karabay *et al.*,**

2007; Kilic *et al.*, 2009; Teng *et al.*, 2009, Chawla *et al.*, 2009; Gunasekara *et al.*, 2009). Furthermore, mobile phones had 18 times more bacteria than toilet handles and 16% of mobile phones were contaminated with *E. coli* and 1 in 6 cell phones were contaminated with fecal matter in U.K, respectively (**Andrew, 2010 & Sora, 2011**).

2.3- Mobile phones and Bacterial Pathogens:

2.3.1- Staphylococcus aureus:

Staphylococcus aureus is gram-positive cocci and is normally found on the skin, as well the respiratory tract of humans (**Chaibenjawong and Foster, 2011**). *S. aureus* can cause a host of various illnesses, from minor skin infections to much more serious diseases, which include pneumonia and bacteremia. Likewise, *Staphylococcus aureus* is one of the most common causes of nosocomial infections (**Nikolic *et al.*, 2011**). Furthermore, **Sumritivanicha *et al.* (2011)** described Staphylococcus aureus is a common bacterium found on the skin and in the noses of up to 25% of healthy people and animals can cause illnesses from pimples and boils to pneumonia and meningitis, and is a close relative of methicillin resistant *Staphylococcus aureus* (MRSA). *Methicillin-resistant Staphylococcus aureus* (MRSA) is of particular importance in the medical community, as it has evolved resistance to beta-lactam antibiotics (**Holmes and Williams, 2010**).

Staphylococcus aureus is a well-known micro biota of the human skin which could be transferred into mobile phone via hand to hand or contact (**Suganya and Judia, 2012; Yusha"u *et al.*, 2012**). *S.aureus* is an important pathogen due to a combination of toxin-mediated virulence, invasiveness, and antibiotic resistance nature of the organism. This organism causes a wide range of diseases, including endocarditis, osteomyelitis, toxic-shock syndrome, pneumonia, food poisoning and carbuncles. *S.aureus* can resist pH from 4.2 to 9.3, with an optimum of 7 to 7.5, sodium chloride

concentrations (up to 15% Na CL) and can grow in a wide range of temperatures from 7° C to 48.5°C with an optimum of 30 to 37°C. These parameters enable the organism to grow in a wide range of environments. Several reports indicated that the occurrence of *S.aureus* mobile phones (**Tambekar *et al.*, 2006; Khivsara *et al.*, 2006, Ekrakene & Igeleke, 2007; Akinyemi *et al.*, 2009**).

Recently, it was found that the isolation rate of various organisms for all of the reviewed studies; in 39 studies, *S. aureus* was the most frequently isolated microorganism (n = 26; 66.7%), and CoNS again ranked in second place (n = 19; 48.7%), **figure2 -1 (Ulger *et al.* 2015)**.

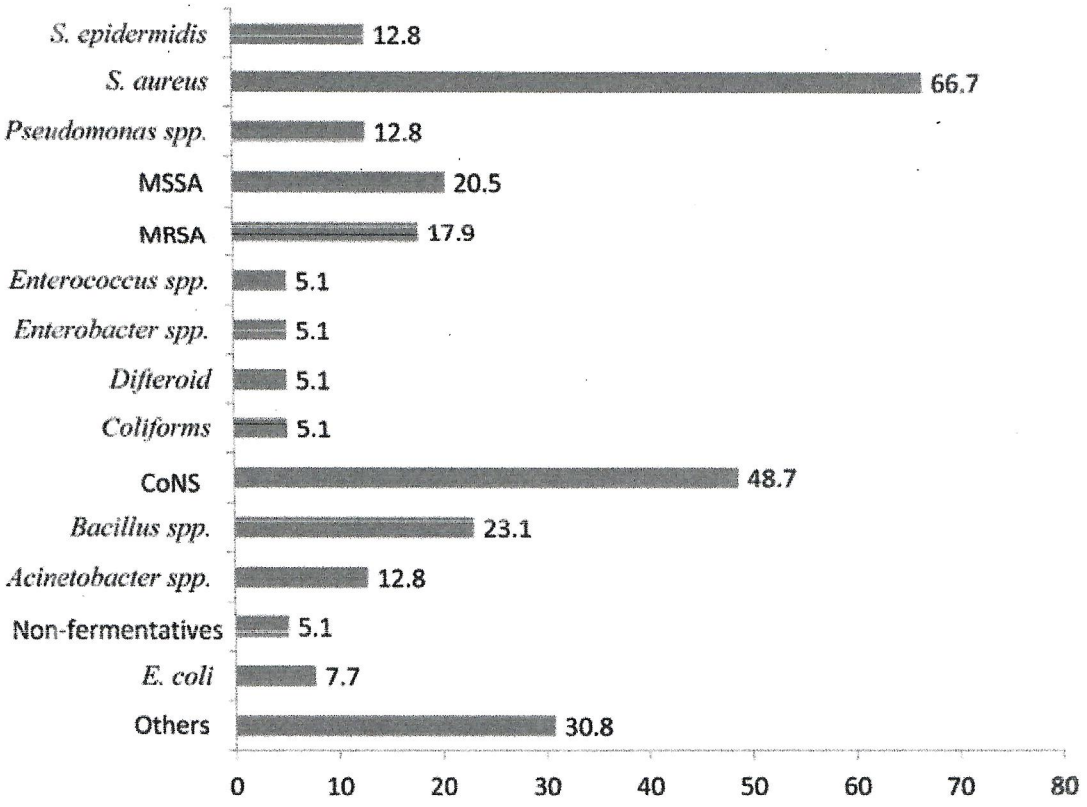

Figure2- 1. Distribution of main types of microorganisms isolated from all mobile phones **(Ulger *et al.* 2015)**.

2.3.2- *Staphylococcus epidermidis:*

Staphylococcus epidermidis is another most commonly found species on phone surfaces (**Nikolic *et al.*, 2011**). The organism is gram-positive cocci, and is a commensal that makes up a large part of the normal human skin flora. Regardless of this, according to Hedin (**1993**) *S. epidermidis* has the potential to be a pathogen, particularly in hospital patients with compromised immune systems. While *S. epidermidis* has not shown the ability to colonize and grow on phones, electronic devices can act as vectors that transmit the bacteria through contact. This poses a problem as *S. epidermidis* can be transmitted onto other plastic surfaces, including those that are inserted into the body such as catheters and prosthetic implants. As **(Otto 2009)** reported when inside the body, these surfaces provide an accommodating environment for *S. epidermidis* to persist and even grow into biofilms. In addition, it was revealed the contamination rate of *S. epidermidis* on phones is constant throughout the year, with little to no seasonal variation **(Abdollahi and Mahfouzi, 2010)**.

2.3.3- *Enterobacteraceae:*

The Enterobacteriaceae is a family of Gram-negative, non-spore-forming bacteria and is one of the most important groups of bacteria known to human. This family includes a number of important foodborne pathogens, such as *Salmonella*, *E. coli*, and *Shigella*. A study conducted elsewhere indicated that among the isolates, 18.2% were *Shigella spp.* and *Salmonella spp.* (**Tagoe *et al.* 2011**). It was documented that the presence of *E. coli* and *Salmonella spp.* on the mobile phones indicates the presence of faecal contamination, which can result in community-acquired infections and disease outbreaks. Consequently, mobile phones can be heavily colonized by high quantities of pathogenic bacteria and the potential sources of disease transmission

requiring application of sound personal hygiene as preventive methods (**Prakash & Pawar 2012**).

2.3.4- Coliforms:

Coliform bacteria include a wide range of aerobic and facultative anaerobic, Gram-negative, non-spore-forming bacilli. They are mostly inhabitants of gastrointestinal tract of animals including human, which include *E. coli*, *Klebsiella spp* and *Enterobacter spp.* A study conducted in Nigeria by **Ilusanya *et al.* (2012)** identified that mobile phones of food venders were positive for *Escherichia coli.* Besides, report by **Goldblatt *et al.* (2007)** elsewhere revealed that the presence of coliforms on mobile phones. Furthermore, report from Nigeria by **Akinyemi *et al.* (2009)** has shown the presence of coliforms on mobile phone samples. Therefore, the presence of fecal coliforms like *E. coli* on the mobile phones indicates that the fecal contamination of mobile phones and the existence of sanitary problem among the users. As **Souza (2005)** reported coliforms are representative constituent of the fecal microbiota and are indicator organisms their detection in mobile phones may also indicates the potential occurrence of other microorganisms which could be even more pathogenic to human beings.

2.3.5- Salmonella spp.:

In many developed countries, *Salmonella* is the second most common cause of bacterial foodborne illness after *Campylobacter. Salmonella* are widely distributed in nature with a diverse range of host species including mammals, birds, fish and reptiles (**Harris *et al.*, 2003; Chris *et al.*, 2011**).

Studies have revealed that mobile phones were contaminated with *Salmonella spp.* and have been implicated in a few outbreaks of mobile phone related *Salmonella* problem (**Prakash and Pawar, 2012, Tagoe *et al.*2011**). Another study on mobile

phones contamination reported that among the isolates 3% was *Salmonella spp.* In addition, from India, it was documented that mobile phones used by medical professionals, 13.89% was *Salmonella typhi* positive (**Prakash and Pawar, 2012**).

2.3.6. Acinetobacter baumannii:

Acinetobacter baumannii is gram-negative coccobacilli, which are characterized by their truncated rod shape. The organism is ubiquitous that can be found in the normal skin flora, as well as in soil and bodies of water, amongst others (**Peleg *et al.*, 2008**). Furthermore, these scholars have mentioned that strains of *A. baumannii* resistant to multiple antibiotics have been arisen, which combined with its ability to persist in hospital environments for extended periods of time, has led to its emergence as a potentially dangerous nosocomial pathogen.

In other report, too *A. baumannii* has been reported to contaminate cell phones, hospital phones, as well as other electronic devices such as keyboards (**Borer *et al.*, 2005**). Moreover, some strains have also shown to be extremely resistant to desiccation, surviving for several months with little to no reduction in the number of colonies (**Wendt *et al.*, 1997**). Nosocomial *Acinetobacter baumanniiis* commonly acquired through cross-transmission because of its propensity to survive in the hospital environment and persistently contaminate fomites (**Girma G. 2015**).

2.4-Antimicrobial Resistance of Microorganisms isolated from Mobile phones:

According to the **WHO (2002)**, anti-microbial resistance is one of the world"s most serious public health problems. 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 (**Struelens, 1998**). On the other hand, currently growing evidence has shown that contaminated fomite or surfaces play a key role in the spread of bacterial infections with antimicrobial resistance (**Hota, 2004; Butcher and Ulaeto, 2005**). Moreover, antimicrobial resistance is a global phenomenon that has resulted in high morbidity and mortality because of treatment failures and increased health care costs (**Laxminarayan & Malani, 2007**). According to the report of **Brady *et al.* (2006)** and **Brady *et al.* (2009),** antibiotic-resistant strains of bacteria have been isolated from mobile phones leading to concern regarding cross-contamination and infection, especially in hospital environments. Hospital acquired infection caused by multi-drug resistant (MDR) gram-positive organisms such as *Staphylococcus aureus* and *Enteroccal species* are a growing problem in many health care institutions (**Singh *et al.*, 1998**).

According to report by **Sepehri *et al.* (2009),** there is marked resistances in bacteria isolated from mobile phones to commonly used antibiotics were observed. Accordingly, 50% of the microbes isolated from mobile phones had shown susceptibility for only 41.67% of the tested antibiotics whereas 33.33% of the antibiotics that means, Ampicillin, Penicillin, Cloxacillin and Cefuroxime were 100% ineffective (**Khan & Malik, 2001**).

Study by **Tagoe *et al.* (2011)** on antimicrobial sensitivity testing revealed that over 75% of the isolates were susceptible to the Fluoroquinolone and Ceftriaxone antibiotics that were evaluated. Correspondingly, in previous reports in Nigeria had shown that Fluoroquinolones and third-generation cephalosporin are effective against a wide range of bacteria, and are expensive and less abused than other antibiotics (**Akinyemi *et al.*, 2007**). *Salmonella spp.* and *Shigella spp.* showed the most resistance to the antibiotics (87.5%) each whilst *Escherichia coli* were the

most susceptible bacteria to the antibiotics (75%). Amikacin (71.4%) and Gentamicin (63.6%) were the most effective antibiotics whilst Ampicillin, Penicillin G, Cloxacillin showed the least effectiveness with 100% bacteria resistance (**Tagoe *et al.*, 2011**). *S. aureus* isolated from mobile phones have shown resistant to methicillin, amoxicillin, Pencillin G, augmentin, Erythromycin and lincomycin (16.9%).All the isolates of mobile phones were susceptible to Ofloxacillin while resistance to Pefloxacin. Resistance to Gentamycin, Cotrimoxazole, and Tetracycline ranged between 75% and 83% was also documented. With the exception to Ofloxacin resistance to other Fluoroquinolones indicates the increasing tendency as reported previously (**East *et al.*, 2001**). However, **Ulger *et al.*, (2009)**, had documented the isolation of methicillin-resistant *S. aureus* strains from the mobile phones of health care workers.

On the other hand, a recent study conducted by **Kawo and Musa (2013)** in Nigeria, on antibiotic susceptibility profile of bacteria associated with mobile cell phones indicated that total resistance of the *Salmonella species* against some of the tested antibiotics (Gentamycin, Perfloxacin and Streptomycin) and low susceptibility of the isolates to Gentamycin. Similar results were recorded in previous studies by **Tagoe *et al.* (2011)** conducted elsewhere, which represent public health problems.

It was f that, *Pseudomonas* and *Acinetobacter species* isolated from mobile phones showed multi drug resistance to commonly used antibiotics. Furthermore, they also documented that the ability of these organisms to contaminate mobile phones is expected as they are multi drug resistant organisms and are responsible for infection in predisposed patients in the hospital (**Trived *et al.* 2011**).

2.5- Methicillin-Resistant-Staphylococcus aureus (MRSA):

The major reservoirs for MRSA are colonized or infected patients and, occasionally, personnel in the hospital **(Boyce 1992).**environmental surfaces frequently touched by health care workers are commonly contaminate in the rooms of patients colonized or infected with MRSA. Nosocomial infection result in sever health and financial difficulties for patient and healthcare facilities . Multiplying resistant strain of *S.aureus* , particularly MRSA, pose a major clinical and epidemiological problem in hospitals , as they are easily transferred among hospital staff and patients (Neely et al,2005) . It was also found the contamination of the inanimate environment with MRSA occurred when either infected or colonized individuals were present in hospital room . It was demonstrated how the hands (gloved or otherwise) of the healthcare workers can become contaminated ,presumably by touching surface in the immediate vicinity of an infected patient **(Boyce , 1997 ,Bhalla *et al*, 2004).** More clearly , it was found that 65%of nursing staff that had directly treated an infected individual contaminated their gowns/uniforms with organism MRSA contamination of gloves was also observed in 42%of personnel who had no direct contact with patient , but had touched surfaces in infected patients room **(Boyce *et al*, 1997).**The proportional of hospital surfaces contaminated with MARSA has varies considerable in published studies, ranging from 1%-27% surfaces in patient rooms or regular hospital wards, and from a few percent to 64% of surfaces in burn units MRSA patient **(Boyce, 2007)** Ratesof environment contamination also vary on the basis of the site of infection in source patients contamination is more common in the rooms of the patients with infected urine or wounds that is in the room of patients with bacteremia only (Boy et l,1997) .In the other study , contamination is more common in the rooms of patient with heavy gastrointestinal colonization by MRSA at other body sites ,but not in their stool (Otter et al , 2006) .Also , the inanimate environment of burns units tends to be more heavily contaminated than that of the non-burn units. MRSA contamination rates range from 1% to18%in non-burn wards and up to 64% in burns unit (Boyce et al , 1997). Hydrotherapy rooms associated with burn units have particularly high contamination rate (Boyce et al ,1992). S.aurus has been isolated from hospital mattresses during an outbreak . Most mattresses padding and leaks in mattress covers and common finding during outbreaks (Ndawula e al ., 1991).

It was found that at least 16% of patients were colonizes with MRSA . A significant factor contributing to the transmission of microorganisms is their ability to survive on environmental surfaces(Hails et al .,2000). It also found that keyboard and mice might serve as a source for the transmission of microorganism. Computer keyboards and mice might serve as a source for the transmission of microorganisms in the intensive care unit (ICU) (Hartmann et al., 2004; Anastasiades et al., 2009).

Qualitative bacteriological sampling was used to show that the colonization rate for keyboard and mice with potentially pathogenic bacteria was greater than that of the other surfaces in the ICU (Hartmann et al., 2004).

Studies have shown contamination of common hospital surfaces such as room door handles (Oie et al.,2002), sterile packaging (Dietze et al., 2001), gowns and gloves (Boyce et al., 1997), mops (Oie and Kamiya, 1996), ward fabrics and plastics (Neely and Maley., 2000), health care works pens (Banerjee et al., 1999), keyboard and taps (Bures et al., 2000; Hartmann et al., 2004; Anastasiades et al., 2009), curtains (Trillis et al., 2008) , stethoscope (Cohen egt al ., 1997) , ultrasonic nebulized (Schultsz etal ., 2003), ventilation girlls (cotterill etal.,1996 ;kumari et al., 1998) , blood pressure cuff (de Gialluly et al.,2006) and telephones and mobiles (Ciragil et al.,2206 ,trivedi et al ,. 2011) by MRSA. In addition to this , there is mounting indirect evidence of a link between contaminated surfaces and nosocomial infection (Boyce et al., 1997 ;Talon , 1999 ; Bhalla et al., 2004) .It was shown by molecular methods that identical or closely related isolates were recovered from the patient and their environment ,suggesting possible environmental contamination of the isolation rooms , possibly contributing to endemic MRSA (Sexton et al.,2006).

2.6- Identification of isolates:-

S. aureus identified isolates were further checked for their susceptibility to Methicillin using Oxacillin (1 µg) and Cefoxitin (30 µg) discs on Mueller Hinton agar plates supplemented by 4% NaCl by disk diffusion method described by Bauer and **Kirby (Bauer AW, 1966).** The inhibition zone diameters were measured and interpreted as recommended by the Clinical and Laboratory Standards Institute **(CLSI. 2014).**

2.7- Influence of setting, health personnel demographics and clinical role in cell phone contamination:

As referenced before, the results obtained vary according to the clinical setting involved. Cell phones from health personnel working in intensive care units showed a higher rate of bacterial contamination compared to health personnel working in other clinical areas (**Ustun C, *et al.* 2012**). This relationship was not observed in any other of the studies analyzed, although mention an high contamination rate in cell phones from professionals working in inpatient settings such as intensive care units, operating theaters, dialysis units, burnt centres and others (**Stuchi R, *et al.*, 2013 & Graveto J. *et al.*, 2018**).

Regarding health personnel's cell phones, and according to all the studies analyzed, demographic data such as age, gender and education level did not show any impact on bacterial contamination rates. However, cell phones belonging to doctors present a higher infection rate followed by health technicians and finally nurses (although with no statistical significance) (**Brady R, *et al.*, 2009**). In accordance, one of the studies examined the bacterial contamination rate of cell phones and the hands of the respective holders of such equipment having obtained a higher risk of contamination in doctors' phones, followed by support workers and, finally, nurses (**Ulger F, *et al.*, 2015**).

In one study, cell phones from both health personnel phones involved in direct contact with patients and hospital administrative/clerical professionals and managers were analyzed, concluding that cell phones belonging to the latter group had a higher microbial contamination rate (78%) and a greater number of colonies (of which 29% were considered pathogenic specimens) (**Srikanth P, *et al.*, 2010**).

With regard to health personnel, doctors' cell phones showed higher infection rates. In contrast, and according to **Koroglu *et al,*** which also analyzed the equipment of these two groups in the hospital context, the infection rate among health personnel directly involved with patients and other professionals in the hospital setting were similar (95% and 91%, respectively) (**Koroglu *et al*, 2015**).

2-8-PREVENTIVE STRATEGIES TO DECREASE RISK OF CROSS INFECTION IN CLINICAL CONTEXT:

In order to combat contamination of cell phones by microorganisms, there are three preventive strategies of capital importance: **washing their hands before and after the use of such equipment, regular and standardized disinfection of cell phones and education of health personnel in relation to this theme (Graveto J. *et al.*, 2018).**

2-8-1- Hand hygiene:

Some studies consider the adoption of strict policies regarding hand hygiene, glove use adapted to the various clinical interventions and adequate waste management policies, which will positively impact and influence contamination rates.**(Ustun C, *et al.*, 2012 &Mark D, *et al.*, 2014).** The hands of health personnel are considered the main source of contamination of cell phones, hence the importance of hand washing in breaking the hands-phone-health professional's face cycle of contamination, given the high risk to the health personnel themselves in the sense that the cell phone usage increases the risk of contact of pathogens with "gateways" to the human body such as the ear canal, nasal cavity, eyes and oral cavity **(Brady R, *et al.*, 2009).** This finding may explain results obtained in one particular study, which found colonization by *Staphylococcus aureus* and *Streptococcus mitis/salivaris* not only in health personnel' cell phones, but also in their nasal and oral cavity **(Stuchi R, *et al.*, 2013).**

2-8-2- Use disinfection:

Cell phone disinfection is understood as the most consensual preventive strategy among authors. Disinfection should meet the specific needs of each equipment, which hinders the diffusion of generalized procedures in this regard, and the manufacturer's recommendations must be respected in order to not jeopardize the orderly functioning and integrity of the equipment. Some of the authors identified isopropyl alcohol as the most adequate disinfecting agent for such equipments (**Shakir I, *et al.*, 2015**). The allusion to ethyl alcohol 70%, 0.5% chlorhexidine and ammonia solution was referenced by some authors, although the it has been verified that these options did not show similar and as satisfactory results in combating contamination of cell phones by microorganisms (**Brady R, *et al.*, 2009).**

2-8-3- Education of health personnel:

Continuous education and training has been referred to as the other major preventive strategy, which could be justified by the passive and uninformed attitude demonstrated by various health professional groups involved. Although cell phones are widely used in clinical practice, they are not considered medical equipment, which eliminates the requirement for manufacturers to publish disinfection protocols in several of the countries involved in the studies analyzed (**Brady R, *et al.*, 2009**). Health institutions, regardless of the specifics of each device should implement guidelines for that express the need for regular disinfection of all professional's cell phones, their restricted use or ban in all units or risk-added services (intensive care units, operating theater, etc.) and strengthening of hands hygiene policies before and after the use of the devices (**Ulger F, *et al.*, 2015**).

In addition to these findings, some authors consider that institutional guidelines for other information and communication devices such as computers (and all its components) and tablets are more in number, given the fact that these equipments belong to the health institutions, but the same position should be taken in respect of health professional's cell phones (**Koroglu M, *et al.*, 2015**). In addition to these facts, surveillance and internal legislation developed by health institutions on the impact of cell phone use in the clinical setting is very small, and mostly focused on aspects such as patient confidentiality, clinical information governance, noise in the clinical areas, interference with medical equipment and distraction of professionals that may lead to clinical errors (**Brady R, *et al.*, 2009**).

The future use of nanotechnology based on substances such as titanium dioxide, oxide silver or zinc dioxide could prove useful in creating protective films with possible impact on reducing contamination by microorganisms (**Ulger F, *et al.*, 2015**).

Chapter Three

Subject, Material & method

Subjects, Materials and Methods

3-1.Subjects:

3.1.1- Study area and period:-

The study was conducted at Al-Jumhory Teaching Hospital, which is located in Sana'a city. Al-Jumhory Teaching Hospital is one of the biggest tertiary level referral and teaching hospitals in the Sana'a city. A large number of people from the surrounding governorates and nearby regions visit the hospital both for inpatient and as an outpatient treatment. The study was carried out from April 2018 - July 2018.

3.1.2. Study design and population:

A hospital based cross sectional study was conducted. Information and clinical samples, which were relevant to the study, were collected from the study populations.

Mobiles of all staff or heath personnel including doctors, nurses and dustman in the intensive care unit (ICU), neonate care unit (NCU), emergency unit (E.U) and burns care unit (BCU) or wards whose mobiles suspected to harbor bacterial pathogens.

A questionnaire was used for data collection of all the relevant information on tested mobile phones (**Appendix-1**).

3.1.3. Sample size and sampling technique:

The study samples were taken from mobile phones of all staff or heath personnel including doctors, nurses and dustman in the intensive care unit (ICU), neonate care unit (NCU), emergency unit (E.U) and burns care unit (BCU) or wards whose mobiles suspected to harbor bacterial pathogens. The sample size (n) was calculated by taking prevalence of bacterial contamination of mobile phones of heath care workers as 50% based on various studies from across the country. The allowance of error (E) was taken as 15% of prevalence rate at 5% level of significance.

Contingency for the unknown circumstance was 10%.

$$\mathbf{n} = \frac{(Z\alpha/2)^2 \times P(1-P)}{E^2} = \frac{(1.96)^2 \times 50(26)}{(10.80)^2} = 43 + 10\% = 53$$

The resulting minimum sample size required amounted to 53 mobile phones. Sterile swabs moistened with sterile demineralised water were rotated over the surface of the mobile phone by rotating the swabs on the keys, mouthpiece, and earpiece surfaces.

swabs were streaked over Blood agar supplemented with 5% sheep RBCs and MacConkey agar plates.

3.1.4- Inclusion criteria:

All healthy personnel mobiles including doctors, nurses and dustman in the intensive care unit (ICU), neonate care unit (NCU), emergency unit (E.U) and burns care unit (BCU) or wards There was no age limit and gender bias for study.

3-2- Materials:

3.2-1 Media preparation:

3.2.1 .1. Blood Base Agar (Accumix):

A medium used with the addition of sterile blood for the isolation, cultivation and detection of haemolytic activity of *streptococci* and other fastidious pathogenic organism. Blood Base Agar (Accumix) 500 g was prepared according to manufacturer's instructions labeled on the bottle.

LOT	:BAB-1706

C	EP	CMC Medical Devices & Drugs S.L., C/ Horacio Lengo No.18, CP 29006, Malaga, Spain.

3.2.1.2. MacConkey Agar (Accumix)

For studying carbohydrate fermentation reaction of *coliforms*

MacConkey Agar (Accumix) 500 g was prepared according to manufacturer's instructions labeled on the bottle.

LOT	AB-1704

C	EP	CMC Medical Devices & Drugs S.L., C/ Horacio Lengo No.18, CP 29006, Malaga, Spain.

3.2.1.3. Muller Hinton Agar (Accumix)

Antimicrobial Disc-diffusion susceptibility testing (Low levels of sulfonamide and trimethoprim antagonists, thymine and thymidine, calcium and magnesium).

Muller Hinton Agar (Accumix) 500 g was prepared according to manufacturer's instructions labeled on the bottle.

LOT	MHA-1713

C	EP	CMC Medical Devices & Drugs S.L., C/ Horacio Lengo No.18, CP 29006, Malaga, Spain.

3.2.1.4. Normal saline (SODIUM CHLORIDE INJ. 500ml) Each 100 ml contains:-

Sodium Chloride 0.9 g

Water for Injection 100ml

Lot. No. : 150707

Mfg. Data: 07/2015

Exp. Date: 07/2018

3.2.1.5. TRANSBOT SWAB COTTON (CITOSWAB®)

C	REP

Sulte B, 28 Hertey Street, W1G 9QR, U.K.

www.CE-Marking .EU

REF	2120-0001

LOT	150013

3. 2.1.6.Petridish:

3.2.1.7. Microscope: - LABO® JAS-ANZ®

Labo Microsystems Gmbh Germany

~220V, 50 Hz

HALOGEN LAMP 6 V-20W

FUSE 1.0A

3.2.1.8. Gram stain:

3.2.1.9. Flask, slender, glass slide, Lenses oil and loops.

3.2.1.10. Electronic Balance (SHIMADZU CORPORATION)

TYPE AY220

NO. D440620343

CAPACITY 220g

READABILITY 0.1mg

Cert. No. T5763
321-61961-02

Log No. A01

3.2.1.11. Refrigerator

3.2.1.12. Autoclave (Steam Autoclave Sterilizer high Pressure Sterilization):

- Product Identifiers

GTIN 6926131770343

eBay Product ID (ePID) 1548286428

-Product Key Features

Model 18L

wer: 220V

3.2.1.13. Incubator:

S.NO. 01262g

VOLTS 230

SIZE 14×14

WATTS 5 VOLTS.

3.3. Methods used in microbial identification:

3.3.1. Bacterial Culture: all swabs from mobile phones were cultured on Blood agar and MacConkey agar then incubated at 37 C in incubator for 12-24 hours.

3.3.2. Gram staining (Cappiccino and Sherman 1996):

Gram staining of bacteria was performed from swabs and after culture growth.

3.3.3. Biochemical tests:

3.3.3.1 Catalase test: catalase test was carried out by addition 1_2 drops of 3% hydrogen peroxide (3 ml of 30% of Stock hydrogen peroxide with 97 ml sterile water) on bacterial colony cultured **(Cappiccino and Sherman 1996).**

3.3.3.2 Slide coagulase test:

One staphylococcal colony from culture and one drop of diluted citrated plasma (1 ml citrated plasma with three ml sterile normal saline) were mixed on a slide . Agglutination or clumping of cocci within 1 minute was considered as positive **(Cappiccino and Sherman 1996)**. Negative samples were further tested by tube coagulase test.

3.3.4. Antibiotic sensitivity tests:

3.3.4.1 Mueller Hinton Agar (MHA) (Cappiccino and Sherman 1996)

Mueller agar (BD) was prepared according to manufactures instructions labeled on the bottle . In a 2 L bottle , 1 L of deionized water were mixed with 38g MHA and 20g NaCl , heated and steirred until the agar dissolved . The solution allowed to boil for 1 min , and then autoclaved at 121 c for 15 min . After that it was allowed to cool to about 45 c , and the agar was poured in to sterile petri dishes to have (25-30) ml each that was left overnight at room temperature . The following morning the petri dishes were turned upside down and refrigerated.

3.3.4.2 Oxacillin disk diffusion test (Cappiccino and Sherman 1996):

Oxacillin (1 mg) antibiotic discs (Oxoid) was used to detect methicilline resistant S.aureus . Zones of inhibition was determined in accordance with procedures of the Clinical and Laboratory Standerds Institute (CLSI , 2011) , isolates were categorized as susceptible and resistant . According to Oxacillin , S.aureus isolate were considered susceptible if inhibition zones were ≥13 mm after incubation on 2% NaCl MHA at 35 C. for 24 hours .

3.4. Ethical consideration:

The study proposal was revised and approved by the committee on research Faculty of Medicine and Health Sciences, Emirates International University, Sana'a Yemen. (Appendix-1).verbal consent was taken from all participants included in this study.

3.5. Data management and statistical analysis:

The data were collected and processed to a personal computer (P.C) and then analyzed with the aid of the Statistical program Package (**Dorak, 2018. http://statpages.info/**). There were two types of variable as follow:

- Dependent variables- *S.aureua* and bacillus sp. as well as antibiotics
- Independent variables- sex, age, occupation and dept.

The statistical tests used in this work were:

-Contamination rate.

-Chi-square test with Yates correction for continuity.

Chi-square test was performed to obtain the association between variables. The probability value (p) was then obtained from the distribution of Chi-square tables and calculated at < 0.05 (**Dorak, 2018. http://statpages.info/.**).

Chapter four

Results

RESULTS

The present study aimed to investigate the contamination rate of mobile phones of health care workers (HCWs) in ICUs, NCUs, Emergency care unit ECU and Burn CUs at Al-Jumhory Teaching Hospital, describe the microbiological profile of contaminated mobile phones and investigate the factors associated with mobile phone contamination. So that the results were divided in to three parts.

4.1-Bacterial contamination rate:

The present work was conducted on 46 mobile phones from HCWs at Al-Jumhory Teaching Hospital in Sana'a city and the rate of bacterial contamination of HCWs' mobile phones was 58% (27 phones)- **table 4-1.**

Table 4-1: Distribution of bacterial contamination rate according to gender and bacterial pattern of growth among 46 HWCs.

Bacterial growth / Gender	Bacterial Growth	Bacterial Non growth	TOTAL	
MALE	20 (43%)	15 (32.6%)	**35 (76.1%)**	***X2=0.146***
FEMALE	7 (15%)	4 (8.7%)	**11(23.9%)**	***P=0.703***
Total	**27 (58%)**	**19 (42%)**	**46 (100%)**	

Among total 46 HCWs included in this study; 76.1% (35/46) were males while 23.9% (11/46) were females. In addition, The number of samples taken from male participants was 76.1% (35/46) , of which 20 samples(43%) showed positive growth. On the other hand, 23.9 % (11/46) of the 7 (15%) samples taken from female participants showed positive growth. There was no statistical significant difference between the two groups regarding the bacterial growth and gender. **Table 4-1& figure 4-1.**

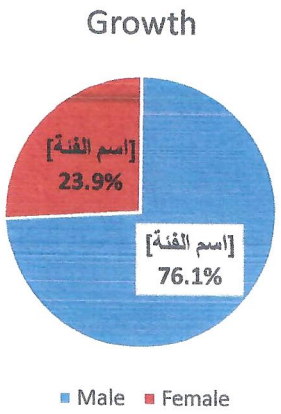

Figure 4-1: Distribution of study participants according to gender.

Regarding their age range, it found that age range 26 35 years was the most contaminated rate. There was no statistical significant difference between the age groups and gender, **table 4-2**.

Table 4-2: Distribution of the study participants according to age group.

Age groups / Gender	14-25 Yrs	25-35 Yrs	37-50 Yrs	TOTAL	*X2*= 6.25
MALE	6 (2)	18 (12)	11 (6)	**35 (20)**	***P*=0.053**
FEMALE	5 (3)	6 (4)	0 (O)	**11 (7)**	
Total	**11 (5)**	**24 (16)**	**11 (6)**	**46 (27)**	

4.2. Microbiological profile of contaminated mobile phones:

Out of 46 cell phones screened in the study, 27 (58%) showed bacterial growth. Of these positive samples, 27(58%) yields tow bacterial species: *Staphylococcus aureus* with 20 (74.1%) isolates was predominant followed by *Bacillus sp.* 7 (25.9%). According to the types of isolated bacteria and gender, the frequency of *Staphylococcus aureus* and *Bacillus sp.* was more prevalent among males than

females. In addition, no statistical significant difference between the isolated bacteria and gender, **table 4-3**.

Table 4-3: Distribution isolated bacteria according to gender.

GENDER / MICROBE	MALE	FEMALE	TOTAL	*X2= 0.47* *P= 0.49*
S.aureus	16	4	20	
Bacillus spp	4	3	7	
Total	**20**	**7**	**27**	

Regarding to the department or ward, the frequency of *Staphylococcus aureus* was more prevalent in the ICU followed by EMR, NCU and Burn Unit. In addition, *Bacillus sp.* was more prevalent in the NCU and absent in Burn Unit. With no statistical significant difference between the isolated bacteria and ward, **table 4-4**.

Table 4-4: Distribution of isolated bacteria according to ward at Al-Jumhory Teaching Hospital.

WARD / MICROBES	I.C.U	EMR.	N.C.U	BURN C.U	TOTAL	*X2= 6.36* *P=0.095*
S.aureus	11	4	3	2	20	
Bacillus spp	1	2	4	0	7	
Total	**12**	**6**	**7**	**2**	**27**	

Regarding to HCWs occupation and isolated bacteria, *Staphylococcus aureus* and Bacillus *sp.* was more isolated from Nurses followed by Doctors with no statistical significant difference between the isolated bacteria and ward, **table 4-5**.

Table 4-5: Distribution of isolated bacteria according to HCWs occupation.

OCCUPATION / MICROBE	DOCTORS	NURSES	CLEANERS	TOTAL	
S.aureus	6	13	1	**20**	***X2= 0.386***
Bacillus spp	2	5	0	**7**	***P= 0.825***
Total	**8**	**18**	**1**	**27**	

As far as anti-biogram of bacteria was concerned, *S.aures* showed 25 % sensitivity to Co-trimoxazole, and Piperacillin tazobactam. Moreover, *S.aures* 25% was resistant to Cefoxitin, Oxacillin and this regarded as *Methicillin-Resistant Staphylococcus aureus* (*MRSA*), and 13 (65%) *S.aures* isolates were Multiple Drug Resistant (MDR), **table4-6.** In other hand, isolated *Bacilus spp.* showed 71% sensitivity to gentamycin followed by Noroxin 42%. While 56% resistant to Optichin and Noroxin. In addition, 67% isolated *Bacilus spp.* were Multiple Drug Resistant (MDR), **table4-6.**

Table 4-6: Antibiotic Sensitivity Profile of bacterial Isolates (N=27)

Microbe / Antibiotic	GEN	CTX	DOX	AMP	P	B	OP	NA	DO	CTP	COT	CIP	NX	O	AMX	PEN	COP	N	POT	MRSA	MDR
S.aures n=20	S(3) 15%	S(2) 10%	-	-	S(5) 25%	-	s(1) 5%	-	S(1) 5%	-	S(5) 25%	S(1) 5%	S(1) 5%	-	S(1) 5%	-	S(1) 5%	-	-	5 (25%)	13 (65%)
	-	M(1) 5%	-	-	M(1) 5%	M(2) 10%	-	-	-	-	-	-	-	-	-	-	-	-	-		
	R(1) 5%	R(4) 20%	-	R(2) 10%	R(2) 10%	R(1) 5%	R(3) 15%	R(1) 5%	-	-	-	R(1) 5%	-	R(1) 5%	-	R(1) 5%	-	R(1) 5%	-		
Bacilus spp n=7	S (5) 71%	S (1) 14%	S(1) 14%	S(2) 28%	-	-	-	S(3) 42%	S(1) 14%	S(1) 14%	-	S(1) 14%	-	-	-	-	-	-	S(1) 14%		18 (67%)
	-	M(1) 14%	-	-	-	M (2) 28%	-	-	-	-	-	-	-	-	-	-	-	-	-		
	-	R(2) 28%	-	R(2) 28%	-	R(3) 42%	R(4) 56%	R(4) 56%	-	-	-	-	-	-	R(3) 42%	-	-	-	-		

GEN= Gentamicin, CTX= Cefoxitin, DOX= Doxycycline, AMP= Ampicillin, P= Permapen"Pencillin" B= Bacitracin, OP=Optichin, NA=Nalidixic, CTP= Citalopram , COT= Cotrimoxazole, CIP= Ciprofloxacin, NX = Norfloxacin, O= Oxacillin, AMX= Amoxicillin, PEN=Penicillin, COP= Copsin, N= Neomycin, S=Sensitive, M= Moderate, R= Resistance.

4.3. Factors associated with mobile phone contamination:

Several various attributes or questions were answered by the study participants in order to determination of risk factors associated with contamination of mobile phones of HCWs.

A highly frequency of contamination rate was observed in the ICU ward so that a highly significant association was noted between the ward or department of HCWs and their knowledge that mobile phones can carry microbes or had role in nosocomial infections (*X2=17.8 & P=0.000*). While a significant association was noted between the ward or department of HCWs and hand washing when they used mobile phones at hospital (*X2=15.7 & P=0.001*). Moreover, a significant association was noted between the ward or department of HCWs and using mobile phone at home and hospital (*X2=8.9 & P=0.031*), **table 4-7.**

Table 4-7: Association between the ward of HCWs with several characteristics of users and mobile phones.

Ward / Attributes	I.C.U		Nursery		Burns		Emergency		*X2* *P*
	Yes	NO	Yes	No	Yes	No	Yes	No	
1- Use mobile in Health center	11	2	11	0	10	1	11	0	*X2*=3.33 *P*=0.344
2- Use the same mobile at home	12	1	10	1	11	0	11	0	*X2*=1.94 *P*=0.584
3- Your family use at home	11	2	6	5	11	0	10	1	**X2=8.91 P=0.031**
4- Hands washing after Dx pt.	11	2	7	4	11	0	3	8	**X2=15.7 P=0.001**
5- Disinfectants using for mobile	10	3	7	4	8	3	6	5	*X2*=1.58 *P*=0.665
6- Mobile carry microbes	13	0	11	0	10	1	5	6	**X2=17.8 p=0.000**
7- Answer mobile call during work	11	2	7	4	5	6	5		2i=5.31 =0.151

No significant association was found between the gender, occupation of HCWs and several characteristics of users and mobile phones, **table 4-8, 9**. Moreover, there was no significant association between isolated bacteria and characteristics of users and mobile phones, **table 4-10.**

Table 4-8: Association between the gender of HCWs with several characteristics of users and mobile phones.

Gender / Attributes		Male		Female		*X2* *P*
		Yes	No	Yes	NO	
1-	Use mobile in Health center	32	3	11	0	*X2*=1.01 *P*=0.315
2-	Use the same mobile at home	33	2	11	0	*X2*i=0.657 *P*=0.418
3-	Your family use at home	30	5	8	3	*X2*=0.983 *P*=0.322
4-	Hands washing after Dx pt.	25	10	7	4	*X2*=0.240 *P*=0.624
5-	Disinfectants using for mobile	25	10	6	5	*X2*=1.09 *P*=0.297
6-	Mobile carry microbes	29	6	10	1	*X2*=0.421 *P*=0.517
7-	Answer mobile call during work	20	15	8	3	*X2*=0.853 *P*=0.356

Table 4-9: Association between the occupation of HCWs with several characteristics of users and mobile phones.

Occupation / Attributes	Doctor		Nurse		Dustman		*X2* *P*
	Yes	No	Yes	No	Yes	No	
1- Use mobile in Health center	9	0	32	3	2	0	*X2*=1.01 *P*=0.604
2- Use the same mobile at home	8	1	34	1	2	0	*X2*=1.27 *P*=0.531
3- Your family use at home	7	2	28	7	2	0	*X2*=0.531 *P*=0.767
4- Hands washing after Dx pt.	6	3	26	9	1	1	*X2*=0.692 *P*=0.707
5Disinfectants using for mobile	6	3	23	12	2	0	*X2*=1.01 *P*=0.602
6- Mobile carry microbes	6	3	32	3	1	1	*X2*=5.36 *P*=0.068
7- Answer mobile call during work	4	5	23	12	1	1	*X2*=1.46 *P*=0.481

Table 4-10: Association between the isolated bacteria with several characteristics of users and mobile phones.

Isolated bacteria / Attributes	*S.aureu*		*Bacillus*		*X2* *P*
	Yes	No	Yes	No	
1- Use mobile in Health center	18	2	7	0	*X2*=0.756 *P*=0.385
2- Use the same mobile at home	19	1	7	0	*X2*=0.363 *P*=0.547
3- Your family use at home	16	4	6	1	*X2*=0.112 *P*=0.738
4- Hands washing after Dx pt	14	6	4	3	*X2*=0.386 *P*=0.535
5- Disinfectants using for mobile	12	8	5	2	*X2*=0.290 *P*=0.590
6- Mobile carry microbes	19	1	5	2	*X2*=2.92 *P*=0.088
7- Answer mobile call during work	15	5	4	3	*X2*=0.793 *P*=0.373

Chapter five

Discussion

DISCUSSION

All over the world, maintaining hygiene standards is a prerequisite in all hospital settings. Excessive usage of mobile phone in the hospital by healthcare professionals has emerged as a matter of valid concern in recent years. It is due to its threat to act as a source of potential pathogens or as vectors for the nosocomial infections.

5.1-Bacterial contamination rate:

Many reports have documented the contamination of mobile phones among HCWs **(Goel M. *et al.*, 2009, Lavanya J, *et al.* 2016 & Almeshal F. *et al.* 2018).**

Of the phones sampled in this current study, the majority of mobile phones (**58%**) were contaminated by bacterial agents, which was approximately comparable to a study conducted in India **(Sharma K, *et al.* 2017)**..

While other studies showed higher contamination rate, it was reported that 94.5% of health care workers' mobile phones were contaminated with various microorganisms, including nosocomial pathogens **(Ulger *et al.* 2009)**. Another study done in India has shown that as much as 98.5% of HCWs' mobile phones were bacterially contaminated **(Sham S. *et al.* 2011)**. However, a study done in Queen Elizabeth hospital in Barbados, West Indies and other in Saudi Arabia had showed lower contamination rate with 45% and 43% respectively. **(Ramesh J, *et al.* 2008 & Almeshal F. *et al.* 2018)**.

The disparity in rate of contamination may be due to variation in the hand hygiene practices, frequency of the use and disinfection of cell phones among HCWs in various hospitals.

This study revealed that male HCW's mobile phones had comparatively more contaminated than female HCWs phone with age range 25-35 years. The present study concurs with the findings of other studies which showed 76% and 69% of mobile phones of male doctors and 44% and 31% of mobile phones of female doctors to be contaminated respectively **(Tambekar DH. *et al.* 2008 & Kokate SB. *et al.* 2012).** As suggested by other study, it might be due to the reason that females generally keep their phones in purses and use it less frequently than male HCWs whereas male HCW keep it in pocket and use it whenever, wherever it was needed, and were thus more contaminated **(Tambekar DH. *et al.* 2008)**.

5.2 Isolated bacteria :

Regarding the isolated microorganisms in the present study, the most frequently isolated bacteria was *Staphylococcus aureus*, which was (74.1%), followed by *B*[illegible] (25.9%) **as** in other studies stated that *S. aureus* the most frequently isolated

microorganism **(Jayalakshmi J. *et al.* 2008, Singh S, *et al.* 2010 & Ulger *et al.*,2015).** Their high occurrence rate could be traced to the fact that they are abundant in human body especially as the normal flora. Moreover, *Bacillus sp* bacteria are omnipresent in nature being able to colonize anything. Moreover, it was found that 100% of mobile phones grew only one bacterial species without polymicrobial growth as showed by other studies **(Chawala*et al.* 2009 & Selim *et al.* 2015).**

In the present study, there was no statistical significant difference in the frequency of isolated bacteria from different departments of the hospital or among different Categories of HCWs. It was noted that the frequency of *Staphylococcus aureus* was more prevalent in the ICU followed by EMR, NCU and Burn Unit. In addition, *Bacillus sp.* was more prevalent in the NCU and absent in Burn Unit. Other researchers observed similar finding, approximately, 74 % of mobile phones that belong to clinicians in ICUs, PICUs, and NCUs was contaminated in Kuwait and 43.6 % was reported from Saudi Arabia **(Heyba *et al.* 2015 & Almeshal F. *et al.* 2018).**

Regarding to HCWs occupation and isolated bacteria, it was found that the prevalence of *Staphylococcus aureus* and *Bacillus sp.* was more isolated from Nurses followed by Doctors with no statistical significant difference between the isolated bacteria and ward. This was in concordance with **Trivedi R .*et al.* 2011** and **Tambe N. *et al.*2012**. They stated that higher rate of contamination among paramedical staff may be due to their direct exposure to body fluids, tissues etc. harboring various pathogenic organisms and lower level of awareness about the hand hygiene practices **(Sharma K. *et al.* 2017).**

According to antibiotic sensitivity pattern of bacterial isolates, the study revealed that *S.aures* showed **25 %** sensitivity to Co-trimoxazole, and Piperacillin tazobactam. Moreover, *S.aures* **25%** was resistant to Cefoxitin, Oxacillin and this regarded as *Methicillin-Resistant Staphylococcus aureus* (*MRSA*), and 13 (**65%**) *S.aures* isolates were Multiple Drug Resistant (MDR). In other hand, isolated *Bacilus spp.* showed 71% sensitivity to gentamycin followed by Noroxin 42%. While 56% resistant to Optichin and Noroxin. In addition, **67%** isolated *Bacilus spp.* were Multiple Drug Resistant (MDR). This was in agreement with another study conducted in Sudan (**Adhikari S. *et al.* 2018**).

Methicillin-Resistant Staphylococcus aureus (*MRSA*) was 25%, which in accordance with study conducted in India (**Sharma K. *et al.* 2017**). Incidence of MRSA isolated from cell phones was variable in different geographical areas like 16.9% in Mumbai **(Kuhu Pal. *et al.* 2015)** 52.4% in Bhabnagar **(Trivedi R .*et al.* 2011)**, 52% in Nigeria

(***Ulger F. et al. 2009)*** and 26.8% in Sudan with 21.4% Multiple Drug Resistant (MDR). (**Adhikari S. *et al.* 2018**).

Variation in antibiotic resistance pattern in different geographic areas or different time frame in same place might depend on antibiotic policy of the hospital at that particular time (**Kuhu Pal. *et al.* 2015**).

The observed high rate of antibiotic-resistant bacteria (MRSA and MDR in this study could be attributed to both the misuse and abuse of antibiotics. The prevalence of antibiotic-resistant bacteria is a serious problem with important implications for hospital infection prevention and control program. Although the geographic distribution of these bacteria is worldwide, the epidemiology and dissemination patterns appear to differ within and across regions (**Pal P, *et al.* 2013 & Selim *et al.* 2015**).

MRSA, like all *S.aureus* survives on skin, dust and on environmental surfaces. In healthy individuals, they can be colonized asymptomatically. Therefore, the most common sources of transmission to patients and hospital environment are hospital staff as well as visitors and patients with MRSA infection or who carry the infection asymptomatically **(Badr R. *et al.* 2012).** Until now, hands are considered the main mode of transmission to inanimate objects like apron, swipe cards, mobiles; key boards etc have also been studied to carry MRSA.

MRSA is problematic for patients in hospital with invasive devices or surgical wounds and lowered immunity having higher risk of contracting infection as compared to public. Among patients being treated in hospital and/or having weakened immune system HA- MRSA occurs most commonly and found to cause life threatening infections , such as blood stream infections , surgical site infections or pneumonia (**Rachna Tewari *et al.*2015**).

5.3- Risk factors :

Bacterial colonization on the mobile phones can be reduced by, proper training of staff about hand washing, use of alcohol disinfectant wipes, use of alcohol-chlorhexidine wipes, and by imposing restrictions on the use of mobile phones in high-risk areas. The present study find that. a highly frequency of contamination rate was observed in the ICU ward so that a highly significant association was noted between the ward or department of HCWs and their knowledge that mobile phones can carry [illegible] or had role in nosocomial infections (*X2=17.8 & P=0.000*). While a significant association was noted between the ward or department of HCWs and hand washing [illegible] used mobile phones at hospital (*X2=15.7 & P=0.001*). Moreover, a significant association

was noted between the ward or department of HCWs and using mobile phone at home and hospital (*X2=8.9 & P=0.031*).

Many studies have reported ethyl or isopropyl alcohols as effective, disinfectant. These precautions may also be adopted for phones of patients, their companions and visitors. Ultraviolet irradiation by ultrasonic cleaner might be used as a disinfectant, and silicone cell phone covers that are easier to clean might offer some protection. HYGreen is a system which monitors HCWs hand hygiene by detecting fumes of sanitizer or soap formed while usage from the hands. Decolonization regimens should be strictly followed for patients and healthcare workers if found positive. Avoidance and completion of antibiotic treatment protocols will enhance the margin of safety **(Sichani M. *et al.* 2011 & Rachna Tewari *et al.*2015**

Chapter six

Conclusions& Recommendations

Conclusions and Recommendations

6.1 COCULOSIONS :

1-Bacterial contamination rate of mobile phones among health care workers in Al-JumhOry teaching hospital was 58% in Sana'a city.

2- *S.aureus* and *Bacillus* was the bacterial isolated and the most prevalent was *S.aureus* followed by *Bacillus.*

3-High microbial contamination rate among nurses in the ICU unit.

4-Methacillin resistance *S.aureus* (MRSA) 25% among HCWs and multidrug resistance was high 65%.

5-Hand washing and use of mobile phone in hospital and home were associated with microbial contamination of HCWs mobile phone.

6.2 RECOMMENDATIONS:

1-Futher studies must be conducted in more than one general hospitals to investigate the accurate contamination rate and prevalence.

2-Futher studies must be carried out to investigate the microbial profile in nosocomial infections.

3- Methicillin resistance and multidrug resistance is huge public health problems particularly in hospital. Hence, more study concerned with this problem must be conducted in Yemeni hospitals.

4-Epdemiological studies must be conducted to investigate the risk factors associated with microbial contamination of HCWs and assist to spres nosocomial infection.

5- Work shop related to nosocomial infections must be contacted to prevent to this health problems.

References

REFERENCES

References:

1. **Abdollahi, A. and Mahfouzi, S. (2010):** Bacterial contamination of Hospital Telephones. Pakistan J Med. Sci., 26: 747-750.

2. **Abdollahi, A. and Mahfouzi, S. (2010):** Bacterial contamination of Hospital Telephones. Pakistan J Med. Sci.,26:747-750.

3. **Adhikari S et al. Int J Res Med Sci. 2018 Mar;6(3):966-973 www.msjonline.org A clinicopathological study of vernal conjunctivitis in urban and rural areas of Eastern India: A hospital based study.**

4. **Akinyemi, K. O., Atapu, A. D., Adetona, O. O.and Coker, A.O. (2009):** The potential role of mobile phones in the spread of bacterial infections .J Infect DevCtries. 3:628-632.

5. **Akinyemi, K. O., Atapu, A. D., Adetona, O. O.and Coker, A.O. (2009):** The potential role of mobile phones in the spread of bacterial infections .J Infect DevCtries. 3:628-632.

6. **Akinyemi, K.O., Bamiro, B.S. and Coker, A.O. (2007):** Salmonellosis in Lagos Nigeria: Incidence of Plasmodium falciparum-associated Co-infection, Pattern of Antimicrobial Resistance, and Emergence of Reduced Susceptibility to Fluoroquinolones., J Health Popul Nur., 25: 351-358.

7. **Andrew (2010). Mail Online UPDATED:07:51 GMT, 30 July.**

8. **Aronson SH (1977) The Lancet on the telephone 1876-1975. Med Hist 21: 69-87.**

9. **Bauer AW, Kirby WM, Sherris JC, Turck M. Antibiotic susceptibility testing by a standardized single disk method. Am J Clin Pathol. 1966 Apr;45(4):493-6.**

10. **Badr RI, ibrahimBadr H, Ali NM. Mobile phones and nosocomial infections. International Journal of Infection Control. 2012 Mar 26;8(2).**

11. **Bhat, S.S., Hegde, S.K. and Salian, S. (2011). Potential of Mobile Phones to Serve as a Reservoir in Spread of Nosocomial Pathogens. Online J. Health. Allied. Scs., 10:14-15.**

REFERENCES

12. Borer, A., Gilad, J., Smolyakov, R., Eskira, S., Peled, N.andPorat, N. (2005).Cell Phones and Acinetobacter Transmission.Emerg Infect Dis. 11: 1160-1161.

13. Brady RR, Verran J, Damani NN, Gibb AP (2009) Review of mobile communication devices as potential reservoirs of nosocomial pathogens. J Hosp Infect 71: 295-300.

14. Butcher, W. and Ulaeto, D. (2005). Contact inactivation of bacteria by household disinfectants. J Appl Microbiol. 99:279-284.

15. Chaibenjawong, P. and Foster, S.J. (2011). Desiccation tolerance in Staphylococcus aureus. Archives of microbiology.193:125-135..

16. Chawla, K., Mukhopadhayay, C., Gurung, B., Bhate, P. and Bairy, I. (2009). Bacterial „Cell" Phones: Do cell phones carry potential pathogens? J Hlth Aplli Sci. 8:8-19.

17. Chris, B., Mieke, U., Han, J. and Andy, D. (2011). The Enterobacteriaceae and their Significance to the Food Industry. Europe International life Sciences Institute, Belgium.

18. Clinical and Laboratory Standards Institute. Performance standards for antimicrobial susceptibility testing;Twenty-fourthinformational supplement, M100-S24. Wayne, PA: CLSI; 2014.

19. Cozanitis DA, Grant J, Mäkelä P (1978) Bacterial contamination of telephones in an intensive care unit. Anaesthesist 27: 439-442.

20. Ekrakene, T. and Igeleke, L.C.(2007).Micro-organisms associated with public Mobile Phones along Benin-sapele Express Way, Benin City, Edo State of Nigeria.J Appl Sci Res. 23:354-385.

21. Fares Almeshal1, Feras Asiri1, Anas Alyamani1, Mohammed Altuwaijri1, Sameera Aljehani1,2,4, Abdulhai Almuhana2 and Adel Alothman1,3,4. BACTERIAL CONTAMINATION OF HEALTHCARE WORKERS' MOBILE PHONES IN A TERTIARY CARE CENTER IN SAUDI ARABIA

22. Goel M, Goel A. Beware, your phone is 'bugged'; Mobile phone of dental professionals, a source of bacterial contamination – a bacteriology study. Indian journal of dental science. 2019;1(1):42-7.

REFERENCES

23. Golblatt, J.G., Krief, I. and Klonsky, T. (2007) .Use of cellular telephones and transmission of pathogens by medical staff in New York and Israel. Infe Contr and HospEpidemol.28:500-503.

24. Graveto J., Costa P.& Santos, C. (2018): CELL PHONE USAGE BY HEALTH PERSONNEL: PREVENTIVE STRATEGIES TO DECREASE RISK OF CROSS INFECTION IN CLINICAL CONTEXT. Texto Contexto Enferm, 27(1) :e5140016.

25. Gunasekara, T.D., Kudavidanage, B. P. and Peelawattage M. K. (2009). Bacterial contamination of anaesthetists hands, personal mobile phones and wrist watches used during theatre sessions, Sri Lankan. J.

26. Harris, J.L., Farber, N.J., Beuchat, R.L., Parish, E. M., Suslow, V. T., Garrett, H. E. and Busta, F.F. (2003). Outbreaks Associated with Fresh Produce: Incidence, Growth, and Survival of Pathogens in Fresh and Fresh-Cut Produce. Comprh Revi in Food Sci and Food Safety. 2:38-77.

27. Heyba M, Ismaiel M, Alotaibi A, Mahmoud Baqer H, Safar A , et al. Microbiological contamination of mobile phones of clinicians in intensive care units and neonatal care units in public hospitals in Kuwait. BMC Infect Dis. 2015;15(1):434. DOI: 10.1186/s12879-015- 1172-9 .

28. Holmes, J.W. and Williams, M.D. (2010). Methicillin-resistant Staphylococcus aureus screening and eradication in the surgical intensive care unit: Is it worth it? Am J Surg., 200:827-831.

29. Hota, B. (2004). Contamination, disinfection and cross-colonization: are hospital surface reservoirs for nosocomial infection? Clin Infect Dis. 39: 1182-1189.

30. Ilusanya, O.A.F., Adesanya, O.O., Adesemowo, A. and Amushan, N.A. (2012).Personal Hygiene and Microbial Contamination of Mobile Phones of Food Vendors in Ago-Iwoye Town, Ogun State, Nigeria.Pak J Nutra .11: 276-278.

31. Jacobs MR, Dagan R, Appelbaum PC, Burch DJ. 1998;42:589- 95, Prevalence of antimicrobial-resistant pathogens in middle ear fluid: multinational study of 917 children with acute otitis media. Antimicrob Agents Chemother.

REFERENCES

32. Jayalakshmi J, Appalaraju B, Usha S (2008) Cellphones as reservoirs of nosocomial pathogens. J Assoc Physicians Ind 56: 388-389.

33. Karabay, O., Kocoglu, E. and Tahtaci, M. (2007). The role of mobile phone in the spread of bacteria associated with nosocomial infections. J Infect Develop Countries.1: 72-73.

34. Karabay, O., Kocoglu, E. and Tahtaci, M. (2007). The role of mobile phone in the spread of bacteria associated with nosocomial infections. J Infect Develop Countries.1: 72-73.

35. Kawo, A.H. and Musa, A.M. (2013). Enumeration, Isolation and Antibiotic Susceptibility Profile of Bacteria Associated With Mobile Cellphones in a University Environment. NJBS, 21: 39-44.

36. Khan, R.M.K. and Malik, A. (2001). Antibiotic resistance and detection of â-lactamase in bacterial strains of Staphylococci and Escherichia coli isolated from foodstuffs. World J Microbiol Biotechnol.17:863- 868.

37. Khivsara, A., Sushma, T. and Dhanshree, B. (2006).Typing of Staphylococcus aureus from mobile phones and clinical samples .Current Sci.90:910-912.

38. Kilic, I.H., Ozaslan, M., Karagoz, I.D., Zer, Y. and Davutoglu, V. (2009).The microbial colonization of mobile phones used by healthcare staffs.Pak J Biol Sci. 1: 882 -884.

39. Kokate SB, More R S, Gujar V, Mundhe S, Zahiruddin SJ. Microbiological flora of mobile phones of resident doctors J. Biomedical Science and Engineering 2012 [cited 2012 Nov];5: 696-698. doi:10.4236/jbise.2012.511086 Available on :URL: http://www.scirp.org/journal/jbise.

40. Koroglu M, Gunal S, Yildiz F, Savas M, Ozer A, Altindis M. Comparison of keypads and touch-screen mobile phones/devices as potential risk for microbial contamination. J Infect Dev Ctries [Internet]. 2015 [cited 17 Jun 2017]; 9(12).

41. Landman, D., J. M. Quale and D. Mayorga et al. 2002. :Citywide clonal outreak of multiresistant Acinetobacter baumani and Pseudomonas aeruginosa in Brooklyn.

REFERENCES

42. Lavanya J, Swaroop Rani NB, Jais M, Upadhya AK. Microbial Contamination of Mobile Phones in a Tertiary Health Care Setting. Int.J.Curr.Microbiol.App.Sci. 2016;5(9);508-13. doi: http://dx.doi.org/10.20546/ijcmas.2016.509.056.

43. Laxminarayan, R. and Malani, A. (2007).Extending the Cure: Policy responses to the growing threat of antibiotic resistance. Washington, DC, Resources for the Future.

44. Manning ML, Davis J, Sparnon E, Ballard RM (2013) iPads, droids, and bugs: Infection prevention for mobile handheld devices at the point of care Am J Infect Control 41: 1073-1076.

45. Mark D, Leonard C, Breen H, Graydon R, O'Gorman C, Kirk S. Mobile phones in clinical practice: reducing the risk of bacterial contamination. Int J Clin Pract [Internet]. 2014 [cited 17 Jun 2017]; 68(9):1060-4.

46. Neely, A.N. 2007. Persistence of micro- organisms on common hospital surfaces: strategies to control their dissemination. Infect. Control Resour. 4(4): 1 8.

47. Nikolic, M., Arandjelovic, M., Stankovic, A. and Krivokapic, L. (2011). Bacterial contamination of mobile phones used in hospitals. HEALTHMED, 5:1254-1259.

48. NY: The pre antibiotic era has returned, Arch. Int. me. 162(13)1520,

49. Otto, M. (2009). Staphylococcus epidermidis the 'accidental' pathogen. Nature Reviews Microbiology, 7:555-567.

50. Pal K, Chatterjee M, Sen P, and Adhya S. Cell Phones of Health Care Professionals: A Silent Source of Bacteria. Natl J Lab Med. 2015; 4(4):33-38. DOI: NJLM/2015/13984:2069 .

51. Pal K, Chatterjee M, Sen P, and Adhya S. Cell Phones of Health Care Professionals: A Silent Source of Bacteria. Natl J Lab Med. 2015; 4(4):33-38. DOI: NJLM/2015/13984:206919,

52. Peleg, A.Y., Seifert, H. and Paterson, D.L. (2008). Acinetobacter baumannii: emergence of a successful pathogen. Clinical microbiology reviews, 21:538-582.

53. Prakash D. P. and Pawar, S.A. (2012).Nosocomials Hazards of Doctors' Mobile Phones. J Theor and Expe Biol. 8: 115-121.

REFERENCES

54. Prakash D. P. and Pawar, S.A. (2012).Nosocomials Hazards of Doctors" Mobile Phones. J Theor and Expe Biol. 8: 115-121.

55. Pugh, A. M. (2006). "Health & Wellness: Cell Phones Breed Staph and Other Bacteria: The Petri dish in your pocket" Associated Content Publishers. Available online www.http/ newsonomics.com/yahoos.

56. Rachna Tewari, Mridu Dudeja, Saltanat Jamal "Mobiles and Pens of Hospital Staff, Patients and Visitors Found to Carry MRSA".

57. Radicati. S. (2014). Mobile statistic report, 2014-2018. Retrieved from http:/ /www.radicati.com/wp/wp-content/uploads/2014/01/Mobile-statistics-Report-2014-2018-Executive-Summary.pdf.

58. Rafferty KM, Pancoast SJ (1984) Brief report: bacteriological sampling of telephones and other hospital staff hand-contact objects. Infect Control 5: 533-535.

59. Ramesh J, Carter AO, Campbell MH, Gibbons N, Powlett C, Moseley H Sr, Lewis D, Carter T (2008) Use of mobile phones by medical staff at Queen Elizabeth Hospital, Barbados: evidence for both benefit and harm J Hosp Infect 70: 160-165.

60. Revelas A. J 2012, Healthcare-associated infections: a public health problem. Niger Med Apr 1;53 (2):59-64.

61. Selim HS, Abaza AF. 2015;10:1-9, Microbial contamination of mobile phones in a health care setting in Alexandria, Egypt. GMS Hyg Infect Control.

62. Sepehri, G., Talebizadeh, N., Mirzazadeh, A., Mir-shekari, T. and Sepehri, E. (2009).Bacterial Contamination and Resistance to Commonly Used Antimicrobials of Healthcare workers' Mobile Phones in Teaching Hospitals, Kerman, Iran.Amer J of Appl Sci. 6: 806-810.

63. Sham SB, Sundeep HK, Shailaja S. Potential of mobile phones to serve as a reservoir in spread of nosocomial pathogens. J Hosp Infect. 2011 Jun; [Cited]. Available from: http://www.ojhas.org/issue38/2011-2-14.htm.

REFERENCES

64. Sharma K, Najotra D.K, Slathia P, Raina S.Microbiological flora of cell phones: a reservoir of potential pathogens?. Int J Med Res Rev 2017;5(02):204-208 doi:10.17511/ijmrr. 2017.i02.16.

65. Sichani MM, Karbaizadeh V. Bacterial contamination of health care workers mobile phones and the efficacy of surface decolonization techniques. Afr J Microbiol Res. 2011; 5(30) : 5415 – 18.

66. Singh, V., Aggarwal, V., Bansal, S., Garg, S., Chowdhary, N. (1998): Telephone mouthpiece as a possible source of hospital infection. J. Assoc. Physicians*India,* 46(4): 372 373.

67. Singh S, Acharya S, Bhat M, Rao SK, Pentapati KC. Mobile phone hygiene: potential risks posed by use in the clinics of an Indian dental school. J Dent Educ. 2010 Oct;74(10):1153-8.

68. .Soto, R.G., Chu, G L., Goldman, M, J., Rampil, J. I. and Ruskin, J.K. (2006). Communication in critical care environments. Mobile telephones improve patient cares. Anaesth. Analg.102: 534-541.

69. Souza, E. L., Lima, E. O. and Sousa, C. P. (2005). Inhibitory action of some essential oils and phytochemicals on the growth of various moulds isolated from foods. Braz Arch Biolog Technol.48: 245-250.

70. Srikanth P, Rajaram E, Sudharsanam S, Lakshmanan A, Mariappan U, Jagannathan K. Mobile phones: emerging threat for infection control. J Infect Prevent [Internet]. 2010 [cited 17 Jun 2017]; 11(3):87-90.

71. Struelens, M. J. (1998). The epidemiology of antimicrobial resistance in hospital acquired infections: problems and possible solutions, British Med. J vol. 17: 652–654

72. Stuchi R, Oliveira C, Soares B, Arreguy-Sena C. Contaminação bacteriana e fúngica dos telefones celulares da equipe de saúde num hospital em Minas Gerais. Cienc Cuid Saude [Internet]. 2013 [cited 17 Jun 2017]; 12(4):760-7.

73. Suganya, S. and Judia, V. (2012). International Journal of Environmental Sciences, 3: 44-54.

74. Sumritivanicha, A., Chintavavilas, K. and Apisarntha,N. (2011). Infection control and hospital Epidemiology Journal, 32: 633-636.

75. Tagoe, D.N., Gyande, V.K. and Ansah, E.O. (2011). Bacterial Contamination of Mobile Phones: When Your Mobile Phone Could Transmit More Than Just a Call! WebmedCentral microbiology.2:WMC002294.

REFERENCES

76. Tagoe, D.N., Gyande, V.K. and Ansah, E.O. (2011). Bacterial Contamination of Mobile Phones: When Your Mobile Phone Could Transmit More Than Just a Call. WebmedCentral microbiology.2:WMC002294.

77. Tambe N N, Pai C. A Study of microbial flora and mrsa harboured by mobile phones of health care personnel. International Journal of Recent Trends in Science and Technology. 2012;4(1):14-18.

78. Tambekar, D.H., Dhanorkar, D.V., Gulhane, S. R. and Dudhane, M. N. (2006). Prevalence and Antimicrobial susceptibility pattern of Methicillin resistant Staphylococcus aureus from health care and community associated sources. Afr J Infect Dis. 1: 52 - 56 52.

79. Teng, S. O., Lee, W. S., Ou, T. Y., Hsieh, Y. C., Lee, W. C. and Lin, Y. C. (2009). Bacterial contamination of patients' medical charts in a surgical ward and the intensive care unit: impact on nosocomial infections. J Microbiio. Immun. and Infec., 42: 86–91.

80. Trivedi, H. R., Kairavi, J. D., Lopa, P. T., Saklainhaider, S. M. and Tanuja, B. J. (2011). Role of Mobile Phone in Spreading Hospital Acquired Infection: A Study in Different Group of Health Care Workers. National J. Inte. Res.Med., 2: 61-66.

81. Tambekar DH, Gulhane PB, Dahikar SG, Dudhane MN .Nosocomial hazards of Doctors mobile phones in hospitals. J Med Sci . 2008 ; 8(1): 73 - 76

82. Ulger F, Dilek A, Esen S, Sunbul M, Leblebicioglu H. Are healthcare workers' mobile phones a potential source of nosocomial infections? Review of the literature. J Infect Dev Ctries [Internet]. 2015 [cited 17 Jun 2017]; 9(10):1046-53. Available from:

83. Ustun C, Cihangiroglu M (2012) Health care workers' mobile phones: a potential cause of microbial cross-contamination between hospitals and community. J Occup Environ Hyg 9: 538-542.

84. Visvanathan A, Gibb AP, Brady RR (2011) Increasing clinical presence of mobile communication technology: avoiding th he pitfalls. Telemed J E Health 17: 656-661.

85. Wendt, C., Dietze, B., Dietz, E. and Ruden, H. (1997). Survival of A[illegible]r baumannii on dry surfaces. J Clin. Microbiol., 35:1394-1397.

REFERENCES

86. West DM (2013): Improving Health Care through Mobile Medical Devices and Sensors. 2013. https://www. brookings.edu/wp-content/uploads/2016/06/West_Mobile-Medical-Devices_v06.pdf (30 August 2016).

87. White DA (1980) Are telephones an infection hazard? Br Med J 280: 696-697.

88. WHO. (2002). Prevention of hospital acquired infections: a practical guide, 2nd edition.

89. Yusha"u, M., Bello, M. and Sule, H. (2012). International Journal of Biomedical and Health Sciences, 6: 97-102.

90. Yusha"u, M., Bello, M. and Sule, H. (2012). International Journal of Biomedical and Health Sciences, 6: 97-102.

الجمهورية اليمنية
وزارة التعليم العالي و البحث العلمي
الجامعة الاماراتية الدولية
كليه الطب و العلوم الصحية

التهديد الجرثومي الصامت: المحمول الخلوي للكوادر الصحية

بحث مقدم كتوطئة للحصول على درجة البكالوريوس في علوم المختبرات الطبية

مقدمة من

الهام عبدالله حسن الشاطر
بشرى أحمد أحمد الرازقي
سماح أحمد عبدالكريم سكران
فلنتينا محمد عبيد الأثوري
ليلى أيمن محمد البهلولي
مرام زيد مطهر المطهر
نسمة مسعود غيلان العلوي
نورا خليل محمد الأكحلي

تحت إشراف :

الأستاذ المساعد الدكتور / عبدالباسط الغوري
ماجستير / دكتوراه – العلوم الطبية الاساسية
(رئيس قسم المختبرات الطبية – الجامعة الإماراتية الدولية)
كلية الطب و العلوم الصحية – الجامعة الإماراتية الدولية

2017/2018