UNIVERSITY OF GHANA

COLLEGE OF HEALTH SCIENCES

SCHOOL OF PUBLIC HEALTH

MOBILE PHONE USE AND ASSOCIATED BACTERIAL CONTAMINATION IN THE NEONATAL INTENSIVE CARE UNIT OF THE KORLE-BU TEACHING HOSPITAL

BY

MAUD ESSABAH FANDOH

10262880

A DISSERTATION SUBMITTED TO THE SCHOOL OF PUBLIC HEALTH, UNIVERSITY OF GHANA IN PARTIAL FULFILLMENT OF THE REQUIREMENT FOR THE AWARD OF MASTER OF PUBLIC HEALTH (MPH) DEGREE

JULY 2018

DECLARATION

I declare that this work was originally done by me under supervision and all materials and resources from other studies used have been duly acknowledged within the work. I further declare that this work has neither in whole nor in part been submitted for any degree in this university or elsewhere.

……. …….

MAUD ESSABAH FANDOH DATE

(STUDENT)

19/10/2018

…….. ……

PROFESSOR RICHARD ADANU DATE

(SUPERVISOR)

DEDICATION

I dedicate this work to my children who bore with me anytime I had to be away from home; to old girl for her total service and understanding.

ACKNOWLEDGEMENT

Am grateful to God for this achievement. To the staff of NICU, thank you for voluntarily accepting to participate in this study. To my supervisor Professor Richard M. Adanu, the Dean, School of Public Health Legon, I say I highly appreciate your time and guidance throughout this study. Am also grateful to Dr. Appiah-Korang Labi, the Clinical microbiologist who assisted me with the laboratory aspect of my work. Finally to Professor Christabel E. Laryea, head of NICU, thanks for your mentorship.

ABSTRACT

Use of mobile phones in the neonatal intensive care unit by healthcare workers can lead to contamination and spread of healthcare associated infections among hospitalized neonates. An understanding of dynamics of mobile phone usage as well as contaminating bacteria forms an important step in developing infection control strategies to regulate its use in clinical areas of the neonatal intensive care unit.

Methods: I conducted a cross-sectional study to assess mobile phone use, attitudes about their use among staff of the neonatal intensive care unit of the Korle-Bu Teaching Hospital as well as bacterial contamination of mobile phone devices. The study was conducted over a 3 week period. I used unobtrusive observation, self-administered questionnaire administration and took imprints of mobile phone devices using RODAC plates to achieve the objectives of the study. A total of 40 phones were sampled and imprints were taken and cultured. Antibiotic Sensitivity was done.

Results: Most respondents (94.7%) claimed to use mobile phones whilst at work; and this was mainly for clinical reasons. The majority of respondents (86.8%) believed their phones were contaminated whilst 24 (63.4%) were likely to support banning of mobile phone use in clinical areas. Mobile phone use was dominant (88.9%) by medical doctors. The commonest use of the mobile phone was for clinical examination of patients. Most phones (97.5%) were contaminated by microorganisms. Average colony count was 3 colony forming units per cm^2. Multi-drug resistant coagulase negative Staphylococcus 40(36.4%) was the commonest organism isolated from the phones.

Conclusion: There was high use of mobile phone in patient care areas of the NICU mostly done by medical doctors. Most phones of healthcare workers were contaminated with potential pathogenic bacteria. Banning the use of mobile phones in the patient care areas in the NICU is a feasible strategy that is likely to be supported by staff.

Keywords: Mobile Phone, contamination, bacteria, healthcare workers.

TABLE OF CONTENT

LIST OF TABLES

LIST OF FIGURES

LIST OF ACRONYMS

DECT- Digital Enhanced Cordless Telephones

HAI- Hospital Acquired Infection

HCW- Healthcare Workers

IPC- Infection Prevention and Control

ICU- Intensive Care Unit

KBTH- Korle-Bu Teaching Hospital

MHD- Mobile Hand-held Devices

MP- Mobile Phone

MRSA- Methicillin-Resistant Staphylococcus Aureus

NICU- Neonatal Intensive Care Unit

NHCW- Non-Healthcare Workers

PMP- Personal Mobile Phones

PDA- Personal Digital Assistants

PED- Personal Electronic Devices

SPSS- Statistical Package for the Social Sciences

USA- United State of America

WHO- World Health Organisation

OPERATIONAL DEFINITION OF TERMS

Healthcare workers- In this study Healthcare Workers refer to doctors and nurses who are licensed to work in hospitals in Ghana

Healthcare Associated infections- Refers to infections acquired and transmitted in healthcare settings

Mobile phone contamination- Refers to the presence of microorganisms on the mobile phones of healthcare workers.

Mobile phone use- Refers to touching of mobile phone while at work for whatever purpose.

CHAPTER ONE

INTRODUCTION

1.1 Background

Since the advent of mobile phones devices, they have become available in many clinical and non-clinical environments. They are used for instant social and professional communication and endless resource utilization. In 2013, medical apps for mobile phone devices accounted for 2.21% of all apps with 19,474 available on apple or android products (Mark et al., 2014)).Usage of such phones in clinical work demonstrates no sign of abating with new applications traded on an everyday basis. Yet anecdotally, mobile phones have been implicated as a source of bacterial contamination. Drug resistant pathogens such as methicillin resistant Staphylococcus aureus and vancomycin resistant Enterococci have been recovered from as many as 10% of mobile phones raising important safety concerns over the use of such devices in clinical areas (Mark et al., 2014) Hospital acquired infections (HAI) are the most important worldwide safety worry for patients and health-care professionals (WHO, 2008, 2011). It is increasingly recognized as a major contributor to client‘s morbidity and mortality worldwide as well as increased cost (Neidell et al., 2012; Payne, Carpenter, Badger, Horbar, & Rogowski, 2004). Among neonates the risk of acquiring HAIs is increased due their immature immune system and the frequent invasive procedures conducted on them(Hooven & Polin, 2014). In developing countries this risk is further compounded by varying challenges with infection prevention and control in hospitals (Benedetta Allegranzi et al., 2011).

The majority of HAIs usually occurs as a result of cross infection, with the unclean hand being a major source of transmission. Contamination of the hand usually occurs after contact with different elements in the healthcare environment without observing appropriate hand hygiene

procedures. Thus most campaigns aimed at reducing the global burden of HAIs have focused on improving the hand hygiene situation in healthcare settings (Benedetta Allegranzi et al., 2013; Pires et al., 2017).

Worldwide neonatal deaths account for an estimated 1.6 million deaths annually (Zaidi et al., 2005). The majority of these deaths occur in developing countries. In 2012, approximately 680,000 neonatal deaths were due to bacterial infections (Seale et al., 2014). Improving infection prevention and control in the neonatal population especially in developing countries is thus critical in the global quest to reduce neonatal morbidity and mortality statistics.

1.2 Problem Statement

Pathogenic bacteria have been found to survive for long periods on several surfaces making them a potential source of transmission of HAIs when appropriate hand hygiene procedures are not observed (Boyce, 2007; Otter, Yezli, Salkeld, & French, 2013). In the past decades global penetration of mobile technology device use has increased dramatically and this has spread into the healthcare environment. In the hospital these devices may be used as a means of communication, resource material or instruments of patient care (Boruff & Storie, 2014; Mark et al., 2014; Morris, Moore, & Shaunak, 2012). In critically ill patients such as neonates, the use of personal devices such as watches and rings are discouraged, as they represent potential reservoirs of infection (Mark et al., 2014; Saxena, Singh, Agarwal, Mehta, & Dutta, 2011). Previous studies have shown mobile technology devices especially phones as potential sources of infection transmission (Akinyemi, Atapu, Adetona, & Coker, n.d.; Ulger et al., 2009). Thus increased use of such devices without the observation of appropriate infection prevention and control guidelines may increase the risk of HAI transmission.

In Ghana, several initiatives have been carried out in the health sector to promote a safe environment and efficient and effective Infection Prevention and Control (IPC) practices in health care settings (MOH, 2015), yet there is lack of studies that looked at the use of mobile phones and associated transmission of HAIs in healthcare facilities. At the neonatal intensive care unit (NICU) of the Korle-Bu Teaching Hospital anecdotal evidence shows an increase in the use of mobile devices for different purposes**.** There has been frequent out- break of infections on the unit within the past two years and previous studies at the unit showed suboptimal hand hygiene practices among healthcare workers (Asare, Enweronu-Laryea, & Newman, 2009; Yawson & Hesse, 2013). This situation increases the risk of spreading infections in the unit with associated poor clinical outcomes. However, in spite of the frequent usage of these devices among healthcare workers in the unit, there is no research done to examine the usage of mobile phones and potential transmission of HAIs. Thus this study sort to examine the use of mobile phones and associated bacterial contamination in the neonatal intensive care unit of the korle-bu teaching hospital.

1.3 Justification

Reducing healthcare associated infections among neonates is an important global target(–Every Newborn, An Action Plan To End Preventable Deaths," 2014). In Ghana the Ministry of Health has set a target of reducing neonatal sepsis by 50% by 2018(Ministry of Health, 2014). Understanding the potential sources of infection transmission will lead to appropriate preventive strategies. Thus all efforts to understand the transmission patterns of these infections among hospitalized neonates will contribute to efforts in reducing these infections in the neonatal intensive care unit of KBTH and the country as a whole.

This study will provide information on the use of mobile phones among healthcare workers and the associated bacterial contamination and transmission of infection to aid in institution of infection prevention and control measures regarding the use of mobile phones in hospitals.

1.4 Conceptual Framework

In this study, I am conceptualizing that there is increased use of mobile phones in the NICU of Korle-Bu Teaching Hospital, with minimum attendant hand hygiene. This is likely to lead to increased contamination of these devices by pathogenic bacteria with an increased chance of these devices serving as sources of hospital acquired infections for newborns as depicted in figure 1.1 below.

As shown in the diagram, the factors that may influence mobile phone usage by either doctors or nurses include the use of it as a tool for assessment of the newborn where, they look at the assessment chart downloaded on the phone to guide them in assessing the newborns.

Healthcare workers may also use it to communicate findings to a senior colleague in seeking views about a particular case. Some of the doctors and nurses also use it as a way of social networking by getting in touch with friends and family within the patient‘s area.

Poor hygiene after the use of the mobile phone can lead to potential nosocomial infection where organisms could be transferred from the phone to patients. The frequency of mobile phone usage by either the doctors or nurses to either communicate, social network, as a tool for assessment or as a source of reference and the poor hygiene practices after usage will lead to potential nosocomial infection.

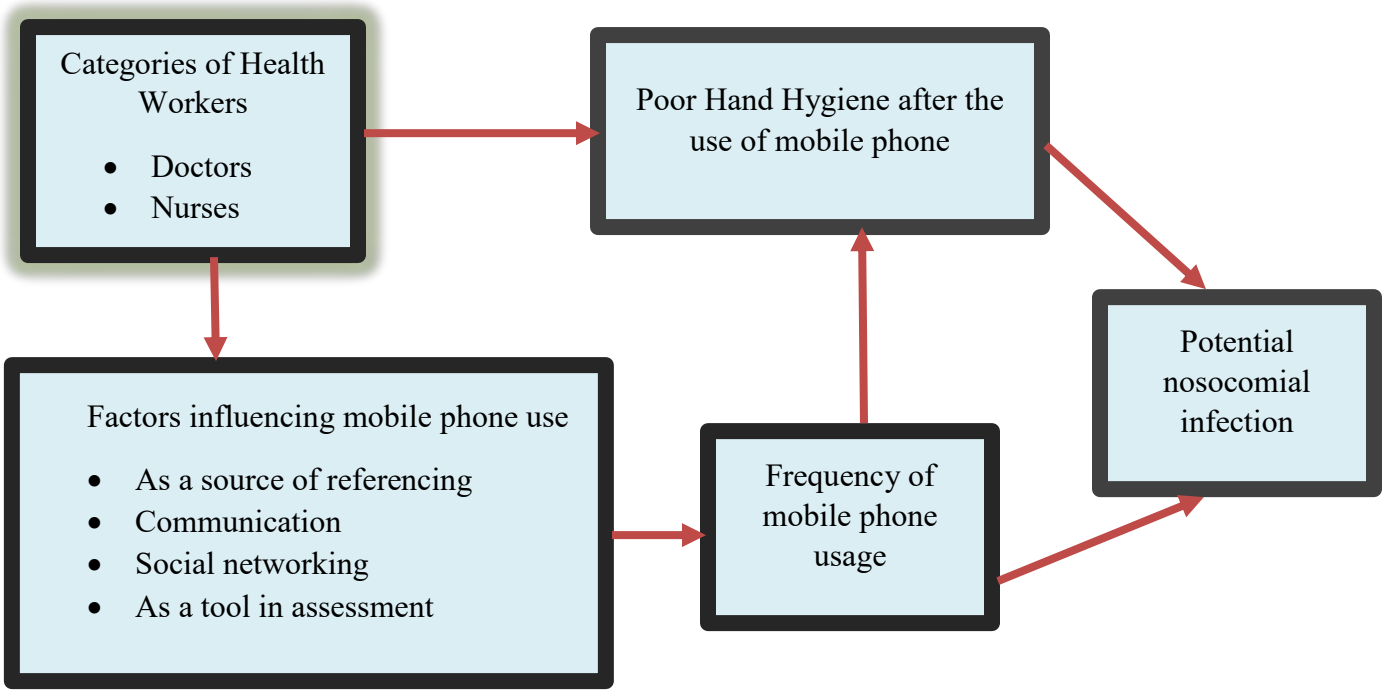

Figure 1.1: Conceptual framework of mobile phone use and associated bacterial contamination

(Source: Author's construct)

1.5 Research Questions

1. What is the frequency of use of mobile phone devices among doctors and nurses of the NICU of the KBTH?

2. What are the factors associated with use of mobile phone devices among doctors and nurses in the NICU of the KBTH?

3. What is the level of bacterial contamination of mobile phone in the NICU at KBTH?

1.6 Objectives of the study

These comprised of the general objectives and specific objectives of the study.

1.6.1 General Objective

To describe mobile phone use and attitudes concerning its use as well the level of bacterial contamination of these phones at Korle-Bu Teaching Hospital.

1.6.2 Specific Objectives

1. To determine the frequency of use of mobile phones device among doctors and nurses of the NICU of KBTH

2. To determine motives behind the use of mobile phones within patient care areas.

3. To determine the bacterial contamination on mobile phones together with their antibiotic susceptibility profile.

1.7 Outline of the study

The study comprises of six chapters. Chapter one presents the introduction where the background, problem statement, justification, objectives and research questions are explained. Chapter two consists of a review of existing literature of related studies on the subject matter under investigation. Chapter three presents the methods used in conducting the study. Chapter four presents the results of the study. Chapter five presents discussions of the findings. Chapter six presents the summary, conclusion and recommendations of the study.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Introduction

This chapter offers an evaluation of existing works on the usage of mobile phone devices and the associated and potential transmission of infection in healthcare settings. It identifies disparities and similarities in findings as well as the context specific factors influencing study findings on this subject matter. The chapter consists of five sections.

2.2 Mobile Phones and Healthcare.

Research shows that the worldwide organization for mobile telecommunication was established in 1982 in Europe with the idea of providing and refining communication linkage (Akinyemi, Atapu, Adetona, & Coker, 2009). But there has been a rapid progress of modern technology in the area of mobile telecommunication since its establishment in the last two decades contributing greatly to several fields of study including the medical fields as well as the advancement of knowledge for personal usage. This technical know-how comprises personal computers, beepers, mobile hand-held devices (MHDs) (wireless tablets such as iPad, droids, etc.) and mobile phones (MPs) (Ulger et al., 2009). The global spread of mobile information technology devices and increased access to internet connectivity has resulted in the use of these devices as resources in several spheres of daily activity. The healthcare delivery space has not been spared, and has seen increased adaptation of these devices for different purposes (Barton, 2012)

According to Kotris, Drenjančević, Talapko, and Bukovski, (2017), the number per capita of mobile phones is often much larger than the population of a country. Sowah (2008) in his study argued that currently, MPs have turn out to be one of the most essential accessories of

professional and community life. In hospitals as well as healthcare settings, MPs and MHDs aid in accelerating in flow of health information and data sharing as well as querying. This help in communicating in emergency situations with its use and access to wireless media technology. These devices may be used as sources of reference material during patient care, data collection instruments in research, as well as instruments of care e.g. taking a pulse and respiratory rate (Mark et al., 2014; Morris et al., 2012; Osborne, Phull, & Matone, 2012). In settings where there is poor hospital communication network they serve as the main form of communication among healthcare workers at different locations. Also, as technical knowhow has advanced, mobile hand devices which produce investigations from laboratory and imaging outcomes, information as well as photographic images is being used by doctors in the course of ward reviews to interact with resident doctors and learners. Health care workers (HCWs) retrieve pharmacological information and write ups by mobile phones and mobile hands held devices , thus facilitating knowledge acquisition and clinical performance (Visvanathan, Gibb,&Brady,2011).

Moreover, studies have shown that it is doable, by means of advancement in mobile communications, to closely follow-up on diseases, expose polygenic disease and respiratory disorder, which does not require the patient is there within the hospital. MPs offer distinctive services for situations, adore the treatment of chronic infections, vaccinations, and therefore can be used as the device of epidemics.

MPs primarily offer accessibility to medical experts while not limiting facilitation of communication with patients.

As a result, Khan et al. (2015), concluded that the merger of the electronic health document and convenient personal computer has transformed the medical landscape.

2.3 Prevalence of Mobile Phones use among Healthcare Workers

The use of mobile phones and other telecommunication devices have been reported among healthcare workers and students studying to become healthcare workers(Zakai, Mashat, & Abumohssin, 2016). According to Pillet et al., (2016), MPs have become common in both public and hospital locations and have become an inevitable part of our lives nowadays. The global spread of mobile information technology devices and increased access to internet connectivity has resulted in the use of these devices as resources in several spheres of daily activity and the healthcare delivery space has not been spared, and has seen increased adaptation of these devices for different purposes (Barton, 2012). These devices may be used as sources of reference material during patient care, data collection instruments in research, as well as instruments of care e.g. taking a pulse and respiratory rate (Mark et al., 2014; Morris et al., 2012; Osborne, Phull, & Matone, 2012). In settings where there is poor hospital communication network they serve as the main form of communication among healthcare workers at different locations. Several studies have reported that above fifty percent of healthcare workers HCWs admit using MPs (either personal or professional devices) in their practice, which includes physical interaction with patients (Visvanathan, Gibb, Brady, 2011; Goldblatt et al, 2007; Ramesh et al, 2008; Manning, Davis, Sparnon, & Ballard, 2013).

A study was conducted to determine the way HCWs mobile phones get contaminated through prevalent viruses by Pillet et al. (2016), at the University Hospital of Saint-Étienne, France, from January to March 2013.This was the era of spread of epidemic viruses (influenza viruses, RSV, gastroenteritis-associated viruses). Health care workers of the children and adult emergency rooms, and those of the common children‘s units and the contagious illnesses units, were involved. The term ‗mobile phones‘ was used to indicate both Personal Mobile Phones (PMPs)

and Digital Enhanced Cordless Telephone (DECTs). Physicians and residents were considered to be medical staff (n = 55); nurses and nurses‘ assistants were considered to be paramedical HCWs (n = 59). The software used for the collection of data was Excel while statistical analyses were performed by SPSS 20.0 software. The results showed that All HCWs owned a PMP, and 99 of them (86.8%) used a DECT daily at work. All the HCWs declared that they knew that MPs could host infectious agents. The participants received more than ten calls per workday in 65.6% of cases and no statistical difference was found among categories. HCWs used their PMPs in hospital in 37.7% (43/114) of cases, with medical HCWs using their PMP more frequently than paramedical HCWs (respectively, 33/65 vs. 10/53, p <0.001). Paediatric staff used MPs during care significantly less frequently than adult staff (27/56 vs. 46/58, p <0.001). Seventy-eight HCWs (68.4%) halted patient care to answer their MP (their own MP or a shared MP). This proportion was significantly lower in paediatric staff than in adult staff (27/56 vs. 46/58, p <0.001).

In a survey conducted among Canadian medical students and residents, widespread use of smartphones and tablets in clinical settings was reported (Boruff & Storie, 2014). In other studies, widespread use among health workers has been observed in other setting (Goldblatt et al., 2007; Mark et al., 2014).

2.4 Microorganisms associated with Mobile Phone use in healthcare settings

As healthcare workers carry out various activities in the hospital in caring for patients while touching their mobile phones at the same time, they can easily transmit microorganisms from patients to their mobile phones and vice versa. Evidence from research indicates that the possible infection of telephones was first suggested by Aronson et al. in 1977. Then, in 1978, Cozanitis

reported that telephones could pose a risk of transmitting infections within the intensive care unit (ICU). Early in the 1980s, White-Rafferty and Pancoast buttressed these reports with different studies in which thirty-nine studies published between 2005 and 2013 were reviewed. Of these, 19 (48.7%) identified coagulase-negative staphylococci (CoNS), and 26 (66.7%) identified Staphylococcus aureus. The frequency of growth of organisms varied.It was observed that, 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.

However, a first study on MPs use among healthcare workers and the possibility of infection transmission was performed by Borer in 2005, and many other studies have been published since (Ulger, Dilek, Esen, Sunbul, & Leblebicioglu, 2015). For instance, a study conducted in a mixed tertiary intensive care unit with eight beds and 14 operating rooms examined the contamination of mobile phones with nosocomial pathogens. In total, 200 healthcare workers comprising of 15 senior, 79 assistant doctors, 38 nurses and 68 healthcare staff were included in the study. They were screened and cultures were subsequently obtained from the dominant hand of participants and their mobile phones at the same time. Data was collected on the Gender, profession and duration of their profession, ring use, dominant hands of HCWs, and routine cleaning of the mobile phones. The data collection procedure include rotating over the surface of both sides of the mobile phones of healthcare workers with a sterile swab moistened with sterile saline. Secondly, the entire ventral surface of the dominant hand (including ventral surfaces of the thumb and the fingers) of HCW's was rubbed with a sterile swab. The sampling of the dominant hand and mobile phone swabs (twice for hands and twice for mobile phones) were then immediately streaked onto two plates that consist of blood agar supplemented with 5%

defibrinated sheep blood and eosin methylene blue agar. The plates were incubated aerobically at 37°C for 48 hours. Isolated microorganisms were identified using gram stain, colony counts, morphology, catalase and oxidase reaction and all isolates were allocated to the appropriate genera. They found that the rate of bacterial contamination of mobile phones is 94.5% and the microorganisms identified included Staphylococcus aureus, Streptococcus spp., CoNS, Enterococcus spp., Non-fermentative gram negatives, Coliforms, Moulds, and Yeasts. They thus concluded that the hands and mobile phones of HCWs' were contaminated with various types of microorganisms and Mobile phones used by HCWs in daily practice may be a source of nosocomial infections in hospitals(Ulger et al., 2009).

2.5 Mobile Phone use among healthcare workers and transmission of Healthcare Associated Infections

Healthcare Associated Infection also known as Nosocomial infection is an important problem in all modern hospitals globally. Research shows that as early as 1861 a Physician named Semmelweis demonstrated that bacteria were transmitted to the patients by the contaminated hands of healthcare workers (Ulger et al., 2009). HAIs typically occur as a result of cross infection between patients, between patients and staff, and between patients and inanimate objects; with the major mode of transmission being the unclean hand(B. Allegranzi & Pittet, 2009). Thus most campaigns against HAIs have focused on hand hygiene(Benedetta Allegranzi et al., 2013; Pires et al., 2017; Sax et al., 2007; WHO, 2005).

Studies have shown that bacteria can survive on several inanimate objects found in the hospital environment and serve as a source of transmission of HAIs. Frequently touched surfaces such as door handles, bed rails, computer key pads have been shown to habour bacteria such as

methicillin resistant Staphylococcus aureus, vancomycin resistant Enterococcus sp, Acinetobacter sp, Escherichia coli, Klebsiella sp, Pseudomonas sp for extended periods of time and continues to be a source of transmission of infection if regular surface disinfection is not conducted(Kramer, Schwebke, & Kampf, 2006; Otter, Yezli, & French, 2011)

Since the hand of healthcare workers are used to handle mobile phones in their attempts to use them during working periods, there is the potential for contamination of mobile phones and transmission of microorganisms to patients and vice versa. For example various studies indicates that fomites (computer keyboards, clothing, stethoscopes, ties, cell phones) are well-described sources for transmission of pathogenic bacteria in hospital settings. The touchscreen nature, portability, and high probability of coincidental use during patient encounters makes mobile phones and other portable electronic devices (PEDs) a possible reservoir for the transmission of pathogens (Ulger et al., 2009; Longtin et al., 2014). Another study found that, mobile phones are exposed to many microbes including those associated with the skin due to the regular use of the mobile phone by HCWs thus making them good carrier for microbes, resulting in the spread of different microorganism from the user (Ekrakene & Igeleke, 2007).

Additionally, many epidemiological studies reveal that contaminated surfaces contribute greatly to the spread of infectious diseases in the healthcare setting and Mobile phones are more problematic as far as infection transmission is concern compared with other stationary fomites. This is due to the fact that they promote inter-ward (and possibly inter-facility) transmission and elimination of pathogens on them are very difficult (Nwankwo et al., 2014). Other studies have found that mobile phones of in healthcare settings are hardly cleaned once handled and may transmit microorganisms, comprising multiple resistant ones, after contact with the patient, and

can be a basis for bacterial cross-contamination (Brady, Verran, Damani, & Gibb, 2009; Jayalakshmi, Appalaraju, & Usha, 2008; Ustun,& Cihangiroglu, 2012).

The high usage of mobile phones inn healthcare settings are likely to lead to the contamination of these devices, making them a possible source of a hospital acquired infection, especially if appropriate infection prevention practices are not observed. The risk of transmission is heightened because they are likely to be operated with an ungloved hand and their fragile electronics preclude regular disinfection (Redelmeier & Detsky, 2013). They also have the potential to undermine hand hygiene efforts since healthcare workers are less likely to observe hand hygiene after contaminating their hands with their phones after an initial observation of hand hygiene (Morris et al., 2012; Redelmeier & Detsky, 2013). In a recent survey in Britain, 63% of respondents expected their phones to be contaminated, of these 37% admitted to cleaning it regularly (Mark et al., 2014). These factors have resulted in suggestions that mobile phones be routinely decontaminated or completely kept away from patient care areas (Shakir, Patel, Chamberland, & Kaar, 2015).

2.6 Prevalence and impact of Hospital Acquired infections (HAIs) among neonates

Hospital Acquired infections are also referred to as ~~n~~osocomial" infections that affect patients in a hospital or healthcare setting, 48hrs after admission. These infections are usually not present or incubating in the patient at the time of admission. They may also be acquired in hospitals but manifest after discharge. Globally these infections are regarded as the greatest challenge to issues of patient safety, since they are associated with prolonged hospital stay, increased medical cost, spread of antibiotic resistant bacteria and increased mortality(Cardoso, Ribeiro, Aragão, Costa-Pereira, & Sarmento, 2013; De Angelis, Murthy, Beyersmann, & Harbarth, 2010; Neidell et al.,

2012; WHO, 2005). Among neonates HAIs are responsible for 4-56% of all neonatal deaths, in South-East Asia and Africa it is estimated to cause about 75% of death (–WHO)

At any given time, the prevalence of health care-associated infection in developed countries varies between 3.5% and 12%, whilst in resource limited settings the prevalence it is 15.5 per 100 patients. The risk of acquiring these infections is higher among critically ill patients. Among intensive care unit (ICU) patients in high-income countries, approximately 30% of patients are affected by at least one health care-associated infection(Magill et al., 2014). In low and middle-income countries, the frequency of ICU-acquired infection is at least 2–3 fold higher than in high-income countries; device-associated infection densities are up to 13 times higher than in the USA(Benedetta Allegranzi et al., 2011). Among newborns in developing countries, health care-associated infection rates are said to be three to twenty times higher than those recorded in high-income countries(Benedetta Allegranzi et al., 2011; Zaidi et al., 2005). This situation is attributed to poor infection prevention and control practices observed in these settings(Nejad, Allegranzi, Syed, Ellis, & Pittet, 2011). Other documented risk factors of HAIs are use of indwelling devices, prolonged hospital stay, inappropriate antibiotic use and immunosuppression.

Among neonates the risk of developing hospital acquired infections is increased due to their immature immune system, reduced normal flora on the skin and other mucosal surfaces , the need to perform regular invasive procedures as well as prolonged hospitalization (Hooven & Polin, 2014). Hospital acquired infections neonates are typically of bacterial origin and are usually caused by different species of *Staphylococcus* , and multi-drug resistant Gram negative bacteria(Hooven & Polin, 2014; Srivastava & Shetty, 2007; Zaidi et al., 2005). In a study conducted in Brazil coagulase negative Staphylococcus (36%) and Staphylococcus

aureus(23.6%) were the commonest causes of hospital acquired infections among neonates(Brito et al., 2010), whilst in Turkey Gram negative organisms and *Staphylococcus epidermidis* were associated with ventilator associated pneumonia and bloodstream infections respectively(Yapicioglu et al., 2011).

Of the varying infections caused by bacteria in neonates, a bloodstream infection is considered the most severe because of its associated increase in morbidity, mortality and extra health care costs. In the United States of America, 19.7% of hospital acquired bloodstream infections were recorded among neonates. The marginal cost of these infections varied from $5,875 in very low birth weight neonates to $12,480 among neonates with birth weight between 700grams and 1kg. Excess length of stay for this study varied from 4 days in very low birth weight neonates(1.01-1.25kg) to 7 days in those with birth weight of 751 g-1kg (Payne et al., 2004). In a similar study conducted in Germany patients who developed at least one bloodstream infection had a mortality of 5.6% (Schwab, Zibell, Piening, Geffers, & Gastmeier, 2015).

2.7 Prevention strategies of HAIs

Preventing HAIs has been one of the cornerstones of the WHO patient safety program. Through several campaigns such as clean care saves lives, fight antibiotic resistance it is in your hands and launching of policy documents etc. The WHO has sought to reduce the global burden of hospital acquired infections. Effective hand hygiene has been found to be reduce HAIs by at least 50 %(Benedetta Allegranzi et al., 2011). Studies from developing countries however, show very low rates of compliance to hand hygiene practices in health care institutions. (B. Allegranz et al. 2011). Previous hand hygiene studies conducted among healthcare workers in two tertiary hospitals in Ghana showed very low rates of hand hygiene compliance as Care-related hand

hygiene compliance among doctors ranged from 9.2% to 57% and 9.6% to 54% among nurses. (Asare et al., 2009; Owusu-Ofori et al., 2010; Yawson & Hesse, 2013). This state of affairs coupled with increase in mobile phone device usage in critical care areas such as the NICU may hamper efforts to curb HAIs.

2.8 Chapter summary

The existing literature on the subject matter under study reveals that mobile phone use among healthcare workers pose considerable risk to the transmission of various bacteria and microorganisms. The important role of mobile phones in healthcare delivery has been amply demonstrated in several studies from different regions. Yet other studies have identified various microorganisms on mobile phones of healthcare workers which serve as potential sources of transmission of healthcare associated infections to patients and vice versa. The numerous microorganisms identified on the mobile phones of healthcare workers included Staphylococcus aureus, Streptococcus spp., CoNS, Enterococcus spp., Non-fermentative gram negatives, Coliforms, Moulds, and Yeasts including viruses.

CHAPTER THREE

3.0 METHODS

3.1 Introduction

This chapter presents the steps taken in conducting the research. It outlined the study design and describes the study setting and study population. The chapter also presents the sample size of the study and the sampling method used in the selection of study participants, the techniques employed in data collection, processing and analysis.

3.2 Study Design

A cross-sectional study using quantitative tools was used to assess mobile phone use, attitudes about their use and bacterial contamination of phones in the NICU of KBTH. The study was conducted over a three week period and involved the following:

- **Phase 1**- a week observation of mobile phone use patterns
- **Phase 2-** A one week of microbiological sample taking and analysis
- **Phase 3**- one week of questionnaire administration and retrieval of questionnaire.

3.3 Study Setting

This study was conducted at the neonatal intensive care unit of the (NICU) Korle-Bu Teaching Hospital. This is a 2000-bed tertiary teaching hospital with about 138 new admissions per day(Korle-Bu Teaching Hospital, 2013). The hospital was established in 1923 and is the largest teaching hospital in Ghana. It became a teaching hospital in 1962. The hospital covers all medical specialties and provides referral healthcare services to an estimated population of 29.6 million Ghanaians and is also has three centers of excellence. These are the Reconstructive Plastic Surgery and Burns Centre, the National Cardiothoracic Centre and the National Centre for Radiotherapy and Nuclear Medicine which receive and manage clients including those hailing from neighboring countries such as Nigeria, Burkina Faso and Togo. The NICU of the hospital is a 55 bed capacity unit and acts as the main referral center for Greater Accra Region and Southern Ghana region. The unit has 3 main cubicles and a Kangaroo mother care unit. It admits approximately 2,400 neonates a year.

The Korle-Bu Teaching Hospital is located in the Ablekuma South District which is one of the Sub-Metropolitan Districts of Accra Metropolitan Assembly. It is bounded on the east by the Odododiodio constituency, on the west by Weija constituency, on the south by the Gulf of Guinea (sea) and on the north by Ablekuma Central and North constituencies. The figures below shows google maps of Ablekuma south district and Korle-Bu Teaching Hospital respectively.

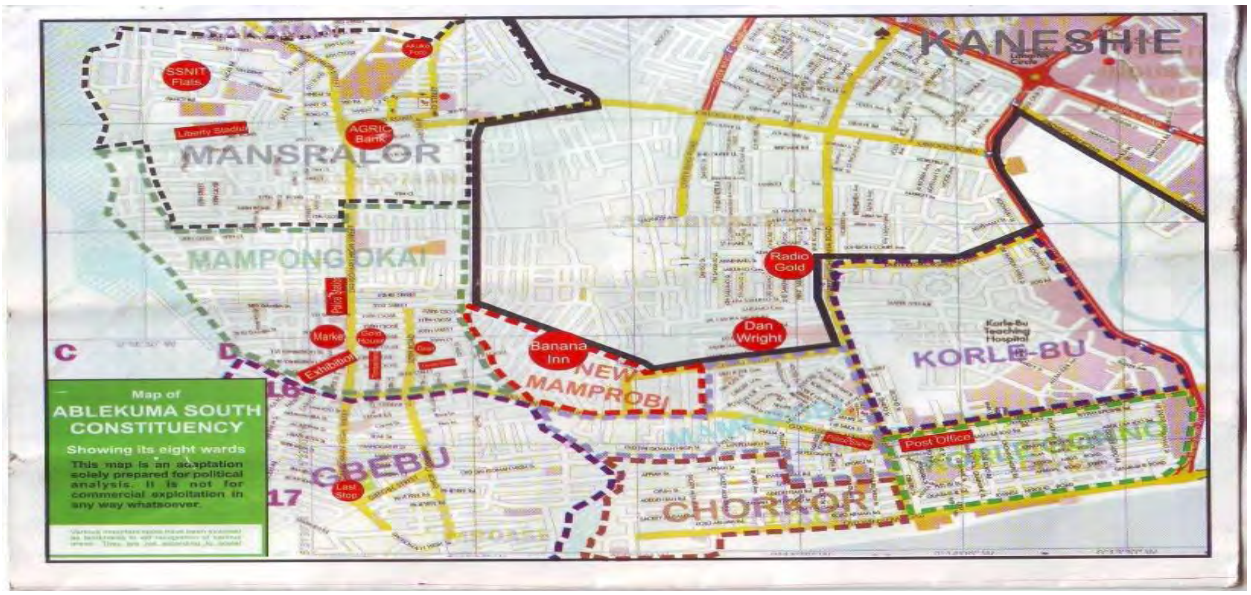

Figure 3.1: Map of Ablekuma South District. Source: Google maps (2018).

Figure 3.2: Map showing the location of Korle-Bu Teaching Hospital. Source: Google maps (2018)

3.4 Study Variables

3.4.1 Independent variable

The independent variable in this study is mobile phone use and bacteria contamination among healthcare workers in the NICU of Korle-Bu Teaching Hospital.

3.4.2 Dependent variables

These following are the dependent variables considered in the study which are expected to influence the dependent variable:

1. Socio-demographic characteristics of study participants (Age, educational level, sex, professional category and duration of practice).
2. Attitudes of healthcare workers towards mobile phone use at work.

3.5 Study population

The study population involved all doctors and nurses working at the NICU as full time employees of the Korle-Bu Teaching Hospital.

3.5.1 Inclusion criteria

All doctors and nurses who were at post or present on duty at the NICU of the Korle-Bu Teaching Hospital during the study period were involved in the study. Only those eligible and were willing to participate in the research were chosen.

3.5.2 Exclusion criteria

Doctors and nurses who were present but not full time employees of the Korle-Bu Teaching Hospital were excluded from the study. Doctors and nurse who were present but not on duty

were excluded. Doctors and nurses were present but not willing to participate in the study were also excluded from the study. Doctors and nurses who were on leave were also excluded.

3.6 Sample size

All staff comprising made up of doctors and nurses who were permanent employees of the NICU of the Korlr-Bu Teaching Hospital and at post during the period of the study were recruited using total enumeration. A total of 40 staff was recruited to participate in the study.

3.7 Sampling Method

Total enumeration of all doctors and nurses present at the NICU and on duty at the time of the study were recruited for the study.

3.8 Data collection procedure/ technique and Tools

3.8.1 Phase 1: Observation of mobile phone device use

I conducted unobtrusive observation of NICU staff as they go about their activities and document any use of mobile devices. Observations were conducted three times a day, to cover the morning, afternoon and evening shifts. Each cubicle was observed for a period of 30 minutes per shift. Observations were conducted using an instrument adapted from the WHO hand hygiene observation instrument(WHO, 2009). (Appendix 1) A maximum of four individuals was observed per shift per day.

3.8.2 Phase 2: Microbial contamination of mobile phone devices

Imprint of the area of the key pad of all phones of staff was done on a selected day. Imprints were taken from phones of all staff during the morning, afternoon and night shift using Replicate Organism Detection and Count Plates (RODAC$^{\text{Becton Dickinson}}$). Sampling was done half way during each shift. Samples were sent to the Medical Microbiology Department of the School of Biomedical and Allied Health Sciences for culture. Bacterial load on the phones were determined by counting the total number of colony forming units on the plate; and determining the colony forming units per centimeter square area of key pad. Organisms were identified using their phenotypic and biochemical characteristics. Antibiotic susceptibility was conducted using the Kirby Bauer disc diffusion method and interpreted using the Clinical Laboratory and Standards Institute guidelines.

Figure 3.3: A RODAC Plate

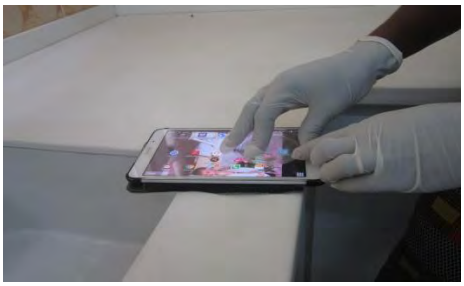

Figure 3.4: Taking an imprint of a mobile phone using the RODAC plate

Figure 3.5: RODAC plates before incubation

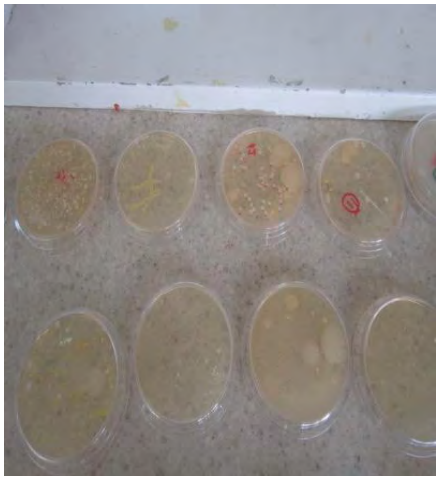

Figure 3.6: RODAC plate with bacterial colonies after incubation.

3.8.3 Phase 3: Questionnaire survey

To describe attitudes of staff concerning mobile phone use in the NICU I employed a questionnaire based survey (Mark et al., 2014). A structured questionnaire was designed and administered to participants. The questionnaire was made up of 2 sections. Section A collected data on socio-demographic and general information of participants while section B gathered information on characteristics and attitude of staff towards mobile phone use at work. Appendix 2 shows the questionnaire of the study.

The questionnaire was self-administered. The entire questionnaire was handed to the head of Nurses and senior resident doctors at the NICU for distribution and completion. Each questionnaire included a cover letter explaining the purpose of the study and a consent form requesting the participation of the staff and assuring them that confidentiality will be maintained. The questionnaires were without any identifiers to ensure anonymity of the respondents. The completed questionnaire was returned to the head of nurses and medical doctors and was collected by the principal investigator.

3.9 Data Quality

Information gathered on each respondent was cross checked after to ensure that the questionnaire was completely and properly filled and all information correctly collected.

3.10 Pre-Test/ Pilot Study

The questionnaire was pretested among health care workers of the Department of Surgery to allow for corrective actions on any inconsistent and ambiguous questions.

3.11 Data Processing and analysis

Results were entered into Microsoft ACCESS 2016 for editing. Statistical analysis was done using Vassar stats (http://vassarstats.net/). Level of significance was set at P value of <0.05. Study outcomes were compared between doctors and nurses, where appropriate. The observational outcome for mobile phone use was recorded as a proportion of the number of times mobile phones were used for an activity to the total frequency of mobile phone usage.For samples with microbial growth on RODAC plates, the numbers of counted colonies were converted to colony forming units per cm^2 using the formula $A = \pi r^2$(A=area; r=radius of RODAC plate). The colony forming units per cm^2 was noted as the total aerobic microorganisms, and recorded as the microbial contamination level per phone. For microbial contamination of phones, mean ± standard deviation, or median with interquartile range were calculated where appropriate. Sample means were compared with Student‘s t-tests.

3.12 Data management, storage and usage

All data were kept in locked cabinets accessible to only me. All records bore no identifiable numbers to ensure confidentiality. Data were keyed into a password protected Access database which was created for the purpose of this study.

3.13 Ethical Considerations

Institutional ethical clearance was sought and obtained from the Institutional Review Board, Korle-Bu Teaching Hospital to conduct the study (KBTH- IRB /00013/2018). Individual consent was sought from all staff` willing to participate in the study before they were included in the study. Permission was sought from the management and head of the Korle-Bu Teaching Hospital and NICU respectively before the study. Names of participants were not taken. Instead entry for each participant was represented with a number in order to ensure anonymity.

3.14 Declaration of conflict of interest

I declare that as the principal investigator in this study, I have no conflict of interest in this study.

3.15 Funding of the study

The study was conducted in partial fulfilment of requirements for the award of a Master of Public Health (MPH) degree by the School of Public Health, College of Health Sciences, University of Ghana, Legon. Hence, all estimated cost of the study were borne solely by me as the principal researcher.

3.16 Validity and Reliability

The study measured the face and content validity of questionnaires used in this study. Ten physician consultants from Korle-Bu Teaching Hospital and 10 public health specialists from the School of Public Health, University of Ghana were selected by convenience sampling. A pool of 20 questions on attitudes of staff concerning mobile phone use in the NICU was generated. For assessing the face validity of questionnaire, two reviews were carried out by the physician and public health panel to write their comments about the location of items, correct scaling and grammatical structure of each item, and the necessity of adding new items or removing existing items. This process reduced the number of questions to 16. After item analysis, the total number of statements in the final questionnaire was 15. The corrected questionnaire was evaluated by short pre-testing of the questionnaire by interviews with 20 doctors and 20 nurses representative of the population to be sampled. They were asked about questions layout and length, question difficulty and ease of completion. Time to complete the questionnaire was also assessed. Respondents were given the opportunity to ask questions and raise queries with questionnaire items. Content validity was assessed by another team of physician consultants. The amended draft questionnaire after face validation was distributed to the group together with a brief outline of the project and a score sheet. The score sheet listed each question and asked the respondent to score the item out of 10 in relation to appropriateness, importance and phrasing. A column was also provided on the score sheet for other/additional comments to be completed as necessary by the respondent. Responses were collated and the questionnaire was amended as appropriate. Cronbach‘s alpha coefficient was calculated to assess the internal consistency reliability of the questionnaires. Cronbach‘s alpha values beyond 0.70 were considered satisfactory for reliability.

3.17 Limitation of the study design

The limited number of healthcare workers within the unit made it difficult to observe mobile phone practices unobtrusively. Although data collection in the observations studies was done discretely, it is plausible that mobile phone practice in within the patient`s area may have been influenced by the observational assessments (Hawthorne effect). Although the Phase 3 questionnaire underwent vigorous validation testing, limitations may still remain in the reliability of the questionnaire used. Repeat reliability testing (test–retest) was not performed to evaluate the tendency of the questionnaire for consistency in repeated measurements of the same phenomenon. Although the possibility that information yielded from the questionnaire study on attitudes of staff on mobile phone use may not be representative of the entire population of healthcare workers in Korle-Bu Teaching Hospital, it is notable that robust content and face validity were performed in the development of this questionnaire. Thus future qualitative studies in the topic area may expand on the findings derived from this instrument. It is also noteworthy, the bacterial cultures from mobile phones were not examined for resistance mechanisms such as methicillin resistant Staphylococcus aureus and extended-spectrum beta-lactamases-producing Enterobacteriacaea. Such determination would better highlight the public health importance of the contaminating isolates and the implications for antibiotic treatment in potential infections.

3.18 Chapter Summary

The chapter presents the methods employed in the conduct of this study. It described the various steps followed in the conduct of the study. This chapter outlined the study variables, sample size determination and how the respondents were selected. It further outlined the processes followed in administering the questionnaire and how the data obtained was processed and analyzed. It also

provides a detail description of the study area as well as steps that were taken to ensure data quality. The next chapter presents the results of the study.

CHAPTER FOUR

4.0 RESULTS

4.1 Introduction

This chapter presents the results of the study and comprised of different sections. The first section is made up of the demographic characteristics of participants while the rest of the sections reports the study findings in line with the objectives of the study.

4.2 Socio-demographic characteristics of respondents

A total of 40 questionnaires were distributed to staff of the NICU. Thirty eight (38) questionnaires were completed correctly and returned, giving a 95 % response rate. Of the 38 respondents in the study, majority (90%) were female. In terms of age group composition, half (50%) of the respondents were between the age range of 30-34 years while 34.2% were aged between 25-29 years. The mean age of the participants was 32.6 years (SD: 7.40). Table 4.1 shows the details of the demographic characteristics of study participants.

With regards to the professional composition of study participants, nurses were of the majority making up 90% of the total respondents while only 10% were medical doctors. The ranks of

respondents were also assessed and the results show that senior nurses constituted two-fifth (39.5%) of the respondents.

Table 4.1 shows details of the socio-demographic characteristics of respondents

Variable	Frequency	Percentage (%)
Age (Years) (mean ±SD)	32.6±7.4	
< 20	0	0
20-24	0	0
25-29	13	34.2
30-34	19	50.0
35-39	3	7.9
40-44	0	0
45-49	0	0
50-54	1	2.6
55-60	2	5.3
> 60	0	0
Sex		
Male	34	90.0
Female	4	10.0
Occupation		
Doctor	12	31.6
Nurse	26	68.4

4.3 Use of Mobile Phone at work

The study aimed to determine the proportion of healthcare staff who use mobile phone at the NICU of the Korle-Bu Teaching Hospital. All respondents were asked to indicate YES and NO

to a question on whether they use mobile phone at work or not. The findings show that majority (36/38) of the healthcare staff use mobile phone while at work representing 94.7%. while only (2/38) respondents reported no use of mobile phone on duty representing 5.3% of study participants. Figure 4.1 illustrates the proportion of healthcare staff who use mobile phone during work at the NICU of the Korle-Bu Teaching Hospital.

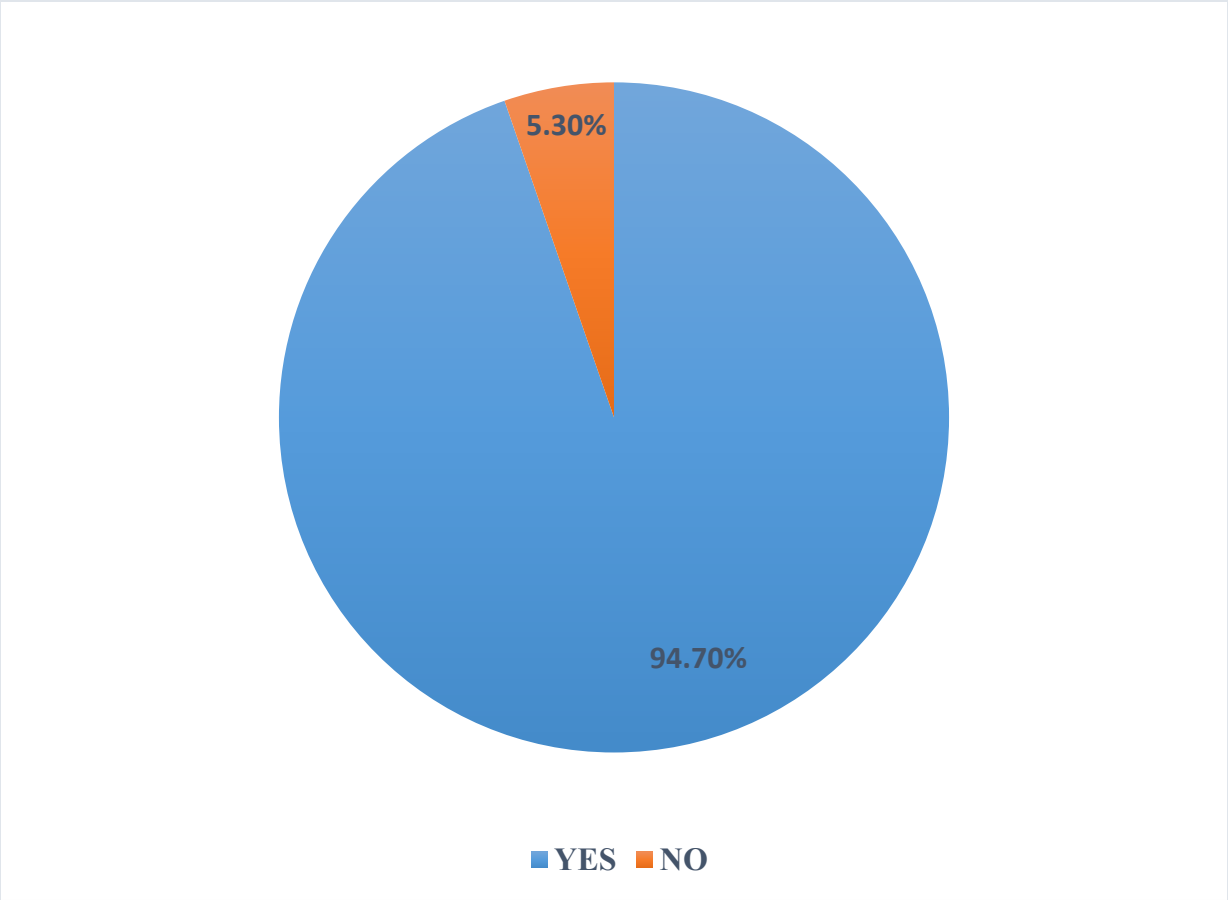

Figure 4.1: Proportion of healthcare staff who use mobile phone at work in the NICU of KBTH.

4.4 Frequency of Mobile Phone use during work

The number of time healthcare staff used mobile phone during work is expected to increase the likelihood of contamination. All respondents were assessed on the number of times they use their mobile phones daily while at work. Their responses were categorized into less than ten times, between ten to twenty times and more than twenty times.

The results are shown in figure 4.2 below. Of the 36 respondent who reported mobile phone use during work, majority (83.3%) reported daily mobile phone use of less than ten times during their shift of work while only 5.6% used their mobile phones more than twenty times daily while on duty.

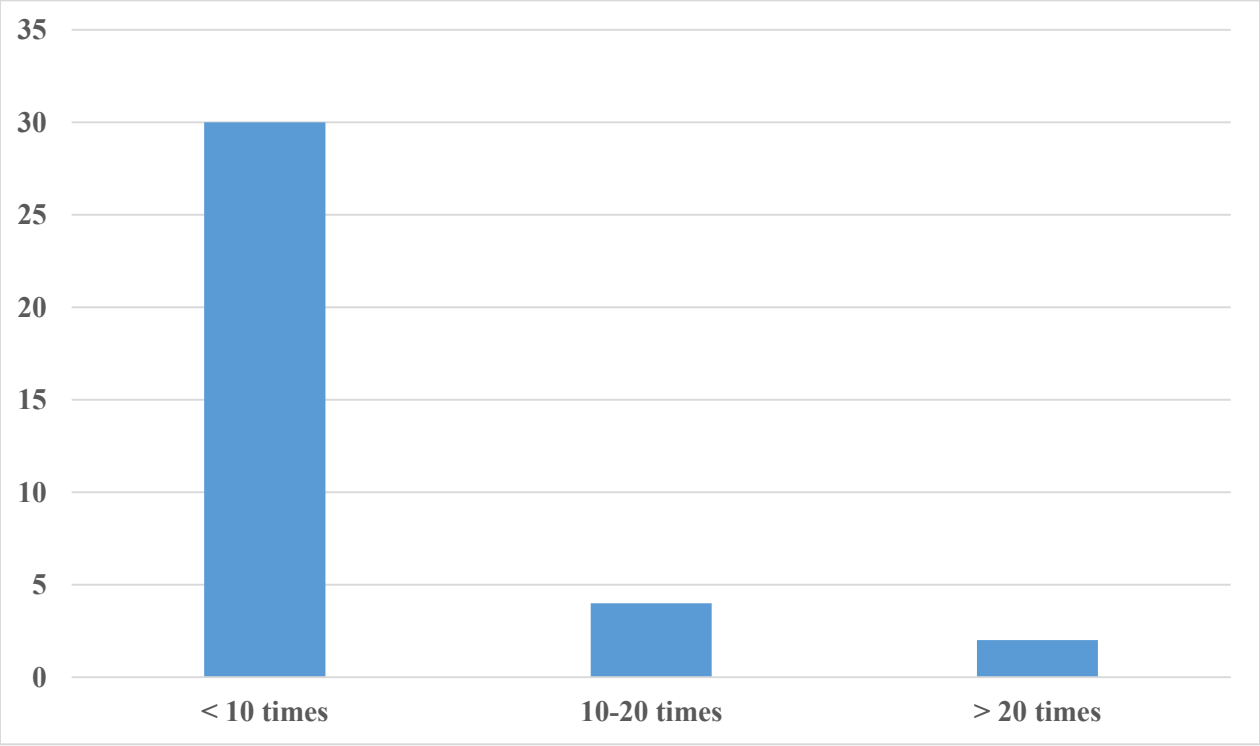

Figure 4.2: Frequency of daily mobile phone use during work.

4.4 Purposes for Mobile Phone use in the NICU among healthcare staff

The various purposes for which participants use mobile phone during their period of work was examined in order to ascertain the reasons behind mobile phone use among healthcare staff. The respondents were examined for reported reasons and purposes of mobile phone use as well as observed reasons and purposes for mobile phone use and the results are presented as follows:

4.4.1 Reported reasons for mobile phone use

Firstly the general reasons and purposes of mobile phone use were assessed. Their responses were grouped into professional reference tool, clinical use, personal use, social media and entertainment. Some respondents gave multiple reasons and purposes for using mobile phones at work. Majority (50.7%) of the reasons given for mobile phone use at work for clinical purpose while 26.1% was as a professional reference tool. Only 2.9% of the reasons given for mobile phone use at work among the participants was for entertainment.

The specific purposes for clinical use of mobile phone was also examined among respondents. The findings indicates that the foremost reason for mobile phone use by healthcare staff in the NICU of KBTH was for communication with patient families representing 25% of all the reasons given for clinical use. The use of mobile phone for communication among colleague healthcare staff as a reason for mobile phone use was 23.8% while only 4.8% use mobile phone for calculation of drug doses.Table 4.2 illustrates reported reasons for mobile phone use among study participants.

Table 4.2: Reasons for mobile phone use at work among study participants

Variable	Frequency	Percentage (%)
General Reasons for Mobile Phone use at work		
Professional reference tool	18	26.1
Clinical use	35	50.7
Personal use only	8	11.6
Social media	6	8.7
Entertainment	2	2.9
Clinical reasons for use of Mobile Phone at work		
Communication with patient families		
Communication with colleagues	21	25.0
Light source	20	23.8
Reference tool	14	16.7
Time-piece for vitals	11	13.1
For calculation of drug dose	13	15.5
	4	4.7

4.4.2 Observed reasons for Mobile Phone use

Twenty-one (21) observations were conducted over a 1 week period, 3 observations per day. Each observation period lasted for 30 minutes. In total mobile phone use in clinical areas were observed 72 times. Of this 64 observations of mobile phone use at work were by medical doctors representing 88.9% of the total observations of mobile phone use among healthcare staff in the NICU of KBTH. Only 8 observations of mobile phone use was noted among nurses representing 11.1% of the total observations of mobile phone use. Mobile phones were mainly used for the purposes of clinical examination (20/72 observations), this was solely done by medical doctors. For other purposes mobile phones were more likely to be used as a calculator (15/72observations), this practice was significant among medical doctors (13/72 observations) compared to nurses (2/72 observations). Figure 4.3 shows details of observed practices of mobile phone use during working periods among study participants.

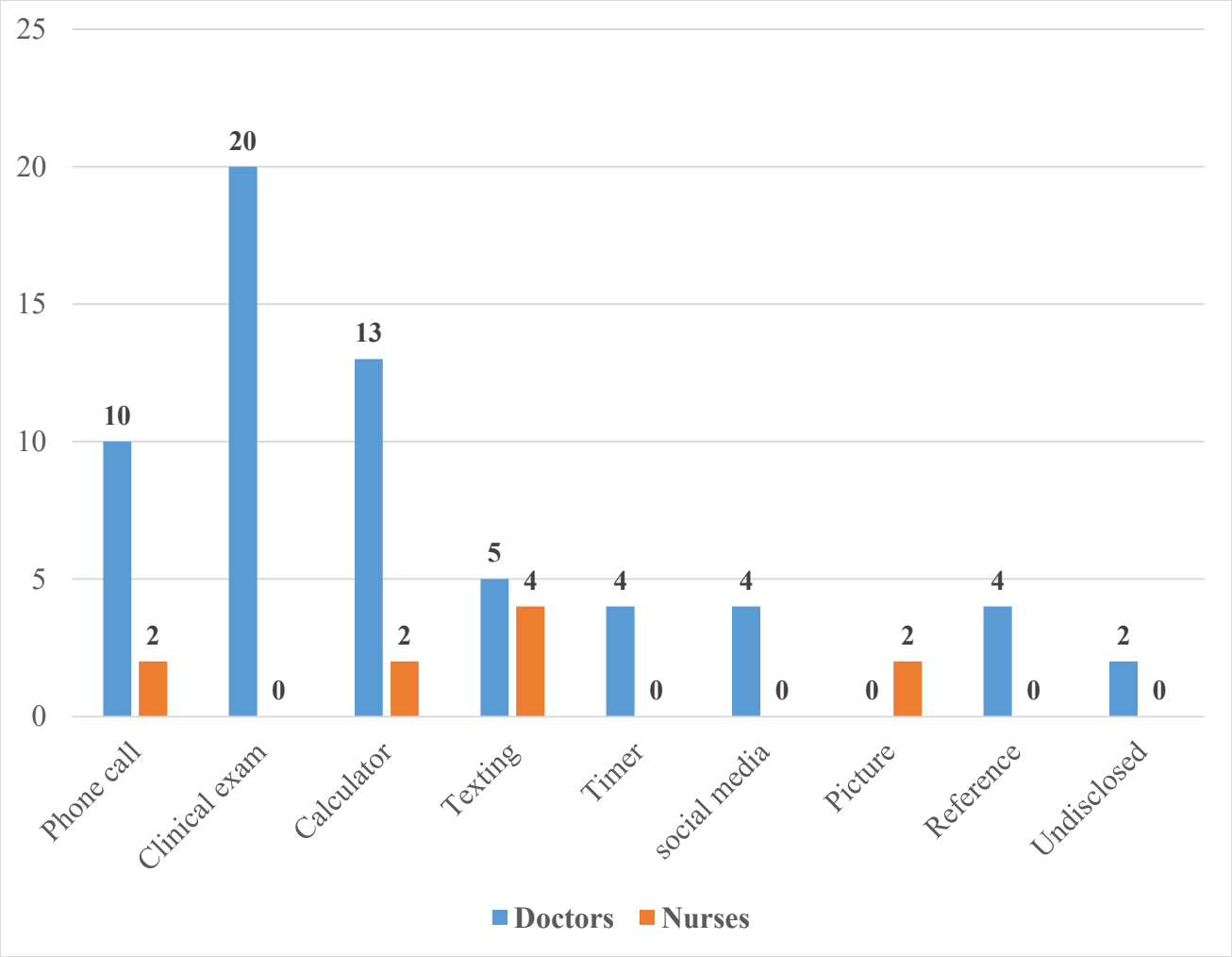

Figure 4.3: Observed practices of mobile phone use during work among respondents

4.5 Perceptions of mobile phone contamination and hand hygiene practices

In total, more than half of respondents (86.8%) believed their mobile phones were contaminated at work. While (63.2%) of the respondents believed their phones were moderately contaminated, whilst 23.7% thought their phones were highly contaminated. Most respondents (42.1%) claimed to wash their hands always after touching their mobile phones; whilst (13.2%) never washed

their hands. The majority of respondents were likely to change the frequency of mobile phone use at work if they knew it was contaminated with (55.3%) very likely and (23.7%) highly likely. Only (21.1%) were not likely to change the frequency of their mobile phone use if they knew it was contaminated.

Most (63.2%) respondents were likely to support the banning of mobile phones in clinical areas with 42.1% very likely to support banning of mobile phone use in clinical areas while 21.1% were highly likely. However, 36.8% of healthcare staff in the NICU of the Korle-Bu Teaching were not likely to support banning of mobile phone use in clinical areas. In terms of decontamination of mobile phones daily after work, majority (57.9%) of study respondents do not decontaminate their phones daily after work while 42.1% reported decontaminating their phone daily after work.

Table 4.3 shows details of perception of mobile phone contamination and hand hygiene practices among study participants.

Table 4.3 Perception of mobile phone contamination and hand hygiene practices

Variable	Frequency	Percentage (%)
Wash hand after phone use before touching patient		
Never	5	13.1
Occasionally	15	39.5
Always	16	42.1
Do not recall	2	5.3
Phone decontamination daily after work		
Yes	16	42.1
No	22	57.9
Perception on degree of contamination at work		
Not contaminated	5	13.1
Moderately contaminated	24	63.2
Highly contaminated	9	23.7
Change in frequency of Phone use if contaminated at work		
Not likely	8	21.1
Very likely	21	55.3
Highly likely	9	23.6
Support of phone banning in clinical areas		
Not likely	14	36.8
Very likely	16	42.1
Highly likely	8	21.1

4.6 Bacterial contamination of mobile phones surfaces by aerobic bacteria

The mobile phones of staff of the NICU were assessed for the presence of bacterial contamination using RODAC plates. Of the 40 mobile phones assessed, 39 of the phones were contaminated by bacteria giving a percentage of 97.5%. The mean colony per mobile phone was

3.01(range-0-10.6) colony forming units per cm2. There was no significant difference between average colony counts on the mobile phones of medical doctors and nurses.

A total of 110 bacterial isolates were identified from mobile phones of staff at the NICU. They comprised of Gram negative (11.8%) and Gram positive bacteria (88.2%). Among the Gram negative bacteria isolates, Pseudomonas species and Non-coliform bacteria constituted close to two-fifth (38.5%) while 15.4% was Coliforms bacteria. Only one (7.7%) isolate of Acinetobacter species was identified on the mobile phone of participants. Majority of the Pseudomonas species and Non-coliform bacteria isolates were found on the mobile phone of nurses and no Coliforms bacteria was identified on the mobile phones of doctors.

Of the 97 Gram positive bacteria isolates, the most frequently encountered were coagulase negative Staphylococcus (CoNs) representing 41.2% of Gram positive bacteria isolates, followed by Micrococcus species with 30.9% while 26.8% was Bacillus species. Staphylococcus aureus was the least (1.0%) common Gram positive bacteria isolate identified on the mobile phones of respondents. The single Staphylococcus aureus isolate identified was found on the mobile phones of doctors while majority of the CoNs, Micrococcus species and Bacillus species were found on the mobile phones of nurses with 72.5%, 73.3% and 73.1% respectively.

Overall the commonest bacteria isolate identified on the mobile phone of healthcare staff in the NICU of KBTH in this study were CoNs while non-pathogenic bacteria (Micrococcus sp and Bacillus sp) isolated made up 50.9% of bacteria.

Total aerobic bacteria load of mobile phone surfaces

Mobile phones	Total colony counts per surface area (cfu/cm^2)			
	Mean ±SD	Median	(Interquartile range)	Range
All mobile phones (n=40)	3.01±3.45	1.75	(0.62-3.45)	0.00-10.62
Mobile phone handlers				
Doctors (n=13)	[a] 2.49±3.56	1.20	(0.42-1.88)	0.00-10.62
Nurses (n=27)	[a] 3.27±3.36	2.05	(0.85-4.35)	0.14-10.62

*SD, standard deviation. Same superscripts within a column signify no significant difference at P<0.05, where

Table 4.4: Antimicrobial Resistance patterns of bacterial agents identified

Organism	Number isolated Doctors Nurses	MER R	PTZ R	PEN R	AMP R	CTX R	CTZ R	ERY R	COT R	TET R	TPN R	LNZ R	CLI R	FOX R
Gram Negatives														
Pseudomonas species	1 4	- (0)	-	-	-	-	- (0)	-	-	-	-	-	-	-
Acinetobacter species	0 1		-	-	-	-	- (0)	-	-	-	-	-	-	-
Coliforms	0 2	1 (50.0)	1 (50.0)	-	2 (100)	1 (50.0)	- (0)	-	- (0)	-	-	-	-	-
Non-coliform bacteria	2 3	- (0)	- (0)	-	-	5 (100)	1 (20.0)	-	-	-	-	-	-	-
Gram Positives														
Staphylococcus aureus	1 0	-	-	- (0)	-	-	-	- (0)	- (0)	- (0)	- (0)	- (0)	- (0)	- (0)
CoNs	11 29	-	-	31 (77.5)	-	-	-	20 (50.0)	16 (40.0)	12 (30.0)	1 (2.5)	2 (5.0)	10 (25.0)	21 (52.5)
Micrococcus species	8 22	-	-	-	-	-	-	-	-	-	-	-	-	-
Bacillus species	7	-	-	-	-	-	-	-	-	-	-	-	-	-

	19													
Total	110	1 (0.9)	1 (0.9)	31 (28.2)	2 (1.8)	6 (5.5)	1 (0.9)	20 (18.2)	16 (14.6)	12 (10.9)	1 (0.9)	2 (1.8)	10 (9.1)	21 (19.1)

Antimicrobial resistance tests for the bacterial agents isolated was performed to determine the level of resistance of the isolates to various antimicrobial agents. The finding revealed that CoNs were highly resistant to penicillin as 77.5% of the bacterial agents isolated could not be inhibited by penicillin. The level of resistance of CoNs to Erythromycin, Cotrimoxazole, Tetracycline, Cefoxitin and Clindamycin were found to be 50.0%, 40.0%, 30.0%, 52.5% and 25.0% respectively.

Also all (100%) of the bacterial agents isolated as coliform and non-coliform bacteria were found to be resistant to Ampicillin and Ceftriaxone respectively. Half (50.0%) of coliform bacterial agents isolated were resistant to Peropenem, Piperacillin/Tazobactam and Ceftriaxone. Table 4.4 illustrates details of antimicrobial resistance tests for the bacterial agents isolated in this study.

`

CHAPTER FIVE

5.0 DISCUSSION

5.1 Introduction

This chapter discusses the study findings. The findings are compared to results from other existing studies in literature on the subject under investigation with the few to identifying similarities and differences in findings.

5.2 Background Characteristics of respondents

The study was conducted among healthcare staff of the NICU of Korle-Bu Teaching Hospital mainly doctors and nurses. As a result the study participants were solely doctors and nurses who were permanent employees of the KBTH and work in the NICU. The results showed that nurses constituted the majority of the study respondents and this could be attributed to the dominant presence of nurses in the Ghanaian healthcare system. Nurses form the majority of the workforce of healthcare workers in Ghana and are always the majority in the various hospitals across the country. Additionally, the female sex dominates the nursing profession in Ghana and this could account for the high numbers of female participants in the study compared to the male sex.

The age composition of the respondents showed that an overwhelming majority of the healthcare workers were aged between 25 years and 39 years making up 92.1% of the respondents. This points to a young workforce of healthcare workers in the NICU of the KBTH where this study was conducted. Specifically 34.2% were between age 25 years and 29 years while 50.0% were between age 30 and 34 years. This means that overall, 84.2% of the healthcare workforce in the NICU were below age 35 years and this reflects the general age characteristic of the Ghanaian healthcare workforce in present times where young healthcare graduates are being absorbed into the healthcare sector (GHS, 2016).

5.3 Mobile phone use and frequency of use at work

The use of mobile phone by healthcare workers has been extensively documented. This was evident in this study. Over 90% of the respondent reported mobile phone use during working periods with only 5.3% reporting no use of mobile phone at work. This implies that mobile phone use in the NICU of the KBTH among healthcare staff is widespread similar to findings from previous studies on mobile phone use among healthcare worker in other regions globally. For instance, Pillet et al., (2016) in their study to determine the contamination of healthcare workers‘ mobile phones by epidemic viruses in a University Hospital of Saint-Étienne, France found that all HCWs owned a Personal Mobile Phone, and 99 of them (86.8%) used a digital enhanced cordless telephones (DECTs) daily at work. The widespread use of mobile phones by healthcare staff found in this study further confirms similar findings in several other studies (Goldblatt et al., 2007; Mark et al., 2014, Boruff & Storie, 2014).

It could be argued that the overwhelming use of mobile phones at work by the respondents could be for various reasons. This is supported by previous studies which revealed that healthcare workers use mobile phones at work due to the fact that these devices may be used as sources of reference material during patient care, data collection instruments in research, as well as instruments of care e.g. taking a pulse and respiratory rate and in settings where there is poor hospital communication network they serve as the main form of communication among healthcare workers at different locations (Mark et al., 2014; Morris et al., 2012; Osborne, Phull, & Matone, 2012).

Furthermore the frequency of utilization of mobile phones by healthcare staff at work is expected to influence the possibility of contamination and transmission of healthcare associated infections.

More 80% of the participants reported using their mobile phones less than ten times at work. This is contrary to findings by another study that the participants received more than ten calls per workday in 65.6% of cases (Pillet et al., 2016). In this study only 10.5% and 5.6% of the healthcare staff used their mobile phones 10-20 times and more than 20 times respectively while at work daily. These proportions in frequency of usage of mobile phones at work are low compared to the 65.6% reported in the previous study. The difference in proportion of frequency of use could be due to the difference in sample size. Whilst the study in France sampled 114 healthcare staff, this study involved only 40 healthcare staff.

5.4 Reasons for mobile phone use at work

Several reasons were given by study respondents for using mobile phone at work of which majority (50.7%) were for clinical purpose. This is important considering the fact that the level of sophistication of mobile phones nowadays presents an array of uses across all fields, and their use could serve a lot of purpose in the hospital setting. This could account for the high use of mobile phones among the respondents. This view is backed by Visvanathan, Gibb and Brady (2011), who contend that the use of Mobile Phones can advance the quality, speed and effectiveness of communication in healthcare settings.

Evidence also shows that mobile phone use in the healthcare landscape contributes greatly in controlling many medical conditions such as diabetes, and asthma as well as increase in rates of vaccination after the inno-vations of mobile communications. This is because mobile phones can be used to carefully monitor diseases, such as diabetes and asthma, even without requiring the patient‘s presence in the hospital and also presents with unique facilities for situations, such as the management of contageous infections, vaccinations, and the remote control of

epidemics(Ulger, Dilek, Esen, Sunbul, & Leblebicioglu, 2015; Ramesh et al., 2008; Soto, Chu, Goldman, Rampil, & Ruskin, 2006). Further research findings indicates that MPs and other MHDs help accelerate in-hospital flow of medical information and information sharing and querying, and thus help improve interaction among healthcare workers in times of emergencies since mobile phones presents numerous applications including access to pharmaceutical knowledge and literature which facilitates learning and clinical performance among healthcare workers as well as access to wireless media technology (Visvanathan, Gibb, & Brady, 2011; Vilella et al., 2004).

The use of mobile phone for communication both among healthcare staff and with patients and their families were identified as the highest reasons for mobile phone use by the respondents. This confirms findings by another study that mobile phone use by healthcare workers was essential as it provides them with limitless access to facilitate communication between themselves and with patients and their families.

5.5 Mobile phone use and bacterial contamination

In this study a significant proportion of respondents (86.8%) believed their mobile phones were contaminated at work, a possible reason why most of them claimed they wash their hands after touching their mobile phones while at work. This suggest that doctors and nurses at the NICU of the KBTH are conscious of their mobile phones being potential carriers of microorganisms that could play a role in transmission of healthcare associated infections. This assertion is affirmed by other studies which show that mobile phone devices may serve as a reservoir of bacteria noted to cause nosocomial infections and may facilitate their transmission from the hands of healthcare

workers to patients (Manning, Davis, Sparnon, & Ballard, 2013; Brady, Verran, Damani, & Gibb, 2009; Jeske, Tiefenthaler, Hohlrieder, Hinterberger, & Benzer, 2007).

In view of the potential of mobile phones aiding in the transmission of healthcare associated infections, it is suggested that adequate hand hygiene as well as device cleaning and disinfection could decrease this risk (Pillet et al., 2016). Thus the finding in this study that most respondents claimed to wash their hands after touching their mobile phones at work is crucial in order to limit transmission of healthcare associated infections through mobile phone use among healthcare workers. However, this finding contradicts another study finding which revealed that HCWs do not regularly apply hygiene procedures such as regular cleaning of their mobile devices and do not perform hand hygiene before or after their use, although they may be aware that these devices could carry pathogenic microorganisms (Nwankwo, Ekwunife, & Mofolorunsho, 2013; Brady, Fraser, Dunlop, Paterson-Brown, & Gibb, 2007).

There was high contamination of mobile phones in this study. The observed average count of 3 colony forming units (CFUs) per cm^2 is within the limits of < 5 CFUs per cm^2 deemed acceptable for high contact areas in healthcare facilities. However a proportion of mobiles phones cultured organisms that were outside this acceptable range. Counts >5 CFUs per cm^2 are likely to be associated with an increased risk of infection for patients no matter the contaminating organism(Dancer, 2004).

Coagulase negative Staphylococcus (CoNS) was the commonest organism isolated. This finding is not unusual; as these organisms are common skin flora and have been found as contaminants on mobile phone in other studies (Akinyemi et al., n.d.; Mark et al., 2014)(. Although CoNS are normal flora they are known to be pathogenic in very low birth weight neonates as well as common cause of device associated infections.

Pseudomonas sp was the commonest Gram negative organism isolated from the phones. This organism is a common environmental pathogen known to persist for prolonged periods in the environment.

Low levels of antibiotic resistance were observed among majority of organisms except for CoNs. Multi-drug resistance among CoNS is a usual finding, they are known to harbour resistant genes which are usually spread among Gram positive bacteria(Leclercq, 2009; Rogers, Fey, & Rupp, 2009). Although antibiotic resistance was low among Gram negative bacteria, meropenem resistance was detected among one coliform identified. Meropenem resistant organisms represent an epidemiologically important organism in intensive care units. They are responsible for several outbreaks, are usually difficult to treat and are associated with poor clinical outcomes.

CHAPTER SIX

6.0 CONCLUSION AND RECOMMENDATIONS

6.1 Introduction

This chapter presents summarizes the study findings and attempts to draw conclusions on the study results. It also presents recommendations proffered in line with the findings of the study.

6.2 Summary

The study assessed mobile phone use at work among healthcare staff of the neonatal intensive care unit of Korle-Bu Teaching Hospital of Ghana. In total, 38 staff of the unit successfully completed and returned a structured questionnaire which was self-administered to them. Study participants were also observed for their use of mobile phones at work. Data were entered into Microsoft Excel and Access database and analyzed.

The results show that most of the healthcare staff of the NICU were of young age between twenty-five years and thirty-nine years. Over ninety percent of the healthcare staff in the unit use mobile phone at work but frequency of usage was less than ten times in a day while at work among majority of them. Most of the staff use mobile phone at work for clinical reasons particular for the purposes of clinical examination. Majority (86.8%) of the healthcare staff believed their mobile phones were contaminated so most respondents (42.1%) wash their hands always after touching their mobile phones while at work. The proportion of mobile phones of healthcare staff found to be contaminated was found to be 97.5% with a total of 110 bacterial isolates identified from mobile phones of staff at the NICU comprising of Gram negative (11.8%) and Gram positive bacteria (88.2%). Pseudomonas species and Non-coliform bacteria constituted the majority (38.5%) among the Gram negative bacteria while among the Gram

positive the frequently encountered were coagulase negative Staphylococcus (CoNs) representing 41.2% of Gram positive bacteria isolates.

Antimicrobial resistance tests for the bacterial agents isolated was performed revealed that CoNs were highly resistant to penicillin as 77.5% of the bacterial agents isolated could not be inhibited by penicillin and all (100%) of the bacterial agents isolated as coliform and non-coliform bacteria were found to be resistant to Ampicillin and Ceftriaxone respectively.

6.3 Conclusion

On the basis of the findings, the study concluded that mobile phone use at work among healthcare staff at the NICU of KBTH was high and majority of them perceived their phones to be contaminated and wash their hands after touching their mobile phones during work. The use of mobile phones at work among healthcare staff claimed to be for clinical purposes.

The level of contamination of mobile phones of healthcare staff with bacteria agents was high and some of the bacteria agents were highly resistant to some antimicrobial agents.

6.4 Recommendations

The following recommendations were made base on the findings of the study. The recommendations are categorized into the following:

6.4.1 Recommendations for practice

In view of the finding that most healthcare staff in the unit wash their hands after touching their mobile phones during work and are supportive of bans on the use of mobile phones at work, it will be crucial for hospital authorities to intensify hand hygiene practices among healthcare staff.

This could be done through the provision of reliable and easily accessible hand washing materials such as hand washing stands and hand sanitizers for use among staff during working periods. Healthcare staff should also adhere strictly to hand hygiene practices during work and should be constantly given refresher trainings through the in-service training units on the need for hand hygiene in preventing transmission of healthcare associated infections through mobile phone use.

6.4.2 Recommendations for policy

There is the need for hospital authorities to institute control measures as regards mobile phone use during working periods. Hospital authorities should thus develop institutional policies on mobile phone use during work.

6.4.3 Recommendations for research

There is the need for large scale research involving different units of the hospital to determine the level of mobile phone use among healthcare staff and the extent of contamination of mobile phones with bacteria agents.

6.5 Limitations to the study

The study examined mobile phone use among healthcare staff of only in the NICU of the KBTH. As a result the findings could not generalized to the population of healthcare staff of the KBTH in respect of mobile phone use and level of bacterial contamination during working periods.

REFERENCES

Akinyemi, K. O., Atapu, A. D., Adetona, O. O., & Coker, A. O. (n.d.). Brief Original Article The potential role of mobile phones in the spread of bacterial infections. Journal of Infection in Developing countries; 3(8) 628-32.

Allegranzi, B., Gayet-Ageron, A., Damani, N., Bengaly, L., McLaws, M.-L., Moro, M.-L., … Pittet, D. (2013). Global implementation of WHO's multimodal strategy for improvement of hand hygiene: a quasi-experimental study. *The Lancet Infectious Diseases*, *13*(10), 843–851. https://doi.org/10.1016/S1473-3099(13)70163-4

Allegranzi, B., Nejad, S. B., Combescure, C., Graafmans, W., Attar, H., Donaldson, L., & Pittet, D. (2011). Burden of endemic health-care-associated infection in developing countries: systematic review and meta-analysis. *The Lancet*, *377*(9761), 228–241. https://doi.org/10.1016/S0140-6736(10)61458-4

Allegranzi, B., & Pittet, D. (2009). Role of hand hygiene in healthcare-associated infection prevention. *The Journal of Hospital Infection*, *73*(4), 305–315. https://doi.org/10.1016/j.jhin.2009.04.019

Asare, A., Enweronu-Laryea, C. C., & Newman, M. J. (2009). Hand hygiene practices in a neonatal intensive care unit in Ghana. *The Journal of Infection in Developing Countries*, *3*(5).352-356. https://doi.org/10.3855/jidc.242

Boruff, J. T., & Storie, D. (2014). Mobile devices in medicine: a survey of how medical students, residents, and faculty use smartphones and other mobile devices to find information. *Journal of the Medical Library Association : JMLA*, *102*(1), 22–30. https://doi.org/10.3163/1536-5050.102.1.006

Boyce, J. M. (2007). Environmental contamination makes an important contribution to hospital infection. *Journal of Hospital Infection*, *65*, 50–54.

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

Brady RR, Fraser SF, Dunlop MG, Paterson-Brown S, Gibb AP. Bacterial contamination of mobile communication devices in the operative environment. J Hosp Infect 2007;66:397–8.

Brito, D. V. D., Brito, C. S. de, Resende, D. S., Moreira do Ó, J., Abdallah, V. O. S., & Gontijo Filho, P. P. (2010). Nosocomial infections in a Brazilian neonatal intensive care unit: a 4-year surveillance study. *Revista Da Sociedade Brasileira de Medicina Tropical*, *43*(6), 633–637. https://doi.org/10.1590/S0037-86822010000600006

Cardoso, T., Ribeiro, O., Aragão, I., Costa-Pereira, A., & Sarmento, A. (2013). The Impact of Healthcare-Associated Infection on Mortality: Failure in Clinical Recognition Is Related with Inadequate Antibiotic Therapy. https://doi.org/10.1371/journal.pone.0058418

Dancer, S. J. (2004). How do we assess hospital cleaning? A proposal for microbiological standards for surface hygiene in hospitals. *Journal of Hospital Infection*, *56*(1), 10–15. https://doi.org/10.1016/j.jhin.2003.09.017

De Angelis, G., Murthy, A., Beyersmann, J., & Harbarth, S. (2010). Estimating the impact of healthcare-associated infections on length of stay and costs. *Clinical Microbiology and Infection*, *16*(12), 1729–1735. https://doi.org/10.1111/j.1469-0691.2010.03332.x

Ekrakene T, Igeleke CL. Micro-organisms associated with public mobile phones along Benin-sapele Express Way, Benin City, Edo State of Nigeria. J Appl Sci Res 2007;3(12):2009–12

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

Jeske HC, Tiefenthaler W, Hohlrieder M, Hinterberger G, Benzer A. Bacterial contamination of anaesthetists‘ hands by personal mobile phone and fixed phone use in the operating theatre. Anaesthesia 2007;62:904–6.

Hooven, T. A., & Polin, R. A. (2014). Healthcare-associated infections in the hospitalized neonate: a review. *Early Human Development*, *90*, *Supplement 1*, S4–S6. https://doi.org/10.1016/S0378-3782(14)70002-7

Khan, A., Rao, A., Reyes-sacin, C., Hayakawa, K., Szpunar, S., Riederer,Levine, D. (2015). American Journal of Infection Control Use of portable electronic devices in a hospital setting and their potential for bacterial colonization. *American Journal of Infection Control*, *43*(3), 286–288. https://doi.org/10.1016/j.ajic.2014.11.013

Korle-Bu Teaching Hospital. (2013). *Korle Bu Teaching Hospital , 2012 Annual Report*. Accra, Ghana.http://kbth.gov.gh/assets

Kotris, I., Drenjančević, D., Talapko, J., & Bukovski, S. (2017). Identification of microorganisms on mobile phones of intensive care unit health care workers and medical students in the tertiary hospital, 85–90. https://doi.org/10.17392/878-16

Kramer, A., Schwebke, I., & Kampf, G. (2006). How long do nosocomial pathogens persist on inanimate surfaces? A systematic review. *BMC Infectious Diseases*. https://doi.org/10.1186/1471-2334-6-130

Leclercq, R. (2009). Epidemiological and resistance issues in multidrug-resistant staphylococci and enterococci. *Clinical Microbiology and Infection*, *15*(3), 224–231. https://doi.org/10.1111/j.1469-0691.2009.02739.x

Longtin Y, Schneider A, Tschopp C, Renzi G, Gayet-Ageron A, Schrenzel J, et al. Contamination of stethoscopes and physicians‘ hands after a physical examination.Mayo Clin Proc 2014;89:291-9.

Magill, S. S., Edwards, J. R., Bamberg, W., Beldavs, Z. G., Dumyati, G., Kainer, Fridkin ,S. K. (2014). Multistate Point-Prevalence Survey of Health Care–Associated Infections. *New*

England Journal of Medicine, *370*(13), 1198–1208. https://doi.org/10.1056/NEJMoa1306801

Manning ML, Davis J, Sparnon E, Ballard RM. iPads, droids, and bugs: infection prevention for mobile handheld devices at the point of care. Am J Infect Control 2013;41:1073–6.

Mark, D., Leonard, C., Breen, H., Graydon, R., O'Gorman, C., & Kirk, S. (2014). Mobile phones in clinical practice: reducing the risk of bacterial contamination. *International Journal of Clinical Practice*, *68*(9), 1060–1064. https://doi.org/10.1111/ijcp.12448

Ministry of Health. (2014). Ghana National Newborn Health Strategy and Action Plan 2014-2018.Ministry of Health, Ghana. https://www.ghanahealthservice.org/downloads/Ghana_National_Newborn_

Morris, T. C., Moore, L. S. P., & Shaunak, S. (2012). Doctors taking a pulse using their mobile phone can spread MRSA. *BMJ*. https://doi.org/10.1136/bmj.e412

Neidell, M. J., Cohen, B., Furuya, Y., Hill, J., Jeon, C. Y., Glied, S., & Larson, E. L. (2012). Costs of Healthcare- and Community-Associated Infections With Antimicrobial-Resistant Versus Antimicrobial-Susceptible Organisms. *Clinical Infectious Diseases*, *55*(6), 807–815. https://doi.org/10.1093/cid/cis552

Nejad, S. B., Allegranzi, B., Syed, S., Ellis, B., & Pittet, D. (2011). Health-care-associated infection in Africa: a systematic review. *Bulletin of the World Health Organization*, *89*(10), 757–765. https://doi.org/10.2471/BLT.11.088179

Nwankwo, E. O., Ekwunife, N., & Mofolorunsho, K. C. (2014). Nosocomial pathogens associated with the mobile phones of healthcare workers in a hospital in Anyigba , Kogi state , Nigeria, 135–140. https://doi.org/10.1016/j.jegh.2013.11.002

Otter, J. A., Yezli, S., & French, G. L. (2011). The Role Played by Contaminated Surfaces in the Transmission of Nosocomial Pathogens. *Infection Control & Hospital Epidemiology*, *32*(7), 687–699. https://doi.org/10.1086/660363

Otter, J. A., Yezli, S., Salkeld, J. A. G., & French, G. L. (2013). Evidence that contaminated surfaces contribute to the transmission of hospital pathogens and an overview of strategies to address contaminated surfaces in hospital settings. *American Journal of Infection Control*, *41*(5, Supplement), S6–S11. https://doi.org/10.1016/j.ajic.2012.12.004

Owusu-Ofori, A., Jennings, R., Burgess, J., Prasad, P. A., Acheampong, F., & Coffin, S. E. (2010). Assessing Hand Hygiene Resources and Practices at a Large African Teaching Hospital. *Infection Control & Hospital Epidemiology*, *31*(8), 802–808. https://doi.org/10.1086/653025

Payne, N. R., Carpenter, J. H., Badger, G. J., Horbar, J. D., & Rogowski, J. (2004). Marginal Increase in Cost and Excess Length of Stay Associated With Nosocomial Bloodstream Infections in Surviving Very Low Birth Weight Infants. *Pediatrics*, *114*(2), 348–355.

Pillet, S., Berthelot, P., Mory, O., Gay, C., Viallon, A., Lucht, F., & Pozzetto, B. (2016). Contamination of healthcare workers ' mobile phones by epidemic viruses. *Clinical Microbiology and Infection*, *22*(5), 456.e1-456.e6. https://doi.org/10.1016/j.cmi.2015.12.008

Pires, D., Kraker, D., Adriana, M. E., Tartari, E., Abbas, M., & Pittet, D. (2017). –Fight Antibiotic Resistance—It"s in Your Hands': Call From the World Health Organization for 5th May 2017. *Clinical Infectious Diseases*, *64*(12), 1780–1783. https://doi.org/10.1093/cid/cix226

Ramesh J, Carter AO, Campbell MH, Gibbons N, Powlett C, MoseleySr H, et al. Use of mobile phones by medical staff at Queen ElizabethHospital, Barbados: evidence for both benefit and harm. J Hosp Infect2008;70:160–5.

Rogers, K. L., Fey, P. D., & Rupp, M. E. (2009). Coagulase-Negative Staphylococcal Infections. *Infectious Disease Clinics of North America*, *23*(1), 73–98. https://doi.org/10.1016/j.idc.2008.10.001

Sax, H., Allegranzi, B., Uçkay, I., Larson, E., Boyce, J., & Pittet, D. (2007). –My five moments for hand hygiene": a user-centred design approach to understand, train, monitor and report hand hygiene. *Journal of Hospital Infection*, *67*(1), 9–21. https://doi.org/10.1016/j.jhin.2007.06.004

Saxena, S., Singh, T., Agarwal, H., Mehta, G., & Dutta, R. (2011). Bacterial colonization of rings and cell phones carried by health-care providers: are these mobile bacterial zoos in the hospital? *Tropical Doctor*, *41*(2), 116–118. https://doi.org/10.1258/td.2010.100186

Schwab, F., Zibell, R., Piening, B., Geffers, C., & Gastmeier, P. (2015). Mortality Due to Bloodstream Infections and Necrotizing Enterocolitis in Very Low Birth Weight Infants: *The Pediatric Infectious Disease Journal*, *34*(3), 235–240. https://doi.org/10.1097/INF.0000000000000532

Sclafani J, Tirrell TF, Franko OI. Mobile tablet use among academic physicians and trainees. J Med Syst Feb.2013;37 (1):9903. https://www.ncbi.nlm.nih.gov/pubmed/23321961

Seale, A. C., Blencowe, H., Manu, A. A., Nair, H., Bahl, R., Qazi, S. A., … Lawn, J. E. (2014). Estimates of possible severe bacterial infection in neonates in sub-Saharan Africa, south Asia, and Latin America for 2012: a systematic review and meta-analysis. *The Lancet Infectious Diseases*, *14*(8), 731–741. https://doi.org/10.1016/S1473-3099(14)70804-7

Soto RG, Chu LF, Goldman JM, Rampil IJ, Ruskin KJ. Communication incritical care environments: mobile telephones improve patient care.Anesth Analg 2006;102:535–41.

Sowah LN (2008) The future of the Mobile Internet: How do we tap into its fullest benefits? Technology Blogs, 1-2.

Srivastava, S., & Shetty, N. (2007). Healthcare-associated infections in neonatal units: lessons from contrasting worlds. *Journal of Hospital Infection*, *65*(4), 292–306. https://doi.org/10.1016/j.jhin.2007.01.014

The Radicati Group, Inc. Mobile Statistics Report, 2014-2018. Radicati S, Ed. Palo Alto, CA, USA: The Radicati Group, Inc, 2014. http://www.radicati.com/ wp/wp-content

Ulger, F., Dilek, A., Esen, S., Sunbul, M., & Leblebicioglu, H. (1978). Review Are healthcare workers ' mobile phones a potential source of nosocomial infections ? Review of the literature. https://doi.org/10.3855/jidc.6104

Ulger, F., Esen, S., Dilek, A., Yanik, K., Gunaydin, M., & Leblebicioglu, H. (2009). Are we aware how contaminated our mobile phones with nosocomial pathogens ?, *4*, 4–7. https://doi.org/10.1186/1476-0711-8-7

United Nations Childrens Fund, World Health Organisation (June,12, 2014). Every Newborn, An Action Plan To End Preventable Deaths. http://apps.who.int/iris/bitstream/10665/127938/1/9789241507448_eng.pd

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.

Vilella A, Bayas JM, Diaz MT, Guinovart C, Diez C, Simó D, Muñoz A, Cerezo J (2004) The role of mobile phones in improving vaccination rates in travelers. Prev Med 38: 503-509.

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.

WHO. (2005). World alliance for patient safety global patient safety challenge. Geneva: World Health Organisation. http://apps.who.int/iris/handle/10665/43358

WHO. (2008). Patient safety in african health services: issues and solutions Report of the Regional Director. World Health Organisation Regional Office for Africa. http://www1.paho.org/hq/dmdocuments/2010/PHC

WHO. (2009). WHO Guidelines on Hand Hygiene in Health Care. Geneva: World Health Organisation. http://www.who.int/gpsc/5may/tools/who_guidelines-handhygiene_summary.pdf

WHO. (2011). Report on the Burden of Endemic Health Care-Associated Infection Worldwide. World Health Organisation. http://apps.who.int/iris/bitstream/10665/80135/1/9789241501507_eng.pdf

WHO | Prevention of hospital-acquired infections: A practical guide. 2nd edition. *WHO*. http://www.who.int/csr/resources/publications/drugresist/WHO_CDS_CSR_EPH_

Yapicioglu, H., Ozcan, K., Sertdemir, Y., Mutlu, B., Satar, M., Narli, N., & Tasova, Y. (2011). HealthCare-associated Infections in a Neonatal Intensive Care Unit in Turkey in 2008: Incidence and Risk Factors, A Prospective Study. *Journal of Tropical Pediatrics*, *57*(3), 157–164. https://doi.org/10.1093/tropej/fmq060

Yawson, A. E., & Hesse, A. A. J. (2013). Hand hygiene practices and resources in a teaching hospital in Ghana. *The Journal of Infection in Developing Countries*, *7*(4):338-47. https://doi.org/10.3855/jidc.2422

Zaidi, A. K., Huskins, W. C., Thaver, D., Bhutta, Z. A., Abbas, Z., & Goldmann, D. A. (2005). Hospital-acquired neonatal infections in developing countries. *The Lancet*, *365*(9465), 1175–1188. https://doi.org/10.1016/S0140-6736(05)71881-X

Zakai, S., Mashat, A., & Abumohssin, A. (2016). Bacterial contamination of cell phones of medical students at King Abdulaziz University , Jeddah , Saudi Arabia. *Journal of Microscopy and Ultrastructure*, *4*(3), 143–146. https://doi.org/10.1016/j.jmau.2015.12.004

APPENDICES

Appendix 1: Observation form

Mobile phone use and associated bacterial contamination in the neonatal intensive care unit of the Korle-Bu Teaching Hospital

Observation form

DATE:	SESSION:	CUBICLE:
START TIME:	END TIME:	DURATION:

Opportunity	Doctor		Nurse		Nurse/Doctor	
1	□	Phone call □ Clinical exam □ Others □	□	Phone call □ Clinical exam □ Others □	□	Phone call □ Clinical exam □ Others □
2	□	Phone call □ Clinical exam □ Others □	□	Phone call □ Clinical exam □ Others □	□	Phone call □ Clinical exam □ Others □
3	□	Phone call □ Clinical exam □ Others □	□	Phone call □ Clinical exam □ Others □	□	Phone call □ Clinical exam □ Others □
4	□	Phone call □ Clinical exam □ Others □	□	Phone call □ Clinical exam □ Others □	□	Phone call □ Clinical exam □ Others □
5	□	Phone call □ Clinical exam □ Others □	□	Phone call □ Clinical exam □ Others □	□	Phone call □ Clinical exam □ Others □
6	□	Phone call □ Clinical exam □	□	Phone call □ Clinical exam □	□	Phone call □ Clinical exam □

		Others □		Others □		Others □
7	□	Phone call □ Clinical exam □ Others □	□	Phone call □ Clinical exam □ Others □	□	Phone call □ Clinical exam □ Others □
8	□	Phone call □ Clinical exam □ Others □	□	Phone call □ Clinical exam □ Others □	□	Phone call □ Clinical exam □ Others □
9	□	Phone call □ Clinical exam □ Others □	□	Phone call □ Clinical exam □ Others □	□	Phone call □ Clinical exam □ Others □
10	□	Phone call □ Clinical exam □ Others □	□	Phone call □ Clinical exam □ Others □	□	Phone call □ Clinical exam □ Others □

Appendix 2: Questionnaire

Mobile phone use and associated bacterial contamination in the neonatal intensive care unit of the Korle-Bu Teaching Hospital Study Questionnaire

Demographics and General Information		
1.Date:____/____/_____	2.Age:_____	3.Sex: Male □ Female □
4.Occupation: senior Nurse □ junior nurse Rotation Nurse □ Medical Doctor □		
Characteristics of Phone Use		
5. Do you use your phone whilst in NICU? Yes □ No □		
6. What do you use your phones for? Multiple choice allowed. A. Personal use only □ B. As a professional reference tool □ C. As a clinical instrument for patient care □ D. For purposes of social media □		

E. Clinical and personal use □ F. Entertainment □
7. If you answered yes to question 5, how many times in a day? A. 10 times or less □ B. Between 10 and 20 times □ C. More than 20 times a day □
8. If you use your phone for clinical purposes, tick the most appropriate common clinical use of your phone. A. communication with families □ B. Communicating with Collegues □ C. Use as a time piece for vitals □ D. Use as light source □ E. Reference tool F. Others(specify)_____
9. If you answered no to question 5 what are your reasons? A. Because of institutional policy □ B. Because of clinical reasons □ C. Others_____
10. Do you wash your hands before touching a patient after touching your phone? A. Never □ B. Occasionally □ C. Always □ D. Do not recall □
11. Do you decontaminate your phone daily after close of work? Yes □ No □
12. From your perspective what degree of contamination of your phone occurs at work? 1. Not contaminated) □ 2.Moderately contaminated □ 3. Highly contaminated □
13. On a scale of 1-3 how likely are you to change your frequency of phone use at work if you knew it was contaminated? 1. Not likely □ 2. Very likely □ 3. Highly likely □

14. On a scale of 1-3 how likely are you to support banning the use of phones in clinical areas as a practical option to control hospital acquired infections in the NICU? 1.Not likely □ 2.Very likely □ 3. Highly likely □

Appendix: 3. Consent form

Title of study: Mobile Phone Use and Associated Bacterial Contamination in the Neonatal Intensive Care Unit of the Korle-Bu Teaching Hospital.

You are being invited to participate in a study conducted by Maud Essabah Fandoh, from the school of public health, university of Ghana. This study is designed to find out how often staffs of the unit uses mobile phone within the patients environment and the type of organisms that contaminate the phone at the NICU of the Korle-Bu Teaching Hospital.

You are kindly requested to participate in this study by completing the attached questionnaire, you will be observed for a maximum of 30minutes during work and imprints from your phone will be taken for assessment at the laboratory. Any information obtained in connection with this study cannot be identified with you and will remain anonymous.

Your participation is voluntary. Your decision not participate will not affect you in any adverse manner.

If you have any question about the study, please feel free to contact Maud Essabah Fandoh (0246809021).

Your signature on this document indicates that you have read and understood the information provided above and that you voluntarily agree to participate in this study.

Signature: _____

Date: _____/_____/_____