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Barriers and Levers to Hand Hygiene Practices among Nigerian Healthcare Workers: A Mixed Methods Research Study

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Yetunde Oluremi Ataiyero (RN, MSc)

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For my doting husband, Adegbenga

and

my adorable children, Iretomiwa and Tiwalade

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Publications and Conferences

Publications

1. Ataiyero, Y., Dyson, J., & Graham, M. (2018) Barriers to hand hygiene practices among healthcare workers in Sub-Saharan African countries: a narrative systematic review. PROSPERO. CRD42018087062 Available from: https://www.crd.york.ac.uk/prospero/display_record.php?ID=CRD42018087062

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Peer-Reviewed Conferences

1. Reasons for poor hand hygiene compliance among healthcare workers in Sub-Saharan African countries – Poster Presentation. *Infection Prevention Society Conference, Harrogate*. 26th – 28th September 2016.

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Abstract

This research explores the barriers and levers to hand hygiene practices among Nigerian healthcare workers (HCWs). The overall aim was to determine the hand hygiene compliance rate, understand the barriers and levers to hand hygiene practices and validate the barriers and levers to hand hygiene instrument (BALHHI) for Nigerian HCWs. A convergent mixed methods research approach was employed.

In study one, a systematic review of 27 hand hygiene studies from Sub-Saharan African (SSA) countries was conducted. An overall hand hygiene compliance rate among HCWs in SSA was estimated to be 21.1%. The main barriers identified included heavy workload, infrastructural deficit and poorly positioned hand hygiene facilities.

In study two, a ward infrastructure survey and hand hygiene observations of HCWs in surgical wards were conducted using the WHO ward infrastructure survey and modified hand hygiene observation tool, respectively. Hand hygiene resources were found to be insufficient, overall hand hygiene compliance rate was 29.1% and compliance was less than 40% across all professional groups.

In study three, BALHHI was validated through three rounds of psychometric testing – face validity, construct validity and test-retest reliability. This resulted in a 10-item instrument with good psychometric properties.

In study four, a survey of barriers and levers to hand hygiene among surgical HCWs was conducted using BALHHI. Knowledge deficit was the greatest barrier. All three domains of the Theoretical Domains Framework (TDF) and 10 items remaining on the instrument were also considered as barriers to hand hygiene.

In study five, barriers and levers to hand hygiene practices among surgical HCWs were explored using semi-structured interviews. Knowledge deficit was the biggest barrier followed by infrastructural deficit.

This thesis has demonstrated the significance of using a mixed methods research approach and use of theory in research going by the rich findings of this research. Prioritising adequate funding of health systems in SSA countries is critical to enhancing patient safety.

Table of Contents

List of Appendices

List of Figures

List of Tables

Glossary

Absolute fit indices – fundamentally indicate how well a proposed theory fits the data

Alcohol-based hand rub – alcohol-containing preparation (liquid, gel or foam) designed for application to the hands to inactivate microorganisms and/or temporarily suppress their growth

Alternative medicine – wide range of healthcare practices which are not part of a country's traditional or conventional medicine and are not fully integrated into the dominant healthcare system

Automatic responses – involuntary reaction

Catheter associated urinary tract infections – occur when bacteria in a catheter bypass the body's defence mechanisms (such as the urethra and the passing of urine) and enter the bladder

Central line associated bloodstream infections – HCAI occurring within 48 hours of vascular catheter placement

CMIN/df - ratio of minimum discrepancy (chi square) and degree of freedom

Cognitive bias – systematic error in thinking based on personal beliefs and experiences

Communicable diseases – infectious or transmissible diseases that spread from one person to another

Comparative fit – measures the fit of a model as being relative to a baseline model

Confirmatory factor analysis – used to examine the dimensionality of an instrument, as well as examining the latent structure of an instrument during scale development

Construct validity – appropriateness of inferences made on the basis of observed and latent (unobserved) variables

Cronbach's alpha – measure of internal consistency

Face validity – subjectively checking whether an instrument measures the concept in question

Five moments of hand hygiene – an evidence-based, user-centred approach which defines the key moments HCWs should perform hand hygiene namely before patient contact, after patient contact, before aseptic procedure, after touching patients' surroundings and after exposure to body fluids

Fundamental attribution error – tendency to assume an individual's behaviours are dependent on personal or dispositional causes, rather than on social and environmental stimuli

Goodness of fit – how well the observed data fit into the assumed model

Hand hygiene – any action of hand cleansing which include handwashing and disinfection with alcohol-based hand rub

Handwashing – washing hands with plain or antimicrobial soap and water

Health system – aggregate of all the organisations, institutions, resources and people whose principal purpose is to improve health

Healthcare associated infections – infections acquired by patients, as a result of hospital admission within 48 hours (or even after discharge) while healthcare for other medical reasons are required, which were absent before they presented at the healthcare facility

Healthcare worker – anyone that delivers care and services to the sick and ailing either directly as doctors and nurses or indirectly as aides, helpers, laboratory technicians, or even medical waste handlers

Incidence rate – number of new cases of a disease occurring within a period of time

Infant mortality rate – infant death before first birthday, expressed per 1000 live births

Infectious diseases – caused by pathogenic microorganisms, such as bacteria, viruses, parasites or fungi; the diseases can be spread, directly or indirectly, from one person to another.

Infrastructure – term to include facilities, equipment, and products that are required to achieve optimal hand hygiene practices within the facility

Internal consistency – measure of reliability of an instrument

Life expectancy – overall mortality level of a population

Maternal mortality rate – annual number of female deaths per 100,000 live births from any cause related to or aggravated by pregnancy or its management (excluding accidental or incidental causes)

Model specification – process of selecting variables to be included in a regression model

Modification indices – data-driven indicators of changes to the model that are likely to improve model fit

Neonatal mortality rate – death among children under 28 days of life, in a given year per 1000 live births

Orthodox medicine – system in which medical doctors and other healthcare professionals (such as nurses, pharmacists, and therapists) treat symptoms and diseases using drugs, and/or surgery.

Out of pocket expenditure – direct payments made by individuals to healthcare providers at the time of service use.

Parsimony of fit – evaluates the number of estimated parameters of the theoretical model while assessing the model fit

Pearson's Correlation Coefficient - measures the degree at which the relationship between two variables can be described linearly

Point of care – place where three elements come together: the patient, the healthcare worker, and care or treatment involving contact with the patient or his/her surroundings (within the patient zone)

Prevalence rate – proportion of cases in a population having a disease or characteristic at a given time

Significance level – probability that the results could have occurred by chance (if the null hypothesis were true)

Soap – detergent-based products that contain no added antimicrobial agents or may contain these solely as preservatives. They are available in various forms including bar soap, tissue, leaf, and liquid preparations

Standardised residuals – localised areas of strain between proposed and estimated models

Surgical site infections - infections that occur after surgery in the part of the body where the surgery was performed

Teaching hospital – hospital affiliated with medical and nursing schools to provide medical and nursing education and to improve healthcare through learning and research

Test-retest reliability – administration of an instrument at two different times to measure if the consistency with which the items on the instruments are answered or individual's scores remain relatively the same

Theoretical Domains Framework – integrative framework of 33 psychological theories which identifies key theoretical constructs of behaviour change

Traditional medicine – aggregate of knowledge, skills and practices based on the theories, beliefs and experiences indigenous to different cultures, whether explicable or not, used in the maintenance of health as well as in preventing, diagnosing, improving or treating physical and mental illness

Under five mortality rate – probability of dying between birth and fifth birthday per 1000 births

Ventilator acquired pneumonia – pneumonia occurring more than 48 hours after patients have been intubated and received mechanical ventilation

List of Abbreviations

ABHRs	Alcohol-Based Hand Rubs
AMOS	Analysis of Moment Structure
BALHHI	Barriers and Levers to Hand Hygiene Instrument
BCTs	Behaviour Change Techniques
BPS	British Psychological Society
C. albicans	Candida albicans
C. difficile	Clostridium difficile
C. glabrate	Candida glabrate
C. krusei	Candida krusei
C. parapsilosis	Candida parapsilosis
C. tropicalis	Candida tropicalis
CA-BSI	Catheter-Associated Bloodstream Infections
CASP	Critical Appraisals Skills Programme
CA-UTI	Catheter-Associated Urinary Tract Infections
CDC	Centre for Disease Prevention and Control
CEBMa	Centre for Evidence-Based Management
CMIN	Minimum Discrepancy (Chi square value in AMOS)
df	Degree of Freedom
DHSC	Department of Health and Social Care
E. coli	Escherichia coli
EBP	Evidence Based Practice
ECDC	European Centre for Disease Prevention and Control
EFA	Exploratory Factor Analysis
EVD	Ebola Virus Disease
HCAI	Healthcare Associated Infections
HCWs	Healthcare Workers
HIV/AIDS	Human Immunodeficiency Virus/Acquired Immunodeficiency Syndrome
ICU	Intensive Care Unit
IPC	Infection Prevention and Control
MI	Modification Indices
MRC	Medical Research Council

MRSA	Methicillin-Resistant Staphylococcus Aureus
MSSA	Methicillin-Sensitive Staphylococcus Aureus
N/A	Not Applicable
NAFDAC	National Agency for Food and Drug Administration and Control
NCD	Non-Communicable Disease
NHIS	National Health Insurance Scheme
NHS	National Health Service
NICE	National Institute for Health and Care Excellence
O&G	Obstetrics and Gynaecology
ONS	Office for National Statistics
OOP	Out-of-Pocket
P Value	Probability value
PHC	Primary Health Care
PRISMA	Preferred Reporting Items for Systematic Reviews and Meta-Analyses
REC	Research Ethics Committee
RMR	Root Mean Square Residual
RMSEA	Root Mean Square Error of Approximation
SD	Standard Deviation
SHSW REC	School of Health and Social Work Research Ethics Committee
Sig. (2-tailed)	Significance level
SPSS	Statistical Package for Social Sciences
SR	Standardised Residuals
SRMR	Standard Root Mean Square Residual
SSA	Sub-Saharan Africa
SSI	Surgical Site Infections
t	Test statistic
TDF	Theoretical Domains Framework
UK	United Kingdom
VAP	Ventilator Associated Pneumonia
WHO	World Health Organisation
x^2	Chi Square

Chapter 1 **Introduction to the Study**

1.1 Introduction

This thesis explores the barriers and levers to hand hygiene practices among healthcare workers (HCWs) in a Nigerian teaching hospital. This chapter gives an overview of the thesis including the rationale for the research and why I am interested in the topic area. The chapter presents the research question and the aim and objectives of the study and concludes with an outline of the structure and content of the thesis.

1.2 Rationale for the Research

Infectious diseases account for one-quarter of all human deaths and a comparable fraction of morbidity (Brownlie, 2012). Largely, people from lower income countries die from infectious diseases such as lower respiratory infections, Human Immunodeficiency Virus and Acquired Immune Deficiency Syndrome (HIV/AIDS), diarrhoeal diseases, malaria and tuberculosis which collectively account for about one-third of all deaths from these countries (World Health Organisation (WHO), 2018). African countries are facing continual increase in rates at which infectious diseases occur even though a fast-growing burden of non-communicable diseases (NCDs) is concurrently being experienced in the region (Young et al., 2009; Fenollar & Mediannikov, 2018). Sub-Saharan African (SSA) countries carry the heaviest burden of these diseases, considering the huge impact of HIV/AIDS, malaria, tuberculosis and other neglected tropical diseases (WHO, 2017). Infectious diseases account for 69% of mortality in SSA (Young et al., 2009). SSA region accounts for 90% of malaria deaths and more than 70% of all people living with HIV/AIDS (WHO, 2017; Njunda et al., 2016).

What's more, patients continue to encounter healthcare associated infections (HCAI) while accessing healthcare facilities despite global advancement in delivery of quality care and emphasis on patient safety (Devnani et al., 2011). HCAI are infections acquired by patients consequent to hospital admission (or after discharge) or following community care, which were not present or incubating before admission (WHO, 2010). HCAI remain a global healthcare challenge and a safety burden to patients, their visitors and HCWs (Rutter et al., 2014). HCAI are contracted following direct healthcare treatment which can be medical or surgical interventions or from being in contact with any healthcare facility (National Institute for Health and Care Excellence (NICE), 2013). HCAI contribute to prolonged hospital stay, additional hospital expenditures, greater disease burden and higher patient morbidity and mortality (Haque et al., 2018; Jia et al., 2019). Not only that, HCAI are also responsible for high economic burden on patients and the healthcare system (Jia et al., 2019).

1.3 Researcher Interests

My desire to conduct a PhD on hand hygiene practices started as a nursing student in Nigeria when I was examined in an orthopaedic ward on the steps involved in handwashing. Only then did it occur to me that handwashing was not just automatic. It has its own technicalities and procedures. Before this, I had never thought of or seen hand hygiene as a clinical procedure; nor had I undergone any hand hygiene training. This was my first exposure to this subject which motivated me to read about the seemingly simple and interesting topic. Later, as a nurse at the burns and plastic ward, a surgical unit of a teaching hospital where infection prevention and control (IPC) practices were considerably high, I had first-hand clinical exposure on how patients contract HCAI on the ward and I noticed that the burn patients, especially those with severe injuries, often became infected with gram-

negative bacteria within days of hospital admission. Indeed, gram-negative bacteria wound infections (e.g. Pseudomonas aeruginosa, Klebsiella pneumoniae, Acinetobacter baumanni, E.coli, Enterobacteria spp. and Proteus spp.) are predominant among burn patients with Pseudomonas aeruginosa exhibiting a wider spread compared to the other pathogens (Azzopardi et al., 2014). In practice, I wondered if this might be connected to the hand hygiene practices of the HCWs in this unit as facilities seemed inadequate. There was no running water most of the time, water was stored in a large container and we used bowls to pour water on our hands, liquid soaps were diluted without any standardised dilution formula, there was only one automatic hand dryer on the ward, no disposable towels, we mostly used cotton hand towels to dry our hands. There were no alcohol-based hand rubs (ABHRs). When available, ABHRs were bought personally by the HCWs.

1.4 Research Aim

The overall aim of this research is to determine the hand hygiene compliance rate, understand the barriers and levers to hand hygiene practices and validate the barriers and levers to hand hygiene instrument (BALHHI) for Nigerian HCWs.

1.5 Research Objectives

1. To establish the hand hygiene compliance rate and identify the barriers and levers to hand hygiene practices among HCWs in SSA countries through a systematic literature review.
2. To assess and offer context to the hand hygiene resources available in a Nigerian teaching hospital.
3. To conduct hand hygiene observations amongst surgical HCWs in a Nigerian teaching hospital.

4. To adapt and test the validity (face and construct) and reliability (test-retest) of BALHHI among HCWs of a Nigerian teaching hospital.
5. To establish the barriers and levers to hand hygiene among Nigerian HCWs in a teaching hospital through a survey of BALHHI.
6. To further understand the barriers and levers to hand hygiene compliance among surgical HCWs in Nigeria, using semi-structured interviews.
7. To propose theory-based knowledge translation interventions aimed at increasing HCWs' hand hygiene compliance using the theoretical domains framework (TDF).

1.6 Research Questions

To achieve the aim and objectives, the following research questions guide this study –

1. What does the literature tell us about hand hygiene compliance rates and the barriers and facilitators to hand hygiene of HCWs in SSA countries?
2. What are the hand hygiene resources in the surgical wards of a teaching hospital in Nigeria?
3. What is the hand hygiene compliance rate of HCWs in the surgical wards of a teaching hospital in Nigeria?
4. What are the barriers and levers to hand hygiene practices among Nigerian HCWs in a teaching hospital?
5. Is BALHHI valid and reliable among Nigerian HCWs?

1.7 Structure and content of the thesis

The thesis is structured into ten chapters.

This chapter introduces the thesis and gives a general overview of the research, the researcher's interests, rationale for the study, research aim, objectives and questions and introduces the structure of the rest of the thesis.

Chapter two gives a comprehensive contextual background to the research. An overview of HCAI in developed and developing countries and its impact in hospitals generally is presented here along with the cause and types of HCAI. This is followed by a description of the Nigerian healthcare system. Here, the geographical and demographic overview, key health indices, healthcare structure and organisation, health workforce and essential medicines and supplies are discussed in detail. The chapter goes further to describe hand hygiene practices. The definition, historical context, cultural and religious views of hand hygiene were described here. A section on hand hygiene compliance concludes the chapter.

Chapter three is a systematic literature review of studies conducted on hand hygiene practices in SSA countries. The aim of the review was to identify all published studies from SSA countries that reported on the compliance rate and the barriers and levers to hand hygiene practices. Twenty-seven articles were included in the review having met the inclusion and exclusion criteria that guided the selection process. The articles were critically appraised using standardised critical appraisal tools to establish methodological quality. Findings from the reviewed articles were analysed thematically and presented. The existing research supported the need for the study presented in chapter four onward. A chapter summary is offered at the end of the chapter.

Chapter four is the research methodology chapter where the theoretical underpinnings of the study are presented, and the philosophical assumptions of research methods are discussed. The rationale behind the choice of methodology is offered here by first describing the qualitative and quantitative research approaches and their theoretical assumptions. The necessity for a third research methodology, the mixed methods research approach is then presented and the typologies for mixed methods research are given. This is followed by the identification of the most suitable research methodology for this study. The significance of theoretical frameworks in behaviour change research is then given and the choice of the theoretical domains framework (Michie et al., 2005) justified. A flowchart of the research process is presented, and a chapter summary concludes the chapter.

Chapter five presents the ward infrastructure survey of hand hygiene resources in surgical wards and hand hygiene observations of surgical HCWs in the research context. The research design is described here including the description of the research setting and the process of obtaining ethical approvals for the research. The chapter then divides into two parts – ward infrastructure survey and hand hygiene observations. For each of the parts, the study aim, objective and study question are presented first. This is followed by the study designs, participants, procedures, ethical considerations and methods of data analysis. The findings are then presented. Hand hygiene resources were compared to the WHO recommended minimum standards. The overall compliance rate is calculated, and compliance rates were analysed based on the "my five moments of hand hygiene" (WHO, 2009b), professional group and seniority and shift patterns. The My five moments of hand hygiene is an evidence-based, user-centred approach which defines the key moments HCWs should perform hand hygiene (namely before and after patient contact, before aseptic

procedure, after touching patients' surroundings and after exposure to body fluids (WHO, 2009b). A brief summary of findings including the study strengths and limitations concludes the chapter.

Chapter six presents the validation and testing of the barriers and levers to hand hygiene instrument (BALHHI), a UK validated instrument (Dyson et al., 2013). This involves the distribution of BALHHI among HCWs of a Nigerian teaching hospital and three rounds of testing – face validity, construct validity through a confirmatory factor analysis (CFA) and test-retest reliability. After presenting the research aim and question, the research design is described including a description of BALHHI, maintaining rigour and the ethical considerations for the study. This is followed by the detailed account of the methods and results for each of the three rounds of instrument testing. Findings from each of the three rounds are then summarised, discussed and the study strengths and limitations presented.

Chapter seven presents the barriers and levers to hand hygiene survey. This study aims to establish the barriers and levers to hand hygiene among Nigerian HCWs in a teaching hospital through a survey of BALHHI. The chapter opens with the research aim, objectives and question, followed by the research design. The data collected during the construct validity round of instrument testing will be used to conduct the survey. Participants' knowledge of hand hygiene practices will also be tested using the knowledge test questions already included in BALHHI. The methods of data analysis are then presented followed by the research findings. A summary of findings section including the study strengths and limitations concludes the chapter.

Chapter eight presents the qualitative aspect of this research. The study aims to further understand the barriers and levers to hand hygiene practices using semi-structured

interviews. The appropriateness of the research design is described as well as the sampling and participant recruitment processes, pilot interviews, ethical considerations, data analysis and results. The chapter concludes with a summary of findings, including the study strengths and limitations.

Chapter nine summarises the entire research and responds to each of the questions posed in the thesis based on the key themes. Study findings are then discussed within the context of the global hand hygiene literature and also in terms of the theoretical underpinning of the study. The chapter integrates the quantitative and qualitative elements of the research and goes on to propose pragmatic intervention strategies to improve hand hygiene practices. The contributions of the thesis to knowledge as well as the research limitations are then presented. A chapter summary concludes the chapter.

Chapter ten is the conclusion chapter where recommendations for policy, practice, education, and research are given. The researcher's personal reflections concludes the chapter.

Chapter 2 Contextual Background to the Research

2.1 Introduction

To establish a deeper insight into this study, this chapter gives a comprehensive contextual background to the research. Healthcare associated infections (HCAI) in developed and developing countries, including the types and causal agents are described here. A detailed description of the Nigerian healthcare system and infection prevention and control practices (IPC) in developing countries are also discussed in detail in this chapter. Moreover, hand hygiene practices, as an IPC measure are also presented in this chapter including the definition, historical context, cultural and religious views as well as compliance rates. A chapter summary is offered at the end of this chapter.

2.2 Healthcare Associated Infections in Developed Countries

Globally, it is estimated that 1.4 million patients are affected by HCAI (Cooper & Percival, 2014) however, the exact global estimate of its prevalence is unknown owing to sparse accessibility of reliable data (Allegranzi et al., 2017). Between 5%-10% of patients receiving care in acute care settings in developed countries contract such an infection (WHO, 2010). Based on available statistics, for every 100 hospitalised patients, 6 to 7 will acquire a minimum of one HCAI in developed countries while 10 hospitalised patients will acquire at least one HCAI in developing countries (Allegranzi et al., 2017). In fact, most global reports on HCAI are more on prevalence than incidence rates (Ali et al., 2018). The prevalence rates of the impact of HCAI vary between countries. Annually, more than 4 million patients had approximately 4.5 million HCAI incidences in Europe, with about 300,000 patients acquiring HCAI in England (European Centre for Disease Prevention and Control (ECDC), 2010;

Ampofo, 2013). Notably, on any given day, about 80,000 patients or 1 in 18 patients have at least one HCAI in Europe (ECDC, 2013).

2.3 Healthcare Associated Infections in Sub-Saharan African Countries

Despite a dearth of reporting, it is clear the impact of HCAI in developing countries, particularly in Africa, is more pronounced than in developed countries. In a meta-analysis, virtually 66% of the developing countries in the world had no published reports on the burden of HCAI thereby rendering the exact enormity unknown (Allegranzi et al., 2011). The few reports available present poor statistical illustrations of HCAI prevalence. For instance, it reported that HCAI contribute 4%-56% to all causes of neonatal mortality with 75% of these mortalities occurring in SSA and South-East Asia (Khan et al., 2017). The frequency of HCAI, especially in high-risk patients in developing countries is 2 to 3 times more than in developed countries (Allegranzi et al., 2017). The paucity of data and wide range of estimates is explained to be due to non-existence of surveillance studies, a dearth of reliable data and the use of different terminologies relating to HCAI in these countries (Raka & Mulliqi-Osmani, 2012; Khan et al., 2017).

There is difficulty in ascertaining the exact picture of HCAI in SSA countries, especially in the remote areas because the few available studies were predominantly single-centre studies conducted in tertiary hospitals (Rothe et al., 2013). Nonetheless, prevalence rates ranged from 1.4% to 71.48% in studies conducted in countries of Burkina Faso, Ethiopia, Gabon, Ghana, Morocco and Uganda (Greco & Magombe, 2011; Hien et al., 2012; Razine et al., 2012; Scherbaum et al., 2014; Yallew et al., 2016; Ali et al., 2018; Labi et al., 2019). In a systematic review of HCAI in Africa, the hospital-wide prevalence of HCAI ranged from 2.5% to 14.8% in countries of Algeria, Burkina Faso, Senegal and Tanzania (Gosling et al., 2003;

Bagheri Nejad et al., 2011). Specifically, HCAI prevalence rates ranged from 2.6% to 45.1% in Nigeria (Afolabi et al., 2011; Ige et al., 2011; Iwuafor et al., 2016; Iliyasu et al., 2018). In surgical wards, the aggregate incidence varied between 5.7% and 45.8% in studies conducted in Ethiopia and Nigeria (Bagheri Nejad et al., 2011). Surgical wards have most infections (43.9%) in a Nigerian study conducted in a teaching hospital over a five-year period (Ige et al., 2011). In this study, surgical site infections (SSI) and urinary tract infections (UTI) were the most prevalent with values of 30.7% and 43.9% respectively. Figure 2.1 shows the prevalence rates of HCAI in SSA countries (Mbim et al., 2016:p4).

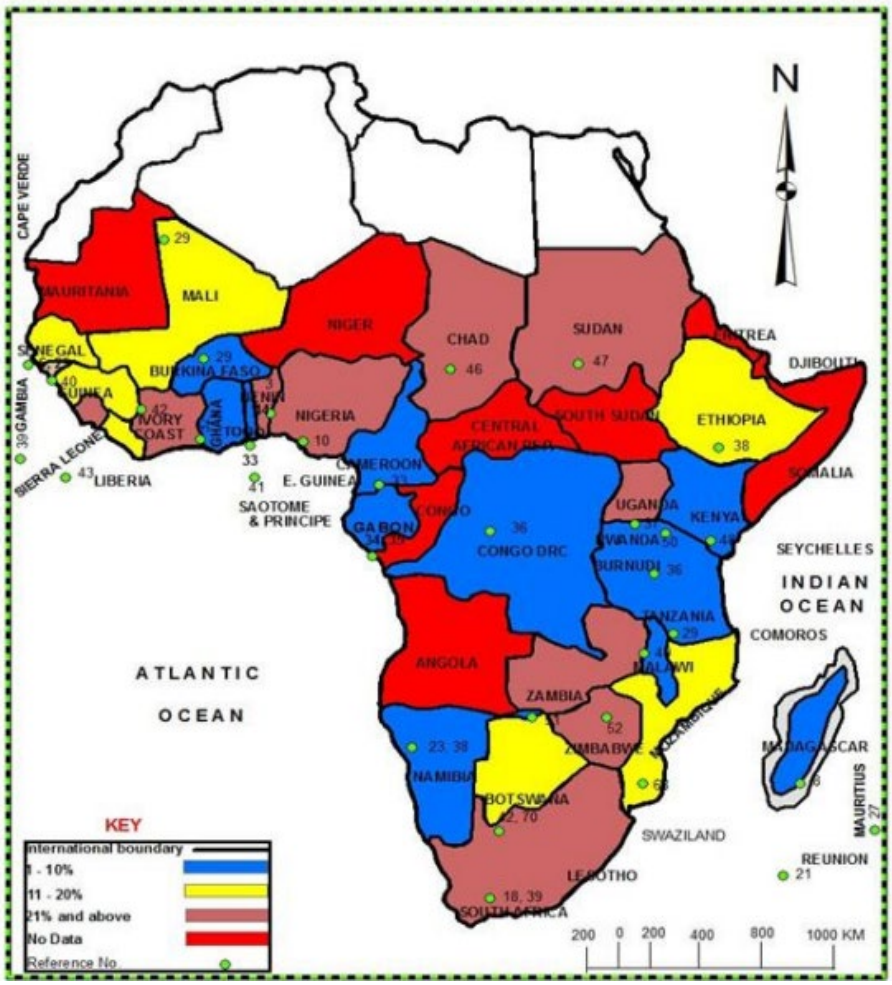


Figure 2-1 Prevalence Rates of Healthcare Associated Infections in Sub-Saharan African Countries (Mbim et al., 2016)

2.4 Causal Agents of Healthcare Associated Infections

The commonest of HCAI are those caused by methicillin-resistant Staphylococcus aureus (MRSA), methicillin-sensitive Staphylococcus aureus (MSSA), Clostridium difficile (C.difficile) and Escherichia coli (E.coli) (ECDC, 2013). E.coli are bacteria often found in the intestines and can cause a range of infections such as UTI, cystitis and intestinal infections. E.coli sometimes cause blood stream infections (BSI) when they spread from other primary infections (Public Health England, 2017a).

Staphylococcus aureus are also a type of bacteria that frequently inhabit in human skin and mucosa without causing harm to the body unless there is an alteration in the skin (breakage) or during invasive medical procedures. They cause infections such as pneumonia, BSI, wound and skin infections (Public Health England, 2017c).

Pseudomonas aeruginosa are opportunistic gram-negative bacteria which are largely found in the environment (Public Health England, 2018). Pseudomonas infections are usually seen in people with weakened immune systems such as patients with severe burn injury, cancer patients and new-borns (Centers for Disease Control and Prevention (CDC), 2013). They cause several infections such as device-associated (catheter, respiratory devices), ear infections especially, in children and blood infections (Public Health England, 2018).

Clostridium difficile are bacteria found in human intestines which are commonly found among patients who have compromised immune systems (e.g. older people) or those who have taken antibiotics (CDC, 2015). They are the chief cause of infective diarrhoea in hospitalised patients and are predominantly common in immune-compromised people and the aged (Public Health England, 2019). Environmental contagion makes C.difficile a

challenge as its spores are able to live anywhere hence, they are found everywhere one could think of.

Other HCAI are caused by viral and fungal pathogens which may be from exogenous or endogenous sources. Exogenous sources are external, not from patients for example, visitors, HCWs, medical equipment and the hospital environment (Custodio, 2016). Endogenous sources include body sites that are ordinarily housed by microbes e.g. the gastro-intestinal and genito-urinary tracts as well as the nasopharynx (Custodio, 2016).

Even though SSI are predominantly caused by bacteria, it is imperative to note that these can also be caused by fungi (CDC, 2017). Fungal infections can be as mild as skin rashes while others may be as fatal as fungal pneumonia. The rate of invasive healthcare-associated fungal infections has increased intensely owing to risk factors like critically ill patients, ageing population in countries with sophisticated medical technologies, extensive use of broad spectrum antimicrobials and the resultant prevalence of different types of cancer (Su-Pen Yang et al., 2013; Bougnoux et al., 2018; Cortegiani et al., 2018). In the United States, candida infection accounts for 8%-12% of all central line-associated BSI with crude mortality rate in candidaemia exceeding 40% (Gulia et al., 2010). Overall rate of candidaemia in England, Wales and Northern Ireland was 3.6 per 100,000 population in 2016 (Public Health England, 2017b). Over 17 candida species have been identified as causative pathogens of BSI with C. albicans, C. tropicalis, C. parapsilosis, C. glabrate and C. krusei accounting for over 90% of all cases of invasive candidiasis, therapeutic failure and antimicrobial drug resistance (Cortegiani et al., 2018; Xiao et al., 2019).

Viral HCAI include rotavirus, norovirus acute gastroenteritis and respiratory viruses (McIntosh, 2018). Respiratory viruses are common in children's healthcare centres and

usually include paramyxoviruses (such as respiratory syncytial virus), parainfluenza viruses types I, 2,3 and 4, human metapneumovirus), the orthomyxoviruses (including influenza A and B), the picornaviruses (such as rhinoviruses and respiratory enteroviruses) and the respiratory adenoviruses (Demmler-Harrison, 2019). A Korean study reported an overall incidence rate of 3.9 per 1000 cases, with the commonest being rhinovirus (30.3%), followed by influenza (17.6%) and parainfluenza (15.6%) (Choi et al., 2017). In another study, 10% of intensive care unit (ICU) patients acquired pneumonia while hospitalised, 32% of which was through respiratory viruses (Loubet et al., 2017).

2.5 Types of Healthcare Associated Infections

There are four categories of HCAI (CDC, 2014) and these will be discussed in succession.

2.5.1 Central Line-Associated Bloodstream Infections

Central line-associated bloodstream infections (CLA-BSI) are regarded as the commonest cause of HCAI to the bloodstream and a major cause of morbidity and mortality in SSA countries (Lester et al., 2020). They are among the most dangerous complications that can occur among patients receiving care in the ICU (Karch et al., 2015). CLA-BSI have been considered as an important cause of death which has not been comprehensively explored in developing countries (Rosenthal, 2009). The prevalence rates of CLA-BSI in SSA countries are profound. Studies from Gabon, Ghana and Burkina Faso reported prevalence rates of 3.33% (Hien et al., 2012), 19.5% (Labi et al., 2019) and 20% (Scherbaum et al., 2014) respectively while prevalence ranged from 8.2% to 14.1% in Ethiopia (Yallew et al., 2016; Ali et al., 2018) and 1.9% to 49% (Adeyemi et al., 2010; Iwuafor et al., 2016; Iliyasu et al., 2018; Popoola et al., 2019; Iliyasu et al., 2020) in Nigeria. CLA-BSI are usually a consequence of poor insertion

procedure or failures in hygiene protocols during placement as well as on-going care of the catheter insertion site (Legeay et al., 2015).

2.5.2 Catheter-Associated Urinary Tract Infections

Catheter-associated urinary tract infections (CA-UTI) are identified as the commonest HCAI in the UK, accounting for 17.2% of all HCAI with between 43% and 56% of UTI associated with an indwelling catheter (Loveday et al., 2014). CA-UTI account for nearly 20% of bacteraemia in acute settings and almost 50% in long term facilities (Nicolle, 2014). Prevalence rates of CA-UTI ranged from 6.7% to 32.2% in countries of Ethiopia, Burkina Faso, Ghana, South Africa, Gabon and Uganda (Hien et al., 2012; Scherbaum et al., 2014; Yallew et al., 2016; Ali et al., 2018; Nair et al., 2018; Labi et al., 2019; Odoki et al., 2019). Prevalence rates are worse in Nigeria, ranging from 16% to 43.1% (Ige et al., 2011; Raji et al., 2013; Onyegbule et al., 2014; Iwuafor et al., 2016; Olaniran et al., 2016; Igbudu, 2018; Iliyasu et al., 2018). The predominant causative organism is E.coli with Nigerian studies reporting as high as 60% prevalence rate (Raji et al., 2013; Olaniran et al., 2016; Igbudu, 2018).

2.5.3 Surgical Site Infections

Surgical site infections (SSI) are defined as postoperative infections occurring within 30 days of surgical procedures or one year of permanent implants (Badia et al., 2017). An SSI occurs when micro-organisms get into the part of the body that has been operated on and multiply in the tissues (Public Health England, 2014). SSI are the most investigated and most virulent type of HCAI in developing countries, affecting up to one-third of surgical patients (Allegranzi et al., 2017). SSI are a significant cause of post-surgical morbidity and mortality (Chu et al., 2015). In a systematic review of HCAI in Africa, majority of the studies reviewed

here concentrated on SSI with cumulative majority incidence rate ranging from 2.5% to 30.9% (Bagheri Nejad et al., 2011). However, the study by Chu et al. (2015) where 1276 women underwent caesarean section reported only 7.3% of SSI, 93% of which were superficial. SSI incidence rates in some SSA studies such as Ethiopia, Ghana and Tanzania ranged between 19.1% and 75% (Mawalla et al., 2011; Mengesha et al., 2014; Laloto et al., 2017; Tabiri et al., 2018; Labi et al., 2019). Specifically, a systematic review and meta-analysis conducted in Nigeria estimated the cumulative incidence rate of SSI at 14.5% (Olowo-Okere et al., 2019). Thirty-two studies were included in this review across the country. One Nigerian study omitted in this review reported an incidence rate of 20.3% (Nwankwo et al., 2012). Conversely, the cumulative incidence rate of SSI in the UK ranged from <1% to 9.2% (Public Health England, 2017d). In terms of prevalence rates, values ranged from 10% to 57.7% in countries of Burkina Faso, Ethiopia, Gabon, Ghana, and South Africa (Hien et al., 2012; Scherbaum et al., 2014; Yallew et al., 2016; Nair et al., 2018; Ali et al., 2018; Labi et al., 2019) whereas in Nigeria, prevalence rates ranged from 9.9% to 30.7% (Ige et al., 2011; Ikeanyi et al., 2013; Olowo-Okere et al., 2017; Iliyasu et al., 2018; Olowo-Okere et al., 2018).

2.5.4 Ventilator-Associated Pneumonia

Ventilator-associated pneumonia (VAP) is described as a kind of lung infection arising 48-72 hours after endotracheal intubation of patients, contributing to nearly fifty per cent of all cases of hospital acquired pneumonia (Kalanuria et al., 2014). The incidence rate is around 10% while fatality rate is about 20% (Lin et al., 2018). Eighty-six percent of hospital acquired pneumonia are associated with mechanical intubation and are referred to as VAP (Koenig & Truwit, 2006). VAP is the commonest of HCAI in patients receiving intensive care and is estimated to occur in 9%-27% of all patients on mechanical ventilation (Hunter, 2012). The

incidence rate of VAP per 1000 ventilator days ranges from 13 to 51 (Charles et al., 2014). Similarly, crude mortality rate from VAP varied between 24% and 76% (Choudhuri, 2013). This presents VAP as an important healthcare challenge especially in critically ill patients in resource deprived countries. Unfortunately, there is lack of gold standard to define VAP which has consequently led to under-diagnosis and over-diagnosis of the fatal condition (Hunter, 2012).

To cap it all, the systematic review of HCAI in developing countries by Allegranzi and colleagues (2011) identified 22 prevalence studies of which half reported frequency of infections higher than 10 per 100 patients. Amongst patients in this population, 29% of the HCAI were SSI, 24% UTI, 19% BSI, 15% pneumonia while 13% were grouped under other infections. Similarly, an analysis of 220 publications on HCAI in developing countries reported that 71% of the included studies presented rates of VAP per 1000 device days, 79% showed rates of CLA-BSI per 1000 device days while 80% of these studies showed rates of CA-UTI per 1000 device days (Rosenthal, 2011). SSI are reported as the chief HCAI with proportions extremely higher than those reported in developed countries (Allegranzi et al., 2011). The only Nigerian studies found reported 2.7% prevalence rate of hospital acquired pneumonia (Iliyasu et al., 2018) and 6.7% (3 patients) with respiratory tract infections, two of whom were on ventilators (Iwuafor et al., 2016). Notably, the researcher did not find any study which primarily surveyed VAP among hospitalised patients in Nigeria thereby creating a major vacuum as the prevalence and incidence rates as well as their impact on healthcare cannot be fully appreciated.

2.6 Impact of Healthcare Associated Infections on Hospitals

Although the economic burden of HCAI in developing countries has been largely undocumented (Al-Tawfiq & Pittet, 2013), the UK National Health Service (NHS) incurs an estimate of £1 billion ($1.29 billion) extra cost while caring for patients who acquired HCAI annually (NICE, 2017). In the United States, both direct and indirect costs of HCAI in acute care hospitals have been estimated to be between $96 and $147 billion (£74 - £113.7 billion) annually (Marchetti & Rossiter, 2013). The burden of HCAI is more severe in high-risk patient populations such as those admitted to ICU, burn and transplant units, and the neonatal wards due to their immunocompromised status (Khan et al., 2017; Haque et al., 2018). Higher prevalence rates of HCAI have been reported in ICU patients, with 5-10 times greater possibility than those acquired in general medical and surgical wards (Singh et al., 2013). In developed countries, nearly one-third of ICU patients have had a minimum of one episode of HCAI with grave effects in terms of morbidity and mortality (Allegranzi et al., 2017). An ECDC 2014 surveillance report noted up to 8% of ICU patients presented with at least one ICU HCAI (ECDC, 2017). The proportion of ICU patients with HCAI ranged from 4.4% to 88.9% in low- and middle-income countries (Allegranzi et al., 2017).

Contracting HCAI in ICU could be linked to the exposure of the critically ill patients to invasive medical devices such as urinary catheters, central venous and arterial catheters and endotracheal tubes consequently subjecting them to weakened normal skin and mucosal barriers (Singh et al*.,* 2013). However, it can be argued that the population of patients in ICU is usually less than those in other general wards. Therefore, the findings above must be interpreted with caution. The reported prevalence rates of HCAI in ICU might be higher than those in general medical and surgical wards but the entire population should be taken into cognisance. It should be noted that even though there might be minute prevalence rates in

these wards, more patients might actually be at risk of HCAI in these wards compared to ICU.

For instance, in an Ireland national HCAI survey, the highest HCAI prevalence rate (16.5%) was recorded in augmented care units (these are adult and paediatric ICUs, high dependency units, neonatal ICU and special care baby units). Sixty-nine out of 419 surveyed patients had HCAI. Likewise, in surgical and medical wards, prevalence rates of HCAI were 6.7% and 4.8% respectively; values which are lower than that recorded in the critical care units and which can literally translate that more HCAI are seen in the critical care units. However, while the total number of patients in the surgical and medical wards was 1981 and 3042 respectively, 133 and 146 patients in these respective wards acquired HCAI (Health Protection Surveillance Centre, 2012). This confirms that although there is higher prevalence rate in ICUs, more infectious rates are seen in the general wards when the population size is considered. To affirm this, the English national point survey on HCAI also reported a similar finding. HCAI prevalence rate among patients in ICU was 23.4%, where 1351 patients were surveyed, 316 of them acquired HCAI. In surgical and medical wards, prevalence rates of 8% and 5.5% were recorded, the total number of patients surveyed being 11088 and 17010 while those that acquired HCAI were 893 and 942 for surgical and medical patients respectively (Health Protection Agency, 2012).

The situation is comparable in Nigeria. A ten-year (2000-2009) review reported HCAI prevalence rates of 14.7%, 3% and 4.9% in ICU, medical and surgical wards respectively (Afolabi et al., 2011). Of the 1129 HCAI cases recorded during the 10-year period, 433 were from the surgical wards, 208 from the medical wards while only 72 were from the ICU. This translates to the percentages of infection in surgical and medical wards being 38.3% and

18.4%, respectively in contrast to ICU which accounted for only 6.4%. The remaining cases were from other wards like orthopaedic, Obstetrics & Gynaecology (O&G), paediatric and neonatal wards (Afolabi et al., 2011). Moreover, in the five-year (2005-2009) survey of HCAI by Ige et al. (2011), although the ICU was not among the wards surveyed, highest infection rate was reported in the surgical ward, followed by medicine, O&G and paediatrics with HCAI rate of 48.3%, 20.5%, 16.1% and 15.1% respectively. In this study, the surgical ward had the highest prevalence rate compared to other wards (Ige et al., 2011).

Notably in all the studies reviewed above, HCAI are highest in surgical wards when compared to all the wards. Hence, it is arguable that there are more HCAI in surgical wards since they have more patient population acquiring one or more of these infections while on hospital admission.

2.7 The Nigeria Healthcare System

This aspect of the review focusses on the Nigerian population, and their healthcare system. It will be discussed based on demographics and key health indices of the Nigerian population as well as the structure and governance of the health system, healthcare financing, provision of essential medicines and health supplies and the Nigerian health workforce. The key health indices will be compared with the UK key statistics, as an example of a developed country and inferences will be drawn.

Whilst health systems are central to optimal healthcare delivery, inadequate institutional capacity has been identified as one of the characteristic challenges in health systems in Africa (Kyabayinze et al., 2012).

> "One of Africa's major public health challenges is building and strengthening health systems capable of delivering essential health care to the population as African countries have weak and dysfunctional health systems" (WHO, 2006).

Health system is an aggregate of all the organisations, institutions, resources and people whose principal purpose is to improve health (WHO, 2019d). A health system requires personnel, finances, information, materials, transportation, communications and general guidance and direction (WHO, 2019c). It also requires delivery of responsive and economically fair services, while treating people politely. The basic components of a serviceable health system include good health services, performing and active human resources, operational health information systems, essential medical supplies, a good health funding system as well as good leadership and governance (WHO, 2007). A disruption in any one of these building blocks can perhaps impede the outcome of an effectual healthcare intervention (Pang & Peeling, 2007).

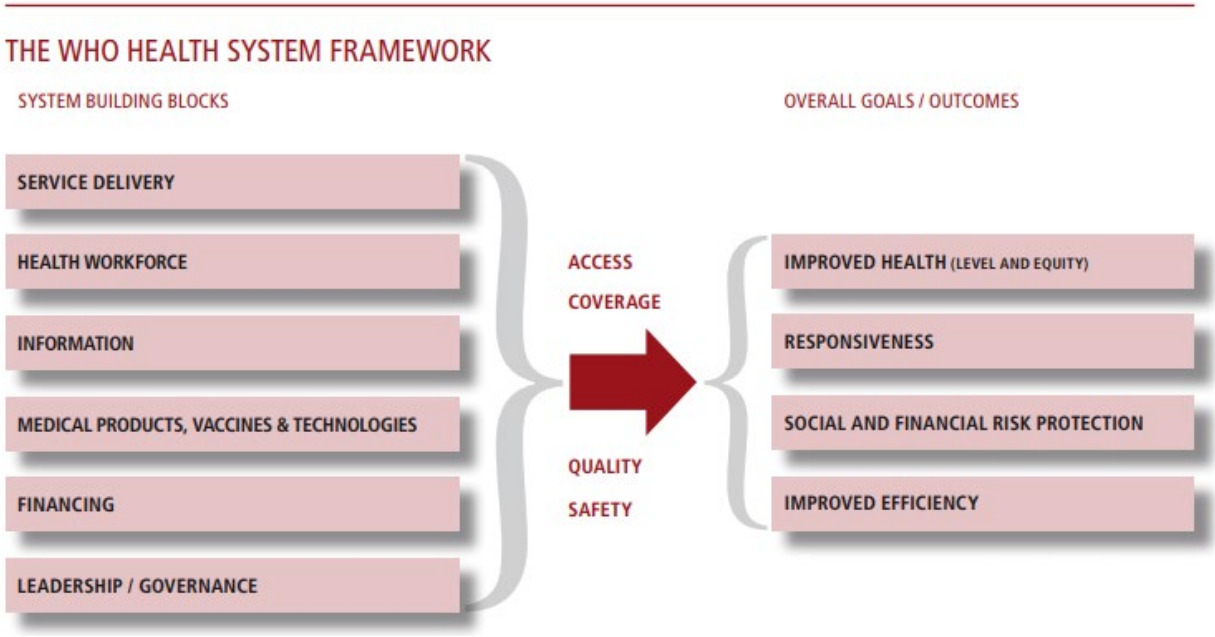


Figure 2-2 The World Health Organisation Health System Framework (WHO, 2007)

2.7.1 Geographical and Demographic Overview of Nigeria

The Federal Republic of Nigeria is located in Western Africa, bordering the Gulf of Guinea, between Benin and Cameroon (Central Intelligence Agency, 2019). The country also shares its border with the Republic of Niger and Chad (Nations Encyclopedia, 2019). Figure 2.3 shows the map of Africa highlighting the SSA countries in green colour, and showing Nigeria and its country borders (Paton, 2014).

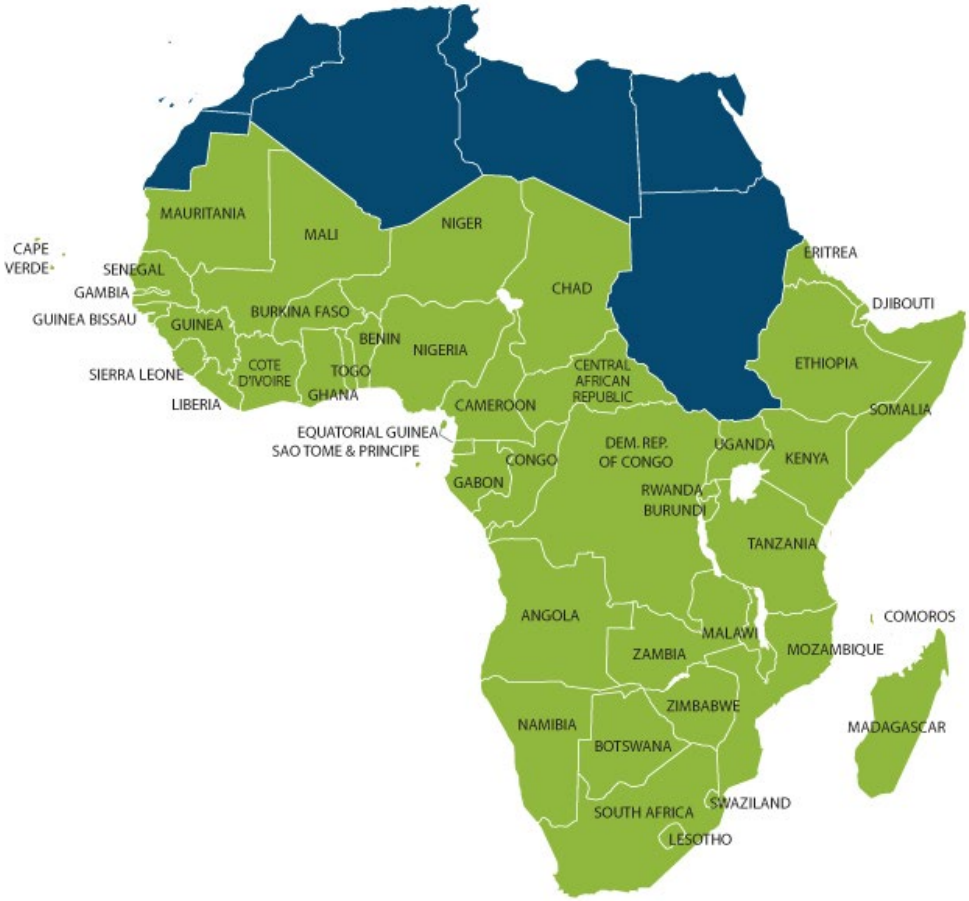


Figure 2-3 Map of Africa Showing the Sub-Saharan African Countries
(Paton, 2014)

Nigeria is the largest country in Africa and the 7th most populous country in the world with the latest estimates of over 200 million citizens (World Population Review, 2019), a quite significant rise when compared to the 186 million estimate in 2016 (WHO, 2019f). This can be linked to the country's current population growth rate which contributes 2.62% to the

world population (World Population Review, 2019), unlike the UK with country population of 67 million and a growth rate of 0.5% which is thought to be its slowest since 2004 (Office for National Statistics (ONS), 2020). Nigeria is one of the developing countries in SSA and is home to over 500 ethnic groups and diverse languages (Blench, 2019). A federal system of government is run in Nigeria, comprising of a Federal Capital Territory, which is situated in Abuja, 36 states and 774 Local Government Areas (National Bureau of Statistics, 2019b). Figure 2-4 below is the map of Nigeria showing the Federal Capital Territory and the 36 states of the federation (United Nations, 2014).

Figure 2-4 Map of Nigeria
(United Nations, 2014)

2.7.2 Key Health Indices in Nigeria

Sub-Saharan African (SSA) countries possibly have the poorest health profiles in Africa (Deaton & Tortora, 2015). Unlike the UK where the leading causes of death are mostly

NCDs, NCDs account for only 29% of all deaths in Nigeria (WHO, 2019e; ONS, 2020). The table below shows the leading causes of death in Nigeria and the UK.

Table 2-1 Leading Causes of Death in Nigeria and the United Kingdom

S/N	Nigeria (CDC, 2019)	United Kingdom (ONS, 2020)
1	Lower respiratory infections	Malignant neoplasm of trachea, bronchus and lung
2	Neonatal disorders	Ischaemic heart diseases
3	HIV/AIDS	Influenza and pneumonia
4	Malaria	Dementia and Alzheimer's diseases
5	Diarrhoeal diseases	Chronic lower respiratory diseases
6	Tuberculosis	Cerebrovascular diseases
7	Meningitis	Accidental poisoning
8	Ischaemic heart disease	Suicide
9	Stroke	
10	Cirrhosis	

As at 2018, life expectancy at birth for males and females is 53 and 55 in Nigeria (World Bank, 2019f) and 79.3 and 82.9 years in the UK (ONS, 2019) respectively. As at 2018, neonatal mortality rate, infant mortality rate, and under five mortality rate are 33, 76 and 120 in Nigeria, and 3, 4, and 4 in the UK per 1000 live births respectively (World Bank, 2019a; World Bank, 2019c; World Bank, 2019g). Similarly, maternal mortality rates per 100,000 live births is 917 in Nigeria and 7 in the UK respectively, as at 2017 (World Bank, 2019b). SSA countries account for 38% of global neonatal deaths (Usman et al., 2019) and 68% of all maternal deaths globally (United Nations Children's Fund (UNICEF), 2019).

By inference, these statistics may be due to the Nigerian healthcare system as a whole, having been ranked 187th unlike the UK which ranked 18th out of 191 countries in the global health service performance (WHO, 2000). This situation has not changed as Nigeria is still characterised by high disease burden, low health indicators and underfinanced healthcare system. Weakened public healthcare system with low coverage of key health interventions

has made high disease burden persist in the country (UNICEF, 2019). With infectious diseases leading the causes of death in Nigeria, the risk of HCAI transmission is higher than in the UK where causes of death are mostly from NCDs. There is little or no HCAI surveillance studies and their impact on hospitalised patients has not been extensively explored. The epidemiological data given above is typical of all developing countries especially those in SSA. The disease burden has been ascribed to weak, under resourced health system with limited institutional capacity to facilitate efficient resources and lack of commitment from the government (Muhammad et al., 2017; Amegah, 2018; Gouda et al., 2019), poor access to healthcare services in terms of geographical accessibility, availability of basic facilities and skilled service providers, accessibility of financial resources as well as social and cultural acceptability by service users and providers (Jacobs et al., 2011; Mooketsane & Phirinyane, 2015). This suggests the existence of strong interplay between the system of healthcare and the health outcomes, especially the life expectancy of any country (Hao et al., 2020).

Table 2-2 Comparison of the Key Health Indices in Nigeria and the United Kingdom

S/N	Indices	Nigeria	United Kingdom
1	Life Expectancy (male)	53	79.3
	Life Expectancy (female)	55	82.9
2	Neonatal Mortality Rate	33	3
3	Infant Mortality Rate	76	4
4	Under Five Mortality Rate	120	4
5	Maternal Mortality Rate	917	7
6	Global Ranking in Health Service Performance	187th/191 countries	18th/191 countries

2.7.3 Healthcare Structure and Organisation

The Federal government of Nigeria acknowledges and operates three systems of healthcare delivery which are the orthodox, traditional and alternative methods consequently, compounding the healthcare challenges of the country (WHO, 2019b). Orthodox medicine is the use of any admixture in the treatment of diseases in human body by trained professionals (Osemene et al., 2011) while traditional and alternative medicine is the aggregate of healthcare practices (native or imported) that are delivered outside of conventional medicine and not fully integrated into the dominant healthcare system (James et al., 2018). Only orthodox medicine will be discussed in this section as traditional and alternative medicines are not relevant within the scope of this discussion.

In orthodox medicine, which is the widely acceptable health care delivery form and the area of exploration of the subject of this study, Nigeria operates a dual health system delivery, namely the public and private healthcare sectors. The public healthcare system in Nigeria is decentralised and structured along the tertiary, secondary and primary levels of healthcare with the systems being simultaneously run by the federal and state ministries of Health, and the local government health department (Abimbola et al., 2015; Eboreime et al., 2017). A decentralised health system aims at bringing health services closer to the end users (Eboreime et al., 2017).

In England, the Department of Health and Social Care (DHSC) takes a central role at making health policies, securing, and allocating resources and funding the NHS to meet the demands of the people and their communities (Department of Health and Social Care, 2013). Primary care providers such as the general practitioners, opticians, dentists and pharmacists are the first point of care in England while hospital services are for specialised, surgical or emergency care (DHSC, 2013). The structure is similar in Nigeria where the

Federal Ministry of Health oversees the activities of other levels, it is also responsible for the entire health policy formulations and reforms as well as delivery of healthcare at the federal medical centres and the teaching hospitals (Olakunde, 2012). The State Ministry of Health provides healthcare at the secondary level through the state/general hospitals and the comprehensive health care centres whereas the Local Government Health Department provides primary health care (PHC) services through the PHC centres (Eboreime et al., 2017). This implies that decentralisation of health services leaves the PHC governance to the weakest tier of government (local government). However, HCWs prefer to work at secondary and tertiary levels of care because of prompt payment of salaries and living in urban centres where living conditions are better than in the rural areas (Abimbola et al., 2015). Consequently, this results in dearth of HCWs at the PHC level and patients accessing secondary and tertiary levels of care more by boycotting the PHC level, unlike in England where there is increasing preference for community-based care for non-urgent cases (DHSC, 2013).

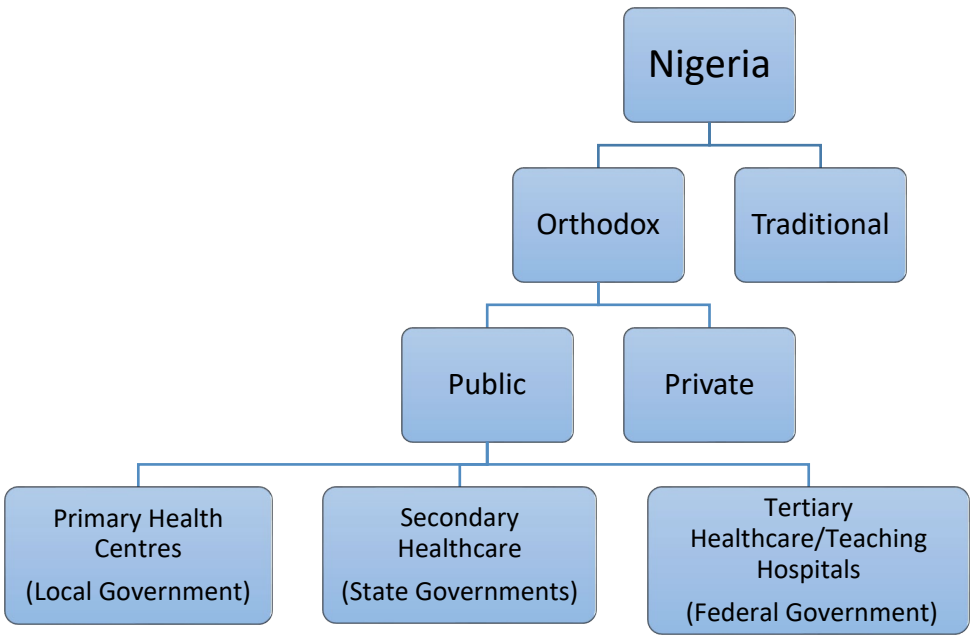


Figure 2-5 Levels of Healthcare in Nigeria

2.7.4 Healthcare Financing

Healthcare financing is a key determinant of healthcare outcome and performance of health systems (Liaropoulos & Goranitis, 2015). A good health financing system ensures sufficient funds for health, in ways that guarantee people access to required services, and safeguard them from financial hardship connected to having to pay for them; and it provides incentives for providers and users to be efficient (WHO, 2007). The total expenditure on health by the Federal Government of Nigeria is much less than the Abuja Declaration Budget of 15% (WHO, 2019f) agreed at a meeting of heads of state of African countries where they pledged to allocate at least 15% of each country's annual budget to healthcare (WHO, 2011).

Nigeria has never met this declaration since inception 19 years ago, indeed, a decline has been observed in the government's budget allocation for health. For instance, in the year 2014 budget, only about 6% of the entire budget was allocated to healthcare (Ihekweazu, 2013) out of which 70% went to the urban centres where most of the population reside and the remaining 30% to the rural areas (Obom-Egbulem, 2010). This confirms that while there are insufficient funds for healthcare delivery across the federation, there is marked inequality in the distribution of the available funds since more attention is being paid to the urban areas than the rural communities. Similarly, in the 2016 budget, only 3.6% of the budget was allocated to healthcare where about 221.7 billion NGN (474 million GBP) was earmarked for health out of the entire 6.08 trillion NGN (12.8 billion GBP) budget for the year (Vanguard, 2015). Only 46 billion NGN (98.5 million GBP) out of over 10 trillion NGN (22.1 billion GBP) was allocated to health for the year 2020 budget (Budget Office of the Federation, 2019; Onyeji, 2019).

For many African countries, healthcare financing is largely from tax revenues, donor funds and Out-of-Pocket (OOP) expenditure (McIntyre et al., 2008). Same goes for Nigeria with the inclusion of health insurance, both social and community (Olakunde, 2012). OOP expenditure are any direct payments, excluding any prepayment for health services made by individuals to healthcare providers at the time of service consumption (WHO, 2020). OOP expenditure on health in Nigeria is 75.21% as at 2016 (The World Bank, 2019). OOP expenditure may discourage patients from accessing healthcare which may be detrimental to their wellbeing (Heinzlef et al., 2020). The National Health Insurance Scheme (NHIS) is a social health insurance scheme that was adopted in 2005 to guarantee universal health coverage for all Nigerians. In this scheme, the government is expected to make some financial commitment to both employed and unemployed citizens while employers contribute on behalf of their employees to improve access to healthcare as well as relieve the cost implications on the citizenry (Olakunde, 2012). However, since the full launch of the NHIS in 2005, only 4% of the country's population, basically the federal government staff have benefited from it while only 2 out of the 36 states of the federation adopted the scheme (WHO, 2019a). Moreover, many Nigerians who can afford it practise medical tourism (receiving medical treatment abroad) especially for general surgeries and disease management in cardiology, neurology and cancer management (Akunne et al., 2019; Oleribe et al., 2019).

In 2014, Nigeria's total expenditure health as percentage of Gross Domestic Product (GDP) was estimated to be 3.7% while the total expenditure per capita is $217 (WHO, 2019f). Corruption has also been identified as a major healthcare challenge. In the 2018 corruption perception index, Nigeria was ranked 144th out of 180 countries (Transparency

International, 2018). This agency further affirmed that there is no openness in the budget of Nigeria thus making it increasingly difficult to calculate the actual percentage of the budget being spent on healthcare in the country.

2.7.5 Nigeria Health Workforce

Globally, the health system of a country is dependent on the health workforce for optimal delivery of high-quality services (Spero et al., 2011). There is heavy shortage of HCWs across SSA countries, with a deficit of 2.4 million doctors and nurses reported (Naicker et al., 2010). There is dearth of statistical evidence on the recent ratio of HCWs to patients in Nigeria. However, it is acknowledged that the density of Nigerian physicians, nurses and midwives are very low when compared to the WHO recommended minimum density of 2.28 health workers per 1000 population (Kinfu et al., 2009). As of 2013, density of physicians per 1000 people is 0.4 while density of nurses and midwives is 1.5 in Nigeria[1], unlike in the UK where the density for physicians and nurses and midwives is 2.8 and 8.3 respectively as at 2017 (World Bank, 2019d; World Bank, 2019e). As at December 2007, Nigerian doctors on medical register were 55,376 while registered nurses were 128,918[1] (WHO, 2018b). Migration of Nigerian HCWs to developed countries has remained one of Nigeria's greatest challenges in health workforce thereby resulting into inadequate production and inequitable distribution of HCWs in the country (WHO, 2019b). Furthermore, the available HCWs are concentrated in the urban tertiary health institutions, particularly in the southern

[1] These are the latest data found on these statistics.

region of the country consequently depriving those in the remote areas access to skilled workers and ensuing in gross health inequalities (WHO, 2019b).

2.7.6 Essential Medicines and Medical Supplies

Adequate provision, accessibility and availability of essential medicines and supplies are of top importance for significant reduction in morbidity and mortality rates to be realised (Tumwine et al., 2010). However, lack of medical supplies remains one of public health's major challenges, with about one-third of global population out of reach of necessary drugs and about 50% of this population in poor countries of Africa and Asia (Oluka et al., 2010; Obuaku, 2014). Inadequate supply and non-availability of essential drugs and supplies across the health facilities in Nigeria is prevalent. This is attributable to poor budgetary allocation, which is noted to have increasingly been on decline as one of the main reasons for the lack of essential drugs in public healthcare centres in Nigeria (Ohuabunwa, 2010). Most patients pay for medicines OOP which is unaffordable for most people due to high costs (WHO, 2016). There is uncontrolled retailing of medicines with fake or poor-quality drugs sold at times, thereby complicating the efforts of the National Agency for Food and Drug Administration and Control (NAFDAC) (Home Office, 2018). NAFDAC, a federal parastatal under the Federal Ministry of Health, established in 1992, is responsible for the regulation and control of the manufacture, importation, exportation, advertisement, distribution, sale and use of food, drugs, cosmetics, medical devices, chemicals, detergents and packaged water in Nigeria (National Agency for Food and Drug Administration and Control, 2017).

2.8 Infection Prevention and Control Practices

Standardised infection prevention and control (IPC) programmes play a weighty role in achieving a decline in morbidity and mortality rates, hospital stay and the economic burden of HCAI in hospitalised patients (Samuel et al., 2010). Extensive global attention has been on IPC practices within healthcare facilities, amongst healthcare service users and of course, HCWs (Kamulegeya et al., 2013). The importance of upholding IPC measures cannot be overemphasised since healthcare consumers, their visitors as well as HCWs stand a high chance of spreading infectious diseases from and to one another if appropriate IPC measures are not strictly adhered to (Amoran & Onwube, 2013). Numerous empirical studies have reiterated the correlation between active adherence to IPC measures and a decline in transmission of infectious diseases (Vindigni et al., 2011). Some of the general guidelines for IPC among others are efficient hand hygiene practices, using personal protective equipment, safe handling and disposal of sharps and clinical wastes, managing blood and bodily fluid spillages, maintenance of asepsis and aseptic techniques, decontamination (cleaning, disinfection, and sterilisation) of equipment; correct use of in-dwelling devices and managing accidental exposure to blood-borne viruses (Royal College of Nursing, 2012).

Despite the available IPC measures, a noticeable gap is still seen in the global acceptance of best practices to arrest cross-contamination. This is chiefly prevalent in developing countries where IPC measures are largely limited due to numerous challenges such as non-availability of basic amenities, defective sanitation and hygienic conditions, shortage of skilled HCWs as well as knowledge deficit (Allegranzi & Pittet, 2009; Desai et al., 2019). Most healthcare facilities in developing countries, especially Africa, lack effective IPC programmes and there

is dearth of awareness of the problem and a massive shortage of trained personnel in IPC practices (Alp et al., 2011; Yallew et al., 2016). Likewise, lack of knowledge, limited time and resources, misplaced priorities of the government and hospital managers and other barriers such as poor water supply, epileptic power supply, lack of an enabling environment, poor utilisation of IPC manual and poorly organised IPC workshops have been linked to poor IPC programmes (Samuel et al., 2010; Kamulegeya et al., 2013; Tenna et al., 2013; Chipfuwa et al., 2014; Ogoina et al., 2015). The recent outbreak of Ebola Virus Disease (EVD) in West Africa (2014-2016), which claimed about 4000 lives attest to the fact that there is an urgent need to boost the IPC standards and practices in developing countries. A survey revealed very poor level of IPC measures are in place in health facilities in Rivers state (Eastern part of Nigeria) which was one of the two states that experienced EVD outbreak in Nigeria in 2014 (Okwor et al., 2015). Two tertiary, 24 public secondary and 66 private secondary health facilities were included in this survey and it was reported that only 1 of the 2 tertiary hospitals had an IPC committee in place, only 1 of the hospitals had an IPC policy which was not operational and none of the hospitals had a good score for both the availability of IPC materials and practice of good IPC measures (Okwor et al., 2015). The barriers identified here relate generally on IPC practices.

To summarise, HCAI are a big issue in SSA countries considering the magnitude and impact identified in this chapter. On this basis, there is need for high levels of compliance to IPC practices. However, IPC measures are still very elementary and at primitive level in SSA countries due to institutional problems relating to non-availability and inaccessibility of funding and essential resources, absence of IPC policies and poor knowledge and training on IPC practices. A systematic review that explores the barriers and levers to hand hygiene

practices, as an IPC practice in SSA countries is conducted in the next chapter. The role of hands in the transmission of HCAI is discussed in the following section.

2.9 Role of Hands in HCAI Transmission

Contaminated hands play a significant role in the spread of HCAI (Dixit et al., 2012). WHO (2009) outlined five sequential steps through which HCAI are transmitted from one patient to another via HCWs hands:

(i) organisms are present on the patient's skin, or have been shed onto inanimate objects immediately surrounding the patient;
(ii) organisms must be transferred to the hands of HCWs;
(iii) organisms must be capable of surviving for at least several minutes on HCWs' hands;
(iv) handwashing or hand antisepsis by the HCW must be inadequate or entirely omitted, or the agent used for hand hygiene inappropriate; and
(v) the contaminated hand or hands of the caregiver must come into direct contact with another patient or with an inanimate object that will come into direct contact with the patient.

Owing to this evidence, hand hygiene is considered the most important, primary IPC measure to achieve a decline in HCAI (Graf et al., 2011; WHO, 2009b).

2.10 Hand Hygiene

2.10.1 Definition

Hand hygiene includes any action of hand cleansing which include handwashing and disinfection with alcohol-based hand rub (ABHR). Handwashing implies washing of hands with regular (non-medicated) soap and water, or with just water while antiseptic handwashing involves washing of hands with soap and water, or other detergents containing an antiseptic agent (WHO, 2009b). Similarly, antiseptic hand-rubbing comprises the use of an antiseptic hand-rub to diminish or inhibit the growth of microbes without the

need for an exogenous source of water and requiring no rinsing or drying of hands with towels or other devices (WHO, 2009b).

The figure below describes the *"My 5 moments of hand hygiene",* identified by the WHO as an evidence-based, user-centred approach which defines the key moments HCWs should perform hand hygiene. The five approaches are before patient contact, after patient contact, before aseptic procedure, after touching patients' surroundings and after exposure to body fluids (WHO, 2009b).

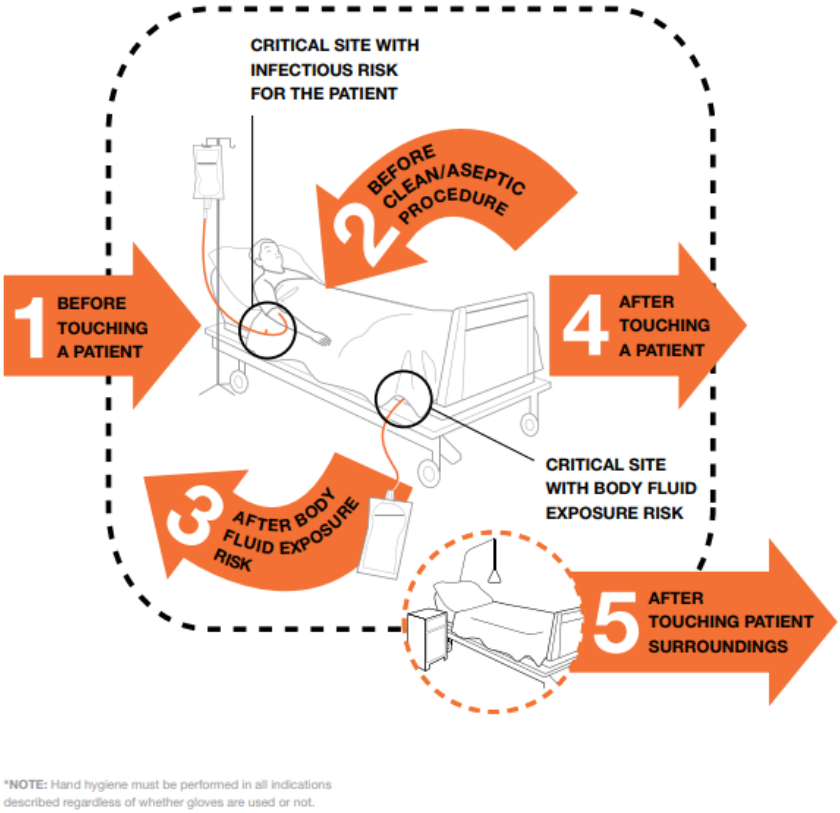


Figure 2-6 The World Health Organisation My Five Moments of Hand Hygiene (WHO, 2009b)

2.10.2 Historical Context of Hand Hygiene Practices

The importance of hand hygiene practices was first recognised in early 1840s by Dr Oliver Wendell Holmes following high prevalence of puerperal fever (Anargh et al., 2013). In his article on *"the contagiousness of puerperal fever"*, Dr Holmes argued that patients needing obstetric care acquired puerperal fever due to unclean hands of HCWs attending to them (Lane et al., 2010). However, his viewpoints gained little or no attention until around mid-nineteenth century when a French chemist and pharmacist, Labarraque advocated for the use of calcium hypochlorite for universal hygienic purposes. Labarraque also gave satisfactory evidence on how to achieve a decline in maternal mortality and puerperal fever through hand hygiene practices (Mathur, 2011; Mortell et al., 2013).

In 1847 Ignaz Semmelweis from Vienna, Austria also observed a difference in rates of maternal mortality due to puerperal fever in two obstetric clinics (16% compared with 7%) (Mathur, 2011). Semmelweis noted that medical practitioners and students who went directly into delivery rooms after performing autopsies had foul smelling odours on their hands despite washing their hands with soap and water (WHO, 2009b). He hypothesised that *cadaverous particles* were conveyed through the hands of the doctors from the autopsy room to the delivery rooms, thereby causing puerperal fever in the parturient women. He then proposed that thorough hand scrubbing with chlorinated lime solution should be conducted before any contact is made with and between the patients, especially after leaving the autopsy room (CDC, 2002). This move brought forth a momentous result, resulting in a remarkable decline in the mortality rate in the obstetric clinics from 16% to 3% (WHO, 2009b).

This was the leading evidence on the importance of hand hygiene in preventing HCAI. The use of antiseptic agents in disinfecting contaminated hands between patient contacts appeared to be more effective than ordinary handwashing with soap and water (CDC, 2002). The contributions of Joseph Lister to antiseptic practice and Louis Pasteur who some decades later, introduced the germ theory of disease which is the scientific basis for hand hygiene practices have also been emphasised (WHO, 2009b; Katz, 2004).

In recent times, hand hygiene guidelines have been given increasing importance in hospitals. For example, the CDC guideline for handwashing and hospital environmental control in 1985 (Garner & Favero, 1986) which was later reviewed in 2002 (CDC, 2002). In 2005, the WHO launched "Clean Hand is Safer Care", a global hand hygiene campaign, with the global handwashing day launched on October 15, 2008 and celebrated every year (WHO, 2009b; Mathur, 2011). There is compelling evidence now on the importance of hand hygiene as the chief measure to prevent HCAI. Hand hygiene is a practical and evidence-based approach with demonstrated impact on quality of care and patient safety across all levels of health systems (WHO, 2019g).

2.10.3 Cultural and Religious Views of Hand Hygiene Practices

For centuries, washing of hands using soap and water has been typically regarded as a behavioural form of personal hygiene and a way to impede the transmission of communicable diseases (Boyce & Pittet, 2002; CDC, 2002). Mishra et al. (2013) noted that handwashing has also both religious and cultural affiliations. SSA countries have been identified as being among the most religious regions of the world, with majority being Christians (57%), 29% Muslims and 13% traditional African worshippers (Pew Research Center, 2010). Regardless of whether dirt is actually existent or physically evident, within a

religious and cultural context hand hygiene is done for several reasons including hygienic, ceremonial and symbolic reasons, as part of religious rites; and in some certain everyday situations (Allegranzi & Pittet, 2009; Mishra et al., 2013). It is likely that handwashing with soap and water is consistently done by Muslims (including HCWs) due to their religious obligation of praying five times daily, with ablution as a basic prerequisite which is the most important of the five tenets of Islam (Ahmed et al., 2006; WHO, 2009; Ng et al., 2017). However, although there is scientific evidence that using topical alcohol-based solutions are more effective hand hygiene practice (Ahmed et al., 2006), Muslim HCWs may hesitate to comply with this recommendation due to their religious obligation to refrain from contact with alcohol, or because of their concern about alcohol absorption by route of the skin (Kramer et al., 2007). Likewise, Hinduism, Judaism, and Sikhism have precise guidelines for handwashing stated in holy texts, and this is done at some important times of the day (Allegranzi & Pittet, 2009; Mishra et al., 2013). In the Christian faith on the other hand, apart from the ritual sprinkling of holy water on hands before consecration of bread and wine during Holy Communion, and handwashing after contact with the holy oil in the Catholic Church, there are no definite injunctions on hand cleansing (Allegranzi & Pittet, 2009). Similarly, the Buddhist faith has no detailed indications for hand hygiene in daily life or ceremonial instances apart from the hygienic act of handwashing after food (Mishra et al., 2013).

Culture may have a prevailing influence on HCWs regardless of their religious background. In some west African countries like Ghana, hand hygiene is routinely done in some special occasions of daily life in conformity to primeval traditions. For example, handwashing must be done before raising anything to one's lips (Allegranzi & Pittet, 2009; Mishra et al., 2013).

Equally, it is a norm to make available outdoor facilities (a bowl of water with special leaves) for hand aspersion to welcome guests and permit them to wash their hands and faces even before the purpose of their visit is made known (Allegranzi & Pittet, 2009; Mishra et al., 2013). These may influence the HCWs' adherence to hand hygiene recommendations though there is dearth of studies to substantiate this argument (Allegranzi & Pittet, 2009). It is also noteworthy that no literature is found that explains any cultural influence on Nigerian HCWs' compliance to hand hygiene guidelines.

2.10.4 Hand Hygiene Compliance

Hand hygiene practice is acknowledged as the cheapest and most efficient way of preventing HCAI (Mathur, 2011). Between 15%-30% of HCAI can be avoided through hand hygiene practices (Weston & Weston, 2014). Yet, compliance rates of HCWs to hand hygiene guidelines are very low (Graf et al., 2011). Numerous studies have reported a compliance rate usually less than 50% of all the hand hygiene opportunities despite its wide scope, being cheap, affordable and accessible (Huis et al., 2012). A large systematic review of hand hygiene in developed countries suggests compliance rate of only 40% (Erasmus et al., 2010). Higher HCAI prevalence in developing countries have been credited to a range of factors (e.g. reuse of instruments, scarcity of basic facilities) including low compliance to infection control measures (Rosenthal, 2011). However, there is no review on the compliance with or the barriers and facilitators to hand hygiene practices in SSA countries. Therefore, a review of these factors was conducted as part of the research presented in this thesis and is presented in chapter 3.

Hand hygiene is a complex behaviour with several factors influencing its practice (Srigley et al., 2015). Whitby et al. (2006) described the behavioural determinants of hand hygiene as inherent and elective drivers. Inherent hand hygiene behaviours are those behaviours

undertaken when hands are physically dirty, feel sticky or when hands have been somewhere considered to be dirty (such as genitals, axillae or groins) while elective hand hygiene behaviours encompass all other hand hygiene opportunities (Whitby et al., 2006).

Noteworthy are the five multimodal hand hygiene improvement strategies identified by the WHO (2009), aimed at improving hand hygiene compliance rate:

1. System change – this involves ensuring that all necessary infrastructure is available to allow HCWs to practice hand hygiene. This includes access to safe, continuous water supply, soap and towels, and readily accessible ABHRs at the point of care (WHO, 2009).
2. Training/education – providing regular training on hand hygiene importance based on the *"My five moments for hand hygiene"* approach and the correct procedures for handwashing and hand-rubbing, to all HCWs (WHO, 2009).
3. Evaluation/feedback – monitoring hand hygiene practices and infrastructure along with related perceptions and knowledge among HCWs, while providing performance and results feedback to staff (WHO, 2009).
4. Reminders at workplace – prompting and reminding HCWs about the importance of hand hygiene and about the appropriate indications and procedures for performing it (WHO, 2009).
5. Institutional climate change – creating an environment and the perceptions that facilitate awareness-raising about patient safety issues while guaranteeing consideration of hand hygiene improvement as a high priority at all levels (WHO, 2009).

2.11 Chapter Summary

This chapter gives a comprehensive contextual background to this research. The impact of HCAI, the relevance of efficient hand hygiene practices in reducing HCAI and a detailed overview of the Nigerian healthcare system were described in this chapter. The next chapter is the systematic literature review of studies conducted on hand hygiene compliance as well as barriers and levers to efficient practices in SSA countries.

Chapter 3 Systematic Literature Review

3.1 Introduction

In the previous chapter, the researcher highlighted the importance of identifying the hand hygiene compliance rate as well as the barriers and levers to hand hygiene practices among HCWs of Sub-Saharan African (SSA) countries. This chapter presents the systematic literature review on the barriers and levers to hand hygiene practices among HCWs in SSA countries. A systematic literature search on electronic databases was conducted by using a set of defined selection criteria. The methodological quality of the included studies was appraised using standardised critical appraisal tools such as the critical appraisal skills programme (CASP) tool and a narrative synthesis of extracted data was performed. Identified gaps from the discussion around the themes gave a stronger ground for the necessity to conduct the other studies in this research.

3.2 Review Aim and Objectives

The overall purpose of the systematic review is to identify published studies from SSA countries that report on the compliance and barriers and levers to effective hand hygiene practices among HCWs. Findings from this study will be synthesised and gaps in literature will be identified for further research.

3.3 Review Questions

1. What is the hand hygiene compliance rate of HCWs in SSA countries?
2. What are the barriers and levers to hand hygiene practices among HCWs in SSA countries?

3.4 Methods

Bearing in mind the review aim, objectives and questions, an integrated mixed methods systematic review, which combines both qualitative and quantitative data into a single mixed methods synthesis (Sandelowski et al., 2006), was undertaken. In a mixed methods systematic review, the principles of mixed methods research are applied to the review process thereby maximising the findings of evidence from different types of research (Pearson et al., 2015) hence, suitable for this review.

3.4.1 Literature Search Strategy

A scoping review was conducted to confirm that there is no similar existing literature and to identify relevant search terms. A search through the PROSPERO database also found no ongoing reviews on the review topic. The protocol for this review can be found on PROSPERO, with registration number CRD42018087062 (Ataiyero et al., 2018). A systematic literature search was conducted using the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines (Moher et al., 2010) and subject-specific databases were explored namely CINAHL Complete, MEDLINE and PsycINFO. These databases were explored since they house peer-reviewed articles from different disciplines including nursing, midwifery, medicine and psychology (Parahoo, 2014). Grey literature was searched by exploring relevant websites (for instance, World Health Organisation), citation and key author searching was conducted so pertinent literatures were not left out.

Different key words were combined during the literature search and to boost the returned searches, names of countries within SSA were also combined. Where applicable, Boolean operators of “AND” and “OR” were used to combine the key terms. Truncation was also

employed to ensure that the different forms of the words were searched simultaneously so relevant articles were not missed out. The final search strategy is presented below:

hand hygien* or handwash* or hand wash*

AND

barrier* or challeng* or practic* or facilitat* or complian* or adheren*

AND

healthcare worker* or health care worker* or nurs* or medic* or healthcare profession*

AND

africa* or sub-sahara* or sub sahara* or Gambia* or Swaziland* or Sao Tome and Principe* or central Africa* or Mosambique* or cote d'ivoire* or Comoros* or Madagascar* or Lesotho* or Senegal* or Seychell* or Togo* or Somalia* or Sudan* or guinea* or Tanzania* or Sierra Leone* or Niger* or Kenya* or Botswana* or Burundi* or Benin or Angola* or Cameroon* or Congo* Maurit* or Liberia* or Ghana* or Uganda* or Malawi* or Burkina Faso or Chad* or Zimbabwe* or Zambia* or Namibia*

3.4.2 Inclusion and Exclusion Criteria

The inclusion and exclusion criteria to ensure only relevant literature were included are presented in table 3.1 below.

Table 3-1 Inclusion and Exclusion Criteria

Inclusion	**Exclusion**
Published between 2005 and 2017 because their evidence is both current and comprehensive	
Explored hand hygiene barriers and/or compliance of HCWs to provide answers to the review question	

Inclusion	Exclusion
Conducted in SSA countries and among hospital-based HCWs since this is the focussed setting for the review	Conducted in other African countries and/or among community HCWs
Only empirical studies are appropriate for the review questions	
Peer-reviewed studies as they are more reliable, having undergone the rigour of quality assessment	Non-peer-reviewed studies
Only studies published in English language being the researcher's first language	Published in non-English languages due to lack of translation resources

3.4.3 Study Selection and Data Extraction

The search for published studies generated 278 research papers and these were reduced to 74 following the application of inclusion and exclusion criteria and removal of duplicates. Thirteen papers were identified from citation searching giving a total of 87. These were reduced to 44 following title review and 29 after abstract were screened for eligibility using the inclusion and exclusion criteria. However, since abstract may be vague, inadequate and sometimes misleading, Parahoo (2014) recommends that such articles may be fully assessed and scrutinised for selection purposes then skimming through the contents of the articles. On further assessment for full eligibility (Aveyard, 2014), two studies were excluded (one was not peer-reviewed and the other did not explore barriers, levers or compliance to hand hygiene practices) leaving the total studies included to 27. The articles considered eligible were examined in full text. The article selection process is shown in figure 3.1 using the PRISMA flow diagram (Moher et al., 2010).

3.5 Methodological Quality Appraisal of Included Studies

All the 27 papers were assessed for methodological quality using the Critical Appraisal Skills Programme (CASP) checklist and the Centre for Evidence-Based Management (CEBMa) checklists depending on the study designs (Center for Evidence Based Management, 2014;

Critical Appraisal Skills Programme, 2018). Only exceptions to quality of the included studies will be discussed in the results section. Notably, none of these studies were excluded based on quality appraisal (see table 3.2).

3.6 Data Analysis

3.6.1 Quantitative Data

Since one of the key components of the review aim was to estimate hand hygiene compliance rate of HCWs from SSA countries, data on the number of hand hygiene opportunities, reported overall hand hygiene compliance rate, compliance before and after patient contact (depending on what was reported), and area of specialty were extracted and synthesised to estimate the hand hygiene compliance rates. Findings here will be integrated with findings from the qualitative data when the review findings are discussed.

3.6.2 Qualitative Data

The six steps to thematic analysis were employed in this review (Braun & Clarke, 2006). Active and repeated reading of each of the articles was done to enhance familiarisation with the articles. Whilst reading these papers, notes of important data/information were taken which eventually led to the generation of a list of ideas. A spreadsheet where synopses of the data were recorded was produced and the preliminary codes from results of papers were generated here. These codes were derived from data with similar meanings/attributes and were thereafter collated and sorted into potential themes. The broad and subthemes were identified from this and a thematic map drawn to demonstrate the relationship between the themes. These themes were reviewed by reading the collated extracts in each theme which were in turn, considered for the formation of coherent data. The significance of each theme was identified by further defining and refining the themes to come up with

an analysis of each of them. As advised by Aveyard (2014), study outcomes were identified, similar words were grouped together in a different table, so they are easily identifiable when referred to and the themes were generated from this.

3.7 Review Findings

In this section, the PRISMA flow diagram that shows the article selection process is presented first. This is followed by the characteristics and methodological quality appraisal of included studies. Study findings are then presented according to the study aims. Data are extracted to present as compliance and/or barriers. Hand hygiene compliance rates gathered from included studies are presented and compliance was tabulated (see table 3.3) according to overall rate, before and after patient contact and according to practitioner group (where this information was reported). This is followed by two broad themes – individual (personal) barriers and organisational (institutional) barriers, each of which has subthemes that will be presented in this section. Both quantitative and qualitative data will be discussed together. The studies that report on any given individual (personal) barriers are identified in table 3.4 while those that report on organisational (institutional) barriers are identified in table 3.5.

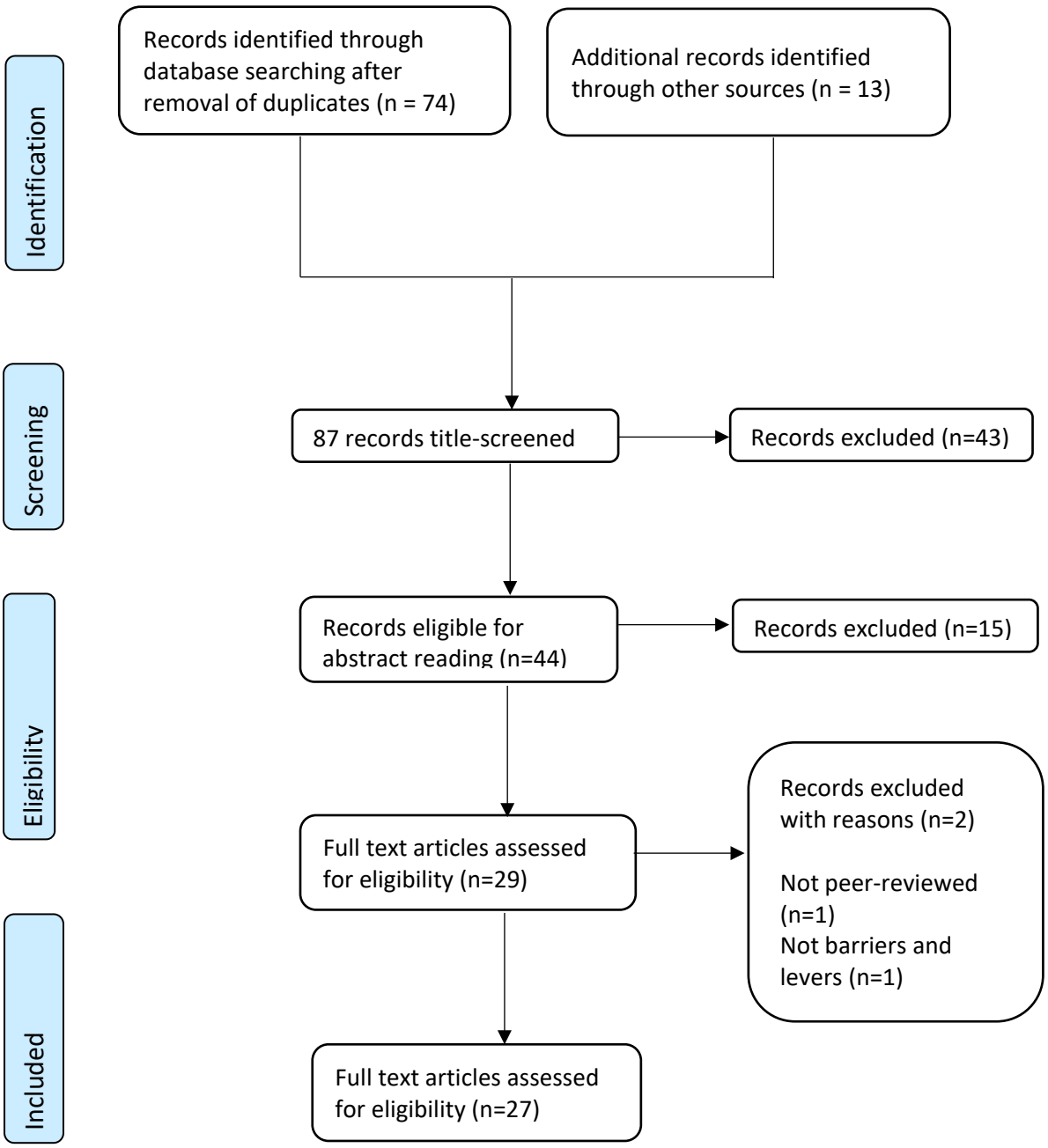


Figure 3-1 The Article Selection Process using PRISMA
(Moher et al., 2010)

3.7.1 Characteristics of Included Studies

Twenty-seven studies are included in this review. See table 3.2 for the description of included studies. The included papers are of different research methodologies. Nine studies (Opara & Alex-Hart, 2009; Alex-Hart & Opara, 2011; Omogbai et al., 2011; Bello et al., 2013; Ekwere & Okafor, 2013; Tobi & Enyi-Nwafor, 2013; Ojong et al., 2014; Amissah et al., 2016; Ango et al., 2017) used questionnaires only while 4 conducted observational studies on hand hygiene practices (Asare et al., 2009; Alex-Hart & Opara, 2014; Yawson & Hesse, 2013; Shobowale et al., 2016). The remaining 14 studies employed mixed methods as their research methodology. Of these studies, 6 (Allegranzi et al., 2010; Schmitz et al., 2014; Uneke et al., 2014; Muhumuza et al., 2015; Holmen et al., 2016; Patel. et al., 2016) are interventional studies which used quasi-experimental study design, 3 (Kalata et al., 2013; Omuemu et al., 2013; Abdella et al., 2014) combined observation with questionnaires, 3 (Owusu-Ofori et al., 2010; Mearkle et al., 2016; Holmen et al., 2017) employed both observation and interviews while the remaining 2 studies conducted focus group discussions (FGDs) which they combined with questionnaires and observations respectively (Samuel et al., 2005; Ibeneme et al., 2017). Notably, 5 (Samuel et al., 2005; Owusu-Ofori et al., 2010; Yawson & Hesse, 2013; Mearkle et al., 2016; Ibeneme et al., 2017) included ward infrastructure survey in their studies.

In terms of study location, a rich mix of countries from SSA are represented in the review. Thirteen studies were conducted in Nigeria (Opara & Alex-Hart, 2009; Alex-Hart & Opara, 2011; Omogbai et al., 2011; Bello et al., 2013; Ekwere & Okafor, 2013; Omuemu et al., 2013; Tobi & Enyi-Nwafor, 2013; Alex-Hart & Opara, 2014; Ojong et al., 2014; Uneke et al., 2014; Shobowale et al., 2016; Ango et al., 2017; Ibeneme et al., 2017), 4 from Ghana (Asare et al., 2009; Owusu-Ofori et al., 2010; Yawson & Hesse, 2013; Amissah et al., 2016), 2 from Uganda

(Muhumuza et al., 2015; Mearkle et al., 2016), 2 from Ethiopia (Abdella et al., 2014; Schmitz et al., 2014), 2 from Rwanda (Holmen et al., 2016; Holmen et al., 2017) and 1 each from Mali (Allegranzi et al., 2010), Eritrea (Samuel et al., 2005), Malawi (Kalata et al., 2013) and South Africa (Patel. et al., 2016).

Furthermore, there is a range of study participants across the 27 studies. Thirteen studies (Allegranzi et al., 2010; Owusu-Ofori et al., 2010; Bello et al., 2013; Yawson & Hesse, 2013; Abdella et al., 2014; Schmitz et al., 2014; Uneke et al., 2014; Muhumuza et al., 2015; Amissah et al., 2016; Mearkle et al., 2016; Patel. et al., 2016; Shobowale et al., 2016; Ango et al., 2017) included nurses, doctors, ward assistants and other HCWs while 5 studies (Asare et al., 2009; Alex-Hart & Opara, 2011; Alex-Hart & Opara, 2014; Holmen et al., 2016; Holmen et al., 2017) recruited only doctors and nurses as participants. Three studies (Kalata et al., 2013; Omuemu et al., 2013; Tobi & Enyi-Nwafor, 2013) employed just doctors while 1 study included only nurses (Ojong et al., 2014). One study had dentists and dental students (Omogbai et al., 2011), one study had medical students (Opara & Alex-Hart, 2009), 1 study had physiotherapists (Ibeneme et al., 2017) and the final study included patients alongside HCWs (Samuel et al., 2005).

3.7.2 Methodological Quality Appraisal

The study design including ethical considerations, methods of data collection, sample size, language and whether findings are generalisable or transferable are discussed in this section.

3.7.2.1 Ethical Considerations

Six studies did not give any account of obtaining ethical approval (Asare et al., 2009; Owusu-Ofori et al., 2010; Alex-Hart & Opara, 2011; Alex-Hart & Opara, 2014; Schmitz et al., 2014;

Shobowale et al., 2016), 2 studies only took verbal consent from participants (Samuel et al., 2005; Omuemu et al., 2013) while 1 study reported informed consent was deliberately not taken to ensure their observational study was done blindly (Tobi & Enyi-Nwafor, 2013). The importance of ethical considerations in research cannot be over-emphasised. Strict compliance to ethical principles is a fundamental determinant of research integrity (Resnik & Shamoo, 2011). Likewise, one study (Opara & Alex-Hart, 2009) reported that questionnaires were retrieved immediately. Participants might have felt coerced into completing the questionnaire in this instance. Ideally, research participation should be autonomous and non-coerced (Dugosh et al., 2010).

3.7.2.2 Self-Administered Questionnaires

None of the 14 included papers that used self-administered questionnaires employed a theoretical framework to structure their questions (Opara & Alex-Hart, 2009; Alex-Hart & Opara, 2011; Omogbai et al., 2011; Bello et al., 2013; Ekwere & Okafor, 2013; Kalata et al., 2013; Omuemu et al., 2013; Tobi & Enyi-Nwafor, 2013; Alex-Hart & Opara, 2014; Ojong et al., 2014; Muhumuza et al., 2015; Amissah et al., 2016; Ango et al., 2017; Ibeneme et al., 2017). This is a major shortcoming as participants are more likely to give logical rather than true responses when completing the questionnaires. The actual picture of the particular situation is obtained when questions are underpinned by theoretical frameworks (Cane et al., 2012). Using theories give better explanation to the relationship between varying factors influencing human behaviours towards adopting best practices and more understanding is provided on why some implementation strategies are more effective than others. (Dyson et al., 2011). Furthermore, 5 studies (Opara & Alex-Hart, 2009; Alex-Hart & Opara, 2011; Omogbai et al., 2011; Tobi & Enyi-Nwafor, 2013; Ojong et al., 2014) did not report the response rates from their self-administered questionnaires. Lack of response to

questionnaires by respondents is described as nonresponse bias (Fincham, 2008). Bryman (2016) noted that the lower the response rate, the greater the risk of bias which undermines the reliability, validity and consequently the generalisability of the survey findings.

3.7.2.3 Observational Studies

Observer's bias cannot be ruled out in 17 studies and Hawthorne effect could have been triggered (Samuel et al., 2005; Asare et al., 2009; Allegranzi et al., 2010; Owusu-Ofori et al., 2010; Kalata et al., 2013; Omuemu et al., 2013; Yawson & Hesse, 2013; Abdella et al., 2014; Alex-Hart & Opara, 2014; Schmitz et al., 2014; Uneke et al., 2014; Muhumuza et al., 2015; Holmen et al., 2016; Mearkle et al., 2016; Patel. et al., 2016; Shobowale et al., 2016; Holmen et al., 2017). Nine studies did not give an account of observing participants covertly (Samuel et al., 2005; Owusu-Ofori et al., 2010; Omuemu et al., 2013; Abdella et al., 2014; Alex-Hart & Opara, 2014; Schmitz et al., 2014; Uneke et al., 2014; Mearkle et al., 2016; Patel. et al., 2016) whereas 4 studies (Allegranzi et al., 2010; Muhumuza et al., 2015; Holmen et al., 2016; Holmen et al., 2017) stated covert observation was not conducted in their studies as staff were aware of being observed. Therefore, observer's bias cannot be ruled out in these studies and participants might have changed their hand hygiene practices because they knew they were being observed.

3.7.2.4 Other Issues

Small sample sizes were used in five studies (Alex-Hart & Opara, 2014; Ojong et al., 2014; Muhumuza et al., 2015; Amissah et al., 2016; Ango et al., 2017; Ibeneme et al., 2017) and this might undermine the study findings. It is important that the sample precisely represents the target population, and that sufficient sample size is employed to enhance the

transferability of the study findings (Kline, 2015). One study did not investigate the study aim (Ibeneme et al., 2017) while in another study, it is unclear if there was misinterpretation of the other language than English used (Owusu-Ofori et al., 2010).

Table 3-2 Description of Included Studies

S/N	Author (Year)	Population and Sample	Research Aim and Methods	Summary of Research Findings	Quality Appraisal (Exceptions)
1	Abdella et al. (2014)	HCWs at a University Hospital in Ethiopia (n=405)	To assess hand hygiene compliance and determinants in a cross-sectional study through hand hygiene observations and a questionnaire	Compliance was 16.5%. Determinants were training, provision and locations of facilities, time, skin irritation, glove use, IPC committee and provision of individual towel/tissue paper	Observer's bias
2	Alex-Hart and Opara (2011)	HCWs at a University teaching hospital in Nigeria (n=258)	To explore perceptions, attitudes and handwashing practices through a cross-sectional study involving questionnaires	Rate of handwashing of the HCWs in this hospital reported to be low; figure not given. Factors influencing hand hygiene practices: fear of contracting disease, handwashing facilities and training/education	Self-reported bias, no account of ethical consideration, no account of questionnaire pilot study
3	Alex-Hart and Opara (2014)	HCWs at a University teaching hospital in Nigeria (n=150)	To assess the handwashing practices through observational study	Overall compliance not reported. Factors influencing hand hygiene practices: glove use, patient contact type, need for personal protection and time of the day.	Observer's bias, no account of ethical consideration, no account if data collection instrument used was standardised
4	Allegranzi et al. (2010)	HCWs at a University teaching hospital in Mali (n=224)	To evaluate the feasibility and effectiveness of the hand hygiene implementation strategy through a before and after study involving questionnaires, observations and an inventory of resources in each of 24 clinical wards	Factors influencing hand hygiene practices: professional category, hand hygiene indication, presence of hand sanitiser, facilities	Observer's bias

S/N	Author (Year)	Population and Sample	Research Aim and Methods	Summary of Research Findings	Quality Appraisal (Exceptions)
5	Amissah et al. (2016)	HCWs at a teaching hospital in Ghana (n=130)	To assess hand hygiene knowledge and practices through a cross-sectional, descriptive study (questionnaire)	Factors influencing hand hygiene practices: heavy workload, forgetfulness, lack of water, lack of cleaning towels, lack of hand dryer, lack of detergent, lack of time, hand hygiene training	Self-reported bias, no account of questionnaire pilot study
6	Ango et al. (2017)	HCWs in government-owned facilities in a local government area in Nigeria (n=144)	To assess knowledge, attitude and practice of hand hygiene through cross-sectional study involving questionnaire	Factors influencing hand hygiene practices: irregular water supply, inconveniently located sink, lack of hand sanitiser, lack of soap, knowledge/training, patient contact type	Self-reported bias
7	Asare et al. (2009)	HCWs in a teaching hospital in Ghana (n=38)	To evaluate the nature and frequency of patient contacts and HCWs' compliance to hand hygiene guidelines through observations	Overall compliance not reported. Factors influencing hand hygiene practices: contact type, glove use, occupational category and training/education	Observer's bias, no account of ethical consideration, small sample size
8	Bello et al. (2013)	HCWs in a teaching hospital in Nigeria (n=356)	To assess practice, knowledge, beliefs/attitudes and determinants of handwashing practices through cross-sectional study involving questionnaire	Factors influencing hand hygiene practices: lack of facilities/poor quality, lack of time, heavy workload and forgetfulness	Self-reported bias, no account of questionnaire pilot study
9	Ekwere and Okafor (2013)	HCWs in a teaching hospital in Nigeria (n=430)	To evaluate hand hygiene knowledge, attitude and practices and to identify both the barriers and motivators of handwashing	Factors influencing hand hygiene practices: fear of contracting disease, heavy workload, facilities, patient contact type, training/knowledge and occupational category.	Self-reported bias

S/N	Author (Year)	Population and Sample	Research Aim and Methods	Summary of Research Findings	Quality Appraisal (Exceptions)
			practices through cross-sectional study involving questionnaire		
10	Holmen et al. (2016)	HCWs in a hospital in Rwanda(n=66)	To explore hand hygiene compliance improvement following implementation of WHO tool kit through a quasi-experimental study. Observations and surveys conducted at baseline and 3 weeks post implementation	Factors influencing hand hygiene practices: occupational category, knowledge, contact type, lack of resources	Observer's bias
11	Holmen et al. (2017)	HCWs in a hospital in Rwanda (interviews n=17)	To assess hand hygiene compliance through observations at a rural hospital in Rwanda after hand hygiene improvement initiatives interviews.	Study is a continuation of previous study – see above (Holmen et al., 2016) Overall compliance fell from 68.9% to 36.8% within a year. Factors influencing hand hygiene practices: professional group, role model attitude, hand hygiene more for personal protection	Observer's bias
12	Ibeneme et al. (2017)	Physiotherapists in 3 tertiary hospitals in Nigeria (FGDs n=15; questionnaire n=44)	To investigate compliance through cross-sectional study involving questionnaire, FGDs and inventory of resources	Factors influencing hand hygiene practices: inadequate infrastructure and materials, hand hygiene protocol, forgetfulness, distant location of hand hygiene facilities	Self-reported bias, small sample size Study aim (compliance) not investigated
13	Kalata et al. (2013)	Doctors and medical students in a hospital in Malawi (Observations n=58; questionnaires n=116)	To investigate hand hygiene compliance through observations and questionnaire	Compliance rate was 23.5% with only 30% of all hand hygiene being effective. Factors influencing hand hygiene practices: lack of resources, heavy workload, forgetfulness, negligence, location of facilities,	Observer's bias (observations), self-reported bias (questionnaire), small sample size (observations)

S/N	Author (Year)	Population and Sample	Research Aim and Methods	Summary of Research Findings	Quality Appraisal (Exceptions)
				professional category and perceived risk of infection	
14	Mearkle et al. (2016)	HCWs in two hospitals in Uganda (Observations n=37; interviews n=9)	To explore current hand hygiene practice through observation and identify any barriers through inventory and interviews.	Factors influencing hand hygiene practices: contact type, hand hygiene training/knowledge, means of self-protection, busy workload, forgetfulness (carelessness), location of facilities	Observer's bias, small sample size
15	Muhumuza et al. (2015)	HCWs in a national hospital in Uganda (baseline n=18; follow-up n=20)	To improve hand hygiene practice through an interventional study involving baseline (2 weeks) and follow up (2 weeks) observations and questionnaires. Implementation involved training, display of posters, feedback on baseline audit, provision of resources	Factors influencing hand hygiene practices: workload and overcrowding, staff attitude and lack of knowledge, limited resources	Observer's bias (observations), self-reported bias (questionnaire)
16	Ojong et al. (2014)	Nurses in a general hospital in Nigeria (n=102)	To assess the practice of handwashing through cross-sectional survey	Factors influencing hand hygiene practices: knowledge, IPC unit/guideline and facilities	Self-reported bias, no account of questionnaire pilot study
17	Omogbai et al. (2011)	Dentists and dental students in a teaching hospital in Nigeria (n=105)	To assess handwashing attitudes and practices through cross-sectional survey	Factors influencing hand hygiene practices: glove use, time, facilities, forgetfulness, skin irritation, contact type	Self-reported bias, no account of questionnaire pilot study
18	Omuemu et al. (2013)	Doctors in a teaching hospital in Nigeria	To ascertain the knowledge and practice of hand hygiene among	Overall compliance is 16.7%. Factors influencing hand hygiene practices: lack of facilities, forgetfulness, lack of	Self-reported bias (survey), observer's bias (observations)

S/N	Author (Year)	Population and Sample	Research Aim and Methods	Summary of Research Findings	Quality Appraisal (Exceptions)
		(questionnaire n=326; observations n=108)	medical doctors through cross-sectional survey and observations	time, glove use, skin irritation, professional category, time of the day, contact type	
19	Opara and Alex-Hart (2009)	Medical students in a teaching hospital in Nigeria (n=261)	To assess the perceptions, attitudes and handwashing practices through a cross-sectional survey	Factors influencing hand hygiene practices: lack of facilities, lack of motivation, lack of time, procedure type, time of the day	Self-reported bias, no account of questionnaire pilot study, questionnaires were retrieved immediately; respondents might have been coerced into filling the questionnaires
20	Owusu-Ofori et al. (2010)	HCWs in a teaching hospital in Ghana (interviews n=27; observations (hand hygiene opportunities n=1226)	To establish baseline hand hygiene practices and resources through observations, interviews and inventory of hand hygiene resources	Overall compliance was 12%. Factors influencing hand hygiene practices: contact type, professional group, limited resources, lack of knowledge	Observer's bias, no account of ethical consideration, misinterpretation of Twi language likely
21	Patel et al. (2016)	HCWs in a hospital in South Africa (trained n=557; observed n=497; intervention group n=146)	To establish an improvement in hand hygiene compliance using a multifaceted pre-post intervention study involving pre-study needs assessment questionnaire, training and display of posters. Post-intervention evaluation involved observations and monthly feedback	Factors influencing hand hygiene practices: ward type, professional category, lack of motivation, time constraints, staff rotations and turnover of doctors and nurses.	Observer's bias
22	Samuel et al. (2005)	HCWs in a hospital in Eritrea	To assess quality of hand hygiene care through FGDs, observations and inventory of resources in	Overall compliance rate not reported.	Observer's bias, small sample size

S/N	Author (Year)	Population and Sample	Research Aim and Methods	Summary of Research Findings	Quality Appraisal (Exceptions)
		(Observations n=30; FGDs n=34 HCWs, 30 patients)	medical, surgical and obstetric units)	Factors influencing hand hygiene practices: contact type, glove use, training	
23	Schmitz et al. (2014)	HCWs in a university teaching hospital in Ethiopia (observations n = not reported; post-intervention survey n=161)	To define baseline hand hygiene compliance and assess the impact of implementing the WHO multimodal hand hygiene strategy through a before and after study. Intervention: distribution of hand sanitisers and implementation of the WHO multimodal hand hygiene strategy Pre and post-intervention : hand hygiene observations and post intervention questionnaires.	Factors influencing hand hygiene practices facilities, knowledge, professional group, time of the day, ward type (better in emergency rooms than surgical wards), type of patient care, hand sanitiser type (HCWs preferred commercially prepared to hospital prepared sanitisers)	Observer's bias, no account of questionnaire pilot study, no account of ethical consideration
24	Shobowale et al. (2016)	HCWs in a teaching hospital in Nigeria (n=148)	To assess the compliance level with respect to appropriate hand hygiene practices through observational study	Compliance before and after patient contact was 5.7% and 27% respectively. Factors influencing hand hygiene practices: assumption of hand hygiene as a means of personal protection, contact type, glove use	Observer's bias, no account of ethical consideration
25	Tobi and Enyi-Nwafor (2013)	HCWs in a teaching hospital in Nigeria (n=100)	To evaluate the handwashing knowledge, practices and compliance through questionnaire	Factors influencing hand hygiene practices: lack of time, skin irritation, lack of and inconveniently placed facilities, handwashing thought as not necessary, poor knowledge of policies	Self-reported bias, no account of questionnaire pilot study, informed consent not taken

S/N	Author (Year)	Population and Sample	Research Aim and Methods	Summary of Research Findings	Quality Appraisal (Exceptions)
26	Uneke et al. (2014)	HCWs in a teaching hospital in Nigeria (intervention phase n=202; evaluation phase n=209)	To identify factors associated with hand hygiene non-compliance through a cross-sectional, interventional study. Intervention phase: training, reminders at workplace etc. Training preceded by questionnaire administration and FGDs. Evaluation phase: observations	Factors hand hygiene influencing practices: facilities, forgetfulness, occupational category, contact type, skin irritation, lack of awareness, absence of guidelines	Observer's bias
27	Yawson and Hesse (2013)	HCWs in a teaching hospital in Ghana (observations n= not reported)	To provide baseline survey data on hand hygiene practices and determine resources available in all the major clinical service provision centres through an observational study	Overall compliance rate not reported. Factors influencing hand hygiene practices: professional group, patient contact (exposure) type, facilities, perceived risk of infection	Observer's bias

3.7.3 Hand Hygiene Compliance Rate

Nine studies on hand hygiene compliance rate were synthesised in this review to establish an overall compliance rate among HCWs from SSA countries. From synthesis of the limited data available from the 9 studies, the total number of hand hygiene opportunities was 3221 while the total number of participants was 994. Overall hand hygiene compliance rate was estimated to be 21.1%. Doctors had better compliance rate irrespective of the type of patient contact. Before patient contact, the mean compliance rate was 16.3% among all professional groups, 19% among doctors and 17.5% among nurses. Compliance rate after patient contact was much improved being 39.1% across all professional groups, 50.8% among doctors and 31.1% among nurses.

Table 3-3 Hand Hygiene Compliance Studies

SN	Author	Hospital Area	Number of hand hygiene opportunities (Participant Numbers)	Overall compliance rate (%)	Compliance before patient contact	Compliance after patient contact
1	Abdella et al. (2014)	Not reported	Opportunities not reported (n=405)	16.5	Not reported	Not reported
2	Alex-Hart and Opara (2014)	Children's emergency and Neonatal ICU	Opportunities not reported (n=150)	Not reported	17.4 (Drs)	64 (Drs)
3	Asare et al. (2009)	Neonatal ICU	Opportunities not reported (n=97)	Not reported	15.4 (Drs) 14.1 (nurses)	38.5 (Drs) 9.9 (nurses)
4	Holmen et al (2017)	Maternity. Paediatrics, Internal Medicine	1273 (Participant numbers not reported)	36.8	24.3 (Drs) 20.8 (nurses)	50 (Drs) 52.3 (nurses)
5	Kalata et al. (2013)	Medicine, Surgery, Paediatrics, Obstetrics and Gynaecology	722 (n=58)	23.5	Not reported	Not reported
6	Omuemu et al. (2013)	Anaesthesiology, Community Health, Family Medicine, Haematology, Internal Medicine, Psychiatry, Obstetrics and Gynaecology, Paediatrics, Radiology, Surgery	Opportunities not reported (n=108)	16.7	Not reported	Not reported
7	Owusu-Ofori et al. (2010)	Children's Health, Medicine, Surgery, Medical Emergency Unit, Paediatric Emergency Unit	1226 (Participant numbers not reported)	12	6	20

SN	Author	Hospital Area	Number of hand hygiene opportunities (Participant Numbers)	Overall compliance rate (%)	Compliance before patient contact	Compliance after patient contact
8	Shobowale et al. (2016)	Emergency, ICU, Medicine, Paediatrics, Surgery, General Out-Patient Department, Dental	Opportunities not reported (n=176)	Not reported	5.7 *(calculated by self)*	27 *(calculated by self)*
9	Yawson and Hesse (2013)	Internal Medicine, Surgery, Child Health, Obstetrics and Gynaecology, Central Laboratory	Neither opportunities nor participant numbers reported	Ranged from 9.2 to 57 (Drs) and 9.6 to 54 (nurses)	Not reported	Not reported
	Synthesis of Data where possible		**Total number of opportunities =3221** **Total number of participants =994**	**Mean across all papers=21.1**	**Mean across all papers and professional groups=16.3** **Drs=19, nurses=17.5**	**Mean across all papers and professional groups=39.1** **Drs=50.8, nurses=31.1**

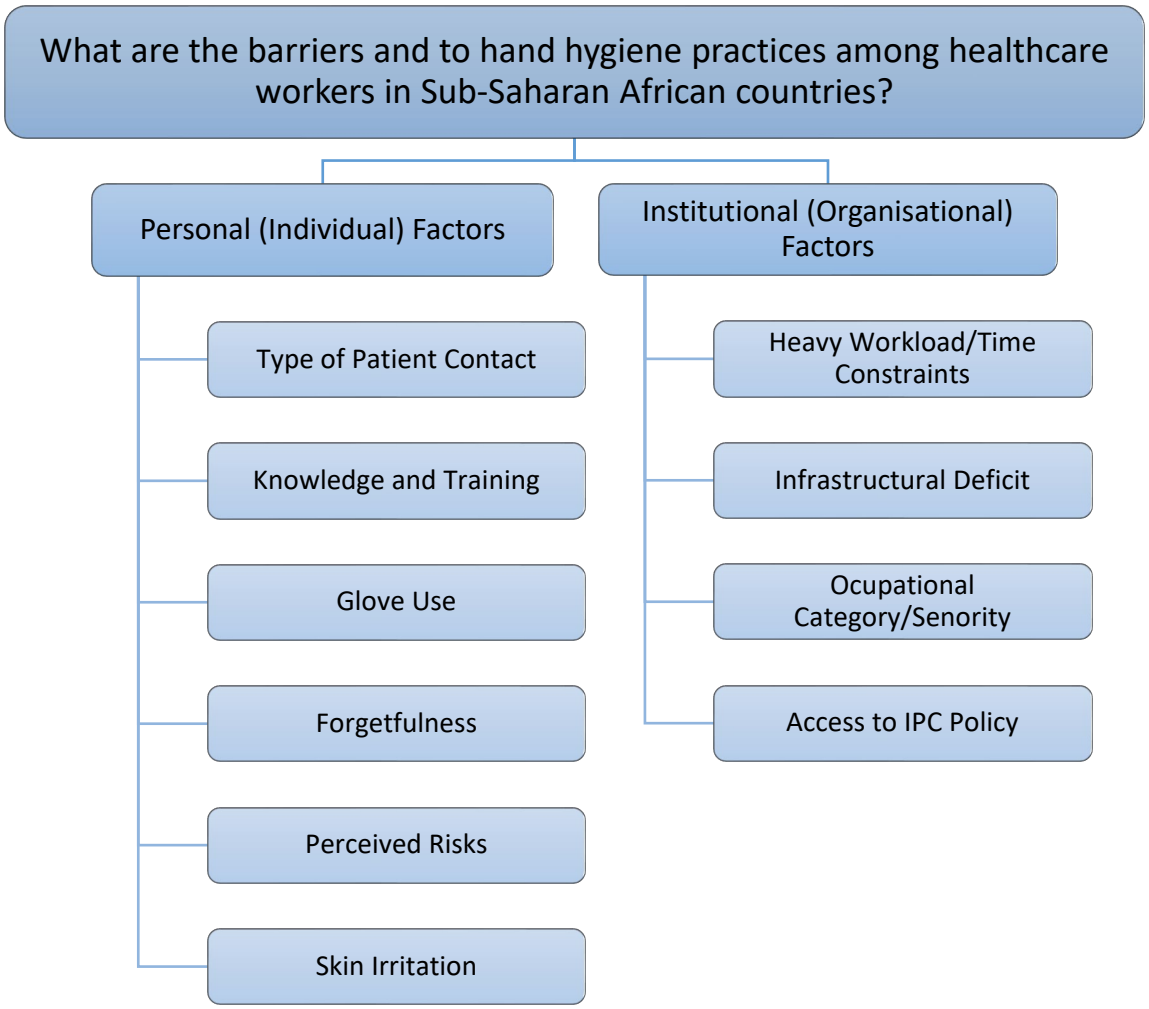


Figure 3-2 Barriers and Levers to Hand Hygiene Thematic Map

3.7.4 Theme One - Individual (Personal) Barriers

3.7.4.1 Type of Patient Contact

In terms of patient contact, two studies (Amissah et al., 2016; Omuemu et al., 2013) identified participants performing hand hygiene before and after patient contact and 2 studies (Mearkle et al., 2016; Samuel et al., 2005) in-between patients. Hand hygiene practices before patient contact ranged from 0.8% (Schmitz et al., 2014) to 91% (Ango et al., 2017) whereas for after patient contact, this ranged between 3% (Schmitz et al., 2014) to 97.7% (Ekwere & Okafor, 2013). On exposure to body fluids or when hands are visibly soiled, 5 studies (Ango et al., 2017; Holmen et al., 2017; Omogbai et al., 2011; Opara & Alex-Hart, 2009; Shobowale et al., 2016) reported on this ranging from 50% (Holmen et al., 2017) to 98.1% (Omogbai et al., 2011). When carrying out simple procedures across professional groups, 4 studies (Alex-Hart & Opara, 2014; Asare et al., 2009; Patel. et al., 2016; Schmitz et al., 2014) reported on this with nurses' hand hygiene practices ranging from 1.3% (before patient contact) to 88.4% (after patient contact) whereas for doctors, this ranged from 0% (before patient contact) to 100% (after patient contact) (Alex-Hart & Opara, 2014).

3.7.4.2 Knowledge and Training

Thirteen studies (Samuel et al., 2005; Owusu-Ofori et al., 2010; Omogbai et al., 2011; T. A. Ekwere & Okafor, 2013; Abdella et al., 2014; Ojong et al., 2014; Schmitz et al., 2014; Uneke et al., 2014; Muhumuza et al., 2015; Amissah et al., 2016; Holmen et al., 2016; Mearkle et al., 2016; Ango et al., 2017) identified poor hand hygiene knowledge/training as a barrier to hand hygiene practices. All studies except 3 (Abdella et al., 2014; Schmitz et al., 2014; Holmen et al., 2016) identified lack of previous or continuous education/training on when to perform hand hygiene whereas 3 reported improvement in compliance after training HCWs to emphasise on the importance of education on hand hygiene practices.

3.7.4.3 Glove Use

Seven studies (Omogbai et al., 2011; Omuemu et al., 2013; Abdella et al., 2014; Amissah et al., 2016; Shobowale et al., 2016; Ango et al., 2017; Holmen et al., 2017) reported that participants believed hand hygiene is unnecessary when gloves are used. In one study, participants preferred glove use to hand hygiene practice (Samuel et al., 2005).

3.7.4.4 Forgetfulness

Eight studies (Alex-Hart & Opara, 2011; Amissah et al., 2016; Bello et al., 2013; Ibeneme et al., 2017; Kalata et al., 2013; Omogbai et al., 2011; Omuemu et al., 2013; Uneke et al., 2014) identified forgetfulness as a barrier to hand hygiene practices. Interview participants in one study (Mearkle et al., 2016) viewed this as carelessness, FGD participants in another (Uneke et al., 2014) also affirmed this while some participants in a study (Opara & Alex-Hart, 2009) noted this as form of laziness.

3.7.4.5 Perceived Risks

Three studies identified fear of contracting diseases as their motivator for enhanced hand hygiene practice (Opara & Alex-Hart, 2009; Alex-Hart & Opara, 2011; Ekwere & Okafor, 2013). In some studies (Opara & Alex-Hart, 2009; Omogbai et al., 2011; Ekwere & Okafor, 2013), more than 70% of study participants noted hand hygiene as a means to protect HCWs from infections while some participants stated hand hygiene is unnecessary in the absence of perceived risks of infection (Tobi & Enyi-Nwafor, 2013). More than twice the HCWs will perform hand hygiene in high risk centres compared to medium risk centres (Yawson & Hesse, 2013) and this is supported by HCWs' prevalent belief of being able to physically recognise infectious patients whereby their hand hygiene practices are enhanced in such instance (Mearkle et al., 2016).

3.7.4.6 Skin Irritation

Five studies (Omogbai et al., 2011; Omuemu et al., 2013; Tobi & Enyi-Nwafor, 2013; Schmitz et al., 2014; Uneke et al., 2014) identified skin irritation from hand sanitisers and soaps as a reason for poor hand hygiene practice. Participants noted their hand hygiene practice improved if provided with commercially prepared sanitisers compared to the hospital prepared ones which they expressed less preference for (Schmitz et al., 2014).

Table 3-4 Theme One – Individual (Personal) Barriers

S/N	Author (Year)	Type of Patient Contact	Knowledge and Training	Glove Use	Forgetfulness	Perceived Risk	Skin Irritation
1	Abdella et al. (2014)		✓	✓			
2	Alex-Hart and Opara (2011)				✓	✓	
3	Alex-Hart and Opara (2014)	✓		✓			
4	Allegranzi et al. (2010)	✓					
5	Amissah et al. (2016)	✓	✓	✓	✓		
6	Ango et al. (2017)	✓	✓	✓			
7	Asare et al. (2009)	✓					
8	Bello et al. (2013)				✓		
9	Ekwere and Okafor (2013)	✓	✓			✓	
10	Holmen et al. (2016)	✓	✓				
11	Holmen et al. (2017)	✓					
12	Ibeneme et al. (2017)				✓		
13	Kalata et al. (2013)				✓		
14	Mearkle et al. (2016)	✓	✓		✓	✓	
15	Muhumuza et al. (2015)	✓	✓				
16	Ojong et al. (2014)		✓				
17	Omogbai et al. (2011)	✓	✓	✓	✓	✓	✓
18	Omuemu et al. (2013)	✓		✓	✓		✓

S/N	Author (Year)	Type of Patient Contact	Knowledge and Training	Glove Use	Forgetfulness	Perceived Risk	Skin Irritation
19	Opara and Alex-Hart (2009)				✓	✓	
20	Owusu-Ofori et al. (2010)	✓	✓				
21	Patel et al. (2016)	✓					
22	Samuel et al. (2005)	✓	✓	✓			
23	Schmitz et al. (2014)	✓	✓				✓
24	Shobowale et al. (2016)	✓		✓			
25	Tobi and Enyi-Nwafor (2013)					✓	✓
26	Uneke et al. (2014)	✓	✓		✓		✓
27	Yawson and Hesse (2013)					✓	

3.7.5 Theme Two – Institutional (Organisational) Barriers

3.7.5.1 Infrastructural Deficit

Some studies identified lack or insufficient or poor quality of soap as a barrier (Opara & Alex-Hart, 2009; Allegranzi et al., 2010; Alex-Hart & Opara, 2011; Bello et al., 2013; Schmitz et al., 2014; Amissah et al., 2016; Ango et al., 2017). Others noted lack of water (Opara & Alex-Hart, 2009; Allegranzi et al., 2010; Alex-Hart & Opara, 2011; Bello et al., 2013; Amissah et al., 2016; Ango et al., 2017) and some reported lack/insufficient, leaking and/or blocked sinks as barriers (Allegranzi et al., 2010; Bello et al., 2013; Uneke et al., 2014; Holmen et al., 2016; Holmen et al., 2017). Some studies stated absence of hand sanitisers as a barrier (Allegranzi et al., 2010; Bello et al., 2013; Kalata et al., 2013; Schmitz et al., 2014) though in one study hand sanitisers were always available but not necessarily used (Asare et al., 2009). In terms of locations of hand hygiene facilities, 7 studies identified inconvenient locations of wash sinks and hand sanitisers as barrier for poor hand hygiene practices (Opara & Alex-Hart, 2009; Alex-Hart & Opara, 2011; Bello et al., 2013; Kalata et al., 2013; Omuemu et al., 2013; Ango et al., 2017; Ibeneme et al., 2017). Three studies noted lack of support, commitment and motivation by hospital managers as a barrier to hand hygiene practices (Opara & Alex-Hart, 2009; Alex-Hart & Opara, 2011; Patel. et al., 2016).

3.7.5.2 Heavy Workload, Inadequate Staffing and Time Constraints

Eight studies reported heavy workload and inadequate staffing (Samuel et al., 2005; Opara & Alex-Hart, 2009; Bello et al., 2013; Ekwere & Okafor, 2013; Omuemu et al., 2013; Uneke et al., 2014; Muhumuza et al., 2015; Amissah et al., 2016) and 8 studies noted time constraints as barriers to hand hygiene practice (Opara & Alex-Hart, 2009; Alex-Hart & Opara, 2011; Omogbai et al., 2011; Bello et al., 2013; Tobi & Enyi-Nwafor, 2013; Abdella et al., 2014; Patel. et al., 2016; Ibeneme et al., 2017).

3.7.5.3 Occupational Category and Seniority

Five studies showed higher hand hygiene compliance rates among nurses than doctors (Owusu-Ofori et al., 2010; Yawson & Hesse, 2013; Schmitz et al., 2014; Uneke et al., 2014; Patel. et al., 2016) and 5 reported better compliance among doctors than nurses (Asare et al., 2009; Allegranzi et al., 2010; Amissah et al., 2016; Holmen et al., 2016; Holmen et al., 2017). One study found no significant difference between compliance rates of doctors and nurses (Ekwere & Okafor, 2013), 2 studies found that the higher the professional level, the better their hand hygiene practices (Kalata et al., 2013; Omuemu et al., 2013) and one reported higher compliance among nursing students than nurses (Allegranzi et al., 2010).

3.7.5.4 Access to Infection Prevention and Control Policy

Four studies (Ekwere & Okafor, 2013; Tobi & Enyi-Nwafor, 2013; Abdella et al., 2014; Uneke et al., 2014) indicated participants' ignorance of WHO hand hygiene guidelines, the presence of any IPC committee in hospitals and the presence of any documentary evidence on hand hygiene and disinfection practices. One study (Ibeneme et al., 2017) reported most of the participants were aware of hand hygiene protocol in their unit.

Table 3-5 Theme Two – Institutional (Organisational) Barriers

S/N	Author (Year)	Heavy Workload and Time Constraints	Infrastructural Deficit	Occupational Category/Seniority	Access to IPC Policy
1	Abdella et al. (2014)	✓			✓
2	Alex-Hart and Opara (2011)	✓	✓		
3	Allegranzi et al. (2010)		✓	✓	
4	Amissah et al. (2016)	✓	✓	✓	
5	Ango et al. (2017)		✓		
6	Asare et al. (2009)			✓	
7	Bello et al. (2013)	✓	✓		
8	Ekwere and Okafor (2013)	✓		✓	✓
9	Holmen et al. (2016)		✓	✓	
10	Holmen et al. (2017)		✓	✓	
11	Ibeneme et al. (2017)		✓		✓
12	Kalata et al. (2013)		✓	✓	
13	Mearkle et al. (2016)	✓	✓		
14	Muhumuza et al. (2015)	✓	✓		
15	Omogbai et al. (2011)	✓	✓		
16	Omuemu et al. (2013)	✓	✓	✓	

S/N	Author (Year)	Heavy Workload and Time Constraints	Infrastructural Deficit	Occupational Category/Seniority	Access to IPC Policy
17	Opara and Alex-Hart (2009)	✓	✓		
18	Owusu-Ofori et al. (2010)		✓	✓	
19	Patel et al. (2016)	✓	✓	✓	
20	Samuel et al. (2005)	✓			
21	Schmitz et al. (2014)		✓	✓	
22	Tobi and Enyi-Nwafor (2013)	✓			✓
23	Uneke et al. (2014)	✓		✓	✓
24	Yawson and Hesse (2013)			✓	

3.8 Discussion of Review Findings

3.8.1 Principal Findings

This review has drawn together empirical evidence on hand hygiene compliance rates and the barriers and levers to hand hygiene practices among HCWs in SSA countries. From included papers, the mean hand hygiene compliance rate among HCWs in SSA countries is 21.1%. The identified barriers are type of patient contact, hand hygiene knowledge and training, glove use, forgetfulness, no perceived risks, skin irritation, infrastructural deficit and their inconvenient locations, heavy workload, inadequate staffing and time constraints, occupational category and seniority, and access to IPC policy. Findings from this review suggest that the barriers in developing countries are comparable to those of western countries aside from heavy workload, infrastructural deficit and poorly positioned facilities which are more abundant in developing countries. To understand the barriers specifically related to SSA, these were considered within the context of the wider literature relating to developed and developing countries.

3.8.2 Findings in the Wider Context

All individual barriers identified in the review of SSA have been identified in developing countries too. The majority of the included papers noted hand hygiene compliance is influenced by the type of patient contact/procedure and hand hygiene compliance was generally better after patient contact. A systematic review of studies from developed countries reported improved hand hygiene compliance after patient contact or when there is perceived risk of infection (Erasmus et al., 2010). Findings from this review also suggest that HCWs perceive hand hygiene as a means of personal protection rather than to ensure patient safety. This finding is congruent to research conducted in developed countries, for example, (Boscart et al., 2012) where only 1 of 8 interviewed nurses identified patient safety

as hand hygiene facilitator whereas the others focussed on their personal safety. One study also reported that hand hygiene practices are better adhered to when high-risk procedures are performed or when there is exposure to blood and body fluids (Korniewicz & El-Masri, 2010). Forgetfulness too is a barrier identified in the review of SSA and developed countries e.g. The Netherlands (Erasmus et al., 2009). This review also identified that the more senior a HCW, the more likely they have better hand hygiene practices. This is consistent with the findings of the study from both other developing countries such as Israel (Cantrell et al., 2009) as well as developed countries (Barrett & Randle, 2008; Erasmus et al., 2009; Lankford et al., 2003; Snow et al., 2006) which reported a difference in compliance among resident doctors and consultants. Noteworthy is the submission of these authors (Lankford et al., 2003; Snow et al., 2006; Barrett & Randle, 2008; Erasmus et al., 2009) that the influence of senior HCWs on their junior colleagues cannot be over-emphasised as they serve as role models and influence their practices. Barrett and Randle (2008) referred to this as professional socialisation which is defined as the acquisition of values, norms, attitudes, behaviours, skills and roles of a profession (Rejon & Watts, 2013). Likewise, skin irritation from frequent hand hygiene was identified as a barrier in this review. Many studies have also reported this (Haas & Larson, 2008; Squires et al., 2013). One of the reviewed studies affirmed that HCWs would use commercially prepared hand rubs as they are perceived to be less irritating to the skin than the hospital prepared sanitisers (Schmitz et al., 2014).

Most of the institutional barriers identified in this review have been identified in other developing countries too. For instance, the included papers noted heavy workload as a barrier to hand hygiene practice. Heavy workload is typical of healthcare systems generally, especially those of developing countries and it has often been stressed by several other

studies (Akyol, 2007; Barrett & Randle, 2008; Anargh et al., 2013) as a barrier to hand hygiene compliance. Some authors have attributed this to stressful work situations (Lasebikan & Oyetunde, 2012; Olayinka et al., 2013). The typical shortage of HCWs in SSA countries, evidenced by the low densities of doctors and nurses against the WHO recommended minimum also confirmed this (Kinfu et al., 2009). Poor hand hygiene practices can also be linked to infrastructural deficit and inconvenient locations (Pittet et al., 2000; Pittet, 2000; WHO, 2009b) where shortage of water supply, inadequate sinks and their locations, lack of soap and hand sanitisers were identified as barriers (Nicol et al., 2009; Joshi et al., 2012). This may explain HCWs' preference to glove use which included papers reported would not be changed between patients (Pittet et al., 2000). However, this review suggests dissimilar findings in relation to occupational category, especially doctors and nurses and their hand hygiene compliance. This is the case in the two studies from India (Alsubaie et al., 2013; Mahfouz et al., 2013). In developed countries, nurses nearly always have better compliance than doctors (Erasmus et al., 2010) though in SSA countries, evidence suggests this varies.

3.8.3 Strengths and Limitations

Quality appraisal of research process, in this case, the systematic literature review is important so as to evaluate the robustness, reliability and generalisability of the review outcomes (Polit & Beck, 2012). This is the first systematic review which synthesises previous studies relating to hand hygiene compliance, barriers and levers among HCWs in SSA. This is a contribution to body of knowledge as greater knowledge will be provided than lone papers would, and findings can be useful for other purposes upon dissemination. However, some methodological limitations of this review are discussed below.

Being an inexperienced and a lone reviewer, data extraction and development of themes was largely time consuming. Some difficulties on conducting a systematic review, for instance critical appraisal and evaluation of research processes as well as the interpretation of statistical data in the reviewed papers were encountered. However, this was overcome and may have insignificant effect on the review as the reviewer enjoyed robust support and meticulous supervision by the supervisors. Similarly, some difficulty was encountered in pulling out terms which eventually fell into the generated themes. This was overcome by regular reading of the papers till the messages were drawn.

Moreover, English language being the language of instruction of the reviewer, non-English articles were excluded from this study so as to aid the reviewer's interpretation and extraction of data from the reviewed papers. However, since most SSA countries have other languages of communication, pertinent and useful information might have been missed in the process of excluding non-English articles.

The main limitation for this review is the dearth of literature from SSA that report either compliance or barriers and levers. Moreover, there is no routine surveillance of hand hygiene in SSA and included papers did not always report their process of observation. It is possible that processes varied between papers and results were highly subjected to the Hawthorne effect.

3.8.4 Implications for Practice and Research

Based on the findings of this review, hand hygiene compliance is low and there exist abundant barriers to efficient hand hygiene practices among HCWs in SSA countries. The review findings have established massive gaps in research on hand hygiene practices of HCWs in SSA. There is a need for more reports of hand hygiene compliance in SSA and

studies need to report the process of observation to allow replication of methods. Whilst many hospital areas are covered, there are no reports suggesting compliance rates for surgical wards (where patients are likeliest to contract SSI, the most common form of HCAI in SSA as previously established in chapter two) and non-ICU wards and these need to be prioritised.

There are relatively more studies reporting barriers to hand hygiene in SSA. There were no studies found that reported compliance or barriers and levers in prioritising patient safety. While the overall hand hygiene compliance rate among Nigerian HCWs remains unknown or largely undocumented, most of the studies included in the systematic review are questionnaire-based which were not conceptualised by using any theoretical frameworks. Therefore, the findings of these studies might have been compromised by not considering the full range of behavioural determinants or by failure to mitigate cognitive biases. As most studies examining barriers and levers to hand hygiene were questionnaire based, there is a need to explore a deeper understanding using qualitative methods.

In lieu of this, the researcher anticipates establishing the compliance rate and identify and gain a deeper understanding of the barriers and levers to hand hygiene practices of HCWs in surgical wards of a Nigerian teaching hospital. Despite the alarming rates of SSI in SSA countries (see chapter 2), there is dearth of hand hygiene studies that focus specifically on surgical wards in SSA countries. Studies included in this review were conducted across all specialities/wards. Presently, there is no known literature or research that has investigated this aspect of healthcare thereby confirming the significance of this study.

3.9 Chapter Summary

In this chapter, a systematic literature review of hand hygiene practises among HCWs in SSA countries was conducted. Overall hand hygiene compliance rate was estimated to be 21.1%. Doctors had better compliance than nurses irrespective of the type of patient contact. Barriers identified in this review are consistent with the findings of studies conducted elsewhere however it appears that heavy workload, infrastructural deficit (e.g. lack of water, soap, hand sanitisers and blocked/leaking sinks) and poorly positioned facilities are more likely in developing countries. This chapter identified that there is a need for more reports of hand hygiene compliance in SSA and emphasis needs to be placed on surgical wards where SSI, the commonest form of HCAI in SSA are likeliest. The next chapter gives a detailed description of the research methodology and theoretical underpinnings of this current research.

Chapter 4 **Research Methodology**

4.1 Introduction

Research approaches are the entire practices and procedures employed in a study from broad assumptions to detailed methods of data collection and analysis (Creswell & Creswell, 2018). They are the guiding principles for the researcher's choice of strategy and processes for undertaking research (Dyson & Norrie, 2010). In any research, careful planning is needed in order to maintain its credibility, relevance and integrity. The overall aim of this research is to determine the hand hygiene compliance rate, understand the barriers and levers to hand hygiene practices and validate the barriers and levers to hand hygiene instrument (BALHHI) for Nigerian HCWs. Owing to the complexity of the overall research aim, there is a need to draw on multiple methodologies to achieve the research aim.

This chapter begins by broadly discussing the qualitative, quantitative and mixed methods research approaches. The theoretical underpinnings, philosophical assumptions and methodological considerations which ground the research approaches are discussed and specifically, the relevance and rationale for the choice of mixed methods research approach employed in this study are offered in this chapter. The methodological issues surrounding mixed methods research are also discussed. What's more, the significance of underpinning research by theoretical frameworks is described and the rationale surrounding the choice of the theoretical domains framework is given. A chapter summary is given as the concluding section of this chapter.

4.2 Paradigmatic Stances in Research

At the rudimental level of all forms of research and inquiry, there exists the human desire of researchers to understand and make sense of the world (McEvoy & Richards, 2006). Research paradigms are a way of guiding researcher's selection of both research questions

and methods employed to study them (Morgan, 2007; Morgan, 2014). A researcher's choice of research paradigm alongside their associated ontological, epistemological and methodological assumptions impact the researcher's thoughts, actions and conduct during the research process (Norton, 1999). Though inter-linked as the assumptions of an approach to a research methodology is an upshot of the researcher's understanding of the world (ontology) and the understanding of what we can know about the world (epistemology), the three philosophical terms (ontology, epistemology and methodology) are three distinctive facets to knowledge (Dew, 2007). The awareness of these philosophies aims to increase the robustness and quality of the research.

Ontology in social sciences is concerned with the nature of reality as it deals with the science of being and their relations (Bryman, 2016). An ontological research stance is how the researcher answers to the question "what is reality?" and assumptions inferred from this influence the research approach (Byrne, 2017). Ontology requires the researcher to ask themselves their perceptions of the world and how this influences people's behaviours. Epistemology on the other hand is the researcher's answer to the question "how can you know reality?" (Bryman, 2016). It is about how we can make knowledge claims of any kind and deals with questions about how we perceive and understand reality (Byrne, 2017).

The aim of both ontological and epistemological philosophical stances in research is to establish a holistic view of knowledge perception, our self-perception in relation to knowledge and the methodological approaches employed to discover it (Patel, 2015). There are three prominent methodological approaches for shaping the philosophical foundations of modern research namely qualitative, quantitative and mixed methods research methodologies (Creswell & Creswell, 2018). Each research methodology has its strengths

and weaknesses. To establish how the most appropriate methodology for this research was determined, the three approaches alongside their paradigmatic stances are discussed in the following sections.

4.2.1 Qualitative Research Methodology and its Philosophical Worldview

Qualitative research entails exploring and understanding the meaning an individual or group of people give to a social or human problem or phenomenon (Creswell & Creswell, 2018). It involves the study of human perception, understanding and experiences of an identified phenomenon rather than numerical counts of the phenomenon from which statistical inferences are drawn (Moule and Goodman, 2014). Qualitative research operates on the interpretivist paradigm which allows the researcher to explore complex issues from the perspective of the people involved (Scotland, 2012). Interpretivism (also called social constructivism) is an ontological viewpoint which asserts that social phenomena are created from perceptions and consequent actions of those social actors concerned with existence (Bryman, 2016). It is based on the ontological position of relativism that multiple realities exist and the epistemological stance of subjectivism that meanings are not discovered but rather constructed following human interaction with the social world and that interpretation of knowledge is imperative to uncover the underlying meaning (Scotland, 2012; Creswell & Creswell, 2018). In social constructivism, there is development of subjective meanings of individual experiences which are varying and multifaceted thereby making the researcher investigate the complexity of views rather than limiting meanings to few categories or ideas (Crotty, 1998; Cohen et al., 2017).

The five most popular qualitative approaches of inquiry across social and health sciences are ethnography, phenomenology, case study, narrative and grounded theory (Creswell &

Creswell, 2018). Whilst ethnographic research involves data collection through observations and/or interviews of a particular cultural group in their real life context over a lengthy period of time (Creswell & Creswell, 2018), phenomenological research explores human experiences about a given phenomenon described by the study participants (Bryman, 2016). In case study research, there is in-depth exploration of a case or multiple cases in their natural setting (Yin, 2018) whereas grounded theory aims at generating theory following systematic data collection and analysis in a bid to explore social relationships and behaviours of a target population group (Noble & Mitchell, 2016) while narrative inquiry concentrates on individual stories of research participants' lived experiences or events and subsequently making sense of the stories (Reissman, 2005). Other approaches include action research (where there is collaboration between the researcher and participants by detecting a problem and finding solution based on the problem identified (Bryman, 2016), discourse analysis (which analyses language patterns across texts and the relationships between language and the sociocultural contexts in which it is being used (Paltridge, 2012) and participatory action research (Creswell & Creswell, 2018).

Qualitative researchers use inductive reasoning by commencing the research with an open mind or with as few presumptions as possible thereby allowing for theory emergence from collected data (O'Reilly, 2009). Inductive reasoning approach examines a particular aspect of social life and theories are derived from the resultant data (May, 2011).

4.2.2 Quantitative Research Methodology and its Philosophical Worldview

Quantitative research involves the collection of numerical data and generalising it across groups of people or to provide an explanation to a given phenomenon (Muijs, 2010). It tests objective theories through examination of the relationship among variables (Creswell &

Creswell, 2018). In quantitative research, a research question is investigated by focussing on discrete and measurable aspects of an area of clinical and theoretical interest (Martin & Thompson, 2000). Quantitative research operates on the positivist paradigm and it involves the analysis of statistical data to elaborate on a presumed hypothesis (Hickson, 2008; Watson, 2015). Positivism is an ontological position which asserts that social phenomena and their meanings have an existence that is independent of social actors which are discoverable through research (Scotland, 2012; Bryman, 2016). It is based on the ontological position of realism that there is one single reality or truth which is independent of the researcher and the epistemological stance of objectivism that knowledge is absolute, measurable, value free and not situated in any political or historic contexts (Scotland, 2012). The consequent knowledge generated from positivists is based on carefully observing and measuring the objective reality that exists in the world (Creswell & Creswell, 2018). Postpositivism, which have similar ontological and epistemological stances as positivism emerged in the 20th century and represents thoughts after positivism (Scotland, 2012). In postpositivism, the conventional concept of absolute truth is challenged by acknowledging that when human actions and behaviours are being studied, *"every scientific statement must remain tentative"* (Popper, 1968) because researchers cannot be completely positive about their knowledge claims (Scotland, 2012; Creswell & Creswell, 2018).

Three approaches of inquiry are identified in quantitative research namely experimental, nonexperimental and longitudinal designs (Creswell & Creswell, 2018). In experimental research, causal relationships are investigated, and researcher is able to manipulate variables to check the relationship between one and another variable (Centre for Innovation in Research and Teaching, 2018). Examples include quasi-experiments (which are less

rigorous) and applied-behavioural analysis or single-subject experiments (where experimental treatments are applied to single or small group of individuals over time) (Bryman, 2016; Creswell & Creswell, 2018). Nonexperimental research does not demonstrate true cause and effect relationship as manipulation of variables are not permitted but relies on the interpretation, observations and likely interactions to draw on conclusions (Bryman, 2016). Examples of nonexperimental research include causal-comparative research (where two or more variables in terms of a cause that has already happened are compared) and correlational designs (where correlational statistics are employed to measure the relationships between two or more groups) (Creswell & Creswell, 2018). In longitudinal designs, there is data collection over some time in order to explore developing trends and ideas (Bryman, 2016).

Quantitative research operates on the premise of deductive reasoning where a hypothesis is developed from existing theory which is then followed by the exploration of the empirical world through data collection in order to test the hypothesis (May, 2011; Watson, 2015). In deductive approach, a general picture of social life is first considered before a particular aspect of it is studied to test the strength of the existing theories (May, 2011).

4.2.3 Mixed Methods Research Methodology and its Philosophical Worldview

The third methodological approach, mixed methods research sits in between a continuum as it incorporates elements from both qualitative and quantitative research approaches (Creswell & Creswell, 2018). Mixed methods research has gained increased popularity in use especially in the fields of nursing and health sciences (Doyle et al., 2016). It is guided by philosophical assumptions that enable the mixture of qualitative and quantitative approaches throughout the research process and it compensates for the weaknesses of

both methods (Burke Johnson et al., 2007; Hanson et al., 2005). In mixed methods research, there is the application of both qualitative and quantitative methods in the rigorous collection and analysis of data in a research study thereby offering better insight and deeper understanding of research problems than either of qualitative or quantitative research designs would (Kumar, 2014; Plano Clark & Ivankova, 2016; Creswell & Creswell, 2018).

The major current issue for mixed methods research is identified as "paradigmatic foundations" (Tashakkori & Teddlie, 2010). This issue is critical in terms of how to conceptualise, address and/or move beyond the former "paradigmatic wars" that have characterised social science research for the past several decades (Shannon-Baker, 2016) owing to the belief that qualitative and quantitative research paradigms could never be mixed due to the intrinsic distinctions fundamental to them (Doyle et al., 2016). Philosophical issues arise in mixed method research because generally speaking, quantitative research is associated with positivism whereas qualitative research is associated with constructivism and mixing the two approaches with distinct epistemological assumptions may suggest the acceptance of multiple realities since the nature of reality presumed in the various theories of knowledge is different (Creswell & Plano Clark, 2011). This explains why mixed methods research encourages the use of multiple research paradigms rather than the typical association of certain paradigms for quantitative researchers and others for qualitative researchers (Creswell & Creswell, 2018). Although using a combination of qualitative and quantitative research approaches is widely advocated, there is considerable scope for confusion due to the complex ontological and epistemological issues that need to be resolved (McEvoy & Richards, 2006). For some researchers, adopting a dialectical approach by using two or more paradigms offers a

solution to the problem (Shannon-Baker, 2016). Dialectical approach sees each paradigm as a distinctive worldview and two or more paradigms can be used together in a research process where there are conflicting ideas (Greene, 2008; Shannon-Baker, 2016). Dialectics emphasises that the method used in a research process should depend on the phenomenon being studied (Shannon-Baker, 2016).

For most researchers, the solution to the paradigmatic wars lies in the use of an alternative paradigm which supports the plurality of assumptions and methods (Greene, 2008). One of the major stances in dealing with the alterative or conflicting paradigms in mixed methods research is pragmatism. Pragmatism has been identified as a *"leading contender for the philosophical champion of the mixed methods arena"* (Greene, 2008 pp.8) which accepts concepts to be relevant only if they support action. To a pragmatic researcher, the research question is the most important factor of the research viewpoint as both positions of positivism and social constructivism can be combined within the scope of a single research according to the nature of the research question (Burke Johnson & Onwuegbuzie, 2004; Bryman, 2016). The pragmatic viewpoint submits that the consequences are more important than the process (Doyle et al., 2016). Practically, pragmatism offers healthcare researchers the autonomy to choose the best methods to answer the research question at hand, advocating for a balance between subjectivity and objectivity throughout the research (Doyle et al., 2016). Philosophically, pragmatism supports the view that while there are distinctive features in qualitative and quantitative methods, they are also commensurate as both enhance knowledge development and shared meaning making (Shannon-Baker, 2016).

Though mixed methods research has been criticised because it requires extra time, more resources, researcher's expertise knowledge of both qualitative and quantitative research

approaches and as having complicated research procedures which require clear presentation if reader is going to be able to sort out the different procedures (Doyle et al., 2016; McKim, 2017), but the value of this research approach outweighs its difficulty. Five rationales for conducting mixed methods research are identified as triangulation, complementarity, development, initiation and expansion (Greene et al., 1989). Whilst triangulation involves using both qualitative and quantitative data to cross-check results, initiation requires using results from different methods specifically to check incongruent areas so as to obtain new insights whereas in development, results from one method are used to develop or inform the use of another method (Tariq & Woodman, 2013). Moreover, expansion examines different aspects of a research question where different methods are needed for each aspect while complementarity involves the use of data obtained from one method to explain findings from another (Tariq & Woodman, 2013).

As a methodology, mixed methods research entails the philosophical assumptions guiding the data collection and analysis as well as the integration of qualitative and quantitative approaches in all phases of the research process. As a method, mixed methods research involves the collection, analysis and integration of both qualitative and quantitative data in a single or series of studies (Creswell & Creswell, 2018). There is practicability in mixed methods research as the researcher is free to employ all methods possible to address a research problem and the researcher tends to provide solutions using both numbers and words through the combination of deductive and inductive reasoning (Burke Johnson & Onwuegbuzie, 2004; Creswell & Creswell, 2018). This logic of reasoning called abduction recognises and addresses the weaknesses of solely using pure inductive or deductive

reasoning approaches by making judgement that offers the best explanation for the observations being made (Thomas, 2011; Farquhar, 2012).

4.3 Positioning this Research

The present research is designed such that there are different phases to address the research questions, which are both qualitative and quantitative in nature. Mixed methods research is the methodology of choice in this study as the researcher will be able to blend findings from both the quantitative and qualitative phases of this research. This approach offers deeper and comprehensive evidence for investigating a research problem than either of quantitative or qualitative research alone would (Burke Johnson et al., 2007). Because pragmatics recognise that there are many diverse ways of interpreting the world, that no single viewpoint can ever give the entire picture and that there may be multiple realities (Saunders et al., 2012), the philosophical assumptions underpinning this research originate from the pragmatic research paradigm. This implies an ontological belief that reality is continually deliberated, challenged or inferred and an epistemological position that essentially believes in using pluralistic approaches to derive knowledge about the phenomenon being studied (Creswell & Creswell, 2018).

The importance of underpinning the choice of a research methodology on the research question cannot be overstated as the choice of methodology greatly impacts on the conduct of the research, type of data generated and the interpretation of the findings of the research (Bryman, 2016; Denzin & Lincoln, 2017). The five research questions in this study are:

1. What does the literature tell us about hand hygiene compliance rates and the barriers and facilitators to hand hygiene of HCWs in SSA countries?

2. What are the hand hygiene resources in the surgical wards of a teaching hospital in Nigeria?
3. What is the hand hygiene compliance rate of HCWs in the surgical wards of a teaching hospital in Nigeria?
4. What are the barriers and levers to hand hygiene practices among Nigerian HCWs in a teaching hospital?
5. Is BALHHI valid and reliable among Nigerian HCWs?

The first research question was answered in the previous chapter where a systematic literature review of studies from SSA countries was conducted to ascertain the compliance rate, barriers and levers to hand hygiene practices of HCWs from SSA countries. The four unanswered research questions are complex, and the researcher is unable to answer them using one research methodology. A mixed methods research approach is considered most suitable for this research as more than one research question have been proposed and more robust findings will be derived if answered both quantitatively and qualitatively. The 2nd and 3rd research questions focus on surgical wards because of the high prevalence of SSI in Nigeria as reported in the contextual background to the research (chapter 2) and because it is important to evaluate the hand hygiene resources available in the surgical wards. To the best of the researcher's knowledge, hand hygiene compliance rate in this area of healthcare has not been previously explored within the Nigerian context. Questions four and five were not limited to surgical HCWs because of the limited surgical staff strength in the research setting (see chapter 5). To answer the fourth research question, barriers and levers to hand hygiene practices will be assessed quantitatively through survey because of its potential for a large sample size, and qualitatively through interviews to give deeper insight into the

study. The fifth research question will be answered through psychometric measurement of latent variables in relation to the barriers and levers to hand hygiene practices among HCWs within the research context.

Both quantitative and qualitative research approaches have recognised strengths and weaknesses. While the limitation of quantitative approaches lies in the absence of dialogue owing to its lack of detailed exploration of human perceptions and beliefs about a phenomenon, these are the identified strengths of qualitative research (Gerrish & Lacey, 2010; Choy, 2014). Quantitative research is weak in understanding the context in which people talk as the voices of the participants are not directly heard. More so, the objective nature and lack of suitability in quantifying circumstances related to meanings and life experiences is a flawed approach of quantitative research (Parahoo, 2014).

In terms of researcher-participant interactions, because quantitative researchers maintain a detached approach and remain in the background, their own personal biases and interpretations are rarely expressed thereby ensuring collection of objective data (Choy, 2014; Creswell & Creswell, 2018). However, there is risk of bias in qualitative research as researchers are present during data collection and because of personal interpretations made by researchers (Anderson, 2010). The direct experience of qualitative researchers have been argued to boost the collection of valuable and meaningful data (Anderson, 2010).

Findings are generalisable in quantitative research since studies involve large population but this is not so in qualitative studies because of the small sample size involved (Creswell & Creswell, 2018) although findings in qualitative research are transferrable (Anderson, 2010). Both generalisability (quantitative) and transferability (qualitative) relate to the external

validity of research findings and they measure the degree of applicability of findings to other contexts (Bryman, 2016).

Positivism (quantitative approach) and interpretivism (qualitative approach) are two extreme, mutually exclusive research paradigms about the nature and sources of knowledge (Collis & Hussey, 2014). Neither qualitative nor quantitative research approach is superior to each other in obtaining knowledge (Watson, 2015). To enhance knowledge development and progression beyond the inherent limitations of both methods, the combination of both methods of enquiry is advocated for (Choy, 2014).

4.3.1 Choosing a Mixed Methods Research Design

There exists a plethora of mixed methods research designs and typologies however the three core mixed methods designs are the explanatory sequential design, exploratory sequential design and the convergent design (Creswell & Creswell, 2018).

The explanatory sequential design entails collecting and analysing quantitative data followed by the collection and analysis of qualitative data so as to explain the quantitative results (Doyle et al., 2016; Bryman, 2016). In this design, data are collected sequentially and the findings of the quantitative phase of the study inform the development of the qualitative phase (Doyle et al., 2016). The key limitations of this design are in the disparate sample sizes for each study phase and the identification of quantitative results for further exploration (Doyle et al., 2016).

In exploratory sequential design, which is the reverse sequence of explanatory sequential design (Creswell & Creswell, 2018), qualitative data are first collected before collecting the quantitative data. The qualitative phase is important in developing instruments not in

existence, identifying unknown variables and developing theories or hypotheses (Creswell & Plano Clark, 2011) whereas the quantitative phase can serve to test the instrument and/or to generalise qualitative results to a wider population (Doyle et al., 2016). The limitations of this design are in focussing on the appropriate qualitative results to use, selecting samples for both phases of the research and the challenges of developing and testing an instrument (Doyle et al., 2016).

The third design is the convergent design, also called convergent parallel design or concurrent triangulation design) which is the commonest of the core and complex mixed methods research approaches. In this design, a central research question is addressed and both quantitative and qualitative data are collected at the same time (Creswell & Creswell, 2018; Doyle et al., 2016).

> "The design tends to be associated with triangulation exercises whereby the researcher aims to compare two sets of findings and also situations in which the researcher aims to offset the weaknesses of both quantitative and qualitative research by capitalising on the strengths of both" (Bryman, 2016).

The core belief in convergent design is that both qualitative and quantitative data give different types of information. Findings of one aspect of the research are independent of the results of other aspects and findings are usually merged while interpreting results (Creswell & Plano Clark, 2011). The convergent parallel design will be employed in this study as both the quantitative and qualitative data will be collected simultaneously, and their findings are independent of each other. Besides, findings of this research will be integrated during the interpretation of results. Being an early mixed methods researcher, the researcher aims that using a convergent design will strengthen the validity of the current research (Doyle et al., 2016). A key limitation to convergent design is determining what to

do in instance of result divergence instead of convergence although divergence does not usually connote a research error (Doyle et al., 2016; O'Cathain et al., 2010).

4.4 Significance of Theoretical Frameworks in Behaviour Change Research

The significance of theoretical frameworks in research conduct cannot be overstated being one of the most important aspects in research process. Theoretical frameworks are a platform for common language aimed at identifying contexts, designated problems and interventions in generalisable terms thereby guiding the strategies for adaptation (Lawton et al., 2016). Though clinical guidelines, policy and initiatives have hitherto generated no continued behaviour change, IPC context appears a probable field for successful application of theoretical frameworks (Edwards et al., 2012). Hand hygiene is a complex behaviour yet behaviour change theories are often omitted when trying to change HCWs' hand hygiene behaviour (Srigley et al., 2015). These theories offer promising tools to improve hand hygiene compliance rates (Huis et al., 2012). Some studies found that behaviour change theories can predict hand hygiene behaviours and that interventions based on behaviour change theories have resulted in improved hand hygiene compliance (Harne-Britner et al., 2011; Mayer et al., 2011; Fuller et al., 2012; Pontivivo et al., 2012; Smith et al., 2018). Some of these models have been applied to the implementation of evidence-based practice (EBP) (Davies et al., 2010; Michie et al., 2005) as behaviour change theories offer comprehensive theoretical basis for tackling the issues of implementation (Dyson et al., 2013).

Despite the appreciation of the impact of underpinning behaviour change investigations and interventions to address suboptimal clinical practice with psychological/behaviour change models, this is difficult. There is a vast array of behaviour change theories, hence theories are complex, and there is no consensus on which theory to use (Michie et al., 2005). Also,

theories and their theoretical constructs may overlap making it inaccessible to healthcare researchers (Michie et al., 2005). More so, no single behaviour/behaviour change theory is comprehensive and theories are rarely clearly explained thereby making it difficult to generalise interventions underpinned by behaviour change theories to other different context (Taylor et al., 2013).

4.4.1 Theoretical Domains Framework of Behaviour Change

The theoretical domains framework (TDF) of behaviour change sought to address some of the problems with using behaviour change theories and will be employed in this research. The TDF was specifically designed by a group of health psychologists within the British Psychological Society (BPS) to identify the key theoretical constructs of behaviour change for use in EBP implementation and for developing strategies for effective implementation (Michie et al., 2005). This theoretical model is an integrative framework of behaviour change theories aimed at simplifying and integrating an array of psychological theories of behaviour change to aid the application of theoretical approaches to behaviour change interventions (Phillips et al., 2015). A synthesis of a single framework for assessing implementation and other behaviour change as well as informing design of intervention was produced from 33 psychological theories and 128 key theoretical constructs related to behaviour change identified through a consensus process involving experts of psychology (Michie et al., 2005). These theories and constructs were explored from which emanated 11 theoretical domains namely *knowledge, skills, social/professional role and identity, beliefs about capabilities, beliefs about consequences, motivation and goals, memory, attention and decision processes, environmental context and resources, social influences, emotion* and *action planning* (Michie et al., 2005). The TDF has been subsequently revised and validated with 14 domains where optimism, reinforcement and intentions were considered important

and included instead of being embedded in the earlier 11 domains of the original version of the TDF (Cane et al., 2012; Cowdell & Dyson, 2019). For this research, the original version of the TDF will be used (Michie et al., 2005) for two reasons. First, the TDF version 1 is more widely used/tried and tested by researchers (Mazza et al., 2014; Murphy et al., 2014; Backman et al., 2015; Cullinan et al., 2015; Cadogan et al., 2016; Cadogan et al., 2017; Glidewell et al., 2018). Secondly, a large number of behaviour change techniques (BCTs) taken from a taxonomy (Abraham & Michie, 2008) were mapped to the domains (behavioural determinants) of this version of the TDF not the version 2 (Michie et al., 2008). BCTs are the specific strategies used in interventions to promote behaviour change (Webb et al., 2010). This research will be underpinned by the TDF and interventions aimed at improving hand hygiene practices of Nigerian HCWs will be proposed using BCTs. The value of BCTs is in their standardised definitions which enable the identification of techniques contributing to interventions as well as ensure that effective interventions can be replicated (Abraham & Michie, 2008; Webb et al., 2010).

4.4.2 Rationale for Adopting Theoretical Domains Framework in this Research

The practical uses of the TDF were explored by some scholars and six uses of the TDF identified (Atkins et al., 2017; Craig et al., 2017):

1. The TDF has been employed by scholars across diverse healthcare systems to guide intervention development and promote the implementation of guidelines or healthcare interventions (McKenzie et al., 2008; McKenzie et al., 2010; French et al., 2012; Taylor et al., 2014; Backman et al., 2015; Tavender et al., 2015).
2. The TDF has been used to identify the influences on behaviours through the exploration of barriers and levers to implementation of definite evidence-based

behaviours (Michie et al., 2007; Francis et al., 2009; Amemori et al., 2011; Dyson et al., 2011; Bussières et al., 2012; Beenstock et al., 2012; Duncan et al., 2012; McSherry et al., 2012; Patey et al., 2012; Murphy et al., 2014; Tavender et al., 2014).

3. The TDF has been used to guide theory-based process evaluations (Michie et al., 2008; Cane et al., 2012; Curran et al., 2013) and to design broader intervention strategies (Michie et al., 2014).
4. According to theory, the TDF has been used to characterise an existing intervention to implement evidence-based care to facilitate accurate replication (Steinmo et al., 2015; Steinmo et al., 2016)
5. The TDF has been used to understand factors that may impede uptake of an intervention (Patey et al., 2012; Connell et al., 2014).
6. The TDF has also been used in instrument design (Francis et al., 2012) and across not only HCW behaviour but also patient/public health behaviours (Gainforth et al., 2016).

The themes gathered from the systematic literature review conducted in this research (chapter 3) revealed that a need for behavioural change of HCWs in SSA is paramount. Using the TDF to underpin this research will help to address all potential barriers and levers to hand hygiene practices among HCWs in the research context. Habitual behaviours are formed from repetition, performing behaviours automatically once formed and from situational cues associated with the behaviour (Kurz et al., 2015). HCWs are unlikely to cite factors that impact on their hand hygiene behaviours such as automatic responses to cues like emotion, unless they are asked (Dyson et al., 2011). More so, there is a tendency to assume an individual's behaviours are dependent on personal or dispositional causes, rather

than on social and environmental stimuli. This is called fundamental attribution error (Ross, 1977). Underpinning this research with the TDF will help to uncover these cognitive biases.

To the best of the researcher's knowledge and based on the methodological quality appraisal of the reviewed papers, no study from SSA countries that explored hand hygiene practices of HCWs used a theoretical framework. Hence, this study will investigate the barriers and levers to hand hygiene practices among the surgical HCWs, using the TDF with a view to proposing a theory-based knowledge translation intervention to increase HCWs' compliance with the standardised hand hygiene guidelines. Moreover, previous research has seldom established an understanding of how context affects HCWs' behaviours while developing, implementing and assessing interventions (Edwards et al., 2012), this will be addressed in this study as the relationship of the research context will be explored.

The current research consists of four studies which employ both quantitative and qualitative methods in order to effectively answer the research questions. The next page is a flowchart on the entire research process. The research aims, designs, methods, results and summary of findings for each of the studies are presented in the next four chapters. This is followed by a discussion of findings chapter where the researcher attempts to integrate the study findings and discuss in light of wider literature.

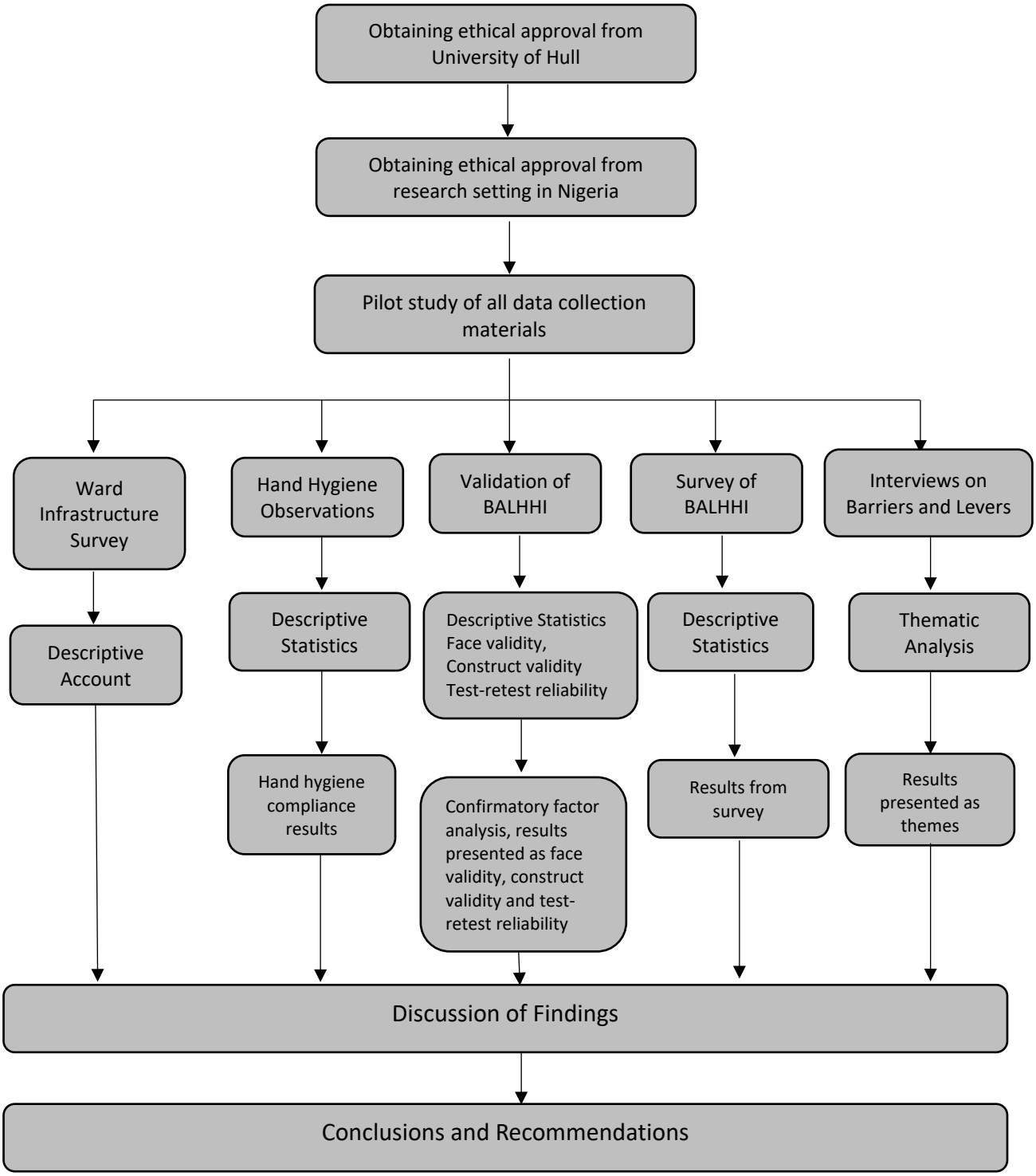


Figure 4-1 Flowchart of the Research Process

4.5 Chapter Summary

This chapter has described this current research as a mixed methods research. First, an outline of the three types of research methodologies, their philosophical stances and theoretical assumptions was given. This was narrowed down to the methodological decisions undertaken in this research and the researcher attempted to justify the choice of mixed methods research methodology by describing the philosophical worldview as well as the strengths and weaknesses. The mixed method research designs were then presented, the choice of convergent mixed method research design for this study was justified and the current research was positioned. The next chapter describes the ward infrastructure survey and hand hygiene observations undertaken in this research.

Chapter 5 Ward Infrastructure Survey and Hand Hygiene Observations

5.1 Introduction

The overall aim of this research is to determine the hand hygiene compliance rate, understand the barriers and levers to hand hygiene practices and validate the barriers and levers to hand hygiene instrument (BALHHI) for Nigerian HCWs. In chapter three, a literature review was conducted which sought to establish the hand hygiene compliance rate and identify the barriers and levers to hand hygiene practices among HCWs in SSA countries. The researcher presented the evidence available and identified a dearth of literature from SSA countries reporting on hand hygiene compliance rates in surgical wards. The review also found a need for studies to report process of observations to allow for replication of methods.

In this chapter, the description of the research setting is presented first followed by the process of obtaining ethical approvals for the research. The chapter then divides into two parts. The first part describes the ward infrastructure survey conducted in the surgical wards included in this research while the second part describes the hand hygiene observations conducted as part of this research. The study aims and questions are offered first, followed by the design, participants and procedures. Then the ethical considerations are given, and methods of data analysis are presented. Findings from both the ward infrastructure survey and hand hygiene observations are then presented followed by the study strengths and limitations. The chapter concludes with a chapter summary. Figure 5.1 illustrates the process of ward infrastructure survey and hand hygiene observations.

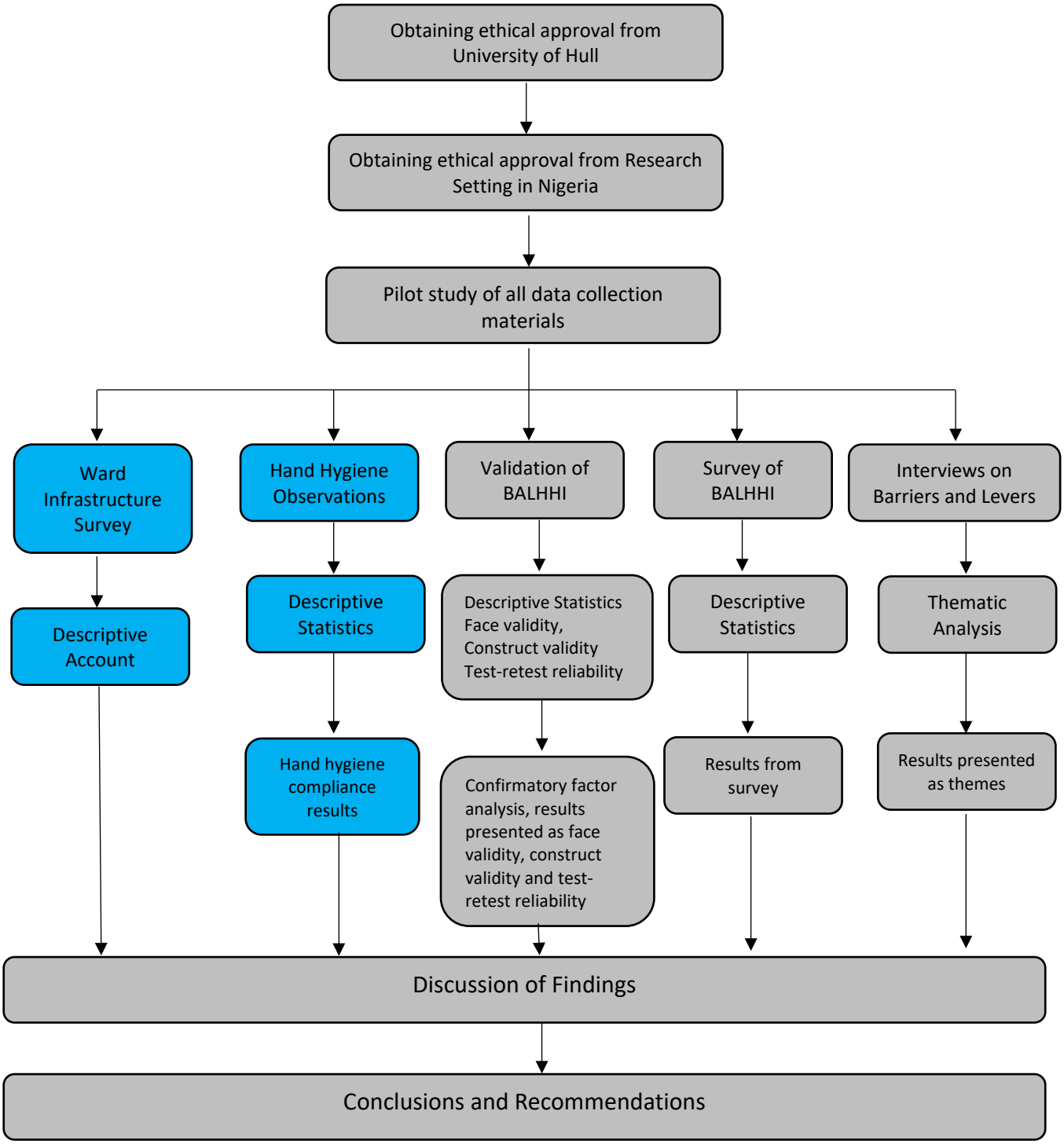


Figure 5-1 Flowchart Illustrating the Ward Infrastructure Survey and Hand Hygiene Observations

5.2 Research setting

When deciding on the research setting, there is need to consider feasibility, access to population of interest, establishing a trusting relationship with potential study participants, ability to conduct a research in the setting and assurance of largely upholding the quality and credibility of the data to be collected (Marshall & Rossman, 2016). Two hospitals were considered and secured as the study sites – sites A and B[2], both in South West Nigeria. This is because of their similarities in terms of types of services rendered. Site A is a public teaching hospital. However, due to prolonged industrial action at site A, which is unlikely at site B, being a private teaching hospital, site B was selected, and the research was conducted there.

Site B is a faith-based teaching hospital established in 1907 and later converted to a teaching hospital in 2009. This hospital, which was opened for use in 1923, offers fully accredited training programmes in medicine, nursing, midwifery, and residency in family medicine[3]. Site B is a popular hospital in the country with reputable history in rendering high quality and prompt care at affordable costs. It has 400 bed capacity, over 800 staff and students, and caters for about 50000 outpatients and 10000 inpatients annually. There is reportedly a higher level of overall satisfaction among users of private hospitals in Nigeria (Adesanya et al., 2012).

Since this research focusses largely on surgical wards, data were collected from only the adult male and female surgical wards of this hospital for the ward infrastructure survey,

[2] The site names were pseudonymised for anonymity reasons.
[3] Equivalent to general practice in the UK.

hand hygiene observations and the qualitative study on the barriers and levers to hand hygiene practices (chapter 8). The paediatric surgical ward was excluded because of their specific characteristics reported from previous research in terms of high level of dependency, immune status (Posfay-Barbe et al., 2008) and inability to generalise or transfer findings from paediatric to adult wards. For the chapters on instrument validation and testing (chapter 6) and the barriers and levers to hand hygiene practices survey (chapter 7), data were collected across all specialties (see chapter 6, section 6.6.5 for the justification).

5.3 Research Ethics and Ethical Approvals

Research ethics lay emphasis on the capacity of any research to contribute to the body of knowledge hence researchers have the ethical obligations to enrich knowledge through their research (Savin-Baden & Major, 2013). Therefore, the most appropriate research design with clearly defined research goals and objectives should be employed in a research process to uphold its integrity. Likewise, the research methodology and method of inquiry should be ethically appropriate for the type of inquiry being studied (Savin-Baden & Major, 2013).

After satisfactorily reviewing the researcher's ethics application documents, the initial ethical approval was granted by the University of Hull School of Health and Social Work Research Ethics Committee (SHSW REC) on 17/07/2017 (REF 279 – see appendix A). An amendment which was made on 19/03/2018 was granted on 22/03/2018 (see appendix B) for some reasons. The initial plan was to conduct the survey and interviews from the UK and ask qualified nurses to conduct hand hygiene observations as practised in other countries like the UK but the researcher later decided to travel to Nigeria to collect the data so as to

enrich her knowledge of engaging in research process. Only the test-retest reliability round of the instrument testing required the assistance of an administrative help. Secondly, the HCWs of the intended research setting were on strike for almost a year and this delay stalled the research progress hence, the decision to change the research setting.

Ethical approval to conduct the study was granted in March 2018 by the research ethics committee of the study site (see appendix C) following the submission of all required documents including a research proposal, copy of ethical approval document from the SHSW REC, attached documents such as the participant information sheet and consent forms and a fee payment. This was issued after a supporting letter was written by both of the researcher's supervisors, to confirm her studentship, as requested by the REC chairman of the study site (see appendix D). No revision to the research proposal was required.

The ethical considerations relating to both qualitative and quantitative research methodologies are considered in mixed methods research design, being a combination of both methodologies (Caruth, 2013). Probable ethical issues need to be anticipated, hence it is important to be actively aware of the ethical issues that might arise and these need to be reflected throughout the research process (Vanclay et al., 2013; Creswell & Creswell, 2018). Adequate attention must be given to likely ethical issues at every phase of the research process (Creswell & Creswell, 2018), and with prior anticipation and planning on ethical issues during the research design phase, it becomes less problematic when ethical dilemma ensues and they are better managed effectively (Creswell & Creswell, 2018).

It is important to have ethical considerations when preparing the final reports of a research (Bocec, 1997). The input and voices of the participants must be presented honestly, and findings need to be genuine, credible, and verifiable. Falsification of data and plagiarism

must be avoided (Bryman, 2016). Findings must also be disseminated such that the beneficiaries of the research, especially the participants and the academic community have access to it (Savin-Baden & Major, 2013).

In this research, the specific ethical considerations taken according to the research methods are discussed under each of the phases of the data collection process.

5.4 Part A – Ward Infrastructure Survey

5.4.1 Study Aim

To assess and offer context to the hand hygiene resources available in a Nigerian teaching hospital.

5.4.2 Study Objective

To collect data about structures and resources at surgical ward level in the research context.

5.4.3 Study Question

What are the hand hygiene resources in the surgical wards of a teaching hospital in Nigeria?

5.4.4 Study Design

The hand hygiene facilities surveyed on the two surgical wards included the staff, sinks, water, soap, disposable towels, and alcohol-based hand rubs (ABHRs). To ascertain their level of availability, hand hygiene reminder leaflets and posters were also surveyed on the wards. The WHO hand hygiene ward infrastructure survey form (WHO, 2009a) was used to collect data on the hand hygiene facilities available on the wards (see appendix E). This form was used in this study because it is one of the tools for *"system change"*, one of the components of the *"five multimodal hand hygiene improvement strategies"* recommended by the WHO (2009). The five components were identified in chapter two of this thesis, (conceptual background to the research, section 2.9.4). Similarly, hand hygiene leaflets and

posters relate to the *"reminders in the workplace"* component of the implementation strategies (WHO, 2009). The ward infrastructure survey form is in two parts. The first part assesses handwashing and hand-rubbing facilities and resources on the wards while the second part consists of a grid which assesses the exact number of hand hygiene resources and the products in place (WHO, 2009a).

5.4.5 Participants

The survey was conducted in the two adult surgical wards of the research setting. No people (patients and HCWs) were included in this survey.

5.4.6 Procedure

The matrons-in-charge of the two surgical wards were contacted prior to arriving at the research setting to intimate them with details of the research study. On the day of the survey, the matrons-in-charge were approached with the research ethical approval and the researcher was granted access to the wards to conduct the survey. Because of the nurses' busy schedule, the researcher could move freely on the ward to conduct the survey by self however, when in doubts, details/clarifications were obtained from the matrons. For instance, the matrons confirmed the number of staff in both nursing and medical professional groups. Only pictures relating to hand hygiene materials were taken to give a pictorial representation of the setting. Pictures of patients or staff performing clinical procedures were avoided.

5.4.7 Ethical considerations

Ethical approval was obtained to conduct the ward infrastructure survey (See section 5.3 of this chapter). The ethical approval allowed pictures of the hand hygiene resources to be taken, where applicable. No people were involved as participants in this study.

5.4.8 Data Analysis

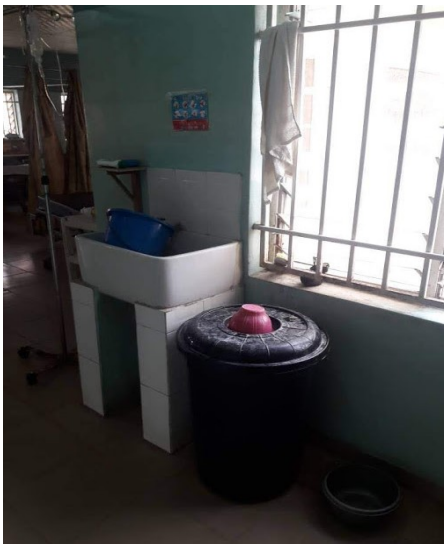
A descriptive account of the hand hygiene resources was conducted.

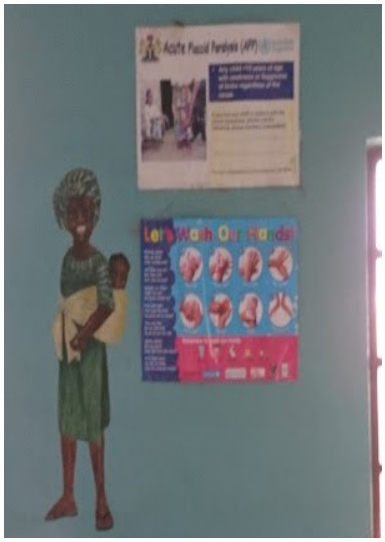
5.4.9 Findings from Ward Infrastructure Survey

There were 15 nurses and 6 health assistants in each of the male and female surgical wards. There were 15 doctors attached to the two wards. The wards are open wards and patients of different surgical needs including but not limited to general surgery, urology and orthopaedics are admitted on the wards. There were 30 beds and 21 beds in the male and female surgical wards, respectively. Each bed was separated by curtains to provide some privacy for the patients, but these were not always used. There were no private rooms for patients on the wards as there is a private ward in the hospital where patients who are more financially buoyant and of varying healthcare needs are admitted.

As at the time of the survey, each ward had two sinks with visibly clean water running from taps. There were no faulty sinks though a sink and its environment were visibly dirty. Taps were knob-operated, no elbow-operated taps were available. There were plastic water storage facilities, as well as buckets and bowl to manually pour water on the hands in case water was not running. Soap was always available, but they were either bar soaps or heavily diluted liquid soap without any record of dilution standard. Each of the wards also had a treatment room with running water and soap. There were no disposable towels at any point during the survey, but cotton towels were provided, and these were reportedly changed per shift. There were no wall mounted ABHRs on patients' bedsides or pocket-sized ABHRs. When available, ABHRs are placed on and used from the nurses' station. Disposable gloves were always by patient bedsides. Posters illustrating hand hygiene were displayed by the sinks but not in multiple areas of the ward. No other type of hand hygiene reminders was displayed. Hand hygiene observation has never been done in the hospital prior to this study.

The pictures below show some of the hand hygiene resources available on the adult male and female surgical wards of the research setting.





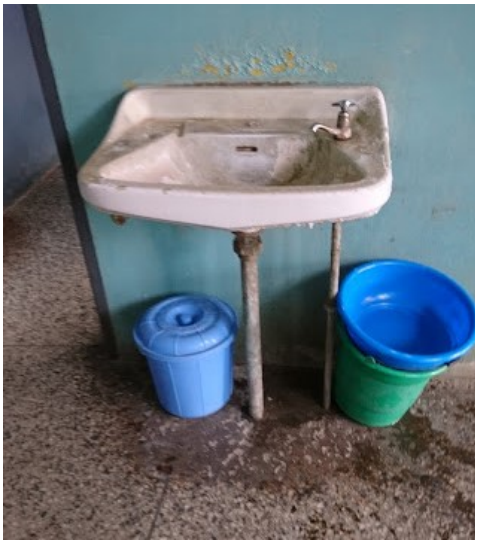


Figure 5-2 Pictorial Representation of Hand Hygiene Resources in a Surgical Ward

5.5 Part B – Hand Hygiene Observations

5.5.1 Study Aim

To determine the hand hygiene compliance rate among surgical HCWs in a Nigerian teaching hospital through hand hygiene observations.

5.5.2 Study Question

What is the hand hygiene compliance rate of HCWs in the surgical wards of a teaching hospital in Nigeria?

5.5.3 Study Design

To determine the hand hygiene compliance rate of surgical HCWs in the research setting, a nonparticipant hand hygiene observation was considered the most appropriate approach. Direct observation is the gold standard measure for hand hygiene compliance (Randle et al., 2010) because it offers both qualitative and quantitative about why and when failures to perform hand hygiene occur (Chavali et al., 2014).

Observational research is a method of data collection where the researcher observes the participants of a social system in a bid to understand and gain deeper insights into the phenomenon being studied in its natural context (Mills et al., 2010). In observational studies, the researcher has direct, face-to-face experience of the participants and is able to record events as they occur in their natural settings (Creswell & Creswell, 2018). Denscombe (2014) identified the two broad types of observational research as participant and structured (systematic or nonparticipant) observation.

In participant observation, the researcher is well immersed in the social context being studied for an extended timeframe and is engaged in the daily activities of the people being studied (Denscombe, 2014). Participant observation is mostly used by ethnographers to

elicit information and meanings associated with the lifestyles, cultures, beliefs and behaviours of the participants (Denscombe, 2014; Bryman, 2016). Nonparticipant observation on the other hand, entails the direct observation of behaviours of a certain group of people using an observation schedule which consists of clearly formulated rules for observing, including what to look out for and recording the participants' behaviours (Bryman, 2016). People's behaviours and not what they say they do are directly observed here (Denscombe, 2014) and the researcher is present but does not partake or only seldom partakes in the activities of the social context (Allen, 2017).

Though it has been criticised for a number of things including its focus on the behaviours of observed participants rather than the intentions that inform the behaviours, the likelihood of an observation schedule missing the contextual information underpinning participants' behaviours and the probability of not being able to totally eliminate Hawthorne effect especially when observation schedules are used, nonparticipant observation takes strength in its timesaving feature as it collects sizeable amount of data in fairly short duration and produces quantitative data which are pre-coded and ready for analysis (Denscombe, 2014).

Observations can be either covert or overt (Miller & Brewer, 2003). In covert observation, the researcher is already a member of the social context under study but there are no direct interactions between the people under study and the researcher (Mills et al., 2010; Allen, 2017). Covert observation is mostly participant observation and only used in circumstances where obtaining informed consent or appropriate briefing of the observed participants is difficult or infeasible (Allen, 2017) and among sensitive groups, settings or behaviours (Miller & Brewer, 2003). In covert observation, the researcher status of the observer is

concealed from the participants being observed subjecting the observation to the inherent ethical issues of deception (Mills et al., 2010).

Overt observation, on the other hand is employed in instances where it is impractical to conceal the identity of the researcher from the observed participants such as situations where there is communication gap or the researcher has a different skin colour from the observed participants (Miller & Brewer, 2003). The advantage of overt observation is that participants are able to give informed consent and there are no deceptions in this form of observation (Mills et al., 2010). Besides, respect for persons, an ethical component requires that the use of deception or covert methods be sparingly employed under certain circumstances (Vanclay et al., 2013).

In this research, a direct, nonparticipant overt observation of hand hygiene opportunities of HCWs in the two adult surgical wards was conducted. A modified WHO hand hygiene observation form was used (see appendix F). The form consists of institutional level characteristics including the ward, department, staff category (medical, nursing or health assistants), and professional level according to seniority. It is structured using the WHO *"My 5 Moments of Hand Hygiene"* (WHO, 2009b) which can be ticked either Yes or No.

5.5.4 Participants

The matrons-in-charge of the two surgical wards were contacted prior to arriving at the research site to intimate them with details of the research study. All research information including participant information sheet and researcher details were made available to them. The matrons passed on the research information by pasting the hand hygiene observation notification poster (see appendix G) designed by the researcher on the notice boards and also by verbally communicating it to the HCWs on the wards a week before the study

commenced. Prospective participants, basically all HCWs in the two surgical wards were then provided with the participant information sheet (see appendix H), through the matrons to allow informed choice to either participate or decline and such that any queries can be clarified by the researcher.

5.5.5 Procedure

Though several observational studies on hand hygiene compliance have been conducted covertly with the rationale of limiting observer's bias which may consequently influence the practice of observed HCWs, covert observation was impractical in this study for some reasons. First, the researcher was not a staff of the research setting and the challenge of observer's bias persists. Secondly, unlike in developed countries like the UK, hand hygiene observational audit is not routinely done in Nigerian hospitals. To the best of the researcher's knowledge, this research is the first-hand hygiene observations conducted in the research setting. Therefore, the researcher wanted to give the participants a choice to either participate or not so, overt observation was employed, and participants were aware of the study durations.

All observed data were collected manually using the modified WHO hand hygiene observation form. The form was piloted prior to study commencement to ensure its fitness for purpose. The initially observed data were emailed to the researcher's supervisors to ensure data were collected correctly. Hand hygiene opportunities observed included one of the "My five moments of hand hygiene" namely : *"before patient contact, before aseptic procedure, after exposure to body fluids, after patient contact* and *after touching patient surroundings"* (WHO, 2009b). On the day the observations commenced, participants were reminded they needed not to do anything differently during observations and staff were

required to continue with their normal practice on the ward. The wards were open wards and because curtains meant for patient privacy were not always used, procedures being done on patients' bedsides could be seen clearly from the nurses' station. Hence, the researcher stood quietly at a corner in the nurses' station and did not interrupt patient care. This was to limit the challenge of reactivity in overt observation, where the observed participants are likely to change their behaviours when they are aware of being observed (Salkind, 2010). Creswell & Creswell (2018) stressed on the importance of approaching the research setting with respect and that the researcher should cause as minimal disruption as possible by displaying sufficient knowledge of research ethics throughout the research process. HCWs observed were those directly involved in patient care including doctors, nurses and health assistants. Observations were done during morning and afternoon shifts only.

5.5.6 Ethical Considerations

Ethics in research is a philosophical concept that deals with the complex issues of moral behaviours such as "good and bad" or "right or wrong" (Savin-Baden & Major, 2013). Ethics assist researchers to consider from a moral perspective how they should normally behave (Vanclay et al., 2013). It is a philosophy of morality that seeks to address the issues of morality. Common morality is defined as the *"…set of norms that morally serious persons share"* (Beauchamp & Childress, 2013). Though some people may share common moral views, divergent degree of views cannot be overruled on what constitutes morality (Holm, 2002). Ethical principles govern both the researcher and the research. Even though the principles do not guarantee an ethical research, they do offer an insight into ethical responsibility being a continuous process and the onus lies on the researcher to ensure this is upheld (Orb et al., 2001).

Ethical approval was obtained to conduct the hand hygiene observations as discussed in section 5.3 of this chapter. Respect for persons and informed consent are the underlying principles from which all other ethical principles emerge from (Vanclay et al., 2013). They entail providing the participants with adequate information and ensuring participants have sufficient understanding of the research as well as the consequences of participation to help them make informed decisions (Savin-Baden & Major, 2013; Vanclay et al., 2013). Participant information sheets were distributed to all HCWs working on the two surgical wards through their ward matrons. Instead of obtaining informed consent, dissent was employed in this study with a view to giving HCWs a choice to either participate in the observations or not. Dissent is an individual's prospective refusal to participate or withdraw from active participation in research activities (Brown et al., 2017). The HCWs' right to dissent was stated on the participant information sheet and the hand hygiene observation notification poster. A dissent form was designed for this purpose (see appendix I). Contact details of the researcher were given on both the observation notification poster and the participant information sheet to answer any queries or if anybody wanted to object to being observed, such individual could contact the researcher and could complete a dissent form. The plan was that if anyone did, hand hygiene observations would be done on days dissented HCWs are not on shift. This is to limit the effects the observations could have on them (as they might feel embarrassed, feeling they would be easily identified by not taking part in the study) and their social influences on other HCWs who have agreed to be observed. No one asked to be excluded from being observed. No information identifiable to any member of staff was collected and patients were not observed.

5.5.7 Data Analysis

Using Statistical Package for Social Sciences (SPSS) version 24.0, descriptive analysis of hand hygiene observation results was conducted, and results were presented according to professional group, seniority and hand hygiene opportunity of the participants.

5.5.8 Findings from Hand Hygiene Observations

The hand hygiene observations were conducted in May 2018, in the male and female surgical wards of the research setting. A total of 700 hand hygiene opportunities, 350 per surgical ward was observed for a period of 7 days to estimate the compliance rate. Of these, 341 were nurses, 238 were doctors and 121 were health assistants. Two hundred and eighty-two opportunities were recorded in the morning shifts and 418 opportunities recorded for afternoon shifts. The overall hand hygiene compliance rate was estimated as 29.1%. Compliance to hand hygiene varied across professional groups – 35.7% for doctors, 31.1% for nurses and 10.7% for health assistants. Hand hygiene compliance also varied according to the "five moments of hand hygiene" – 20.5% for before patient contact, 66.7% for before aseptic procedure, 78.5% for after exposure to body fluids, 10% for after touching a patient and 37.8% for after touching patient's surroundings.

Table 5.1 presents the distribution of hand hygiene opportunities and compliance rates according to professional category, "five moments of hand hygiene", ward and shift patterns.

Table 5-1 Overall Hand Hygiene Compliance Rate

Categorical Variables	Hand Hygiene Opportunities (n)	Compliance (n, %)
Overall	**700**	**204 (29.1)**
Professional Category		
Nurses	341	106 (31.1)
Doctors	238	85 (35.7)
Health Assistants	121	13 (10.7)
Moments of Hand Hygiene		
Before patient contact	224	46 (20.5)
Before aseptic procedure	36	24 (66.7)
After exposure to body fluids	65	51 (78.5)
After touching a patient	211	21 (10.0)
After touching patient's surroundings	164	62 (37.8)
Shift Pattern		
Morning shift	282	85 (30.1)
Afternoon shift	418	119 (28.5)
Ward		
Male surgical ward	350	60 (17.1)
Female surgical ward	350	144 (41.1)

All the professional groups had their best compliance after exposure to body fluids with compliance rates of 88.5% for doctors, 73.5% for nurses and 60% for health assistants. The least compliance was seen after touching a patient: 4.8% for health assistants, 10.1% for doctors and 12% for nurses. There were no hand hygiene opportunities before aseptic procedure for health assistants. Notably, doctors always had the highest compliance rate across the five moments of hand hygiene apart from after touching a patient where nurses had better compliance. The hand hygiene compliance rate according to professional group using the "five moments of hand hygiene" is presented in figure 5.3 below.

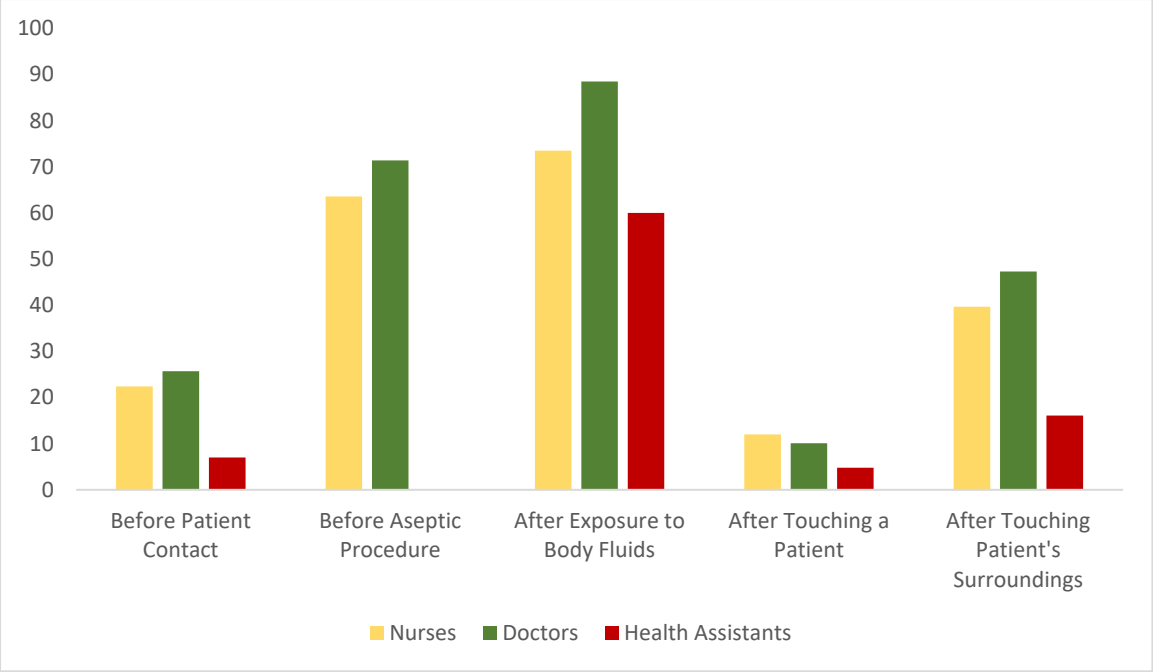


Figure 5-3 Hand Hygiene Compliance Rate according to Five Moments of Hand Hygiene

Hand hygiene compliance was also compared in terms of professional level. Among doctors, compliance ranged from 28% for medical officers to 44.6% for consultants. Compliance for house officers was 31.4% while resident doctors were 44.4% compliant. Among nurses, compliance ranged from 26.3% among assistant chief nursing officers to 34.9% among staff nurses. Compliance was 30% among senior nursing officers and 33.7% among chief nursing officers. This is presented in figures 5.4 and 5.5 below.

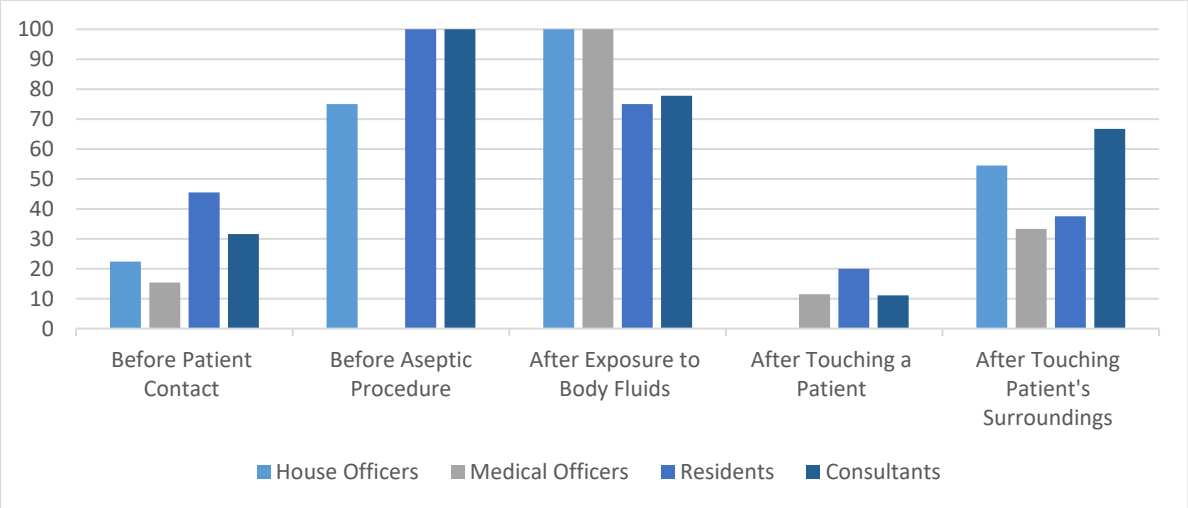


Figure 5-4 Hand Hygiene Compliance Rate according to Professional level (Medical), Based on the Five Moments of Hand Hygiene

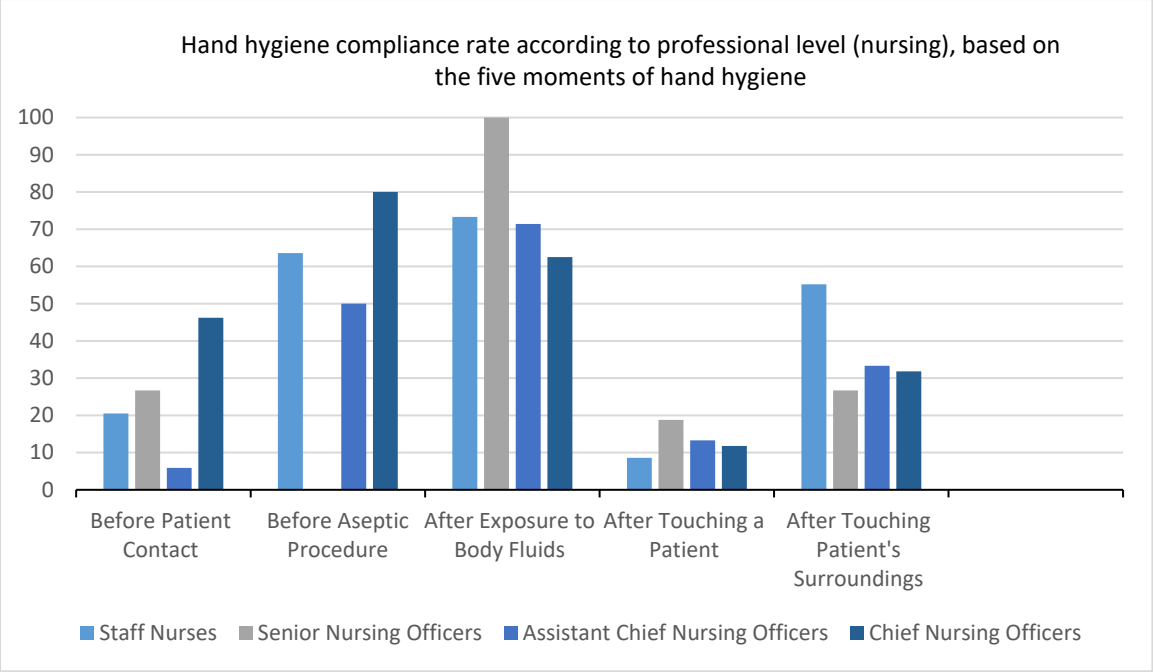


Figure 5-5 Hand Hygiene Compliance Rate according to Professional Level (Nursing), Based on the Five Moments of hand Hygiene

5.6 Study Strengths and Limitations

To the best of the researcher's knowledge, this study is the first to assess the hand hygiene compliance rate of surgical HCWs in this region. This is a contribution to body of knowledge bearing in mind the impact of SSI in SSA countries. However, some study limitations were identified.

The research employed overt observations which could have triggered Hawthorne effect whereby participants change their behaviours because of their awareness of being observed (McCambridge et al., 2014; Guest et al., 2019). However, HCWs' privacy was maintained by employing dissent and avoiding deception which is a big ethical issue in covert observations.

Secondly, observation data were collected manually which could result in missed hand hygiene opportunities however, the researcher sat quietly where clinical procedures and HCWs' hand hygiene practices could be well monitored uninterruptedly. In addition, the study was conducted in short duration however, a range of participants, performing

different clinical procedures, during morning and afternoon shifts, and wards were observed. A lot of hand hygiene opportunities were observed too.

Finally, this study was conducted in a private teaching hospital where more hand hygiene resources are expected to be available. It would be interesting to assess the hand hygiene compliance rates in surgical wards of public hospitals.

5.7 Chapter Summary

This chapter was in two sections. The first section aimed to assess and offer context to the hand hygiene resources available in the research setting while the second section aimed to determine the hand hygiene compliance rate among surgical HCWs through hand hygiene observations. Hand hygiene resources were insufficient at the time of the survey in both male and female surgical wards. The overall hand hygiene compliance rate was 29.1%. Compliance is greatest after exposure to body fluids (78.5%) and among doctors (35.7%). The barriers and levers to hand hygiene compliance are explored in chapters 7 (survey) and 8 (interviews) and using data from these chapters, how the findings compare to wider literature will be discussed in the discussion of findings chapter (chapter 9). In the next chapter, the barriers and levers to hand hygiene instrument (BALHHI) will be validated and tested for use in developing countries using confirmatory factor analysis (CFA).

Chapter 6 **Instrument Validation and Testing**

6.1 Introduction

The overarching aim of this PhD research is to determine the hand hygiene compliance rate, understand the barriers and levers to hand hygiene practices and validate the barriers and levers to hand hygiene instrument (BALHHI) for Nigerian HCWs. In chapter three, hand hygiene compliance rate as well as the barriers and levers to hand hygiene practices among HCWs from SSA countries were identified through a systematic literature review. Most of the studies included in the review were questionnaire-based which were not conceptualised by using any theoretical frameworks. Findings of these studies might have been compromised by not considering the full range of behavioural determinants and cognitive biases might have been missed. In chapter five, the hand hygiene resources in surgical wards and hand hygiene compliance rates of surgical HCWs in the research context were assessed through ward infrastructure survey and hand hygiene observations, respectively. Findings here are comparable to findings from the systematic review (chapter 3). Therefore, it is important to establish the barriers and levers to hand hygiene practices among HCWs from this region, using a standardised instrument.

This chapter presents the adoption, validation and testing of the *Barriers and Levers to Hand Hygiene Instrument* (BALHHI) for Nigerian HCWs. The chapter opens with the research aim which is followed by the research question. The research design is then presented. There are three rounds of validation and testing in this chapter – face validity, construct validity through confirmatory factor analysis (CFA) and test-retest reliability. A detailed account for each of the three rounds of instrument testing, including the methods, analysis, findings and summary of findings for each round is given. This is followed by the study strengths and

limitations. A chapter summary concludes this chapter. Figure 6.1 illustrates the 3 rounds of validation and testing.

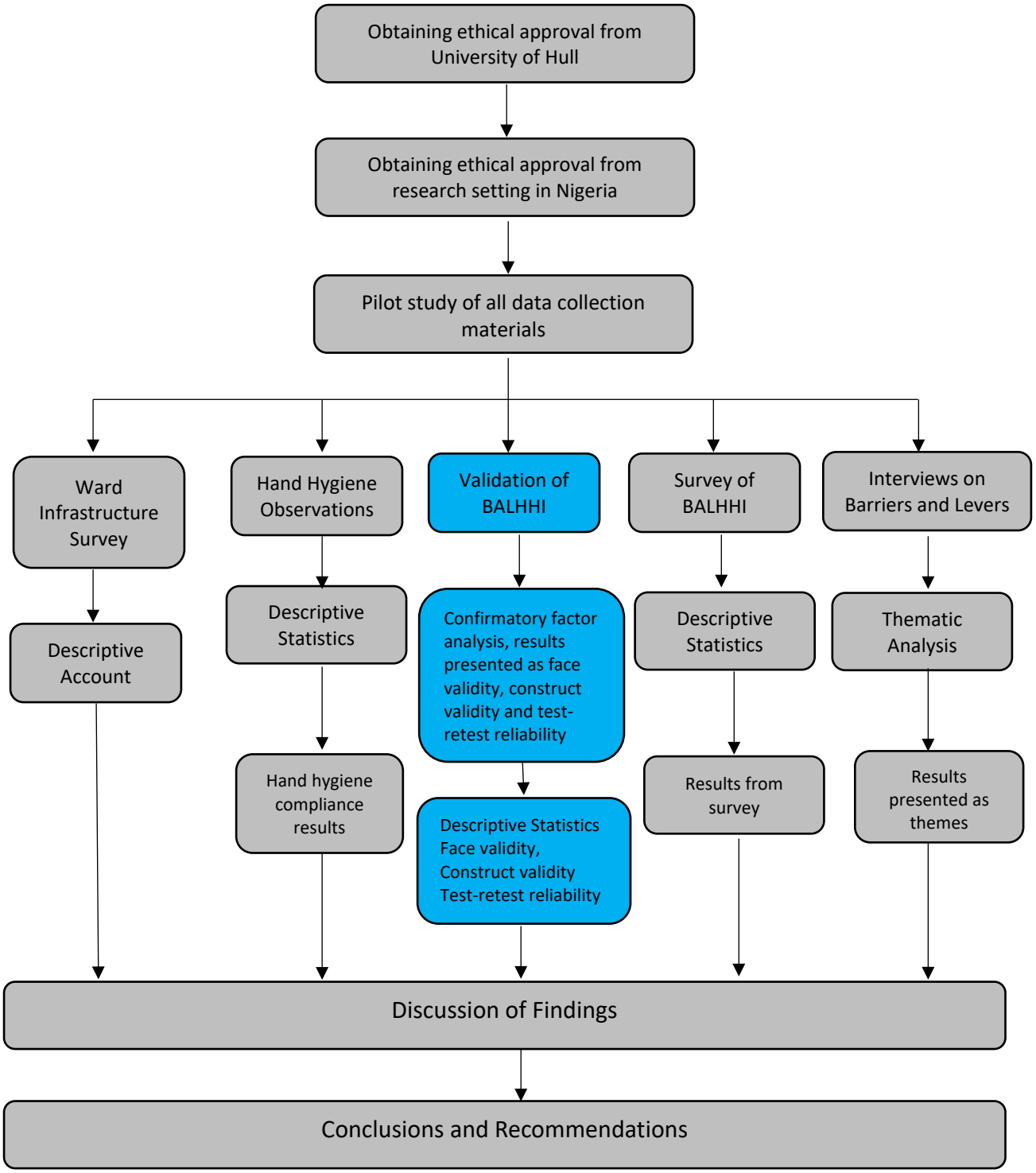


Figure 6-1 Flowchart Illustrating the Instrument Revalidation and Testing Process

6.2 Research Aim

To adapt and test the validity (face and construct) and reliability (test-retest) of the barriers and levers to hand hygiene instrument (BALHHI) among HCWs of a Nigerian teaching hospital.

6.3 Research Question

Is BALHHI valid and reliable among Nigerian HCWs?

6.4 Research Design

In this section, a description of BALHHI, how rigour was maintained and ethical considerations in this chapter are presented. BALHHI was employed and tested in three rounds. The methods for each round of validation and testing are described in the order in which they were conducted.

6.4.1 Description of the Barriers and Levers to Hand Hygiene Instrument (BALHHI)

The success of any research process depends on using the most appropriate research design and the most suitable data collection materials (Bryman, 2016). The BALHHI, a UK validated tool designed by Dyson et al. (2013) was used for this phase of the study, being an instrument that is explicitly related to hand hygiene and also designed using the TDF. The instrument was developed following four stages including a qualitative study to identify the barriers and levers to hand hygiene, a Delphi survey to group the barriers and levers according to the 11 domains of the TDF, a design stage which included selection of items to be included in the instrument and a pilot study to ascertain the acceptability and comprehensibility of the instrument. BALHHI consists of 46 items with 4 demographic items, 7 items testing the knowledge of hand hygiene and 35 other items testing either the barriers or levers to hand hygiene which are already mapped to the 11 domains of the TDF. The last

five questions of the instrument, which are knowledge-based items were adopted from the Institute for Healthcare Improvement (Dyson et al., 2013). The instrument was reported to have good psychometric properties in terms of its internal consistency (α = 0.84), construct validity (x^2/df = 1.84; P < 0.01), RMSEA = 0.05 and CFA = 0.84 (Dyson et al., 2013). BALHHI has been presented for use in clinical practice (Improvement Academy, 2020) and its use to assess the barriers and levers to hand hygiene has been reported (Brackett, 2016; Rees, 2016; Sutherland et al., 2015).

The purpose of using this instrument in this research is to adapt and test its validity (face and construct) and reliability (test-retest) in a Nigerian hospital with a view to developing a similar questionnaire that assesses the barriers and levers to hand hygiene in hospitals of developing countries. A permission was sought from Dr Judith Dyson, being the principal investigator when BALHHI was developed and she is also the main supervisor of this research. Three rounds were involved in this phase of the research including face validity, construct validity and test-retest reliability and these are discussed below accordingly.

6.4.2 Maintaining Rigour

In quantitative research, rigour is achieved through the measure of validity and reliability (LoBiondo-Wood & Haber, 2010). Validity relates to how precisely the findings accurately reflect the data while reliability is concerned with the consistency of the results and its repeatability (Bryman, 2016). The validity (face and construct) and reliability (internal and test-retest) tests conducted in this research are discussed under each round of instrument testing.

6.4.3 Ethical Considerations

Ethical approval was obtained to conduct the instrument validation and testing as discussed in section 5.3. To prevent coercion throughout the three rounds, the researcher allowed the participants to voluntarily decide whether to participate in the study or not (Vanclay et al. (2013). To minimise social desirability bias, participation was anonymous and no identifying information was requested. The questionnaires had the research information and instructions section as the first part, which detailed the participants' rights to voluntary participation, withdrawal, and anonymity. The researcher's contact email address was also provided should anybody want to get in touch for clarifications or queries. Taking informed consent was not considered necessary as completing the questionnaires translates to giving implied consent (Andres, 2012).

6.5 Round One – Face Validity

6.5.1 Introduction

Face validity is largely an intuitive process where the researcher tries to establish that the instrument adequately covers all the content of the concept being observed (Heale & Twycross, 2015; Bryman, 2016).

6.5.2 Aim

The aim of this round is to test variability of response, internal consistency and distribution of items in relation to the 11 domains of the TDF.

6.5.3 Design

In face validity, experts in the field or people with experience are asked their opinions and they judge if on the face of it, the instrument reflects the concept being explored (Streiner et al., 2015; Bryman, 2016). To address the aim of this round, an initial testing of instrument was conducted first followed by the main study. Data such as demographic features of

participants, normality tests of items and domains, and internal consistency were collected in this round. These are further discussed in the analysis section of this round.

6.5.4 Initial Testing of Instrument

Bryman (2016) advised that a small group of comparable people to that of the main study should be engaged in pilot study so as not to contaminate the main study group prior to conducting the main research. To subjectively check with participants if BALHHI truly measures the barriers and levers to hand hygiene practices in Nigeria, an initial testing of BALHHI was conducted with two Nigerian HCWs within the researcher's network. These included a doctor and a nurse who had previously worked within the Nigeria healthcare setting but resident in the UK at this time. Participants were requested to complete the instrument and give feedback on clarity, the time taken to complete and any suggestions for improvement. Results from the initial testing demonstrated that the questionnaire was clear, comprehensible, and satisfactory. No changes were made to the instrument following feedback. Participants' responses were included as part of the data for this round of testing since no changes were made.

6.5.5 Participants

Nigerian HCWs who had previously worked within the Nigerian healthcare setting but resident in the UK at the time of data collection were recruited for this round while those with no previous practice experience within the Nigerian healthcare setting, and also those that were not directly involved in patient care were excluded. No health assistants were recruited in this round too because only trained doctors and nurses are recruited in the UK. Using subjects from the target group as experts ensures the representativeness of the population to whom the instrument is intended for (Zamanzadeh et al., 2015). Determining the number of participants has been arbitrary. While Zamanzadeh et al. (2015) recommend

a minimum of 5 people, another author recommends 10 to 15 people in a homogenous group (Ziglio, 1996). For this round, 13 more Nigerian HCWs were recruited to make a total of 15 participants for this round. It was anticipated that a minimum of 10 participants will be included in this round.

Convenience sampling was employed in this round to capture those that conform to the research interest. Convenience sampling is a type of nonprobability sampling where people are sampled because they are accessible sources of data collection, especially in terms of geographical location (Lavrakas, 2008; Edgar & Manz, 2017). In convenience sampling, subjective approaches are employed in deciding who to include in the sample (Lavrakas, 2008). Both doctors and nurses were recruited through snowballing. People in the researcher's network (for instance, former work colleague) assisted with the recruitment of doctors and nurses within their own network by approaching them with the research information. Snowballing, similar to convenience sampling is a nonprobability sampling technique based on referrals from initial participants to generate additional participants (Allen, 2017). The contact details including their job titles and email addresses were requested and the researcher contacted the potential participants via email with the research details and requesting them to participate in the research.

6.5.6 Procedure

After obtaining ethical approval from the SHSW REC for this research, the researcher sent the instrument to the participants via email. Participants were given two weeks to complete and return the instrument to the researcher via email. Apart from completing the questionnaire, participants were also asked to feedback on the instrument including the time it took to complete it, whether the items on the questionnaire were easily

understandable and suggest any changes that could be made to the instrument or any advice that could improve the research. No prompts or reminders were sent.

6.5.7 Ethical Considerations

The ethical considerations for this round of testing are presented in section 6.4.3 of this chapter.

6.5.8 Data Analysis

All data were inputted into SPSS version 24.0. Data analysis was conducted through descriptive statistics and internal consistency. Demographic features of participants such as gender, job title, areas of specialty and years of experience were collected so as to have an idea of the representativeness of the participants when the results are presented.

6.5.8.1 Descriptive Statistics

Descriptive statistics are used to describe the basic characteristics of the data in a study and they provide simple summaries about the sample and the measures (Trochim, 2020). Descriptive statistics include measures in terms of frequency table, central tendency and measures of dispersion (Watson, 2015; Bryman, 2016). The following measures of descriptive statistics were employed in all the 3 rounds of this chapter.

1. Frequency Tables – A frequency table presents the number of people and the percentage belonging to each of the categories for the variable in question (Bryman, 2016).
2. Measures of Central Tendency – These include, mean, median and mode. While mode is the most frequently occurring number in a distribution (Watson, 2015) and median is the midpoint in a distribution of values (Bryman, 2016), mean is the sum of

all the numbers in a dataset, divided by the number of numbers (Watson, 2015). Only mean scores are calculated in this study.

3. Measures of Dispersion/Variability of Response/Spread – This is a description of how widely the data diverge from the central tendency. The measures of variability tested in this study include range, standard deviation (SD) and normality tests. Range is the difference between the maximum and minimum value in a distribution of values (Bryman, 2016) while standard deviation is a measure that describes the 68% of the data either side of the mean in a normal distribution (Watson, 2015). Standard deviation is calculated by taking the difference between each value in a distribution and the mean and then dividing the total of the differences by the number of values (Bryman, 2016).

   Normal distribution is particularly crucial in instrument testing and a non-normal distribution may be detected by significant skew or kurtosis values (Harrington, 2009). Skew and kurtosis were used to check the normality of data distribution in this study. Skewness deals with the symmetry of distribution while kurtosis deals with the peakedness of a distribution (Tabachnick & Fidell, 2014). A skewed variable is such whose mean is not in the centre of the distribution while a distribution can either be too peaked or too flat. Absolute values of skew greater than 3 indicates an extremely skewed distribution while absolute values of kurtosis greater than 10.0 suggests a flawed distribution (Kline, 2015). Kline (2005) noted that kurtosis values greater than 20.0 imply a significantly serious problem.

In this round, the demographic features such as gender, job title, areas of specialty, years of experience and the year the participants last worked in Nigeria were analysed using

frequency table and calculating the mean scores and standard deviation. Mean scores, standard deviation, skewness and kurtosis for items were also calculated and presented. All 35 items, excluding questions on demographic features and the knowledge test questions were considered.

6.5.8.2 Internal consistency

In psychometric testing, high reliability is a pre-requisite of validity (Nunnally, 1978). The concepts of reliability in quantitative research relate to the degree at which an instrument, given repeatedly, remains the same; the stability of an instrument over time and the similarity of measurements within a given timeframe (kirk and Miller, 1986 cited in (Golafshani, 2003). The two major ways of testing the reliability of an instrument are internal consistency (which involves the single administration of the instrument and it is expected that the scores on an item would correlate with scores on all other items of a given instrument (Streiner et al., 2015), and test-retest reliability (which is discussed at the third round of the instrument testing).

Reliability is usually expressed as a value between 0 and 1 with 0 indicating no reliability and 1 indicating perfect reliability (Streiner et al., 2015). The closer it is to 1, the higher the reliability estimate of the instrument. Cronbach's alpha, Kuder-Richardson or split-halves are the ways of calculating correlations in internal consistency, but Cronbach's alpha is the commonest. It tests whether the items on an instrument measure the same constructs (domains). Streiner et al. (2015) suggest an internal consistency greater than 0.80 though another school of thought is that an alpha of 0.60 or greater is a reasonable level of fit (Ping, 2004).

In this round, internal consistency for the entire questionnaire as well as individual items were calculated and presented in the findings section. Cronbach's alpha was used to test for internal consistency in this study.

6.5.9 Inclusion and Removal of Items

Criteria for consideration when removing items are as follows:

1. Participants' feedback following face validity
2. Lack of variability, which is a standard deviation of less than 1.5 (Ping, 2004), poor correlation of items in the domains which is Cronbach's alpha of less than 0.6 per domain (Ping, 2004) and a Skew of more than 3 in either directions (Kline, 2015).

Instrument design experts advised that items should be largely retained in the early phases of instrument design, especially when domains have few items (Streiner et al., 2015). The above criteria were considered and justification for removing or retaining items made. Moreover, in this round, there were only 15 participants, no health assistants were included, and they all work in the UK at the time of data collection. Decisions to retain or remove items were made by the researcher and supervisors in a series of periodic meetings. All items were considered for inclusion on the instrument in this round of testing.

6.5.10 Findings from Round One of Testing

The only modifications made to BALHHI at this stage was the inclusion of an item that requests the last time the participants worked in Nigeria (see appendix J for original BALHHI modified here). The section for information and instructions was also edited to reflect that the research is being conducted among Nigerian HCWs as part of a PhD research and the researcher's details were included should there be a need to contact the researcher. In

total, 12 questionnaires were retrieved with some useful feedback given which informed the modified BALHHI that was used in the second round of testing.

Findings from demographic features of participants are presented first using descriptive statistics. These include range, mean, standard deviation and a frequency table showing the distribution. Feedback from face validity and modifications made are then presented. This is followed by results from normality tests and variability of response showing the distribution of items in terms of mean, standard deviation, skewness, and kurtosis. The reliability score (internal consistency) of the whole questionnaire and items per domain are then presented. Justifications for retaining or removing any items were made as the findings were presented.

6.5.10.1 Demographic Features of Participants

Twelve out of 15 participants returned the questionnaire giving a response rate of 80%. Seven of them were females (58.3%) while five were males (41.7%). Eight were doctors (66.7%) while four were nurses (33.3%). Nurses were underrepresented in this round. These are presented in table 6.1. Years of experience in profession ranged from 3 years to 27 years (mean = 8.9, SD = 6.11). The last time they worked within the Nigerian healthcare setting ranged from 3 months to 9 years prior to questionnaire administration (mean = 3.4, SD = 2.82). Areas of speciality varied, and this is presented in table 6.2.

Table 6-1 Distribution of Participants according to Gender and Job Title (round 1)

Gender			**Job title**		
Participants	**Frequency**	**Percentage**	**Participants**	**Frequency**	**Percentage**
Male	5	41.7	Doctor	8	66.7
Female	7	58.3	Nurse	4	33.3
Total	**12**	**100.0**	**Total**	**12**	**100.0**

Table 6-2 Distribution of Participants according to Areas of Specialty (round 1)

Participants	Areas of specialty							
	Medicine	**Surgery**	**O&G**	**Paediatrics**	**A&E**	**Out-Patient**	**ENT**	**Total**
Doctors	2	-	1	-	1	2	1	7
Nurses	-	1	2	1	-	-	-	4
Total	**2**	**1**	**3**	**1**	**1**	**2**	**1**	**11**
Percentage	**18.2**	**9.1**	**27.3**	**9.1**	**9.1**	**18.2**	**9.1**	**100.0**

6.5.10.2 Modifications made following Feedback from Face Validity

The feedback from participants were considered in detail and the decision to modify or remove items was justified based on the research aim as well as the literature. These were also discussed with the supervisors and agreement was reached on whether to modify or remove the items following the theoretical justifications.

1. Changing the instrument from seven-point Likert to a five-point Likert scale

Participants recommended changing the Likert scale from 7 to a 5-point scale as they were unsure what the other two points were measuring. This recommendation was accepted and the Likert scale of BALHHI was reduced 7 to a 5-point scale because previous research acknowledged the difficulty for research participants to differentiate between categories that are only subtly different (Boslaugh, 2008).

Traditionally, scales with more points are considered to be more reliable and some researchers have suggested that reliability is heightened with 7-point response categories (Alwin, 1997; Colman & Norris, 1997). Five or 7-point scales are considered generally more practical than longer scales and they yield better quality data than other scale points (Robinson, 2018). Seven-point scales have also been reported to have stronger correlations with t-test results (Lewis, 1993). Though they offer more choice to the participants

(Boslaugh, 2008), 7-point scales have been criticised for their lack of verbal labelling from points 2 to 6 (Lewis, 1993). It is simpler for the researcher to read out (where necessary) the complete list of scale descriptors in a 5-point scale and the researcher finds it easier to analyse the data (Dawes, 2008). Some researchers also suggested that a 5-point scale can increase response rate, quality of data collected as well as reduce the "frustration level" of participants (Babakus & Mangold, 1992; Buttle, 1996; Olakunke, 2003). This is an advantage for participants that commented that there were too many questions, completing the questionnaire was time consuming and it became boring midway. Moreover, some participants suggested that a 5-point Likert scale can be less confusing and more understandable for the participants. Some research also reported higher quality of data with a 5-point scale when compared to a 7 or 11-point Likert scale (Revilla et al., 2014) though resultant data can be comparable when either of 5 or 7-point Likert scale is used (Dawes, 2008).

2. Items on the instrument

Some participants noted there were too many questions on the instrument and completing it was time-consuming and became boring midway. They suggested that some items should be removed to shorten the questionnaire. However, it is impossible to reduce the items on the questionnaire just because there are too many of them. The intention is to retain as many items as possible in this round (Streiner et al., 2015). The instrument is underpinned by the TDF which has 11 domains/constructs. For each of the domains to be viable when the final version of the instrument is developed, there must be a minimum of 3 preferably 4 items per domain (Robinson, 2018). Hence, the researcher decided to retain these questions since feedback is at face validity level.

3. Items local to the UK and irrelevant to the Nigerian context

Participants commented about four items that are irrelevant to the Nigerian healthcare setting. For instance, items 9 and 22, *"government targets have led to improvements in my hand hygiene"* and *"some government targets make hand hygiene more difficult (such as high bed occupancy)"* are local to the UK as there are no government targets on hand hygiene in Nigeria/Africa. This goes for items 30 and 40, *"hospital targets relating to infection control or hand hygiene has led to improvements in my hand hygiene"* and *"some strategies to improve hand hygiene influence my practice"*. These items assume there are hospital targets and strategies but there are none in Nigeria/Africa. All four items fall into the action planning domain. If they are all removed there would be none left in this domain thereby rendering the domain unviable. So, 3 out of 4 items were left in the instrument. It is important to retain these items to alert the researcher to potential problems that might be encountered in the second round of testing. Item 22, *"some government targets make hand hygiene more difficult (such as high bed occupancy)"* was removed because of its similarity to item 9, *"government targets have led to improvements in my hand hygiene"* and because government targets such as high bed occupancy is local to the UK.

4. Language Use

Participants suggested that the researcher should consider rephrasing the words used in some items for fitness into the Nigerian context and better understanding by the participants. This suggestion is welcome because even though English language is the language of instruction in Nigeria, there are over 500 ethnic backgrounds in Nigeria, each having its own local language (Blench, 2019). For the research setting, the population speak mostly Yoruba language and only communicate in English at formal places and when need

be. Therefore, the researcher acknowledges some people may likely find some words difficult to understand hence, the need to choose the easiest to comprehend words. *"Second nature"* in item 14 *("hand hygiene is not second nature for me")* was substituted with *"habit"*, *"praised"* in item 16 *("when staff engage in hand hygiene, they are praised")* was substituted with *"receive positive feedback"* while *"cluttered"* in item 35 *("my environment is cluttered")* was substituted with *"untidy"* as the words synonymised well.

However, *"complacent"* in item 12 *("I feel complacent about hand hygiene")* was left unchanged because of the difficulty to find a word that snugly fits the concept. Suggested synonyms from participants were *"pleased"* or *"satisfied".* Complacent does not mean pleased or satisfied – which only captures a little bit of the concept. Complacency means lack of critical analysis of a persons' actions, smugness, unaware of the potential for error or poor practice, blinded to reality, inflexible to the potential for things to go wrong. Hence the decision to leave it unchanged. Similarly, *"angry"* in item 15 *("I feel angry if hand hygiene is not carried out by others")* was left unchanged. Suggested word from participants was *"uncomfortable"*. Because this item falls into the *"emotion"* domain, the suggested word does not totally capture the emotional undertone of the item hence, it was left unchanged.

5. Modifying item contents

For item 11, *"It is difficult for me to attend hand hygiene courses due to time pressure"*, one participant suggested that the item should first ask if hand hygiene courses are available before asking the question and that participants may skip the question if answered "No". Because this item is about time which falls within the "*environmental context and resources"* domain, the researcher decided to change it such that it is still about time but does not mention courses. Hence the item was changed to *"it is difficult for me to learn*

about hand hygiene due to time pressure". More so, there is already a question about hand hygiene training so, changing it as suggested would be duplication.

Similarly, some participants suggested that item 19, *("there are some practical barriers to hand hygiene because of my particular job/role"* may be divided into two. For instance, *"are there barriers to hand hygiene practices? Yes/No. If yes, please itemise..."*. However, there is no need to break this item down because if there are no practical barriers, participants can score strongly disagree and for the construct validity round, there will be a further question with blank space asking *"are there any further barriers to hand hygiene that you have not already told us about?"*. Table 6.3 presents the summary of the feedback and actions taken.

Table 6-3 Feedback from Face Validity

S/N	Feedback	Decisions taken
1.	Too many items on the questionnaire, consider removing some to shorten the instrument	Items not removed to maintain the viability of the domains. Variability of response will be used to judge removal of items
2.	Consider reducing the scale from a seven-point to a five-point scale	Scale was reduced to a five-point scale. (See justifications in text above)
3.	Some items are local to the UK, consider removing them for relevance to the Nigerian context	Only item 22 was removed because of its similarity to item 9 and to maintain the viability of the domain
4.	Consider rewording some words with words that are better comprehended Item 12 – "complacent" might be rephrased as "pleased/satisfied" Item 14 – "second nature" might be rephrased as "habit" Item 15 – may not be "angry" but can be "uncomfortable" Item 16 – "praise" might be rephrased as "positive feedback" Item 35 – "cluttered" might be rephrased as "untidy"	Items 14, 16 and 35 were reworded as advised. Items 12 and 15 were left unchanged as the suggested words do not fully capture the meanings of the concepts in the items
5	Consider modifying the contents of items 11 and 19	Item 11 was modified while 19 was left unchanged (see justification in text above)

6.5.10.3 Normality Tests and Variability of Response

Skewness, kurtosis, mean scores and standard deviations were calculated to measure the distribution of all 35 items in this round. A skew of more than 3 in either directions and Kurtosis greater than 10 suggest a flawed distribution (Kline, 2015). No items had a skew value greater than 3 or kurtosis value greater than 10. Six items (items 20, 21, 34, 36, 37, 42) had standard deviation values less than 1.5 (Ping, 2004) but these items were retained following the recommendation of inclusivity by instrument development experts (Streiner et al., 2015), to ensure there are enough items for the domains to be viable. The mean scores, standard deviation, skew and kurtosis values of the items are presented in table 6.4.

Table 6-4 Normality Tests and Variability of Responses of the Items (round 1)

Normality Tests and Variability of Response				
Items	**Mean**	**SD**	**Skew**	**Kurtosis**
8. I engage in hand hygiene out of respect for my patients	3.27	2.05	0.65	-0.85
9. There are government targets have led to improvements in my hand hygiene	5.45	2.12	-1.12	0.17
10. Hand hygiene is a non-negotiable part of my role	5.82	1.78	-1.49	1.11
11. It is difficult for me to attend hand hygiene courses due to time pressure	3.55	2.25	-0.01	-1.60
12. I feel complacent about hand hygiene	2.91	1.70	0.47	-0.78
13 Sometimes I miss out hand hygiene simply because I forget it	3.82	1.99	-0.35	-1.60
14. Hand hygiene is not second nature for me	5.36	1.69	-0.70	-0.40
15. I feel angry if hand hygiene is not carried out by others	3.27	2.24	0.367	-1.43
16. When staff engage in hand hygiene they are praised	3.19	1.94	0.29	-1.45
17. I am more likely to forget hand hygiene if I am tired	4.73	2.10	-0.19	-2.05
18. Hand hygiene training is available to me	2.91	2.51	0.73	-1.56
19. There are some practical barriers to hand hygiene because of my particular job/role	5.09	2.34	-0.99	-0.34
20. If I do not engage in hand hygiene I may catch an infection	7.00	0.00	.	.
21. I cannot be bothered with hand hygiene	6.73	0.65	-2.42	5.51

Normality Tests and Variability of Response				
Items	**Mean**	**SD**	**Skew**	**Kurtosis**
22. Some government targets make hand hygiene more difficult (such as high bed occupancy)	2.27	1.74	2.29	6.11
23. If I omitted hand hygiene I would blame myself for infections	2.91	2.43	0.95	-0.74
24. I engage in hand hygiene because I do not want to let the team down	4.82	2.04	0.39	-0.72
25. There are adverts or newsletters about hand hygiene in my workplace	3.18	2.41	0.34	-1.75
26. I am reluctant to ask others to engage in hand hygiene	3.09	1.97	0.13	-1.87
27. The frequency of hand hygiene required makes it difficult for me to carry it out as often as necessary	4.27	2.15	-0.14	-1.57
28. I disagree with some parts of the hand hygiene guidelines	5.27	2.41	-1.12	-0.24
29. I am confident in my ability to carry out hand hygiene	2.00	1.84	2.34	5.89
30. Hospital targets relating to infection or hand hygiene has led to improvements in my hand hygiene	3.63	2.46	0.32	-1.78
31. I feel frustrated when others omit hand hygiene	2.82	1.78	1.25	2.12
32. If I engage in hand hygiene it improves patient confidence	2.36	1.80	1.21	0.12
33. Hand hygiene guidelines are easily accessible	3.82	2.18	-0.14	-1.41
34. Hand hygiene is part of my professional culture	2.00	1.26	0.73	-1.30
35. My environment is cluttered	3.64	2.29	0.43	-1.45
36. I feel guilty if I omit hand hygiene	6.09	0.83	-1.47	3.96
37. I feel ashamed if I omit hand hygiene	2.36	1.36	2.09	5.55
38. My area of work has poor staffing levels	2.55	1.92	1.32	1.70
39. Supervision from senior staff means that carrying out hand hygiene is easier for me	5.09	1.92	-0.98	0.46
40. Some strategies designed to improve hand hygiene influence my practice	3.64	2.50	0.41	-1.60
41. My hand hygiene is encouraged by others	4.27	2.41	-0.13	-1.76
42. If I miss out hand hygiene I will be subject to disciplinary action	6.09	1.38	-1.04	-0.98

6.5.10.4 Internal Consistency

The reliability score for the whole questionnaire was calculated as 0.6 using Cronbach's alpha. In terms of reliability score of items according to domains, only 4 out of 10 domains

("knowledge and skills, social/professional role and identity, emotion, action planning") had a minimum score of 0.6. While Cronbach's alpha was checked for all items per domain, the researcher did not use the Cronbach's alpha values to remove items at this stage. This is following the recommendation of Streiner et al. (2015). The Cronbach's alpha of items per domain are presented in table 6.5.

Table 6-5 Cronbach's Alpha of Items Per Domain (round 1)

Domains	Items	Cronbach's Alpha per domain	Cronbach's alpha if item deleted
Knowledge and skills	Hand hygiene training is available to me	0.82	0.75
	There are adverts or newsletters about hand hygiene in my workplace		0.84
	Hand hygiene guidelines are easily accessible		0.68
Social/professional role and identity	I engage in hand hygiene out of respect for my patients	0.79	-
	Hand hygiene is a non-negotiable part of my role		-
Belief about capabilities	There are some practical barriers to hand hygiene because of my particular job/role	0.46	-0.12
	I am reluctant to ask others to engage in hand hygiene		0.72
	The frequency of hand hygiene required makes it difficult for me to carry it out as often as necessary		0.15
	I am confident in my ability to carry out hand hygiene		0.43
Belief about consequences	If I do not engage in hand hygiene I may catch an infection	0.09	0.10
	If I omitted hand hygiene I would blame myself for infections		-0.15
	If I engage in hand hygiene it improves patient confidence		-0.84
	If I miss out hand hygiene I will be subject to disciplinary action		0.46

Domains	Items	Cronbach's Alpha per domain	Cronbach's alpha if item deleted
Motivation and goals	I feel complacent about hand hygiene	0.19	0.05
	I cannot be bothered with hand hygiene		-0.03
	I disagree with some parts of the hand hygiene guidelines		-0.94
Memory, attention and decision processes	Sometimes I miss out hand hygiene simply because I forget it	-2.09	0.33
	Hand hygiene is not second nature for me		-1.44
	I am more likely to forget hand hygiene if I am tired		-3.77
Environmental context and resources	It is difficult for me to learn about hand hygiene due to time pressure	0.53	0.62
	My environment is cluttered		0.03
	My area of work has poor staffing levels		0.50
Social influences	When staff engage in hand hygiene they are praised	0.26	0.43
	I engage in hand hygiene because I do not want to let the team down		-0.44
	Supervision from senior staff means that carrying out hand hygiene is easier for me		0.21
	My hand hygiene is encouraged by others		0.36
Emotion	I feel angry if hand hygiene is not carried out by others	0.61	0.35
	I feel frustrated when others omit hand hygiene		0.12
	I feel guilty if I omit hand hygiene		0.79
	I feel ashamed if I omit hand hygiene		0.49
Action planning	There are government targets which have led to improvements in my hand hygiene	0.70	0.70
	Some government targets make hand hygiene more difficult (such as high bed occupancy)		0.69
	Hospital targets relating to infection or hand hygiene has led to improvements in my hand hygiene		0.58

Domains	Items	Cronbach's Alpha per domain	Cronbach's alpha if item deleted
	Some strategies designed to improve hand hygiene influence my practice		0.52

6.5.11 Summary of Findings (Round One)

This first round of testing was conducted to identify items that showed variability of response, good internal consistency and reasonably normal distributions in relation to the 11 domains of the TDF. An initial testing and face validity of BALHHI was carried out by distributing the instrument among Nigerian HCWs resident in the UK. The instrument was modified following participant feedback from face validity. Variability of response was poor, but items were largely retained to maintain the viability of the domains in accordance to expert recommendations. Only one item from the action planning domain was removed in this round. Though items in this domain were mostly irrelevant in the Nigerian context, they were retained to ensure the domain is viable for the next round of testing. Internal consistency of the whole questionnaire and items per domain was also measured. The reliability score for the whole questionnaire was 0.6 using Cronbach's alpha. Construct validity will be conducted in the next round using confirmatory factor analysis.

6.6 Round Two – Construct Validity

6.6.1 Introduction

Construct validity tests whether inferences can be drawn about test scores related to the concept being studied (Heale & Twycross, 2015). It is the appropriateness of inferences made on the basis of observed and latent (unobserved) variables (Krabbe, 2017). There are two types of construct validity – convergent and discriminant validity. Convergent validity is demonstrated when measures of the same construct are highly correlated (Harrington, 2009; Watson, 2015). Convergent validity confirms that measures that should be theoretically related are in fact related. In contrast, discriminant validity is established when there is low correlations between measures of different constructs (Harrington, 2009). This implies that measures that should not theoretically be related are in fact not related. Construct validity can be measured through confirmatory factor analysis (CFA) and this will be employed in this round. CFA is useful in examining the dimensionality of an instrument, as well as examining the latent structure of an instrument during scale development (Harrington, 2009).

6.6.2 Aim

The aim of this round is for construct validation to check all the items on the instruments fitted within the domains of the TDF.

6.6.3 Design

Two extra items were added to the instrument in this round. First is an item which asked if there are any further barriers to hand hygiene that the participants would like to talk about, and blank spaces were left for this item. The second item added asked if any participants would be willing to complete the questionnaire one more time and in order to facilitate this to provide their contact details in the space provided. This is to allow for the third round of

testing which aimed at evaluating the stability of BALHHI by measuring the test-retest reliability among HCWs from the study site. It was reiterated that their names and contact details provided would not be linked to any information they provide in this research (see appendix K for modified BALHHI for the second round of testing).

6.6.4 Research Setting

The research setting was described in chapter 5, section 5.2.

6.6.5 Participants

To conduct CFA, it is important that an adequate sample size is used in this round. Kline (2015) stressed that the sample must precisely represent the target population at which the test is aimed and that the sample must be sufficiently large enough to reduce the standard errors of the normative data to insignificant proportions. A rule of thumb suggests 5 participants per item being tested (Tabachnick & Fidell, 2014). Since 34 items remained after the first round of testing, this suggests a minimum of 170 participants. Some statisticians suggest that a sample size of less than 100 is “small” and may only be appropriate for simple models while a sample size of 100 to 200 is considered “medium” and may be acceptable if the model is not too complex (Kline, 2016). A sample size of 200 or more is considered “large” and acceptable for most models (Kline, 2016).

To ensure there are enough participants to conduct the CFA, the researcher followed the advice of Kline (2016). The inclusion criterion is all HCWs within the research context, both qualified and unqualified who have direct contact with patients. These include doctors, nurses, health assistants and technicians. Participants for this round of testing were not limited to surgical wards for a number of reasons. Findings from the ward infrastructure survey (chapter 5) suggest there are 57 HCWs (including 30 nurses, 15 doctors and 12 health

assistants) in the 2 adult surgical wards of the research setting. This is insufficient to conduct CFA. As at February 2018, the total number of doctors, nurses, health assistants and technicians in the study site was 322 according to the data obtained from the administrative department of the hospital. Therefore, it is pertinent to extend participants to other areas of specialty. More so, a lot of the findings about cultural elements are relevant to all HCWs in the setting, regardless of their areas of specialty being in the same context, same culture and having received same training.

All potential participants that fit into the research inclusion criteria are included in this round. To accommodate for anticipated low response rate, the instrument was distributed to all HCWs willing to participate with a minimum target distribution of 270.

6.6.6 Procedure

After concluding the ward infrastructure survey and hand hygiene observations (chapter 5), the matrons-in-charge of each of the units of the hospital were met individually and the research information was given to them. They were then asked if they would allow the administration of the questionnaires on their wards. None of them refused. All queries were answered, and the researcher's contact details were provided should anyone needed to get in touch. In some instances, some matrons requested to see the ethical approval from the hospital, and this was made available to them while some delegated one of the nurses on their wards to oversee the administration and retrieval of the questionnaires. Participants were given 2 weeks for the questionnaires to be returned. Self-adhesive envelopes were provided with which the questionnaires are to be returned to promote anonymity of the participants. Participants returned the questionnaires to the designated nurse that administered to them or to the designated location, depending on the ward and

questionnaires were retrieved from the designated nurse per ward, on a daily basis to ensure none of the questionnaires got lost. To enhance the response rate, monetary voucher of N1000 per ward (equivalent of £2.10) was given to the participants.

6.6.7 Ethical considerations

The ethical considerations for this round of testing are presented in section 6.4.3 of this chapter.

6.6.8 Data Analysis

All data were inputted into SPSS version 24.0. Data analysis was conducted through descriptive statistics, internal consistency, and construct validity. The following methods of analysis were employed in this round of testing.

6.6.8.1 Demographic Features of Participants

Demographic features of participants such as gender, job title, areas of specialty and years of experience were collected to check the representativeness of the participants when the results are presented. These were described using descriptive statistics. A frequency table was presented. Mean scores and standard deviation were also calculated and presented. See section 6.5.8.1 on the measures of descriptive statistics used for the demographic features of the participants.

6.6.8.2 Normality Testing and Variability of Responses

Normality tests and variability of responses including mean, standard deviation, skewness and kurtosis were calculated in this round to check the spread of items and their distribution. Skew value of 3.0 and kurtosis of 10 in either direction are considered flawed distribution. See section 6.5.8.1 on the measures of dispersion employed here.

6.6.8.3 Internal Consistency

Internal consistency of the whole questionnaire as well as items per domain was checked to establish the reliability of the questionnaire and items. Cronbach's alpha was used to test for internal consistency in this study. No item was removed based on Cronbach's alpha and negatively worded items are reworded before checking for reliability of the instrument. See section 6.5.8.2 for measures of internal consistency.

6.6.8.4 Construct Validity

This was conducted using CFA, an extremely useful measure within social research to develop new measures, to evaluate psychometric properties of new and existing measures, to examine method effects and construct validation across groups, population and/or time (Brown, 2006). Like in this study, CFA is a great psychometric measure of testing existing measure, BALHHI in this case, to examine if the original structure of an instrument works well in a new population (Harrington, 2009). The CFA for construct validity was conducted using the Analysis of Moment Structure (AMOS) software version 24 and the following steps were involved in the analysis process.

1. Missing Data

The first step was to take care of the missing data. This is a crucial step as missing data can result in misleading results and possible flawed implications of findings (Harrington, 2009). In instances of missing data, it is advised that the values are either estimated or the cases deleted (Tabachnick & Fidell, 2014). For large data points with 5% or less missing data, it is unlikely that the results of data analysis are affected by the missing data and any method of handling the missing data would suffice (Tabachnick & Fidell, 2007). It is worthy to note that

the latest versions of almost all the statistical software packages are able to handle missing data either by imputation or by deletion.

2. Normality Tests

Normal distribution was checked using skewness and kurtosis values. See section 6.5.8.1 for discussion on this. In this study, none of the distribution exceeded 3 or 10 for skew and kurtosis respectively, as advised by Kline (2005). As a result, all items were retained at this stage. Skew and kurtosis were calculated in SPSS version 24.

3. Model Specification in AMOS

The model was specified in the AMOS software version 24. AMOS is a statistical software package, an SPSS added module designed specifically for structural equation modelling and confirmatory factor analysis (Statistics Solution, 2019). AMOS is used to graphically draw models to test hypotheses and confirm relationships between observed and latent variables. To specify the model, data file was inputted from SPSS and variable names as well as values for parameters were edited and entered, respectively. Then the relevant analysis properties needed for the study were selected before the analysis was run.

4. Goodness of Fit

After the model was specified in AMOS and estimates calculated, the initial model fit was checked using the different model fit indices. Each type of fit index gives varying information about model fit or its nonfit so this necessitates researchers to report the multiple fit indices when model fit is being evaluated (Harrington, 2009). In each of the fit indices exists different indices and rules of thumb on the acceptable minimum level of value considered

good fit (Byrne, 2010). However, because different fit indices have been reported by different authors, researchers have noted that many of the fit indices are found to be problematic in their evaluation processes (Kline, 2016). Consequently, individual authors have reported their preferred fit indices (Ping, 2004). Three criteria namely absolute fit, parsimony of fit and comparative fit are recommended based on their popularity in research literature (Brown, 2006) and these were the ones considered in this study and will be briefly discussed below.

5. Absolute Fit Indices

Absolute fit indices assess how well a hypothesised model fits the sample data. It fundamentally indicates how well a proposed theory fits the data (Hooper et al., 2008). Typically, absolute fit indices measure the "badness" of fit and the bigger the index, the poorer the fit is (Kline, 2016). Examples of fit indices in this category are chi square, root mean square residual (RMR) and standard root mean square residual (SRMR). Only the ratio of chi-square (X^2) to degree of freedom (df) was measured in this study, being the commonest absolute fit index measured in research.

Chi square tests the fitness of model against the population (Harrington, 2009). It assesses the magnitude of discrepancy between the sample and the fitted covariance matrices (Hooper et al., 2008). It is however flawed owing to its sensitivity to sample size and will almost always be significant with large samples (Harrington, 2009). This means the greater the chi square, the poorer the fit of the sample data to the hypothesised model. Similarly, when P-value is less than 0.05, it establishes a significant difference between the sample covariance matrix and the implied covariance matrix developed from the hypothesised model. A value less than 2 for X^2/df indicates a good model fit (Byrne, 2010).

6. Parsimony of Fit

Parsimony of fit evaluates the number of estimated parameters of the theoretical model while assessing the model fit. Here, the simplicity of a model is evaluated, and complex models are considered as having poor fit (Harrington, 2009). A complex model indicates that the estimation process is dependent on the sample data. This consequently leads to the development of a less rigorous theoretical model which usually gives better fit indices (Harrington, 2009).

The Root Mean Square Error of Approximation (RMSEA) is the recommended index in this category. RMSEA measures the level at which the model fits "reasonably" well in the population and while it is sensitive to the complexity of the model, RMSEA is insensitive to sample size, unlike chi square (Brown, 2006). In this study, a value less than or equal to 0.05 is considered a close fit, as recommended by Brown (2006).

7. Comparative Fit

Comparative fit measures the fit of a model as being relative to a baseline model. It is centred on the assumption that all latent variables are not correlated (independent models) and are comparable to the sample covariance matrix (Hooper et al., 2008). The recommended fit index here is the comparative fit index (CFI). CFI is not sensitive to sample size like chi square is. The values range between 0 and 1 with values closer to 1 indicating a good fit (Hooper et al., 2008). Brown (2006) recommends that a CFI value of ≥ 0.95 is considered good fit and this was considered in this study.

8. Model Revision

Fitting a model is a repetitive process that starts with a preliminary fit, tests how well the model fits, modifies the model, tests the fit again and restart the entire process until the model converges or fits well enough (Harrington, 2009). In instances of poorly fit models, Harrington (2009) recommends the identification of areas of poor fit and depending on these areas and the indicated revisions, the model can be modified and retested. In this study, areas of poor fit were identified by carefully examining the modification indices (MI) and localised areas of strain (also called standardised residuals (SR). MI > 3.84 or approximately 4 indicate an alteration will possibly lead to a significant improvement of model fit while SR of more than 1.96 (for $p < 0.05$) or 2.58 (for $p < 0.01$) indicates an area of strain (Brown, 2006). However, Brown (2006) further suggested that re-specifying models should not only be statistically based. There needs to be a convincing ground to do so based on empirical and theoretical considerations.

In this study, while MI and SR indicated that removal would improve the fit indices, the items were only removed when there was valid theoretical rationale to do so. Both the findings from the systematic literature review (chapter 3) and the qualitative part of this research (chapter 8) were used to support this section of instrument construction. Careful considerations were made to keep at least 3 items per domain. When an item was removed, the fitness of the model was recalculated according to the model fit indices discussed above. If this did not improve the fit, items were restored but if the model fit improved, the item was taken out.

The goodness of fit and the model revision sections were continuously repeated until a good overall model fit was achieved.

6.6.9 Findings from Round Two of Testing

Two extra items were added to BALHHI in this round. The first item asked if there were any further barriers to hand hygiene that the participants would like to talk about, and blank spaces were left for this item. The second item added asked if any participants would be willing to complete the questionnaire one more time and in order to facilitate this, to provide their contact details in the space provided. This was to allow for the test-retest reliability round of the study.

Findings from demographic features of participants are presented first using descriptive statistics. These include range, mean, standard deviation and a frequency table showing the distribution. This is followed by results of normality tests and variability of response showing the distribution of items in terms of mean, standard deviation, skewness and kurtosis. The reliability score (internal consistency) of the whole questionnaire and items per domain are then presented and findings from construct validity given. The missing data in this study were estimated to be less than 5% therefore, it was decided to impute the mean score of the missing data. This was conducted in SPSS by the researcher. Two questionnaires with too many missing data were excluded in this round. There were no missing data in the demographic items. Justifications for retaining or removing any items were made as the findings were presented.

6.6.9.1 Demographic Features of Participants

Two hundred and seventy questionnaires were distributed out of which 232 were retrieved, giving a response rate of 85.9% but 2 were removed because of too many missing data. In terms of gender, 65.2% were females (n=150) while 34.8% (n=80) were males. There were 115 nurses (50%), 79 doctors (34.4%), 29 health assistants (12.6%), and 7 technicians (3%). Both the health assistants and technicians were underrepresented in this round. The

distribution of participants according to gender and job title is presented in table 6.6. Participants' years of experience ranged from less than a year to 51 years (mean = 7.49, SD = 7.68). Areas of specialty varied, and this is presented in table 6.7.

Table 6-6 Distribution of Participants according to Gender and Job Title (round 2)

Gender			**Job Title**		
Participants	**Frequency**	**Percentage**	**Participants**	**Frequency**	**Percentage**
Male	80	34.8	Doctor	79	34.4
Female	150	65.2	Nurse	115	50.0
Total	**230**	**100.0**	Health Assistants	29	12.6
			Technicians	7	3.0
			Total	**230**	**100.0**

Table 6-7 Distribution of Participants according to Areas of Specialty (round 2)

Participants	**Areas of Specialty**										
	Medicine	**Surgery**	**Paediatrics**	**O&G**	**A&E**	**Outpatient**	**ICU**	**Renal**	**Theatre**	**Others**	**Total**
Doctors	27	12	9	2	8	13	-	1	-	7	79
Nurses	22	24	13	15	12	6	6	4	7	6	115
Health assistants	5	7	6	4	1	-	1	3	1	1	29
Technicians	-	-	-	-	-	-	-	1	6	-	7
Total	**54**	**41**	**28**	**21**	**21**	**19**	**7**	**9**	**14**	**14**	**230**
Percentage	**23.5**	**18.7**	**12.2**	**9.1**	**9.1**	**8.3**	**3.0**	**3.9**	**6.1**	**6.1**	**100**

6.6.9.2 Normality Tests and Variability of Response

Skewness, kurtosis, mean scores and standard deviations were calculated to measure the distribution of all 34 items in this round. A skew of more than 3 in either directions and Kurtosis greater than 10 suggest a flawed distribution (Kline, 2015). The normality tests and variability of responses in terms of the standard deviation, mean, skewness and kurtosis values of the items are presented in table 6.8. No items had a skew value greater than 3 or

kurtosis greater than 10 showing that items were well distributed. Notably, all the 34 items had standard deviation score of less than 1.5 (Ping, 2004) hence all items were retained.

Table 6-8 Normality Tests and Variability of Responses of the Items (round 2)

Normality Tests and Variability of Response				
Items	**Mean**	**SD**	**Skewness**	**Kurtosis**
7. I engage in hand hygiene out of respect for my patients	2.66	1.44	0.36	-1.16
8. There are government targets which have led to improvements in my hand hygiene	3.41	1.37	-0.25	-1.25
9. Hand hygiene is a non-negotiable part of my role	1.80	1.20	1.47	1.11
10. It is difficult for me to learn about hand hygiene due to time pressure	1.94	1.27	1.17	0.12
11. I feel complacent about hand hygiene	2.31	1.34	0.79	-0.62
12. Sometimes I miss out hand hygiene simply because I forget it	2.39	1.38	0.60	-0.94
13. Hand hygiene is not a habit for me	1.62	0.94	1.56	1.84
14. I feel angry if hand hygiene is not carried out by others	2.76	1.22	0.17	-0.98
15. When staff engage in hand hygiene they receive positive feedback	2.53	1.47	0.43	-1.24
16. I am more likely to forget hand hygiene if I am tired	2.71	1.38	0.29	-1.20
17. Hand hygiene training is available to me	2.48	1.30	0.53	-0.85
18. There are some practical barriers to hand hygiene because of my particular job/role	2.38	1.32	0.70	-0.70
19. If I do not engage in hand hygiene I may catch an infection	1.54	1.01	1.87	2.46
20. I cannot be bothered with hand hygiene	1.79	1.21	1.51	1.14
21. If I omitted hand hygiene I would blame myself for infections	2.34	1.33	0.63	-0.92
22. I engage in hand hygiene because I do not want to let the team down	3.37	1.38	-0.27	-1.25
23. There are adverts or newsletters about hand hygiene in my workplace	2.42	1.32	0.55	-0.94
24. I am reluctant to ask others to engage in hand hygiene	2.17	1.12	0.76	-0.27
25. The frequency of hand hygiene required makes it difficult for me to carry it out as often as necessary	2.43	1.27	0.52	-0.85
26. I disagree with some parts of the hand hygiene guidelines	1.98	1.18	1.18	0.48

Normality Tests and Variability of Response				
Items	**Mean**	**SD**	**Skewness**	**Kurtosis**
27. I am confident in my ability to carry out hand hygiene	1.80	1.06	1.35	1.03
28. Hospital targets relating to infection or hand hygiene has led to improvements in my hand hygiene	2.50	1.25	0.38	-0.85
29. I feel frustrated when others omit hand hygiene	2.89	1.18	0.07	-0.85
30. If I engage in hand hygiene it improves patient confidence	2.09	1.12	0.85	0.03
31. Hand hygiene guidelines are easily accessible	2.22	1.17	0.70	-0.43
Hand hygiene is part of my professional culture	1.67	1.01	1.46	1.17
33. My environment is untidy	2.09	1.18	1.02	0.16
34. I feel guilty if I omit hand hygiene	2.27	1.19	0.60	-0.67
35. I feel ashamed if I omit hand hygiene	2.55	1.22	0.29	-0.92
36. My area of work has poor staffing levels	3.12	1.40	-0.18	-1.22
37. Supervision from senior staff means that carrying out hand hygiene is easier for me	3.19	1.31	-0.24	-1.01
38. Some strategies designed to improve hand hygiene influence my practice	2.54	1.23	0.40	-0.90
39. My hand hygiene is encouraged by others	2.55	1.29	0.43	-0.93
40. If I miss out hand hygiene I will be subject to disciplinary action	4.10	1.13	-1.18	0.52

6.6.9.3 Internal consistency

The reliability score for the whole questionnaire was calculated as 0.85 using Cronbach's alpha. only 3 out of 10 domains *("knowledge and skills, memory, attention and decision processes, and emotion")* had a reliability score of at least 0.6. While Cronbach's alpha was checked for all items per domain, the researcher did not use the Cronbach's alpha values to remove items at this stage because removing the other domains with poor reliability scores will leave a few domains to test the instrument. This is following the recommendation of Streiner et al. (2015). The internal consistency of items per domain, using Cronbach's alpha is presented in table 6.9.

Table 6-9 Cronbach's Alpha of Items Per Domain (round 2)

Domains	Items	Cronbach's alpha per domain	Cronbach's alpha if item deleted
Knowledge and Skills	17. Hand hygiene training is available to me	0.68	0.76
	23. There are adverts or newsletters about hand hygiene in my workplace		0.53
	31. Hand hygiene guidelines are easily accessible		0.46
Social/professional role and identity	7. I engage in hand hygiene out of respect for my patients	0.17	-
	9. Hand hygiene is a non-negotiable part of my role		-
Beliefs about Capabilities	18. There are some practical barriers to hand hygiene because of my particular job/role	0.45	0.44
	24. I am reluctant to ask others to engage in hand hygiene		0.33
	25. The frequency of hand hygiene required makes it difficult for me to carry it out as often as necessary		0.30
	27. I am confident in my ability to carry out hand hygiene		0.44
Beliefs about Consequences	19. If I do not engage in hand hygiene I may catch an infection	0.51	0.45
	21. If I omitted hand hygiene I would blame myself for infections		0.32
	30. If I engage in hand hygiene it improves patient confidence		0.38
	40. If I miss out hand hygiene I will be subject to disciplinary action		0.56
Motivation and Goals	11. I feel complacent about hand hygiene	0.31	0.42
	20. I cannot be bothered with hand hygiene		0.14
	26. I disagree with some parts of the hand hygiene guidelines		0.13

Domains	Items	Cronbach's alpha per domain	Cronbach's alpha if item deleted
Memory, attention and decision processes	12. Sometimes I miss out hand hygiene simply because I forget it	0.60	0.35
	13. Hand hygiene is not a habit for me		0.62
	16. I am more likely to forget hand hygiene if I am tired		0.46
Environmental context and resources	10. It is difficult for me to learn about hand hygiene due to time pressure	0.47	0.38
	33. My environment is untidy		0.30
	36. My area of work has poor staffing levels		0.44
Social Influences	15. When staff engage in hand hygiene they receive positive feedback	0.54	0.52
	22. I engage in hand hygiene because I do not want to let the team down		0.61
	37. Supervision from senior staff means that carrying out hand hygiene is easier for me		0.33
	39. My hand hygiene is encouraged by others		0.38
Emotion	14. I feel angry if hand hygiene is not carried out by others	0.74	0.73
	29. I feel frustrated when others omit hand hygiene		0.73
	34. I feel guilty if I omit hand hygiene		0.62
	35. I feel ashamed if I omit hand hygiene		0.64
Action Planning	8. There are government targets which have led to improvements in my hand hygiene	0.59	0.65
	28. Hospital targets relating to infection or hand hygiene has led to improvements in my hand hygiene		0.28

Domains	Items	Cronbach's alpha per domain	Cronbach's alpha if item deleted
	38. Some strategies designed to improve hand hygiene influence my practice		0.52

6.6.9.4 Construct validity

The mean score of missing data was inputted into SPSS while 2 questionnaires with too many missing data were removed from the analysis. Findings from the normality tests and variability of response were presented in section 6.6.9.2.

The initial model fit was calculated against the parameters previously described in the data analysis section (CMIN/df < 2, CFI ≥ 0.95 and RMSEA ≤ 0.05 (Brown, 2006; Byrne, 2010). The initial values were CMIN/df = 2.136 (P< 0.0001), CFI = 0.725 and RMSEA = 0.07. These indicate nonfit of the model, but they are not too far away from the expected values. The modification indices (MI) and standardised residuals (SR) of the items were reviewed to identify areas of strains. Items that fitted poorly (MI > 4 and SR > 2.58) were removed and the model was retested for fit each time. For instance, after the initial model was tested, item 15 *("when staff engage in hand hygiene they receive positive feedback")* indicated poor fit and on reviewing the MI, this item fitted with 6 other domains while on checking the SR, the item fitted with 12 other items. Theoretically, this item was irrelevant to the Nigerian context going by the inherent cultural differences between Nigeria and the UK healthcare setting. Hence, this item was removed, and the model was retested which resulted into slight improvement in the model fit indices (CMIN/df = 2.067 (P < 0.0001) CFI = 0.74 and RMSEA = 0.067.

This process was continued, and 23 other changes were made until the expected model fit indices were achieved. The steps taken in establishing construct validity are shown in table

6.10. The table showed the domains removed and the theoretical justifications. Theoretical justifications referred back to the findings from the systematic literature review (chapter 3) and also referred forward to findings from the qualitative data (chapter 8). Findings from both chapters were used concurrently to justify this section.

The domains and items remaining after the entire process are presented in table 6.11. The reliability scores of the domains per items were also presented in this table. The final model fit indices were CMIN/df = 1.147 (P = 0.220), CFI = 0.981 and RMSEA = 0.025. This is presented in table 6.12. The initial and final models, both designed in AMOS version 24 for the CFA are presented as figure 6.2 and figure 6.3, respectively.

Table 6-10 Steps Taken to Establish Construct Validity using Confirmatory Factor Analysis

S/N	Domains	Actions on items (moved between domains and/or deleted)	Domains and items with MI >4		No of items with SR >2.58	Resulting CMIN/df	Resulting CFI	Resulting RMSEA	Theoretical Justification for deleting/moving items	Cronbach's Alpha of domain if item is deleted
			No of domains	No of items						
1	*Social influences*	Q15 *When staff engage in hand hygiene, they receive positive feedback* – deleted	6	12	1	2.067	0.742	0.068	Findings from the qualitative study (chapter 8) suggests this domain is not relevant to the Nigerian context. Interview participants stressed on "doing their thing", having no role models and lack of feedback from colleagues and senior staff. The contextual background to the research (chapter 2) also submit that the inherent culture of hospitals in Nigeria and the UK are different. Hence, this domain is not relevant to the Nigerian context.	0.52
2	*Beliefs about capabilities*	Q27 *I am confident in my*	4	8	2	2.014	0.766	0.067	All interview participants (chapter 8)	0.44

S/N	Domains	Actions on items (moved between domains and/or deleted)	Domains and items with MI >4		No of items with SR >2.58	Resulting CMIN/df	Resulting CFI	Resulting RMSEA	Theoretical Justification for deleting/moving items	Cronbach's Alpha of domain if item is deleted
			No of domains	No of items						
		ability to carry out hand hygiene – deleted							stressed their self-confidence in hand hygiene practice. Hence, there is no need to retest this item	
3	*Social/professional role and identity*	Q9 *Hand hygiene is a non-negotiable part of my role* – deleted	6	11	4	2.043	0.766	0.067	Both findings from literature review (chapter 3) and qualitative study (chapter 8) suggest HCWs view hand hygiene as critical to clinical practice. Hence, there is no need to retest this item	-
4	*Social/professional role and identity*	Q7 *I engage in hand hygiene out of respect for my patients* – moved to *"beliefs about consequences"* domain	0	1	0	2.043	0.766	0.067	There is no claim that the TDF domains are discrete hence, there is potential for overlap. Item moved to the "beliefs about consequences" domain as it fits better here.	-
5	*Social influences*	Q22 *I engage in hand hygiene*	6	7	0	1.941	0.800	0.064	Ditto as Q15	0.61

S/N	Domains	Actions on items (moved between domains and/or deleted)	Domains and items with MI >4		No of items with SR >2.58	Resulting CMIN/df	Resulting CFI	Resulting RMSEA	Theoretical Justification for deleting/moving items	Cronbach's Alpha of domain if item is deleted
			No of domains	No of items						
		because I do not want to let the team down – deleted								
6	*Social influences*	Q37 *Supervision from senior staff means that carrying out hand hygiene is easier for me* – deleted	1	5	0	1.941	0.800	0.064	Ditto as Q15	0.33
7	*Social influences*	Q39 *My hand hygiene is encouraged by others* – deleted	3	7	0	1.941	0.800	0.064	Ditto as Q15	0.38
8	*Memory, attention and decision processes*	Q13 *Hand hygiene is not a habit for me* – deleted	1	6	2	1.831	0.836	0.060	From the qualitative study (chapter 8), this domain does not seem to be an issue in Nigeria. The big issues were the environment and barriers. Interview participants did not consider items in this domain barriers to hand hygiene practice.	0.62

S/N	Domains	Actions on items (moved between domains and/or deleted)	Domains and items with MI >4		No of items with SR >2.58	Resulting CMIN/df	Resulting CFI	Resulting RMSEA	Theoretical Justification for deleting/moving items	Cronbach's Alpha of domain if item is deleted
			No of domains	No of items						
9	*Memory, attention and decision processes*	Q16 *I am more likely to forget hand hygiene if I am tired* – deleted	3	12	0	1.831	0.836	0.060	Ditto as Q13	0.46
10	*Memory, attention and decision processes*	Q12 *Sometimes I miss out hand hygiene simply because I forget it* – deleted	-	-	-	1.831	0.836	0.060	Ditto as Q13	0.35
11	*Knowledge and skills*	Q31 *Hand hygiene guidelines are easily accessible* – deleted	0	4	0	1.758	0.847	0.058	Items in this domain are not needed because they are being tested in the knowledge questions. Using simple t-test, people's barriers in the knowledge domain (self-reported knowledge) will be correlated with the knowledge questions (tested knowledge)	0.46

S/N	Domains	Actions on items (moved between domains and/or deleted)	Domains and items with MI >4		No of items with SR >2.58	Resulting CMIN/df	Resulting CFI	Resulting RMSEA	Theoretical Justification for deleting/moving items	Cronbach's Alpha of domain if item is deleted
			No of domains	No of items						
12	*Knowledge and skills*	Q17 *Hand hygiene training is available to me* – deleted	1	5	1	1.758	0.847	0.058	Ditto as Q31	0.76
13	*Knowledge and skills*	Q23 *There are adverts or newsletters about hand hygiene in my workplace* – deleted	1	3	0	1.758	0.847	0.058	Ditto as Q31	0.53
14	*Motivation and goals*	Q20 I *cannot be bothered with hand hygiene* – deleted	3	6	0	1.480	0.917	0.046	None of the interview participants (chapter 8) identified this domain as an entity in hand hygiene.	0.14
15	*Motivation and goals*	Q11 *I feel complacent about hand hygiene* – deleted	0	2	0	1.480	0.917	0.046	Ditto as Q20	0.42
16	*Motivation and goals*	Q26 *I disagree with some parts of the hand hygiene*	0	2	0	1.480	0.917	0.046	Ditto as Q20	0.13

S/N	Domains	Actions on items (moved between domains and/or deleted)	Domains and items with MI >4		No of items with SR >2.58	Resulting CMIN/df	Resulting CFI	Resulting RMSEA	Theoretical Justification for deleting/moving items	Cronbach's Alpha of domain if item is deleted
			No of domains	No of items						
		guidelines – deleted								
17	*Belief about consequences*	Q19 *If I do not engage in hand hygiene, I may catch an infection* – deleted	0	3	0	1.393	0.936	0.041	Perceived risk for infection was found as hand hygiene lever in both the literature review (chapter 3) and qualitative study (chapter 8). Hence there is no need to retest this item.	0.45
18	*Emotion*	Q29 *I feel frustrated when others omit hand hygiene* – deleted	0	2	0	1.214	0.966	0.031	Feeling of frustration was not reported as a barrier/lever to hand hygiene in both the literature review (chapter 3) and qualitative study (chapter 8)	0.73
19	*Action planning*	Q8 *There are government targets which have led to improvements in*	0	1	0	1.231	0.968	0.032	Interview participants (chapter 8) noted there were no government policies or targets on hand hygiene.	0.65

S/N	Domains	Actions on items (moved between domains and/or deleted)	Domains and items with MI >4		No of items with SR >2.58	Resulting CMIN/df	Resulting CFI	Resulting RMSEA	Theoretical Justification for deleting/moving items	Cronbach's Alpha of domain if item is deleted
			No of domains	No of items						
		my hand hygiene – deleted							The contextual background to the research (chapter 2) also submit that the inherent culture of hospitals in Nigeria and the UK are different. Hence, questions in this domain are not relevant to the Nigerian context as there are no targets on IPC or strategies to improve hand hygiene in Nigeria.	
20	*Action planning*	Q28 *Hospital targets relating to infection or hand hygiene has led to improvements in my hand hygiene* – deleted	-	-	-	1.231	0.968	0.032	Ditto as Q8	0.28
21	*Action planning*	Q38 *Some strategies designed to improve hand*	-	-	-	1.231	0.968	0.032	Ditto as Q8	0.52

S/N	Domains	Actions on items (moved between domains and/or deleted)	Domains and items with MI >4		No of items with SR >2.58	Resulting CMIN/df	Resulting CFI	Resulting RMSEA	Theoretical Justification for deleting/moving items	Cronbach's Alpha of domain if item is deleted
			No of domains	No of items						
		hygiene influence my practice – deleted								
22	*Belief about capabilities*	Q18 *There are some practical barriers to hand hygiene because of my particular job/role* – moved to *environmental context and resources* domain	-	-	-	1.147	0.981	0.025	There is no claim that the TDF domains are discrete hence, there is potential for overlap. Not all items fall into this domain hence Q18 was moved to "*environmental context and resources"* domain	
23	*Belief about capabilities*	Q24 *I am reluctant to ask others to engage in hand hygiene* – moved to *belief about consequences*	-	-	-	1.147	0.981	0.025	Ditto as Q18 hence item was moved to *"beliefs about consequences"* domain	
24	*Belief about capabilities*	Q25 *The frequency of hand hygiene required makes it difficult for me to carry it out as often as*	-	-	-	1.147	0.981	0.025	Findings from the literature review (chapter 3) and qualitative study (chapter 8) suggest time constraints are a	0.30

S/N	Domains	Actions on items (moved between domains and/or deleted)	Domains and items with MI >4		No of items with SR >2.58	Resulting CMIN/df	Resulting CFI	Resulting RMSEA	Theoretical Justification for deleting/moving items	Cronbach's Alpha of domain if item is deleted
			No of domains	No of items						
		necessary – deleted							barrier to hand hygiene practices. hence, there is no need to retest this item.	

Table 6-11 Final Domains and their Items

Domains	Items	Cronbach's Alpha
Beliefs about consequences	Q7 I engage in hand hygiene out of respect for my patients	0.474
	Q21 If I omitted hand hygiene I would blame myself for infections	
	Q24 I am reluctant to ask others to engage in hand hygiene	
	Q30 If I engage in hand hygiene it improves patient confidence	
	Q40 If I miss out hand hygiene I will be subject to disciplinary action	
Environmental context and resources	Q10 It is difficult for me to learn about hand hygiene due to time pressure	0.555
	Q18 There are some practical barriers to hand hygiene because of my particular job/role	
	Q33 My environment is untidy	
	Q36 My area of work has poor staffing levels	
Emotion	Q14 I feel angry if hand hygiene is not carried out by others	0.725
	Q34 I feel guilty if I omit hand hygiene	
	Q35 I feel ashamed if I omit hand hygiene	

Table 6-12 Outcome Parameters for the Final Model in Confirmatory Factor Analysis

Outcome Parameters for the Final Model in CFA	
Parameters	**Outcome**
CMIN/df	1.147
CFI	0.981
RMSEA	0.025

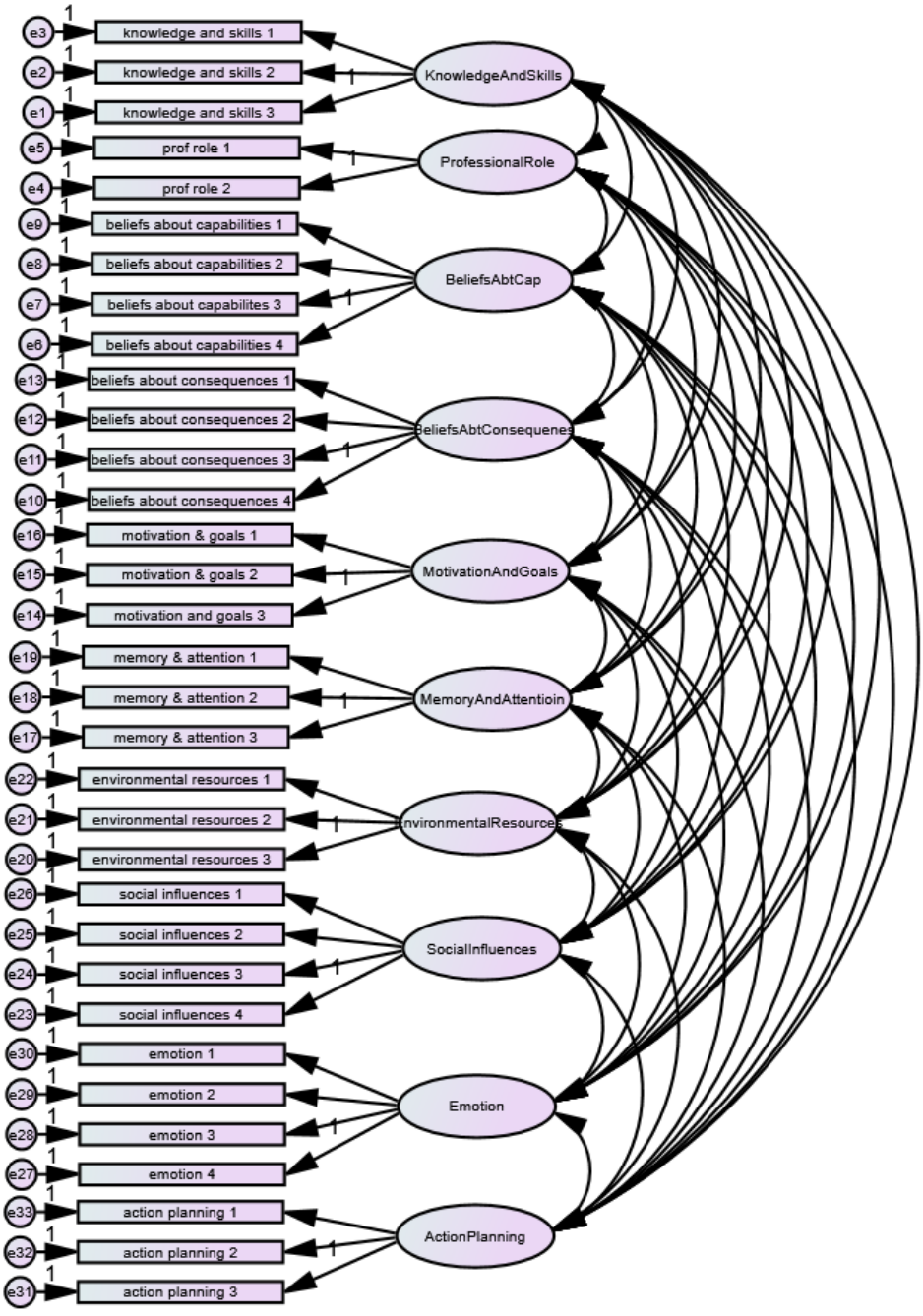


Figure 6-2 Initial Model for CFA using AMOS Version 24

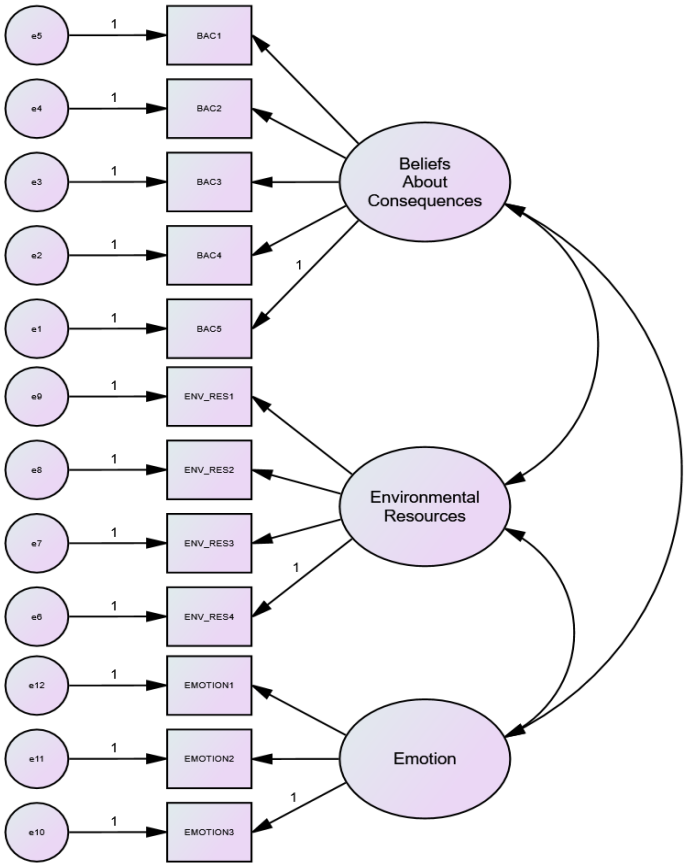


Figure 6-3 Final Model after CFA using AMOS Version 24

6.6.10 Summary of Findings (Round Two)

This second round of testing aimed at construct validation through CFA to ensure that all items on the instrument fitted within the domains of the TDF. BALHHI was distributed among Nigerian HCWs within the research setting. No items were removed following normality tests and variability of responses. The reliability score of the entire instrument for this round is 0.85 using Cronbach's alpha. No item was removed based on reliability score of domains per items. To conduct the CFA, a model was specified in AMOS version 24.0. A model fit was conducted repeatedly until a good fit was achieved following a series of testing, theoretical considerations and judgements. A new BALHHI was produced for use in

developing countries which has 3 domains – *beliefs about consequences, environmental context and resources* and *emotion* and 12 items. In the next round, a test-retest reliability will be conducted.

6.7 Round Three – Test-Rest Reliability

6.7.1 Introduction

The initial step to ensuring an instrument measures what it is intended to measure, is to demonstrate that it produces the same or similar results when used on a set of population on different occasions or by different observers or by similar or parallel tests (Streiner et al., 2015). Test-retest reliability is the second of the two major ways of testing the reliability of an instrument (the first, internal consistency was discussed in section 6.5.8.2). It involves the administration of an instrument at two different times to measure if the consistency with which the items on the instruments are answered or individual's scores remain relatively the same (Golafshani, 2003; Streiner et al., 2015). This attribute of the instrument is known as stability and it implies that the higher the stability of the instrument, the higher its reliability and consequently, the repeatability of the results (Golafshani, 2003). To avoid raising the test-retest reliability score artefactually, care must be taken that the sessions of instrument administration are not too close together and samples must represent the population for whom the test is intended (Kline, 2015). The instrument is considered reliable if the phenomenon being measured remains unchanged between the timeframe of administration and the correlation is high (Streiner et al., 2015).

6.7.2 Aim

The aim of this round is to measure the test-retest reliability of BALHHI among the HCWs of the study site.

6.7.3 Design

This round was carried out by administering BALHHI to the same group of population 4 weeks after administering BALHHI for construct validity (round 2). The correlation was calculated after obtaining the two responses. Test-retest reliability was conducted on only items that remained after CFA (round 2 of testing). No changes were made to the instrument apart from item 46 that was removed. This item required the contact details of those participants from round 2 that were willing to complete the questionnaire one more time for the test-retest reliability round (see appendix L for modified BALHHI administered for test-retest reliability).

6.7.4 Research Setting

The research setting was described in chapter 5, section 5.2.

6.7.5 Participants

Potential participants were identified from the second round of the instrument testing. A systematic review reported sample size for test-retest reliability, ranging from 10 to 663 participants, with a median score of 44 participants (Park et al., 2018). A rule of thumb considers a sample size of less than 30 participants as poor, 30 to 49 participants as fair, 50 to 99 participants as good and 100 and above as excellent (Park et al., 2018). For this round, only 40 participants signified interest to participate in the third round and all 40 of them were contacted.

6.7.6 Procedure

While retrieving questionnaires administered for construct validity and having conducted ward infrastructure survey and hand hygiene observations, the researcher had already developed a close working relationship with some members of staff of the hospital. This

made it easy for the researcher to approach and recruit one of the nurses as an administrative help. This was necessary because of the researcher's inability to stay extra 4 weeks in Nigeria for the third round of testing.

Though the optimal timeframe between instrument testing depends largely on the constructs being measured, the stability of the constructs overtime and the sample population, the recommended time interval for test-retest reliability is 2 weeks (Streiner et al., 2015). This is acceptable considering the time is not too long to cause a significant change in responses or too short that participants would recollect their previous responses to the instrument (Kline, 2015; Streiner et al., 2015). However, a timeframe of 4 weeks was considered appropriate for this round given the shift pattern of the participants, time to complete the instrument and the convenience of the administrative help who assisted with the distribution of the instruments.

The list of participants from the construct validity round was made available to the administrative help who contacted and administered the questionnaires to them. Monetary voucher of N500 (equivalent of £1.05) was given to each of the participants to facilitate their willingness to complete the questionnaire one more time. Participants were given 2 weeks to complete the questionnaire. No reminders were given. The administrative help collated retrieved questionnaires and sent to the researcher in a sealed envelope via a trusted courier service.

6.7.7 Ethical Considerations

The general ethical considerations for this round was described in section 6.4.3. For this round, a confidentiality agreement form was designed by the researcher and signed by the administrative help to ensure that all information obtained from participants are handled

confidentially (see appendix M). Sealed envelopes were provided with the questionnaires and participants were instructed to put completed questionnaires in the envelopes before returning them back to the administrative help.

6.7.8 Data Analysis

All data were inputted into SPSS version 24.0. Data analysis was conducted through descriptive statistics and test-retest reliability. The measures of analysis conducted in this round are described below.

6.7.8.1 Demographic Features of Participants

Demographic features of participants such as gender, job title, areas of specialty and years of experience were collected to check the representativeness of the participants when the results are presented. These were described using descriptive statistics. A frequency table was presented. Mean scores and standard deviation were also calculated and presented. See section 6.5.8.1 on the measures of descriptive statistics used for the demographic features of the participants.

6.7.8.2 Test-Retest Reliability

Pearson's correlation coefficient was used to analyse the items. Pearson's correlation is based on regression analysis which measures the degree at which the relationship between two variables can be described linearly (Streiner et al., 2015). The coefficient usually lies between 0 and 1 (0 for no relationship and 1 for a perfect relationship) and the nearer it is to 1, the stronger the relationship between the variables (Bryman, 2016). Any items between 0 and 0.29 indicate small correlation, 0.30 to 0.49 suggest medium correlation while 0.50 to 1 suggest high correlation (Cohen, 1988).

6.7.8.3 Paired Samples *t* Test

To check if there are any statistically significant differences between the mean values of the test-retest data, paired samples *t* tests were run in SPSS for both instrument items and domains. Paired samples *t* test, also called repeated measures *t* test or dependent *t* test is one of the most widely used statistical tools for comparing differences between samples. It measures whether the mean scores from two measurements, conditions or time points are statistically different from one another (Xu et al., 2017).

6.7.9 Findings from Round Three of Testing

6.7.9.1 Demographic Features of Participants

Thirty out of 40 questionnaires were retrieved, giving a 75% response rate. In terms of gender, 70% were females (n=21) while 30% were males (n=9). Twenty-two were nurses (73.3%), 5 were doctors (16.7%), and 3 were health assistants (10%). Both doctors and health assistants are underrepresented in this round. No technicians completed the instrument. The distribution of participants according to their gender and job titles are presented in table 6.13. Years of experience ranged from 3 months to 3 years (mean = 1.70, SD = 0.47). areas of specialty varied, and these are presented in table 6.14.

Table 6-13 Distribution of Participants according to Gender and Job Titles

Gender			**Job Title**		
Participants	**Frequency**	**Percentage**	**Participants**	**Frequency**	**Percentage**
Male	9	30.0	Nurse	22	73.3
Female	21	70.0	Doctor	5	16.7
Total	**30**	**100.0**	Health Assistant	3	10.0
			Total	**30**	**100.0**

Table 6-14 Distribution of Participants according to Areas of Specialty (round 3)

Participants	Areas of specialty										
	Medicine	Surgery	Paediatrics	laboratory	Theatre	A&E	ICU	O&G	Renal	Psychiatry	Total
Nurses	5	5	3	1	1	2	1	2	1	1	22
Doctors	1	1	1	-	-	1	-	-	1	-	5
Health Assistants	1	-	-	-	1	-	-	-	1	-	3
Total	**7**	**6**	**4**	**1**	**2**	**3**	**1**	**2**	**3**	**1**	**30**
Percentage	**23.3**	**20.0**	**13.3**	**3.3**	**6.7**	**10.0**	**3.3**	**6.7**	**10.0**	**3.3**	**100.0**

6.7.9.2 Test-Retest Reliability

Pearson's correlation coefficient was calculated for the relationship between each of the items for both construct and test-retest reliability rounds. Results were based on n = 30 and $p < 0.01$. This is presented in table 6.15. Medium and high correlations were considered for this study. Two items (Q10 – *"it is difficult for me to learn about hand hygiene due to time pressure"* and Q18 – *"there are some practical barriers to hand hygiene because of my particular job/role"*) were less than 0.30 hence these were removed. Six items had medium correlation (between 0.30 and 0.49) while 4 items ranged between 0.50 and above hence, had high correlation. Pearson's correlation coefficient was also calculated for the agreement between domains. Results were based on n = 30 and $p < 0.01$. This is presented in table 6.16. All items fell within the range of 0.5 and above hence, were in good correlation.

Table 6-15 Pearson's Correlation Coefficients for Instrument Items

Item number	Items	Pearson's coefficient
Q7	I engage in hand hygiene out of respect for my patients	0.70
Q14	I feel angry if hand hygiene is not carried out by others	0.30
Q21	If I omitted hand hygiene I would blame myself for infections	0.41

Item number	Items	Pearson's coefficient
Q24	I am reluctant to ask others to engage in hand hygiene	0.31
Q30	If I engage in hand hygiene it improves patient confidence	0.50
Q33	My environment is untidy	0.66
Q34	I feel guilty if I omit hand hygiene	0.69
Q35	I feel ashamed if I omit hand hygiene	0.49
Q36	My area of work has poor staffing levels	0.46
Q40	If I miss out hand hygiene I will be subject to disciplinary action	0.45

*Item numbers relate to items on the test-retest instrument (round 3)

Table 6-16 Pearson's Correlation Coefficients for Instrument Domains

Domains	Items included	Pearson's coefficient
Beliefs about consequences	Q7, Q21, Q24, Q30, Q40	0.65 (p<0.001)
Environmental context and resources	Q33, Q36	0.50 (p=0.005)
Emotion	Q14, Q34, Q35	0.65 (p<0.001)

6.7.9.3 Paired Samples *t* Tests

There was no statistically significant difference between the mean values of both items and domains when tested with paired *t* test. These are presented in tables 6.17 and 6.18 for items and domains, respectively.

Table 6-17 Paired Samples *t* Test for Instrument Items

Paired Samples *t* Test for Instrument Items						
Item no	Items	Mean	SD	t	df	Sig. (2-tailed)
Q7	I engage in hand hygiene out of respect for my patients	0.33	1.12	1.62	29	0.12
Q14	I feel angry if hand hygiene is not carried out by others	0.30	1.15	1.43	29	0.16
Q21	If I omitted hand hygiene I would blame myself for infections	-0.03	1.63	-0.11	29	0.91

Paired Samples *t* Test for Instrument Items						
Item no	Items	Mean	SD	t	df	Sig. (2-tailed)
Q24	I am reluctant to ask others to engage in hand hygiene	0.17	1.44	0.63	29	0.53
Q30	If I engage in hand hygiene it improves patient confidence	-0.10	0.88	-0.62	29	0.54
Q33	My environment is untidy	-0.17	0.91	-1.00	29	0.33
Q34	I feel guilty if I omit hand hygiene	-0.20	1.03	-1.06	29	0.30
Q35	I feel ashamed if I omit hand hygiene	0.07	1.28	0.28	29	0.78
Q36	My area of work has poor staffing levels	-0.17	1.56	-0.59	29	0.56
Q40	If I omit hand hygiene I will be subject to disciplinary action	-0.07	1.11	-0.33	29	0.75

Table 6-18 Paired Samples *t* Test for Instrument Domains

Paired Samples *t* Test for Instrument Domains					
Domains	**Mean**	**SD**	**t**	**df**	**Sig. (2-tailed)**
Belief about consequences	0.30	3.12	0.53	29	0.60
Environmental resources	-0.33	1.86	-0.98	29	0.34
Emotion	0.17	2.34	0.39	29	0.70

6.7.10 Summary of Findings (Round Three)

This final round of testing aimed at assessing test-retest reliability of BALHHI by distributing the items to the same sample of population on two different occasions and calculating the correlation between the responses. Pearson's correlation coefficient was used to test the reliability of the items. Two items were removed in this round due to poor correlation while the remaining 10 items fell between medium and high correlations. Hence, the final instrument arising from the instrument testing and validation has 3 domains – "*beliefs about consequences, environmental context and resources* and *emotion"* with 5, 2 and 3 items,

respectively. Paired samples *t* tests also showed that there were no statistically significant differences between the mean values of items and domains remaining in the instrument.

6.8 Discussion

This study was conducted following findings identified from the systematic literature review conducted as part of this thesis (chapter 3). The review found that there are no standardised instruments to identify and measure the barriers and levers to hand hygiene practices in developing countries. This makes the replicability of such studies difficult. Standardised instruments are useful tools used to assign scores in some numerical dimensions to latent variables (Morgado et al., 2018). Unobservable constructs (latent variables) are abstract constructs (such as mood) which cannot be measured directly in a single item or variable (Boateng et al., 2018). Psychometric scales are used to measure these behaviours, actions or feelings and allow the researcher to suggest appropriate clinical solutions to the phenomena measured. The systematic review (chapter 3) identified a need to psychometrically develop an instrument that precisely measures the barriers and levers to hand hygiene practices such that implementation strategies are theoretically tailored and research methods can be replicated. This will consequently lead to increased application of evidence-based practice in healthcare (Grimshaw et al., 2012).

In this study, BALHHI which was developed using the TDF (Michie et al., 2005; Dyson et al., 2013) was validated for use in developing countries by testing its validity and reliability in the Nigerian context. While the TDF have been popularly employed in developed countries (Boscart et al., 2012; Squires et al., 2013; Dyson et al., 2011; Dyson et al., 2013; McAteer et al., 2008; Smith et al., 2018; Fuller et al., 2014), this PhD research, to the best of the researcher's knowledge is the first to use the framework on hand hygiene in SSA countries.

The TDF allows effective tailoring of implementation strategies and the application of theoretical approaches to behaviour change interventions (Phillips et al., 2015). It is believed that using the new BALHHI in developing countries will boost more accurate measures of the barriers and levers to hand hygiene in the region.

Harrington (2009) advised on when to conduct a CFA and an exploratory factor analysis (EFA). An EFA is conducted as an exploratory initial step whilst a new instrument is being developed while a CFA can be used as a second step to check whether the structure identified in the EFA works for a new population sample (Harrington, 2009). More so, if a new measure is being developed with a very strong theoretical framework, then the preliminary EFA step may be omitted and the CFA conducted instead (Harrington, 2009). Since BALHHI is an established instrument which is underpinned by the TDF, the researcher decided to conduct a CFA to check if the instrument works in the Nigerian context.

However, referring forward to the qualitative study conducted in chapter 8 of this thesis, the researcher could not have accurately predicted the amount and how very different the barriers and levers to hand hygiene practices are. Therefore, the researcher identified those barriers that are unique to the research context, which might be subjects upon which additional items for BALHHI might be developed in future research. These are:

1. Infrastructural deficit (such as diluting liquid soap with water, using bucket and bowl to fetch water, lack of electricity, lack of ABHRs)
2. Lack of hand hygiene policy (both local and national)
3. Lack of IPC team in the research setting
4. Using methylated spirit to clean hands
5. Lack of incentives
6. Lack of hand hygiene role models

7. Lack of compensation in the event of occupational hazards

6.9 Study Strengths and Limitations

The strength of this study lies in the development of a psychometric instrument that can adequately assess the barriers and levers to hand hygiene practices in developing countries. This is the first instrument in this region that is underpinned by the TDF hence, a huge contribution to theoretical knowledge on hand hygiene among HCWs in SSA countries. However, there are some limitations in this study.

Due to time constraints, the first round of testing (face validity) was conducted among Nigerian HCWs that are resident in the UK. However, the HCWs included in this round of testing met the selection criteria and they were well informed of the Nigerian healthcare work environment, having practised in Nigeria before their relocation to the UK. In future research, participants will be recruited from the same research setting to allow for consistency.

Only doctors and nurses were recruited as participants in the first round. However, this was beyond the control of the researcher as only trained doctors and nurses are recruited in the UK. Before conducting the first round of testing, an initial testing of instrument was conducted with 2 participants. In the future, the researcher would allow enough time to conduct a proper pilot study of instrument before commencing the research.

Sample sizes were small for the first (face validity, n = 15) and third (test-retest reliability, n = 30) rounds of testing. More so, there were no health assistants in round 1 while health assistants and technicians were underrepresented in round 3. There were more females than males in all the 3 rounds hence, the male group might have been underrepresented.

An explanation for this could be the domination of the nursing profession by females, nurses being the largest group of participants in rounds 2 and 3.

Several items could not stand the CFA conducted in round 2 of testing thereby reducing the original BALHHI from a 35-item instrument to a 10-item instrument. Similarly, only 2 items remained in the "*environmental context and* resources" domain. This is regarded as construct underrepresentation whereby an instrument does not capture all the essential elements of the concept, thereby posing a threat to the validity of the instrument (Spurgeon, 2017). However, the researcher will identify in the discussion of findings (chapter 9), subjects from the qualitative study (chapter 8) upon which additional items for BALHHI might be developed in future research.

6.10 Chapter Summary

The aim of this chapter was to validate and test BALHHI for use in developing countries. This section was conducted in three rounds namely face validity, construct validity and test-retest reliability which resulted in a new BALHHI with 3 domains and 10 items. Descriptive statistics were conducted in all the rounds. Face validity checked the suitability of the instrument within the Nigerian context and BALHHI was modified following participants' feedback and theoretical justifications. Construct validity through CFA and model fit following a series of testing, theoretical considerations and judgements were conducted in the second round. The final round measured test-retest reliability of the instrument using Pearson's correlation coefficient. Instrument and items were checked for internal consistency in the first two 2 rounds using Cronbach's alpha. Decisions to retain or remove items were justified. The significance of the new BALHHI was then discussed while subjects upon which additional items for BALHHI might be developed in future research were

identified from the qualitative study (chapter 8). The next chapter presents the barriers and levers to hand hygiene survey, where the new BALHHI is tested.

Chapter 7 Barriers and Levers to Hand Hygiene Practices: A Survey

7.1 Introduction

This chapter presents the barriers and levers to hand hygiene survey conducted in this research. Data from the construct validity round, but only items remaining after the test-retest reliability round of the instrument validation and design chapter (chapter 6) will be used in this chapter. Participants were asked to assess their own hand hygiene compliance rate and that of their colleagues in this chapter. The participants' knowledge of hand hygiene practices was also tested in this chapter using knowledge test questions already incorporated in BALHHI. The aim, objectives and research question are presented first. These are followed by the research design including the participants, procedure and ethical considerations. The methods of data collection and analysis are then described after which the research findings are presented. The study strengths and limitations are then presented. A chapter summary in relation to the research aim and objectives concludes the chapter. A flowchart illustrating the study process is presented figure 7.1.

7.2 Research Aim

To establish the barriers and levers to hand hygiene among Nigerian HCWs in a teaching hospital through a survey of BALHHI.

7.3 Research Objectives

1. To assess participants' self-reported hand hygiene compliance rate.
2. To establish if there are any differences in barriers and levers according to professional group and areas of specialty.
3. To test the participants' knowledge of hand hygiene practices.

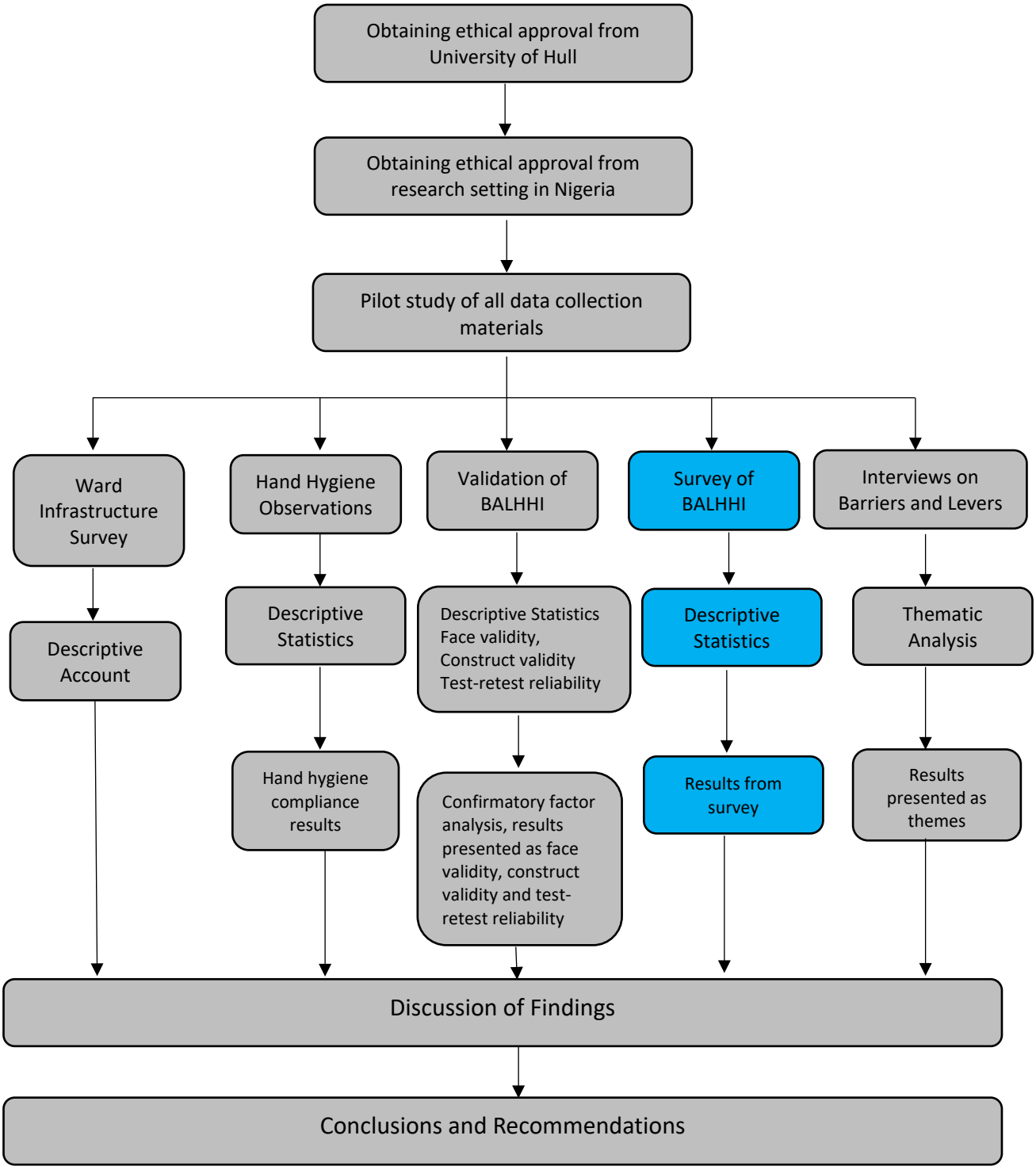


Figure 7-1 Flowchart of the Survey Research Process

7.4 Research Questions

1. What are the self-reported hand hygiene compliance rates for Nigerian HCWs and their colleagues?
2. What are the barriers and levers to hand hygiene practices among Nigerian HCWs in a teaching hospital?

7.5 Research Design

A research design places the researcher in the empirical world and links the research question to data (Punch, 2014). The philosophical assumptions and approaches of inquiry in quantitative research are described in the research methodology chapter (chapter 4, section 4.2.2). The two broad categories of quantitative research designs are experimental and survey designs (Watson, 2015). In experimental designs, the researcher manipulates the independent variable and studies its effects on a dependent variable (Watson, 2015). Survey designs however, provides a numerical description of trends, attitudes and opinions of a population or tests the association among variables of a population, by studying a sample of that population (Creswell & Creswell, 2018). Survey designs are useful in collecting large amounts of data to describe the samples and populations (Watson, 2015).

Survey designs can be either cross-sectional or longitudinal. A cross-sectional design involves a single collection of data on a sample of cases such that quantitative or quantifiable data are collected in connection with two or more variables, which are then analysed to detect patterns of association (Bryman, 2016). Longitudinal studies are more complex, collected over time and usually an extension of repeated cross-sectional designs (Watson, 2015; Bryman, 2016). Self-administered questionnaires are commonly used to collect data in survey designs although structured interviewing can also be conducted.

In this research, cross-sectional, survey design is considered more appropriate because of its capability to collect large amount of data, using self-administered questionnaires. According to Creswell and Creswell (2018), survey designs help the researcher to answer three types of questions:

1. Descriptive questions
2. Questions about the relationships between variables and
3. Questions about the predictive relationships between variables over time.

Using cross-sectional survey design in this research will answer the first two questions identified by Creswell and Creswell (2018). The participants' own hand hygiene compliance rate and that of their colleagues will be assessed first. This will be followed by the assessment of the overall barriers and levers to hand hygiene using BALHHI and any difference according to professional groups and areas of specialty will be identified. Participants' knowledge on hand hygiene will also be tested according to professional group and areas of specialty, using the knowledge test questions already incorporated in BALHHI. How the participants responded to the knowledge test questions will be analysed and reported. The third question is irrelevant in this chapter as it relates to longitudinal studies.

7.5.1 Research Setting

The research setting was described in chapter 5, section 5.2.

7.5.2 Participants

Sample size and participant recruitment were described in section 6.6.5 of the instrument validation and testing chapter (chapter 6).

7.5.3 Procedure

The procedure for administering questionnaire was described in section 6.6.6 of the instrument validation and testing chapter (chapter 6).

7.5.4 Ethical Considerations

The ethical considerations for this round of testing were presented in section 6.4.3 of the instrument validation and testing chapter (chapter 6).

7.6 Data Analysis

Data were inputted into SPSS version 24.0. Data analysis was conducted through descriptive statistics. The following methods of data analysis were employed in this research.

7.6.1 Demographic Features of Participants

Demographic features of participants such as gender, job title, areas of specialty and years of experience were collected to check the representativeness of the participants when the results are presented. A frequency table was presented. Mean scores and standard deviation were also calculated and presented. See section 6.5.8.1 on the measures of descriptive statistics used for the demographic features of the participants.

7.6.2 Self-reported Hand Hygiene Compliance Rates

Participants' self-reported and their colleagues' hand hygiene compliance rates were analysed using descriptive statistics. Mean scores and standard deviations were also calculated and presented.

7.6.3 Barriers and Levers to Hand Hygiene Practices

Only items that were included after validity and reliability testing of BALHHI were analysed. Mean scores and standard deviation were calculated per item and according to domains. All negatively worded items were reversed such that in all cases, 1 represented a lever or an

absence of a barrier and 5 represented a barrier or the absence of a lever. For instance, if a participant answered *"strongly agree"* that *"they engage in hand hygiene out of respect for their patients"*, this would be considered as a lever to hand hygiene. If a participant answered *"strongly disagree",* this would be considered a barrier to hand hygiene. Any mean score above 1 was considered a barrier, any mean score above 3 was considered beyond midpoint and a barrier while items between 2 and 3 were considered as borderline.

7.6.4 Knowledge Test Questions

The knowledge test questions were analysed using frequency table and percentages. The knowledge test questions are binary which assessed right or wrong answers. A graph was also presented to show the proportion that answered correctly and incorrectly. Other questions that surveyed barriers and levers were 5-point Likert scale items.

7.7 Findings from Survey

7.7.1 Demographic Features of Participants

Findings from demographic features of participants are presented using descriptive statistics. These include range, mean, standard deviation and a frequency table showing the distribution. These were presented in section 6.6.9.1 of the instrument validation and testing chapter (chapter 6). The distribution of participants according to gender and job title was presented in table 6.6, the distribution of participants according to areas of specialty was presented in table 6.7 while the mean scores per items were presented in table 6.8 of the instrument validation and testing chapter (chapter 6). The response rate was 85.9%.

7.7.2 Self-reported Hand Hygiene Compliance Rates

Participants' self-reported hand hygiene compliance rate ranged from 30% to 100% with a mean score of 79.4% and standard deviation of 15.80. When asked to assess their

colleagues, participants ranged their hand hygiene compliance rates from 30% to 100% with a mean score of 76% and standard deviation of 16.67.

7.7.3 Barriers and Levers to Hand Hygiene Practices

The broad hand hygiene barriers will be presented first, followed by barriers according to professional groups and areas of specialty.

1. What are the hand hygiene barriers for HCWs?

The mean score according to domains for all the HCWs was calculated. All the three domains fall into the borderline category with domains *"belief about consequences"* (Mean = 2.67, SD = 0.70)*, "environmental context and resources"* (Mean = 2.61, SD = 1.02) and "*emotion"* (Mean = 2.53, SD = 0.97) respectively. This is presented in table 7.1.

Table 7-1 Means and Standard Deviation according to Domains

Domains	Mean	SD
Beliefs about consequences	2.67	0.70
Environmental context and resources	2.61	1.02
Emotion	2.53	0.97

Likewise, the mean score per items for all the HCWs was calculated. All the items were identified as barriers with the greatest being item 40 *("If I miss out hand hygiene I may be subject to disciplinary action")* with mean score of 4.10 (SD = 1.13) and the least being items 30 and 33 *("if I engage in hand hygiene it improves confidence"* and *"my environment is untidy")* with mean score of 2.09 for both items (SD = 1.12 and 1.18 respectively). This is presented in table 7.2.

Table 7-2 Means and Standard Deviation Per items

Item No	Items	Mean	SD
Q7	I engage in hand hygiene out of respect for my patients	2.66	1.44
Q14	I feel angry if hand hygiene is not carried out by others	2.76	1.22
Q21	If I omitted hand hygiene I would blame myself for infections	2.34	1.33
Q24	I am reluctant to ask others to engage in hand hygiene	2.17	1.12
Q30	If I engage in hand hygiene it improves patient confidence	2.09	1.12
Q33	My environment is untidy	2.09	1.18
Q34	I feel guilty if I omit hand hygiene	2.27	1.19
Q35	I feel ashamed if I omit hand hygiene	2.55	1.22
Q36	My area of work has poor staffing levels	3.12	1.40
Q40	If I miss out hand hygiene I will be subject to disciplinary action	4.10	1.13

2. Is there a difference in barriers and levers to hand hygiene according to professional group?

All the professional groups considered the three domains as barriers with mean scores ranging from 1.71 among technicians and 2.83 among doctors. Doctors had the greatest barriers in the three domains with mean scores of 2.82, 2.80 and 2.83 for *"beliefs about consequences", "environmental context and resources"* and *"emotion"* domains respectively. Technicians had the least barrier in the *"environmental context and resources"* domain. See table 7.3 for the mean scores for domains by professional group.

Table 7-3 Mean Scores for Domains by Professional Group

Professional Group (n=230)	Beliefs about Consequences		Environmental Context and Resources		Emotion	
	Mean	SD	Mean	SD	Mean	SD
Nurses (n=115)	2.63	0.73	2.53	0.94	2.44	1.01
Doctors (n=79)	2.82	0.68	2.80	1.09	2.83	0.92
Health Assistants (n=29)	2.48	0.55	2.59	1.04	2.08	0.66
Technicians (n=7)	2.51	0.73	1.71	0.95	2.33	1.11

The mean scores for items according to professional group was calculated and all the items were considered as barriers with mean score ranging from 1.43 among technicians and 4.21 among health assistants. The greatest barrier was seen in item 40 *("if I miss out on hand hygiene, I will be subject to disciplinary action")* across all the professional groups with mean ranging from 3.14 among technicians and 4.21 among health assistants. Doctors and nurses had mean scores of 4.11 and 4.12, respectively.

Doctors had the least barrier in item 24 *("I am reluctant to ask others to engage in hand hygiene")* with mean score of 2.29 (SD = 1.08) while health assistants had the least barrier in item 30 *("if I engage in hand hygiene it improves my confidence")* with a mean score of 1.62 (SD = 0.72). Item 33 *("my environment is untidy")* is the least barrier for nurses and technicians with mean scores of 1.85 (SD = 1.09) and 1.43 (SD = 0.79) respectively. The mean scores and standard deviations for items according to professional group are presented in table 7.4.

Table 7-4 Mean Scores for Items by Professional Group

Item No	Items	Mean score and (standard deviation) of items by professional group			
		Doctors	Nurses	Health Assistants	Technicians
Q7	I engage in hand hygiene out of respect for my patients	2.63 (1.37)	2.82 (1.51)	2.07 (1.16)	2.57 (1.81)
Q14	I feel angry if hand hygiene is not carried out by others	2.91 (1.10)	2.73 (1.26)	2.45 (1.27)	2.71 (1.50)
Q21	If I omitted hand hygiene I would blame myself for infections	2.63 (1.25)	2.23 (1.36)	2.07 (1.33)	2.00 (1.41)
Q24	I am reluctant to ask others to engage in hand hygiene	2.29 (1.08)	2.02 (1.08)	2.41 (1.32)	2.43 (1.27)
Q30	If I engage in hand hygiene it improves patient confidence	2.44 (1.23)	1.95 (1.04)	1.62 (0.72)	2.43 (1.40)
Q33	My environment is untidy	2.48 (1.21)	1.85 (1.09)	2.14 (1.30)	1.43 (0.79)
Q34	I feel guilty if I omit hand hygiene	2.69 (1.14)	2.13 (1.25)	1.76 (0.64)	2.14 (1.35)
Q35	I feel ashamed if I omit hand hygiene	2.90 (1.12)	2.46 (1.26)	2.03 (1.05)	2.14 (1.57)
Q36	My area of work has poor staffing levels	3.11 (1.39)	3.21 (1.38)	3.03 (1.52)	2.00 (1.15)
Q40	If I miss out hand hygiene I will be subject to disciplinary action	4.11 (0.99)	4.12 (1.19)	4.21 (1.05)	(1.57)

3. Is there a difference in barriers and levers to hand hygiene according to area of specialty?

All three domains were considered as barriers of hand hygiene according to areas of specialty with mean score ranging from 1.86 in ICU to 3.00 in A&E. For "*beliefs about consequences"* domain, barrier is greatest in O&G (mean = 2.92) and least in theatre (mean = 2.33). For *"environmental context and resources"* domain, barrier is greatest in A&E (mean

= 3.00) and least in theatre (mean = 2.18). For *"emotion"* domain, barrier is greatest in Medicine (mean = 2.91) and least in ICU (mean = 1.86).

In surgery, the greatest barrier is the "*environmental context and resources"* domain (mean = 2.77, SD = 0.85) while the least barrier is the *"emotion"* domain (mean = 2.60, SD = 0.82). The mean score for domains according to areas of specialty are presented in table 7.5.

Table 7-5 Mean Scores for Domains by Area of Specialty

Areas of Specialty (n=230)	Beliefs about Consequences		Environmental Context and Resources		Emotion	
	Mean	SD	Mean	SD	Mean	SD
Medicine (n=54)	2.75	0.70	2.79	0.94	2.91	1.05
Surgery (n=34)	2.70	0.79	2.77	0.85	2.60	0.82
Paediatrics (n=28)	2.41	0.74	2.40	1.14	2.02	0.80
Outpatient clinic (n=19)	2.37	0.64	2.34	1.31	2.28	0.92
Theatre (n=14)	2.33	0.56	2.18	1.01	2.14	0.95
A&E (n=21)	2.70	0.64	3.00	1.29	2.35	1.19
ICU (n=7)	2.89	0.68	2.36	0.90	1.86	0.54
O&G (n=21)	2.92	0.52	2.52	0.87	2.75	1.01
Renal (n=9)	2.89	0.59	2.61	0.65	2.37	0.70
Others (Psychiatry, Dermatology, Ophthalmology, Laboratory and ENT (n=14)	2.90	0.69	2.29	0.91	2.90	0.67

All the items were considered as barriers when compared by areas of specialty with mean score ranging from 1.29 in ICU and 4.67 in O&G. Just as seen for items across professional groups, barrier was greatest for items across all specialties in item 40 *("if I miss out on hand hygiene I will be subject to disciplinary action")* with mean score ranging from 3.07 (SD = 1.44) in theatre and 4.67 (SD = 0.58) in O&G. The least barrier was seen in item 33 *("my environment is untidy")* in ICU with mean of 1.29 (SD = 0.49).

In surgery, the greatest barrier was seen in item 40 *("if I miss out on hand hygiene I will be subject to disciplinary action")* with mean score of 4.21 (SD = 1.12) while the least barrier was in item 24 *("I am reluctant to ask others to engage in hand hygiene")* with mean score of 2.05 (SD = 1.11). The mean scores for items according to areas of specialty is presented in table 7.6.

Table 7-6 Mean Scores and Standard Deviation of Items by Area of Specialty

Item No	Items	Mean score (standard deviation) of items according to areas of specialty									
		Medicine	Surgery	Paediatrics	Outpatient	Theatre	A&E	ICU	O&G	Renal	Others
Q7	I engage in hand hygiene out of respect for my patients	2.70 (1.27)	2.44 (1.53)	2.07 (1.46)	2.32 (1.11)	3.07 (1.64)	2.76 (1.55)	3.71 (1.38)	3.29 (1.45)	2.78 (1.30)	2.64 (1.50)
Q14	I feel angry if hand hygiene is not carried out by others	3.00 (1.08)	3.14 (1.19)	2.21 (1.23)	2.11 (0.81)	2.57 (1.34)	2.57 (1.50)	2.00 (1.15)	3.05 (1.20)	2.67 (1.32)	3.07 (0.92)
Q21	If I omitted hand hygiene I would blame myself for infections	2.57 (1.18)	2.58 (1.47)	2.11 (1.34)	2.05 (1.39)	1.71 (1.14)	2.29 (1.45)	1.86 (1.07)	2.33 (1.35)	2.33 (1.58)	2.50 (1.22)
Q24	I am reluctant to ask others to engage in hand hygiene	2.41 (1.12)	2.05 (1.11)	2.43 (1.37)	1.68 (0.95)	1.79 (1.05)	1.90 (0.97)	1.71 (1.11)	2.43 (1.12)	2.67 (1.00)	2.14 (0.77)
Q30	If I engage in hand hygiene it improves patient confidence	2.30 (1.14)	2.21 (1.15)	1.46 (0.64)	1.74 (1.10)	2.00 (1.24)	2.19 (1.21)	2.57 (1.81)	1.90 (0.89)	2.11 (0.78)	2.64 (1.15)
Q33	My environment is untidy	2.17 (1.19)	2.26 (1.11)	1.93 (1.46)	2.11 (1.29)	1.71 (0.83)	2.52 (1.50)	1.29 (0.49)	2.10 (1.09)	1.67 (0.71)	2.00 (0.78)
Q34	I feel guilty if I omit hand hygiene	2.65 (1.32)	2.40 (1.12)	1.79 (0.96)	2.32 (1.25)	1.71 (1.07)	2.10 (1.22)	1.43 (0.54)	2.24 (1.04)	1.78 (1.09)	3.00 (1.04)
Q35	I feel ashamed if I omit hand hygiene	3.07 (1.15)	2.28 (1.05)	2.07 (1.09)	2.42 (1.22)	2.14 (1.41)	2.38 (1.40)	2.14 (0.90)	2.95 (1.50)	2.67 (1.22)	2.64 (0.84)
Q36	My area of work has poor staffing levels	3.41 (1.12)	3.28 (1.37)	2.86 (1.56)	2.58 (1.61)	2.64 (1.45)	3.48 (1.60)	3.43 (1.51)	2.95 (1.36)	3.56 (1.33)	2.57 (1.34)
Q40	If I miss out hand hygiene I will be subject to disciplinary action	3.76 (1.11)	4.21 (1.12)	4.00 (1.36)	4.05 (1.03)	3.07 (1.44)	4.38 (0.97)	4.57 (0.79)	4.67 (0.58)	4.56 (0.73)	4.57 (0.65)

7.7.4 Knowledge Test Questions

The knowledge test questions were analysed using frequency and percentages. Generally, participants displayed suboptimal level of hand hygiene knowledge. While almost 80% of the participants showed an understanding of when to perform hand hygiene, only slightly above 50% of the participants knew the techniques to follow and the idea that bacteria are spread most readily through hand contamination. Notably, less than 50% of the participants knew clostridium difficile is not readily killed by alcohol-based hand products.

Doctors showed better knowledge on when to perform hand hygiene, understanding that bacteria are most readily spread through hand contamination and knowing that clostridium difficile is not readily killed by alcohol-based products. Nurses only showed better knowledge when it comes to the techniques to follow when there is need to perform hand hygiene when hands are not visibly soiled.

Technicians displayed least knowledge on when to perform hand hygiene and understanding that bacteria are most readily spread through hand contamination whereas health as showed least knowledge on the techniques to follow when there is need to perform hand hygiene and knowing that clostridium difficile is not readily killed by alcohol-based products. The proportion of HCWs that answered the questions correctly is presented in table 7.7. The findings here will be discussed further in the discussion of findings chapter (chapter 9).

Table 7-7 Proportion of HCWs that Answered the Questions Correctly

Professional Group	Q41: In which of the following situations should hand hygiene be performed	Q42: Most effective hand hygiene method when hands are not visibly soiled	Q43: How are antibiotic-resistant bacteria most frequently spread from one patient to another in healthcare settings?	Q44: Is Clostridium difficile (the cause of antibiotic-associated diarrhoea) readily killed by alcohol-based hand hygiene products?
	Freq (%)	**Freq (%)**	**Freq (%)**	**Freq (%)**
Nurses	82 (71.3)	61 (53.0)	58 (50.4)	41 (35.7)
Doctors	68 (86.1)	40 (50.6)	58 (73.4)	46 (58.2)
Health assistants	22 (75.9)	12 (41.4)	12 (41.4)	9 (31.0)
Technicians	5 (55.6)	3 (42.9)	2 (28.6)	4 (57.1)
Total	**177 (77.0)**	**116 (50.4)**	**130 (56.5)**	**100 (43.5)**

7.8 Study Strengths and Limitations

This survey has provided numerical insights into the top barriers and levers to hand hygiene practices. Barriers and levers to hand hygiene according to job titles and areas of specialty were also identified in terms of the TDF domains. Some study limitations were identified.

First, the survey was conducted in only one setting however, the survey is just an aspect of the PhD research. The qualitative study conducted in the next chapter gives deeper insights into the barriers and levers to hand hygiene practices in the research context. More so, the response rate was high (85.9%) and sample size is representative of the study population. Hence, the findings are generalisable. The study was also conducted in a private teaching hospital where the barriers and levers to hand hygiene practices may be different when compared to public hospitals. However, HCWs' culture and trainings are unlikely to differ. Future research could explore both private and public hospitals to compare findings.

There is also a chance of extreme responding (Lavrakas, 2008). This is common with Likert scales where participants are likely to select the most extreme options.

7.9 Chapter Summary

The aim of this chapter was to establish the barriers and levers to hand hygiene among Nigerian HCWs in a teaching hospital through a survey of BALHHI. This study was a cross-sectional design. The mean score for participants' and their colleagues hand hygiene compliance rates were calculated and presented. Self-reported hand hygiene compliance ranged from 30% to 100% for both participants and their colleagues. Similarly, the mean scores for each of the domains and items according to professional groups and areas of specialty were calculated and presented. All the 3 domains and 10 items were considered as barriers. The frequency and percentages of the participants that answered the knowledge test questions were also calculated and presented. Findings from this study will be compared with the interview results in the discussion of findings chapter (chapter 9). The next chapter describes the qualitative exploration of the barriers and levers to hand hygiene among the HCWs from the research setting.

Chapter 8 Barriers and Levers to Hand Hygiene Practices: A Qualitative Study

8.1 Introduction

This chapter presents the qualitative aspect of this research. In a bid to build on the findings from the systematic literature review (chapter 3), and also to understand the reasons for the low hand hygiene compliance rate found in the hand hygiene observations chapter (chapter 5), HCWs were asked what they considered as barriers and levers to hand hygiene practices. The aim, objective and research question of this chapter are given first. This is followed by the research design where the choice of an interview style and the methods employed in this research are described. The results are then presented in themes, followed by the study strengths and limitations. A brief chapter summary is given in relation to the research aim as the concluding paragraph of this chapter. A flowchart illustrating the study process is presented figure 8.1.

8.2 Research Aim

This chapter aims to further understand the barriers and levers to hand hygiene compliance.

8.3 Research Objective

The chapter objective is to conduct semi-structured interviews among surgical HCWs working in adult male and female surgical wards of a Nigerian teaching hospital.

8.4 Research Question

What are the barriers and levers to hand hygiene practices among Nigerian HCWs of a teaching hospital?

8.5 Research Setting

The research setting was described in chapter 5, section 5.2.

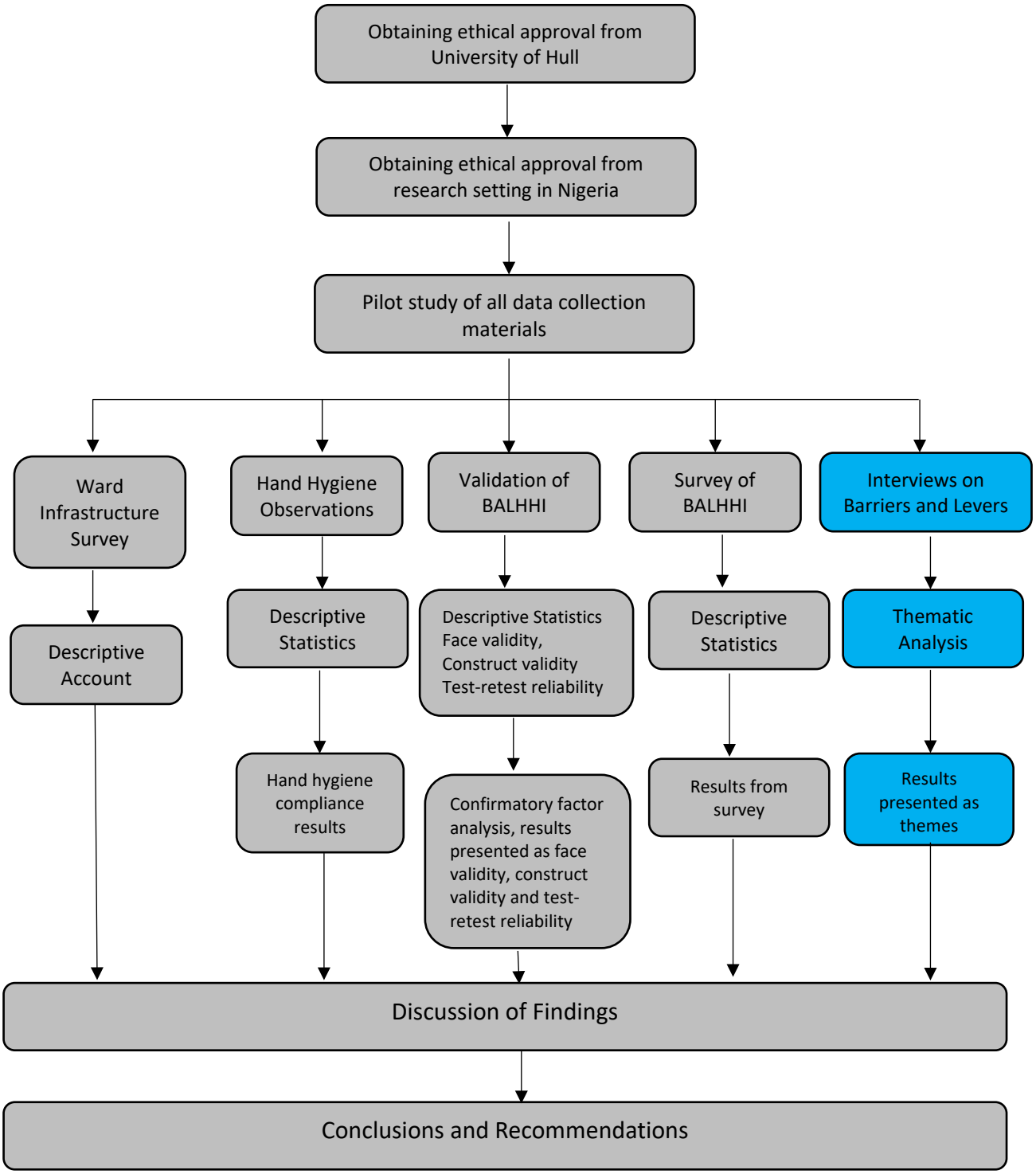


Figure 8-1 Flowchart of the Qualitative Research Process

8.6 Research Design

To address the research aim, an interpretivist approach is considered the most rational choice. Adopting this approach, face-to-face, semi-structured interviews is the method of choice, with the view to eliciting deeper insight and understanding into the perceived barriers and levers to hand hygiene among surgical HCWs of the study site. All the interview types and how the most appropriate interview style was decided are discussed in the next section.

8.6.1 Choosing the Interview Style

Interviewing is the commonest method of data collection in qualitative research (Jamshed, 2014). While some other authors identified the basic types of interviews as structured, unstructured and semi-structured interviews (Gill et al., 2008), Bryman (2016) acknowledged two forms of interviews, structured and qualitative interviews, the latter being a general term for unstructured and semi-structured interviews. Interviewing operates as a continuum with structured interviews being at the quantitative end of the scale and qualitative interviews on the other end of the continuum with increasing levels of flexibility and lack of structure (Edwards & Holland, 2013; Mason, 2017).

Structured interviews, also called standardised interviews involves the administration of predetermined questions, (or interview schedule which is usually a collection of questions) designed to be asked by the interviewer to all research participants (Given, 2008). It is widely used in quantitative research to maximise the reliability and validity of measurement of key research constructs by subjecting the participants to equal opportunities of asking questions and documenting responses, thereby reducing errors from variations in question asking and greater accuracy and ease of analysing the participants' responses (Given, 2008;

Bryman, 2016). Structured interview is seldom used in qualitative research due to its inability to give deeper insight into the social phenomena being studied. The style of questions employed in structured interviews makes it unfit to answer the research question in this chapter. Questions are usually close ended, very definite and often offer the participants a fixed range of answers (Bryman, 2016). Therefore, this type of interview is not suitable for this phase of the research as it is unable to give insight into the research aim.

Qualitative interviews are much less structured with more open-ended questions and more attention is paid on the participants' views and perceptions in a bid to elicit richer and more detailed responses (Bryman, 2016). Specifically, unstructured (or unstandardised) interviews involve the researcher initiating the discussion by introducing the topic of interest in a flexible, nondirective approach thereby allowing participants to develop their own opinions and follow their train of thoughts (Denscombe, 2014). This type of interview is used in ethnographic research, fieldwork or when relatively new domains are being studied (Given, 2008; Jamshed, 2014). The style of questioning is informal, and emphasis is placed on the participants' thoughts where fairly nonspecific, open-ended questions are asked in order to understand their perception on the topic of interest (Given, 2008; Bryman, 2016).

Specifically, semi-structured interviews are a qualitative data collection method where participants are asked a set of predetermined questions about the topic of interest, usually called an interview guide developed beforehand by the researcher (Given, 2008; Bryman, 2016). Semi-structured interviews are regarded as the gold standard method of inquiry in qualitative research (Silverman, 2006). There is a clear list of issues to be addressed as well as questions to be answered and this assists to shape areas for exploration and also gives opportunity to the participants to elaborate on a spontaneous idea or response in more

detail, using a less structured style of questioning (Gill et al., 2008; Ryan et al., 2009; Denscombe, 2014). The interview guide may be followed dogmatically by asking questions in the order the researcher had written them or pragmatically based on the participants' responses by allowing the participants speak freely and widely on issues raised by the interviewer (Given, 2008; Denscombe, 2014). Topics of interview guide are shaped from the research questions and may rely on the theoretical framework underpinning the research (Given, 2008).

Noteworthy, structured interviews have been criticised for lack of recognition of participants' views and perceptions while unstructured interviews are considered as timewasting where irrelevant information are given whereas semi-structured interviews make up for this by using predetermined set of open-ended questions to elicit rich and in-depth data from participants (Holloway & Wheeler, 2010). The flexible approach of semi-structured interviews, unlike structured interviews allows for the exploration of information considered important to the participants which the researcher may not have earlier deemed as essential (Gill et al., 2008; Ryan et al., 2009). Hence, emphasis is laid on the participants elaborating on their own points of interest (Denscombe, 2014). Likewise, in semi-structured interviews, the researcher has more control over the topic of interest than in unstructured interviews and there are no fixed range of responses to each question as in structured interviews (Bryman, 2016).

In this study, the participants were guided to tell their own stories. A self-developed, open-ended interview schedule was developed and used. Examples of questions included in the interview schedule are given in figure 8.2 while the entire interview schedule is presented in appendix N. The interview schedule was underpinned by the TDF while designing it because

it covers all potential determinants of clinical behaviours (see section 4.4.2 on rationale for adopting the TDF for this research). Relevant questions were arranged according to the 11 domains of the framework. For instance, the questions: *"what is your understanding of the need for hand hygiene?, "what comes to your mind when you hear hand hygiene?"* are examples of questions that test their knowledge of hand hygiene and this falls into the "knowledge" domain of the framework.

Domains	Interview Questions
Knowledge	Can you describe your understanding of the need for hand hygiene? When do you perform hand hygiene?
Skills	Can you describe how to perform hand hygiene?
Social/Professional Role and Identity	Do you think hand hygiene guidelines are consistent with your professional standards of practice? How? How will you describe the importance of performing hand hygiene to you as a person?
Beliefs about capabilities (self-efficacy)	Is performing hand hygiene easy or difficult for you? Why do you think so? Can you describe any previous barriers or difficulties you have had performing hand hygiene? Do you think you can improve your hand hygiene compliance despite the barriers? If yes, how do you intend to? If no, why do you think so?

Figure 8-2 Examples of Questions in Included the Interview Schedule

8.6.2 Sampling and Participant Recruitment

It is important that a sampling plan gives a clear indication of the criteria for selecting the research participants and also an estimate of the sample size needed (Polit & Beck, 2012). This is especially necessary in qualitative studies so that credible conclusions can be presented, and development of theories can be enhanced. To this end, purposive sampling, which allows the researcher to include all the potential participants that fitted into the selection criteria and conformed to the research interests is used (Silverman, 2017). This is a form of nonprobability sampling technique which is used when it is not feasible to include a

large number of study participants and when there is difficulty of controlling samples selected through probability sampling methods (Denscombe, 2014). Purposive sampling is particularly valuable in qualitative research where rich, in-depth information about a specific group is sought (Palinkas et al., 2015).

The criteria for recruiting study participants included those HCWs, especially doctors and nurses with varying years of clinical experience that are directly involved in patient care, who work in the surgical wards and comprehend English language. Health assistants were excluded from the interviews as they are unlikely to have the basic English language knowledge capacity required to engage in the interviews.

While retrieving questionnaires administered for construct validity and having conducted the ward infrastructure survey and hand hygiene observations, the researcher had already developed a close working relationship with the members of staff of the two surgical wards of the hospital. This made approaching the members of staff with invitation to participate in the interview fairly easier than anticipated. First, the matrons-in-charge of the two wards, whom already had the detailed structure of data collection were approached and reminded individually. Then, the surgical staff were approached and invited to participate with detailed research information, including the participant information sheet (see appendix O) distributed to all of them. To avoid coercion, the researcher reiterated the voluntary rights of HCWs to participation and withdrawal at any stage of the interviews during recruitment. Potential participants were requested to contact the researcher using the contact details provided if they had any questions. Participants were given 48 hours to decide whether they intended to participate or not and they were required to signify interest within the timeframe. No prompts or incentives were given as most of the potential participants

already had monetary incentives for the questionnaire survey. Vanclay et al. (2013) advised that financial incentives to encourage participation should not be excessive such that it would be considered a bribe or an inappropriate inducement.

There were 30 nurses and 15 doctors working on the surgical wards. The researcher aimed to interview 15 to 20 HCWs and the plan was to stop the interviews when data saturation was reached. Data saturation is the point at which no new information or themes are being derived from the interviews (Faulkner & Trotter, 2017). Data saturation is suggested to be reached at 7 to 12 interviews (Guest et al., 2006), though some authors suggested that having more than 15 participants can complicate data analysis (Miles et al., 2013), some recommended 8 to 16 participants (Namey et al., 2016).

8.6.3 Procedure

Prior to commencement of the interviews, the researcher introduced herself again and gave detailed research information including the study purpose verbally. Participants had earlier received participant information sheet before agreeing to partake in the study. It was reiterated that the interview was solely for academic research purpose and that no personal information of the participants were required other than their profession and years of experience. This is to check if occupational category and years of experience influence participants' hand hygiene practices. The researcher and potential participants agreed on a convenient date and time, and preferred location within the hospital environment and where participants could talk freely, privately, without noise or any form of distractions. This was mostly in the matron's office on the ward. All queries were clarified first before commencing the interviews.

8.6.4 Pilot Interviews

Pilot studies are important ways of addressing potential practical issues in research process, checking and prioritising important questions (van Teijlingen & Hundley, 2002). More so, interview schedules could be strengthened when interviews are piloted (Castillo-Montoya, 2016). The first two interviews conducted in this study acted as pilot. These were transcribed and emailed to the research supervisors for peer review. The pilot interviews assisted the researcher to ensure that the questions were understandable and appropriate for the research context. The pilot interviews also enhanced the understanding of the researcher on the best ways to ask questions to obtain richer information from the participants. Probing questions were developed from the pilot interviews. Minor changes including rewording questions that participants did not fully understand were done. The transcribed pilot interviews were included in this study as useful information that are relevant to the study were given and no changes were made to the interview.

8.6.5 Ethical Considerations

Ethical approval was obtained to conduct the qualitative study as discussed in section 5.3. The consent forms (see appendix P) were explained to the participants and duly signed. In any research, a signed written consent form should be obtained based on adequate disclosure of relevant information including the benefits and any risks of participation (Perlman, 2004; Vanclay et al., 2013). Verbal consent was also taken, and audio recorded. Participants' rights to voluntary participation and withdrawal at any stage of the interview were emphasised. Vanclay et al. (2013) submitted that participants should exercise autonomy by allowing them to voluntarily decide whether they want to participate in the study or not, without being subjected to any coercion or threat of harm for non-participation. The participants must be also informed that they can withdraw from the

research at any time (Vanclay et al., 2013). However, the researcher noted that any relevant information they gave prior to withdrawal would be used in the research.

Moreover, the participants' rights to privacy and confidentiality must be upheld by the researcher throughout the research process. Savin-Baden and Major (2013) stressed that confidentiality is paramount in maintaining participants' privacy and anonymity. To build a working trust between the researcher and the participants, confidentiality and privacy must be given an earnest consideration. Participants should be assured that any information they give will be kept confidential and the researcher should be able to judge appropriately what should be considered private and what can be publicly disclosed (Vanclay et al., 2013). All entrusted information must be kept confidential by the researcher and specific permission must be given by the participants if the researcher intends to record (audio or video) the participants. Equally, the researchers are expected to avoid undue intrusion into what will be considered as private and personal lives of the participants.

Likewise, the identity of the participants must be protected unless otherwise stated. Vanclay et al. (2013) stressed that people participate in research on the premise that they will be kept anonymous hence, their anonymity must be protected. Pseudonyms, numbers or aliases can be used to replace individual names and results can be presented together as in case studies instead of reporting them individually that might render participants becoming easily identifiable (Creswell & Creswell, 2018).

In this research, participants were assured of their confidentiality and anonymity and also informed that pseudonyms would be used. Participants were reminded that they did not have to answer any questions they were not comfortable with though no questions were included that were expected to cause any distress. Interviews were audio recorded, and the

researcher ensured the participants were comfortable with this and that it was solely to have a full grasp of the discussion we were having.

8.7 Data Analysis

All interviews were transcribed verbatim by the researcher. The transcripts were then imported into NVivo version 12 data management software for qualitative data analysis purposes. A thematic analysis suggested by Braun and Clarke (2006) was conducted. This inductive approach, from data extraction to generation of themes was employed using the suggested 6 steps (Braun & Clarke, 2006). The processes involved are described below.

8.7.1 Familiarising with the Data

The audio-recorded interviews were transcribed verbatim by the researcher. During the transcription process, all the conversations and information given by the participants were carefully listened to. To ensure the precision of the transcription and to be as conversant with the data as possible, the transcripts were read several times and cross-checked with the audio recordings. The transcripts were checked for interesting ideas that were frequently emerging in line with the research question. A new folder containing copies of the transcripts was created on the researcher's personal laptop and named "transcripts with highlights" where the likely codes were highlighted as the researcher read the transcripts and had ideas of what these could be because of their recurrence. The transcripts were then entered into NVivo version 12 as the researcher got used to the data.

8.7.2 Generation of Initial Codes

From the highlighted likely codes of the transcripts, the researcher generated an early list of likely codes which were then referred to during the electronic coding unto NVivo. The researcher ensured that every sentence of each of the 16 transcripts was coded. The research question was borne in mind throughout the coding process and where possible,

the barriers and levers to hand hygiene practices were coded using the participants' exact words. This necessitated the generation of more codes as all the data were coded and those that were not included in the early coding list were identified at this stage (see appendix Q for initial codes generated in NVivo).

8.7.3 Searching for Themes

To ascertain how the codes harmonised into themes, some of the initial codes were reshuffled where necessary so as to ensure that the most related codes were put under one theme. The relationship between the themes were considered, with some codes considered as the main theme and others as subthemes, and in instances of some codes not fitting at all into any theme at this stage, the codes were put in a theme titled "miscellaneous" for later consideration.

8.7.4 Reviewing Potential Themes

At this stage, the generated themes were checked with the data coded into them to ensure they harmonise well in terms of fitness and relationship. Where the themes and data did not go together, these were tweaked by moving some to the *"miscellaneous*" theme for later consideration. After getting the data into the most suitable themes, the themes were reviewed against the entire dataset. This was necessary to ensure that the themes actually captured all of the entire dataset and that they were the most relevant to the research question. The *"miscellaneous"* theme was also examined, and it was easier to move the data to the most suitable themes at this stage. Where data did not fit into any themes, they were discarded (see appendix R for a worked sample of coding steps to generation of themes).

8.7.5 Defining and Naming the Themes

This stage involved refining and re-naming the themes until they effectively captured the research question. To ensure the accuracy of the titles given to the themes and subthemes,

a narrative report was written on them, respectively. This was to fully depict the degree at which the themes captured the dataset.

8.7.6 Producing the Report

A thematic analysis of all the themes and data extracts was given at this phase. Appendix S presents the thematic analysis. Great caution was taken to avoid repetition while giving a full account. This will be presented in the findings section.

8.8 Ensuring Trustworthiness of the Study Process

Rigour or trustworthiness is synonymous to validity and reliability in qualitative research (Thomas & Magilvy, 2011). Internal validity, external validity, internal reliability and external reliability are the views of validity and reliability proposed by some qualitative researchers (LeCompte & Goetz, 1982; Kirk & Miller, 1986). However, some researchers proposed different measures of quality in qualitative research due to the ontological stance of quantitative research that there are absolute truths about the world which is the job of the social scientists to reveal (Bryman, 2016). Instead, Guba and Lincoln (1994) argued that there can be more than one and possibly several accounts of truth. A different way of looking at validity and reliability will ensure rigour in qualitative studies (Guba & Lincoln, 1994). Hence, the use of trustworthiness and authenticity was proposed to assess the quality of qualitative research as alternatives to reliability and validity. Trustworthiness is made up of four criteria each of which has an equivalent criterion in quantitative research – credibility, transferability, dependability and conformability (Bryman, 2016). Each of these criteria and how they were upheld in this research are discussed below.

8.8.1 Credibility

Credibility parallels with internal validity in quantitative research. This is the degree of good relationship between the researchers' observations and the theoretical ideas they develop

(Bryman, 2016). Credibility ensures that the research is carried out according to the principles of good practice (Bryman, 2016). For this study, the researcher had already developed a close working relationship with the surgical staff of the hospital while retrieving questionnaires administered for the quantitative phase of this research and having conducted the hand hygiene observations. Some of the staff were eager to share their personal perceptions of the barriers and levers to their hand hygiene practices. This is classed as a strength for qualitative research because prolonged involvement in a social setting over a long period of time allows the researcher to create a link between the concepts and observations (Bryman, 2016).

In credibility, the findings reflect the true representation of the participants' construction of realities of the phenomenon being studied (Savin-Baden & Major, 2013). Some authors suggested that for study findings to be credible, the researcher should submit the results to members of the social setting being studied in order to obtain confirmation that the researcher has fully understood the social world (Guba & Lincoln, 1994). This is called respondent or member validation. For this study, responses from previous participants were used to elicit more information, clarification of grey areas and deeper responses from other participants to enhance understanding of the researcher about the participants' views. Informal discussions were held with some surgical staff to verify information provided by some participants on their barriers and levers to hand hygiene practices. A meeting was held by the researcher and matrons-in-charge of the surgical wards to provide anonymised feedback on some reasons identified by the participants as barriers to their hand hygiene practices. The researcher reiterated that a detailed report of the research findings will be submitted to the hospital management when the research is concluded.

8.8.2 Transferability

Transferability parallels with external validity in quantitative research. It is the degree to which findings can be generalised across social settings (Kirk & Miller, 1986). This is an issue in qualitative research usually because of the small sample size (Bryman, 2016). However, some authors argue that it is not the researcher's responsibility to suggest the transferability of the findings (Savin-Baden & Major, 2013). Though it is impossible to achieve generalisability in its real sense, qualitative researchers are advised to produce a thick description of the setting so as to assist other researchers make an informed judgement on the transferability of the findings to other settings (Guba & Lincoln, 1994). For this study, the researcher attempted to address the issue of generalisability in a number of ways. First, the researcher provided a comprehensive contextual background to the study, including a rich description of Nigeria in terms of geography, demographics, healthcare system and the key health indices. More so, the researcher has provided an in-depth description of the research process. A thick description of analysis and interpretation of the data are also provided in this chapter. This comprehensive information are expected to allow for informed judgement on the applicability of findings to wider settings (Marshall & Rossman, 2016).

8.8.3 Dependability

This concept parallels to reliability in quantitative research. To establish the merit of a research in terms of dependability, Guba and Lincoln (1994) suggested keeping an audit trail as a criterion for trustworthiness. Audit trail entails ensuring that complete records are kept of all phases of the research process, from formulating the problem to selecting the research participants, data collection and analysis, in an accessible manner (Bryman, 2016).

In this study, the researcher has provided a detailed description of the study aim, questions and design. The procedures for conducting the interviews have been outlined and the researcher has also provided an explicit account of the rationale behind the different decisions taken in the study. Theoretical accuracy in documenting and transcribing data was ensured. The researcher has justified the data analysis approach and rationale for choices made. In the results section, direct quotations of participants were provided to substantiate the arguments made in the discussion of findings chapter. The researcher also attached as appendices the interview schedule and emergent themes from the thematic analysis. Results are presented in the next section.

Peer review is also important during the course of the research and definitely at the end to ascertain that proper procedures are being and have been followed (Bryman, 2016). This is to assess the extent to which theoretical inferences can be justified (Thomas & Magilvy, 2011). The research supervisors were the major peer reviewers. Emails were continuously exchanged throughout the data collection process to discuss progress. The first interview was transcribed and emailed to them to check the reliability of the interview schedule and the entire data collection process.

8.8.4 Confirmability

This concept parallels with objectivity in quantitative research. Objectivity is the principle drawn from positivism that, as far as it is possible, researchers should be detached from what they study so findings depend on the nature of what was studied rather than on the personality, beliefs and values of the researcher (Payne & Payne, 2004). Even though objectivity is unachievable in qualitative research, confirmability ensures that the researcher has acted in good faith and that the research findings truly represent the views of the

participants on the phenomenon of study (Jensen, 2008). In confirmability, it should be evident that the researcher has not explicitly allowed personal values or theoretical inclinations to influence the conduct of the research and the findings arising from it (Bryman, 2016). To enhance objectivity in this study, direct quotes of participants were provided as evidence to show that only participants' views take sole representation in this study. Moreover, the researcher has described the processes of ensuring credibility, transferability and dependability which further ascertain confirmability in this study.

Triangulation of multiple sources of data in terms of multiple cases, multiple informants or more than one data collection method can significantly strengthen the study's applicability to other settings (Marshall & Rossman, 2016). Guba and Lincoln (1994) also recommended triangulation to establish the credibility of research findings. This qualitative study is part of a mixed methods research design. To facilitate triangulation, the researcher conducted ward infrastructure survey, hand hygiene observations and barriers and levers to hand hygiene survey. Findings will be integrated at the discussion of findings chapter to enhance the validity and reliability credibility of this research.

8.9 Findings in Qualitative Research

This section gives a detailed description of findings from the inductive thematic analysis of the semi-structured interviews conducted as part of this research. The emergent themes will be discussed in relation to the research question: "what are the barriers and levers to hand hygiene practices among Nigerian HCWs of a teaching hospital?" with a view to achieving the research aim of "to further understand the barriers and levers to hand hygiene compliance using semi-structured interviews".

Sixteen HCWs including four doctors and 12 nurses participated in the interviews. There were 4 males and 12 females and length of clinical experience ranged from 4 months to 35 years. The mean time taken for the interviews was 20 minutes as participants were not very keen to freely discuss about their hand hygiene practices. The problems encountered during the data collection process are discussed at the conclusions chapter where the researcher reflected on the whole research process. Table 8.1 describes the characteristics of the interview participants.

Table 8-1 Characteristics of the Interview Participants

S/N	Pseudonyms	Length of experience	Gender	Profession
1	Alice	6 months	Female	Nurse
2	Andrew	4 years	Male	Doctor
3	Anna	25 years	Female	Nurse
4	April	35 years	Female	Doctor
5	Betty	1 year	Female	Nurse
6	Brian	3 years	Male	Doctor
7	Chloe	6 years	Female	Nurse
8	Chris	3 years	Male	Nurse
9	Emily	4 years	Female	Nurse
10	George	10 years	Male	Doctor
11	Kate	3 years	Female	Nurse
12	Kim	7 years	Female	Nurse
13	Lisa	12 years	Female	Nurse
14	Mya	4 months	Female	Nurse
15	Peppa	3 years	Female	Nurse
16	Tara	5 years	Female	Nurse

Findings are presented according to two broad themes – personal and institutional, with 9 (namely *hand hygiene knowledge and skills, self-confidence on hand hygiene practices, perceived risks, forgetfulness, role models, glove use, respect from patients, skin irritation,*

and *emotion*) and 11 (namely *infrastructural deficit, hand hygiene knowledge and skills, incentives, heavy workload, time constraints, human resources, hospital reputation, staff wellbeing, means of hand hygiene education, hospital policy on hand hygiene resources and dirty environment*) subthemes respectively and these will be discussed below. Figure 8.3 below is the thematic image which illustrates the themes and subthemes derived. A worked sample of coding steps to generation of themes is presented in appendix R while the thematic analysis is presented in appendix S.

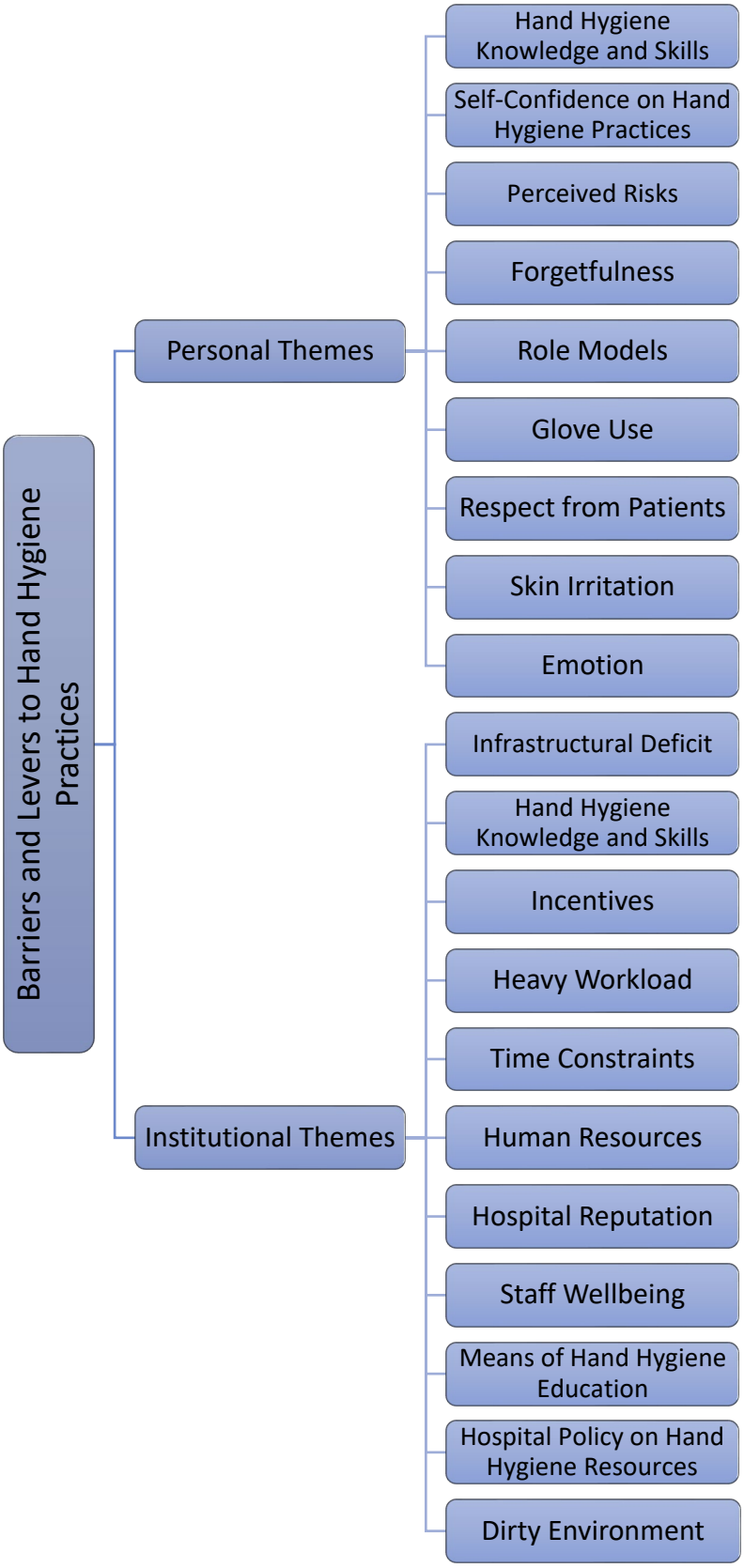


Figure 8-3 Thematic Image of the Barriers and Levers to Hand Hygiene Practices

8.9.1 Personal Themes

This theme relates to what participants identified as their individual barriers and levers to hand hygiene practices. There are nine subthemes here namely – hand hygiene knowledge and skills, self-confidence in hand hygiene practices, perceived risk for infection, forgetfulness, role models, glove use, respect from patients, skin irritation and emotion. These will be described in the following paragraphs.

8.9.1.1 Hand Hygiene Knowledge and Skills

Three subthemes are identified here – when to perform hand hygiene, how to perform hand hygiene and participants' perception of hand hygiene.

a) When to perform hand hygiene –

All the 16 participants demonstrated relative knowledge of when to perform hand hygiene, in terms of hand hygiene opportunities.

> "Performing hand hygiene is something that should be done every time in as much as you are in the hospital or in the hospital environment. Either when you want to step into the ward, or when you touch a particular patient, you wash your hands…and before you even touch another patient, you should wash your hands. When you are done with your ward round activity before you take your lunch, your...anything you want to eat in the hospital, you are meant to actually observe hand washing. And basically too, using ABHRs especially when you have to, when you are out of the hospital environment and you want to greet your friends, there is need for you to clean your hands...you might not be able to wash your hands at that particular moment but using ABHRs would help to limit the transfer of infections from yourself to another person. So, it's something we do all around, all the time" – Andrew (Dr)

> "Initially when you resume work before starting your procedures, you have to wash your hands, either before medication or even before attending to your patients, you have to wash your hands. Then in between patient contact, you have to wash. During the procedures, after contact with the patients, we also have to wash our hands and so many others like before and after attending to the patients, when you're going back home, before attending to anybody you have to wash your hands" – Alice (Nurse)

b) How to perform hand hygiene –

All 16 participants also demonstrated basic knowledge of how to perform hand hygiene and some participants were able to give thick descriptions of the steps involved.

> "…Hand hygiene is not just handwashing alone in the hospital…it entails everything like you looking after cuts and bruises on your hands, then of course, how you wash your hands…then the techniques of washing will change pertaining to what you want to do. The regular handwashing requires eight steps…of course, you should always wet your hands, avoid bar soaps…I prefer liquid soaps, occasionally when you can't come in contact with water, like when you are in a remote area, you may decide to use hand sanitiser which is a step down from using good liquid soap to wash your hands. So, first thing first, you wet your hands and at the beginning of handwashing you can actually touch the tap but once you wash you don't touch again, you should use your elbows, so a little water in your hands, press on the soap dispenser, then get some lather…then of course, wash inside, outside, in-between, in the nails, around the thumb, then you wash from the hands towards the elbows and then you rinse down in same manner…of course, after you've washed you shouldn't touch the tap or the soap dispenser. Subsequently, avoid laying your hands on a used towel, if you have disposable towels, that's good, if there's hand dryer that's even better but if that is not available, it's better to air dry" – George (Dr)

> "Okay, it involves seven stages. The first is that you wash the palm then after the palm you wash in between the fingers, you wash the back of the hand, then in between the nails too, wash the wrist, you wash the thumb then allow it to drain" – Peppa (Nurse)

> "I do it every time, like I'm a handwashing freak (laughs)…even at home it's more like part of my life, I can't do anything without washing my hands…I have to wash my hands first, that's my first instinct. So, it doesn't really matter what I want to do, I wash my hands all the time…Before I start any procedure with my patients, I wash my hands, whatsoever the type of procedure I do…after I wash my hands too. So before and after any contact with my patient, I wash my hands…probably, I might have attended to a patient, I wash my hands, if I want to take anything, I still wash my hands…before and after eating I wash my hands" – Kate (Nurse)

> "Ok, there are standard ways to wash the hands. You wash your palms, you wash in between your fingers, you try to wash the inside of your palm, rub like this (describes rubs hands palm to palm step) and then you wash the back, you wash down and then with your hands stretched like this (describing right palm

over left dorsum with fingers interlaced step), you try to clean up and then your hands are clean depending on what you want to do…" – Brian (Dr)

c) HCWs' Perception of Hand Hygiene Practices –

Nine participants identified hand hygiene practice as an innate behaviour. Specifically, five participants described hand hygiene as "part of you", 4 other participants identified it as a normal thing to do, one described it as a culture, another participant noted it becomes habitual with practice while two identified it as a lifestyle.

"…to me I think it's the normal thing just like the back of my hand...just wash your hands and go...something that you know it's your normal routine that you should do in your day to day activities" – Andrew (Dr)

"It's just like a lifestyle…a normal thing to do" – Kate (Nurse)

"It is easy, you know what you do every day and every time becomes part of you" – Mya (Nurse)

"Once it becomes part of you, it's not something that you have to be told or you have to remember all the steps. If you've been doing it then it becomes habitual for you" – George (Dr)

*"…*when it becomes a culture….it becomes part of your life, it's easy" – Brian (Dr)

8.9.1.2 Self-confidence in hand hygiene practices

All the sixteen participants asserted that they find hand hygiene practice very easy and they have come to master its practice over time.

"Very, very easy. Because most of the time, here in male surgical ward, there are some procedures that you have to do, and you have to wash your hands unless you are deceiving yourself…you just have to wash your hands. Even mere opening some doors on the ward, there are some people that mere opening the door, they will wash their hands" – Betty (Nurse)

"Too easy…because I don't know how I feel if I haven't performed hand hygiene…like now, I can't count how many times that I have washed these hands today. I just can't…even when the question just flashes to me like "have I?" I will just go back and wash it again…You get used to it and it becomes a normal thing. In fact, first thing to do when you get to work is to wash your hands before starting the day's job and then you continue like that" – Chloe (Nurse)

"It is easy when it becomes a culture….it becomes part of your life, it's easy" – Brian (Dr)

"It's easy…though I might not follow the steps, but I just make sure to wash my hands, so it comes consciously so I will say it's easy. When you get used to it after a while, it becomes easy. Once it becomes part of you, it's not something that you have to be told or you have to remember all the steps. If you've been doing it then it becomes habitual for you" – George (Dr)

"To me it's easy because it's part of me already. It's part of me…even at home. The more I do it, the better you get at it and the easier it becomes for you. It's just like a lifestyle…a normal thing to do" – Kate (Nurse)

8.9.1.3 Perceived risk for infection

All the sixteen participants emphasised on the need to protect themselves, their family members, patients and colleagues when there is fear of contracting diseases, and this will prompt them to perform hand hygiene. Notably, issues around lack of compensation in event of occupational hazard, poor salary, type of unit, patient and procedure are raised under this finding.

a) Need to Protect Self and Patients from Infections

All 16 participants noted they will perform hand hygiene to protect themselves and the patients from contracting preventable diseases. A participant stressed on the nonexistence of compensation following occupational hazards at workplaces in Nigeria and why it is necessary to protect themselves when there is perceived risk for infection.

"I see it as the number one thing…I see it as the first thing because…like in our healthcare setting you find out that…you know in Nigeria now, there is no

insurance for you and you're on your own if anything happens to you so one has to be protective of oneself so, I don't joke with it" – Kate (Nurse)

"…the hospital will continue to run if anything happens to you…so we need to protect our lives ourselves" – Kim (Nurse)

"The need for hand hygiene, as I said earlier on is to ensure that the hands are clean, free from bacteria or any form of contamination so that when we move from patient to patient, we don't transfer infections to them. We do have some patients who are on admission for something else and later they develop what is called nosocomial infections, hospital acquired infections. So, we need to be careful that we are not the direct culprit transmitting the infections to our patients…Just to ensure we don't transfer infections from our patients to ourselves, other patients, our colleagues and members of our household. There are doctors and nurses who have died on account of such, contracting infections like Ebola, Lassa fever, yellow fever, tuberculosis. At times, you may need to do what is called barrier nursing because you don't want to contract infections – April (Dr)

b) Need to Protect Colleagues from Infections

Fourteen participants affirmed the need to perform hand hygiene to protect their colleagues. There is an understanding that non-performance of hand hygiene might put their colleagues at risk of infections too.

"If something is wrong with me, directly or indirectly my colleagues will get affected. We interact together and get to share some things, so if I am infected, my colleagues might be infected too. And again, if you infect a patient, your colleague is still coming and then the chances of your colleagues getting infected by that patient has increased even after taking universal precautions" – Brian (Dr)

"Yeah, if I'm performing it, there are some ways you make contact to your colleagues like hand shaking so I'm trying to prevent infection spread to my colleagues when I perform hand hygiene" – Peppa (Nurse)

c) Need to Protect Family Members

Seven participants laid emphasis on the importance of performing hand hygiene in order to protect their family members from contracting infections through them.

> "Yes. One of the things that helps me...that keeps reminding me is the fact that I want to try as much as possible not to get infected, especially my family who are non-medicals and they don't know what I've touched in the hospital. So I don't want to start spending my meagre salary on health issues at home...so that's one of the things that keeps reminding me that oh...you have families at home...you have people that are not medically-inclined and they don't even know whether I washed my hands or not, So those are the things that keep reminding me that ok I don't want to get nosocomial infections and at the same time, I don't want to transfer to others" – Andrew (Dr)

> "Not just in the hospital…even at home. Because you are not just protecting yourself, you are protecting your patients, you are protecting your family members, you are protecting your colleagues…I remember when I had my daughter, she's 2 now. It was 2 steps before you get to her. First step you have to sanitise when you get to the house, second step you have to sanitise again and if you have to carry her, you must wash your hands. It was that bad. People say I was paranoid but hey, my child has never been admitted to the hospital, she's never had any infections and we're keeping that going. Two years 5 months now, never had an infection" – Lisa (Nurse)

d) Type of contact

The kind of contact being made determines how committed the HCWs' are to hand hygiene practices. The participants cited that being on a surgical ward, having surgical patients most likely with wounds and the potential for getting the wounds infected are reasons for maintaining hand hygiene practices. Specifically, eleven participants emphasised on the type of procedure as a prompt to perform hand hygiene. It is found that dirty procedures, invasive or procedures that require aseptic technique will necessitate hand hygiene practice.

> "There are some procedures that no matter how hasty you are, you just have to perform hand hygiene, so it depends on the kind of procedures. Some are dirty procedures that…you just have to wash and wash to clean your hands" – Chloe (Nurse)

> "It is very important before and after every procedure as it is for our own good. You know that in hospital, we have different types of cases that we attend to and it will serve as…erm, let me say that just to avoid contracting the infections" – Mya (Nurse)

However, one participant noted that she performs hand hygiene normally irrespective of the kind of contact. The participant stressed she finds the practice easier this way.

> "I told you I'm a handwashing freak, so I treat all patients equally…I do the same thing with everybody. It doesn't matter the symptoms, what I'm about to do or the kind of patient I'm making contact with. In fact, every patient to me is potentially infectious. Like in this hospital, we have a unit for hepatitis B infected patients, and the same way I wash my hands and use gloves for them is the same way I do for other patients too…it's not as if I use more gloves or wash my hands more because a patient is infected with HIV or hepatitis B virus. No. The same way, the same thing. It makes it easier because if I'm not doing the same thing, I might forget here and there" – Kate (Nurse).

Another participant also noted that touching hospital equipment might prompt hand hygiene.

> "…Also some other hospital facilities, you want to touch something, you want to take your stethoscope, you want to take the BP apparatus probably you want to check the BP yourself and some other hospital appliances...by the time you are touching them...you should have it at the back of your mind that there is risk of contamination" – Andrew (Dr)

e) Type of Unit

Seven participants stressed that the unit/ward they work in influences their hand hygiene practices. Being in infectious or surgical wards will inform HCWs' hand hygiene practice.

> "It is very important in our unit….you know this is a surgical ward. We take care of patients, wound, so you have to wash your hands. Some are infected, after dressing you clean your hands before going to the next patient" – Anna (Nurse)

> "There was a time I was in a unit where you see infectious patients primarily and by the time you get to that kind of unit, there is this thing that continues to ring on your head (laughs)...you are in an infectious environment. So as much as possible, hand washing is as good as you are breathing in your normal air (laughs)...if you are not doing it, it's like you are not breathing again. So, when you get to such environment, subconsciously you want to...because of what is at stake...because of the environment I find myself" – Andrew (Dr)

f) Type of Patient

Twelve participants noted that the type of patient they care for, for instance having infectious patients on the ward will influence their hand hygiene practices. One participant said:

> "Normally I can wash my hands once but when I feel there is more to the patient's condition I can wash twice, 3 times or as many as possible (laughing)…like a hepatitis B patient, I wash my hands more than I normally do…it will make me perform it more though I perform it normally, but the frequency might increase" – Peppa (Nurse)

Another participant noted he would avoid touching a patient when there is perceived risk of infection and hand hygiene facilities are lacking.

> "Sometimes when I reach a patient's bedside I don't touch. I fold my hands behind me, and my house officers tell me this is what's going on…then I tell them okay, change this, add this. Unless, I have to really touch the patient…maybe I've not seen the patient before and I have to examine then, yes, I will touch the patient. But I will avoid touching the patient if water or hand sanitiser is not available" – George (Dr)

g) Greeting Culture

The greeting culture of Nigerians, which usually entails physical contact/touch like a handshake for a formal setting, prompts HCWs to perform hand hygiene. Seven participants attested to this finding.

> "If you do not wash your hands and you meet a colleague and shake hands, you've transferred some of the germs within your hands to the person. So, it prevents...it also protects them from contracting germs from you" – Betty (Nurse)

> "It's also important because we are in Africa and here, we do a lot of greeting and you shake hands or touch each other, and we are dealing with patients which involves lots of touching" – George (Dr)

> "There are some ways you make contact to your colleagues like hand shaking so I'm trying to prevent infection spread to my colleagues when I perform hand hygiene" – Peppa (Nurse)

8.9.1.4 Forgetfulness

Fourteen participants identified with this finding. While six participants stressed that they cannot forget to perform hand hygiene no matter the circumstance, the remaining eight participants noted they are likely to forget if they have a busy workload or during emergencies.

> "I don't forget, I remember all the time…it's at the back of my mind all the time to wash my hands" – Anna (Nurse)

> "No, I've never experienced it" – April (Dr)

> "In this environment where there may not be water? Yes. Many times, you touch a patient and you forget to wash and then you remember, I didn't do this…I didn't wash my hands in-between patient care…and you leave what you're doing and perform hand hygiene before you come back to the patient but the deed is already done" – George (Dr)

> "…it is likely I forget to wash my hands before attending to others, because of the workload. Like now, I may be attending to one patient and they are bringing another patient in, before I wash my hands…the person that they are bringing in maybe in shock, I will want to rush to attend to the person" – Lisa (Nurse)

8.9.1.5 Role models

In this subtheme, while five participants highlighted some of their senior colleagues they look up to as role models, the remaining eleven participants submitted that they do not have role models of hand hygiene practice. Most of the participants noted they just "*do their thing"* by following the hand hygiene posters on their wards and not relying on anyone else's practice.

> "Yes, but not in this unit, my previous Matron. She is very good at the procedure; you just have to do it and that was in the ICU. She is very good. I look up to her" – Chris (Nurse)

> "I'm trying to think. Maybe a dermatologist that was here. She used to really wash her hands. Though I've been washing my hands frequently before I met her, but she was way ahead in the game. It's a whole new level that I try to attain" – George (Dr)

> "Personally, I don't follow anyone…I believe in myself…I don't follow multitude. It's a personal thing because even if you are a matron, it doesn't mean you will know how to do it more than I do" – Kim (Nurse)

> "Because of the setting that we find ourselves, we are health workers, so we don't even need anybody to tell us that we should do this before we do. I never heard about role model on hand hygiene…I don't have any role model. I want to be myself" – Betty (Nurse)

> "Nobody" – April (Dr)

8.9.1.6 Glove Use

Seven participants submitted that glove use can interfere with observing proper hand hygiene practices. Five participants noted they resolve to using gloves when they have busy

schedule while two noted they prefer to be gloved in emergency situations rather than going back and forth to perform handwashing or use ABHRs.

> "…there are some times that you have a lot of things to do and perhaps you were actually on gloves with the other person, you might just change the gloves and wear another and say to yourself, let me just be on gloves instead of going back and forth because there are many things to do. I don't want to call it a barrier, but it alters handwashing" – Chloe (Nurse)

> "It's possible to forget in an emergency situation because your priority then is to save the patient and some emergencies may not give you adequate time to wash your hands or use hand gloves so you may need to rush and do some things but when it's a bleeding case, then you have to wear your gloves before you can go ahead to do anything to safeguard yourself" – Andrew (Dr)

> "…when there is work overload at times, you tend to just wear gloves, remove them and wear another to attend to the patients. So, you would have attended to a number of patients before you come back to the wash basins and our sinks are very far from where the patients are. And patients at times are not patient enough and will be like "I am calling you, but you are washing your hands instead"…so you just have to go and wear another gloves to attend to them" – Emily (Nurse)

Likewise, some participants described that the type of procedure and patient also determines their choice of performing proper hand hygiene or using gloves.

> "I also wear gloves when there are lots of patients to attend to…so, it really depends on the procedure and the number of patients I need to attend to" – Kate (Nurse)

> "At times, we use our discretion. For instance, if you want to make a bed for an infectious patient, you have to wear gloves even though you won't wear gloves for bed making on a normal circumstance. If you then went to another patient without wearing gloves, then the former patient will become suspicious and may raise eyebrow. So that's why I said we need to use our discretion too…maybe one will just use gloves for all of them" – Kim (Nurse)

Some participants noted their preference for glove use when there is inadequate supply of water, soap or ABHRs.

> "When the desirable is not available, the available becomes desirable. One should not interfere with the other. You need to clean your hands then wear gloves…. universal precautions so if in the instance, there is no water or soap…it is not a normal occurrence but if that is the case at least you must ensure that depending on what you want to do, there is something that is protecting your hand. So, I am not inferring that the use of gloves is in lieu or to replace washing of hands" – Brian (Dr)

8.9.1.7 Respect from Patients

Four participants are of the opinion that HCWs will earn patients' respect through performing hand hygiene practices while 3 participants noted it will boost patients' confidence and morale in the HCWs.

> "It increases patients' morale that we respect them. Imagine before you see a patient you wash your hands and you wash your hands again before touching them, that means you respect that patient and the patient sees himself like…ok I am a human being. There are ways you treat a patient that he feels he is less of a human. And psychologically, that patient might get better…it makes us gain respect from the patients and boosts their confidence in us and so they can trust us with their health" – Brian (Dr)

> "When patients see you washing your hands, they're happy with the way you handle them….that you wash your hands, they're happy" – Anna (Nurse)

> "For us, this hand hygiene is a normal thing that we should do effortlessly, so the public sees us with integrity and dignity, and they respect us that we will do the right thing as much as possible, so they can trust us with their health" – Kim (Nurse)

> "That's the compliment the public actually give to nurses though…that nurses usually regularly wash their hands" – Mya (Nurse)

8.9.1.8 Skin Irritation

Three participants noted they get skin irritation from frequent handwashing and especially when locally made liquid soaps are provided by the hospital for handwashing. The participants identified this as a hindrance to observing hand hygiene.

"First is the inadequate provision of appropriate soap. Like now, you know in Nigeria, a lot of people are making liquid soap…the acidic content of the soap depends on what your trainer taught you…some will have too much acid and caustic soda making it so harsh on the skin. So if someone isn't conscious of that or when the hospital buys from such people whose products were poorly mixed, it can cause skin problems, especially for people who don't recognise such liquid soap quickly…like me, I know the effect immediately I wash my hands with that kind of liquid soap and I would avoid using it the next time. And from that, I'd be restricting myself from washing my hands in the hospital or at work and that's a big problem as I may forget to wash my hands since it's not in my conscious mind to do so. I might end up using my hands to eat like that…take spoon or play with children around me" – Kim (Nurse)

"I can say I've been doing it over time but sometimes, I get tired of washing my hands with it being white and very dry and I don't really like it when my hands are all dry" – Alice (Nurse)

"Sometimes, some of us react to the liquid soap provided because they cause harm to the hands…like sometimes hand becomes so hard" – Mya (Nurse)

8.9.1.9 Emotion

Three participants expressed that the emotional impact non-performance of hand hygiene would have on them heightens their hand hygiene practices. One participant viewed patients acquiring HCAI while on hospital admission as an indictment on the HCWs and he could go depressed if things go wrong. He further stated that performing hand hygiene makes him feel great.

"You know the feeling you have when you take your bath in the morning? You feel great. You attended to a patient and you clean yourself up, it makes you feel reasonable…it's an indictment on us that we are treating a patient and the patient is getting nosocomial infections…being a surgical unit. If you don't perform hand hygiene, all wounds will go infected and that will delay the healing process of such wound and can fatally lead to death when it gets really worse. And if you are doctor that still has your bowels of compassion, you can become depressed seeing this" – Brian (Dr)

Similarly, one participant said he would be seen as a bad doctor if hand hygiene is not done while another participant noted he would be unhappy if any of his patients come down with infections.

> "I do not really see anything that should interfere with handwashing practices because everything still boils down to your hygiene. So, whatever you do, if you are poor with your hygiene, it still bounces back to make you a bad person or bad doctor or even make worse out of your life" – Andrew (Dr)

8.9.2 Institutional Themes

Institutional themes are the systemic barriers or levers acquired by the HCWs arising from the managerial style of the hospital executives. There are eleven subthemes here namely infrastructural deficit, hand hygiene knowledge and skills, incentives, heavy workload, time constraints, human resources, hospital reputation, staff wellbeing, means of hand hygiene education hospital policy on hand hygiene and dirty environment. Barriers to hand hygiene practices are mostly identified here and lack of administrative willpower, drive and support is fundamental to the subthemes that emerged. The need to boost hospital economy by cutting costs and frugal supply of resources needed for effective hand hygiene practices by the HCWs are central to this theme. Findings here suggest that provision of physical, educational and human resources as well as incentives which are required for effective hand hygiene practices are lacking. Each of these factors are discussed as subthemes accordingly, and interview excerpts are quoted in the following paragraphs.

8.9.2.1 Infrastructural Deficit

All sixteen participants identified abundant infrastructural deficit as a theme. Soaps, water, sinks, taps, alcohol-based handrubs (ABHRs), hand drying facilities are the hand hygiene facilities stressed here.

a) Soaps

Soap is the first resource to be discussed here. Findings from this study suggest that the kind of soap used for handwashing depends on what the hospital management supplies. For instance, nine participants attested to using more of bar soaps than liquid soaps for handwashing while five participants stated they sometimes use liquid soaps too.

> "We use whatsoever soap that is available in the hospital…both bar and liquid soap depending on what is available" – Alice (Nurse)

> "The ideal thing should have been to use liquid soap where you would be able to use your elbow to press but here, like I said, this is a developing country where we find ourselves, so we use bar soap or antiseptic bar soap just to wash your hands....the same hands we use to pick the soap is what we also use to drop the soap too when you're done washing…it's not very ideal in the sense that you would have picked the soap with a potentially infected hand, wash your hands with the bar soap and then drop it again for someone else to use. This might expose the next user to microorganisms that are different from what they want to wash off their hands. But like they say, when the preferred is not available, the available becomes the preferred" – Lisa (Nurse)

Some participants noted that when liquid soaps are provided, they are heavily diluted without any standard measure of dilution. This is closely linked to hospital economic reasons so as to ensure that the liquid soaps last enough for the timeframe the hospital management expected them to last for. Some examples are offered below.

> "….like when there is no soap, we can take an empty bottle of detergent and put water inside, shake thoroughly and use that to wash your hands" – Betty (Nurse)

> "In this hospital, we mostly use bar soap although liquid soaps are available at times, but it would have been diluted and be very watery even when it is available…I don't know the ratio of soap to water all I know is that it's always very watery and you will have to apply it a number of times before it lathers" – Lisa (Nurse)

> "You know the problem with hospital economy, and they have to water down the liquid soap and of course, you're introducing infections when you start messing with the medium…and because of the economy they are trying to cut cost, so they don't give us the correct solution, or the solution is watered down" – George (Dr)

> "The kind of handwashing liquid soap we use, we have to dilute with water because of economic reasons…because if it finishes before time, we won't get another one, so we have to maximise what we have…if it finishes before time then you won't get a replacement until you are due for another one by their own calculation. So, we have to reconstitute and dilute with water…we just dilute and make sure it still has the soapy effect" – Peppa (Nurse)

> "…we dilute just depending on our interest" – Tara (Nurse)

Two participants stated that liquid soaps provided might be the locally made soaps whose chemical components might have been poorly mixed, without any accurate measure, consequently leading to skin irritation after use.

> "First is the inadequate provision of appropriate soap. Like now, you know in Nigeria, a lot of people are making liquid soap…the acidic content of the soap depends on what your trainer taught you…some will have too much acid and caustic soda making it so harsh on the skin. So if someone isn't conscious of that or when the hospital buys from such people whose products were poorly mixed, it can cause skin problems, especially for people who don't recognise such liquid soap quickly…like me, I know the effect immediately I wash my hands with that kind of liquid soap and I would avoid using it the next time. And from that, I'd be restricting myself from washing my hands in the hospital or at work and that's a big problem as I may forget to wash my hands since it's not in my conscious mind to do so. I might end up using my hands to eat like that…take spoon or play with children around me" – Kim (Nurse)

b) Sinks

The participants noted they are mostly clear and not blocked although 2 participants noted the sinks might be dirty at times and this might deter them from performing handwashing.

> "Some handwash basins are not good enough too. Some are dirty and you don't want to wash your hands in a dirty sink so as not to get the hands contaminated again through the sink" – Tara (Nurse)

Only one participant stressed that the sinks may be blocked at times and there might be difficulty fixing them on time which might consequently be a barrier to hand hygiene practice.

> "Yes, it's possible to have blocked sinks and it now depends on the hospital to make adequate provision for that because some of the people working in the hospital maintenance department too might say they're too busy to come and fix it…and you cannot put a bowl underneath the sink. Sometimes, when the sink is leaking and the plumber needs to repair it but the plumber is busy…and since it's not only your ward they have to attend to…it then becomes a problem to wash the hands out of not wanting to walk around the ward to where else the sink is located" – Kim (Nurse)

While 4 participants find that a minimum of one sink per ward, usually located at the nurses' station, are enough, 2 other participants noted the sinks are inconveniently located and they have had to walk down to the nurses' station each time they wanted to perform handwashing.

> "We have three sinks here. If one is not working, another will" – Chloe (Nurse)

> "The access to the sink…most times, the sink is usually far away from the patients. You see a patient; you walk a distance to wash your hands then come back and continue the cycle of seeing patient and walking distance to perform hand hygiene. So sometimes, when I have so many patients on the ward, I just use hand sanitiser in-between patient care which is not the ideal but hey, I have to do that to save my time. So, there are so many barriers…the barriers are limitless" – George (Dr)

> "Most times, when you finish, you have to come back to the centre of the ward to wash your hands before you can attend to other patients" – Emily (Nurse)

c) Water Supply

Inadequate provision of water is the subtheme here. While 4 participants opined that there is adequate provision of running water in the hospital, 10 participants submitted that this is

not always the case.

> "We have running water, all our taps are running" – Anna (Nurse)

> "We may not have running water and we just have to depend on another source" – Betty (Nurse)

> "At times, before our orderlies (ward assistants) can get a bowl of water, you will just be hanging your hands there and you won't be able to do other things…just for them to get water" – Emily (Nurse)

Five participants noted they have had to rely on using buckets and bowl to store and fetch water respectively for handwashing with someone, usually a ward assistant pouring the water unto their hands.

> "Most times we use soap so when water is not running, I'm not usually comfortable pouring water with bowl…I prefer to wash under the running water so, I just manage with what I have but I don't usually feel comfortable doing that…and the bowl might be contaminated in the process of getting water from a bucket to the bowl with the unwashed hands" – Chloe (Nurse)

> "What we practice here is to get someone, maybe a ward orderly or an assistant, just to pour water in your hands" – Andrew (Dr)

> "It's not really easy to pour water on your hands yourself when you are using a bowl…it's not very effective but at times, we may be two, someone will help the first person to pour water on their hand and when you are through, you will also help the other person to pour water. So that way, it's more effective than pouring it yourself" – Emily (Nurse)

Two participants noted that there might be insufficient boreholes or lack of electricity to pump water at times and the ward assistants of the wards would have to take turns on when to fetch water.

> "There was a problem in this hospital before though it's been solved now…we had problem with our water supply and there wasn't enough boreholes to pump water so much so that they were rationing by ward and might not rotate to your

> ward for days…though we have water storage but if it finishes and it isn't your ward's turn yet then you resort to ward assistant fetching water in buckets or from other wards…and they are not on duty every time" – Kim (Nurse)

Two participants also stressed they have had to buy sachet or bottled water in extreme cases of lack of water to practice handwashing.

> "There are times that I had to get bottled water to wash my hands just because I just want to wash my hands and go. So, sometimes you see me carrying bottled water...not basically because I want to drink but just also to wash my hands in case there is no water on the ward" – Andrew (Dr)

Three participants noted there were instances they had to use ABHRs where handwashing would have been more appropriate, due to lack of water.

> "There are some places I've been to that if not for the sake of ABHRs that I have on myself, you would have put soap in your hands before you discover there is no water" – Brian (Dr)

Six participants stressed that there are no automated or elbow-operated taps on their wards. Only pillar taps are available which they noted might be a source of infection spread.

> "We don't have the elbow-operated taps…we have the normal taps you open to and fro on the ward so that's what we use" – Chloe (Nurse)

> "We have in some places not everywhere but what I always remind them is that when you open the tap to wash your hands, after washing you should pour water on the knobs so that you rinse it off" – Anna (Nurse)

d) Hand drying facilities

Ten participants identified with this subtheme as a barrier to effective handwashing. All the participants noted that there are no automated hand dryers or disposable towels on the wards.

> "There is no hand dryer in this hospital…there is no towel dispenser" – Chris (Nurse)

> "Here is not disposable towel…we use towel" – Tara (Nurse)

> "The fact that there are no hand dryers is also another barrier because ideally, you should air dry so in the absence of hand dryer, I just use my clean hand towel that I brought from home so I can continue my work because I cannot use wet hands to write inside the patient's case notes but if there are hand dryers like we have in airports and public toilets abroad and all those places it will be very easy. And some teaching hospitals in Nigeria have hand dryers in their wards for instance, the X and Y teaching hospitals[4] have hand dryers. So, you just dry your hands after washing, it makes it easier" – April (Dr)

Notably, HCWs are provided with cotton towels which are washed and changed 2-3 times per shift depending on how soiled the towels are.

> "We don't have the automatic ones. We have towels we hang by the basin, that's what everybody uses…but we change the towels per shift. There are sometimes, they change like twice in a shift" – Emily (Nurse)

Another participant submitted a belief that HCWs are not likely to transfer infections to one another through shared towels.

> "Ideally, we should be using disposable towels but here we are managing the cloth towel…we believe that we are all health workers, so we won't contaminate ourselves…then we do change it often when soiled so we don't use soiled towels to contaminate the hands we just washed" – Kim (Nurse)

Most of the participants stated that they use personal hand towels in order to limit their exposure to infections through shared hand towels.

[4] Hospital names pseudonymised for anonymity reasons. These hospitals are government-owned and relatively newer than the research setting.

> "The first barrier is lack of hand dryers. We only have towels…and after washing your hands, the same towel someone else had used is what is available for use even when it's wet although I have my own personal towel but it's not too good. We have been advocating for hand dryers and if we have dryers, we won't have all these issues" – Kate (Nurse)

> "…ideally, you should air dry so in the absence of hand dryer, I just use my clean hand towel that I brought from home so I can continue my work" – April (Dr)

> "For me I have a personal towel that I use" – Mya (Nurse)

While describing the steps involved in handwashing, a participant stressed:

> "…avoid laying your hands on a used towel, if you have disposable towels, that's good, if there's hand dryer that's even better but if that is not available, it's better to air dry" – George (Dr)

e) Alcohol-Based Hand Rubs (ABHRs)

Fifteen participants identified that ABHRs are not usually available on the wards.

> "It is not always available in the hospital, the last time I saw it was about 2 months ago. There are some units that they just have to have it like the ICU" – Chris (Nurse)

> "The hospital does not provide hand sanitisers" – April (Dr)

Furthermore, 2 participants noted that ABHRs are only supplied when the state government has freely supplied them, or the hospital is being inspected by the governing body or the products are expired or about to expire. One participant also noted having to choose between liquid soap and ABHRs.

> "We don't normally get ABHRs from the hospital, we have to buy from outside and even when the hospital supplies it, you have to check the expiry date. It's either it's about to expire or it has expired…I don't know…maybe it's an African mentality of just having it in store but not giving it out. There was a time I went to meet one of the matrons that we needed handwashing liquid soap and

> ABHRs. You know what she told me? She asked me to choose one of the two, that we can't have the two. So, I picked the liquid soap and left. So, that's the case here. So, when we request for the two, we already know we can't get them both. Even when they supply, they give us small bottles and by the time we see them bringing the sanitisers, we know it's either it's about to expire or it has expired or maybe it's a free one given to the hospital by the state government" – Kate (Nurse)

Several participants affirmed to buying pocket-sized ABHRs for personal use.

> "Sometimes, even to get hand sanitisers, the hospital will tell you there is no money to provide enough sanitisers for health workers to use on the wards and if you have to buy on your own" – Anna (Nurse)

> "Hospital? You buy with your money. Some wards do have it though, but I don't know the source. But you can always move around with your own pocket-sized sanitisers" – Brian (Dr)

> "The one I am using presently I purchased it myself" – Chris (Nurse)

> "I have a pocket sanitiser for myself and not that the hospital provided it" – Peppa (Nurse)

> "Inside my handbag, I put hand sanitiser there so that if for any reason there is no water, the hand sanitiser will come handy and be used as substitute" – April (Dr)

8.9.2.2 Hand Hygiene Knowledge and Skills

Here, participants gave insight into their knowledge of hand hygiene policy, their practice, training and misconceptions about hand hygiene practices and the subthemes will be discussed consecutively.

a) Hand Hygiene Policy

All the 16 participants indicated that there are no local policies on hand hygiene practices in the hospital. Likewise, 6 participants noted they have never seen neither are they aware of the WHO policy on hand hygiene.

> "Well, I have skimmed through one document by the WHO before on the internet. Then, I've also seen posters on the steps involved on the wards. Each ward will have at least one poster by the sink" – Chris (Nurse)

> "It was when you started this research that I learnt there actually is a guideline on hand hygiene which I've never seen before…" – April (Dr)

> "It's not like the hospital has its own policy on handwashing…no we don't, no we don't" – Tara (Nurse)

Responses from some participants denoted that there might be missed hand hygiene opportunities where sufficient knowledge of hand hygiene practices is lacking. For instance, 5 participants stated that they do not follow any steps to perform hand hygiene, they "*just do it"* while two participants were unable to describe how to perform hand hygiene.

> "I can't really remember the techniques, but I know we have techniques we use in hand hygiene practice. I will try….we start with the palm; we make sure we clean in between the fingers to ensure there is no dirt in between the fingers so as to prevent contamination…I don't follow the procedure. I only wash my hands anyhow. I majorly focus on the space between the fingers, the nails and the palms and below the forearm" – Alice (Nurse)

> "I might not follow the steps, but I just make sure to wash my hands" – Emily (Nurse)

> "There is no special procedure for hand hygiene" – Peppa (Nurse)

When asked about the *"my five moments of hand hygiene"*, a participant responded with:

> I've not seen it before" – Tara (Nurse)

b) Hand Hygiene Training

All the participants noted they rely on hand hygiene trainings they had during their medical and nursing education. Ten participants identified they have never had any formal hospital

training on hand hygiene since they were employed. When asked if they have had any local training organised by the hospital, 2 participants responded as below:

> "Hmmm…not really, just what we were taught in school…no formal training. And as a staff in this hospital and everywhere I had worked before now, I have never been formally trained on how to perform hand hygiene" – Emily (Nurse)

> "I have worked in this hospital for like one and half years and since I came, they've not conducted any such training" – Kate (Nurse)

Only 4 participants have had recent hand hygiene training three of which were during the EVD outbreak in 2014 but was not organised by the hospital while the remaining participant had his training as an intern and while preparing for his residency examination.

> "Well, apart from my knowledge from medical school and the periodic training I had during the Ebola disease outbreak, I can't think of any formal training on hand hygiene before" – Andrew (Dr)

> "Yes, at some point during my housemanship we did have some training on hand hygiene and of course, during my residency training before I wrote my part one exam, we did a course on hand hygiene because it is also examinable" – George (Dr)

c) Misconceptions on Hand Hygiene Practices

Some participants had some misconceptions about hand hygiene techniques. Specifically, 5 participants described they first perform handwashing before using ABHRs.

> "ABHRs is used after we have already washed our hands…some use it immediately" – Mya (Nurse)

One participant noted using ABHRs alone as a measure of hand hygiene is not enough and as such the two techniques of handwashing and using ABHRs should be observed.

> "I feel ABHRs are not good enough. There are some things you pick up that you will not know you've picked up. I'd give you an example. I touch a patient on chest tube and the chest tube is leaking from the side to the patient body…or I touch a patient that has wet himself and it is dried up quite alright…my hands have not been visibly soiled, but I know I've picked up something and I need to wash my hands. A hand sanitiser would not be ideal in such instance" – George (Dr)

Furthermore, 2 participants noted they could use methylated spirit on their hands in instances of needlestick injuries, cuts or bruises. One of the participants stressed that methylated spirit offers higher protection in such instances than handwashing or using ABHRs would do.

> "And once in a while you have a prick that warrants you to use methylated spirit and this time around it will be for your own safety…well, it will kill any microorganisms faster than just washing hands with soap and water…methylated spirit could become part of hand hygiene…If you sustain a needle prick injury, of course you would be scared so, you want to do more than just cleaning with water and soap" – Brian (Dr)

> "They tell you to use spirit as a crude way...methylated spirit to perform hand hygiene then you go assuming you've done something right. That's the way it is here" – Andrew (Dr)

Similarly, 2 participants stated that HCWs are expected to know how to perform hand hygiene and specifically, 1 participant noted that his senior colleagues would have pointed out to him if he needed a refresher course on his hand hygiene practice.

> "They (hospital management) will feel that since you are a staff nurse, you ought to have known that since you were a student and it's what you've known from school you will now practise in the field" – Kim (Nurse)

> "Of course, they (the senior colleagues) expect me to know it and they must have seen me do it"…like I said, they would have seen me do it, if I needed to be taught again, they probably would have done that" – Brian (Dr)

Likewise, 3 participants affirmed the general perception of the public that nurses are neat and as such, they know how to perform hand hygiene.

> "That's the compliment the public actually give to nurses though…that nurses usually regularly wash their hands" – Kate (Nurse)

> "Yes, even when you don't notice it, the nurses at home…people do see they tend to wash their hands more often…it's because it has become part of you, even since we've been students…even when you carry a baby, you want to naturally wash your hands and you do it in your subconscious mind…they think its normal procedures for us to do as health workers" – Kim (Nurse)

8.9.2.3 Incentives

Incentives, in form of praise, appreciation or reward is the subtheme here. None of the participants had ever received any incentives before for regular hand hygiene practices. In fact, some of the participants opined that incentives should not be given as they think HCWs' hand hygiene practices would decline the moment the incentives are removed. Furthermore, 2 participants believe seeing their patients get well and having job satisfaction are enough incentives for them.

> "No way! When you do it, you do it for yourself" – George (Dr)

> "No, they don't do that. You perform hand hygiene for yourself" – Tara (Nurse)

> "There are no incentives and I don't think there should be any...it's something everybody should key into...something everybody should see reasons to do. By the time you try to give incentives to people, you are trying to make them not see the importance of observing good hand hygiene...good hand washing hygiene. So, it doesn't really help people because by the time there is no incentives, they won't want to do it again. So that's the problem. So if...you don't need to give people incentives…there shouldn't be any incentive because anything that has to go with incentives, when the incentive is not forthcoming, people try to withdraw from doing it again and that will make the practice worse" – Andrew (Dr)

> "Incentives? The reward is from God. How do you mean incentives? The reward is in seeing your patients get well, they are not getting nosocomial infections. The reward is in practising in the healthcare system for 20, 25, 40, 50 years and you are still the person you are, you've not gotten HIV, hepatitis B, C from patients as rampant as they are, you did not get it. The reward is in seeing that the standard of care has increased. So, the reward is more of social than personal rewards of course, there are social things that make you happy that become personal but those are the rewards for me" – Brian (Dr)

Some participants stated adequate provision of hand hygiene resources is enough incentives for them.

> "Incentives? The hospital makes sure they supply liquid soap, they give us liquid soap, they make sure our taps are running and they give us antiseptic hand wash at times" – Anna (Nurse)

8.9.2.4 Workload

Twelve participants identified heavy workload as a barrier. Some of the participants noted that doctors could see between 20 to 30 patients a day while the nurse to patient ratio is on the average of one nurse to 15 patients per shift.

> "It's usually more difficult when you have to see 20 to 30 patients and you walk down the ward to wash your hands…with sinks that are really far away" – George (Dr)

> "…when we are busy…when we need to attend to so many patients, as you can see, a nurse to like 10 patients, at times 15, so you will want to perform your duties as early as possible and during those periods, we may not be able to perform hand hygiene like in between contact with patients so we skip that part" – Alice (Nurse)

> "The major thing is the workload, if I am to care for a patient and another patient is demanding for my care at the same time … I have to wash my hand before attending to others. If I concentrate on one, I will be able to do the normal thing I am supposed to do at the right time. It may skip my mind to wash my hands before attending to others that needs my attention" – Lisa (Nurse)

> "Then at times, one is very busy…like you just finished a procedure, removed your gloves and patient will be calling for your attention again and you just have

to rush there without washing your hands and when you get there, you'd be like let me just wear gloves before I touch this patient" – Emily (Nurse)

8.9.2.5 Time Constraints

Ten participants identified lack of time as a result of heavy workload as a barrier to hand hygiene practices. The participants emphasised that sometimes they are stressed so much that they are unable to take breaks during their shifts due to lack of time and may have to spend one or two extra hours to tidy up their work after their shift must have ended. Interestingly, none of the participants complained about the time required to perform hand hygiene.

> "At times, work gets really busy that you have no time to spare and you just want to get the work done before the end of your shift" – Emily (Nurse)

> "Like if you're in a hurry, during that period you may not perform hand hygiene – Alice (Nurse)

> "Another thing again is time. Maybe for example, you have ward rounds and then at the same time, that same day you have to run clinics and you have a full ward, by the time you wash your hands on the first patient, you've forgotten that you need to do the same thing because of time" – Andrew (Dr)

8.9.2.6 Human Resources

Five participants recognised staff shortage as a barrier to hand hygiene practices. This is closely linked to heavy workload and lack of time, both of which are direct consequences of staff shortage.

> "Definitely we are short-staffed. An 8am-4pm job and you rarely have time to go on break and then you tend to spend extra working hours...1 or 2 hours depending on the wards...just to ensure you tidy up your work for the day and that all patients are seen" – Andrew (Dr)

> "We are short staffed. We are very, very short staffed" – Emily (Nurse)

> "It is obvious that we are short staffed, and it is not the problem of this facility. It is the problem of this country. In developed climes, you have like a doctor to about 25 or 250 people, in Nigeria it's nothing less than a doctor to nothing less than 10000 people. So, you can imagine you need to attend to that large number of people, and you want to be scrubbing per person, then Nigerians will be dying because of your negligence" – Brian (Dr)

8.9.2.7 Hospital Reputation

All the participants submitted that their hand hygiene practices will be heightened when they bear in mind the need to reduce infection spread among patients in the hospital and that this will consequently boost the hospital reputation to the public. Five participants stated that performing hand hygiene will shorten patients' hospital stay thereby boosting the reputation of the hospital.

> "To the hospital, at least, there will be reputation outside that when you go to their hospital, you don't go home with what you didn't have before. It's also cost-effective and more patients will come to the hospital if there are no nosocomial infections…people will patronise the hospital more and they can rely on the health services rendered by the hospital, they get cured and they go home on time" – Emily (Nurse)

> "People will talk very well of the hospital because they know it's very clean. The nurses are very clean people, they wash their hands from time to time. They have confidence in the hospital" – Anna (Nurse)

Six participants believe it will boost hospital economy while five participants stated that patient turnover rates will be increased when there is reduced infection spread.

> "Simple handwashing can reduce length of hospital stay for the patient, the hospital cost and then it will increase the turnover rate of the hospital" – Chloe (Nurse)

> "The hospital will generate income faster. If patients are not lying on bed for too long, they will be able to pay their bills promptly and they will be discharged and there will be having enough space for other patients to come in" – Lisa (Nurse)

"…it's an indictment on us that we are treating a patient and the patient is getting nosocomial infections. Patients come in with something and then goes back home with something else. So, it decreases the way others view the hospital…the rating of the hospital…When patients come to the hospital and they get well and go home, people will believe more in the hospital. The hospital will not be spending their resources on one person, it will also help…of course, that is the benefit to the society already, because the people that are sick, as the turnover is increasing…patients come in, they get well and go, the other sick people can get space to come in, get treated and go. And then the society will have less burden, sick people will be reducing, people will get healthy and the society will be a better place to live in" – Brian (Dr)

"…it also reduces the hospital cost. Like I said, nosocomial infections we see them as more of a problem and so we start culturing, trying to find out which one is it. So, the hospital is spending more to fight nosocomial infections whereas if there is good hand washing practice, I think the hospital would spend less on that" – Andrew (Dr)

8.9.2.8 Staff Wellbeing

Three participants noted that staff wellbeing will be heightened through this process.

"Hand hygiene is important for staff wellbeing in that if something is wrong with me, directly or indirectly my colleagues will get affected. We interact together and get to share some things, so if I am infected, my colleagues might be infected too. And again, if you infect a patient, your colleague is still coming and then the chances of your colleagues getting infected by that patient has increased even after taking universal precautions" – Brian (Dr)

"…it will lessen the breakdown rates of the staff and the amount of sick leave the staff take will be reduced. You know some people are so sensitive, for example if they didn't wash their hands before eating and the person comes down with abdominal upset…that individual will not be able to perform his/her role and may take sick leave from the hospital. And this will affect the hospital in the sense that there won't be effective running of the job and the patients will be complaining, there will be staff shortage on duty but when the hospital provides the necessary things, they will know their staff are okay, their children are okay, the job is going on well, and patients are being cared for the way they should be and there won't be transfer of infections from work to their houses. So, it will reduce the morbidity and mortality rates amongst the health workers and the patients too and then it shortens the length of stay of patients in the hospital" – Kim (Nurse)

8.9.2.9 Means of Hand Hygiene Education

Three participants stated that both patients and non-professional hospital staff will learn from about the importance of regular hand hygiene practices through HCWs' hand hygiene practices.

> "…You are indirectly or directly educating the patients because when they come to the hospital, we are meant to enlighten them vis-à-vis their health. Some of them come from the villages and see us do these things, they can even ask why this, and we educate them. And then they go back to their villages, so we've created awareness. We don't need to travel miles and climb rocks or go through valleys to get health education done, we can through hand hygiene…they see us, and they've learnt from us" – Chris (Nurse)

> "We learn from it…all of us are not nurses so by working in an environment where hand hygiene is regularly done, they learn the importance and it will eventually become part of them as they practice it often" – Kate (Nurse)

> "…the non-medical staff on the ward like the ward assistants, we still have to teach them about hand hygiene. So, our practice influences theirs too" – George (Dr)

8.9.2.10 Hospital Policy on Hand Hygiene Resources

Seven participants identified unfavourable hospital policies on supply of hand hygiene resources as barriers to compliance.

One participant noted that the supply of hand hygiene resources is at discretion of hospital managers and that products may not be replaced if finished before the expected time. Hence, HCWs resort to diluting liquid soap to lengthen its span.

> "Do they (hospital management) care? They don't care. If they do there will be water and liquid soap and hand sanitiser all the time" – Emily (Nurse)

> "Sometimes, even to get ABHRs, the hospital will tell you there is no money to provide enough ABHRs for health workers to use on the wards" – Betty (Nurse)

> "You know problem with the hospital economy, and they have to water down the liquid soap and of course, you're introducing infections when you start messing with the medium…and because of the economy they are trying to cut cost. So they don't give us the correct solution, or the solution is watered down" – George (Dr)

Hospital managers also make HCWs choose between the supply of liquid soap or ABHRs, they keep hand hygiene products in store until they are about to expire or already expired. Hospital managers only supply ABHRs when freely given by government or when hospital is being inspected by governing board.

> "When the hospital supplies it, you have to check the expiry date. It's either it's about to expire or it has expired...maybe it's an African mentality of just having it in store but not giving it out. There was a time I went to meet one of the matrons that we needed handwashing liquid soap and ABHRs. You know what she told me? She asked me to choose one of the two, that we can't have the two. So, I picked the liquid soap and left. So, that's the case here. When we request for the two, we already know we can't get them both. Even when they supply, they give us small bottles and by the time we see them bringing the ABHRs, we know it's either about to expire or it has expired or maybe it's a free one given to the hospital by the state government" – Kate (Nurse)

8.9.2.11 Dirty Environment

Two participants noted that dirty environment is a barrier to hand hygiene practices

> "…generally, our environment is usually dirty" – George (Dr)

> "our environment is dusty at times" – Anna (Nurse)

8.10 Strengths and limitations

The qualitative aspect of this research contributes to findings from the quantitative aspect (chapter 7) by providing deeper insights into the hand hygiene behaviours of the HCWs. The themes generated from the interview data will support the in-depth discussion of findings in the next chapter. The interview schedule used was theorised using the TDF thereby

increasing the confidence in the data collected. However, some study limitations were identified.

Some of the participants were not keen to be tape-recorded probably because of their loyalty to their employers. The lack of willingness consequently resulted into short interview duration for most of the participants (mean time was 22 minutes). Health assistants were excluded from the interviews as they are unlikely to have the basic English language knowledge capacity required to engage in the interviews. The researcher however acknowledged this group of HCWs might have offered deeper insights into the barriers and levers to hand hygiene in the research context. In the future, the researcher would employ translation services so as to capture all useful information about the concept being studied.

8.11 Chapter Summary

This chapter has identified the barriers and levers to hand hygiene practices among Nigerian HCWs using semi-structured interviews. Two broad themes emerged – personal and institutional which were further divided into 9 (namely *hand hygiene knowledge and skills, self-confidence on hand hygiene practices, perceived risks, forgetfulness, role models, glove use, respect from patients, skin irritation,* and *emotion*) and 11 (namely *infrastructural deficit, hand hygiene knowledge and skills, incentives, heavy workload, time constraints, human resources, hospital reputation, staff wellbeing, means of hand hygiene education, hospital policy on hand hygiene resources and dirty environment*) subthemes respectively. These are fully discussed in the next chapter, the discussion of findings where the results are compared to findings from the survey of barriers and levers to hand hygiene (chapter 7), findings from the ward infrastructure survey and hand hygiene observations (chapter 5) and in relation to wider literature.

Chapter 9 Discussion of Findings

9.1 Introduction

The overall aim of this research is to determine the hand hygiene compliance rate, understand the barriers and levers to hand hygiene practices and validate the barriers and levers to hand hygiene instrument (BALHHI) for Nigerian HCWs. A convergent mixed methods research design was employed, and data were collected from HCWs in a Nigerian teaching hospital using both quantitative and qualitative research approaches. The research aim was developed following the contextual background to the research (chapter 2) where the impact of HCAI globally and in SSA countries as well as the importance of regular, effective hand hygiene practices of HCWs in reducing the burden and spread of HCAI were highlighted. The chapter also found that there is no literature review of the studies available on hand hygiene practices of HCWs in SSA countries. This prompted the conduct of a systematic literature review (chapter 3) where hand hygiene compliance rate in SSA countries was estimated and the barriers and levers to effective hand hygiene practices were established. The review found that there is need for more reports on hand hygiene compliance in SSA countries and it is important to accurately report the process of observation to allow for replication of methods.

To address the research aim, four more studies were designed in this research – ward infrastructure survey and hand hygiene observations, hand hygiene instrument validation and testing, barriers and levers to hand hygiene survey and a qualitative study on the barriers and levers to hand hygiene practices. Findings from each of the studies were presented in chapters 5, 6, 7 and 8, respectively.

In this chapter, summaries of studies are presented first. This is followed by discussions of the principal findings within the wider context and the qualitative and quantitative elements

of the research are integrated where necessary. The contribution of the thesis to knowledge as well as the study limitations are then outlined. A chapter summary is offered at the end of this chapter.

9.2 Summary of Studies

9.2.1 Research Objective 1

> "To establish the hand hygiene compliance rate and identify the barriers and levers to hand hygiene practices among HCWs in SSA countries through a systematic literature review" (Chapter 3)

In chapter two (contextual background to the research), the researcher found there was no systematic review on the hand hygiene practices of HCWs from SSA countries. This necessitated the conduct of a systematic literature review of hand hygiene studies from SSA countries in chapter 3. Following a methodical search for articles, 27 studies met the selection criteria and were consequently included in the review. The overall hand hygiene compliance rate of HCWs from SSA countries was estimated to be 21.1%. The review also showed that compliance was highest after exposure to body fluids and before aseptic procedures and generally lower in other aspects of patient contact. Doctors had greatest compliance rate across professional groups. Findings from the review also suggest that the barriers in SSA countries are comparable to those of developed countries aside from heavy workload, infrastructural deficit and poorly positioned facilities which are more abundant in developing countries. It is important to note that since this literature review was completed, 23 papers from SSA countries have been published. This implies that new findings might have emerged.

9.2.2 Research Objective 2

> "To assess and offer context to the hand hygiene resources available in a Nigerian teaching hospital" (Chapter 5)

In this chapter, ward infrastructure survey of the two adult surgical wards in the research context was conducted. The survey objective was to collect data about structures and resources at surgical ward level in the research context. The WHO ward infrastructure survey form (WHO, 2009) was employed. The survey found insufficient hand hygiene resources in the two wards, below the WHO recommended minimum standards.

9.2.3 Research Objective 3

> "To conduct hand hygiene observations amongst HCWs in a Nigerian teaching hospital" (Chapter 5)

In this chapter, the hand hygiene compliance of surgical HCWs of the study site was captured over 7 days through direct observation. A modified WHO hand hygiene observation tool was employed, and 700 hand hygiene opportunities were captured. Despite HCWs' knowledge of being observed, the study found that the overall hand hygiene compliance was low (29.1%) and compliance was less than 40% across the three professional groups of doctors, nurses and health assistants. Hand hygiene compliance was highest after exposure to body fluids and before aseptic procedures, and generally lower in other aspects of patient contact. Doctors also had the greatest compliance rate when the types of patient contact were considered.

To identify the specific barriers and levers to hand hygiene practices among the Nigerian HCWs in this research setting, a survey of the barriers and levers to hand hygiene practices was considered necessary. Most of the SSA studies included in chapter 3 are questionnaire-based but not conceptualised by using any theoretical frameworks and methods were not

comprehensively reported to allow for replication of the studies. This prompted the next phase of the research where BALHHI, a UK validated instrument that measures the barriers and levers to hand hygiene (Dyson et al., 2013) was tested for validity and reliability, for use in developing countries. A survey of the barriers and levers to hand hygiene among Nigerian HCWs was also conducted using BALHHI.

9.2.4 Research Objective 4

> "To adapt and test the validity (face and construct) and reliability (test-retest) of BALHHI among HCWs of a Nigerian teaching hospital" (Chapter 6)

To develop an instrument that measures the hand hygiene barriers and levers in developing countries, BALHHI was tested for validity and reliability in three rounds. In the first round, initial testing of instrument was conducted with 2 participants and face validity was conducted with 11 Nigerian HCWs that are resident in the UK sampled through convenience/snowball sampling. An item was added to BALHHI to ask when last the participants worked within the Nigerian healthcare setting. Descriptive statistics of participants according to gender, job title and areas of specialty were conducted and preliminary tests of skewness and kurtosis, and variability of responses of the items were performed. Reliability tests were also performed using Cronbach's alpha. Only one item was removed and 4 items were modified following participant responses and the theoretical justifications of item removal and/or modification. The 7-point Likert scale was also reduced to a 5-point Likert scale.

In the second round, BALHHI was distributed among HCWs of the study site (n=230). Descriptive statistics of participants according to gender, job title and areas of specialty were conducted and preliminary tests of skewness and kurtosis, and variability of responses

of the items were performed. Internal consistency was also tested using Cronbach's alpha and a confirmatory factor analysis was performed to test for construct validity. The initial model was modified until a good fit was achieved following the assessment of modification indices and standardised residual scores. Theoretical justifications of why items may or may not fit within the domains were also considered. This resulted in a 12-item instrument measuring three domains of the TDF (Michie et al., 2005).

In the third round, BALHHI was distributed for test-retest reliability (n=30) using Pearson's correlation coefficient. Descriptive statistics of participants according to gender, job title and areas of specialty were conducted. Four items had high correlation ranging between 0.50 and 0.70, six items had medium correlation ranging between 0.30 and 0.49 while two items with less than 0.30 were removed. This resulted in a 10-item instrument with 2, 3 and 5 items in *environmental context and resources, emotion* and *belief about consequences* domains, respectively. Paired samples *t* tests also showed that there were no statistically significant differences between the mean values of items and domains remaining in the instrument.

9.2.5 Research Objective 5

> "To establish the barriers and levers to hand hygiene among Nigerian HCWs in a teaching hospital through a survey of BALHHI" (Chapter 7)

To address this research objective, a survey of the barriers and levers to hand hygiene among Nigerian HCWs was conducted using the data collected during the construct validity round (n=230) although only the domains and items remaining in the final questionnaire were tested. Mean scores for each of the domains and items according to professional groups and areas of specialty were calculated and these data were used to answer

questions relating to the barriers and levers to hand hygiene practices among Nigerian HCWs. The frequency and percentages of the participants that answered the knowledge test questions were also calculated and presented.

1. What are the greatest barriers and levers to hand hygiene?

All the three domains were considered as barriers. However, the domain *"belief about consequences"* posed the greatest barrier to hand hygiene practices of Nigerian HCWs while the domain *"emotion"* posed the least barrier.

2. Is there a difference in barriers and levers according to professional groups?

Doctors markedly had the highest mean scores across all the 3 domains compared to other professional groups of nurses, health assistants and technicians. Similarly, doctors had considerably higher mean scores for items across professional groups, followed by nurses. Higher mean scores imply greater barriers. This implies that doctors and nurses require greater support to enhance their hand hygiene compliance rate. Some studies have established this finding that doctors are less likely to perform hand hygiene compared to other HCWs (Pittet et al., 2000; Mortell et al., 2013). Moreover, correctly answered questions ranged from 43.5% to 77.% across the professional groups (see figure 6.3). Doctors answered the knowledge test questions correctly most of the time, while health assistants and technicians had lower scores than the other groups of professionals. This might be connected to lack of professional qualifications for this staff group.

3. Is there a difference in barriers and levers according to areas of specialty?

There are few statistically significant differences in barriers and levers according to areas of specialty of the HCWs. The key difference was the low mean score within the domain *"emotion"* in ICU.

Self-reported hand hygiene compliance rates were also assessed and this ranged from 30 to 100% for both participants and their colleagues.

9.2.6 Research Objective 6

> "To further understand the barriers and levers to hand hygiene compliance using semi-structured interviews" (Chapter 8)

To address the sixth research objective, semi-structured interviews were conducted among 16 participants. An interview schedule was developed using the TDF and this guided the interview. Two broad themes – personal and institutional were derived and 9 and 11 subthemes were identified, respectively. Each of these subthemes were described in chapter 8. The subthemes fall into 10 domains of the TDF namely – *"knowledge, skills, belief about capabilities, memory, attention and decision processes, beliefs about consequences, beliefs about capabilities, social/professional role and identity, social influences, environmental context and resources, emotion and motivation and goals"*. The knowledge and skills domain are discussed together as participants referred to the 2 domains concurrently.

9.2.7 Research Objective 7

> "To propose theory-based knowledge translation interventions aimed at increasing HCWs' hand hygiene compliance using the Theoretical Domains Framework" (Chapter 9)

Later on in this chapter, the researcher identified the significance of theoretically informed intervention design. Though it is beyond the scope of this research, findings from this research support a number of recommendations to start this process. Pragmatic intervention strategies aimed at improving hand hygiene practices of HCWs in the research context were suggested and recommendations to carry the suggestions forward were made.

9.3 Findings in the Wider Context

The discussion around instrument validation and testing was presented in section 6.8 of chapter 6. Three central issues are discussed here namely –

1. Hand hygiene compliance rate.
2. Barriers and levers to hand hygiene practices.
3. Improving hand hygiene compliance through tailored interventions.

9.3.1 Hand Hygiene Compliance

In this section, the actual (observed) and self-reported hand hygiene compliance rates are discussed first, then according to professional groups, seniority level, my 5 moments of hand hygiene and shift patterns.

9.3.1.1 Self-Reported and Observed (Actual) Hand Hygiene Compliance

One of the most significant findings of this research is the suboptimal hand hygiene compliance rate in SSA countries. Findings from the systematic review in chapter 3 (overall hand hygiene compliance rate was identified as 21.1%, synthesised from 9 studies that

reported on compliance) and the hand hygiene observations in chapter 5 (overall hand hygiene compliance rate identified as 29.1%, across 2 adult surgical wards in a Nigerian teaching hospital) are consistent with studies conducted in other countries. For instance, a systematic review of studies from developed countries reported less than 40% hand hygiene compliance rate (Erasmus et al., 2010). Findings from the survey (chapter 7) conducted in this research also found higher self-reported hand hygiene compliance rates for participants (79.4%) and their colleagues (76%). Several studies have reported this finding where self-reported hand hygiene compliance rates are higher than the actual (observed) compliance (Jenner et al., 2006; Alshammari et al., 2018).

This finding can be linked to the tendency of research participants giving socially desirable responses rather than talk about their actual practice. Several studies have reported that high self-reported hand hygiene knowledge does not necessarily translate to better hand hygiene compliance level (Jenner et al., 2006; Watanabe, 2011; Joshi et al., 2012; Nematian et al., 2017; Oliveira et al., 2017; Alshammari et al., 2018; Jemal, 2018). Social desirability bias is the likelihood to underreport socially undesirable responses and behaviours and to overreport more desirable features with respect to the current social norms and standards (Perinelli & Gremigni, 2016; Latkin et al., 2017). A literature review found that socially desirable response is often driven by two concepts – impression management which is the desire to avoid embarrassment, unease and distress that revealing socially undesirable responses might bring and self-deception, which is the motivation to maintain a positive self-concept (Tourangeau & Yan, 2007).

The discrepancy between self-reported and actual hand hygiene practice might also be that because HCWs are usually less busy when completing a questionnaire, they are able to think

through their responses unlike during observations when they are often times busy (Jenner et al., 2006). Hence, the recommendation of direct hand hygiene observations for measuring hand hygiene compliance is not out of place. Other identified reasons for poor hand hygiene compliance are discussed in section 9.3.2 of this chapter.

9.3.1.2 Hand Hygiene Compliance Rates and Professional Groups

Greater hand hygiene compliance among doctors (35.1%) than other professional groups (31.1% for nurses and 10.7% for health assistants) was also found in chapter 5 of this thesis. While some studies from other developing countries have equally reported similar finding (Sahay et al., 2010; Mahfouz et al., 2013), there is more contrary evidence from both developing and developed countries that doctors are less likely to comply with hand hygiene guidelines when compared to other professional groups (Pittet et al., 1999; Bischoff et al., 2000; Salemi et al., 2002; Suchitra & Lakshmidevi, 2006; Erasmus et al., 2010; Al-Mendalawi & Bukhari, 2011; Alsubaie et al., 2013; Alshammari et al., 2018; Le et al., 2019). Likewise, doctors displayed better hand hygiene knowledge when the knowledge questions were tested in the barriers and levers to hand hygiene survey (chapter 7). For instance, doctors showed better understanding than other professional groups when asked about instances when hand hygiene should be performed (86.1%) than nurses (71.3%), health assistants (75.9%) and technicians (55.6%). Doctors' better compliance may be attributed to differences in training between doctors and other professional groups (Sahay et al., 2010; Holmen et al., 2016). One of the doctors included in the qualitative study of this research (chapter 8) noted hand hygiene is an examinable concept for residency (postgraduate training) in surgery.

9.3.1.3 Hand Hygiene Compliance Rates and Seniority level

For professional level, findings from the hand hygiene observations (chapter 5 – consultants more compliant than residents, medical officers and house officers; chief nursing officers more compliant than assistant chief and senior nursing officers) and the systematic review (chapter 3) established that the higher the level of a HCW in the profession, the more likely they have better hand hygiene practices. This is consistent with findings from other studies (Aiello et al., 2009; Cantrell et al., 2009). Several authors (Erasmus et al., 2009; Barrett and Randle, 2008; Lankford et al., 2003 and Snow et al., 2006) submitted that the influence of senior HCWs on their junior colleagues cannot be overemphasised as they serve as role models and influence their practices. The impact of role models on hand hygiene will be discussed later in this chapter.

9.3.1.4 Hand Hygiene Compliance Rates and the *"My Five Moments for Hand Hygiene"*

Higher hand hygiene compliance rates were found before performing aseptic procedures (66.7%) and when there is exposure to body fluids (78.5%) in chapter 5 of this thesis. Several studies, from both developing and developed countries have previously reported better hand hygiene compliance when there is high risk for infection and before aseptic procedures (Pittet et al., 1999; Erasmus et al., 2010; Korniewicz & El-Masri, 2010; Randle et al., 2010; WHO, 2010; Mathur, 2011; Alsubaie et al., 2013). There is increased compliance when hands are visibly dirty or sticky (Allegranzi & Pittet, 2009). While hand hygiene compliance after exposure to body fluids are prompted by a desire to protect oneself (Whitby et al., 2007), compliance before aseptic procedures has a great impact on patient safety and prevention of HCAI (Alsubaie et al., 2013).

In the qualitative study (chapter 8), all the 16 interview participants included noted they would heighten their hand hygiene practices to protect themselves, their family members, patients and colleagues when there is fear of contracting diseases. This finding has been reported before (Boscart et al., 2012; Salmon & McLaws, 2015; Jeanes et al., 2018). In the barriers and levers survey (chapter 7), the item *"if I omit hand hygiene, I would blame myself for infections"* (mean score = 2.58) explains why HCWs would want to perform hand hygiene when there is risk for infection.

Another striking finding in this research is the low hand hygiene compliance rates recorded in other types of patient contact – before patient contact (20.5%), after patient contact (10%) and after touching patient's surroundings (37.8%). Similar findings have been documented elsewhere (Erasmus et al., 2010; Randle et al., 2010; McLaughlin & Walsh, 2011; Alsubaie et al., 2013; Fitzgerald et al., 2013; Chavali et al., 2014; Randle et al., 2014; Musu et al., 2017). A systematic review found a compliance rate of 20.5% before patient contact (Erasmus et al., 2010).

Poor compliance at these moments of hand hygiene may play a major role in spreading pathogens in and around the hospital and the hands of the HCWs may serve as a reservoir for the transmission of the pathogens (Temime et al., 2009; Hornbeck et al., 2012; Shobowale et al., 2016). Some researchers stated that pathogens can be transferred to up to the next 7 touched surfaces following a single contact with a contaminated surface or inanimate object (Barker et al., 2004; Reynolds et al., 2005). The low compliance before patient contact might be explained by the strong belief of some HCWs that hand hygiene practices are first to protect themselves before the patients (Chavali et al., 2014). For instance, a study found significantly lower hand hygiene compliance before touching urinary

catheter than after (Biswal et al., 2013). Likewise, poor compliance before patient contact might suggest that it is more important to control cross-contamination from patient to patient rather than preventing it which might have been informed by emphasis on infection control rather than prevention (Jenner et al., 2006). It is important that patient safety is central to every HCW's actions (Salmon & McLaws, 2015).

According to published research, poor hand hygiene compliance after touching patient's surroundings might be due to poor risk perception for touching patient surfaces such as bedrails, drip stands, lockers, door handles and overbed tables rather than patients' skins (Dancer, 2009; McLaughlin & Walsh, 2011). There is likelihood that HCWs believe person-to-person contact are significantly more likely to transmit pathogens than surface-to-person contact (McLaughlin et al., 2013). While HCWs often underestimate the danger of patient surfaces (McLaughlin & Walsh, 2011), the false impression that touching patient surfaces is less risky creates erroneous belief for HCWs that they are performing hand hygiene when it matters most and are doing so effectively (Gluyas, 2015). This perception is flawed since the commonest HCAI result from bacteria that survive on surfaces for months (McLaughlin et al., 2013). A study found that over half of the inanimate objects were not microbiologically clean when screened (Griffith et al., 2000). There is an increasing evidence that environmental decontamination is an important factor in reducing HCAI (Randle et al., 2010) hence, the need to improve on environmental cleaning generally and specifically at surfaces nearest to patients (Pittet, 2009; Dancer, 2010; Dancer, 2014). The role of patient surroundings in infection spread (Randle et al., 2010) needs to be investigated in future research and HCWs also need to be aware that cross contamination can occur at seemingly low risk activities (Fitzgerald et al., 2013). Some of the interview participants (chapter 8) noted dirty environment as a barrier to hand hygiene practice. Dancer (2014) suggests that

cleaning becomes an evidence-based practice with standardised procedures of assessment to control the spread of HCAI.

9.3.1.5 Hand Hygiene Compliance Rates and Shift Pattern

This research also found higher hand hygiene compliance in morning shift (30.1%) than afternoon shift (28.5%). Similar findings are reported where HCWs were more compliant in the morning shift than afternoon shift (Kuzu et al., 2005; Alsubaie et al., 2013). While Randle et al. (2010) argued that hand hygiene compliance is independent of the time of the day, some authors stated that HCWs are likely to practise hand hygiene more in evening shifts than the morning shifts (Duggan et al., 2008). This may be connected to the heavy workload and time constraints identified as barriers to hand hygiene practices later in this chapter. More so, having more clinical procedures to carry out in morning shifts than in the later shifts might also be a reason for this finding.

9.3.2 Barriers and Levers to Hand Hygiene Practices

This section will be discussed using the domains of the TDF (Michie et al., 2005). The researcher will integrate findings from the quantitative (chapter 7) and qualitative (chapter 8) studies on the barriers and levers to hand hygiene practices within the research context. Findings from these studies will be discussed in light of wider literature and where relevant, with findings from the systematic review (chapter 3), ward infrastructure survey and hand hygiene observations (chapter 5).

Ten domains were identified as either barriers, levers or both namely *"knowledge, skills, belief about capabilities, belief about consequences, environmental context and resources, memory, attention and decision processes, motivation and goals, social influences, emotion and social/professional role and identity".* Only *"action planning"* domain was not identified

as either barrier or lever to hand hygiene practices from the studies. The definitions of the domains and their constructs will be offered first before they are discussed in relation to wider literature.

9.3.2.1 Knowledge, Skills and Belief about Capabilities

The principal finding of this current research is the suboptimal level of hand hygiene knowledge and skills found among the research participants. Knowledge and skills are discussed together here because they are interlinked and as suggested by Dyson et al. (2013) while developing and testing BALHHI, they are likely to overlap. Knowledge and skills are both personal and institutional barriers and findings here include hand hygiene policy and training, HCWs' perceptions, when and how to perform hand hygiene, and misconceptions about hand hygiene practices. The relevant domains of the TDF for these findings are knowledge, skills and belief about capabilities. Knowledge is defined as "an awareness of the existence of something, skill is "the ability or proficiency acquired through practice" while belief about capabilities is "the acceptance of truth, reality, or validity about an ability, talent, or facility that a person can put into constructive use" (Cane et al., 2012pp. 13). The relevant knowledge constructs for this research are knowledge of condition/scientific rationale and procedural knowledge while the relevant constructs for skills are skills development, competence, ability and practice (Cane et al., 2012pp. 13). The relevant constructs for belief about capabilities are self-confidence, perceived competence, self-efficacy, perceived behavioural control, self-efficacy and professional confidence (Cane et al., 2012pp. 13).

1. Hand Hygiene Policy

The current research found that there are no national or local hand hygiene guidelines in Nigeria and the research setting, respectively (chapter 8). Some studies included in the systematic review (chapter 3) also confirmed lack of awareness on hand hygiene policy or any documentary evidence on hand hygiene in their hospitals (Ekwere & Okafor, 2013; Tobi & Enyi-Nwafor, 2013; Abdella et al., 2014; Uneke et al., 2014). Lack of hand hygiene guidelines and HCWs' difficulty to comprehend the WHO hand hygiene guidelines (WHO, 2009) have been reported elsewhere (Al-Hussami et al., 2011; Salmon & McLaws, 2015; Teker et al., 2015). This is contrary to what obtains in developed countries where apart from the global and national policies, there are local guidelines in every hospital which are usually in accordance with their local governance processes (WHO, 2009; NHS Improvement, 2019). This implies that the absence of hand hygiene guidelines would in effect lead to the HCWs' resultant inability to recognise hand hygiene opportunities and the consequent low hand hygiene compliance rate as seen in this present research. There is an urgent need to develop and adopt practical hand hygiene guidelines to the local context, which are easily comprehensible, user-friendly and scientifically evident to facilitate the understanding of the HCWs (Salmon & McLaws, 2015).

2. Hand Hygiene Training

The qualitative study (chapter 8) conducted in this research also found that most of the HCWs had no prior hospital training on hand hygiene and that HCWs rely on hand hygiene training from nursing and medical schools and during disease outbreaks such as EVD and Lassa fever. The systematic review conducted in this research (chapter 3) also found lack of previous or continuous education or training as barrier to effective hand hygiene practices.

This might explain the knowledge gap seen when participants' knowledge of hand hygiene practices was tested in the survey (chapter 7). This finding is unlike what occurs in developed countries where periodic training is organised (NHS Improvement, 2019). Though there is concern on actual evidence that education increases compliance with any aspect of infection control (Cooper, 2007), adequate hand hygiene knowledge is expected to improve the overall hand hygiene compliance with recommended guidelines and also identify methods of HCAI transmission and prevention (Musu et al., 2017; Engdaw et al., 2019). Numerous studies have shown that educational programmes tailored at hand hygiene practices can effectively increase hand hygiene compliance among HCWs (Aiello et al., 2008; Helder et al., 2010; Sjöberg & Eriksson, 2010; Al-Wazzan et al., 2011; Jaggi & Sissodia, 2012; Higgins & Hannan, 2013; Huis et al., 2012; Szilágyi et al., 2013; O'Donoghue et al., 2016; Gould et al., 2017; Matar et al., 2018; Engdaw et al., 2019). However, it remains unclear how to precisely determine the actual mode of delivery of such teachings (Gould & Drey, 2013). Salmon & McLaws (2015) advised that implementation of hand hygiene guidelines should be tailored by educational programmes aimed at HCWs' understanding and the lack of adoption of a duty of care by HCWs to their patients' safety should be addressed.

3. When and How to Perform Hand Hygiene

All the interview participants from the qualitative study (chapter 8) affirmed that they were very knowledgeable in their recognition of when to perform hand hygiene. Findings from the knowledge test questions included in the BALHHI survey (chapter 7) also showed many participants (77%) knew when to perform hand hygiene. However, only 50.4% of survey participants (chapter 7) correctly answered the knowledge test question on how to perform hand hygiene when hands are not visibly soiled. The hand hygiene observations (chapter 5)

also found low compliance and staff did not follow the WHO recommended guidelines on hand hygiene practices.

Alshammari et al. (2018) attributed this inconsistency to HCWs' ignorance of hand hygiene guidelines or lack of awareness of their own hand hygiene behaviours. This could be true as in this current research, 6 interview participants noted their lack of awareness of the WHO hand hygiene policy (WHO, 2009). There exists a huge knowledge gap among the participants which necessitates urgent training and provision of hand hygiene guidelines to improve the hand hygiene knowledge and practices of HCWs in the research context. The finding here may also relate to the tendency of participants to give socially acceptable responses (discussed above).

4. Misconceptions about Hand Hygiene Practices

The qualitative study (chapter 8) conducted in this research also found that Nigerian HCWs have deficient knowledge of the efficacy of alcohol-based hand hygiene products. Only about half of the survey participants (chapter 7) showed good knowledge of the use of alcohol-based hand hygiene products when tested on the most effective hand hygiene method when hands are not visibly soiled and the efficacy of alcohol-based hand hygiene products when there is Clostridium difficile infection. Similarly, some interview participants (chapter 8) displayed poor knowledge of the efficacy of alcohol-based hand hygiene products as some noted they would only use alcohol-based hand hygiene products after handwashing. Previous research have established the effectiveness of alcohol-based hand hygiene products when compared with handwashing (Pittet et al., 2000; Girou et al., 2002; Wendt et al., 2004; Larson et al., 2005; WHO, 2009; Salmon et al., 2014). Alcohol-based

hand hygiene products are particularly effective in reducing the transfer of MRSA bacteria (Vernaz et al., 2008; Lee et al., 2012).

Another striking finding in this research is the use of methylated spirits in the event of needlestick injury as confirmed by some interview participants (chapter 8). This is a harmful practice and authors have warned against skin contact with methylated spirits as they contain methanol which may be toxic to the skin when absorbed (Dasgupta & Wahed, 2014; Chan & Chan, 2018). The use of methylated spirit as a form of hand hygiene might be a direct consequence of poor hand hygiene knowledge due to lack of adequate education and training as well as lack of awareness of the WHO hand hygiene guidelines. There is therefore need for proper orientation and improved awareness of HCWs from this region on the harmful impact of pouring methylated spirits on their hands as a form of hand hygiene.

9.3.2.2 Belief about consequences

In this research, the belief about consequences domain has both barrier and lever components. This domain is defined by Cane et al. (2012 pp.13) as the "acceptance of the truth, reality, or validity about outcomes of a behaviour in a given situation". The relevant constructs of the domain for this research are beliefs, outcome expectancies, characteristics of outcome expectancies anticipated regret and consequents (Cane et al., 2012pp. 13). The levers found in this domain are mostly reported by interview participants (chapter 8) including perceived risk for infection (this was previously discussed in the hand hygiene compliance section above), improved patient turnover rates, shortened hospital stay, boost in patient confidence, and improved hospital economy.

1. Greeting Culture

Another lever of hand hygiene found in this research is the greeting culture of Nigerians. Handshake is a common form of greeting not only among Nigerians but other cultures as well (Ghareeb et al., 2013; Mela & Whitworth, 2014; Commisceo Global, 2019). Handshake is an invaluable bonding tool between HCWs and their patients (Fred, 2015). Beyond warmth, welcome and professionalism, a handshake between patients and HCWs can transmit pathogens such as Clostridium difficile, MRSA, Escherichia coli and vancomycin-resistant enterococci (D'Arrigo, 2014). Hence, the growing advocate for handshake greetings to be banned within healthcare settings. Fist bump or high five are found to be better as they can reduce HCAI transfer drastically, although bacteriologic studies found fist bumps to be much cleaner than handshakes or high fives (Ghareeb et al., 2013; D'Arrigo, 2014; Mela & Whitworth, 2014). However, Fred (2015) argued that banning handshakes might not be a solution to HCAI transfer because technically, the handshake is not the problem rather the handshaker who should ensure attempts at making contacts with patients are with clean hands. There is no evidence that either fist bumps or high-fives are being employed as a form of greeting within the Nigerian healthcare setting.

2. Absence of IPC committee

The item *"If I miss out hand hygiene, I will be subject to disciplinary action"* has the greatest barrier (mean score = 4.21 for surgical wards) when the items within the domains were surveyed (chapter 7). This might be related to the lack of IPC committee in the hospital as found in this research. Several studies have confirmed that the absence of administrative sanctions impacts on noncompliance of HCWs (Pittet, 2001; WHO, 2009; Teker et al., 2015).

There is an urgent need for establishment of IPC team that will oversee hand hygiene practices of HCWs and develop a reward-punitive system within the research context.

3. Skin irritation

The systematic review (chapter 3) and data from the qualitative study (chapter 8) found skin irritation as a barrier to hand hygiene practices. Previous studies have reported this finding (Pittet, 2001; Boyce & Pittet, 2002; Lampel et al., 2007; WHO, 2009; Visscher & Randall Wickett, 2012; White et al., 2015; Wolfe et al., 2016; Larson, 2017; Jeanes et al., 2018). A literature review found that HCWs were 4.5 times more likely in 2012 to suffer from irritant contact dermatitis, due to the rise in MRSA as in year 1992 (McGuckin & Govednik, 2017).

Skin irritation or contact dermatitis might arise from frequent handwashing with soap and water immediately before or after using hand sanitisers or donning gloves on wet hands (WHO, 2009). Apart from frequent handwashing, some interview participants from the qualitative study (chapter 8) highlighted the use of locally made liquid soap and supply of expired ABHRs by the hospital management as direct causes of skin irritation.

Use of moisturising cream following handwashing, using alcohol-based hand hygiene products instead of handwashing when hands are not visibly soiled, provision of alternative hand hygiene products for HCWs with confirmed allergies or adverse reactions and allowing hands to dry completely before donning gloves are some of the recommendations to combat skin irritation (WHO, 2009).

9.3.2.3 Environmental Contexts and Resources

Environmental contexts and resources are defined as “any circumstance of a person's situation or environment that discourages or encourages the development of skills and

abilities, independence, social competence, and adaptive behaviour" (Cane et al., 2012pp.14). Relevant constructs include environmental stressors, resource/material resources and barriers and facilitators (Cane et al., 2012pp.14). Heavy workload, time constraints and insufficient human resources, infrastructural deficit, hand glove use and dirty environment are discussed here.

1. Heavy Workload, Time Constraints and Insufficient Human Resources

Interview participants from the qualitative study (chapter 8) found heavy workload, time constraints and insufficient human resources as barriers to effective hand hygiene practices. This finding is consistent with findings from the systematic review (chapter 3) and the researcher's observation of 2 nurses for over 20 patients per shift while conducting the hand hygiene observations (chapter 5). More so, findings from the survey (chapter 7) also suggest staff shortage as a barrier to hand hygiene practices in surgical wards (*"my area of work has poor staffing levels*" – mean score was 3.28). Several studies from developing countries have also reported this finding (Picheansathian et al., 2008; Jang et al., 2010; Marjadi & McLaws, 2010; Joshi et al., 2012; Sharma et al., 2012; Gurley et al., 2013; Harsha & Devi, 2013; Salmon & McLaws, 2015; Werne & Dieckhaus, 2015; White et al., 2015; Diwan et al., 2016; Jimmieson et al., 2016; Sadule-Rios & Aguilera, 2017; Zhang et al., 2019). The link between staff shortage, heavy workload and insufficient time was discussed in the contextual background to the research (chapter 2) and systematic review (chapter 3).

Shortage of HCWs has characterised SSA countries from time and authors attributed this to lack of medical graduates (Henderson & Tulloch, 2008; Mullan et al., 2011), disease outbreak and infections (Tawfik & Kinoti, 2006), and brain drain (Henderson & Tulloch, 2008; Mullan et al., 2011; Aluttis et al., 2014; Miseda et al., 2017). Other factors

contributing to HCW shortage are inadequate education and training capacity (Henderson & Tulloch, 2008; Liu et al., 2017), poor working conditions (Henderson & Tulloch, 2008; Liu et al., 2017), weak human resources (Henderson & Tulloch, 2008; Liu et al., 2017), lack of effective planning (Henderson & Tulloch, 2008; Liu et al., 2017), and inadequate incentives (Henderson & Tulloch, 2008; Liu et al., 2017), low salaries, limited health budgets and limited opportunities for professional development (Henderson & Tulloch, 2008). Efforts at setting up health services aimed at achieving universal health coverage are handicapped by the shortage and inequitable distribution of HCWs which present binding constraints to health service delivery (Liu et al., 2017; Miseda et al., 2017). To tackle this problem, there is need for policy makers to allocate resources and set priorities based on expectations of the need for HCWs in this region and capacity to support HCWs (Liu et al., 2017). Need for proper allocation of HCWs' workload to ensure effective and efficient hand hygiene practices has also been recommended (Zhang et al., 2019).

2. Infrastructural Deficit

Interview participants from the qualitative study (chapter 8) identified insufficient or inconveniently positioned sinks, inadequate access to soap and water, inadequate supply of ABHRs and their inconvenient locations at points of care, unavailability of disposable towels or automated hand dryers as barriers to proper hand hygiene practices. Infrastructural deficit was found as a barrier in the systematic review (chapter 3) and has been reported in several other studies (Akyol, 2007; Borg et al., 2009; Jang et al., 2010; Devnani et al., 2011; Mathur, 2011; Boscart et al., 2012; Anargh et al., 2013; Shinde & Mohite, 2014; Salmon & McLaws, 2015; Smiddy et al., 2015; Teker et al., 2015; White et al., 2015; Sadule-Rios & Aguilera, 2017; Le et al., 2019). Unavailability of hand hygiene facilities is particularly worse

in developing countries. It was estimated that 6% of healthcare facilities have access to basic water and sanitation services (National Bureau of Statistics, 2019).

WHO (2009) recommends that all healthcare settings should have written guidelines that describe the appropriate placement of sinks, soap and ABHR dispensers. There should be at least one sink to every 10 beds and soap and fresh towels at every sink (WHO, 2009). Whilst conducting the ward infrastructure survey (chapter 5), there were 2 sinks to 30 and 21 beds in each of the male and female surgical wards, below the recommended minimum standards. However, there was supply of running water, only bar soaps and heavily diluted liquid soaps were available on the wards, and disposable towels were not available, but cotton towels were changed per shift. Some interview participants from the qualitative study (chapter 8) noted there is limited supply of running water sometimes because of lack of electricity to pump water and that water is sometimes stored in bucket and they use bowl to fetch water to perform hand hygiene. WHO (2009) also recommends at least bottles of ABHR positioned at points of care in each ward or given to staff. No ABHRs were available when the ward infrastructure survey (chapter 5) was conducted. Some interview participants (chapter 8) noted that they usually buy pocket-sized ABHRs with their personal money.

These findings have been reported elsewhere where the authors noted that most wards in Nigerian hospitals lack adequate facilities for effective hand hygiene practices and use the bucket and bowl method as alternative to running water (Ogunsola & Adesiji, 2008). A recent study where the environmental conditions and standard precaution items of healthcare facilities in low and middle income countries were explored found that 50% of the healthcare facilities lacked piped water, 39% lacked handwashing soap, 39% lacked

adequate infectious waste disposal, 73% lacked sterilisation equipment and 59% lacked reliable energy services (Cronk & Bartram, 2018). Improved access to hand hygiene resources will significantly improve compliance by HCWs (Whitby et al., 2006; Munoz-Price et al., 2014; Saito et al., 2017; Tang et al., 2019).

3. Hand Gloves

Another notable finding in this study is how the use of hand gloves impacts on the hand hygiene compliance of HCWs. There is evidence that glove use is an important risk factor, misuse and/or overuse of which can imply poor compliance with hand hygiene guidelines (Katherason et al., 2010; Fuller et al., 2011; Eveillard et al., 2012; Loveday et al., 2014; Cusini et al., 2015). The systematic review (chapter 3) found that some SSA HCWs believed hand hygiene is unnecessary when gloves are used. Likewise, five of the interview participants in the qualitative study (chapter 8) expressed their preference for glove use instead of hand hygiene practices especially when they are busy. This finding might not differ from what obtains in developed countries. For instance, a study identified a major rise in HCAI associated with glove use for all patients rather than using them for standard precaution purposes only (Bearman et al., 2007). In another study conducted within 15 hospitals in the UK, the researchers found that gloves were often worn without indication and not worn when indicated, thereby submitting a strong association between glove use and lower rates of hand hygiene compliance (Fuller et al., 2011). Some studies also reported that for isolated patients, HCWs who donned gloves prior to entering their rooms are likely to only remove the gloves after leaving the rooms without changing the gloves or practising satisfactory hand hygiene as indicated (Thompson et al., 1997; Chau et al., 2011; Cusini et al., 2015; Burdsall et al., 2017). However, a few studies reported increased hand hygiene

compliance following glove use (Kim et al., 2003; Lankford et al., 2003; Eveillard et al., 2011). These authors argued that donning gloves may remind HCWs of their personal risk of HCAI transmission and this may prompt them to perform hand hygiene as indicated (Cusini et al., 2015).

Baloh et al. (2019) outlined three ways glove use can reduce hand hygiene practices. First, HCWs are likely to shift their motivation for self-protection to glove use thereby undermining their motivation to perform hand hygiene (Baloh et al., 2019). Fear and disgust are identified as strong motivators to wear gloves as well as perform hand hygiene (Loveday et al., 2014; Smiddy et al., 2015; Wilson et al., 2017). Hand hygiene practises can be diminished if the motivators are satisfied by glove use and vice versa (Baloh et al., 2019). Likewise, glove use might be a convenient alternative for HCWs who are sceptical of the hand hygiene guidelines and the need to perform hand hygiene as often as indicated, especially when gloves are also used (Baloh et al., 2019). Lastly, HCWs may find glove use without hand hygiene more acceptable because they do not need to wear gloves on wet hands or wait for their hands to dry, thereby consequently reducing skin dryness and irritation (Baloh et al., 2019).

4. Dirty Environment

Another barrier found in this research is the dirty environments Nigerians find themselves. Two interview participants from the qualitative study (chapter 8) noted that their environments are dirty while findings from the survey (chapter 7) found the item *"my environment is untidy"* as a barrier with a mean score of 3.28. A recent report revealed over 168 million Nigerians live in filthy environments (Orizu, 2020). Forty two percent and 24% of Nigerians are reported to have access to basic sanitation services and practice open

defecation, respectively (National Bureau of Statistics, 2019). In the 2018 global Environmental Performance Index, Nigeria ranked 100 out of 180 countries compared to the UK which ranked number 6 (Yale Center for Environmental law and Policy, 2020). Similarly, Nigeria scored 7.75% and ranked 168 when water and sanitation index were reported whereas the UK scored 100% and ranked first in the same indicator (Yale Center for Environmental law and Policy, 2020). This implies that Nigerian HCWs have found themselves in the position of regularly performing hand hygiene because of the unclean environments most of the public live in. This might have consequently heightened their skills and confidence in hand hygiene practices, without necessarily undergoing any formal training or having access to the hand hygiene guidelines. It will be interesting to compare hand hygiene compliance in hospitals to the social norm in this context. The role of environmental decontamination is discussed in compliance section 9.3.1.4 of this chapter.

9.3.2.4 Memory, Attention and Decision Processes

The next domain to be discussed is memory, attention and decision processes. Cane et al. (2012) defined this domain as "the ability to retain information, focus selectively on aspects of the environment and choose between two or more alternatives". The relevant constructs here are memory, attention and attention control (Cane et al., 2012pp.14). Within this domain, only habits and forgetfulness were identified as lever and barrier, respectively by interview participants in the qualitative study (chapter 8).

1. Habits

All the 16 interview participants (chapter 8) demonstrated basic knowledge of how to perform hand hygiene and some were able to give thick descriptions of the steps involved. They all described hand hygiene as very easy and that they have come to master the

procedure over time and with practice, using phrases like hand hygiene practice is “part of me”, “habitual/cultural for me”, “I don’t have to be told”, “an innate behaviour/lifestyle for me”. This implies that HCWs know what to do but the numerous barriers to hand hygiene practices have incapacitated them to engage in an ideal practice.

Habits are learned behaviours that are performed automatically (Gardner et al., 2012). Automatic responses are generally triggered by environmental cues, allowing the individual to perform routine actions highly efficiently while focussing attention on other things (Ersche et al., 2017). When habits are formed, control gradually shifts away from being guided by the intentions to being automatically triggered by environmental cues (Ersche et al., 2017). This implies that hand hygiene may be reliably practised in instances where it is habitual (Dyson et al., 2011; Smiddy et al., 2015). It is important to explore habit as a determinant of hand hygiene because automatic behaviours have a higher chance of being performed in busy clinical environments where multiple tasks compete for HCWs’ conscious attention (Kupfer et al., 2019).

2. Forgetfulness

Forgetfulness was identified as a barrier to hand hygiene in the systematic review (chapter 3). Research from both developed and developing countries confirmed forgetfulness as a reason for poor hand hygiene compliance (Erasmus et al., 2009; WHO, 2009; Teker et al., 2015; White et al., 2015; Le et al., 2019). This barrier might be related to insufficient hand hygiene cues and reminders at strategic locations in hospital wards (Jeanes et al., 2018). For instance, while conducting the hand hygiene observations (chapter 5), the researcher found that hand hygiene display posters were only at one handwash station per surgical ward. This implies that the poor hand hygiene compliance of HCWs in this research setting might be

connected to the lack of prompts on the wards. WHO (2009) recommends that the “how to” and “five moments” posters should be displayed in all test wards (such as patient’s rooms, staff areas, out-patients).

Reliance on cues and reminders at workplace by several hand hygiene intervention studies is based on the presumption that forgetfulness is an important factor for poor compliance (Gould & Drey, 2013; Gould et al., 2017). Several hand hygiene intervention studies where cues, display posters and reminders were used alongside some or all of the WHO recommended multimodal implementation strategies reported increased hand hygiene compliance (Tschudin-Sutter et al., 2010; Mathai et al., 2011; Biswal et al., 2013; Al-Dorzi et al., 2014; Rodriguez et al., 2015; Su et al., 2015; Alshehari et al., 2018; Jeanes et al., 2018). Examples of cues and prompts used by some studies are display posters at strategic locations such as handwash sinks and places where HCW-patient interactions occur such as patient bedsides (Mahfouz et al., 2014), ABHR placement near points of care (Munoz-Price et al., 2014; Salati & Al Kadi, 2014), display posters and pamphlets as reminders of ABHR techniques (Salati & Al Kadi, 2014; O'Donoghue et al., 2016), ultraviolet light that switches on when someone enters the room (Diegel-Vacek & Ryan, 2016), posters showing a stern pair of male eyes and clean scent to remind HCWs to perform hand hygiene (King et al., 2016), posters with information about the consequences of noncompliance for HCWs and patients (Grant & Hofmann, 2011).

9.3.2.5 Motivation and Goals

The next domain to be discussed is motivation and goals. Woolley and Fishbach (2018) stated that an activity is motivated when it is considered as an end in itself or because the benefits of pursuing the activity cannot be separated from the activity itself. Low level of

HCW motivation has often been identified as a central problem in health service delivery which subsequently has a negative impact on HCWs' performance, the facilities and healthcare system as a whole (Mathauer & Imhoff, 2006).

Absence of incentives was identified as a barrier to hand hygiene practices from the qualitative study (chapter 8) conducted. Incentives, one of the constructs of motivation and goals are designed to motivate and encourage HCWs to perform well and improve their outcomes (Abduljawad & Al-Assaf, 2011; Cane et al., 2012). Several studies have confirmed that incentives such as certificate of recognition, praise or appreciation can improve HCWs' hand hygiene compliance (Erasmus et al., 2010; Huis et al., 2012; Srigley et al., 2015; Kingston et al., 2016; Gould et al., 2017; Sendall et al., 2019). Lack of motivation also contributes to the current wave of brain drain of doctors and nurses from SSA countries to developed countries as they have better renumeration and quality of life in these countries than in developing countries (Akhigbe & Ifeyinwa, 2017). Job satisfaction is derived from a composed mix of benefits received on the job and employee motivations (Ekere & Amah, 2014). Motivating HCWs importantly resulted from the institutional capacity to improve their working conditions (Ebuehi & Campbell, 2011). Interview participants in the qualitative study (chapter 8) noted that continuous provision of hand hygiene facilities will enhance their hand hygiene practices and not necessarily through individual/physical rewards. It is important that the hospital management makes adequate provision for HCWs in a bid to heighten their hand hygiene practices. There is also need for recognition of those HCWs who appropriately follow the hand hygiene guidelines. A recent study found that immediate and frequent rewards for task completions increases people's work interests and fulfilment and this is sustainable even when the rewards are eventually removed (Woolley & Fishbach,

2018). This could be in form of ward appreciation, through award of certificate to the tidiest ward or ward with the best hand hygiene compliance rate to boost HCWs' hand hygiene practices.

Another key finding from the qualitative study (chapter 8) is the absence of compensation in the event of occupational hazard and delayed payment of salary. It is important that HCWs are supported in the discharge of their professional duties. Motivation could also be increased through more focussed non-monetary intervention policies among HCWs and regular payment and increment of employee salary (Akhigbe & Ifeyinwa, 2017; Ndikumana et al., 2019). Organisations need to consider occupational hazards of hospital environment when fixing the pay of the employees (Akhigbe & Ifeyinwa, 2017).

9.3.2.6 Emotion

Cane et al. (2012) defined emotion as "a complex reaction pattern, involving experiential, behavioural and psychological elements, by which the individual attempts to deal with a potentially significant matter or event". The relevant constructs of the domain to this research are affect, stress, positive and negative effect (Cane et al., 2012pp.14).

This research found feelings of anger, shame and guilt as emotional factors relating to hand hygiene practices in the research context. The three items from the survey (chapter 7) were more of hand hygiene levers than barriers. Mean scores between 2 and 3 were considered as borderline in the survey (chapter 7). The items are *"I feel guilty if I omit hand hygiene"* (mean = 2.40), *"I feel angry if hand hygiene is not carried out by others"* (mean = 3.14) and *"I feel ashamed if I omit hand hygiene"* (mean = 2.28). In the qualitative study (chapter 8), interview participants stated it is an indictment on HCWs, they may feel like bad HCWs, depressed and unhappy if patients contract HCAI while on hospital admission.

Anger is a representative response of individuals faced with an unwanted situation (Jeong & Kim, 2016), guilt triggers when events deemed incongruent with one's identity goals are attributed to specific unstable or controllable aspects of the self while shame is triggered when attributions are made to stable or uncontrollable self (Sznycer, 2019). Shame and guilt are initiated by self-reflection and self-evaluation, and they serve as an emotional moral barometer that offers instant reaction on our social and moral acceptability (Tangney et al., 2007). Shame and guilt are part of self-conscious emotions which motivate people to avoid discredit and avoid harming people who are dear to us, in this case, patients (Sznycer, 2019).

Emotion is seldom recognised as a barrier or lever to hand hygiene and when cited, it is usually related to feelings of disgust from dirty hands, as a facilitator for hand hygiene (Curtis et al., 2009; Dyson et al., 2011; Chatfield et al., 2017; Kupfer et al., 2019). To the best of the researcher's knowledge, this research is the first to report this finding in SSA countries. It is important to enhance hand hygiene knowledge and training among HCWs so they are able to recognise hand hygiene opportunities and comply with the guidelines so the feelings of anger, shame and guilt can be reduced.

9.3.2.7 Social Influences

Social influences are defined as "those interpersonal processes that can cause individuals to change their thoughts, feelings or behaviours" (Cane et al., 2012pp.14). The relevant constructs of social influences domain include social pressure, social norms, group conformity, social support and modelling (Cane et al., 2012pp.14).

1. Role Models

An item from the barriers and levers survey (chapter 7) was found to be a barrier ("I am reluctant to ask others to engage in hand hygiene" – mean score= 2.05). This finding might be due to lack of role models and not ready to be one. Many interview participants (chapter 8) noted they do not have role models of hand hygiene. The hand hygiene observations (chapter 5) conducted in this research also found that the consultants more compliant than their junior counterparts although for nurses, the staff nurse (the lowest cadre of nurses) were found to be more compliant. Studies have shown that having hand hygiene role models, mentors and strong leadership may improve hand hygiene compliance (Lankford et al., 2003; Pittet et al., 2004; Snow et al., 2006; Whitby et al., 2006; Erasmus et al., 2009; Jang et al., 2010; Alp et al., 2011; Lieber et al., 2014; McInnes et al., 2014; Sendall et al., 2019). The current study also found there are no IPC personnel or department to champion ensuring hand hygiene guidelines are effectively adhered to in the research setting. This means that the HCWs are only able to follow the guidance of their direct senior colleagues on the wards, and not hospital IPC experts, which may not be entirely right. A recent study confirmed that the presence of a clearly identified leader improved hand hygiene compliance in Italy (Petrilli et al., 2017). Consistently ensuring positive examples by superiors and role model training will have great impact in improving hand hygiene compliance among HCWs (Santosaningsih et al., 2017; Zottele et al., 2017; Sendall et al., 2019).

2. Hospital Administrators and Employee Loyalty

Another key finding here is the HCWs' reluctance to comment on the barriers to effective hand hygiene practices in the research context. For instance, some interview participants

(chapter 8) noted they did not require updates or further training on hand hygiene by the hospital because they were sufficiently trained while in nursing and/or medical schools while some insisted the available hand hygiene resources in the hospital were sufficient to effectively practise hand hygiene and that it is normal to purchase ABHRs using personal finances. An interview participant (chapter 8) also mentioned that the hospital administrators sometimes require them to choose between the supply of soap for handwashing or ABHR products. The researcher opines this might be connected to the research setting being a private teaching hospital resulting into employee loyalty where workers feel they are unable to challenge their managers or speak out because they feel it is unsafe to do so (Kosinski, 2017). This finding has been previously reported. A study found that only 1% of company employees feel extremely confident when it comes to raising concerns at critical moments at work (Blackham, 2016). Scholars reported that loyal employees show abnormal state of emotional sense of duty concerning organisational success (Akhigbe & Ifeyinwa, 2017).

Two viewpoints relating to employees keeping silent are personality perspective and situational perspective. Personality perspective suggests that some employees innately lack the disposition to speak out about critical issues, may be too introverted or shy to effectively express their viewpoints (LePine & Van Dyne, 2001; Tangirala et al., 2013). Situational perspective on the other hand argues that employees might be reluctant to speak up because they feel the work environment is not conducive for it and they might suffer significant social costs by challenging their managers (Nembhard & Edmondson, 2006). The situational viewpoint might apply to the interview participants (chapter 8) of the current research as most problems of Nigeria health industry revolve around poor

management (Oleribe, 2009). With the current poverty rate in Nigeria being projected at 50.1% and the unemployment rate of 8.1% in Nigeria, and 6.2% for SSA countries compared to 3.9% in the UK, the workers are likely to keep quiet when they ought to speak out against mismanagement, in a bid to keep their jobs (The World Bank, 2020a; The World Bank, 2020b).

Hospital administrators need to be concerned about the effects of their leadership behaviours and organisational culture on the work attitude of their employees, their job satisfaction and the success of the organisation (Perra, 2000; Berson & Linton, 2005; Casida & Pinto-Zipp, 2008). It is important for hospital administrators to improve the work environment and establish a good organisational infrastructure in order to increase employee job satisfaction (Tsai, 2011). One way of improving work environment is through staff engagement to enable them deliver high quality care with better patient experience, fewer errors and lower infection and mortality rates (Daugherty Biddison et al., 2016; Frampton et al., 2017). Organisations need to facilitate hand hygiene and protect their staff from factors that have a detrimental impact such as occupational stress (Hanna et al., 2009).

9.3.2.8 Social/Professional Role and Identity

Social/professional role and identity domain is defined as a coherent set of behaviours and displayed personal qualities of an individual in a social or work setting (Cane et al., 2012pp.13). The relevant constructs here are professional identity, professional role, social identity, and professional confidence (Cane et al., 2012pp.13).

1. Patients' Confidence and Trust

In the qualitative study (chapter 8), some participants mentioned that HCWs' regular practice of hand hygiene will boost patient's morale, the confidence they have in the care they receive and the likelihood of patients "trusting us with their health". Two items from the barriers and levers to hand hygiene survey (chapter 7) – *"if I engage in hand hygiene, it improves patient confidence"* (mean = 2.21) and "*I engage in hand hygiene out of respect for my* patients" (mean = 2.44) confirmed this finding. This finding has been previously reported (WHO, 2009; Harris et al., 2011; WHO, 2018).

Confidence in healthcare is defined as a belief in the trustworthiness or reliability of care (Wong et al., 2014). Trust is a crucial element of HCW-patient relationship and the foundation of any therapeutic relationship (Dinç & Gastmans, 2013). Establishing trust between HCWs and patients will enhance patient engagement thereby improving patient's prospect of being an active member of the patient care team (Leslie & Lonneman, 2016). Professional competencies and interpersonal caring attributes are key to developing trust (Dinç & Gastmans, 2013). This may include commitment to providing the best care and adequate knowledge and skills to undertake clinical procedures (Belcher & Jones, 2009). Low levels of patient confidence in healthcare can lead to poorer health outcomes and avoidance of care. Hence, there is need for HCWs to consciously gain and maintain the trust and confidence of their patients.

2. Means of Hand Hygiene Education

Another finding from the qualitative study (chapter 8) is that performing hand hygiene is a way of educating patients on the need for hand hygiene. Patient education has been

reported to reduce hospital admission and/or readmission rates, improve quality of life and patient outcomes (Hews-Girard et al., 2017). Previous research in patient education has demonstrated the significance of using learning theories and principles to develop and deliver patient education (Hews-Girard et al., 2017). This finding might be explained using the behaviourist perspective of learning, which focusses on observable, measurable behaviours. In behaviourism, learning consists of a change in behaviour following the acquisition, reinforcement and application of associations between stimuli from the environment and observable responses of an individual (Aliakbari et al., 2015; Mukhalalati & Taylor, 2019). This implies that HCWs' hand hygiene practices will consequently influence the patients' practices as they are likely to assume the HCWs practices are standard, as a result of their professional role and social identity. Positive consequences strengthen behaviour and ultimately promote learning while negative consequences weaken it (Taylor & Hamdy, 2013). Hence, it is important for HCWs to ensure that recommended hand hygiene techniques are adhered to so as to improve their patient's hand hygiene compliance.

9.3.3 Improving Hand Hygiene Compliance through Tailored Interventions

The seventh research objective which is to propose theory-based knowledge translation interventions aimed at increasing HCWs' hand hygiene compliance using the TDF informed this aspect of the research.

To efficiently improve the HCWs' behaviours on hand hygiene, it is important to move from establishing the barriers and levers to tailoring implementation strategies (French et al., 2012). Behaviour change is central to improving clinical practices and therefore healthcare outcomes (Cane et al., 2012). There is growing evidence that interventions aimed at

behaviour change should draw on theories of behaviour and behaviour change in their development (Michie et al., 2008). A systematic review concluded that behavioural theories might help guide interventions (Srigley et al., 2015) while institutions such as the Medical Research Council (Craig et al., 2013) and NICE (NICE, 2014) also advocate the use of theory to inform health behaviour change interventions (Cowdell & Dyson, 2019).

There is little evidence on how to develop theory-based interventions and researchers tend to use theory to explain behaviour not to change the behaviour (Michie et al., 2008). Behaviour change techniques (BCTs), developed by some behavioural psychologists are the smallest components of an implementation intervention (Craig et al., 2017). BCTs are observable, replicable and irreducible "active ingredients" that offer a common language with which to describe intervention contents (Glidewell et al., 2018pp.2). First, two psychologists identified and defined a set of 26 theory-linked BCTs following 3 systematic reviews (Abraham & Michie, 2008). To improve on this, a group of 4 behavioural psychologists developed 35 comprehensive BCT taxonomy linked to the 11 theoretical constructs (behavioural determinants) of the TDF (Michie et al., 2008). The BCTs and definitions were generated from 2 systematic reviews, brainstorming and a systematic search of 9 textbooks used in training applied psychologists (Michie et al., 2008). In a series of consensus exercises which involved 54 experts in delivering and/or designing behaviour change interventions, an extensive, hierarchically organised taxonomy of 93 distinct BCTs were developed (Michie et al., 2013). In this version, experts were drawn from seven countries and varied discipline such as psychology, behavioural medicine, and health promotion, and this resulted into BCTs with relevance among experts from varied behavioural domains. Michie and colleagues (2008) suggest evidence-based BCTs can be

directed at identified behavioural determinants (theoretical constructs/domains) and evidence of their role in behaviour change can be investigated. Behaviour change techniques are typically complex, involving practical and methodological difficulties that any successful evaluation must overcome (Craig et al., 2013).

9.3.4 Process of Intervention Design

Though literature on intervention designs is emerging (Hrisos et al., 2008; McEachan et al., 2008; French et al., 2012; Taylor et al., 2013; Cadogan et al., 2016; Thomas & Mackintosh, 2016; Craig et al., 2017), a systematic review reported the absence of agreed, practical processes of designing knowledge translation interventions (Colquhoun et al., 2017). The UK Medical Research Council recommends a methodical approach to intervention development, guided by theory and best evidence available (Cadogan et al., 2016).

9.3.4.1 Systematic Processes of Theory-based Intervention Design

Theoretically informed intervention designs involve 4 main stages – specifying the target behaviour, exploring the mediators of the target behaviour, mapping the theoretical constructs to BCTs and designing pragmatic interventions. Figure 9.1 demonstrates the systematic process of designing theory-based interventions adapted from French et al. (2012).

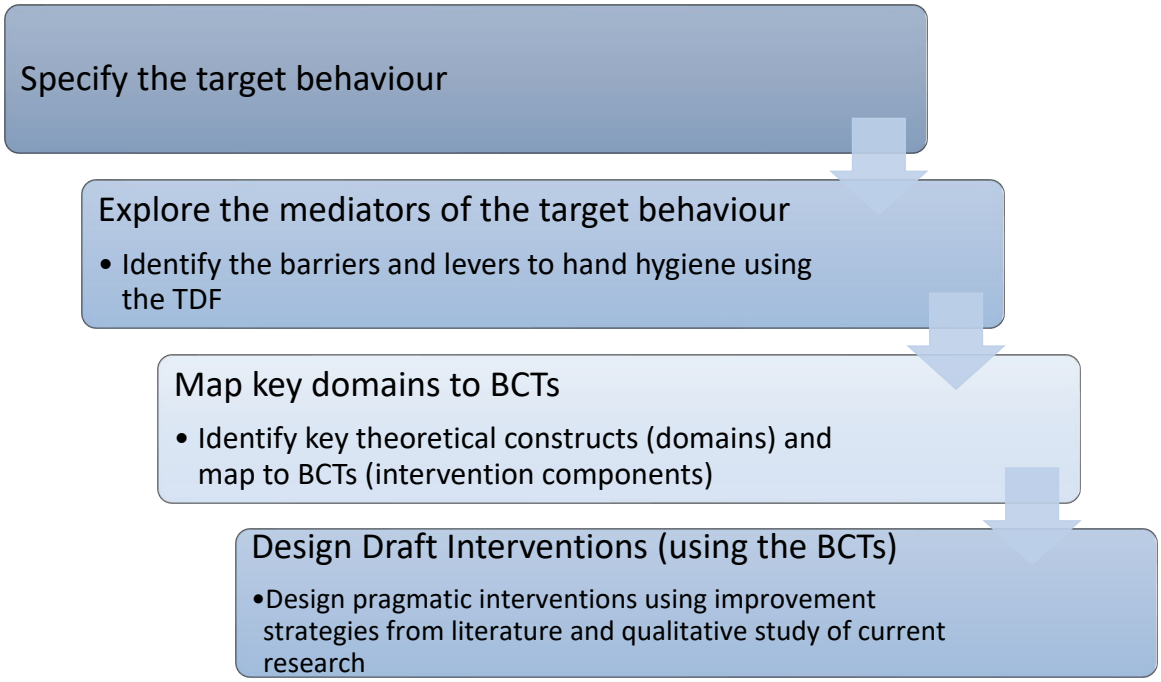


Figure 9-1 Flowchart Demonstrating Systematic Process of Theory-based Intervention Design

1. Specify target behaviour

In chapter two, the target behaviour, hand hygiene, was identified after reviewing the impact of HCAI globally and in SSA countries. Hand hygiene was chosen because there is strong evidence that though it is cheap, seemingly easy to perform, and a decline in transmission of HCAI is likely through consistent hand hygiene practices, compliance is reportedly low globally, usually less than 40% (Erasmus et al., 2010). The systematic review conducted in chapter 3 affirmed low hand hygiene compliance in SSA countries (21.1%) while the hand hygiene observations (chapter 5) conducted in this research found an overall 29.1% compliance rate. This led to the exploration of barriers and levers to hand hygiene practices of HCWs in the adult surgical wards of the research context (chapters 7 – survey and 8 – qualitative study).

2. Explore the mediators (barriers and levers) of hand hygiene using a theoretical framework

The current research identified the barriers and levers to hand hygiene practices using both quantitative and qualitative research methods, underpinned by the TDF (Michie et al., 2005). For the quantitative study, a survey of the barriers and levers to hand hygiene was conducted using BALHHI (chapter 7) while qualitatively, semi-structured interviews of surgical HCWs were conducted (chapter 8). The interview schedule was underpinned by the TDF while designing it and relevant questions were arranged according to the 11 domains of the TDF.

3. Identify key theoretical constructs and map to BCTs (intervention components)

For the survey (chapter 7), all negatively worded items were reversed such that in all cases, 1 represented a lever or an absence of a barrier and 5 represented a barrier or the absence of a lever. Items on BALHHI were calculated according to each of the 3 domains included – *beliefs about consequences, environmental context and resources* and *emotion*. All the domains had mean scores greater than 1 and hence, were considered barriers (see chapter 7 for detailed report of analysis and findings). For the qualitative interviews, inductive thematic analysis of the interview transcripts was undertaken to identify the key theoretical domains that described the identified barriers and levers to hand hygiene at a theoretical level. The interview findings generated two key themes – personal and institutional as well as 20 subthemes which fall into 10 domains of the TDF. Only the *action planning* domain was not coded from the interview transcripts (see chapter 8 for detailed report of analysis and results).

The TDF guided the choice of the BCTs (intervention components) identified. In this research, the 35 BCT taxonomy developed by Michie et al. (2008) is considered most suitable because the BCTs have already been mapped to the theoretical constructs (behavioural determinants) of the TDF (Michie et al., 2005) which underpins this research.

4. Design draft interventions

While developing implementation interventions, scholars advise that because there is likelihood of contextual issues significantly influencing the delivery and impact of complex clinical interventions (Craig et al., 2013), a theory-based, evidence-driven approach which takes context into account should be considered (Craig et al., 2017). Factors such as feasibility and relevance to the local context, and acceptability by the target group are usually considered when intervention functions to overcome identified barriers are being examined (Taylor et al., 2013; Cadogan et al., 2016; Thomas & Mackintosh, 2016).

9.3.4.2 Behaviour Change Techniques and Constructs of the Theoretical Domains Framework

Intervention developers also advise that each BCT should be examined for effectiveness as part of an intervention change according to each domain. For each domain, at least one BCT with "agreed use" linked to a list of pragmatic strategies (Michie et al., 2008) that could be utilised among HCWs from the research setting. For instance, one identified barrier is infrastructural deficit as almost all interview participants (chapter 8) indicated they lacked the appropriate environmental resources to practise hand hygiene effectively. So this barrier (infrastructural deficit) was mapped to the domain *"environmental context and resources"* as it was considered that this domain was best addressed using the BCT *"environmental changes"* (Michie et al., 2008). Example of suggested pragmatic interventions included adequate provision of hand hygiene facilities and their convenient

locations. Another example of an identified barrier is knowledge gap, and this was mapped to the domain *"knowledge"*. The BCT *"information regarding behaviour"* is considered most appropriate to address this domain and suggested interventions included hand hygiene training of HCWs delivered by credible personnel such as senior staff or IPC specialists, provision of WHO and designing local hand hygiene policy with considerations to the local context, display of hand hygiene posters on the ward and distribution of leaflets to sensitise HCWs on hand hygiene importance.

It is important to note that although there are more BCTs that could be added in this research (Michie et al., 2013), only these ones will be included because of their empirical evidence and the BCTs have been mapped by psychological experts based on the empirical evidence (Michie et al., 2008). The researcher opines that the identified BCTs are sufficient to address the needs of this research. The taxonomy of BCTs and their use within domains formed the basis for pragmatic interventions suggested in table 9.1.

9.3.4.3 Engaging Stakeholders, Modes of Delivery, and the APEASE Crtieria

Taylor et al. (2013) noted that behaviour change occurs within complex social and environmental contexts that demonstrate local variations. Therefore, co-designing is key in intervention design. Interventions aimed at patient safety will be most effective when designed by local stakeholders (those with local expertise and implicit knowledge) as well as account of evidence and external expertise (Taylor et al., 2013; Cadogan et al., 2016). Whilst this approach is beyond the scope of this research, there are data that support a number of recommendations to start the process of the intervention design.

The modes of delivery of the suggested interventions were not considered in this research consequent to time constraints experienced by the researcher making it impossible to

conduct a feasibility study to implement the suggested interventions and evaluate their effectiveness (French et al., 2012).

Another aspect that is beyond the scope of this research is the APEASE criteria. The APEASE criteria are a set of criteria developed to support intervention designers to make context-based decisions on intervention content and delivery (Michie et al., 2014; Atkins, 2016). The criteria and the associated questions are presented in table 9.1 (Michie et al., 2014) whilst table 9.2 shows the suggested pragmatic interventions using the TDF and BCTs.

Table 9-1 The APEASE Criteria and Associated Questions

S/N	Criteria	Associated Questions
1	Affordability	Can it be delivered to budget?
2	Practicability	Can it be delivered as designed? It is feasible to deliver?
3	Effectiveness/Cost-effectiveness	Does it work? (ratio of effect to cost)
4	Acceptability	Is it judged appropriately by relevant stakeholders? (publicly, professionally, politically) Is it acceptable to those receiving and delivering it and at a political level?
5	Side-effects/Safety	Does it have an unwanted side-effects, unintended consequences, or safety issues?
6	Equity	Does it benefit some groups over others? Will it reduce or increase the disparities in health, wellbeing, or standard of living?

Table 9-2 Suggested Pragmatic Interventions using the Theoretical Domains Framework and Behaviour Change Techniques

Item No	TDF Domains (Behavioural Determinants)	Barrier/Lever	Behaviour Change Techniques	Suggested/Potential Pragmatic Interventions
1	Knowledge and skills	Knowledge gap (Personal and institutional barrier – the biggest barrier across all groups of HCWs in the qualitative study and survey)	Information regarding behaviour; rehearsal of relevant skills	Organise hand hygiene training delivered by credible people such as senior staff or Infection Prevention and Control (IPC) specialists (Gould et al., 2017) Provide HCWs with information to improve hand hygiene knowledge and skills six-monthly (suggested by Andrew, Chloe and Lisa, interview participants) Demonstrate the steps involved in hand hygiene to staff during training. IPC specialists should ensure they model the steps correctly. Provide the WHO hand hygiene policy to all workers Design local hand hygiene policy bearing the Nigerian healthcare system in mind. The WHO policy can be revised for this purpose Display posters on the steps involved in hand hygiene and the “my five moments of hand hygiene” at strategic locations on the ward (Gould et al., 2017) Distribute leaflets that will sensitise HCWs on hand hygiene importance

Item No	TDF Domains (Behavioural Determinants)	Barrier/Lever	Behaviour Change Techniques	Suggested/Potential Pragmatic Interventions
2	Environmental context and resources	Glove Use (Personal barrier identified from qualitative study)	Information regarding behaviour; modelling/demonstration of behaviour by others	As in Item 1 Information on hand glove misuse Delineate when to use gloves and when to perform hand hygiene IPC specialists to describe to HCWs how hand gloves are used and when to perform hand hygiene
3	Environmental context and resources	Infrastructural deficit (Institutional barriers identified by all qualitative study and survey participants)	Environmental changes	Sufficient provision of hand hygiene facilities such as running water, liquid soap, alcohol-based hand rubs (ABHRs) and disposable hand towels (suggested by Kim, interview participant) Convenient location of hand hygiene facilities on the wards (suggested by George, interview participant) Using bar soaps, diluting liquid soaps without any standard measure of dilution and using cotton towels for hand drying should be discouraged (suggested by George, interview participant) Staff shortage should be tackled by the hospital management and ensure staff to patient ratio is up to WHO expected standard
4	Social influences	No role models (Personal barrier identified from qualitative study)	Modelling/demonstration of behaviour by others; role-play; persuasive communication	Establish an IPC team who can train other staff on hand hygiene importance Constructive/anonymised feedback by credible sources on hand hygiene compliance of staff

Item No	TDF Domains (Behavioural Determinants)	Barrier/Lever	Behaviour Change Techniques	Suggested/Potential Pragmatic Interventions
5	Belief about consequences	Skin irritation (Personal barrier identified from qualitative study)	Coping skills; planning	Use less-irritating products for instance, ABHRs containing humectants Apply moisturising hand lotions and creams after handwashing Do not wash hands before or after applying ABHRs Allow hands to dry completely before donning gloves (WHO, 2009b)
6	Memory, attention and decision processes	Forgetfulness (Personal barrier)	Self-monitoring; graded tasks; stress management; planning; prompts, triggers, cues; rehearsal of relevant skills; feedback	As in items 1 and 3 Scheduled tasks and prior planning to relieve pressure and likelihood to forget to perform hand hygiene Feedback from colleagues and patients will encourage practice (suggested by Emily, interview participant)
7	Motivation and goals	No incentives (Institutional barrier)	Rewards; incentives; social processes of encouragement, pressure and support	As in item 3 Staff welfare (including the need for compensation in the event of occupational hazard) should be heightened, so staff are happy to perform their professional duties (suggested by interview participant, Kate) Staff salary should be paid as at when due so as to motivate them to engage in ideal practices (suggested by interview participant, Andrew) Staff/wards should be appreciated when they are committed to practising hand hygiene. Staff/wards could be given a prize, certificate or named hand hygiene ambassadors for a stipulated time.

Pragmatic interventions aimed at improving hand hygiene practices of Nigerian HCWs were suggested in the table above. Ideally, the suggested interventions should be guided by contributions from local stakeholders and available evidence, findings from the qualitative study (chapter 8) and available evidence from literature are a good platform to start this process. To carry this forward, a feasibility study is important, and considerations should be given to the local context and what is likely to be feasible and acceptable by the target group using the APEASE criteria.

9.4 Contributions of this Thesis to Body of Knowledge

In this section, the significance of the theoretical underpinning of this research will be discussed first followed by the value of the mixed methods research approach employed.

9.4.1 Theory-led Approach

The main strength of this study is its theoretical contribution to the body of knowledge by employing a theory-led approach to understand the barriers and levers to hand hygiene among HCWs from SSA countries within the Nigerian context. To the best of the researcher's knowledge, this is the first research on hand hygiene among HCWs in SSA countries, underpinned by the TDF. The only other study found to have used the TDF in SSA countries explored the reasons for missed opportunities for vaccination among children from the northern part of Nigeria (Adamu et al., 2019).

Using the TDF strengthened the findings of this research. Researchers have reported that the TDF increases their confidence in undertaking projects and provided a broad perspective and means of understanding the implementation problem and potential solutions in theoretical terms (Phillips et al., 2015; Atkins et al., 2017). The strength of the TDF lies in its theoretical coverage and capability to identify comprehensive set of beliefs that could

hypothetically be barriers and enablers of behaviour change (Francis et al., 2012; Phillips et al., 2015).

In this study, the researcher was able to establish the barriers and levers to hand hygiene practices within the research context using the TDF for both the quantitative and qualitative aspects of the research. Three studies conducted as part of this research were underpinned by the TDF namely the development of a psychometric instrument that measures the barriers and levers to hand hygiene among HCWs from SSA countries (chapter 6), the barriers and levers to hand hygiene survey using BALHHI where the top barriers were measured and identified (chapter 7) and a qualitative study that gives an in-depth exploration of the barriers and levers to hand hygiene through semi-structured interviews (chapter 8). The TDF allows for intervention replication by enabling a clear process of design and suggesting explicit BCTs (Webster et al., 2015). Some BCTs were also suggested for tailored implementation strategies in this research (chapter 9) and these will be considered in future research. The TDF provides a theoretical lens through which the cognitive, affective, social and environmental behavioural influences are viewed (Atkins et al., 2017). Using the TDF enabled the researcher to measure (quantitative research) and derive (qualitative) latent variables such as emotion that otherwise, would be impossible to generate.

The TDF has been criticised for a number of reasons the first being its descriptive form rather than theory thereby lacking the ability to specify relationships between the domains consequently making it unable to generate testable hypothesis (Francis et al., 2012; Atkins et al., 2017). Secondly, it has been criticised for its lack of formal guidance on how to apply the TDF (Atkins et al., 2017) and intervention developers requires a knowledge of both the

process and relevant BCTs (Cowdell & Dyson, 2019). Being an early researcher, it was quite challenging using the TDF although the researcher enjoyed the expertise and robustness of the research supervisors. Thirdly, the application of the TDF can be time consuming especially where there are multiple target behaviours (Phillips et al., 2015; Cowdell & Dyson, 2019). However, the importance of the TDF outweighs its limitations. The significance of the TDF in behavioural research are further discussed in chapter 4 (section 4.4).

9.4.2 Mixed Methods Approach

This research also contributes to theoretical knowledge on hand hygiene by using a mixed methods research approach to explore the barriers and levers to hand hygiene practices. Mixed methods research is the methodology of choice in instances where there may be a need to combine both qualitative and quantitative research designs due to lack of preference and suitability of one approach over the other (Parahoo, 2014). The articles included in the systematic review (chapter 3) are mostly quantitative. However, the current research acknowledged the need to assess the hand hygiene resources in surgical wards of the research context through ward infrastructure survey (chapter 5), established the hand hygiene compliance rate in surgical wards of the research context through observations (chapter 5), validated and tested an instrument (BALHHI) that measures hand hygiene barriers and levers in SSA countries (chapter 6), assessed the barriers and levers to hand hygiene through survey using BALHHI (chapter 7) and semi-structured interviews (chapter 8).

Although the mixed methods research approach was time consuming, the strength of using a mixed methods approach in this research lies in the richer understanding of the hand hygiene behaviours of Nigerian HCWs and blending both the qualitative and quantitative

elements of the research to enhance the findings. Though, a staged mixed methods design could have been more appropriate rather than collecting the data concurrently as in this research however, concurrent mixed methods design allows for triangulation where the sets of findings are compared thereby offsetting the weaknesses of both quantitative and qualitative data and capitalising on the strengths of both (Bryman, 2016). Both the quantitative and qualitative perspectives of the research participants were integrated thereby providing deeper insight and better understanding of their hand hygiene behaviours.

9.5 Research Limitations

The strengths and limitations relating to each of the studies conducted in this research were discussed in the chapters. Only the general research limitations will be discussed in this section.

A key limitation is that only one research setting was employed in this study. However, being a PhD research, this study lacks the abundance of time and resources to include more research setting. The research was conducted in a private teaching hospital where hand hygiene resources are likely to be more than it is in public hospitals thereby reducing the barriers and impacting on HCWs' compliance to hand hygiene practices. However, the incessant industrial action of HCWs in Nigerian public hospitals necessitated the use of a hospital where staff are unlikely to embark on strike action.

Another limitation is the collection of quantitative data before the qualitative because there was a need for the survey (quantitative) and a deeper understanding (qualitative) of the barriers and levers to hand hygiene. However, barriers that are unique to the research

context, which might be subjects upon which additional items for BALHHI might be developed in future research were identified in section 6.8 of chapter 6.

9.6 Chapter Summary

This chapter presented the discussion of the research findings of this thesis in light of existing literature. In this chapter, the researcher tried to integrate the quantitative and qualitative findings on this thesis. Hand hygiene compliance rate found in this study was comparable to previously reported compliance rates in other countries while the barriers and levers to hand hygiene practices were discussed using the domains of the TDF. In addition, BCTs were used to suggest pragmatic intervention strategies aimed at improving hand hygiene compliance and practices of HCWs from this context. What's more, the contributions of the thesis to the body of knowledge as well as the general research limitations were presented. The next chapter concludes this thesis where recommendations and personal reflections are presented.

Chapter 10 Conclusions

10.1 Introduction

In this chapter, recommendations for policy, practice, education, and research are presented which are followed by the researcher's personal reflection on the PhD journey.

10.2 Recommendations

This study has demonstrated how the use of theory and a mixed methods approach can elicit information on the barriers and levers to hand hygiene practices. Numerous implications and recommendations have been identified from the research findings compared to evidence from literature and recommended standard practices. Some recommendations have been made in section 3.8.4 following the systematic literature review (chapter 3). In this section, the researcher makes recommendations in terms of policy, practice, education, and research in relation to the other phases of this research.

10.2.1 Recommendations for Policy

Prioritising adequate funding of health systems in SSA countries is critical to enhancing patient safety and changing the narrative in SSA countries.

Findings from this research suggest the need for provision of the WHO hand hygiene guidelines in every ward to enhance HCWs' knowledge on when and how to perform hand hygiene. There is need to develop national and local hand hygiene policy and guidelines in collaboration with the HCWs and tailored to the Nigerian/hospital context.

In addition, there is an urgent need to make provision for adequate and well positioned hand hygiene resources to facilitate HCWs' hand hygiene practices. At the very least, the WHO recommended minimum standards should be adhered to (WHO, 2009b). It is equally

important to establish a functioning IPC unit in the hospital and members should be knowledgeable on their responsibilities so as to guide HCWs' hand hygiene practices adequately and appropriately.

To enhance staff commitment to patient safety and care delivery, findings from this research suggest there is an urgent need to improve staff welfare in the hospital in terms of regular payment of salaries, compensating staff in the event of occupational hazards, and maintaining the WHO minimum recommended patient to HCW density. There is also need to encourage HCWs' hand hygiene practices through incentives such as appreciation or certificates.

10.2.2 Recommendations for Practice

Findings from this research suggest HCWs should prioritise patient safety and there is need for HCWs to be able to recognise hand hygiene opportunities and perform hand hygiene at these key moments. It is important for HCWs to recognise that hand hygiene practices before patient contact and after touching patient surroundings are equally as important as before aseptic procedures, after patient contact and after contact with bodily fluids.

HCWs also need to acknowledge the necessity surrounding following the recommended steps of hand hygiene so as to ensure effective hand hygiene practices. It is important that HCWs do not replace hand hygiene with glove use in events of heavy workload. Moreover, HCWs might benefit from hand hygiene role models/champions.

10.2.3 Recommendations for Education

The biggest finding of this research is knowledge gap. Therefore, it is important to ensure HCWs have sufficient knowledge of effective hand hygiene practices. Inclusion of hand

hygiene education in medical and nursing curriculum has been advocated for. Regular training and refresher courses on hand hygiene within the hospital are of paramount importance. Trainings should be contextual, underpinned with theories, and aligned with the WHO policies and guidelines. There should be a feedback mechanism whereby previous hand hygiene trainings can be improved on.

The hospital should fund conference attendance and subscription to relevant journals to keep the HCWs abreast of current trends and best practice on hand hygiene.

10.2.4 Recommendations for Research

The current research focussed on surgical wards only. There is need for more studies in this area of clinical practice which focus on hand hygiene compliance rate and/or barriers and levers to hand hygiene practices. Future research could use the electronic monitoring system to take more accurate hand hygiene observation data (Dyson & Madeo, 2017). Likewise, audit with feedback, being an important component of the WHO hand hygiene guidelines and interventions should be employed in future research.

A hospital-wide research to include other wards, allowing sufficient time for hand hygiene observations could be explored in future research. The current research was conducted in a private teaching hospital where barriers are expected to be lower. Despite the findings of this research, it is anticipated that there will be more barriers to hand hygiene in government-owned hospitals. Therefore, to strengthen the reliability and allow for transferability and generalisability of study findings, multi-site research using public hospitals is recommended for future research.

Likewise, to facilitate an in-depth understanding of hand hygiene practices in SSA region, future research needs to be conceptualised with theoretical frameworks. This will heighten the robustness of the research. In future instrument design, an EFA could be conducted before a CFA is done so as to understand the theoretical structure of the phenomenon of study although this was not necessary for BALHHI since it has been previously validated. The new BALHHI could be used to measure hand hygiene barriers and levers and a revalidation to improve the instrument is welcome in further research.

To understand their perceptions on hand hygiene, hospital administrators should be included in future research using in-depth research methodologies such as focus group discussions or interviews.

To heighten HCWs' hand hygiene practices, a feasibility study on the tailored implementation strategies suggested in chapter 9, using a consensus approach could be conducted.

10.3 Final Thoughts

This study attempted to extensively explore on the hand hygiene practices of Nigerian HCWs and the overall research aim was achieved – BALHHI was validated for use in developing countries, hand hygiene compliance rate was calculated and the barriers and levers to hand hygiene practices were identified.

I situated my position in chapter one where I highlighted my interests and motivations for the research topic. Despite my insider's knowledge of the Nigerian healthcare system, having trained and practised as a nurse within the context before, this research gave more insight into the institutional challenges inherent in the health systems of SSA countries like

Nigeria, where limitations to ensuring patient safety are abundant. I took modules on different research methods to understand the typologies, feasibility and applicability to an extensive study such as this. This enhanced my knowledge and choice of the research methodology employed. Using a mixed methods approach and underpinning the study with theory gave more depth to the research findings.

I drew on these three things – my knowledge of the Nigerian healthcare system, using a mixed methods design and using the TDF to explore the research topic in-depth. Whilst I am of the opinion that some research participants, especially during interviews were reluctant to talk about some of the barriers they encounter in practice, being a private teaching hospital and going by their loyalty to the hospital managers, I strongly believe that conducting the study in a government-owned/public institution would uncover even more. However, this does not undermine the huge findings of this research. The choice of a private teaching hospital is also a direct consequence of the inherent systemic barriers. For instance, I initially obtained ethical approval to conduct the research in a government-owned teaching hospital but this was met with several months of incessant strike action owing to non-payment of HCWs salaries.

This research has also exposed me to the resilience of HCWs in SSA countries. I would praise these HCWs because despite the abundant barriers, some of which are non-existent in developed countries, their hand hygiene compliance rate is still comparable globally. This suggests that HCWs have devised individual means to cope and adapt to the limited resources available to practise hand hygiene in an unideal situation.

I am also of the opinion that Nigerian HCWs need to be more open to research. Some of the HCWs were not keen to participate because of my status as a young Nigerian nurse who was

in a researcher position. Nursing education in Nigeria is still largely at the diploma and undergraduate level and going to the research context as a PhD researcher was unbelievable to some of the participants. However, I am happy that my position could motivate a few of the young nurses I met and discussed with, who have been challenged to proceed in further education just by knowing that I am a nurse.

Completing this PhD research is a huge achievement for me although it was met with several challenges – family commitments such as raising two young children while studying full time, collecting data in Nigeria while my family was in the UK, taking the mandatory postgraduate training scheme modules to achieve the University of Hull's requirement of conducting a PhD, attending conferences, learning how to use software packages like SPSS, AMOS and NVivo, analysing all the extensive data myself and writing up the thesis. However, I enjoyed very robust supervision from my supervisors. They were indeed very professional, supportive and they ensured that I managed it all even when it seemed impossible and daunting. I found that even though a PhD journey is very lonely and personal, having a huge support system like good supervisors and colleagues is calming and encouraging.

Findings from the systematic review have been presented and published in peer-reviewed conferences and journal (Ataiyero et al., 2019), respectively. Other research findings will be disseminated appropriately – to the hospital management of the research context, at conferences and in peer-reviewed journals.

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Appendix A Initial Ethical Approval from School of Health and Social Works Research Ethics Committee, University of Hull

UNIVERSITY OF HULL

University of Hull
Hull, HU6 7RX
United Kingdom
T: +44 (0)1482 346311 | E: j.bloggs@hull.ac.uk
w: www.hull.ac.uk

PRIVATE AND CONFIDENTIAL
Yetunde Ataiyero
School of Health and Social Work
Faculty of Health Sciences
University of Hull
Via email

School of Health and Social Work
Research Ethics Committee

T: 01482 463336
E: E.Walker@hull.ac.uk

REF 279

13th July 2017

Dear Yetunde

REF 279 – Barriers and Levers of Hand Hygiene Compliance among Nigerian Healthcare Workers

Thank you for your responses to the points raised by the School of Health and Social Work Research Committee.

Given the information you have provided I confirm approval by Chair's action.

Please refer to the Research Ethics Committee web page for reporting requirements in the event of subsequent amendments to your study.

I wish you every success with your study.

Yours sincerely

Professor Liz Walker
Chair, SHSW Research Ethics Committee

Cc file

Appendix B Amended Ethical Approval from School of Health and Social Works Research Ethics Committee, University of Hull

UNIVERSITY OF HULL

University of Hull
Hull, HU6 7RX
United Kingdom
T: +44 (0)1482 463336 | E: e.walker@hull.ac.uk
w: www.hull.ac.uk

PRIVATE AND CONFIDENTIAL
Yetunde O Ataiyero
Faculty of Health Sciences
University of Hull
Via email

22nd March, 2018

Dear Yetunde,

REF FHS 279 – Barriers and Levers of Hand Hygiene Compliance among Nigerian Healthcare Workers.

Thank you for your application to make minor amendments to the study as referenced above.

Given the information you have provided I confirm approval by Chair's action.

Please refer to the Research Ethics Committee web page for reporting requirements in the event of subsequent amendments to your study.

I wish you every success with your study.

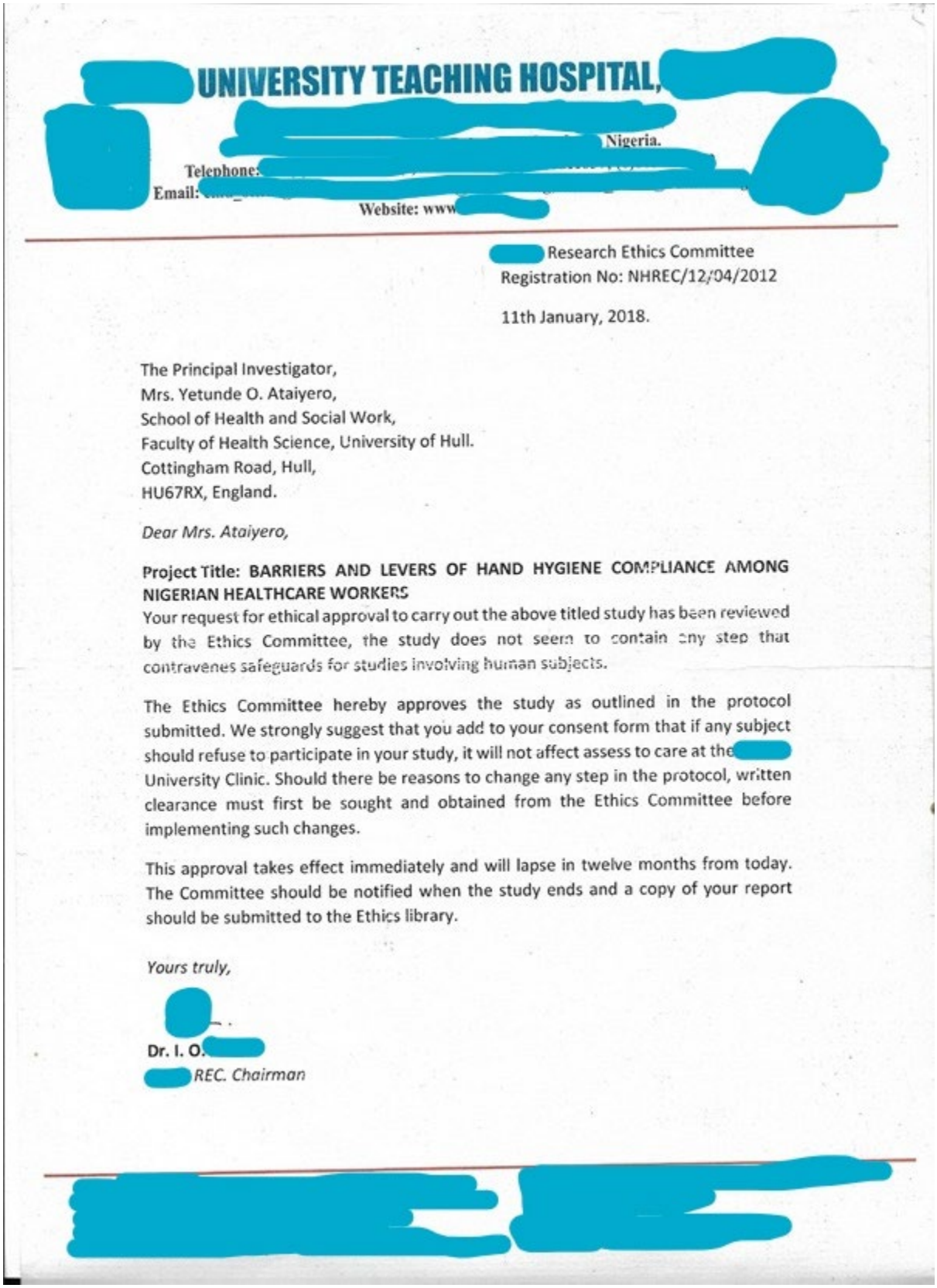
Yours sincerely

Professor Liz Walker
Chair, FHS Research Ethics Committee

UNIVERSITY OF HULL

Liz Walker | Professor of Health and Social Work Research | Faculty of Health Sciences
University of Hull
Hull, HU6 7RX, UK
www.hull.ac.uk
e.walker@hull.ac.uk | 01482 463336
@UniOfHull /UniversityOfHull universityofhull

Appendix C Ethical Approval from Research Ethics Committee of Study Site



[redacted] UNIVERSITY TEACHING HOSPITAL, [redacted]

[redacted] Nigeria.

Telephone: [redacted]

Email: [redacted]

Website: www[redacted]

[redacted] Research Ethics Committee

Registration No: NHREC/12/04/2012

11th January, 2018.

The Principal Investigator,
Mrs. Yetunde O. Ataiyero,
School of Health and Social Work,
Faculty of Health Science, University of Hull.
Cottingham Road, Hull,
HU67RX, England.

Dear Mrs. Ataiyero,

Project Title: BARRIERS AND LEVERS OF HAND HYGIENE COMPLIANCE AMONG NIGERIAN HEALTHCARE WORKERS

Your request for ethical approval to carry out the above titled study has been reviewed by the Ethics Committee, the study does not seem to contain any step that contravenes safeguards for studies involving human subjects.

The Ethics Committee hereby approves the study as outlined in the protocol submitted. We strongly suggest that you add to your consent form that if any subject should refuse to participate in your study, it will not affect assess to care at the [redacted] University Clinic. Should there be reasons to change any step in the protocol, written clearance must first be sought and obtained from the Ethics Committee before implementing such changes.

This approval takes effect immediately and will lapse in twelve months from today. The Committee should be notified when the study ends and a copy of your report should be submitted to the Ethics library.

Yours truly,

[redacted]

Dr. I. O. [redacted]

[redacted] *REC. Chairman*

[redacted]

Appendix D Ethical Support Letter to Research Ethics Committee of Study Site

UNIVERSITY OF HULL

Moira Graham
Graduate Research Director
Lecturer in Public Health
School of Health and Social Work
University of Hull
Hull, HU6 7RX
United Kingdom
T: +44 (0)1482 464514 | **E:** M.Graham2@hull.ac.uk

The Chairman
Research Ethics Committee
[redacted] University Teaching Hospital
[redacted]
Nigeria

Dear Chair of the Research Ethics Committee at [redacted] University Teaching Hospital,

Re: ***Barriers and Levers of Hand Hygiene Compliance among Nigerian Healthcare Workers.*** **A PhD Study by Ms YetundeAtaiyero, PhD Candidate at the University of Hull, United Kingdom.**

Ms Yetunde Ataiyero is a PhD Candidate at the University of Hull, United Kingdom. Ms Ataiyero is an international nursing student at our University and she hails from Nigeria. Her PhD study is a mixed methods study which aims to examine the barriers and levers of hand hygiene compliance among Nigerian healthcare workers.

I am Dr Moira Graham, Graduate Research Director in the School of Health and Social Care, Faculty of Health Sciences at the University of Hull, UK. Together with Dr Judith Dyson, Senior Lecturer in Improvement Science in the Faculty of Health Sciences at the University of Hull, we are co-supervising Ms Ataiyero's PhD study. Ms Ataiyero has submitted her application for ethical approval to your Committee to undertake her fieldwork research at [redacted] University Teaching Hospital and I am writing to you to in support of this application.

Ms Ataiyero has obtained ethical approval to undertake this research from the School of Health and Social Work, Faculty of Health Sciences Ethical Approvals Committee here at the University of Hull. This approval includes approval of her research proposal, her ethical application to undertake the above study, the information literature associated with the study, and the consent forms for the study.

We at the School of Health and Social Work, Faculty of Health Sciences thank you for reviewing Ms Ataiyero's application for ethical approval to conduct her study. If I can be of any further help please do not hesitate to contact me. Ms Ataiyero's study is important and her systematic review of the literature demonstrates the need for a study such as this to both understand and potentially improve the delivery of health care . We believe that Ms Ataiyeros study will make an important contribution to the knowledge base on hand hygiene practices in Nigeria, Sub Saharan Africa but also internationally.

Yours faithfully,

M. E. Graham.

Dr Moira Graham, PhD, MSc, RN (Adult), SCPHN (Health Visitor)

Dr Judith Dyson PhD, MSc, RGN, RMN, CPsychol

Appendix E Ward Infrastructure Survey Form

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Ward Infrastructure Survey

Period Number*

- The survey should be completed by the hand hygiene programme co-ordinator or an identified and informed health-care worker working within the ward (e.g. a senior nurse who can complete the survey while walking around the ward).
- This questionnaire is in two parts: 1) **questions** on handwashing and handrub facilities and resources available in the ward; 2) a **grid** to assess the exact number of hand hygiene resources and products in place, to be completed by walking to each room or area where patient care/treatment takes place (i.e. the point of care).
- **Short Glossary:**

Alcohol-based handrub formulation: an alcohol-containing preparation (liquid, gel or foam) designed for application to the hands to kill germs.

Facility: health-care setting where the survey is being carried out (e.g. hospital, ambulatory, long-term facility, etc).

Handrubbing: treatment of hands with an antiseptic handrub (alcohol-based formulation).

Handwashing: washing hands with plain or antimicrobial soap and water.

Service: a branch of a hospital staff that provides specified patient care.

Ward: a division, floor, or room of a hospital for a particular category or group of patients (it corresponds to the smallest segmentation of the health-care facility; one service can include multiple wards).

1. **Date:** 2. **Facility:**
3. **Ward:** 4. **Service**:**
5. **City**** 6. **Country****

7. **Department (please select the department which best represents yours):**

☐ Internal medicine ☐ Surgery ☐ Intensive care unit ☐ Mixed medical/surgical
☐ Emergency unit ☐ Obstetrics ☐ Paediatrics ☐ Long-term/rehabilitation
☐ Outpatient clinic ☐ Other

8. **Position of the person completing this questionnaire:**

☐ Head nurse ☐ Head physician ☐ Hand hygiene programme co-ordinator
☐ Hand hygiene programme deputy co-ordinator ☐ Other infection control team member ☐ Others

9. **Number of health-care workers on this ward:** ☐ Nurses ☐ Physicians ☐ Auxiliaries

10. **Is water regularly available?** ☐ Always ☐ Intermittently ☐ Rarely ☐ Never

* To be completed by the data manager.
** Optional, to be used if appropriate, according to the local needs and regulations.

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WHO acknowledges the Hôpitaux Universitaires de Genève (HUG), in particular the members of the Infection Control Programme, for their active participation in developing this material.
Revised August 2009

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A World Alliance for Safer Health Care

SAVE LIVES
Clean **Your** Hands

11. **Is running water available?** ☐ Yes ☐ No

12. **Is water visibly clean?** ☐ Yes ☐ No ☐ Don't know

13. **What kind of taps is available?** ☐ Hand-operated ☐ Elbow/wrist-operated ☐ Foot-operated ☐ Automatic

14. **Are disposable towels available at all sinks?** ☐ Always ☐ Intermittently ☐ Rarely ☐ Never

15. **Is soap available at all sinks?** ☐ Always ☐ Intermittently ☐ Rarely ☐ Never

16. **Is an alcohol-based handrub available?** ☐ Always ☐ Intermittently ☐ Rarely ☐ Never

17. **If yes, what type of handrub dispensers are available? (select all applicable answers)**

☐ Pocket bottle ☐ Bottle affixed to trolley/tray ☐ Bottle affixed to bed
☐ Wall dispenser ☐ Dispenser located on bedside table/trolley

18. **If wall dispensers are available, are they placed at the point of care*?**

☐ Yes ☐ Yes but not at each point of care ☐ No

19. **Does every health-care worker have easy access to handrub pocket bottles?**

☐ Always ☐ Intermittently ☐ Rarely ☐ Never ☐ Not applicable

20. **Is there an assigned person responsible for the refilling or replacement of empty dispensers?**

☐ Yes ☐ No

21. **Are handrub dispensers replaced when empty?**

☐ Always ☐ Intermittently ☐ Rarely ☐ Never ☐ Not applicable

22. **Are posters illustrating handwash technique displayed beside each sink?** ☐ Yes ☐ No

23. **Are posters illustrating handrub technique displayed close to the dispensers and in multiple areas of the ward?** ☐ Yes ☐ No

24. **Are posters illustrating indications for hand hygiene displayed in multiple areas of the ward?** ☐ Yes ☐ No

25. **Is any other type of reminder on hand hygiene displayed/available on this ward?** ☐ Yes ☐ No

26. **Are examination gloves available on this ward?** ☐ Always ☐ Intermittently ☐ Rarely ☐ Never

27. **Are audits on hand hygiene compliance periodically performed on this ward?** ☐ Yes ☐ No

28. **If yes, how frequently?** ☐ At least once a year ☐ At least once every 2 years ☐ Less frequently

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Please now walk to each room or area where patient care/treatment takes place in this ward (i.e. the point of care*) and complete the table below.

	Room N°/ID	Total N° of beds in this room/area	N° of beds with handrub within arm's reach	N° of sinks in this room/area	N° of sinks with clean water	N° of sinks with soap	N° of sinks with disposable towel	N° of sinks with clean water, soap, disposable towel	Total N° of handrub dispensers in this room/area	N° of fully-functioning and filled dispensers	N° of health-care workers encountered	N° of health-care workers encountered with handrub bottle in their pocket
A) Patient rooms on this ward												
1												
2												
3												
4												
5												
6												
7												
8												
9												
10												
TOT	/											
B) Treatment rooms (ambulatory, day hospital, etc.)												
1												
2												
3												
4												
5												
TOT	/											
C) Corridors and other areas with points of care*												
1												
2												
3												
4												
5												
TOT	/											
TOT												

TOT = total; N° = number

*Point of care: the place where three elements occur together: the patient, the health-care worker, and care or treatment involving contact with the patient and his surroundings.

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Lines may be added according to the number of participants.

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Appendix F Modified WHO Hand Hygiene Observation Form

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Modified WHO Hand Hygiene Observation Form

	Ward: Department:														
S/N	Time of the day	Staff Category *NUR – Nursing* *MED – Medical* *HA – Health Assistants*	Professional Level		Before Patient Contact		Before an Aseptic Procedure		After Body Fluid Exposure		After Touching a Patient		After Touching Patient's Surroundings	
			Nursing *Assistant Director of Nursing Services* *Chief Nursing Officer* *Principal Nursing Officer* *Senior Nursing Officer* *Nursing Officer I* *Nursing Officer II*	Medical *Consultant* *Senior Registrar* *Junior Registrar* *Medical Officer* *House Officers*	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
1														
2														
3														
4														
5														
6														
7														
8														
9														

10														
	Additional Notes													

Instructions:

- Observe the first 10 people you see attending to a patient once your observation time has commenced.
- Record whether the person followed the hand hygiene procedure during the above potential 5 'moments. Each 'moment' should have a tick in either a 'Yes' or 'No' box

Yes = They washed their hands or used ABHR at this stage

No = They did not wash their hands or use ABHR at this stage

(Adapted from the WHO Hand Hygiene Observation Form (WHO, 2009b)

Appendix G Hand Hygiene Observation Notification Poster

UNIVERSITY OF Hull

NOTIFICATION OF HAND HYGIENE OBSERVATIONS

Dear all,

As part of a PhD research which seeks to explore the barriers and levers of hand hygiene practices among Nigerian healthcare workers, I will be conducting hand hygiene observations were hand hygiene practices on this ward will be observed against the WHO recommended standards. This is going to enable us estimate the hand hygiene compliance rate of surgical healthcare workers in [redacted] Teaching Hospital.

During these observations, you do not have to do anything differently. You will continue with your normal practice on the ward and you will not be interrupted by the study. I will stand quietly and will not intrude with care. I will not be collecting any information that might identify any member of staff at any time. I will not be observing patients.

I have provided the ward with additional written information which are pasted next to this notice and will also be distributed to you by your ward manager. If you prefer not to be observed, kindly contact the researcher (details below) so you could complete a dissent form and observations will be avoided on days you are on duty.

If you have any queries, please contact me on Y.O.Ataiyero@2015.hull.ac.uk

Thank you for taking time to read this.

Yetunde Ataiyero

Appendix H Participant Information Sheet for Hand Hygiene Observations

UNIVERSITY OF HULL

I would like to invite you to participate in this research which is exploring the barriers and levers to hand hygiene practices among Nigerian healthcare workers (HCWs). Before you decide to take part, it is important you understand the aim and objectives of the study, and what participation will entail. Please read the information below carefully, discuss with others if need be and take time to decide whether you wish to participate or not. If you have any questions, please contact me using the details provided at the end of this information sheet.

Thank you for taking time to read this.

What is the study about?
Healthcare associated infections (HCAI) are estimated to be 2-20 times more prevalent in developing countries especially, Sub-Saharan African countries than it is in developed countries. Good hand hygiene practice is the best method to prevent HCAI although compliance with hand hygiene guidelines remains very low. The study aims to investigate those things that help and hinder hand hygiene compliance among Nigerian HCWs.

Why have I been chosen?
You have been invited to partake in this study because the hand hygiene practices of Nigerian doctors, nurses and health assistants are being observed to ascertain the hand hygiene compliance rate.

Do I have to take part?
No, participation is completely voluntary. This information sheet will tell you what the study is about and the decision whether or not to take part is up to you. If you decide to participate, you are free to withdraw at any time of the study and you do not have to give any reason. However, any information given prior to withdrawal will be used in the study.

What will happen if I decide to take part?
If you decide to participate, your hand hygiene practice may be observed by a hand hygiene auditor who is a nurse you usually work with on your ward who has been trained by the researcher (Yetunde Ataiyero). This will be recorded on a hand hygiene observation form. You will be required to continue with your normal practice on the ward as this will not be interrupted by the audit.

What are the possible disadvantages of taking part?
Participation is not likely to inconvenient you in any way. There are no anticipated risks for this study. If you decide to continue with the study, your hand hygiene practice will be observed and recorded. No personal information will be collected, and all data collected will be treated with strict

confidentiality. In instances where harmful practice is observed, the hand hygiene auditor will take note of this and this will be reported to the matron-in-charge of your ward as part of weekly reported data.

What are the possible benefits of taking part?
You will have access to the findings of the researcher if you want to. You are free to contact the researcher for a copy of the final report on the study.

What do I do now?
You do not have to do anything other than signify your interest to participate in the hand hygiene audit. The audit will be done on your ward at a time that will be duly communicated to you. Before you participate in the study, you will be required to complete a consent form which confirms you fully understand what the study is about, that your queries have been cleared and that you are happy to participate.

Who can I talk to for more information about the study?
Please contact the researcher (Yetunde Ataiyero) using the contact details below if you require additional information about the study.

What will happen if I do not want to carry on with the study?
Participation is entirely voluntary, and you are free to withdraw from the study at any time. However, if you choose to withdraw, any observed practices prior to withdrawal will be used in the study.

Will the information I provide be kept confidential?
Ethical and legal considerations will be applied to handling the information provided. Strict confidentiality and secure storage of all information collected about you during the research will be ensured. No personal data such as names will be recorded or mentioned in any spoken or written reports of the study. The Data Protection Act will be strictly adhered to. All information will be kept confidential and in instances of harmful or bad practices are observed, this will be included as part of weekly reported data that will be reported to the unit head and matron-in-charge of your ward.

What will happen to the results of the study?
Study results will be published in scientific journals after the study duration and as part of a thesis project. Results will also be presented at relevant conferences and professional development events. A summary of findings will be made available to the hospital where research participants have been recruited. If you would like a copy of the final report, please contact the researcher (details below) after June 2019 to request this.

Who has reviewed this?
The University of Hull School of Health and Social Work Research Ethics Committee and the Research Ethics Committee of this hospital.

Further Information and Contact Details
If you have any further questions, queries or comments, kindly contact Yetunde Ataiyero (details below) who is the researcher.

Many thanks for taking time to read this information.

Yours Sincerely,

Yetunde Ataiyero
PhD Researcher
School of Health and Social Work
The University of Hull
Cottingham Road
Hull
HU6 7RX
Y.O.Ataiyero@2015.hull.ac.uk
078xxxxxxx

Supervised by:

Dr Judith Dyson
Senior Lecturer, Implementation Science
School of Health and Social Work
The University of Hull
Cottingham Road
Hull
HU6 7RX
J.Dyson@hull.ac.uk
+441482 464680

Dr Moira Graham
Graduate Research Director
Lecturer in Public Health
School of Health and Social Work
The University of Hull
Cottingham Road
Hull
HU6 7RX
M.Graham2@hull.ac.uk
+441482 464514

Appendix I Hand Hygiene Observation Dissent Form

UNIVERSITY OF HULL

Hand Hygiene Observation Dissent Form

Please put your initials in the box provided for each item.

1. I confirm that I am a Nigerian healthcare worker resident in Nigeria at the time of the study ☐

2. I confirm that I have read and understood the information sheet for the above study. I have had the opportunity to consider the information. If I had any questions, they have been answered satisfactorily. ☐

3. I confirm I *do not* want my hand hygiene practices to be observed in this study. ☐

Reason for dissent (Optional):

.....

.....

Initials of Dissenting Healthcare Worker	Date	Signature
_____	_____	_____

Name of Researcher	Date	Signature
_____	_____	_____

Appendix J Modified BALHHI for Face Validity (Round 1)

UNIVERSITY OF HULL

Information and Instructions

- This questionnaire is part of a PhD research which seeks to explore the barriers and levers to hand hygiene practices among Nigerian healthcare workers.
- The questionnaire has been developed (originally by Judith Dyson (j.dyson@hull.ac.uk), Francine Cheater, Cath Jackson and Rebecca Lawton) because research tells us that hand hygiene will vary from hospital to hospital, between different wards and departments and also according to the role of different practitioners.
- We are trying to identify the factors that influence hand hygiene hence, the information you give will be used to assess the barriers and levers to hand hygiene in Nigeria.
- **This version of questionnaire is for face validity only and aims to determine the relevance and appropriateness to the Nigerian healthcare setting.**
- Participation is completely voluntary and the decision whether or not to take part is up to you. If you decide to participate, you are free to withdraw at any time of the study and you do not have to give any reason. However, any information given prior to withdrawal will be used in the study.
- Simply consider each statement in the light of your own hand hygiene and circle the number that demonstrates to what extent you agree or disagree with the statements given.
- With regards to all questions, think about when and where you last worked in Nigeria.
- It is anticipated that this will take about 10 minutes.
- Your responses will be anonymous as you do not need to put your name on the questionnaire.
- If you have any further questions, queries or comments, kindly contact the researcher, Yetunde Ataiyero (Y.O.Ataiyero@2015.hull.ac.uk).

1.	What is your job title? (e.g. staff nurse)		
2.	How long have you worked in healthcare? (in full years)		
3.	When last did you work in a Nigerian healthcare setting?		
4.	What area of the hospital did you work in? ..... (e.g. orthopaedic)		
5.	Are you male or female (please circle)	M	F
6.	To what extent do you consider you usually comply with good practice guidelines for hand hygiene? (Times you clean your hands compared with opportunities to do so – 0 to 100%)		%
7.	To what extent do you consider your colleagues in your department comply with good practice guidelines for hand hygiene?		%

Please consider your own hand hygiene. Then circle the number between 1 and 7 that best reflects your opinion at present.									
	Strongly agree							Strongly disagree	
8. I engage in hand hygiene out of respect for my patients		1	2	3	4	5	6	7	
9. Government targets have led to improvements in my hand hygiene		1	2	3	4	5	6	7	
10. Hand hygiene is a non-negotiable part of my role		1	2	3	4	5	6	7	
11. It is difficult for me to attend hand hygiene courses due to time pressure		1	2	3	4	5	6	7	
12. I feel complacent about hand hygiene		1	2	3	4	5	6	7	
13. Sometimes I miss out hand hygiene simply because I forget it		1	2	3	4	5	6	7	
14. Hand hygiene is not second nature for me		1	2	3	4	5	6	7	
15. I feel angry if hand hygiene is not carried out by others		1	2	3	4	5	6	7	
16. When staff engage in hand hygiene they are praised		1	2	3	4	5	6	7	
17. I am more likely to forget hand hygiene if I am tired		1	2	3	4	5	6	7	
18. Hand hygiene training is available to me		1	2	3	4	5	6	7	
19. There are some practical barriers to hand hygiene because of my particular job/role		1	2	3	4	5	6	7	
20. If I do not engage in hand hygiene I may catch an infection		1	2	3	4	5	6	7	
21. I cannot be bothered with hand hygiene		1	2	3	4	5	6	7	
22. Some government targets make hand hygiene more difficult (such as high bed occupancy)		1	2	3	4	5	6	7	
23. If I omitted hand hygiene I would blame myself for infections		1	2	3	4	5	6	7	
24. I engage in hand hygiene because I do not want to let the team down		1	2	3	4	5	6	7	
25. There are adverts or newsletters about hand hygiene in my workplace		1	2	3	4	5	6	7	

	Strongly agree							Strongly disagree	
26. I am reluctant to ask others to engage in hand hygiene		1	2	3	4	5	6	7	
27. The frequency of hand hygiene required makes it difficult for me to carry it out as often as necessary		1	2	3	4	5	6	7	
28. I disagree with some parts of the hand hygiene guidelines		1	2	3	4	5	6	7	
29. I am confident in my ability to carry out hand hygiene		1	2	3	4	5	6	7	
30. Hospital targets relating to infection or hand hygiene has led to improvements in my hand hygiene		1	2	3	4	5	6	7	
31. I feel frustrated when others omit hand hygiene		1	2	3	4	5	6	7	
32. If I engage in hand hygiene it improves patient confidence		1	2	3	4	5	6	7	
33. Hand hygiene guidelines are easily accessible		1	2	3	4	5	6	7	
34. Hand hygiene is part of my professional culture		1	2	3	4	5	6	7	
35. My environment is cluttered		1	2	3	4	5	6	7	
36. I feel guilty if I omit hand hygiene		1	2	3	4	5	6	7	
37. I feel ashamed if I omit hand hygiene		1	2	3	4	5	6	7	
38. My area of work has poor staffing levels		1	2	3	4	5	6	7	
39. Supervision from senior staff means that carrying out hand hygiene is easier for me		1	2	3	4	5	6	7	
40. Some strategies designed to improve hand hygiene influence my practice		1	2	3	4	5	6	7	
41. My hand hygiene is encouraged by others		1	2	3	4	5	6	7	
42. If I miss out hand hygiene I will be subject to disciplinary action		1	2	3	4	5	6	7	

43. In which of the following situations should hand hygiene be performed (circle as many letters as apply).

a) Before having direct contact with a patient

b) Before inserting an invasive device (e.g. catheter)

c) When moving from a contaminated body site to a clean body site during an episode of patient care

d) After having direct contact with a patient or with items in the immediate vicinity of the patient

e) After removing gloves

44. If your hands are not visibly soiled or visibly contaminated with blood or other material, which is most effective for reducing the number of disease causing bacteria? (circle one letter corresponding to the single best answer)

a) Washing hands with plain soap and water

b) Washing hands with an antimicrobial soap and water

c) Applying 1.5 to 3ml of alcohol-based hand rub to the hands and rubbing hands together until they feel dry

45. How are antibiotic-resistant bacteria most frequently spread from one patient to another in health care settings? (circle one letter corresponding to the single best answer)

a) Airborne spread resulting from patients coughing or sneezing

b) Patients coming in contact with contaminated equipment

c) From one patient to another via the contaminated hands of clinical staff

d) Poor environmental maintenance

46. Which of the following infections can be potentially transmitted from patients to clinical staff if appropriate glove use and hand hygiene are not performed? (Circle as many letters as apply)

a) Herpes simplex virus infection

b) Colonisation or infection with MRSA (methicillin-resistant Staphylococcus aureus)

c) RSV (Respiratory syncytial virus infection)

d) Hepatitis B virus infection

47. Clostridium difficile (the cause of antibiotic-associated diarrhoea) is readily killed by alcohol-based hand hygiene products. (Circle one letter corresponding to the single best answer)

a) True

b) False

48. Any comments

.....

.....

.....

Thank you for participating![5]

[5] Questionnaire originally developed by Judith Dyson (j.dyson@hull.ac.uk), Francine Cheater, Cath Jackson and Rebecca Lawton. Questions 43 to 47 are adapted from: Institute for healthcare improvement, How to guide: A guide for improving practices among health care workers, 2009. http://www.shea-online.org/Assets/files/IHI_Hand_Hygiene.pdf.

Appendix K Modified BALHHI for Construct Validity (Round 2)

UNIVERSITY OF HULL

Information and Instructions

This questionnaire is part of a PhD research which seeks to explore the barriers and levers to hand hygiene practices among Nigerian healthcare workers. The questionnaire has been developed because research tells us that hand hygiene will vary from hospital to hospital, between different wards and departments and also according to the role of different practitioners.

We are trying to identify the factors that influence hand hygiene hence, the information you give will be used to assess the barriers and levers to hand hygiene in Nigeria. Simply consider each statement in the light of your own hand hygiene and circle the number that demonstrates to what extent you agree or disagree with the statements given. It is anticipated that this will take about 10 minutes.

Participation is completely voluntary and the decision whether or not to take part is up to you. If you decide to participate, you are free to withdraw at any time of the study and you do not have to give any reason. However, any information given prior to withdrawal will be used in the study. Your responses will be anonymous as you do not need to put your name on the questionnaire.

If you have any further questions, queries or comments, kindly contact the researcher, Yetunde Ataiyero (Y.O.Ataiyero@2015.hull.ac.uk).

1. What is your job title? (e.g. staff nurse)		
2. How long have you worked in healthcare? (in full years)		
3. What area of the hospital do you work in? ..... (e.g. orthopaedic)		
4. Are you male or female (please circle)	M	F
5. To what extent do you consider you usually comply with good practice guidelines for hand hygiene? (Times you clean your hands compared with opportunities to do so – 0 to 100%)		%
6. To what extent do you consider your colleagues in your department comply with good practice guidelines for hand hygiene?		%
Please consider your own hand hygiene. Then circle the number between 1 and 5 that best reflects your opinion at present.		

	Strongly agree				**Strongly disagree**
7. I engage in hand hygiene out of respect for my patients	1	2	3	4	5
8. There are government targets which have led to improvements in my hand hygiene	1	2	3	4	5
9. Hand hygiene is a non-negotiable part of my role	1	2	3	4	5
10. It is difficult for me to learn about hand hygiene due to time pressure	1	2	3	4	5
11. I feel complacent about hand hygiene	1	2	3	4	5
12. Sometimes I miss out hand hygiene simply because I forget it	1	2	3	4	5
13. Hand hygiene is not a habit for me	1	2	3	4	5
14. I feel angry if hand hygiene is not carried out by others	1	2	3	4	5
15. When staff engage in hand hygiene they receive positive feedback	1	2	3	4	5
16. I am more likely to forget hand hygiene if I am tired	1	2	3	4	5
17. Hand hygiene training is available to me	1	2	3	4	5
18. There are some practical barriers to hand hygiene because of my particular job/role	1	2	3	4	5
19. If I do not engage in hand hygiene I may catch an infection	1	2	3	4	5
20. I cannot be bothered with hand hygiene	1	2	3	4	5
21. If I omitted hand hygiene I would blame myself for infections	1	2	3	4	5
22. I engage in hand hygiene because I do not want to let the team down	1	2	3	4	5
23. There are adverts or newsletters about hand hygiene in my workplace	1	2	3	4	5
24. I am reluctant to ask others to engage in hand hygiene	1	2	3	4	5
25. The frequency of hand hygiene required makes it difficult for me to carry it out as often as necessary	1	2	3	4	5
26. I disagree with some parts of the hand hygiene guidelines	1	2	3	4	5
27. I am confident in my ability to carry out hand hygiene	1	2	3	4	5

	Strongly agree				**Strongly disagree**
28. Hospital targets relating to infection or hand hygiene has led to improvements in my hand hygiene	1	2	3	4	5
29. I feel frustrated when others omit hand hygiene	1	2	3	4	5
30. If I engage in hand hygiene it improves patient confidence	1	2	3	4	5
31. Hand hygiene guidelines are easily accessible	1	2	3	4	5
32. Hand hygiene is part of my professional culture	1	2	3	4	5
33. My environment is untidy	1	2	3	4	5
34. I feel guilty if I omit hand hygiene	1	2	3	4	5
35. I feel ashamed if I omit hand hygiene	1	2	3	4	5
36. My area of work has poor staffing levels	1	2	3	4	5
37. Supervision from senior staff means that carrying out hand hygiene is easier for me	1	2	3	4	5
38. Some strategies designed to improve hand hygiene influence my practice	1	2	3	4	5
39. My hand hygiene is encouraged by others	1	2	3	4	5
40. If I miss out hand hygiene I will be subject to disciplinary action	1	2	3	4	5

41. In which of the following situations should hand hygiene be performed (circle <u>as many</u> letters as apply).

a) Before having direct contact with a patient
b) Before inserting an invasive device (e.g. catheter)
c) When moving from a contaminated body site to a clean body site during an episode of patient care
d) After having direct contact with a patient or with items in the immediate vicinity of the patient
e) After removing gloves

42. If your hands are <u>not</u> visibly soiled or visibly contaminated with blood or other material, which is most effective for reducing the number of disease-causing bacteria? (circle <u>one</u> letter corresponding to the single best answer)

a) Washing hands with plain soap and water
b) Washing hands with an antimicrobial soap and water
c) Applying 1.5 to 3ml of alcohol-based hand rub to the hands and rubbing hands together until they feel dry

43. How are antibiotic-resistant bacteria most frequently spread from one patient to another in health care settings? (circle one letter corresponding to the single best answer) a) Airborne spread resulting from patients coughing or sneezing b) Patients coming in contact with contaminated equipment c) From one patient to another via the contaminated hands of clinical staff d) Poor environmental maintenance
44. Clostridium difficile (the cause of antibiotic-associated diarrhoea) is readily killed by alcohol-based hand hygiene products. (Circle one letter corresponding to the single best answer) a) True b) False
45. Are there any further barriers to hand hygiene that you would like to tell us about? …… …… ……
46. If you would be willing to complete this questionnaire again, on just one more occasion, please provide your contact details in the space provided below. Your name and contact details will not be linked to any information you have provided in this questionnaire.

Thank you for participating!

Please enclose the completed questionnaire in the envelope provided on your ward, for this purpose.

[6]

Appendix L Modified BALHHI for Test-Retest Reliability (Round 3)

[6] Questionnaire originally developed by Judith Dyson (j.dyson@hull.ac.uk), Francine Cheater, Cath Jackson and Rebecca Lawton. Questions 41 to 44 are adapted from: Institute for healthcare improvement, How to guide: A guide for improving practices among health care workers, 2009. http://www.shea-online.org/Assets/files/IHI_Hand_Hygiene.pdf.

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Information and Instructions

This questionnaire is part of a PhD research which seeks to explore the barriers and levers to hand hygiene practices among Nigerian healthcare workers. The questionnaire has been developed because research tells us that hand hygiene will vary from hospital to hospital, between different wards and departments and also according to the role of different practitioners.

We are trying to identify the factors that influence hand hygiene hence, the information you give will be used to assess the barriers and levers to hand hygiene in Nigeria. Simply consider each statement in the light of your own hand hygiene and circle the number that demonstrates to what extent you agree or disagree with the statements given. It is anticipated that this will take about 10 minutes.

Participation is completely voluntary and the decision whether or not to take part is up to you. If you decide to participate, you are free to withdraw at any time of the study and you do not have to give any reason. However, any information given prior to withdrawal will be used in the study. Your responses will be anonymous as you do not need to put your name on the questionnaire.

If you have any further questions, queries or comments, kindly contact the researcher, Yetunde Ataiyero (Y.O.Ataiyero@2015.hull.ac.uk).

1. What is your job title? (e.g. staff nurse)					
2. How long have you worked in healthcare? (in full years)					
3. What area of the hospital did you work in? ..... (e.g. orthopaedic)					
4. Are you male or female (please circle)			M		F
5. To what extent do you consider you usually comply with good practice guidelines for hand hygiene? (Times you clean your hands compared with opportunities to do so – 0 to 100%)					%
6. To what extent do you consider your colleagues in your department comply with good practice guidelines for hand hygiene?					%
Please consider your own hand hygiene. Then circle the number between 1 and 5 that best reflects your opinion at present.					
	Strongly agree				**Strongly disagree**
7. I engage in hand hygiene out of respect for my patients	1	2	3	4	5

	Strongly agree				**Strongly disagree**
8. There are government targets which have led to improvements in my hand hygiene	1	2	3	4	5
9. Hand hygiene is a non-negotiable part of my role	1	2	3	4	5
10. It is difficult for me to learn about hand hygiene due to time pressure	1	2	3	4	5
11. I feel complacent about hand hygiene	1	2	3	4	5
12. Sometimes I miss out hand hygiene simply because I forget it	1	2	3	4	5
13. Hand hygiene is not a habit for me	1	2	3	4	5
14. I feel angry if hand hygiene is not carried out by others	1	2	3	4	5
15. When staff engage in hand hygiene they receive positive feedback	1	2	3	4	5
16. I am more likely to forget hand hygiene if I am tired	1	2	3	4	5
17. Hand hygiene training is available to me	1	2	3	4	5
18. There are some practical barriers to hand hygiene because of my particular job/role	1	2	3	4	5
19. If I do not engage in hand hygiene I may catch an infection	1	2	3	4	5
20. I cannot be bothered with hand hygiene	1	2	3	4	5
21. If I omitted hand hygiene I would blame myself for infections	1	2	3	4	5
22. I engage in hand hygiene because I do not want to let the team down	1	2	3	4	5
23. There are adverts or newsletters about hand hygiene in my workplace	1	2	3	4	5
24. I am reluctant to ask others to engage in hand hygiene	1	2	3	4	5
25. The frequency of hand hygiene required makes it difficult for me to carry it out as often as necessary	1	2	3	4	5
26. I disagree with some parts of the hand hygiene guidelines	1	2	3	4	5
27. I am confident in my ability to carry out hand hygiene	1	2	3	4	5

	Strongly agree				**Strongly disagree**
28. Hospital targets relating to infection or hand hygiene has led to improvements in my hand hygiene	1	2	3	4	5
29. I feel frustrated when others omit hand hygiene	1	2	3	4	5
30. If I engage in hand hygiene it improves patient confidence	1	2	3	4	5
31. Hand hygiene guidelines are easily accessible	1	2	3	4	5
32. Hand hygiene is part of my professional culture	1	2	3	4	5
33. My environment is untidy	1	2	3	4	5
34. I feel guilty if I omit hand hygiene	1	2	3	4	5
35. I feel ashamed if I omit hand hygiene	1	2	3	4	5
36. My area of work has poor staffing levels	1	2	3	4	5
37. Supervision from senior staff means that carrying out hand hygiene is easier for me	1	2	3	4	5
38. Some strategies designed to improve hand hygiene influence my practice	1	2	3	4	5
39. My hand hygiene is encouraged by others	1	2	3	4	5
40. If I miss out hand hygiene I will be subject to disciplinary action	1	2	3	4	5

41. In which of the following situations should hand hygiene be performed (circle <u>as many</u> letters as apply).

a) Before having direct contact with a patient
b) Before inserting an invasive device (e.g. catheter)
c) When moving from a contaminated body site to a clean body site during an episode of patient care
d) After having direct contact with a patient or with items in the immediate vicinity of the patient
e) After removing gloves

42. If your hands are <u>not</u> visibly soiled or visibly contaminated with blood or other material, which is most effective for reducing the number of disease causing bacteria? (circle <u>one</u> letter corresponding to the single best answer)

a) Washing hands with plain soap and water
b) Washing hands with an antimicrobial soap and water
c) Applying 1.5 to 3ml of alcohol-based hand rub to the hands and rubbing hands together until they feel dry

43. How are antibiotic-resistant bacteria most frequently spread from one patient to another in health care settings? (circle one letter corresponding to the single best answer)

a) Airborne spread resulting from patients coughing or sneezing
b) Patients coming in contact with contaminated equipment
c) From one patient to another via the contaminated hands of clinical staff
d) Poor environmental maintenance

44. Clostridium difficile (the cause of antibiotic-associated diarrhoea) is readily killed by alcohol-based hand hygiene products. (Circle one letter corresponding to the single best answer)

a) True
b) False

45. Are there any further barriers to hand hygiene that you would like to tell us about?

……
……..
……
……..
……
……..

Thank you for participating!

Please enclose the completed questionnaire in the envelope provided on your ward, for this purpose.

7

[7] Questionnaire originally developed by Judith Dyson (j.dyson@hull.ac.uk), Francine Cheater, Cath Jackson and Rebecca Lawton. Questions 41 to 44 are adapted from: Institute for healthcare improvement, How to guide: A guide for improving practices among health care workers, 2009. http://www.shea-online.org/Assets/files/IHI_Hand_Hygiene.pdf.

Appendix M Confidentiality Agreement for Administrative Help

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I _____, a _____ (job description), have been recruited as an administrative help for the above-named research.

I agree to -

1. keep all the research data in my possession confidential by not discussing or sharing the research information in any form or format (completed questionnaires) with anyone other than the researcher.
2. keep all research information in any form or format (completed questionnaires) secure while it is in my possession.
3. return all research information in any form or format (completed questionnaires) to the researcher when I have completed the research tasks.

Name of Administrative Help	Date	Signature

Name of Researcher	Date	Signature

Appendix N Interview Schedule

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These questions are underpinned by the Theoretical Domains Framework.

1. Knowledge
   - Can you describe your understanding of the need for hand hygiene?
   - When do you perform hand hygiene?
2. Skills
   - Can you describe how to perform hand hygiene?
3. Social/Professional Role and Identity
   - Do you think hand hygiene guidelines are consistent with your professional standards of practice? How?
   - How will you describe the importance of performing hand hygiene to you as a person?
4. Beliefs about capabilities (self-efficacy)
   - Is performing hand hygiene easy or difficult for you? Why do you think so?
   - Can you describe any previous barriers or difficulties you've had performing hand hygiene?
   - Do you think you can improve your hand hygiene compliance despite the barriers? If yes, how do you intend to? If no, why do you think so?
5. Beliefs about consequences
   - What are the benefits of performing hand hygiene (to yourself, colleagues, patients, hospitals?)
6. Motivation and goals
   - Is there any need for you to increase your hand hygiene compliance?
   - What will be your reasons to increase your hand hygiene compliance?
   - Are there incentives to practising hand hygiene?
   - Do you have other things you would like to achieve that might interfere with increasing your hand hygiene compliance? If yes, what are they?
7. Memory, Attention and Decision Processes

- When do you consider it necessary to perform hand hygiene?
- What factors influences your decision to perform hand hygiene? (time, type of care, type of patient?)
- Do you often remember or are you likely to forget to perform hand hygiene? When is this likely to happen?

8. Environmental Context and Resources (Environmental Constraints
    - What physical/resource factors (such as time, sink, water, alcohol gel) influence or hinder your hand hygiene practice?
    - Can you describe any competing tasks that may influence your hand hygiene practice?
9. Social Influences (Norms)
    - Does performing hand hygiene practice have any importance in your unit? How?
    - Can you describe how your colleagues' hand hygiene compliance influence (facilitate or hinder) hand hygiene compliance in your unit?
    - Do you look up to anyone as role models on hand hygiene practice?
10. Emotion (in terms of stress, burnout, anxiety, tiredness/cognitive overload, fear)
    - Does hand hygiene practice induce emotional response? If yes, what?
    - How does emotion influence/affect hand hygiene practice?
11. Action Planning
    - Are there any workplace measures in place to ensure you perform hand hygiene?
    - How will you describe these measures?

Appendix O Participant Information Sheet for Interviews

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I would like to invite you to participate in this research which is exploring the barriers and levers to hand hygiene practices among Nigerian healthcare workers (HCWs). Before you decide to take part, it is important you understand the aim and objectives of the study, and what participation will entail. Please read the information below carefully, discuss with others if need be and take time to decide whether you wish to participate or not. If you have any questions, please contact the me using the details provided at the end of this information sheet.

Thank you for taking time to read this.

What is the study about?
Healthcare associated infections (HCAI) are estimated to be 2-20 times more prevalent in developing countries especially, Sub-Saharan African countries than it is in developed countries. Good hand hygiene practice is the best method to prevent HCAI although compliance with hand hygiene guidelines remains very low. The study aims to investigate those things that help and hinder hand hygiene compliance among Nigerian HCWs.

Why have I been chosen?
You have been invited to partake in this study because opinions of Nigerian doctors and nurses are being explored. Their understanding of the barriers and levers to hand hygiene compliance is being investigated.

Do I have to take part?
No, participation is completely voluntary. This information sheet will tell you what the study is about and the decision whether or not to take part is up to you. If you decide to participate, you are free to withdraw from participation at any time of the study and you do not have to give any reason. However, any information given prior to withdrawal will be used in the study.

What will happen if I decide to take part?
If you decide to participate, you will be interviewed by the researcher (Yetunde Ataiyero). To do this, I will ask for your permission to record the interview on a digital audio device. The interview will take approximately 60-90 minutes.

What are the possible disadvantages of taking part?
Participation is not likely to inconvenient you in any way. There are no anticipated risks for this study. If you decide to continue with the study, your perceptions on the barriers and levers to hand hygiene practices will be recorded. No personal information will be collected and all data collected will be treated with strict confidentiality. In instances where harmful practice is divulged, the researcher will take note of this and this will be reported to the matron-in-charge or head of surgery unit as part of anonymised data.

What are the possible benefits of taking part?
You will have access to the findings of the researcher if you want to. You are free to contact the researcher for a copy of the final report on the study.

What do I do now?
You do not have to do anything other than signify your interest to participate in the interview. The interview will be done at a convenient time and venue for you we would both agree upon. Before you participate in the study, you will be required to complete a consent form which confirms you fully understand what the study is about, that your queries have been cleared and that you are happy to participate.

Who can I talk to for more information about the study?
Please contact the researcher (Yetunde Ataiyero) using the contact details below if you require additional information about the study.

What will happen if I do not want to carry on with the study?
Participation is entirely voluntary and you are free to withdraw from the study at any time. However, if you choose to withdraw, the information you have provided prior to withdrawal will be used in the study.

Will the information I provide be kept confidential?
Ethical and legal considerations will be applied to handling the information provided. Strict confidentiality and secure storage of all information collected about you during the research will be ensured. No personal data such as names will be recorded or mentioned in any spoken or written reports of the study. Great care will be taken to ensure that participants are not identifiable from verbatim quotes or details in report. The Data Protection Act will be strictly adhered to. All information will be kept confidential and in instances of harmful or bad practices are observed, this will be included as part of anonymised data that will be reported to the unit head and matron-in-charge of your ward.

What will happen to the results of the study?
Study results will be published in scientific journals after the study duration and as part of a thesis project. Results will also be presented at relevant conferences and professional development events. A summary of findings will be made available to the hospital where research participants have been recruited. If you would like a copy of the final report, please contact the researcher (details below) after June 2019 to request this.

Who has reviewed this?
The University of Hull School of Health and Social Work Research Ethics Committee and Research Ethics Committee of this hospital.

Further Information and Contact Details
If you have any further questions, queries or comments, kindly contact Yetunde Ataiyero (details below) who is the researcher.

Many thanks for taking time to read this information

Yours Sincerely,

Yetunde Ataiyero
PhD Researcher
School of Health and Social Work
The University of Hull
Cottingham Road
Hull
HU6 7RX
Y.O.Ataiyero@2015.hull.ac.uk
078xxxxxxxx

Supervised by:
Dr Judith Dyson
Senior Lecturer, Implementation Science
School of Health and Social Work
The University of Hull
Cottingham Road
Hull
HU6 7RX
J.Dyson@hull.ac.uk
+441482 464680

Dr Moira Graham
Graduate Research Director
Lecturer in Public Health
School of Health and Social Work
The University of Hull
Cottingham Road
Hull
HU6 7RX
M.Graham2@hull.ac.uk
+441482 464514

Appendix P Interview Consent Form

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Please put your initials in the box provided for each item.

1. I confirm that I am a Nigerian healthcare worker resident in Nigeria at the time of the study ☐

2. I confirm that I have read and understand the information sheet for the above study. I have had the opportunity to consider the information. If I had any questions, they have been answered satisfactorily. ☐

3. I understand that my participation is voluntary and that I am free to withdraw at any time without giving any reason and without my legal rights being affected. The information I have provided prior to withdrawal will be used in the study. ☐

4. I understand that any information provided will be audio recorded. The information, including direct quotes from responses may be used in future publications but my identity and workplace will be protected and kept anonymous. ☐

5. I understand that the information I provide will be held in strict confidentiality except in unlikely events of bad or harmful practice. ☐

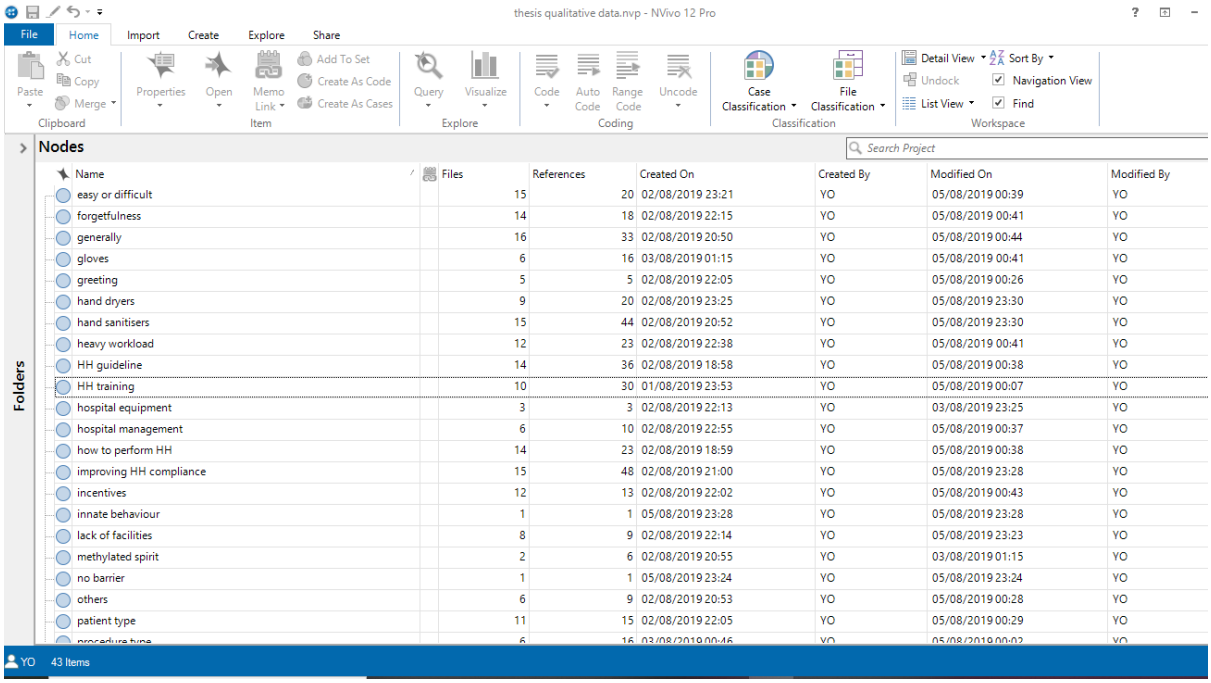
6. I understand that research data will be stored safely. ☐

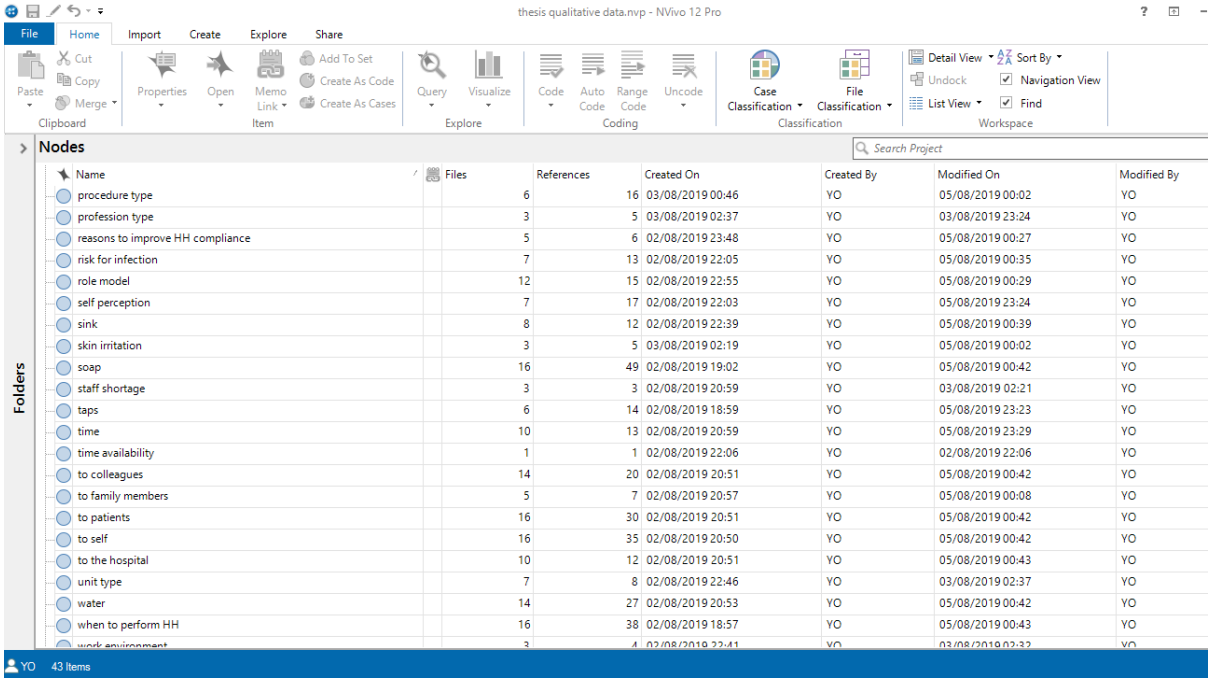
7. I agree to participate in the above study. ☐

Name of Participant	Date	Signature
_____	_____	_____

Name of Researcher	Date	Signature
_____	_____	_____

Appendix Q Initial Coding Using NVivo





Appendix R Sample of Coding Steps to Generation of Themes

Transcribed Data for Kate (Nurse with 3 years' work experience) (R = Researcher; K = Kate)	**Initial coding**	**Refining Themes**	
		Codes (subthemes)	**Themes**
R: What comes to your mind when you hear hand hygiene? K: Hand protection…you know we use our hands for so many things so hand hygiene is the way we protect our hands. The first thing I think of is hand washing then hand rub with ABHRs…then the use of gloves when dealing with contaminated stuff.	Protection Handwashing ABHRs Glove use Decontamination	Understanding hand hygiene importance Self-protection	Hand hygiene lever Risk for infection
R: So, when you use ABHRs, do you use alongside handwashing or you use alone? K: No, no…if I'm using ABHR, I'm using ABHR and if I'm washing my hands, I'm washing my hands.	Performs either handwashing or use ABHRs	How to perform hand hygiene	Hand hygiene knowledge
R: Ok, have you had any previous training on hand hygiene before? K: Well, the only training I had was when I was in the school of nursing. I went to a Mission (faith-based) school of nursing so the "whites" came visiting and they taught us on universal precautions, and they were taking it one after the other so that's when they touched on hand hygiene. The 2nd one was when we had the Ebola outbreak in Nigeria…I was a school nurse then and you know we had to safeguard the children and train them, so we went for a training on hand hygiene because of the outbreak then in the country.	Training from nursing school; foreign trainers on universal precautions Periodic training due to Ebola outbreak	Hand hygiene training	Hand hygiene knowledge

Transcribed Data for Kate (Nurse with 3 years' work experience) (R = Researcher; K = Kate)	Initial coding	Refining Themes	
		Codes (subthemes)	Themes
R: Have you had any training in this hospital before? K: No (emphatically). I have worked in this hospital for like one and half years and since I came, they've not conducted any such training.	No previous hospital training	Hand hygiene training	Hand hygiene knowledge
R: So, when do you perform hand hygiene? K: I do it every time, like I'm a handwashing freak (laughs)…even at home it's more like part of my life, I can't do anything without washing my hands…I have to wash my hands first, that's my first instinct. So, it doesn't really matter what I want to do, I wash my hands all the time.	Every time Handwashing freak Part of my life Cannot do without handwashing First instinct All the time	When to perform hand hygiene	Hand hygiene practice
R: Ok. So, when you are in the hospital, as a nurse, what's going to prompt you to perform hand hygiene? K: Before I start any procedure with my patients, I wash my hands, whatsoever the type of procedure I do…after I wash my hands too. So before and after any contact with my patient, I wash my hands…probably, I might have attended to a patient, I wash my hands, if I want to take anything, I still wash my hands…before and after eating I wash my hands.	Before procedure After procedure Before patient contact After patient contact Before taking anything Before eating After eating	When to perform hand hygiene	Hand hygiene practice
R: How important do you think hand hygiene is? K: I see it as the number one thing…I see it as the first thing because…like in our healthcare setting you find out that…you know in Nigeria now, there is no insurance for you and you're on	First thing to do No insurance if anything goes wrong	Important procedure For self-protection	Hand hygiene practice Lever Risk for infection

Transcribed Data for Kate (Nurse with 3 years' work experience) (R = Researcher; K = Kate)	Initial coding	Refining Themes	
		Codes (subthemes)	Themes
your own if anything happens to you so one has to be protective of oneself. So, I don't joke with it. Yes, I know not doing it can cause cross-infections among patients and again, I can infect myself, so I try to dodge that. If I'm dealing with blood and soiled linens, I wear my gloves…if it's clean procedures like checking vital signs/observations of patients, I wash my hands before I start and after the vital signs, I wear my gloves. I wash my hands when we have many patients, like if I have to move from patient to patient and when I finish with a particular patient, I wash my hands before going to the next or better still, I just use ABHRs. I also wear gloves when there are lots of patients to attend to…so, it really depends on the procedure and the number of patients I need to attend to.	Self-protection Cross-infection among patients when not done Can infect self when not done Glove use when dealing with blood and soiled linens Handwashing for clean procedures like checking patient's vital signs Handwashing or ABHR use in between patient care Glove use when there are lots of patients	To prevent cross-infection among patients Type of procedure determines what precautionary measure is taken Glove use may interfere with hand hygiene practice	
R: Are ABHRs provided by the hospital or you buy yourself? K: No…it's personal pocket-sized sanitisers	Pocket-sized ABHRs; not provided by the hospital	Hand hygiene facilities	Barrier
R: Do you have ABHRs on the ward now? K: Yes, we have	ABHR available on the ward during interview	Hand hygiene facilities	Lever (at this instance)
R: Is it always available? K: No, it's not always available.	ABHRs not always available	Hand hygiene facilities	Barrier
R: What kind of soap and water do you use?	Running water Bar or liquid soap	Hand hygiene facilities	Barrier

Transcribed Data for Kate (Nurse with 3 years' work experience) (R = Researcher; K = Kate)	Initial coding	Refining Themes	
		Codes (subthemes)	Themes
K: I use running water and we use bar soaps or all these normal handwashing liquid soaps. But we use bar soaps like premier, lux (local brands) often.			
R: How often do you use bar soaps? K: Like if you check our sink now, you will see bar soap. We use bar soap as we speak. It's always available…they provide both, but we put the liquid soaps in the central sink while the bar soaps are in the toilet and other handwashing sinks	Bar soap always available Liquid soap at the central sink Bar soap in toilet and other sinks	Hand hygiene facilities	Barrier
R: Can you describe how to perform hand hygiene? K: If I'm using an ABHR, I use between 20-30 seconds and if it's handwashing, I use between 40-60 seconds	Uses 20-30secs for ABHR; 40-60 secs for handwashing	How to perform hand hygiene	Hand hygiene practice
R: So how do you do it? K: I have a song I sing in my head (then she sang a Christian song while describing the steps involved with her hands…for 1 minute 24 seconds)	Described handwashing steps as she sang	How to perform hand hygiene	Hand hygiene practice
R: Wow, that's amazing! I was thinking it's a song on hand hygiene? K: No, it's not	Song not related to hand hygiene	-	-
R: But that's what you sing every time you perform hand hygiene? K: Yes. So, it's become part of me.	Hand hygiene is part of me	Self-claim	Hand hygiene practice
R: You got every step you described as you sing. This is lovely!	-	-	-

Transcribed Data for Kate (Nurse with 3 years' work experience) (R = Researcher; K = Kate)	Initial coding	Refining Themes	
		Codes (subthemes)	Themes
K: Thank you			
R: Have you seen any hand hygiene guideline in this hospital before? K: No. well, it's like I've seen it in the paediatric ward before…by their sink but I can't really remember. Apart from that, I don't think it's in any other ward	Hand hygiene poster seen only in paediatric ward	Hand hygiene guideline	Hand hygiene knowledge
R: So apart from the poster you've seen, there is nothing like a policy document either by the hospital or WHO on the wards? K: I can't remember seeing any before…it might be, but I haven't seen it before	Not seen WHO or local policy on hand hygiene before	Hand hygiene guideline	Hand hygiene knowledge
R: So, do you think the hand hygiene guidelines on the poster you've seen before are consistent with your professional standards of practice? K: Yes, with the one I saw before.	Yes, guidelines are consistent with professional standard of practice	Hand hygiene guideline	Hand hygiene knowledge
R: Why do you think so? K: That's what I know, that's what we were thought in school and that's what I've been doing. It's about how to wash, when to wash, the difference between washing and scrubbing. Scrubbing takes longer time.	Guideline was thought in school and participant has been practising the same thing Guideline about how and when to wash, difference between washing and scrubbing	Hand hygiene guideline and training	Hand hygiene knowledge
R: So at what instance do you perform hand hygiene?	Before patient contact	Hand hygiene knowledge	Hand hygiene practice

Transcribed Data for Kate (Nurse with 3 years' work experience) (R = Researcher; K = Kate)	Initial coding	Refining Themes	
		Codes (subthemes)	Themes
K: I said it before…before and after any contact with patient or any contact with contaminated surfaces, I wash my hands or use hand sanitiser.	After patient contact After contact with contaminated surface		
R: Are you likely to perform hand hygiene more if you have an infectious patient or there is a risk of infection in a procedure? K: I told you I'm a handwashing freak, so I treat all patients equally…I do the same thing with everybody. It doesn't matter the symptoms, what I'm about to do or the kind of patient I'm making contact with. In fact, every patient to me is potentially infectious. Like in this hospital, we have a unit for hepatitis B infected patients, and the same way I wash my hands and use gloves for them is the same way I do for other patients too…it's not as if I use more gloves or wash my hands more because a patient is infected with HIV or hepatitis B virus. No. the same way, the same thing. It makes it easier because if I'm not doing the same thing, I might forget here and there.	Handwashing freak Treats patients equally Same thing for everybody irrespective of symptoms, procedure or type of patient Every patient is potentially infectious No special treatment for infectious patients Makes it easier for her not to forget to perform hand hygiene	Easy to perform hand hygiene Does not depend on type of patient/ward	Hand hygiene practice
R: Is performing hand hygiene easy or difficult for you? K: To me it's easy because it's like it's part of me already.	Hand hygiene is easy Part of me	Innate behaviour/culture	Hand hygiene practice
R: So can we say because you've had to do it over time, it's come to be part of you? K: Yes, it's part of me…even at home. The more I do it, the better you get at it and the easier it becomes for you. It's just like a lifestyle…a normal thing to do. That's the compliment the public	It's part of me The more the practice, the better and easier it becomes Hand hygiene is like a lifestyle A normal thing to do	Innate behaviour/culture	Hand hygiene practice

Transcribed Data for Kate (Nurse with 3 years' work experience) (R = Researcher; K = Kate)	Initial coding	Refining Themes	
		Codes (subthemes)	Themes
actually give to nurses though…that nurses usually regularly wash their hands	The public gives nurses the compliment of regular handwashing		
R: Can you describe any previous barriers or difficulty you've had performing hand hygiene? K: Haaa...barriers here…the first barrier is lack of hand dryers. We only have towels…and after washing your hands, the same towel someone else had used is what is available for use even when it's wet although I have my own personal towel but it's not too good. We have been advocating for hand dryers and if we have dryers, we won't have all these issues. Also, the kind of handwashing liquid soap we use, we have to dilute with water because of economic reasons…because if it finishes before time, we won't get another one, so we have to maximise what we have.	Lack of hand dryers Lack of disposable towels Only reusable towels are available May be used by multiple people even when wet Some have personal towels Staff advocating for hand dryers Liquid soaps are diluted for economic reasons Soap may not be supplied if it finishes before expected time	No hand drying facilities Liquid soaps are diluted for economic reasons Hospital policy or attitude of hospital management on resources	Barriers
R: Is there a stipulated time for you to use a certain amount of liquid wash? K: Yes, there is o…if it finishes before time then you won't get a replacement until you are due for another one by their own calculation. So, we have to reconstitute and dilute with water.	Hospital management only replaces finished product on their discretion Reconstituting liquid soap by diluting with water	Liquid soaps are diluted for economic reasons Hospital policy or attitude of hospital management on resources	Barriers

Transcribed Data for Kate (Nurse with 3 years' work experience) (R = Researcher; K = Kate)	Initial coding	Refining Themes	
		Codes (subthemes)	Themes
R: Is there any formula for dilution? K: No, we just dilute and make sure it still has the soapy effect (laughs)	No formula for dilution Only ensures the liquid soap still foams lather	Hospital policy or attitude of hospital management on resources	Barriers
R: Any other barriers? K: We don't normally get ABHRs from the hospital, we have to buy from outside and even when the hospital supplies it, you have to check the expiry date. It's either it's about to expire or it has expired.	ABHRs not supplied by the hospital Buying personal sanitisers from personal pocket When supplied, might be expired or about to expire	Hospital policy or attitude of hospital management on resources Self-protection	Barriers
R: Why would they supply an expired product? Why not give them out to the wards when they are still effective and needed? K: I don't know…maybe it's an African mentality of just having it in store but not giving it out. There was a time I went to meet one of the matrons that we needed handwashing liquid soap and hand sanitisers. You know what she told me? She asked me to choose one of the two, that we can't have the two. So, I pick the liquid soap and left. So, that's the case here. So, when we request for the two, we already know we can't get them both. Even when they supply, they give us small bottles and by the time we see them bringing the sanitisers, we know it's either it's about to expire or it has expired or maybe it's a free one given to the hospital by the state government.	Keeping resources in store and not supplying to appropriate departments where needed Making a choice between liquid soap and ABHRs Cannot get both ABHRs and liquid soap when requested for both Small bottles are supplied ABHRs may be supplied if about to expire, expired or freely given by state government	Hospital policy or attitude of hospital management on resources Expired products may be supplied	Barriers

Transcribed Data for Kate (Nurse with 3 years' work experience) (R = Researcher; K = Kate)	Initial coding	Refining Themes	
		Codes (subthemes)	Themes
R: Any other barriers? K: Not really, we have functioning sinks just that they are quite a distance to get to. Other than that, we have running water…so that's it.	There are functioning sinks but at a distance Running water supplied	Distant location of sinks Running water available	Barriers Lever
R: So over time, how do you think you can improve on your hand hygiene compliance despite the barriers you've identified? K: Well, that's why I said I always have my own ABHR in my pocket...I have my own hand towel, personal one I use. Another thing we do here because of issue of glove supply, we write out gloves for patients to buy because they don't supply us gloves. So, when patients buy, we can use especially when dealing with blood and other body fluid products.	Has personal pocket-sized ABHR Has personal towel Hospital does not supply gloves Patients buy gloves	Improving hand hygiene compliance	Hand hygiene practice
R: Ok, do you think glove use might interfere with your hand hygiene practice? Are you likely to use gloves more than you perform hand hygiene? K: I told you my glove use is per patient…for any procedure that has to do with blood, maybe changing intravenous access, dressing wounds…anything that has to do with blood, anything that has to do with body fluids, that is when we use gloves…we don't just use gloves anyhow. I won't use glove if I want to make a patient's bed or give blanket to patient or during vital signs check.	Glove use per patient for blood and body fluid contacts No glove use for clean procedures like making patient's bed	Use of gloves Type of procedure	Hand hygiene practice

Transcribed Data for Kate (Nurse with 3 years' work experience) (R = Researcher; K = Kate)	Initial coding	Refining Themes	
		Codes (subthemes)	Themes
R: So how would you describe the importance of performing hand hygiene to you as a person? K: I feel safe. When everybody is panicking about an infectious patient, I just feel safe because I don't discriminate about patients, I practice my hand hygiene regularly, so I don't have to heighten it with a kind of patient. It doesn't matter the status, I know I'm okay.	Safety Doesn't discriminate among patients irrespective of patient condition Practice hand hygiene regularly	Hand hygiene importance	Hand hygiene practice
R: Any benefits to the patients? K: It will reduce cross-infections and cross-contamination among patients.	Reduces cross-infection and cross-contamination among patients	Risk for infection	Hand hygiene practice
R: Any benefits to your colleagues? K: We learn from it…all of us are not nurses so by working in an environment where hand hygiene is regularly done, they learn the importance and it will eventually become part of them as they practice it often.	Learn from regular hand hygiene	Hand hygiene training/knowledge	Hand hygiene practice/improving compliance
R: Any benefits to the hospital? K: I believe in "whatsoever you are doing, you do it well". Hand hygiene is the first line of patient care…the very first thing to do. As long as you are protecting the individual, you are protecting yourself so, I believe hand hygiene should be taken seriously. The hospital has tried though…there is handwash sinks even though it's not enough, but they have tried compared to other hospitals. You go to some hospitals and it's locally made soaps	First line of patient care Protecting the patient means protecting self Hand hygiene should be taken seriously Hospital has provided handwashing sinks though not enough but better than other hospitals	Hospital policy or attitude of hospital management on resources	Hand hygiene practice

Transcribed Data for Kate (Nurse with 3 years' work experience) (R = Researcher; K = Kate)	Initial coding	Refining Themes	
		Codes (subthemes)	Themes
they use to wash their hands, there will be scarcity of water and the likes. So, this hospital is trying to be fair.	Some hospitals have locally made soaps, scarcity of water		
R: So is there any need for you to increase your hand hygiene compliance? K: Well what else do I need to? Maybe if I stumble on something I don't know about hand hygiene before, I can inculcate that.	Acquiring new knowledge may influence increased compliance	Hand hygiene knowledge/training/policy	Improving hand hygiene compliance
R: Are there any incentives to practicing hand hygiene? K: Incentives? Where? Na naija you dey o (You are in Nigeria). You are on your own o (laughs)	Incentive	No incentives	Improving hand hygiene compliance
R: Do you have other things that you'd like to achieve that might interfere with increasing your hand hygiene compliance? Like other patient care needs you may want to attend to that might interfere with your hand hygiene practice? K: Nothing. Because at times, a patient may become curious and ask why you wash your hands so much…so I try to explain that I do it for you, for me and you should be doing it also. So, it's something I'm proud of because especially here in our unit, we don't just do it alone, we teach the patients to do it too, so they know.	Nothing Patient curiosity on the need for frequent hand hygiene practice For self, patient and patients should practice it too Proud of hand hygiene practice Teach patients in the unit to perform hand hygiene	Hand hygiene importance Hand hygiene knowledge	Improving compliance
R: What factors influence your decision to perform hand hygiene? K: If they make ABHR available, if there are hand dryers…it might not even be hand dryers, if we have 3 fresh towels per shift or	Availability of ABHRs, hand dryers will increase hand hygiene practice	Availability of hand hygiene resources will enhance hand hygiene practice Hand drying techniques	Hand hygiene practice Levers

Transcribed Data for Kate (Nurse with 3 years' work experience) (R = Researcher; K = Kate)	Initial coding	Refining Themes	
		Codes (subthemes)	Themes
maybe disposable towels that will help. I know some people that won't wash their hands if there is no clean towel. Even myself at times, if I'm not going to touch the patient, I will just air dry instead of using the towel. But if there is a need for me to touch, that's why I have my personal towel. So, if there are disposable towels and ABHRs, it will go a long way. In fact, there are times we ought to use just ABHRs if they are available, but we end up washing our hands and that takes longer time for washing and drying of hands. And again, you might have just finished attending to a patient and washed and dried your hands, then you have to do it all again to see another patient. Some people will not want to do that because of time involved. It actually takes longer time; ABHRs will be better for some procedures like checking vital signs per patient instead of washing hands. So, if there are more ABHRs then it will be better.	Suggests 3 reusable towels per shift or disposable towels Absence of clean towel will deter some people from hand hygiene Airdrying instead of using towel if not touching patient Personal towel if touching patient Use of hand sanitisers saves time but absence of it means handwashing and drying Seeing multiple patients Time Hand sanitiser better for some procedures instead of handwashing	Act of touch Time saving Preference for ABHRs depending on procedures	
R: So does performing hand hygiene have any importance in your unit? K: Yes. A lot.	Hand hygiene is important in my unit	Hand hygiene importance	Hand hygiene practice
R: Can you describe how your colleagues' hand hygiene compliance influence hand hygiene compliance in your unit?	Patients with low immunity Need to practice infection control	Risk for infection	Hand hygiene importance

Transcribed Data for Kate (Nurse with 3 years' work experience) (R = Researcher; K = Kate)	Initial coding	Refining Themes	
		Codes (subthemes)	Themes
K:We do it. These patients are exposed. Their immunity is low. So, we need to practice infection control. We make it a priority. We cannot afford not to. Everybody in the unit is compliant.	Infection control is a priority Cannot afford not to Everybody is compliant in the unit		
R: So do you look up to anyone as role models on hand hygiene practice? K: Do I look up to anybody? I just do my thing (laughs)	No role model Just do my thing	No role model Self-directed practice	Hand hygiene practice
R: Is there any other thing you'd like to say? K: Nothing really. But this research is good. It will sensitise people more. I believe this will improve the practice of hand hygiene on the wards. Some people don't see hand hygiene as a big deal and they only use gloves so, this research will enlighten people more on its importance.	Sensitising research on improving hand hygiene Some people do not see hand hygiene as important Some people only use gloves	Hand hygiene importance	Hand hygiene practice

Appendix S Thematic Analysis

Broad Themes	Subthemes	Findings	No of participants	Interview Excerpts
Personal	Hand hygiene knowledge and skills	Participants are able to describe when to perform hand hygiene	16	*"I do it every time, like I'm a handwashing freak (laughs)…even at home it's more like part of my life, I can't do anything without washing my hands…I have to wash my hands first, that's my first instinct. So, it doesn't really matter what I want to do, I wash my hands all the time…Before I start any procedure with my patients, I wash my hands, whatsoever the type of procedure I do…after I wash my hands too. So before and after any contact with my patient, I wash my hands…probably, I might have attended to a patient, I wash my hands, if I want to take anything, I still wash my hands…before and after eating I wash my hands" – Kate (Nurse)* *"Hand hygiene in the hospital setting is very important but personally, it's equally very important. It goes beyond the work environment…washing your hands after any procedure that will cause you to pick up any bacteria…or cause you to pick anything infectious or that can harbour infections, you should wash your hands. So, wash your hands before meeting a patient because you don't know what they are carrying, wash your hands after seeing the patient especially, if you move from one patient to the other and especially if that patient is infectious and then of course, some certain procedures require more than just handwashing, we actually scrub especially procedures like anything that has to do with coming in contact with blood vessels, IV line or creating a central access or if you will have to operate or open up a patient then you have to not just wash your hands but also scrub" – George (Dr)*

Broad Themes	Subthemes	Findings	No of participants	Interview Excerpts
				"Initially when you resume work before starting your procedures, you have to wash your hands, either before medication or even before attending to your patients, you have to wash your hands. Then in btw patient contact, you have to wash. During the procedures, after contact with the patients, we also have to wash our hands and so many others like before and after attending to the patients, when you're going back home, before attending to anybody you have to wash your hands" – Alice (Nurse) *"Performing hand hygiene is something that should be done every time in as much as you are in the hospital or in the hospital environment. Either when you want to step into the ward, or when you touch a particular patient, you wash your hands…and before you even touch another patient, you should wash your hands. When you are done with your ward round activity before you take your lunch, your...anything you want to eat in the hospital, you are meant to actually observe hand washing. And basically too, using of ABHRs especially when you have to, when you are out of the hospital environment and you want to greet your friends, there is need for you to clean your hands...you might not be able to wash your hands at that particular moment but using ABHRs would help to limit the transfer of infections from yourself to another person. So, it's something we do all around, all the time" – Andrew (Nurse)*
		Participants able to describe how to perform hand hygiene	15	*"Ok…like I said, hand hygiene is not just handwashing alone in the hospital…it entails everything like you looking after cuts and bruises on your hands, then of course, how you wash your hands…then the techniques of washing will change pertaining to what you want to do. The regular handwashing requires 8 steps…of course, you should always wet your hands, avoid bar soaps…I prefer liquid soaps,*

Broad Themes	Subthemes	Findings	No of participants	Interview Excerpts
				occasionally when you can't come in contact with water, like when you are in a remote area, you may decide to use hand sanitiser which is a step down from using good liquid soap to wash your hands. So, first thing first, you wet your hands and at the beginning of handwashing you can actually touch the tap but once you wash you don't touch again, you should use your elbows, so a little water in your hands, press on the soap dispenser, then get some lather…then of course, wash inside, outside, in-between, in the nails, around the thumb, then you wash from the hands towards the elbows and then you rinse down in same manner…of course, after you've washed you shouldn't touch the tap or the soap dispenser. Subsequently, avoid laying your hands on a used towel, if you have disposable towels, that's good, if there's hand dryer that's even better but if that is not available, it's better to air dry" – George (Dr) *"Okay, it involves seven stages. The first is that you wash the palm then after the palm you wash in between the fingers, you wash the back of the hand, then in between the nails too, wash the wrist, you wash the thumb then allow it to drain" – Peppa (Nurse)* *"Ok, there are standard ways to wash the hands. You wash your palms, you wash in between your fingers, you try to wash the inside of your palm, rub like this (describes rubs hands palm to palm step) and then you wash the back, you wash down and then with your hands stretched like this (describing right palm over left dorsum with fingers interlaced step), you try to clean up and then your hands are clean depending on what you want to do…" – Brian (Dr)*
		Hand hygiene practices described as "habitual",	9	*"…to me I think it's the normal thing just like the back of my hand...just wash your hands and go...something that you know it's*

Broad Themes	Subthemes	Findings	No of participants	Interview Excerpts
		"cultural", "normal", "a lifestyle", norm, or "part of me"		*your normal routine that you should do in your day to day activities" – Andrew (Dr)* *"It's just like a lifestyle…a normal thing to do" – Kate (Nurse)* *"It is easy, you know what you do every day and every time becomes part of you" – Mya (Nurse)* *"Once it becomes part of you, it's not something that you have to be told or you have to remember all the steps. If you've been doing it then it becomes habitual for you" – George (Dr)* *"…when it becomes a culture….it becomes part of your life, it's easy" – Brian (Dr)*
	Self-confidence in hand hygiene practices	All participants see hand hygiene as a simple procedure	16	*"Very, very easy. Because most of the time, here in male surgical ward, there are some dirty procedure that you have to do, and you have to wash your hands unless you are deceiving yourself…you just have to wash your hands. Even mere opening some doors on the ward, there are some people that mere opening the door, they will wash their hands" – Betty (Nurse)* *"Too easy…because I don't know how I feel if I haven't performed hand hygiene…like now, I can't count how many times that I have washed these hands today. I just can't…even when the question just flashes to me like "have I?" I will just go back and wash it again…You get used to it and it becomes a normal thing. In fact, first thing to do when you get to work is to wash your hands before starting the day's job and then you continue like that" – Chloe (Nurse)*
	Perceived risk	Need to protect self and the patients	16	*"I see it as the number one thing…I see it as the first thing because…like in our healthcare setting you find out that…you know in Nigeria now, there is no insurance for you and you're on your own if*

Broad Themes	Subthemes	Findings	No of participants	Interview Excerpts
				anything happens to you so one has to be protective of oneself so, I don't joke with it" – Kate (Nurse) *"The need for hand hygiene, as I said earlier on is to ensure that the hands are clean, free from bacteria or any form of contamination so that when we move from patient to patient, we don't transfer infections to them. We do have some patients who are on admission for something else and later they develop what is called nosocomial infections, hospital acquired infections. So, we need to be careful that we are not the direct culprit transmitting the infections to our patients…Just to ensure we don't transfer infections from our patients to ourselves, other patients, our colleagues and members of our household. There are doctors and nurses who have died on account of such, contracting infections like Ebola, Lassa fever, yellow fever, tuberculosis. At times, you may need to do what is called barrier nursing because you don't want to contract infections – April (Dr)*
		Need to protect colleagues	14	*"If something is wrong with me, directly or indirectly my colleagues will get affected. We interact together and get to share some things, so if I am infected, my colleagues might be infected too. And again, if you infect a patient, your colleague is still coming and then the chances of your colleagues getting infected by that patient has increased even after taking universal precautions" – Brian (Dr)* *"Yeah, if I'm performing it, there are some ways you make contact to your colleagues like hand shaking so I'm trying to prevent infection spread to my colleagues when I perform hand hygiene" – Peppa (Nurse)*

Broad Themes	Subthemes	Findings	No of participants	Interview Excerpts
		Need to protect family members	7	*"Yes. One of the things that helps me...that keeps reminding me is the fact that I want to try as much as possible not to get infected, especially my family who are non-medicals and they don't know what I've touched in the hospital. So I don't want to start spending my meagre salary on health issues at home...so that's one of the things that keeps reminding me that oh...you have families at home...you have people that are not medically-inclined and they don't even know whether I washed my hands or not, So those are the things that keep reminding me that ok I don't want to get nosocomial infections and at the same time, I don't want to transfer to others" – Andrew (Dr)* *"Not just in the hospital…even at home. Because you are not just protecting yourself, you are protecting your patients, you are protecting your family members, you are protecting your colleagues…I remember when I had my daughter, she's 2 now. It was 2 steps before you get to her. First step you have to sanitise when you get to the house, second step you have to sanitise again and if you have to carry her, you must wash your hands. It was that bad. People say I was paranoid but hey, my child has never been admitted to the hospital, she's never had any infections and we're keeping that going. Two years 5 months now, never had an infection" – Lisa (Nurse)*
		Type of procedure	11	*"There are some procedures that no matter how hasty you are, you just have to perform hand hygiene, so it depends on the kind of procedures. Some are dirty procedures that…you just have to wash and wash to clean your hands" – Chloe (Nurse)* *"It is very important before and after every procedure as it is for our own good. You know that in hospital, we have different types of cases*

Broad Themes	Subthemes	Findings	No of participants	Interview Excerpts
				that we attend to and it will serve as…Erm, let me say that just to avoid contracting the infections" – Mya (Nurse)
		Type of unit	7	*"It is very important in our unit….you know this is a surgical ward. We take care of patients, wound, so you have to wash your hands. Some are infected, after dressing you clean your hands before going to the next patient" – Anna (Nurse)* *"There was a time I was in a unit where you see infectious patients primarily and by the time you get to that kind of unit, there is this thing that continues to ring on your head (laughs)...you are in an infectious environment. So as much as possible, hand washing is as good as you are breathing in your normal air (laughs)...if you are not doing it, it's like you are not breathing again. So, when you get to such environment, subconsciously you want to...because of what is at stake...because of the environment I find myself" – Andrew (Dr)*
		Type of patient	12	*"Normally I can wash my hands once but when I feel there is more to the patient's condition I can wash twice, 3 times or as many as possible (laughing)…like a hepatitis B patient, I wash my hands more than I normally do…it will make me perform it more though I perform it normally, but the frequency might increase" – Peppa (Nurse)*
		The greeting culture - Nigerians make physical contact (like handshake) when greeting	7	*"If you do not wash your hands and you meet a colleague and shake hands, you've transferred some of the germs within your hands to the person. So, it prevents...it also protects them from contracting germs from you" – Betty (Nurse)* *"It's also important because we are in Africa and here, we do a lot of greeting and you shake hands or touch each other, and we are dealing with patients which involves lots of touching" – George (Dr)*

Broad Themes	Subthemes	Findings	No of participants	Interview Excerpts
				"There are some ways you make contact to your colleagues like hand shaking so I'm trying to prevent infection spread to my colleagues when I perform hand hygiene" – Peppa (Nurse)
	Forgetfulness	Busy workload and emergency situations may trigger forgetfulness	14	*"I don't forget, I remember all the time…it's at the back of my mind all the time to wash my hands" – Anna (Nurse)* *"No, I've never experienced it" – April (Dr)* *"In this environment where there may not be water? Yes. Many times, you touch a patient and you forget to wash and then you remember, I didn't do this…I didn't wash my hands in-between patient care…and you leave what you're doing and perform hand hygiene before you come back to the patient but the deed is already done" – George (Dr)* *"…it is likely I forget to wash my hands before attending to others, because of the workload. Like now, I may be attending to one patient and they are bringing another patient in, before I wash my hands…the person that they are bringing in maybe in shock, I will want to rush to attend to the person" – Lisa (Nurse)*
	Role models	Five participants have role models, 11participants just follow display posters and "do their thing"	16	*"Yes, but not in this unit, my previous Matron. She is very good at the procedure; you just have to do it and that was in the ICU. She is very good. I look up to her" – Chris (Nurse)* *"I'm trying to think. Maybe a dermatologist that was here. She used to really wash her hands. Though I've been washing my hands frequently before I met her, but she was way ahead in the game. It's a whole new level that I try to attain" – George (Dr)* *"Personally, I don't follow anyone…I believe in myself…I don't follow multitude. It's a personal thing because even if you are a matron, it*

Broad Themes	Subthemes	Findings	No of participants	Interview Excerpts
				doesn't mean you will know how to do it more than I do" – Kim (Nurse) *"Because of the setting that we find ourselves, we are health workers, so we don't even need anybody to tell us that we should do this before we do. I never heard about role model on hand hygiene…I don't have any role model. I want to be myself" – Betty (Nurse)* *"Nobody" – April (Dr)*
	Glove use	Busy schedule, emergency situations, type of unit and procedure will influence hand hygiene practice	7	*"…there are some times that you have a lot of things to do and perhaps you were actually on gloves with the other person, you might just change the gloves and wear another and say to yourself, let me just be on gloves instead of going back and forth because there are many things to do. I don't want to call it a barrier, but it alters handwashing" – Chloe (Nurse)* *"It's possible to forget in an emergency situation because you priority then is to save the patient and some emergencies may not give you adequate time to wash your hands or use hand gloves so you may need to rush and do some things but when it's a bleeding case, then you have to wear your gloves before you can go ahead to do anything to safeguard yourself" – Andrew (Dr)*
	Respect from patients	Some HCWs believe performing hand hygiene will boost patients' confidence in them thereby earning their respect	4	*"When patients see you washing your hands, they're happy with the way you handle them….that you wash your hands, they're happy" – Anna (Nurse)* *"For us, this hand hygiene is a normal thing that we should do effortlessly, so the public sees us with integrity and dignity, and they respect us that we will do the right thing as much as possible, so they can trust us with their health" – Kim (Nurse)*

Broad Themes	Subthemes	Findings	No of participants	Interview Excerpts
	Skin irritation	Frequent handwashing and using locally made soaps	3	*"First is the inadequate provision of appropriate soap. Like now, you know in Nigeria, a lot of people are making liquid soap…the acidic content of the soap depends on what your trainer taught you…some will have too much acid and caustic soda making it so harsh on the skin. So if someone isn't conscious of that or when the hospital buys from such people whose products were poorly mixed, it can cause skin problems, especially for people who don't recognise such liquid soap quickly…like me, I know the effect immediately I wash my hands with that kind of liquid soap and I would avoid using it the next time. And from that, I'd be restricting myself from washing my hands in the hospital or at work and that's a big problem as I may forget to wash my hands since it's not in my conscious mind to do so. I might end up using my hands to eat like that…take spoon or play with children around me" – Kim (Nurse)*
	Emotion	Emotional impact of hand hygiene practice – such as being seen as a bad HCW will enhance their performance	3	*"It increases patients' morale that we respect them. Imagine before you see a patient you wash your hands and you wash your hands again before touching them, that means you respect that patient and the patient sees himself like…ok I am a human being. There are ways you treat a patient that he feels he is less of a human. And psychologically, that patient might get better…it makes us gain respect from the patients and boosts their confidence in us and so they can trust us with their health" – Brian (Dr)*
Institutional	Infrastructural deficit	Soap: Bar soaps mostly used	9	*"The ideal thing should have been to use liquid soap where you would be able to use your elbow to press but here, like I said, this is a developing country where we find ourselves, so we use bar soap or antiseptic bar soap just to wash your hands....the same hands we use*

Broad Themes	Subthemes	Findings	No of participants	Interview Excerpts
				to pick the soap is what we also use to drop the soap too when you're done washing…" – Lisa (Nurse)
		Soap: liquid soaps heavily diluted	4	*"The kind of handwashing liquid soap we use, we have to dilute with water because of economic reasons…because if it finishes before time, we won't get another one, so we have to maximise what we have…if it finishes before time then you won't get a replacement until you are due for another one by their own calculation. So, we have to reconstitute and dilute with water…we just dilute and make sure it still has the soapy effect" – Peppa (Nurse)*
		Soap: liquid soaps may be locally made	2	*"First is the inadequate provision of appropriate soap. Like now, you know in Nigeria, a lot of people are making liquid soap…the acidic content of the soap depends on what your trainer taught you…some will have too much acid and caustic soda making it so harsh on the skin. So if someone isn't conscious of that or when the hospital buys from such people whose products were poorly mixed, it can cause skin problems, especially for people who don't recognise such liquid soap quickly…like me, I know the effect immediately I wash my hands with that kind of liquid soap and I would avoid using it the next time. And from that, I'd be restricting myself from washing my hands in the hospital or at work and that's a big problem as I may forget to wash my hands since it's not in my conscious mind to do so. I might end up using my hands to eat like that…take spoon or play with children around me" – Kim (Nurse)*
		Sinks: sinks may be blocked or dirty	3	*"Yes, it's possible to have blocked sinks and it now depends on the hospital to make adequate provision for that because some of the people working in the hospital maintenance department too might say they're too busy to come and fix it…and you cannot put a bowl*

Broad Themes	Subthemes	Findings	No of participants	Interview Excerpts
				underneath the sink. Sometimes, when the sink is leaking and the plumber needs to repair it but the plumber is busy…and since it's not only your ward they have to attend to…it then becomes a problem to wash the hands out of not wanting to walk around the ward to where else the sink is located" – Kim (Nurse) *"Some handwash basins are not good enough too. Some are dirty and you don't want to wash your hands in a dirty sink so as not to get the hands contaminated again through the sink" – Tara (Nurse)*
		Sinks: inconvenient location of sinks	8	*"The access to the sink…most times, the sink is usually far away from the patients. You see a patient; you walk a distance to wash your hands then come back and continue the cycle of seeing patient and walking distance to perform hand hygiene. So sometimes, when I have so many patients on the ward, I just use ABHR in-between patient care which is not the ideal but hey, I have to do that to save my time. So, there are so many barriers…the barriers are limitless" – George (Dr)*
		Water supply: water may not run leaving HCWs to rely on bucket and bowl use	5	*"At times, before our orderlies (ward assistants) can get a bowl of water, you will just be hanging your hands there and you won't be able to do other things…just for them to get the water" – Emily (Nurse)*
		Taps: taps are knob-operated, not elbow operated	6	*"We don't have the elbow-operated taps…we have the normal taps you open to and fro on the ward so that's what we use" – Chloe (Nurse)*

Broad Themes	Subthemes	Findings	No of participants	Interview Excerpts
		Water supply: Insufficient borehole, lack of electricity to pump water	2	*"There was a problem in this hospital before though it's been solved now…we had problem with our water supply and there wasn't enough boreholes to pump water so much so that they were rationing by ward and might not rotate to your ward for days…though we have water storage but if it finishes and it isn't your ward's turn yet then you resort to ward assistant fetching water in buckets or from other wards…and they are not on duty every time" – Kim (Nurse)*
		Water supply: use of sachet/bottled water in extreme cases	2	*"There are times that I had to get bottled water to wash my hands just because I just want to wash my hands and go. So, sometimes you see me carrying bottled water...not basically because I want to drink but just also to wash my hands in case there is no water on the ward" – Andrew (Dr)*
		Hand drying techniques: No automated dryers or disposable towels; use of cotton towels which are changed twice per shift or personal towels	10	*"Ideally, we should be using disposable towels but here (laughs) we are managing the cloth towel…we believe that we are all health workers, so we won't contaminate ourselves…then we do change it often when soiled so we don't use soiled towels to contaminate the hands we just washed" – Kim (Nurse)* *"We don't have the automatic ones. We have towels we hang by the basin, that's what everybody uses…but we change the towels per shift. There are sometimes, they change like twice in a shift" – Emily (Nurse)* *"The first barrier is lack of hand dryers. We only have towels…and after washing your hands, the same towel someone else had used is what is available for use even when it's wet although I have my own personal towel but it's not too good. We have been advocating for*

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				hand dryers and if we have dryers, we won't have all these issues" – Kate (Nurse)
		ABHRs: ABHRs not always supplied; may be expired or about to when supplied. Personal pocket-sized ABHRs always bought and used by HCWs	15	*"We don't normally get hand sanitisers from the hospital, we have to buy from outside and even when the hospital supplies it, you have to check the expiry date. It's either it's about to expire or it has expired" – Kate (Nurse)* *"Hospital? You buy with your money. Some wards do have it though, but I don't know the source. But you can always move around with your own pocket-sized sanitisers" – Brian (Dr)*
	Hand hygiene knowledge and skills	No previous training	10	*"Hmmm…not really, just what we were taught in school…no formal training. And as a staff in this hospital and everywhere I had worked before now, I have never been formally trained on how to perform hand hygiene" – Emily (Dr)*
		Reliance on training from school and during disease outbreaks	10	*"Well, apart from my knowledge from medical school and the periodic training I had during the Ebola disease outbreak, I can't think of any formal training on hand hygiene before" – Andrew (Dr)*
		No hospital training	12	*"Well, apart from my knowledge from medical school and the periodic training I had during the Ebola disease outbreak, I can't think of any formal training on hand hygiene before" – Andrew (Dr)*
		No local hand hygiene policy	16	*"It's not like the hospital has its own policy on handwashing…no we don't, no we don't" – Tara (Nurse)*
		Lack of awareness on WHO hand hygiene policy	6	*"It was when you started this research that I learnt there actually is a guideline on hand hygiene which I've never seen before…" – April (Dr)*

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	Incentives	All participants stressed on lack of praise or appreciation as a form of incentive when hand hygiene is efficiently observed	16	*"Aaaah, there are no incentives and I don't think there should be any...it's something everybody should key into...something everybody should see reasons to do. By the time you try to give incentives to people, you are trying to make them not see the importance of observing good hand hygiene...good hand washing hygiene. So it doesn't really help people because by the time there is no incentives, they won't want to do it again. So that's the problem. So if...you don't need to give people incentives…there shouldn't be any incentive because anything that has to go with incentives, when the incentive is not forthcoming, people try to withdraw from doing it again and that will make the practice worse" – Andrew (Dr)*
	Heavy workload	Shortage of HCWs results in heavy workload and lack of time	12	*"It's usually more difficult when you have to see 20 to 30 patients and you walk down the ward to wash your hands…with sinks that are really far away" – George (Dr)* *"…when we are busy…when we need to attend to so many patients, as you can see, a nurse to like 10 patients, at times 15, so you will want to perform your duties as early as possible and during those periods, we may not be able to perform hand hygiene like in btw contact with patients so we skip that part" – Alice (Nurse)*
	Time constraints		10	*"At times, work gets really busy that you have no time to spare and you just want to get the work done before the end of your shift" – Emily (Nurse)*
	Human resources		5	*"Definitely we are short-staffed. An 8am-4pm job and you rarely have time to go on break and then you tend to spend extra working hours...1 or 2 hours depending on the wards...just to ensure you tidy up your work for the day and that all patients are seen" – Andrew (Dr)*

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	Need to boost hospital reputation	Increased patient turnover rates and shortened patient hospital stay	5	*"Simple handwashing can reduce length of hospital stay for the patient, the hospital cost and then it will increase the turnover rate of the hospital" – Chloe (Nurse)*
		Way to boost hospital economy	6	*"…it also reduces the hospital cost. Like I said, nosocomial infections we see them as more of a problem and so we start culturing, trying to find out which one is it. So, the hospital is spending more to fight nosocomial infections whereas if there is good hand washing practice, I think the hospital would spend less on that" – Andrew (Dr)*
	Staff wellbeing	Performing hand hygiene will improve staff wellbeing	3	*"…it will lessen the breakdown rates of the staff and the amount of sick leave the staff take will be reduced. You know some people are so sensitive, for example if they didn't wash their hands before eating and the person comes down with abdominal upset…that individual will not be able to perform his/her role and may take sick leave from the hospital. And this will affect the hospital in the sense that there won't be effective running of the job and the patients will be complaining, there will be staff shortage on duty but when the hospital provides the necessary things, they will know their staff are okay, their children are okay, the job is going on well, and patients are being cared for the way they should be and there won't be transfer of infections from work to their houses. So, it will reduce the morbidity and mortality rates amongst the health workers and the patients too and then it shortens the length of stay of patients in the hospital" – Kim (Nurse)*
	Means of hand hygiene education	Non-professional hospital staff and patients will learn about the importance of hand	2	*"…You are indirectly or directly educating the patients because when they come to the hospital, we are meant to enlighten them vis-à-vis their health. Some of them come from the villages and see us do these*

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		hygiene through HCWs' practices		*things, they can even ask why this, and we educate them. And then they go back to their villages, so we've created awareness. We don't need to travel miles and climb rocks or go through valleys to get health education done, we can through hand hygiene…they see us, and they've learnt from us" – Brian (Dr)* "We learn from it…all of us are not nurses so by working in an environment where hand hygiene is regularly done, they learn the importance and it will eventually become part of them as they practice it often" – Kate (Nurse) "…the non-medical staff on the ward like the ward assistants, we still have to teach them about hand hygiene. So, our practice influences theirs too" – George (Dr)
	Hospital policy on supply of hand hygiene resources	Supply of hand hygiene resources at discretion of hospital managers Hospital manager may not replace products if finished before expected time Keeping products in store until they are about to expire or already expired Supply of ABHRs only when freely given by government or when hospital is being inspected by governing board	7	*"Do they (hospital management) care? They don't care. If they do there will be water and liquid soap and hand sanitiser all the time" – Emily (Nurse)* *"Sometimes, even to get ABHRs, the hospital will tell you there is no money to provide enough ABHRs for health workers to use on the wards" – Betty (Nurse)* *"You know problem with the hospital economy, and they have to water down the liquid soap and of course, you're introducing infections when you start messing with the medium…and because of the economy they are trying to cut cost, so they don't give us the correct solution, or the solution is watered down" – George (Dr)* *"When the hospital supplies it, you have to check the expiry date. It's either it's about to expire or it has expired...maybe it's an African mentality of just having it in store but not giving it out. There was a*

Broad Themes	Subthemes	Findings	No of participants	Interview Excerpts
		HCWs having to choose between supply of liquid soap or ABHRs		*time I went to meet one of the matrons that we needed handwashing liquid soap and ABHRs. You know what she told me? She asked me to choose one of the two, that we can't have the two. So, I pick the liquid soap and left. So, that's the case here. When we request for the two, we already know we can't get them both. Even when they supply, they give us small bottles and by the time we see them bringing the ABHRs, we know it's either about to expire or it has expired or maybe it's a free one given to the hospital by the state government" – Kate (Nurse)*