AN EVALUATION OF THE PREPAREDNESS AND SCREENING PROCEDURES FOR EBOLA AT JOMO KENYATTA INTERNATIONAL AIRPORT, NAIROBI

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An Evaluation of the Preparedness and Screening Procedures for Ebola at Jomo Kenyatta International Airport, Nairobi

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DECLARATION

This thesis is my original work and has not been presented for a Degree in any other University.

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This thesis has been submitted for examination with our approval as University Supervisors.

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DEDICATION

I dedicate this work to my wife, Naghea Jilo and my son, Newton Bocha with love and gratitude always.

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I am greatly thankful to the almighty God for the energy, grace, patience and courage He blessed me with throughout my Masters program period. It is with great appreciation that I acknowledge the contributions and support of my supervisors; Prof. Joseph Gikunju and Dr Yeri Kombe; whose time, effort and guidance have immensely contributed to the quality of this thesis.

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ACRONYMS AND ABBREVIATIONS

BDBV:	Bundibugyo Ebolavirus
CBP:	Customs and Border Protection
CDC :	Centers for Disease Control
EBOV:	Viral Zoonosis Ebola
ELISA:	Enzyme-Linked Immunosorbent Assay
EVD:	Ebola Virus Disease
ITROMID:	Institute of Tropical Medicine and Infectious Diseases
JKIA:	Jomo Kenyatta International Airport
KEMRI:	Kenya Medical Research Institute
MOH:	Ministry of Health
PCR:	Polymerase Chain Reaction
PHE:	Public Health England
PHEIC:	Public Health Emergency of International Concern
PPE:	Personal Protective Equipment
RESV:	Reston Ebolavirus
RNA:	Ribonucleic Acid
RT-PCR:	Reverse-Transcription Polymerase Chain
SARS:	Severe Acute Respiratory Syndrome
SUDV:	Sudan Ebolavirus
UN:	United Nations
WHO:	World Health Organization
ZEBV:	Zaire Ebolavirus

DEFINITION OF KEY TERMS

Screening: Screening has been defined as the systematic application of a test or enquiry to identify individuals at sufficient risk of a specific disorder to benefit from further investigation or direct preventive action, among people who have not sought medical attention because of symptoms of that disorder.

Availability of facilities and equipment: This is the availability of Medical laboratory equipment automates or helps analyze blood, urine and genes, personal protective equipment (PPE) and other equipment required in the screening of Ebola virus.

Health personnel skills: This is knowledge and skills that health personnel have in order to prevent, screen, treat and monitor diseases like Ebola.

Health personnel availability and adequacy: This is the sufficiency of staff required to prevent, screen, treat and monitor diseases like Ebola.

ABSTRACT

For about 12 months in the year 2014, the outbreak of Ebola disease in West Africa dominated the world health news. As a result, Kenya banned flights from Sierra Leone and Liberia as a precautionary measure in preventing the disease from entering its territory. This study therefore sought to evaluate the preparedness and screening procedures for Ebola at Jomo Kenyatta International Airport. The specific objectives of the study were to determine the personnel and cadres available for screening passengers for Ebola disease at the Jomo Kenyatta International Airport; describe the process of screening of passengers for Ebola disease at the Jomo Kenyatta International Airport; determine the facilities available for screening passengers for Ebola disease at the Jomo Kenyatta International Airport; and determine the health personnel skills in the screening of passengers for Ebola disease at Jomo Kenyatta international airport. The study made use of a prospective method study approach. The target population was all the 130 health personnel working at the Jomo Kenyatta International Airport. Primary data was collected by use of questionnaires and Key Informant Interview guides. After confirming that all data filled in was accurate, descriptive statistics were utilized to analyze quantitative data. Descriptive statistics included frequency distribution and percentages. The data was then represented in tables and graphs. On the other hand, qualitative data was coded thematically and then evaluated statistically. Content analysis was used to qualitative data, that is, data collected from open ended questions. The results were then presented in form of a prose. The study found that the personnel and cadres available for screening passengers for Ebola disease at the Jomo Kenyatta International Airport included public health officers 59.2%, nurses 22.5%, clinical officers 12.2%, laboratory technicians 4.1%, and doctors 2%. The study also found that the airport's health department had a documented process for screening passengers or Ebola virus. The study revealed that although the health department had most of the facilities and equipment necessary for Ebola disease screening, some were lacking. The lacking facilities and equipment included closed vacuum container, PCR, quarantine room, functional thermos scanners, well equipped laboratory facilities, PCI laboratories. Also, the study found that there were inadequate personnel in the health department at Jomo Kenyatta International Airport for screening of passengers for Ebola disease. The WHO recommends one doctor and 2 nurses for every 1000 patients. Therefore, with a daily passenger of 19,000, the health department at the airport should have at least 19 doctors and 38 nurses. The study concludes that the health department at Jomo Kenyatta International Airport had the required personnel cadre for screening passengers for Ebola disease. The study also concludes that the health department at Jomo Kenyatta International Airport was using WHO guidelines in the screening of passengers for ebola

disease. In addition, the health department had most of the facilities and equipment necessary for Ebola diseases screening some were lacking. Also, the skills required for the screening of passengers for Ebola disease Jomo Kenyatta international airport were available. The study recommends that the health personnel should be assisted to get regular updates on prevention and control of Ebola. This will help them to increase their skills on the screening processes for Ebola virus. This study also recommends that the government of Kenya as well as the management of the airport should ensure that all the required equipment and facilities to screen for Ebola virus is available. Further, the management of Jomo Kenyatta International Airport should employ more health personnel so as to enhance the process of screening passengers for Ebola virus.

CHAPTER ONE

INTRODUCTION

1.1 Background of the Study

There have been multiple Ebola transmission events over the years and more than 20 Ebola outbreaks since the 1970s (Chowell & Nishiura, 2014). In August 2014, the largest, most sustained, and widespread Ebola outbreak in history was declared a Public Health Emergency of International Concern (PHEIC) by the World Health Organization (WHO) (Klompas *et al.*, 2014). The WHO was initially notified of the outbreak in March 2014, after a febrile illness cluster associated with a high case fatality rate in the area of Gueckedou, Guinea, attracted international attention, and was subsequently identified as the viral zoonosis Ebola (EBOV), formerly known as Zaire Ebolavirus(ZEBV) (Towner *et al.*, 2008). This deadly member of the family Filoviridae, an enveloped, negative single-stranded RNA virus, is the most virulent of the five family members. The other members of the Ebolavirus family are Sudan (SUDV), Tai Forest (TAFV), Bundibugyo (BDBV), and Reston (RESV) sub-types. The sequencing data showed that the 2014 outbreak in West Africa was due to infections with a strain of ZEBV, which differed from the viral strains identified in the earlier outbreaks (Farrar & Piot, 2014).

Regarding the current EBOV outbreak, it is hypothesized that the index case most likely originated via animal — human contact like ingestion of undercooked 'bush meat', animal bite, or inadvertent contact with body fluids or blood from an animal (Briand *et*

al., 2014). Following the index transmission event, the predominant mode of the subsequent viral transmission is human-to-human (Baden *et al.*, 2014). This is consistent with the previous observations and characteristics of human-to-human transmission (Feldmann & Geisbert, 2011). Late in the spring of 2014, the number of reported cases declined, causing medical investigators to believe that the course of this outbreak followed the trajectory of previous outbreaks and that the outbreak's 'burnout' phase had begun (Baize *et al.*, 2014). However, within a period of a few months, sporadic cases were being diagnosed beyond Guinea, including Liberia, Sierra Leone, Senegal, Mali, Nigeria, and most recently in the United States and Spain (CDC, 2014). Some of the reported cases were clearly associated with transmission following a history of travel to the affected regions of Africa (Gire *et al.*, 2014).

In West Africa, the number of new EBOV cases was increasing at an accelerating rate, with a number of factors contributing to this phenomenon, including poorly functioning healthcare, under-developed water and waste management systems; a degree of international complacency, population movement within the affected geographic areas (including rural-to-urban migrations); increasing urban population density; local cultural factors (e.g., burial customs); widespread poverty; and a lack of responsiveness from the local and national governments (McCarthy, 2014). To make things worse, there was a shortage of physicians in West Africa (Chan, 2014). For example, before the outbreak, less than a 100 physicians were providing healthcare for 4.3 million people in Liberia (House, 2014). The fact that numerous healthcare workers were themselves becoming

infected with Ebola (including over a 100 healthcare workers who died as of late August 2014) further complicated the already critical situation (Boozary, Farmer & Jha, 2014)

It was noted that the global response to the current epidemic was initially slow, disorganized, financially constrained, and poorly planned and executed (Mills *et al.*, 2011). As it confronts the possibility of as many as 10,000 new cases per week, the international medical community had to realize that the confluence of circumstances and factors beyond human control could not always be in the society's favor, as it were within the last decade, with Influenza H1N1, Influenza H5N1, Hantavirus, or the Severe Acute Respiratory Syndrome (SARS (WHO, 2014). In the face of easy movement across relatively porous borders (intercontinental travel) in an age of super highways, fast rail, and air travel, all 'corners' of the planet have become reachable in a matter of hours, making cities such as Lagos, New York, Tokyo or New Delhi, with populations exceeding 12 million, easily vulnerable (Youde, 2014). In fact, a recently 'imported' case of Ebola in New York City should serve as a wakeup call and a global stimulus for both local and global coordinated action (Smith & Hoije, 2014).

It is important to note that initial care in the first documented US case of Ebola may have been delayed due to poor recognition of the patient's disease symptoms (Fisher-Hoch, 2005). The diagnosis of two healthcare workers from the same hospital and the possible threat of spread of infection to people who had been in close contact with these subsequent cases have threatened a chain of transmission events (Stephenson, 2014). This chain included a number of potentially exposed individuals on a commercial airline

flight from Ohio to Texas on which an individual possibly experiencing early symptom of Ebola may have traveled (Farrar & Piot, 2014).

1.1.1 Jomo Kenyatta International Airport

Jomo Kenyatta International Airport, formerly called Embakasi Airport and Nairobi International Airport, is Kenya's largest aviation facility, and the busiest airport in East Africa. The airport is named after the first Kenyan prime minister and president, Mzee Jomo Kenyatta and is located in Embakasi, 15 kilometers to the south-east of the Nairobi Business District. JKIA has direct flight connections to Europe, the Middle East, Far East and the African Continent. Its importance as an aviation center makes it the pace setter for other airports in the region. The Airport serves a daily average of 19,000 Passengers from Africa, Europe and Asia and is now fully operational following the August 7th, 2014 fire incident with expansion plans already in place to make the aerodrome an even better airport.

1.2 Statement of the problem

According to Center for Disease Control and Prevention (2016), by April 2016, there were 28,616 cases of Ebola and 11,310 deaths in Guinea, Sierra Leone and Liberia. In addition to lost lives, the disease dealt a severe economic blow to families and governments, especially in West Africa. Closed borders and abandoned farms were driving up food costs leaving many people in rural communities hungry. Emergency spending on health services had drawn money from already cash-strapped government budgets.

From the beginning of the year 2014, the country was on high alert following the Ebola outbreak in West Africa. However, health workers screening travelers for Ebola at JKIA complained of poor equipment, lack of follow-up on passengers and low morale. The workers said the gun thermometers they used were not reliable, as they gave different readings. According to the workers, there was no follow-up on screened travelers from the Ebola-hit countries after 21 days, as required (Center for Disease Control and Prevention, 2016).

For 12 months in 2014, the outbreak of Ebola disease in West Africa dominated the world. Kenya banned flights from Sierra Leone and Liberia as a precautionary measure in preventing the disease from entering its territory. This situation resulted in screening of all passengers leaving international airports, seaports, and major ground crossings as directed by the UN health agency. The challenges then were that there was no adequate capacity and screening procedures, health workers were not provided with proper protective clothing and equipment, they stood the risk of getting infected with the virus and when infected with the virus, they would become agents of transmission. Taking into account that a daily average of 19,000 passengers from Africa and other regions come into the country through Jomo Kenyatta International Airport, Kenya stood the risk of admitting some cases of Ebola into the country (Murumba, 2017).

Therefore, this prompted the researcher to carry out a case study at the Jomo Kenyatta International Airport, Nairobi to find out whether the screening for Ebola disease was efficient and effective. The study was carried out at Jomo Kenya International Airport, Nairobi in the year 2015 during the month of December up to February, 2016.

Various studies have been conducted on Ebola screening in various countries. For instance, McCarthy (2014) did an investigation on US increases Ebola screening at five airports, Kumana, Cheung and Chan (2014) conducted a study on airport screening for Ebola: Current thermal scanning procedures are unreliable; Mabey, Flasche and Edmunds (2014) did an investigation of airport screening for Ebola. However, none of these studies was conducted in Kenya or in Africa and hence the findings cannot be generalized to the Kenyan situations. In addition, these studies did not outline how capacity and screening procedures influence the effectiveness of Ebola screening. This study seeks to fill this gap by evaluating the preparedness and screening procedures for Ebola at Jomo Kenyatta international airport.

1.3 Justification

This study is of great importance to the management of the health department at Jomo Kenyatta international airport as it provides information on how health personnel skills and adequacy affect the effective screening of Ebola virus. This information may be used as a basis for developing a training plan and recruiting staff.

The study also informs policy makers on the effectiveness and factors affecting effectiveness of screening of Ebola virus at Jomo Kenyatta international airport. This may help them to make informed and evidence based decisions and formulate policies to improve screening at Jomo Kenyatta International Airport as well as other ports of entry in Kenya.

To the body of knowledge on the state and extent of screening of visitors for Ebola disease, the study adds more information on the influence of various factors like process of screening, availability of facilities and equipment, health personnel skills and health personnel adequacy on the effective screening of Ebola virus. The study also forms a base upon which further studies can be conducted on effective screening of Ebola virus disease at ports of entry centers.

1.4 Research Questions

The research questions of this study were: -

i) What personnel and cadres are there available for screening passengers for Ebola disease at the Jomo Kenyatta International Airport
ii) What is the process of screening passengers for Ebola disease at the Jomo Kenyatta International Airport
iii) What kind of facilities are available for screening passengers for Ebola disease at the Jomo Kenyatta International Airport
iv) What level of skills do the health personnel have in the screening of passengers for Ebola disease at Jomo Kenyatta international Airport

1.5 Objectives

1.5.1 General Objective

To evaluate the preparedness and screening procedures for Ebola at Jomo Kenyatta International Airport, Nairobi.

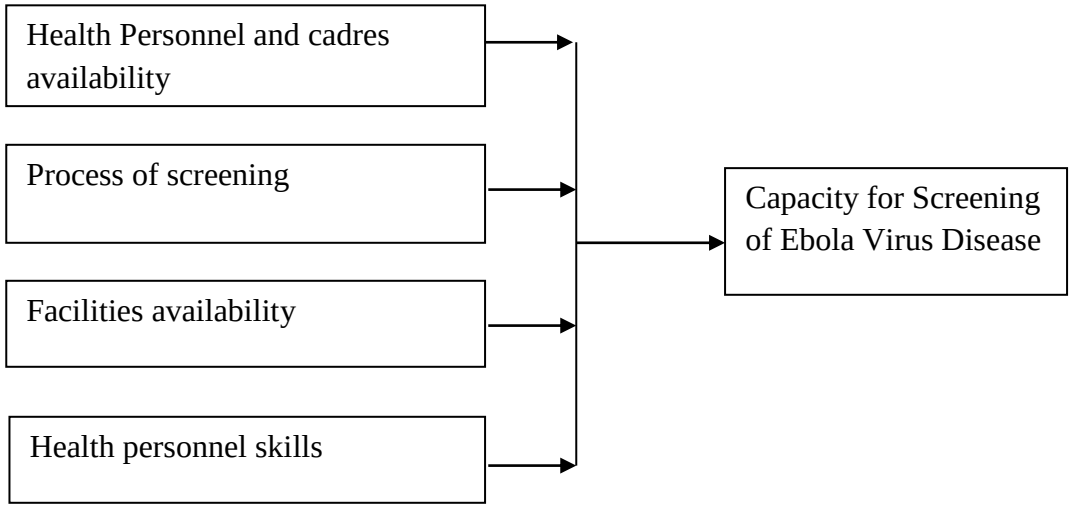
1.5.2 Specific Objectives

The specific objectives of this study were: -

i) To determine the personnel and cadres available for screening passengers for Ebola disease at the Jomo Kenyatta International Airport
ii) To describe the process of screening of passengers for Ebola disease at the Jomo Kenyatta International Airport
iii) To determine the facilities available for screening passengers for Ebola disease at the Jomo Kenyatta International Airport
iv) To determine the health personnel skills in the screening of passengers for Ebola disease at Jomo Kenyatta international airport

1.6 Conceptual Framework

This study seeks to evaluate the preparedness and screening procedures for Ebola at Jomo Kenyatta international airport. The independent variables will be the health personnel cadres and availability, the process of screening, availability of facilities and equipment, health personnel skills. On the other hand, the dependent variable will be the capacity for screening of Ebola virus disease at Jomo Kenyatta International Airport.



Independent Variables **Dependent Variable**

Figure 1.1: Conceptual Framework

CHAPTER TWO

LITERATURE REVIEW

2.1 Epidemiology of Ebola virus

Ebola Virus Disease is not an immunogenic disease with specific natural seasonality, and it can spread throughout the year as suggested by the historical data of Ebola epidemic outbreaks (Table 2.1). In 1976, the first reported EVD outbreaks occurred in Sudan and DRC. Sudan ebolavirus (SUDV) and Zaire ebolavirus (EBOV), which caused these two epidemics, respectively, were the first two human pathogenic Ebola virus species isolated. Within a long period, only a small outbreak was reported in 1979, which occurred in the same area as the 1976 Sudan epidemic (Chowell & Nishiura, 2015). From 1994 to 1997, several EVD outbreaks were reported in Gabon and Zaire, and another human pathogenic Ebola virus, Tai Forest Ebola virus (TAFV), was isolated from a single case during this period. Since 2000, the number of the EVD outbreaks has increased in the African continent, making the EVD epidemic a major public health concern in Africa. While EBOV and SUDV were responsible for almost all, Bundibugyo virus (BDBV), which first emerged in 2007 in Uganda, and then reemerged in 2012 in DRC, was also able to cause an epidemic. Although, the World Health Organization (WHO) classified Kenya as a "high-risk" country for the spread of the deadly Ebola virus, there has been no confirmed case of Ebola virus (Pouris & Yuh-Shan, 2016).

So far, EVD is mainly endemic to the African continent, especially in West Africa. Other countries, such as the United States, Thailand, United Kingdom, Canada, and

Spain had sporadic and possibly imported Ebola cases (Palich *et al.,* 2016). The natural environment of the African continent provides a favorable condition for the survival of Ebola virus. First, the natural and alternate hosts of Ebola virus such as fruit bats, apes, and monkeys are widely distributed in Africa. Second, according to the historical data, EVD mainly distributes between 10° north and south of the equator, with the temperature that benefits Ebola virus survival throughout the year (Liu *et al.,* 2015).

The effective reproduction number, Rt, which measures the average number of secondary cases generated by a typical primary case at a given calendar time, can be helpful to understand the EVD transmission dynamics over time in affected countries as well as gauge the effect of control interventions. Values of $Rt<1$ indicate that the epidemic is in a downward trend. By contrast, an epidemic is in an increasing trend if $Rt>1$. The mean reproduction number for EVD has been estimated at 1.83 for an outbreak in Congo in 1995 and 1.34 in Uganda in 2000 prior to the implementation of control interventions (Chowell & Nishiura, 2015).

Table 2.1: Epidemic outbreaks of Ebola virus disease, 1976 to 2014

Year	Starting month	Area	Species	Cases, n	Deaths, n	Fatality
1976	June	South Sudan	SUDV	284	151	53.2%
1976	September	DRC	EBOV	318	280	88.1%
1979	October	South Sudan	SUDV	34	22	64.7%
1994	June	Gabon	EBOV	52	31	59.6%
1995	April	DRC	EBOV	315	250	79.4%
1996	February	Gabon	EBOV	60	45	75.0%
2000	August	Uganda	SUDV	425	224	52.7%
2001	October	DRC/Gabon	EBOV	122	96	78.7%
2002	December	DRC	EBOV	143	128	89.5%
2004	May	Russia	EBOV	1	0	0%
2007[b]	April	DRC	EBOV	264	187	70.8%
2007	December	Uganda	BDBV	149	37	24.8%
2012	November	Uganda	SUDV	14	7	50.0%
2012	June	DRC	BDBV	52	25	48.1%
2014	March	West Africa	EBOV	19065	7388	38.8%
2014	October	Spain	EBOV	1	0	0%
2014	September	United states	EBOV	5	1	20%
2014	December	Britain	EBOV	1	0	0%

Source: Liu *et al.* (2015)

Ebola is highly infectious in the sense that contact with just a few particles of the virus will be enough to get someone sick. However, it is not so contagious in that the sickness is not easy to transmit. In fact, a person infected with Ebola is not contagious until they start showing symptoms. Should symptoms not present themselves; an individual can be infected without being contagious (Liu *et al.,* 2015).

The Ebola outbreak was a disaster for the International Health Regulations (IHR)—the main international legal rules supporting global health security. The outbreak highlighted dismal compliance with IHR obligations on building national core public

health capacities. During the outbreak, WHO failed to exercise authority it has under the IHR. Many WHO member states violated the IHR by implementing travel measures more restrictive than WHO recommended under the IHR and that lacked scientific and a public health rationale as the IHR requires (Baize et al., 2014).

2.2 Virus Transmission

Fruit bats are considered to be the primary reservoirs of filoviruses and are thought to contribute to the viral transmission, to both non-human primates and humans. According to the Centers for Disease Control (CDC), the modes of Ebola transmission include the following — contact with blood or body fluids of a person who is sick with or has died from Ebola, coming in contact with contaminated objects like needles and touching infected animals, their blood or other body fluids, or bush meat (Feldmann & Geisbert, 2011).

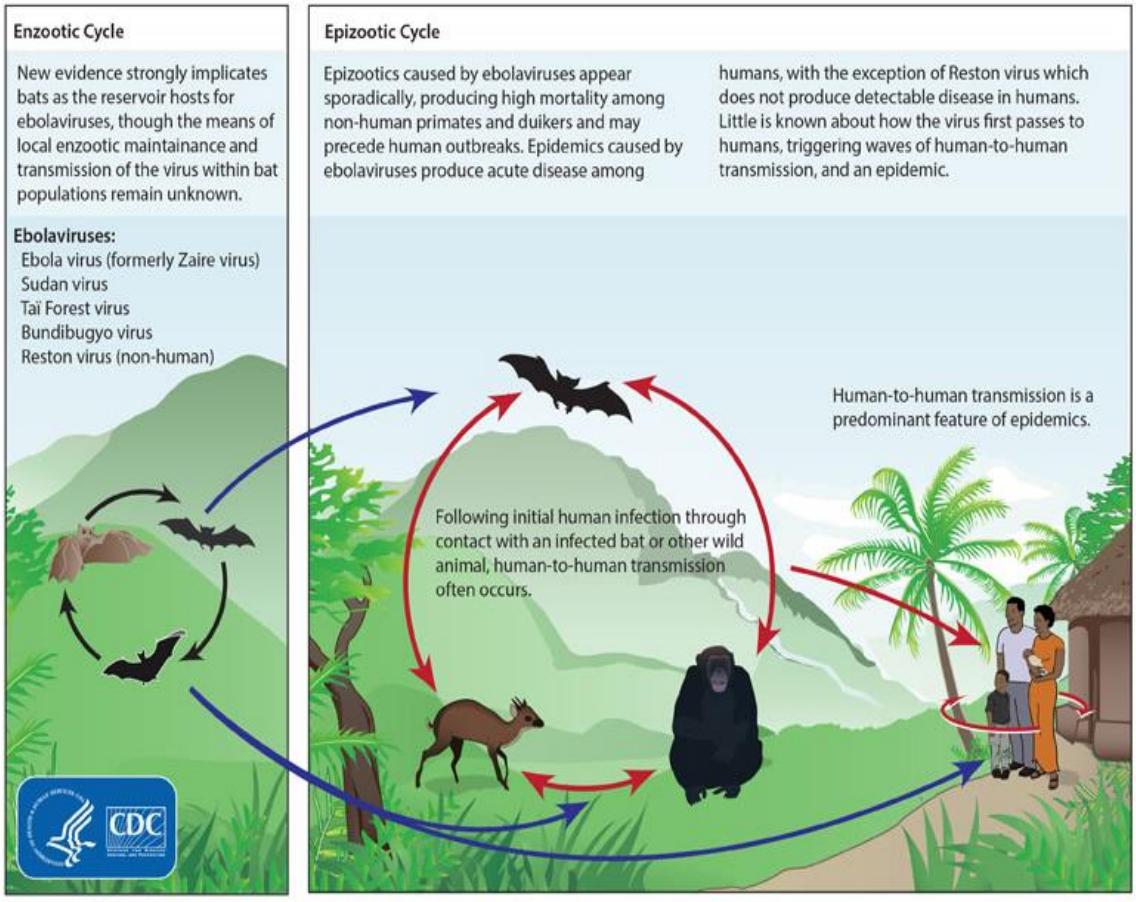


Figure 2.1: Ebola virus transmission from fruit bats to humans.

Source: Centers for Disease Control and Prevention (2014)

2.3 The Life-Cycle of the Virus

2.3.1 Host immune system attack

The early targets of the virus are the monocytes and the macrophages of the host immune system. Other target cells include dendritic cells, liver cells, and endothelial cells. Ebola virus employs different mechanisms to interfere with or even ignore the host immune system completely (Fisher-Hoch, 2005). Most of these host immune system

attack processes involving the virus' structural proteins. One such mechanism is called the antibody-dependent enhancement (ADE) wherein the host antibodies (Abs), facilitate or enhance the virus's attachment to the host cells increasing infection in these cells (Gulland, 2014). The Abs binds to antibody receptors at their Fc sites while the virus binds to the antigen-binding site at the free end of the Abs. *In vitro* studies in Ebola showed that the virus activates the classical pathway of the complement system. Initially, the Ebolavirus binds to its receptor on the host cell surface. Following this, Abs bind to the glycoprotein (GP) spikes of the virus, and the C1q component of the complement system binds to the Ab-GP complex (Jin, 2014). The C1q component enhances the Ab-GP complex to bind to C1q ligands on the host cell surface thus increasing the interaction of the virus with its receptor on the host cell surface. This way, the GP spikes on the virus use the host immune system (Abs and the complement components) to enhance its attachment to the target cells.

In addition to ADE, the virus' protein VP35, blocks the immune system's interferon (IFN) pathways comprising of various cytokines that exert anti-viral responses. VP35 blocks IFN response by competing with the proteins such as retinoic acid-inducible gene 1 (RIG1) protein to activate the IFN pathway. Along with VP35, VP24 also blocks IFN pathway activation. VP24 blocks transcription factors like STAT1 that regulate transcription of the immune system genes. As aforementioned, the primary mRNA transcript of the GP gene encodes the soluble sGP which is speculated to have an anti-inflammatory role during infection which further enhances the virus' escape from host immune system response (Klompas *et al.,* 2014). Moreover, sGP has many similar

epitopes with GP, so it could potentially sequester or absorb host Abs to block their downstream action. Thus, the viral proteins disrupt different components of the immune system to attach to the host cell for subsequent entry.

2.3.2 Virus entry into the host cell

The exact mechanism by which the Ebola virus enters host cells remains poorly understood. One general mechanism to infect host cells for most enveloped viruses including the Ebola virus is endocytosis. Research indicates that the virus utilizes a lipid-dependent, non-clathrin and dynamin-independent endocytic pathway of entry. Macropinocytosis is the most likely mechanism employed by the Ebola virus (Kumana, 2014). This process involves outward extensions of the plasma membrane formed by actin polymerization, which can fold back upon them. The distal loop ends of these extensions or membrane ruffles can fuse to form a macriopinosome. This also means that actin and its associated polymerizing proteins play a pivotal role in virus entry. The exact mechanism by which the virus induces macropinocytosis is not understood. It is speculated that interactions between GP and host cell surface receptors can trigger macropinocytosis to initiate viral entry (Bhattacharyya, Mulherkar & Chandran, 2012).

2.3.3 Virus replication

Once inside the host cell, the virus initiates transcription at the leader end of the genome with the binding of the polymerase complex. VP30 is an important transcription activation factor for viral genome transcription, while VP24 is an inhibitor to this process. The exact mechanism of VP24-dependent transcription termination is not fully

understood, but it seems to be important for converting the virus from its transcriptional or replication active form to one that is geared for virion assembly and exit from host cell (McCarthy, 2014).

2.4.4 Virus budding and exit from host cell

Following replication, the cell loses its connection with other cells as well as attachment to its substrate. Meanwhile, the newly synthesized genomes are packaged into new buds or virions and egresses from the host cell surface with the help of the matrix protein VP40. VP40 interacts with ubiquitin ligase Nedd4 which is a part of human ubiquitination enzyme pathway and links multiple copies of ubiquitin molecules to VP40. VP40 itself is transported to the host cell plasma membrane using the COPII transport system. Once in the plasma membrane, the virus moves through lipid rafts where the final assembly and budding of the virions occur, before their final exit from the host cell (Sobarzo *et al.*, 2013).

Although the structural components of the virus are known, the exact mechanisms by which it causes disease in humans are not completely understood. This poses a major challenge for treatment and to date prevention is the best mode of action to avoid an Ebola outbreak.

2.4 Pathogenesis

The pathophysiology of Ebola is not yet fully understood, however, most studies report that the incubation period varies depending on the type of exposure (i.e., six days for percutaneous and ten days for contact exposure). The WHO Ebola response team's

findings have documented that the mean incubation period was 11.4 days, which did not vary by country. Following viral transmission, symptoms usually appear in approximately eight to ten days (range, 2-21 days) (Geisbert *et al.*, 2004).

After EBOV enters the human body, macrophages and dendritic cells are generally considered as the first cells to be infected. The virus then proliferates rapidly within these cells, releasing multiple new copies into the extracellular fluid. Spread of the virus into the regional lymph nodes amplifies the viral load in the body, causing further viral dissemination to the lymphoid and vascular tissues. Subsequently, a systemic inflammatory response is initiated, resulting in cytokine and chemokine release from the infected macrophages and other cells. This constellation of innate host responses is considered to be responsible for the prodromal symptoms (Sobarzo *et al.*, 2013).

2.5 Screening Procedures of Ebola virus disease

The screening for Ebola Virus Disease can be classified into two: primary screening and secondary screening.

2.5.1 Primary Screening

Primary screening is a process that identifies travelers that may be symptomatic with or were possibly exposed to Ebola. This initial screening can be conducted by a workforce without public health or medical training. Activities include: observing travelers for the signs of disease, temperature screening, and the distribution, collection, and review of a public health questionnaire to determine risk. Primary screening evaluates all travelers

and identifies those that need further evaluation of illness or are at risk of Ebola exposure (Centers for Disease Control and Prevention, 2015).

Travelers who exhibit signs or symptoms consistent with Ebola are referred to secondary screening for further evaluation. Boarding is denied until further assessment and recommendations are made during the secondary screening process. Persons exhibiting any of the following symptoms are referred to secondary screening: fever greater than 38.0 degrees Celsius or 100.4 degrees Fahrenheit, or feeling feverish; severe headache; muscle pain; vomiting; diarrhea; stomach or abdominal pain; and unexplained bleeding or bruising (Centers for Disease Control and Prevention, 2015).

Travelers who have been determined through primary screening to be at risk for Ebola exposure are also referred to secondary screening for further assessment even if they are not exhibiting any symptoms or signs of disease. Risk of Ebola exposures is assessed by using a public health questionnaire during the primary screening process. These travelers are also denied boarding until a further assessment of risk is conducted in the secondary screening process. The types of activities which put travelers at risk for Ebola exposure include: Caring for confirmed Ebola patients either at home or in a healthcare setting without the appropriate use of personal protective equipment (PPE); engaging in the preparation of bodies or burial rites for those who have died from Ebola; and working in a laboratory where Ebola samples are processed without using appropriate PPE or following biosafety precautions (World Health Organization, 2014).

Travelers complete a primary screening form to assess risk of exposure and self-report any symptoms they have experienced within the past 48 hours. Primary screening

personnel review the answers to this questionnaire, while also observing travelers for the symptoms and signs of disease that are consistent with Ebola, and conduct a non-contact temperature screening. If a traveler answers “yes” to any of the questions on the questionnaire, he or she is referred to secondary screening for further evaluation. Travelers who exhibit signs of disease or report symptoms consistent with Ebola are also referred to secondary screening (World Health Organization, 2014).

In addition, travelers with fever of 38.0 degrees Celsius or 100.4 degrees Fahrenheit or higher during primary temperature screening or those who report feeling feverish are also referred to secondary screening. All travelers who have been referred to secondary screening are denied boarding until further evaluation and assessment of risk exposure can be conducted during secondary screening.

Travelers may continue traveling if: all answers to questions on the public health questionnaire are “no”; they do not appear to exhibit any of the signs and or report any symptoms of disease; and they do not have a fever of 38.0 degrees Celsius or 100.4 degrees Fahrenheit or higher.

2.5.2 Secondary Screening

The secondary screening process builds upon the primary screening process by further evaluating travelers identified during primary screening. Secondary screening is conducted by a workforce with public health or medical training. Activities include: in-depth public health interview to assess risk and a brief focused physical exam, which includes a second temperature measurement. Final determinations about travel

restrictions, referral for medical evaluation, or treatment as well as the notification of proper public health authorities should be made following secondary screening (Centers for Disease Control and Prevention, 2015).

Individuals identified in primary screening undergo an in-depth public health, secondary screening interview conducted by a public health or medical professional. During this secondary screening interview, responses to the public health questionnaire are verified and a brief focused physical exam, including a second temperature measurement, are conducted. Primary screening questionnaires are attached to secondary screening interview forms to assist in record keeping (World Health Organization, 2014).

Travelers who exhibit clinical signs and symptoms consistent with Ebola as confirmed by the secondary screening interview and examination are denied boarding and referred for additional medical evaluation and treatment. Appropriate public health authorities are notified as part of this process.

Travelers who are confirmed by the secondary screening interview to be at risk for exposure to Ebola are denied boarding until after the 21-day incubation period has expired. These travelers are given communication materials with messages about the outbreak and where to seek treatment if symptoms develop. Additional travel restrictions are implemented. Appropriate public health authorities are also notified as part of this process (World Health Organization, 2014).

All travelers who have been referred to secondary screening are denied boarding until further evaluation and assessment of risk exposure is completed during secondary screening. Secondary screeners complete a Secondary Screening form with all travelers

who are referred to secondary screening including a second temperature check with a non-contact thermometer and more in-depth questions about signs, symptoms, and exposures. Decisions to deny boarding and recommend either further medical evaluation or treatment or travel restrictions are implemented as described above with consideration of guidance from public health authorities (Centers for Disease Control and Prevention, 2015).

Travelers may continue traveling if: they have no known risks for Ebola exposure as determined by the secondary screening public health interview; they do not appear to exhibit any of the signs or report any symptoms consistent with Ebola as determined by the secondary screening public health interview; and they do not have a fever 38.0 degrees Celsius or 100.4 degrees Fahrenheit or higher, as verified during the secondary screening.

2.6 Clinical Features and Diagnostic Testing

The clinical presentation of Ebola patients' progresses from non-specific 'flu-like' symptoms to multi-organ failure. The mean time from the onset of symptoms to hospitalization is approximately five days (Kalra *et al.,* 2014). After admission, the mean length of stay in the hospital, the mean time to death, and the mean time to discharge are 6.4 days, 4.2 days, and 11.8 days, respectively. With regard to the symptoms, the fevers may be mild during the initial phase of illness, but may evolve to become more abrupt and high-grade, with associated chills and rigors. Non-specific prodromal symptoms are almost always present comprising mainly of malaise, weakness, anorexia, severe headache, and pain in the truncal and lower back muscles.

High fever with relative bradycardia mimicking the presentation of typhoid fever has also been reported. Progressive, diffuse, erythematous, non-pruritic, maculopapular rash around the face, neck, trunk, and arms usually appears by the end of the first week (Wolz, 2014).

As the disease progresses, gastrointestinal symptoms such as diarrhea, nausea, vomiting, and abdominal pain begin to develop. Although bleeding is not seen in the early phase, there may be a gradual appearance of petechiae, ecchymoses, prolonged bleeding from the venipuncture sites, and mucosal hemorrhage, as the disease progresses. Patients who recover from Ebola infection have been reported to show clinical improvement by the middle of the second week (Kalra *et al.*, 2014).

Various derangements in the hematological profile characterized by leukopenia, thrombocytopenia, elevated transaminases, proteinuria, and elevated prothrombin, and thromboplastin times can be seen, and are associated with worse prognosis. The confirmatory diagnosis for Ebola involves detection of the viral antigens or RNA in the blood or other body fluids. Until recently, testing could only be performed in specialized laboratories, and relied on detection of the RNA sequence by reverse-transcription polymerase chain (RT-PCR) reaction or viral antigens by an enzyme-linked immunosorbent assay (ELISA) within three to ten days of onset of symptoms. However, newer rapid diagnostic methods are quickly evolving, and are expected to be available for deployment in the near future (Kumana, 2014).

2.6.1 Effective Screening for Ebola Virus Disease

There is an ongoing debate about the screening of individuals from Ebola-affected countries, who are traveling abroad, with some experts questioning the usefulness of routine traveler screening (Mabey, Flasche & Edmunds, 2014). Although there are no available statistics to support the effectiveness of screening methods used in the current Ebola epidemic, data from the SARS epidemic airport screening in Canada demonstrated that of the 677,494 who completed the screening questionnaire, 2,478 answered with a 'yes' to one or more questions, and among those, none went on to develop SARS (King, 2005). Six major airports installed thermal scanners and screened 467,870 people, of whom 95 suspected 'positives' were further assessed. None of them went on to develop SARS. The total cost of the program was 17 million Canadian dollars (Kalra *et al.* 2014).

From the Ebola case in Texas, it has been recognized that a delay in diagnosis was sufficient enough to create a 'near-panic' situation (Feldman, 2014). Employing adequate screening protocols and ensuring that the 'front-line' personnel are familiar with pertinent policies is of special importance. In order to contain the spread of Ebola, it is of paramount importance to ensure that the medical staff in the Emergency Departments is prepared, that appropriate screening and isolation policies are in place, and that vigilance and clinical suspicion are sufficient enough to readily identify individuals who have recently traveled to EBOV-affected areas or who may have been in contact with an actively symptomatic Ebola patient, keeping in mind the pertinent incubation periods and other key information about the characteristics of the virus.

Despite the significant resources needed to institute such efforts, the societal benefits of limiting or arresting the spread of Ebola outbreak (s) will far outweigh the costs of such concerted initiatives (Luyten, 2014).

Active surveillance is a public health approach that consists of the ongoing, systematic collection, analysis, and interpretation of key clinical data, closely integrated with a prompt dissemination of such data to officials responsible for control and prevention of disease. In case of Ebola, active surveillance consists of close supervision by health officials, with systematic collection of vital signs, and monitoring of key clinical symptoms associated with the early course of clinical infection. The use of active surveillance is critical for containing the outbreaks of Ebola, especially in the densely populated urban settings where human-to-human transmission predominates (Allaranga *et al.*, 2010). It has been recommended that the coordinated response to Ebola outbreaks should include sufficiently funded national and regional interdisciplinary surveillance response systems that incorporate early warning capabilities.

2.6.2 Health Personnel Cadres and Availability

Push and pull factors encouraging nurses to migrate have been discussed extensively in some studies. Push factors are influences that arise from within the source country and facilitate a potential migrant's decision to leave (Pitman *et al.*, 2005). Pull factors reflect actions and omissions of recipient countries that create the demand for, or encourage potential migrants to leave home. These factors cover a broad range of issues including income (or remuneration) levels between source and destination countries; job

satisfaction and perceptions of the work environment and ability to utilize one's professional skills; the organizational environment and career opportunities as well as workers' perceptions of trust in the management of health services; general political and administrative governance; encompassing bureaucratic efficiency and fairness; occupational risk and protection because of HIV/AIDS and poor availability of protective gear; and the welfare, security, and benefits of health professionals during employment and after retirement (Mills *et al.*, 2011). The U.S. government and its allies combating Ebola in West Africa have been frantically recruiting health workers to care for thousands suffering from the killer virus, but while more people are volunteering, finding enough qualified personnel has proven difficult (Allaranga *et al.*, 2010).

Klompas *et al.* (2014) argue that due to severe shortages of health workers and clinics, the majority of people infected with Ebola in Liberia are without access to medical care and treatment. Inadequate access to health personnel and facilities is also a problem in Sierra Leone and Guinea. Human resource constraints and concerns about conditions in health centers are prompting people to care for the ill on their own, facilitating the spread of the virus. The shortage of medics and health facilities also means that people needing care for non-EVD related issues have nowhere to go.

According to Robinson (2014), Sierra Leone is struggling in its fight against Ebola because so many medics have left for jobs in Britain, it has been claimed, amid reports the country's health centers are overflowing with victims. The exodus of doctors and nurses to the UK and other wealthy countries left the West African state 'woefully short' of trained medical staff when the deadly virus struck. It comes as the death toll from the

epidemic increased to 6,915 out of 18,603 cases and as Sierra Leone authorities launched a fresh operation to contain the virus.

2.6.3 Process in screening

Since the beginning of August 2014, CDC has been working with airlines, airports, ministries of health, and other partners to provide technical assistance to countries with Ebola outbreaks. CDC has helped affected countries screen departing travelers from these countries (exit screening). Exit screenings are conducted at airports in these outbreak-affected countries to look for sick travelers or travelers exposed to Ebola and to delay them from boarding an airplane until it is safe for them to travel (Kumana, 2014).

Exit screening might look a little different in each country but contains the same basic elements. The first basic element involves all travelers where they have their temperature taken, answer questions about their health and exposure history and are visually assessed for signs of potential illness (Mabey, Flasche & Edmunds, 2014). The next element involves travelers with symptoms or possible exposures to Ebola are separated and assessed further. The third basic element is where the assessment determines whether they are allowed to travel or not allowed to travel on a commercial flight and referred to public health authorities for further evaluation (Parkes-Ratanshi *et al.*, 2014).

Because of the Ebola outbreak, CDC and Customs and Border Protection (CBP) have begun doing enhanced entry screening of travelers who have been in Guinea, Liberia,

and Sierra Leone. By doing enhanced entry screening at five (5) U.S. airports, CDC evaluates over 94% of travelers from the affected countries (McCarthy, 2014).

Entry screening is a part of a layered approach. When used with other public health measures, entry screening can strengthen efforts to battle this virus. In the United States, the entry screening is for each arriving traveler who has been in Guinea, Liberia, or Sierra Leone. In the first step CBPs' give each traveler a packet of CDC health information that includes information about Ebola, symptoms to look for and what to do if symptoms develop and information for doctors if travelers need to seek medical attention (Gulland, 2014). In the second step CBP take the travelers' temperature, observe them for other symptoms of Ebola, and ask about their exposures and symptoms. In the third step, if a traveler has a fever or other symptoms or has been exposed to Ebola, CBP refers to CDC to further evaluate the traveler. In the fourth step the CDC determine whether the traveler can continue to travel, is taken to a hospital for evaluation, testing, and treatment or is referred to a local health department for further monitoring and support (King *et al.*, 2005; Feldman, 2014).

In England, Public Health England (PHE) is helping to roll out enhanced screening for Ebola starting at Heathrow, then Gatwick and St Pancras (Eurostar), in passengers that Border Force officers identify as having travelled from Sierra Leone, Guinea and Liberia (Public Health England, 2014). Passengers have their temperature taken and complete a questionnaire asking about their current health, recent travel history and whether they might be at potential risk through contact with Ebola patients. Based on the information provided and their temperature, passengers are either given advice or allowed to

continue their journey, or undergo a clinical assessment by PHE staff and if necessary be transferred to hospital for further tests.

2.6.4 Facilities Availability

Besides the huge efforts being put in place for outbreak control and patient care, the preparedness of the laboratory community is thus challenged by another natural hazard (Smith & Hoije, 2014). Indeed, the laboratory environment is only marginally involved in the direct diagnosis of EVD, which is reserved to highly specialized centers in most countries (i.e., typically Bio-safety Level-4 laboratories), but may still be engaged in routine testing of samples from infected patients, especially from those who are considered 'suspect' EVD cases (Fisher-Hoch, 2005). It is thus theoretically possible that healthcare staff, including laboratory personnel, may come into contact and become regrettably infected while managing patients' specimens. This should be seen as a tangible threat, considering that the incubation period of the EVD is typically comprised between 2 and 21 days and blood samples usually begin to test positive on polymerase chain reaction (PCR) only 24 hours before the onset of the symptoms (Stephenson, 2014).

As of 25th August, 2014 more than 250 health care workers had developed the disease in Guinea, Liberia, Nigeria, and Sierra Leone, and more than 120 have died. The demise of these health workers in these affected countries means a deprivation of not only experienced and dedicated medical care but also inspiring national heroes. Consequently, any ordinary worker who falls ill and visits the clinic or hospital may not

receive adequate care and treatment from health workers and may have to spend some amount of his/her productive hours at the health center (Feldmann & Geisbert, 2011).

In order to prevent any potential occasion of contamination and/or infection, clinical laboratories should adopt restrictive measures to handle biological materials, which are potentially contaminated with Ebola virus. As specifically regards sample collection and shipment, it is recommended that phlebotomists should wear gloves, water-resistant gowns, full face shield or goggles, and masks to cover nose and mouth. Adjunctive personal protective equipment (PPE) (i.e., double gloving, overshoes or particulate respirators) may be required in certain situations, such as in the presence of copious amounts of body fluids in the environment (Jin, 2014).

With regard to healthcare worker protection and prevention of healthcare-related transmission of Ebola, many opportunities for improvement have been identified, based on the previous outbreaks. It is critical that the medical community learns from the previous mistakes so that emphasis in the fight against Ebola can shift toward preparing healthcare systems and organizations, establishing better disease surveillance systems, and restoring the trust in health services across affected communities (Geisbert *et al.*, 2004).

Patients infected with EBOV, who seek emergency care, expose ‘front-line’ healthcare workers to significant risk of contracting the infection. Considering the highly contagious nature of the body fluids from individuals with symptomatic infection, dealing with Ebola mandates that healthcare workers follow standard safety precautions

rigorously in order to safeguard themselves and the people with whom they interact (Sobarzo *et al.*, 2013). The critical nature of the personal protective equipment (PPE) in cases of Ebola and the risk of transmission despite taking apparently adequate precautions is exemplified by the two cases of patient-to-nurse viral transmission in Dallas, Texas, one case in Spain, and the recently diagnosed case in New York City. It is important to note that special circumstances requiring heightened vigilance regarding personal protection equipment may arise when caring for patients with Ebola, including the performance of emergency surgery in this population (Wolz, 2014).

Detailed illustrated guidelines have been provided by the WHO regarding the use of protective equipment and handling of potentially infectious Ebola samples. Any biological specimens or samples obtained from EBOV patients should be collected using adequate personal protective equipment, using closed vacuum containers (Lippi, Mattiuzzi & Plebani, 2014). The samples should be transported in leak-proof containers and kept separately from other patient samples. For blood work of patients suspected with EBOV, under no circumstances should manual pipetting and open centrifugation be considered. After the laboratory tests are concluded, disinfectants with a higher potency (preferably, 10% chlorine solution) to kill the virus should be used. Elimination of all infectious materials should be conducted according to the prevailing/approved local protocols, rules, and regulations. It is important to note that the actual approach to bio-hazardous waste disposal has to take into consideration specific economic-based realities and circumstances across different geographic areas. Pertaining to this, it is critical that adequate training of the medical transportation personnel is conducted, to ensure safe

and transmission-free transit of the infected patients and/or infectious materials (Kumana, 2014).

In 2014, the government of Kenya announced that all airlines flying to Ebola-stricken West Africa and transiting through Kenya will have their passengers screened. The decision affected Ethiopian Airlines and Rwanda Air, two carriers that fly to the region. At that point Kenya Airways stopped flying to the worst-hit countries of Guinea, Sierra Leone and Liberia following a government order. Due to this development the Ministry of Health installed digital thermostats at airports and other ports that would automatically take temperatures of travelers. In addition, an isolation facility was identified at Kenyatta National Hospital and additional isolation facilities were made available at Mbagathi District Hospital in Nairobi, in Uasin Gishu County, Busia County, Kajiado County, Mombasa County and other major towns near ports of entry into Kenya. The Ministry also secured special Personal Protective Equipment which was distributed into strategic regional hospitals for use if needed (Adams, 2014).

2.6.5 Health Personnel Skills

With the increasing cases of Ebola in West Africa in 2014, response teams reported lacking adequate training in case investigation, contact tracing, infection control (including safe burial practices), and health education (Towner *et al.*, 2008; Farrar & Piot, 2014). Only some hospitals reported having teams trained in case investigation and contact tracing at the time of its first reported case. Health officials reported that in West Africa corpses had been transported by persons without prior training in safe burial

practices and health care workers had not received any training in transporting a patient with possible Ebola. Further, health officials reported having no functioning ambulance (Briand *et al.*, 2014).

In Grand Cape Mount and Grand Bassa, only one laboratory technician had been trained to safely collect and handle specimens from a possible Ebola patient, whereas Sinoe health officials reported having no laboratory technicians trained in handling Ebola specimens. In addition, health care workers had a limited supply of personal protective equipment and had not received training in its proper use (Gire *et al.*, 2014).

In the years 2014, Kenya rolled out a countrywide Ebola training in all the 47 counties targeting 60 per cent of all health personnel. The training targeted managers (clinicians, epidemiologists, and health promotion experts), other health workers and major health facilities. It also targeted health personnel at airports and ground crossing. WHO country office deployed over 10 technical personnel to facilitate the training. Other facilitation personnel were from Ministry of Health (MOH) and Kenya Medical Research Institute (CDC, 2014).

The Training of Trainers (ToTs) workshop brought together doctors, nurses and public health personnel from Nairobi and representative counties. The training focused on key subjects on the disease and its spread and management including: prevention and control, transmission, surveillance, laboratory diagnosis and management of patients and the nature of Ebola Virus Disease (EVD). It also covered suspect screening, transportation of patients and management of patients and health facilities. The training

is part of the capacity building function of Kenya's Contingency Plan which was set to handle the preparedness and response to Ebola. The trained personnel form the national rapid response team which is ready and available should there be an outbreak (McCarthy, 2014).

2.7 Summary of Theoretical Framework

From the above literature, we can conclude that effective screening of Ebola Virus faces various challenges in different countries in West Africa and around the world. There has been an ongoing debate about the screening of individuals from Ebola-affected countries, who are traveling to other countries, with some experts questioning the usefulness of routine traveler screening. However, there have been cases, like in Texas, where infected individuals travelled to other countries from West Africa transmitting the virus to healthcare workers. The existing capacity and screening procedures for Ebola are of paramount importance in ensuring effective screening for Ebola virus. The measures of capacity and screening procedures include the process of screening, health personnel skills, health personnel adequacy and facilities and equipment availability.

CHAPTER THREE

MATERIALS AND METHODS

3.1 Study design

The study was a mixed methods research, and hence it used in the collection of data. This study made use of a cross sectional study design. This is a type of observational study that involved the analysis of data collected from a population, or a representative subset, at one specific point in time, cross-sectional data. In this design, researchers recorded the information that is present in a population, but they do not manipulate variables (Indrayan, 2010).

3.2 Study Population

The study population was all the 130 health personnel at the Jomo Kenyatta International Airport. It covered all the Public Health Officers, Doctors, Clinical Officers, Nurses and laboratory personnel working at Jomo Kenya International Airport, Nairobi. The Jomo Kenyatta International Airport, Nairobi was chosen because it is the largest port of entry in Kenya and also it handles the bulk of visitors entering Kenya. This study made use of census method and hence all the staff were involved in the study.

3.3 Sample size determination

The total number of staff manning the health facility and desk at the Jomo Kenya International Airport, Nairobi was 130. This study utilized all the existing staff as the

study population. In this respect, a census rather than a sample was undertaken and the principal researcher had the capacity for the necessary data collection from all these.

3.4 Sampling Technique

The study conducted a census as the target population was small and hence the entire population of 130 health personnel was utilized.

3.5 Data Collection Tools

The study collected primary data by use of questionnaires (Appendix II) and Key Informant Interview guides (Appendix III). The key informants were all the heads of departments and sections working at the Jomo Kenyatta International Airport, Nairobi. The questionnaire was a fast way of obtaining data as compared to other instruments. In addition, Questionnaires gave the researcher comprehensive data on a wide range of factors. The questionnaires contained closed-ended questions and few open-ended questions to encourage higher response rate. Open-ended questions provided the respondents with a chance to express their own personal opinion beyond the researcher's span of knowledge. The use of questionnaire in this study had several advantages, which included its ability to reach all respondents and were economical to use in terms of money and time (Bowers, 2008).

3.6 Pilot Testing

A pilot test was a stage where research instruments were administered to a number of individuals in the target population who were not included in the sample size so as to

test the reliability and validity of the instruments. Content validity was used in this study. This was a measure of the degree to which data collected using a particular instrument represents a specific domain or content of a particular concept. To establish the validity of the research instrument, the opinions of experts in the field of study especially the supervisor were sought. This helped to improve the content validity of the data that was collected. It also facilitated the necessary revision and modification of the research instrument thereby enhanced validity.

Reliability refers to a measure of the degree to which research instruments yield consistent results (Kothari, 2004). The researcher selected a pilot group of 13 individuals from the Wilson Airport to test the reliability of the research instruments. The reliability of the questionnaires was measured statistically by measuring the internal consistency. Internal consistency techniques were measured by use of Cronbach's Alpha. The alpha value ranges between 0 and 1 with reliability increasing with the increase in value. Coefficient of 0.6-0.7 was commonly accepted rule of thumb that indicated acceptable reliability and 0.8 or higher indicated good reliability (Bowers, 2008).

3.7 Data collection procedure

This refers to the means the study used to gather the required data or information (Kothari, 2004). Before data collection, a data collection letter was obtained from the University. The principal researcher recruited 2 research assistant officers and trained them on the basic concepts of the study. Afterwards the researcher approached the management of the department of health at the Jomo Kenyatta International Airport to

be allowed carry out the research. Thereafter the researcher administered the questionnaires and interviews to all the respondents.

3.8 Data Processing and analysis

After confirming that all data filled in was accurate, descriptive statistics was utilized to analyze quantitative data. Descriptive statistics such as frequency distribution, percentages, measures of central tendencies (mean) and measures of dispersion (Std deviation), helped the researcher to significantly explain distribution of measurements and to also explain, organize and review data (Bowers, 2008). The data was then represented in tables and graphs. On the other hand, qualitative data was coded thematically and then evaluated statistically. Content analysis was used to qualitative data, that is, data collected from open ended questions. The results were then presented in form of a prose.

3.9 Ethical Considerations

The study was approved by KNH-UoN ERC (Appendix VII). In addition, a written informed consent was obtained from the respondents before administering the questionnaires. The participants were assured of the confidentiality of information obtained and that the information obtained was to be used for academic purposes only. The information obtained from the study was not to influence patients' diagnosis or treatment.

3.10 Expected Outcome

A research document to inform policy makers and healthcare managers to make informed and evidence based decisions on the state and extent of screening of visitors for Ebola disease at Jomo Kenya International Airport, Nairobi.

CHAPTER FOUR

RESULTS

4.1 General Information

The general information covered the respondents' gender, age bracket, level of education and the number of years they had been working in their institution (Table 4.1).

Table 4. 1: General Information of the Respondents

	Frequency	Percent
Gender		
Male	40	40.8
Female	58	59.2
Age (years)		
Below 25 years	12	12.24
25 to 35 years	21	21.43
36 to 45 years	35	35.71
46 to 55 years	25	25.51
56 to 65 years	5	5.1
Level of education		
Secondary education	4	4.1
College	54	55.1
University	26	26.5
Postgraduate	14	14.3
Duration (years)		
Less than 2 years	10	10.2
2 to 5 years	20	20.4
6 to 9 years	22	22.4
10 to 13 years	6	6.1
More than 13 years	40	40.8

From the findings, 59.2% of the respondents indicated that they were female while 40.8% indicated that they were male. This shows that most of the health personnel working at the Jomo Kenyatta International Airport were female.

According to the findings, 75.5% of the respondents reported that they were aged between 36 and 45 years, 25.5% indicated that they were between 46 and 55 years, 21.43% indicated between 25 and 35 years, 12.24% indicated below 25 years and 5.10% indicated between 56 and 65 years. This shows that most of the health personnel working at the Jomo Kenyatta International Airport were aged between 36 and 45 years.

From the findings, 55.1% of the respondents indicated that they had college education, 26.5% indicated that they had university education, 14.3% indicated that they had postgraduate education and 4.1% indicated that they had secondary education. This shows that most of the staff working at Jomo Kenyatta International Airport had at least college education.

According to the findings, 40.8% of the respondents indicated that they had been working at Jomo Kenyatta International Airport for more than 13 years, 22.4% indicated for between 6 and 9 years, 20.4% indicated for between 2 and 5 years, 10.2% indicated for less than 2 years and 6.1% indicated for between 10 and 13 years. This shows that most of the staff had been working at Jomo Kenyatta International Airport for more than 13 years and hence they had the information on the process of screening for Ebola virus in the airport.

4.2 Personnel and cadres available for screening of passengers for Ebola disease

The first objective of the study was to establish the personnel and cadres available for screening passengers for Ebola disease at the Jomo Kenyatta International Airport.

4.2.1 Personnel Cadres in the Health Department in JKIA

This section covered the categories/cadres that the respondents belong to and the results were as shown in figure 4.1.

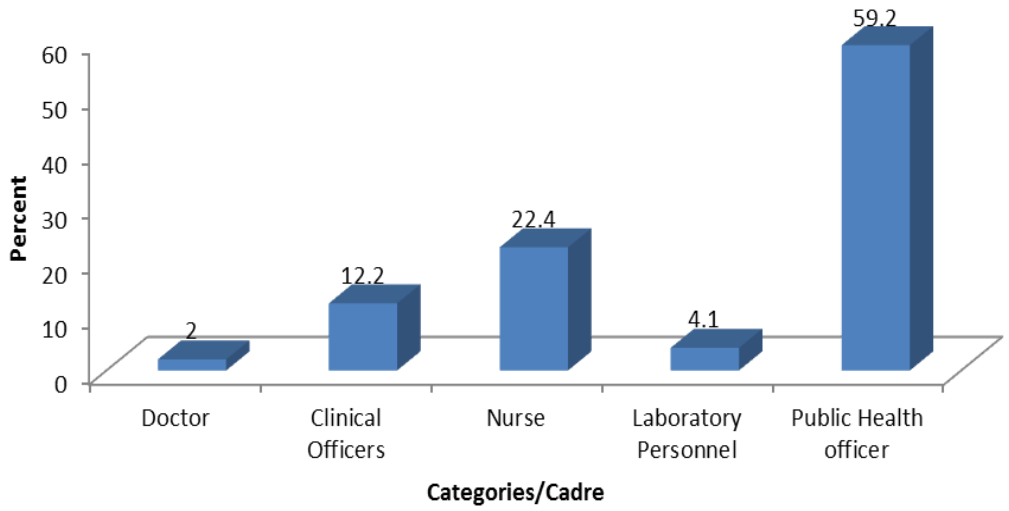


Figure 4.1: Personnel Cadres in the Health Department in JKIA

According to the findings, 59.2% of the respondents reported that they were public health officers, 22.4% indicated that they were nurses, 12.2% indicated that they were clinical officers, 4.1% indicated that they were laboratory personnel and 2% indicated that they were doctors. These findings show that most of the health personnel working at Jomo Kenyatta International Airport were public health officers. The key informants

indicated that the health personnel working at Jomo Kenyatta International Airport include laboratory technicians, public health officers, epidemiologists, clinical officers, nurses, doctors and support staff.

4.2.2 Roles of the personnel in the screening of passengers for Ebola disease

From the findings, the doctors indicated that their roles included clinical examination, treatment and giving of advice to any of the sick passengers. The nurses indicated that their roles included giving first aid and accompanying the suspect to the healthcare facilities. Other roles of the nurses include screening of passengers, quarantine, checking country of origin, history of exposure, notification, triage, isolation, sensitization and sample handling. It was also the role of the nurses to take medical history of the patient and isolate and organize to refer to a hospital of choice KNH. The role of the clinical officers included to examine cases for symptoms or signs as well as to prevent and control infections. The Epidemiologists indicated that their roles include data collection and analysis while the Laboratory personnel indicated that their roles include analysis of samples.

The Public health officers indicated that their roles include screening of patients, sensitization, notification, sample handling, sample processing triage and isolation. The public health officers were also taking temperatures, collecting and verifying information in the scrutiny form and summarizing the information into reports. They were also guiding the passengers through the thermal cameras to pick temperatures, were directing passengers with abnormal temperatures to the clinical staff for further

management and manage quarantine services. The public health officers also identified passengers coming from affected countries in accordance with the disease surveillance forms and take necessary steps.

4.3 The process of screening of passengers for Ebola disease

The second objective of the study was to describe the process of screening of passengers for Ebola disease at the Jomo Kenyatta International Airport.

4.3.1 Availability of a document process for screening of passengers for Ebola disease

The study sought to identify whether they had a document process for screening passengers for Ebola disease (Figure 4.2).

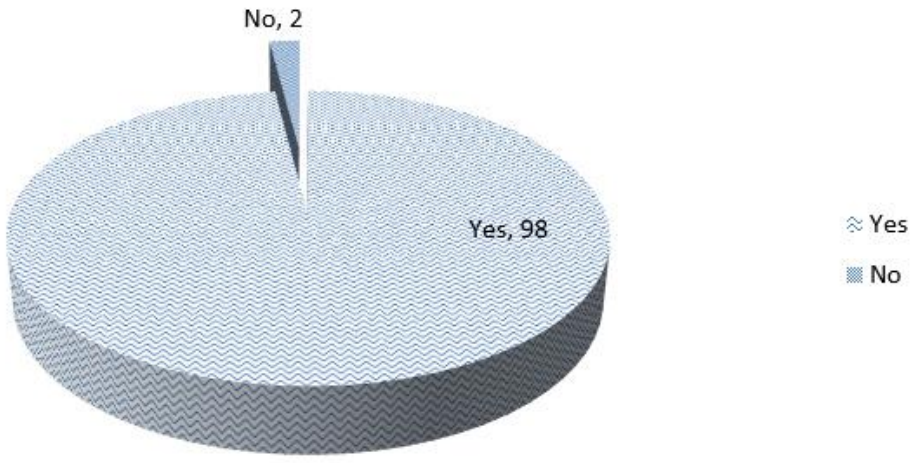


Figure 4.2: Availability of a document process for screening passengers for ebola disease

From the findings, 98% of the respondents indicated that they had a document process for screening passengers for Ebola disease while 2% indicated that they did not. These findings clearly show that there was a document process for screening passengers for Ebola disease at Jomo Kenyatta International Airport.

4.3.2 Steps in Screening of Passengers for Ebola Virus

From the findings, all the respondents (100%) indicated that they followed the step of taking of passengers' temperature of all passengers in screening passengers for Ebola virus. In addition, 93.9% of the respondents reported that the health personnel were asking questions on health and exposure history of all passengers. Also, 98% of the respondents reported that were assessing all passengers for signs of potential illness. Further, 98% of the health personnel indicated that they were separating suspected cases for further assessment. In addition, 85.7% of the health personnel indicated that they quarantined cases for further evaluation.

Table 4.2: Steps in Screening Passengers for Ebola Virus

	Frequency		Percent	
	Yes	**No**	**Yes**	**No**
Taking of passengers temperature of all passengers	98	0	100.0	0.0
Asking questions on health and exposure history of all passengers	92	6	93.9	6.1
Assessment for signs of potential illness of all passengers	96	2	98.0	2.0
Separation and further assessment of suspected cases	96	2	98.0	2.0
Quarantine of cases for further evaluation	84	14	85.7	14.3

4.3.3 Process for the screening of passengers for Ebola disease

The key informants were asked to describe the process of screening passengers for Ebola disease. From the findings the respondents indicated that when passengers come out of the plane they are given the traveler surveillance form to fill. They then proceed to screening area where temperature is taken through either thermal gun or thermal scanner. If the temperature is below 37.5^0C, they were released to go, but if have temperature above 37.5^0C they were taken to observation room (isolation). If within 1 to 2 hours the temperatures have subsided and have no history of travel to the affected

areas and are not showing signs and symptoms of the disease, they are released to go. If the temperatures persist beyond 37.5^0C after 1 to 2 hours they are referred to KNH for further management.

4.4 The facilities available for screening of passengers for Ebola disease

The third objective of the study was to establish the facilities available for screening passengers for Ebola disease at the Jomo Kenyatta International Airport.

4.4.1 Facilities are necessary for screening of passengers for Ebola disease

From the findings, the key informants indicated that these facilities include thermos guns, isolation rooms, Thermoscanners, Surveillance forms, well-equipped laboratory and well-equipped quarantine area with bed and catering facilities and infection control adequate measured. Other facilities include ambulances, disinfectants and PPEs such as gloves, gowns, googles and shoe covers.

4.4.2 Facilities for Screening of Passengers for Ebola Disease

The study found out whether facilities such as Bio-safety Level-4 laboratories and quarantine room for screening passengers for Ebola disease were available. The results were as shown in table 4.3.

Table 4.3: Facilities for Screening Passengers for Ebola Disease

	Frequency		Percent	
	Yes	**No**	**Yes**	**No**
Bio-safety Level-4 laboratories	0	98	0.0	100.0
Quarantine room	74	24	75.5	24.5

According to the findings, all the respondents (100%) reported that their department had no bio-safety Level-4 laboratories. In addition, 75.5% of the respondents indicated that their department had a quarantine room while 24.5% had no idea. From these findings we can deduce that the department of health at Jomo Kenyatta International Airport had a quarantine room but it did not have bio-safety Level-4 laboratories.

4.3.3 Laboratory Equipment for Screening for Ebola Disease

The study established whether various laboratory equipment for screening for Ebola disease were available in the department of health at Jomo Kenyatta International Airport. The results were as presented in table 4.3.

Table 4.4: Laboratory Equipment for Screening for Ebola Disease

	Frequency		Percent	
	Yes	**No**	**Yes**	**No**
Polymerase chain reaction (PCR) analysis equipment	14	84	14.3	85.7
Closed vacuum containers	48	50	49.0	51.0
Leak-proof containers	58	40	59.2	40.8
High potency disinfectants	68	30	69.4	30.6

According to the findings, 14.3% of the respondents indicated that the health department at Jomo Kenyatta International Airport had Polymerase chain reaction (PCR) analysis equipment while 85.7% had no idea. In addition, 49% of respondents indicated that heir department had closed vacuum containers while 51% had no idea. Also, 59.2% of the respondents indicated that the health department had leak-proof containers while 40.8% felt otherwise. Further, 69.4% of the respondents reported that the health department had high potency disinfectants while 30.6% had no idea. From these findings we can deduce that the health department at Jomo Kenyatta International Airport had high potency disinfectants, leak-proof containers, Polymerase chain reaction (PCR) analysis equipment and closed vacuum containers.

4.4.4 Personal Protective Equipment for Screening Passengers

The study also established whether the health department had the stated personal protective equipment for screening passengers for Ebola disease. The results were as presented in table 4.4.

Table 4.5: Personal Protective Equipment for Screening Passengers

	Frequency		Percent	
	Yes	**No**	**Yes**	**No**
Hands Gloves	98	0	100.0	0.0
Gown (fluid resistant or impermeable)	94	4	95.9	4.1
Eye protection (goggles or face shield)	98	0	100.0	0.0
Facemask	96	2	98.0	2.0
Double gloving	88	10	89.8	10.2
Disposable shoe covers	92	6	93.9	6.1
Leg coverings	86	12	87.8	12.2

From the findings, all the respondents (100%) indicated that their department had hands gloves and eye protection (goggles or face shield). In addition, 98% indicated that their department had facemask, 95.9% indicated that their department had gown (fluid resistant or impermeable) and 93.9% indicated that the department had disposable shoe covers. Also, 89.8% of the respondents indicated that the department had double gloving

and 87.8% indicated that the department had leg coverings. This implies that the health department at Jomo Kenyatta International Airport had hands gloves, eye protection (goggles or face shield), gown (fluid resistant or impermeable), facemask, double gloving, disposable shoe covers and leg coverings for screening passengers for Ebola disease.

4.4.5 Other facilities and equipment used in the screening of Ebola virus

The respondents were asked to indicate other facilities and equipment used in the screening of Ebola virus. From the findings, the respondents indicated that other facilities and equipment used in the screening of Ebola virus include thermal scanners, surveillance forms, and hand washing stations and quarantine room.

4.4.6 Functionality of the facilities and equipment in health department at JKIA

The study sought to determine whether the facilities and equipment in the health department were operational. The results were as shown in figure 4.3.

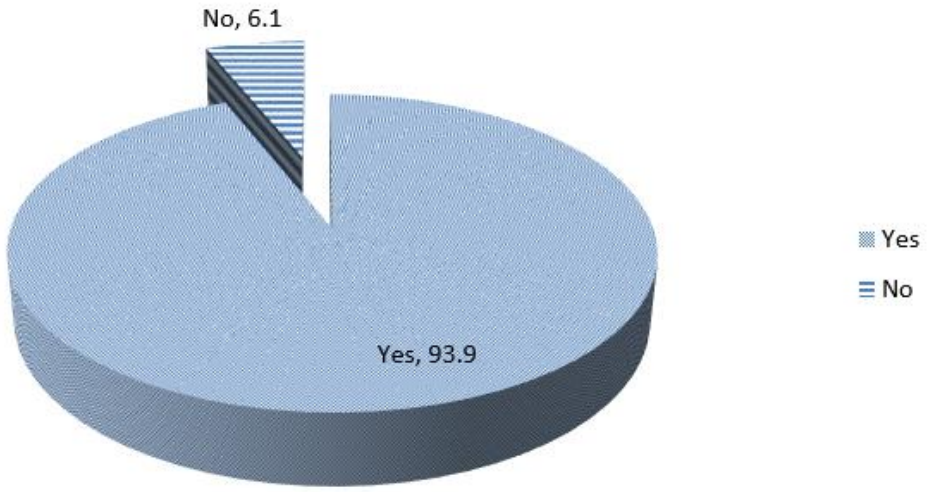


Figure 4.3: Functionality of the facilities and equipment in health department at JKIA

According to the findings, 93.9% of the respondents indicated that the facilities and equipment in their department were operational while 6.1% had no idea. This implies that according to most of the health professionals, the facilities and equipment in health department at Jomo Kenyatta International Airport were operational.

4.4.7 Lack of necessary facilities and equipment in health department at JKIA

The study found out whether there were other facilities and equipment necessary for screening passengers for Ebola virus lacking. The results were as presented in figure 4.7.

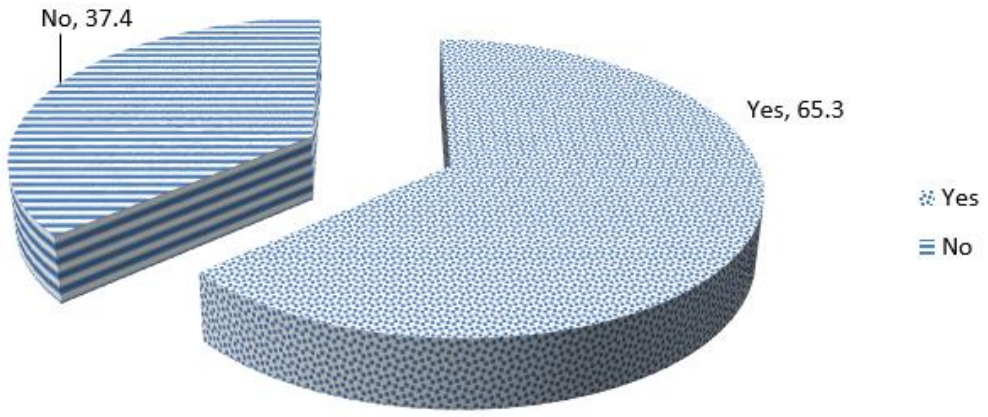


Figure 4.4: Lack of necessary facilities and equipment in health department at JKIA

According to the findings, 65.3% of the respondents indicated that there were other facilities and equipment necessary for screening passengers for Ebola virus lacking in the health department at Jomo Kenyatta International Airport. However, 34.7% indicated that all there were no other facilities and equipment necessary for screening passengers for Ebola virus lacking. These findings show that there were other facilities and equipment necessary for screening passengers for Ebola virus lacking in the health department at Jomo Kenyatta International Airport.

The study also sought to identify other facilities and equipment necessary for screening passengers for Ebola virus lacking in the health department. From the findings, the respondents indicated that bio-safety Level-4 laboratories were missing the health department at the airport.

4.5 The health personnel skills in the screening of passengers for Ebola disease

The fourth objective of this study was to determine the health personnel skills in the screening of passengers for Ebola disease at Jomo Kenyatta international airport.

4.5.1 Adequacy of Personnel in the Health Department at JKIA

The study sought to find out whether there were enough personnel in the department for screening of passengers for Ebola disease. The results were as shown in figure 4.5.

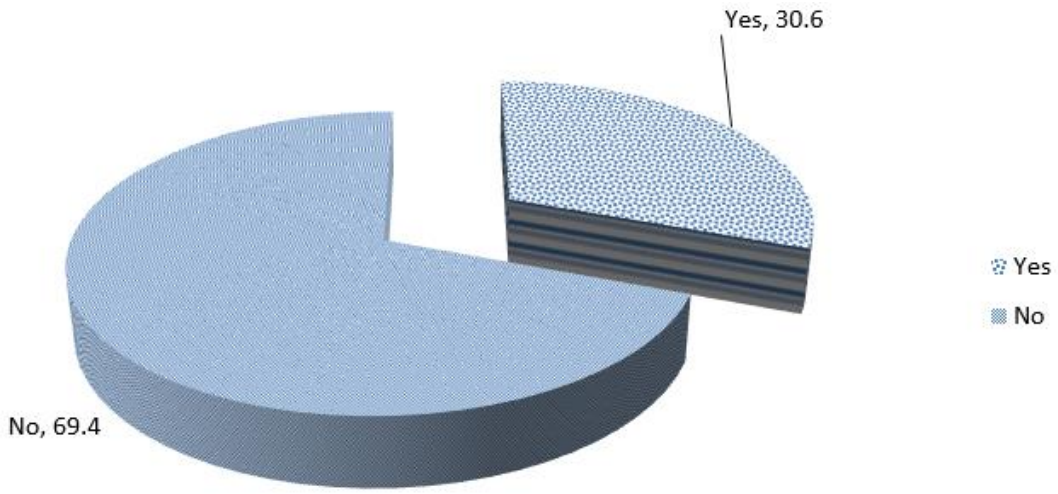


Figure 4.5: Adequacy of Personnel in the Health Department at JKIA

According to the findings, 69.4% of the respondents indicated that there were inadequate personnel in the department for screening of passengers for Ebola disease. However, 30.6% of the respondents felt that there were enough personnel in the department for screening of passengers for Ebola disease. These findings imply that there were inadequate personnel in the health department at Jomo Kenyatta International Airport for

screening of passengers for Ebola disease. These findings were supported by 56% of the key informants. The WHO recommends one doctor and 2 nurses for every 1000 patients. Taking into account that a daily average of 19,000 passengers from Africa and other regions come into the country through Jomo Kenyatta International Airport, there should be at least 19 doctors and 38 nurses. However, there are 2 doctors and 22 nurses in Jomo Kenyatta International Airport.

4.5.2 Skills required for the screening of passengers for Ebola disease

The study sought to establish the skills required for the screening of passengers for Ebola disease. From the findings, the respondents indicated that infection control skills , disease surveillance skills, listening and observing skills, Use of standard operating procedures, s Public health skills as well as laboratory, clinical and data analysis skills. Other skills required include customer care skills, basic skills such as taking of temperatures, observation skills, counseling skills, communication skills, contract tracing, biosafety skills, skills to remove personal protective and case definition, guidelines and management skills. These findings were supported by the key informants who indicated that the skills required include skills for handling the protective kit, screening skills, counseling skills as well as infection prevention and control skills.

4.5.3 Required skills for the screening of passengers for Ebola disease

The study sought to establish whether the personnel in the health department were trained on the required skills for the screening of passengers for Ebola disease. The results were as shown in figure 4.6.

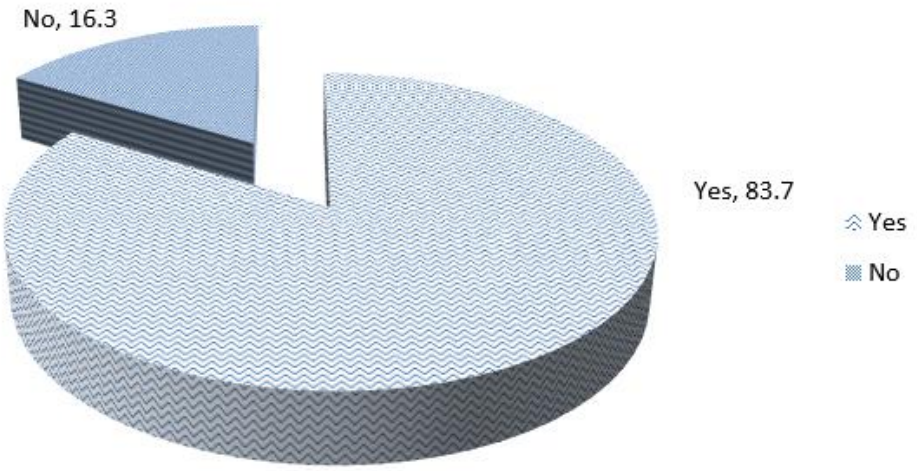


Figure 4.6: Required skills for the screening of passengers for Ebola disease

According to the findings, 83.7% of the respondents reported that the personnel in the health department were trained on the required skills for the screening of passengers for Ebola disease while 16.3% had no information on training. From these findings we can deduce that the personnel in the health department at Jomo Kenyatta International Airport were trained on the required skills for the screening of passengers for Ebola disease. These findings were supported by all the key informants. However, they indicated that there was a need for regular refresher training.

4.5.4 Lacking Skills in the screening of passengers for Ebola disease

The respondents who indicated that the personnel in the health department at Jomo Kenyatta International Airport were lacking in some skills, were also requested to specify the lacking skills. From the findings, the respondents reported that disinfection skills and contact tracing skills were missing.

4.5.5 Effectiveness of screening of passengers for Ebola virus at JKIA

The rating of the effectiveness of screening of passengers for Ebola virus disease Jomo Kenyatta International Airport was sought in a scale of 1 to 5 where 1 was not effective, 2 was fairly effective, 3 was effective, 4 was very effective and 5 was not sure. The results were as shown in figure 4.7.

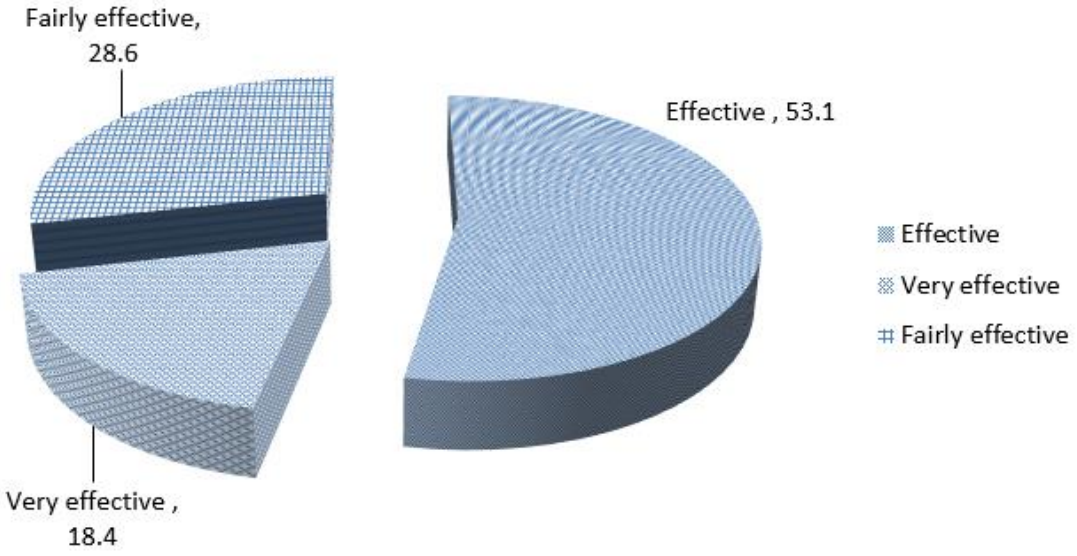


Figure 4.7: Effectiveness of screening of passengers for Ebola virus at JKIA

According to the findings, 53.1% of the respondents indicated that the screening of passengers for Ebola virus disease at Jomo Kenyatta International Airport was effective, 28.6% indicated that it was fairly effective and 18.4% indicated that it was very effective. From these findings we can deduce that the screening of passengers for Ebola virus disease at Jomo Kenyatta International Airport was effective.

CHAPTER FIVE

DISCUSSION, CONCLUSION AND RECOMMENDATIONS

5.1 Discussion

5.1.1 Personnel and cadres available for screening passengers for Ebola disease

The first objective of the study was to establish the personnel and cadres available for screening passengers for Ebola disease at the Jomo Kenyatta International Airport. The study found that most of the health personnel working at Jomo Kenyatta International Airport were public health officers. Other health personnel included laboratory technicians, epidemiologists, clinical officers, nurses, doctors and support staff. However, the study found that the staffs were inadequate. These findings in line with Klompas *et al.* (2014) argument that there were shortages of health workers and clinics in the west African countries like Liberia and hence the spread of Ebola. Similarly, Allaranga *et al.* (2010) found that inadequate access to health personnel and facilities is a problem in Sierra Leone and Guinea.

5.1.2 The process of screening of passengers for Ebola disease

The second objective of the study was to describe the process of screening of passengers for Ebola disease at the Jomo Kenyatta International Airport. The study found out that there was a documented process for screening passengers for Ebola disease at Jomo Kenyatta International Airport. These findings concur with Gulland (2014) findings that

Public Health England (PHE) is helping to roll out enhanced screening for Ebola starting at Heathrow, then Gatwick and St Pancras (Eurostar).

The study established that the health personnel at Jomo Kenyatta International Airport were following the passengers screening steps, which included taking of passengers' temperature, asking questions on health and exposure history of all passengers. These findings are in line with Mabey, Flasche and Edmunds (2014) argument that the first basic element involves all travelers where they have their temperature taken, answer questions about their health and exposure history and are visually assessed for signs of potential illness. The second step involves assessing all passengers for signs of potential illness, separating suspected cases for further assessment and quarantining cases for further evaluation.

The study found that when passengers come out of the plane they are given the traveler surveillance form to fill. They then proceed to screening area where temperature is taken through either thermal gun or thermal scanner. If no high temperature detected, they are released to go, but if have temperature above 37.5^0C they are taken to observation room (isolation). These findings are in line with the Centers for Disease Control and Prevention (2015) argument that primary screening of passengers involves identifying travelers that may be symptomatic with or were possibly exposed to Ebola, which is mainly characterized by temperatures above 37.5^0C.

If within 1 to 2 hours the temperatures have subsided and have no history of travel to the affected areas and are not showing signs and symptoms of the disease, they are released to go. If the temperatures persist beyond 37.5^0C after 1 to 2 hours they are referred to

KNH for further management. These findings are in line with the Centers for Disease Control and Prevention (2015) indication that this is a secondary screening process and involves further investigation of travelers identified in the primary screening process as having temperatures above 37.5^0C.

5.1.3 The facilities available for screening passengers for Ebola disease

The third objective of the study was to establish the facilities available for screening passengers for Ebola disease at the Jomo Kenyatta International Airport. The study established that the facilities necessary for screening passengers for Ebola disease include thermos guns, isolation rooms, Thermoscanners, Surveillance forms, well-equipped laboratory and well-equipped quarantine area with bed and catering facilities and infection control adequate measured. Other facilities include ambulances, disinfectants and PPEs such as gloves, gowns, googles and shoe covers.

The study established that department of health at Jomo Kenyatta International Airport had a quarantine room but it did not have bio-safety Level-4 laboratories. These findings are in line with the WHO guidelines (2015) that to airports health departments should provide appropriate space, separate from other travelers, to interview suspect or affected persons and to quarantine of suspect travelers, preferably in facilities away from the point of entry.

In addition, the health department at Jomo Kenyatta International Airport had high potency disinfectants and leak-proof containers but it did not have Polymerase chain reaction (PCR) analysis equipment and closed vacuum containers. These are in line with

Lippi, Mattiuzzi and Plebani (2014) argument that any biological specimens or samples obtained from EBOV patients should be collected using adequate personal protective equipment, using closed vacuum containers.

The study revealed that the health department at Jomo Kenyatta International Airport had hands gloves, eye protection (goggles or face shield), gown (fluid resistant or impermeable), facemask, double gloving, disposable shoe covers and leg coverings for screening passengers for Ebola disease. These findings are in line with WHO (2014) guidelines that there should be adequate planning to ensure there is sufficient personal protective equipment (PPE) to support response (e.g. port health agencies maintain a four-week supply of PPEs for every responder, and inventory PPE stock for needed supplies every two weeks).

The study established that the facilities and equipment in health department at Jomo Kenyatta International Airport were functional. However, the study established that there were other facilities and equipment necessary for screening passengers for Ebola virus lacking in the health department at Jomo Kenyatta International Airport. These facilities include closed vacuum container, PCR, Quarantine room, Functional thermos scanners, well equipped Lab facilities, PCI laboratories were missing the health department at the airport. These findings are contrary to Adams (2014) findings that in 2014, the ministry of health installed digital thermostats at airports and other ports that would automatically take temperatures of travelers.

5.1.4 The health personnel skills in the screening of passengers for Ebola disease

The fourth objective of this study was to determine the health personnel skills in the screening of passengers for Ebola disease at Jomo Kenyatta international airport. The study established that there are inadequate personnel in the health department at Jomo Kenyatta International Airport for screening of passengers for Ebola disease. These findings are in line with WHO (2014) guideline that staffing needs for entry screening are based on an estimation of the number of travelers to be screened on arrival identified in the planning phase; the layout of airports or port terminals; the location of secondary screening; and the number of arriving conveyances. In general, port health officers are placed in each airport terminal for secondary screening. Multiple work shifts may be required. Shifts should be coordinated around the arrival times of flights targeted for screening.

The study revealed that the skills required for the screening of passengers for Ebola disease include infection control skills, disease surveillance skills, listening and observing skills, Use of standard operating procedures, clinical and data analysis skills. Other skills required include customer care skills, basic skills such as taking of temperatures, observation skills, counseling skills, communication skills, contract tracing, biosafety skills, skills to remove removal of personal protective and case definition, guidelines and management skills.

The study further established that the health personnel had most of the skills required in the screening the passengers, although there was a need for regular refresher training.

The findings are in line with WHO (2014) guidelines that indicate that health departments in points of entry should hold training on proper donning and doffing (putting on and removing) of PPE before screening is implemented. The study established that the screening of passengers for Ebola virus disease at Jomo Kenyatta International Airport was effective. These findings are in line with CDC (2014) report Kenya rolled out a countrywide Ebola training in the year 2014 in all the 47 counties targeting 60 per cent of all health personnel.

5.2 Conclusion

1. The study concludes that the personnel and cadres available for screening passengers for Ebola disease at the Jomo Kenyatta International Airport include public health officers, laboratory technicians, epidemiologists, clinical officers, nurses, doctors and support staff.

2. The study also concludes that there were clear primary and secondary processes of screening passengers for Ebola disease at the Jomo Kenyatta International Airport, which was adopted from World Health Organization manual. Patients with temperatures above 37.5^0C are taken to observation room (isolation) for further investigation.

3. The study further concludes that the health department had most of the facilities and equipment necessary for Ebola diseases screening some were lacking. The available facilities and equipment included quarantine room, high potency disinfectants, Personal protective equipment, leak-proof containers, closed

vacuum containers and Polymerase chain reaction (PCR) analysis equipment. However, bio-safety Level-4 laboratories were lacking.

4. Lastly, the study concludes that the skills required for the screening of passengers for Ebola disease Jomo Kenyatta international airport were available. However, the study found there were inadequate personnel in the health department at Jomo Kenyatta International Airport for screening of passengers for Ebola disease.

5.3 Recommendations

The study found that most of the health personnel in Jomo Kenyatta International Airport had college education. This study therefore recommends that health personnel should be assisted to further their education through provision of scholarships. This will help them to increase their skills on the screening processes for Ebola virus.

The study found that the roles of various categories of health personnel at Jomo Kenyatta International Airport were overlapping. This study therefore recommends that the health department should clearly stipulate the roles and responsibilities of various categories of health personnel.

The study also found that facilities and equipment such as bio-safety Level-4 laboratories, equipped quarantine rooms and closed vacuum containers were not available. This study recommends that the government of Kenya as well as the

management of the airport should ensure that the hospital as all the required equipment and facilities to screen for Ebola virus.

The study also found that there were inadequate personnel in the department for screening of passengers for Ebola disease. This study therefore recommends that the management of Jomo Kenyatta International Airport should employ more health personnel so as to enhance the process of screening passengers for Ebola virus.

5.4 Areas for Further Research

This study found that there was no standardized process for screening passengers for Ebola virus in airports in Kenya. The study therefore suggests that further studies should be conducted to standardize the process for screening passengers for Ebola virus in airports in Kenya.

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APPENDICES

Appendix I: Consent on the Participation

AN EVALUATION OF THE PREPAREDNESS AND SCREENING PROCEDURES FOR EBOLA AT JOMO KENYATTA INTERNATIONAL AIRPORT, NAIROBI

The Purpose

I am Manaseh A. Bocha, a postgraduate student in the college of health sciences of Jomo Kenyatta University, Institute of Tropical Medicine and Infectious Diseases (ITROMID). The main objective of this study is to investigate the existing capacity and screening procedures for Ebola at Jomo Kenyatta international airport, Nairobi. The study also seeks to establish the personnel and cadres available for screening passengers for Ebola disease at the Jomo Kenyatta International Airport; to describe the process of screening of passengers for Ebola disease at the Jomo Kenyatta International Airport; to establish the facilities available for screening passengers for Ebola disease at the Jomo Kenyatta International Airport; and to determine the health personnel skills in the screening of passengers for Ebola disease at Jomo Kenyatta International Airport. I hope that you will feel free to discuss with me your views on existing capacity and screening procedures for Ebola at Jomo Kenyatta international airport.

Procedures

Participation in this study will require I ask you some questions on your views on the existing capacity and screening procedures for Ebola at Jomo Kenyatta international airport. Information will be written down in a separate sheet of paper. You may ask questions related to the study at any time. You may refuse to respond to any questions and you may stop participating at any time without consequences to you.

Discomforts and risks

There will be minimum risk to you for participating in this study. However, some questions you will be asked will be of a sensitive nature and may make you uncomfortable. If this happens you may refuse to answer if you so, choose. You may also stop the interview at any time. The interview shall take approximately 30 minutes of your time.

Benefits

There may be no direct benefits or compensation to you as an individual but the information generated will used by the administrators and other stakeholders to come up with strategies to improve the existing capacity and screening procedures for Ebola at Jomo Kenyatta international airport.

Voluntary Participation and Withdrawal

Your participation is entirely voluntary and should you change your mind you are free to opt out at any time. You may skip questions or stop participating at any time without any penalty.

Confidentiality

I will not identify you and no information that will make it possible for anyone to identify you will be required in this study. The information provided will only be used for academic purposes and will not be given to any organization or individual for any other use. All information will be kept under key and lock and the electronic information will be under a password.

Contact information

Any queries regarding this study may be directed to me, Manaseh A. Bocha cell phone number 0721242301. In addition, if you have any questions on your rights as a research participant you can contact the Kenyatta National Hospital Ethics and Research Committee (KNH/UoN/ERC) by calling 2726300 extensions 44355.

Having been informed about the study and having read the above and understood all that it entails, do willingly give consent to participate in the study.

Participant signature…….

Date……

Researcher's signature…….

Date……

Appendix II: Questionnaire

Please answer the questions below as accurately as possible. All the information provided will strictly be treated with utmost confidentiality. Your answers shall be used for academic purposes only. In the closed ended questions, please tick your answer against each question in the spaces provided. In the open ended questions kindly write the responses in the spaces provided.

General Information

1. Gender

   Male [ ] Female [ ]

2. Age Bracket

   Below 25 years [ ] 25 to 35 years [ ]

   36 years to 45 years [ ] 46 to 55 years [ ]

   56 to 65 years [ ] Above 65 years [ ]

3. Level of education

   Secondary education [ ] College [ ]

   University [ ] Postgraduate [ ]

4. For how many years have you been working in your institution?

   less than 2 years [ ] 2 to 5 years [ ]

   6 to 9 years [ ] 10 to 13 years [ ]

   More than 13 years [ ]

Personnel and cadres available for screening passengers for Ebola disease

5. Which of the following categories/cadres do you belong?

   Doctor [ ] Pharmacists [ ]

Clinical Officers [ ] Nurse [ ]

Laboratory Personnel [ ] Public Health officer [ ]

Epidemiologist [ ]

Others (specify).....

6. Which are the roles of each of the above personnel in the screening passengers for Ebola disease?

.....

.....

.....

The process of screening of passengers for Ebola disease

7. Do you have a document process for screening passengers for Ebola disease?

Yes [ ] No [ ]

8. Do you follow the following steps in screening passengers for Ebola virus?

	Yes	No
Taking of passengers temperature of all passengers		
Asking questions on health and exposure history of all passengers		
Assessment for signs of potential illness of all passengers		
Separation and further assessment of suspected cases		
Quarantine of cases for further evaluation		

The facilities available for screening passengers for Ebola disease

9. Does your department have the following facilities for screening passengers for Ebola disease?

Bio-safety Level-4 laboratories [ ]

Quarantine room [ ]

10. Do you have the following laboratory equipment for screening for Ebola disease?

    Polymerase chain reaction (PCR) analysis equipment [ ]

    Closed vacuum containers [ ]

    Leak-proof containers [ ]

    High potency disinfectants [ ]

11. Do you have the following personal protective equipment for screening passengers for Ebola disease?

    Hands Gloves [ ]

    Gown (fluid resistant or impermeable) [ ]

    Eye protection (goggles or face shield) [ ]

    Facemask [ ]

    Double gloving [ ]

    Disposable shoe covers [ ]

    Leg coverings [ ]

12. Which other facilities and equipment do you use in the screening of Ebola virus?

    .....

    .....

    .....

13. Are the facilities and equipment in your department functional?

    Yes [ ] No [ ]

14. Are there other facilities and equipment that are necessary but are lacking?

    Yes [ ] No [ ]

15. If yes to question number 14 above, which ones?
    (Specify)…….……...

    ……...

    ……..……..

The health personnel skills in the screening of passengers for Ebola disease

16. Are there enough personnel in your department for screening of passengers for Ebola disease?

    Yes [ ] No [ ]

17. Which skills are required for the screening of passengers for Ebola disease?

    .....

    .....

18. Are the staffs in your department trained on the required skills for the screening of passengers for Ebola disease?

    Yes [ ] No [ ]

19. If no, which skills are they lacking?

    .....

    .....

20. Generally, how do you rate the effectiveness of screening of passengers for Ebola virus disease at this airport?

    Not effective [ ] Fairly effective [ ]

    Effective [ ] Very effective [ ]

    Not sure [ ]

Appendix III: Interview Guide

1. Which are the personnel and cadres available for screening passengers for Ebola disease at JKIA?
2. Which are the roles of the above personnel and cadres for screening passengers for Ebola disease at JKIA?
3. What is the process for the screening passengers for Ebola disease?
4. Which facilities are necessary for screening passengers for Ebola disease?
5. Are these facilities available at JKIA?
6. If no, which ones are not available?
7. Which are the skills required for screening passengers for Ebola disease?
8. Do the personnel at JKIA health department possess the stated skills?
9. Do you have adequate staff for screening passengers for Ebola disease?

Appendix IV: Dummy Table for Demographic Variables

	Measures	Number	Percent
Gender	Male	_____	( )
	Female	_____	( )
Age bracket	Below 25 years	_____	( )
	25 to 35 years	_____	( )
	36 to 45 years		( )
	46 to 55 years	_____	( )
	56 to 65 years	_____	( )
	Above 65 years	_____	( )
Level of education	Secondary education	_____	( )
	College	_____	( )
	University	_____	( )
	Postgraduate	_____	( )
Marital status	Married	_____	( )
	Single	_____	( )
	Separated/Divorced	_____	( )
Work Experience	less than 2 years	_____	( )
	2 to 5 years	_____	( )
	6 to 9 years	_____	( )
	10 to 13 years	_____	( )
	More than 13 years	_____	( )

Appendix V: Dummy Table for the Variables

	Measures	Number	Percent
Staff categories/cadres	Doctor	_____	( )
	Pharmacists	_____	( )
	Clinical Officers	_____	( )
	Nurse	_____	( )
	Laboratory Personnel	_____	( )
	Public Health officer	_____	( )
	Epidemiologist	_____	( )
Documented process for screening passengers for Ebola disease	Yes	_____	( )
	No	_____	( )
Facilities available for screening passengers for Ebola disease	Bio-safety Level-4 laboratories	_____	( )
	Quarantine room	_____	( )
Laboratory equipment for screening for Ebola disease	Polymerase chain reaction (PCR)	_____	( )
	Closed vacuum containers	_____	( )
	Leak-proof containers	_____	( )
	High potency disinfectants	_____	( )
Adequacy of personnel	Yes	_____	( )
	No	_____	( )

Appendix VI: CITI Completion Report

COLLABORATIVE INSTITUTIONAL TRAINING INITIATIVE (CITI PROGRAM)

COURSEWORK REQUIREMENTS REPORT*

* NOTE: Scores on this Requirements Report reflect quiz completions at the time all requirements for the course were met. See list below for details. See separate Transcript Report for more recent quiz scores, including those on optional (supplemental) course elements.

- **Name:** Manaseh Bocha (ID: 4687513)
- **Email:** itromid@gmail.com
- **Institution Affiliation:** Kenya Medical Research Institute (ID: 2126)
- **Institution Unit:** Training

- **Curriculum Group:** Students conducting no more than minimal risk research
- **Course Learner Group:** Students - Class projects
- **Stage:** Stage 1 - Basic Course
- **Description:** This course is appropriate for students doing class projects that qualify as "No More Than Minimal Risk" human subjects research.

- **Report ID:** 15309518
- **Completion Date:** 02/14/2015
- **Expiration Date:** 02/14/2016
- **Minimum Passing:** 70
- **Reported Score*:** 92

REQUIRED AND ELECTIVE MODULES ONLY	DATE COMPLETED	SCORE
Kenya Medical Research Institute	02/14/15	No Quiz
Belmont Report and CITI Course Introduction	02/14/15	2/3 (67%)
Students in Research	02/14/15	10/10 (100%)

For this Report to be valid, the learner identified above must have had a valid affiliation with the CITI Program subscribing institution identified above or have been a paid Independent Learner.

CITI Program
Email: citisupport@miami.edu
Phone: 305-243-7970
Web: https://www.citiprogram.org

Appendix VII: Ethics Approval

UNIVERSITY OF NAIROBI
COLLEGE OF HEALTH SCIENCES
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Facebook: https://www.facebook.com/uonknh.erc
Twitter: @UONKNH_ERC https://twitter.com/UONKNH_ERC

KENYATTA NATIONAL HOSPITAL
P O BOX 20723 Code 00202
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Telegrams: MEDSUP, Nairobi

KENYATTA NATIONAL HOSPITAL APPROVED 28 OCT 2015 KNH/UoN-ERC P.O Box 20723-00202 NAIROBI

Ref: KNH-ERC/A/441

28 October 2015

Manaseh A. Bocha
TM309-2891/2014
JKUAT

Dear Manaseh

Research proposal: An investigation into the Existing Capacity and Screening Procedures for Ebola at Jomo Kenyatta International Airport, Nairobi (P459/07/2015)

This is to inform you that the KNH- UoN Ethics & Research Committee (KNH-UoN ERC) has reviewed and **approved** your above proposal. The approval periods are 28th October 2015 – 27th October 2016.

This approval is subject to compliance with the following requirements:

a) Only approved documents (informed consents, study instruments, advertising materials etc) will be used.
b) All changes (amendments, deviations, violations etc) are submitted for review and approval by KNH/UoN ERC before implementation.
c) Death and life threatening problems and serious adverse events (SAEs) or unexpected adverse events whether related or unrelated to the study must be reported to the KNH/UoN ERC within 72 hours of notification.
d) Any changes, anticipated or otherwise that may increase the risks or affect safety or welfare of study participants and others or affect the integrity of the research must be reported to KNH/UoN ERC within 72 hours.
e) Submission of a request for renewal of approval at least 60 days prior to expiry of the approval period. (*Attach a comprehensive progress report to support the renewal*).
f) Clearance for export of biological specimens must be obtained from KNH/UoN-Ethics & Research Committee for each batch of shipment.
g) Submission of an *executive summary* report within 90 days upon completion of the study. This information will form part of the data base that will be consulted in future when processing related research studies so as to minimize chances of study duplication and/or plagiarism.

"Protect to Discover"

For more details consult the KNH/UoN ERC website **http://www.erc.uonbi.ac.ke**

Yours sincerely,

PROF. M.L. CHINDIA
SECRETARY, KNH-UoN ERC

c.c. The Principal, College of Health Sciences, UoN
The Deputy Director CS, KNH
The Chairperson, KNH- UoN ERC
The Assistant Director, Health Information, KNH
Supervisors: Dr. Yeri Kombe, Prof. J. Gikunju

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