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BLOOD BANKS AND THEIR EFFECTIVENESS IN ADDRESSING DISASTERS: A CASE OF THE KENYATTA NATIONAL HOSPITAL

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DECLARATION

Student

This project is my original work and has not been presented for the award of a degree in this University or any other Institution of higher learning for examination.

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This project has been submitted for examination with my approval as the University Supervisor.

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DEDICATION

I would like to dedicate this M.A. Thesis to my loving husband ***Andrew Musingo Otieno*** and our beloved children ***Keynan Otieno Musingo and Sekani Geno Musingo.***

Thank you for your patience, love and support – the three of you complete my life!

ABSTRACT

The main purpose of the study was to examine the critical factors that significantly contribute to supply of safe blood on a sustainable basis at the Kenyatta National Hospital (KNH) Blood Bank Unit (BTU) particularly during emergency situations. The study specifically examined the effectiveness of the existing systems and structures for blood collection and storage at the KNH; the extent of disparity between demand versus supply during both periods of normalcy as well as disasters; and the appropriateness of the strategies in place for ensuring adequate supply of blood at the KNH in the event of a disaster.

The study was based on the structuration theory by Anthony Giddens in The Constitution of Society to explain and integrate agency and structure. The research used a descriptive research design. The target population included 500 blood donors and medical personnel/officials overseeing blood transfusion services at the KNH. Key informants from the KNH, Kenya Red Cross (KRC) and the Kenya National Blood Transfusion Service (KNBTS) were also interviewed. The research used both primary and secondary data and employed the observation and interview research methods facilitated by use of an observation checklist, questionnaires and an interview guide.

The study results indicate that males account for the highest population of blood donors compared to females who are constrained by among others, biological challenges. The youthful population aged 20 – 29 donate most of the blood which is reinforced further by most donors being single. The respective medical personnel are highly educated with 63 percent having attained a bachelors degree or higher. Similarly, most donors are highly educated and account for 52 percent of blood donors. Management and safe storage of blood is constrained by the unavailability of adequate cold storage facilities as well as sufficient space for the BTU. The results showed overreliance on family/friends donors which is not sustainable and has resulted in blood shortage mainly witnessed during disasters.

Medical examination, blood testing, processing and overall standard operating procedures and systems are adequate, though could be enhanced by migrating and embracing digitalized or advanced solutions. The results show that there is inadequate awareness and education on blood donation. That awareness on blood donation is created by word of mouth only during situations when donors interact with medical staff and relatives of patients in need of blood. Reasons for not donating blood are varied and could be mitigated through providing correct information.

The study concludes that the systems and structures that are in place for blood collection at the KNH are mostly sufficient but are faced with some constraints which if addressed, would transform the BTU into a best practice centre especially during disaster response. The study further concluded that there is insufficient supply of blood at KNH and the demand is not met both on a normal day and during disaster events. Lack of awareness and knowledge on the blood transfusion process has contributed to poor supply of blood which has resulted in low donor turnout and over reliance on family replacement donations. Demand, the study concludes, has also been affected by lack of information on the donation process, motivation to give blood and a high rate of infections such as HIV/AIDS and non-communicable diseases.

The study recommends that funding be increased toward providing adequate facilities for storage and management of the BTU; that standard operating procedures and systems though adequate, could be enhanced by migrating and embracing digitalized or advanced solutions. That there is need to identify and resolve training gaps with regard to blood donation in early childhood education and adult targeting through a deliberate effort to disseminate information on the importance of blood donation. The Ministry of Health should establish strategies to reduce reliance on school age children as the biggest donor block by seeking ways to increase the donor pool of those between 18 to 65 years of age and explore policy toward encouraging voluntary non-remunerated donors and providing mechanisms to operationalize the same.

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May God bless you all abundantly!

LIST OF ACRONYMS

AABB	Association of American Bloods Banks
AIDS	Acquired Immune Deficiency Syndrome
BTS	Blood Transfusion Services
BTU	Blood Transfusion Unit
CDC	Centre for Disease Control
HGB	Hemoglobin
HIV	Human Immunodeficiency Virus
KNBTS	Kenya National Blood Transfusion Services
KNH	Kenyatta National Hospital
LBTS	Lesotho Blood Transfusion Services
MDGs	Millennium Development Goals
NCDs	Non Communicable Diseases
PEPFAR	President's Emergency Plan for AIDS Relief
RBTC	Regional Blood Transfusion Centre
SFBA	Safe Blood for Africa
SSA	Sub Saharan Africa
STDs	Sexually Transmitted Diseases
TTIs	Transfusion Transmittable Infections
UBTS	Uganda Blood Transfusion Services
UN	United Nations
UoN	University of Nairobi
URCS	Uganda Red Cross Society
WHA	World Health Assembly Resolution
WHO	World Health Organization

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CHAPTER ONE: INTRODUCTION

1.1 Background to the study

Kenya, with an estimated population of 44 million[1] requires 440,000 units in its blood banks at any given time under normal circumstances based on international norms. This is compared to an average of 169,000 units recorded in 2013, which is less than half of the requirements. The last decade has witnessed significant year by year variations ranging from an average of 40,000 units in 2003, rising to 124,000 in 2007 and dropping to 95,000 in 2008, and rising yet again to 169,000 in 2013. The details are in the literature review. It is noted that the highest blood donation levels were realized during the years of major disasters involving a large number of survivors.

The country has experienced a number of major disasters that have tested the efficacy and degree of readiness as well as responsiveness of the existing systems in ensuring adequate blood supply. For instance during the Westgate terror attack in Nairobi in 2013 that killed 60 people, American Embassy attack in 1998 that led to a loss of over 200 lives and the numerous accidents on the Kenyan roads that kill over 3,000 people annually, among others have resulted in appeals to the public by the Government for blood donations and overstretched the capacity of existing hospitals and blood banks. This is an illustration of erratic supply of blood against demand amidst a growing population as well as the number of disasters.

A number of countries such Kenya's neighbour Uganda has instituted elaborate measures that encourage the population to donate blood in a more consistent manner. Such measures include:- (a) a voluntary blood donor program run in conjunction with the Uganda Red Cross Society (URCS); and (b) setting up 345 temporary blood mobilization and collection outlets to boost blood collection. With these efforts, in 2013, Uganda

[1] World Bank, Kenya Country At a Glance, 2014

blood Transfusion Services (UBTS) managed to collect 250,000 units which is about 83 percent of blood against a requirement of 300,000 units annually[2].

In Kenya such measures are less robust. Instead, there is over-reliance on family replacement donations, compounded by minimal funding from the central government for blood transfusion services. The passing of the 2010 Constitution, poses an additional challenge since blood donation services in the country have to be devolved in harmony with the new system of health care to support efforts toward ensuring equity and access for all citizens.

Blood Transfusion Services (BTS) in Kenya have undergone major changes since the turn of this century. BTS in Kenya has evolved from being organized through surgical practices in the 1930s; to after independence where the Government of Kenya with support of from Kenya Road Cross Society (KRCS) took over in 1964. By the late 1960s BTS was run as part of hospital laboratory services with no dedicated budget line, staff or equipment. Each hospital sourced for its own blood supply. In 1985 with the advent of HIV/AIDS, blood collections reduced and an increase in the cost of blood was evident which resulted in an emphasis on blood safety. In 1994 Kenya recognized the need to set up a national blood service in line with WHO recommendations and WHA resolutions.[21]

1.2 Statement of the problem

Kenya is prone to disasters which often affect vulnerable people disproportionately. Climate change and conflicts are complicated disaster risks which take many forms including; natural hazards such as; flooding, drought or human induced disaster such as civil strife, acts of terrorism, industrial and transport accidents among others. Kenyans also face the threat of epidemics of emerging and reemerging diseases such as spread of

[2] Uganda Blood Transfusion Services Strategic Plan 2010 – 2015

HIV/AIDS, H1N1 virus, Ebola and Malaria. Disasters have resulted in human suffering over the years due to minimal preventive and mitigating measures.[3]

In the past few years, reports in the local media such as Nation and Standard Newspapers and from institutions managing blood banks in Kenya such as the Kenya National Blood Transfusion Services (KNBTS) have highlighted cases of shortages of blood in the country. This was particularly evident during some of the major disasters such as the 1998 terrorist attacks, the 2009 Molo oil tanker fire, after the post-election violence in early 2008, the Sinai fire tragedy in 2011 and the countless acts of terrorism from September 2013 to June, 2014. The shortage of blood led to unnecessary loss of lives in many instances.

On the other hand, the calls for blood donations during disasters have been numerous particularly in cases where the deaths were minimal compared to those injured, clearly signaling the shortage of safe blood supply in Kenya in a consistent and timely manner at all times including during times of disasters. For instance, during the post-election violence in 2008 the prevailing unfavourable conditions that were manifested in ethnic conflict and insecurity not only inhibited the population to donate blood but also blood collections could not happen until calm was restored. Accordingly, the volume of blood donated in 2008 was relatively lower than in 2007. Similarly in 2009 Molo oil tanker disaster, led to a high number of deaths and fewer survivors, and therefore the event did not exert additional pressure on key blood bank, hence there was no increase in the levels of blood requirements in that year.

This research paper was therefore motivated by the fact that Kenya faces significant challenges in developing and maintaining an adequate supply of safe blood on a sustainable basis. The existing health care systems are weak with inadequate basic infrastructure including irregular electricity supply for refrigeration, too few physical

[3] The National Disaster Management Policy of Kenya, June 2013 (draft).

structures and inadequate laboratory equipment, among others. Several reasons have been postulated that contribute to the prevailing situation that is manifested in shortages and unsafe blood which often lead to serious health consequences such as death from postpartum hemorrhage or the transmission of life-threatening infections such as HIV and hepatitis. They include: (a) laxity in implementing relevant policy measures; (b) inadequate financial resources; (c) high prevalence of transfusion-transmissible infections; (d) lack of quality systems; and (e) considerable reliance on family/replacement donations.

It is against this background that this paper examined the critical factors that significantly contribute to the inability to have supply of safe blood on a sustainable basis with a special focus on the Kenyatta National Hospital (KNH) which is the National Referral and Teaching Hospital, as well as a medical research centre.

This paper further sought to establish what challenges may be contributing to constrained supply or shortage of blood at KNH. Whether: (a) ***Institutional*** challenges such as inadequate safety standards, regulation, capacity to manage donated blood etc.); (b) ***Technical***, insufficient health facilities, skilled workers to handle blood; (c) ***Economic*** i.e. incentives to overcome time and travel people need to bear to donate blood and; (d) ***Behavioral*** (people's beliefs, lack of awareness, perception people have about the system/process, etc.).

1.3 Research questions

1. What are the systems and structures that are in place for blood collection and storage at the KNH blood transfusion unit?
2. How much blood is required at the KNH blood bank unit and what is the status of demand versus supply during periods of normalcy and in the event of a disaster?
3. What strategies are in place to address shortfall of blood supply in the event of a disaster at the KNH.

1.4 General objective

The general objective of the research study was to assess the effectiveness of the Kenyatta National Hospital blood bank unit to respond to a disaster.

1.4.1 Specific objectives of the research

1. To examine the systems and structures that are in place for blood collection and storage at the KNH blood transfusion unit;
2. To examine the demand versus supply factors that influence blood transfusion at KNH during periods of normalcy and in the event of a disaster;
3. To identify strategies put in place by key blood bank experts to address shortfall of blood supply at the KNH in the event of a disaster.

1.5 Justification of the study

This study focuses on Kenyatta National Hospital, the largest referral hospital in East and Central Africa. The results of the study will contribute to knowledge by generating and documenting information about blood banks in Kenya as part of disaster relief and management. Being the largest teaching and referral hospital in Eastern Africa it has experienced challenges in maintaining a sufficient supply of blood due to relatively high demand. The study results will be useful to stakeholders in the health sector in undertaking intervention strategies that will support guaranteeing sufficient supply of blood in our blood banks during normal times and more importantly when major disasters occur.

The outcome of the study will also be useful for policy makers and blood donor partners who will rely on the data to formulate appropriate policies and ensure the relevant programmes that are necessary to operationalize the policies are funded. The findings will increase our knowledge on the factors that motivate donors to give blood and also assist in targeting under-represented eligible donor groups by creating more public awareness. The findings will be of help to the government ministries of Health and the

Interior and Coordination of National Government (which is charged with the function of Disasters and Emergency Response), private hospitals, and organizations dealing with blood transfusion services in Kenya.

1.6 Scope and limitation of the study

The study focuses on the readiness of the Kenyatta National Hospital blood bank in relation to disaster management. It examines factors contributing to the constrained supply of safe blood at the KNH i.e. what challenges whether institutional, technical, economic or behavioral that may be at play.

The study examines the systems and structures that are in place for blood collection and storage at the KNH. Here the study was seeking to establish the processes and procedures, facilities, equipment and personnel that support donation and storage of safe blood, more specifically and the major challenges to developing and maintaining an adequate and sustainable supply of safe blood at the KNH. The study targeted the KNH and did not involve other public or private hospitals in Kenya. Although the study could be expanded to other large hospitals in Nairobi or the country, it only focused on the KNH which is the largest referral national/public hospital in Kenya mainly due to time and cost constraints. The study did not capture challenges faced by other hospitals or dispensaries in rural parts of Kenya with no access to proper infrastructure such as electricity supply to facilitate a functional blood bank.

The study also established the quantity of blood required at the KNH by examining the demand versus supply factor during periods of normalcy and in the event of a disaster. The study worked with respondents who were agreeable to provide information on blood donations and blood banks thus limiting it to only those who were willing to provide feedback.

The study strived to identify strategies put in place by key blood bank experts to address shortfall of blood supply at the KNH in the event of a disaster. The focus here would be to determine the level of preparedness and contingency measures put in place in the event of a worst case scenario disaster that requires the highest volumes of blood supply for the KNH. The researcher concentrated on the strategies identified by key blood bank experts affiliated with the KNH and missed out on knowledge of others who work with other public or private hospitals in Nairobi or in other towns within Kenya especially the expertise of those in rural Kenya who may have ingenious ideas on how they handle increased demand for blood.

1.7 Definition of terms

The following definitions applied for the purposes of this research project.

Disaster is a serious, sudden, calamitous event that seriously disrupts the functioning of a community or society and causes human, material, and economic or environmental losses that exceed the community's or society's ability to cope using its own resources. Though often caused by nature, disasters can have human origins.[4]

Disaster/emergency management is the organized analysis, planning, and decision-making, allocations of resources, roles and responsibilities to prepare, prevent, mitigate, respond and recover/rehabilitate from disruptions by disasters.

Disaster risk management is the systematic process of using administrative decisions, organization, operational skills and capacities to implement policies, strategies and coping capacities of the society and communities to lessen the impact of natural hazards and related environmental and technological disasters. This comprises all forms of activities, including structural and non-structural measures to avoid (prevention) or to limit (mitigation and preparedness) adverse effects of hazards.

[4] http://www.ifrc.org/en/what-we-do/disaster-management/about-disasters/what-is-a-disaster/

Blood bank is a cache or bank for blood or blood components, gathered as a result of blood donation, stored and preserved for later use through a blood transfusion. The term "blood bank" typically refers to a division of a hospital where the storage of blood product occurs and where proper testing is performed. However, it sometimes refers to a collection center, and indeed some hospitals also perform collection.[32]

Blood donation is the process where a person voluntarily has blood drawn and used for transfusions and/or made into biopharmaceutical medications by a process called fractionation (separation of whole-blood components). Donation may be of whole-blood or of specific components directly.

Blood transfusion – is the transfer of blood or a component of blood, such as red blood cells, plasma, or platelets, from one person to another to replace blood loss caused by injury, surgery or disease.

Agglutinogens – in the blood are proteins existing on the surface of every red blood cell in the body. The kind of agglutinogens present on the red blood cells helps determine the blood type of a person. If a person has blood type A, his red blood cells are studded with agglutinogens A only. If blood type B, the agglutinogens present are only agglutinogens B. If blood type AB, both agglutinogens A and B are present. In blood type O, there are no agglutinogens on the surface of the red blood cells.

Blood safety – is the adequate and timely provision of safe blood and blood products to all in need of transfusion as part of their treatment. The product must be of the right efficacy and adequate quantity to correct the homeostatic defect in the normal physiology of the blood for the patient; the blood must be free of infections transmissible by blood transfusion.[5]

[5] Status of Blood Safety in the WHO African Region, 2006.

National blood programme – the government programme with overall responsibility for planning, implementation and monitoring of all activities related to blood transfusion throughout the country. Responsibility for the implementation of the blood programme may be fully or partially delegated to a governmental or non-governmental organization designated as the national blood transfusion service.[5]

National blood policy – a statement of intent by the national health authority that defines the organizational, financial and legal measures that will be taken to ensure the quality, safety, availability and accessibility of blood transfusion within the country.[5]

National blood transfusion service - the organization with statutory national responsibility for the provision of blood for transfusion and liaison with clinical services for the appropriate use of blood for patient care. The NBTS coordinates all activities concerned with blood donor recruitment and the collection, testing, processing, storage and distribution of blood and blood products, the clinical use of blood and surveillance of adverse transfusion events. Activities are carried out within a network of national/ regional/provincial blood centres and hospital blood banks.[5]

CHAPTER TWO: LITERATURE REVIEW & THEORETICAL FRAMEWORK

2.1 Introduction

The provision of safe and adequate blood is a government responsibility and should be an integral part of each country's national health care policy and health care infrastructure. The World Health Organization (WHO) recommends that every country should put in place policies, systems and structures to ensure the safety, quality, accessibility and timely availability of blood and blood products to meet the needs of all patients who require transfusion.[6] The structure of the national blood system will depend on the organization and level of development of the health-care system. However, all critical activities within a national blood system should be coordinated at the national level to promote uniform standards; economies of scale; consistency in the quality and safety of blood and blood products, and best transfusion practices. The overall governing body such as the Ministry of Health should provide effective leadership and governance in developing a national blood system that is fully integrated into the health-care system.[7]

Our blood type is the key that unlocks the door to the mysteries of health, disease, longevity, physical vitality and emotional strength. Blood types are as fundamental as creation itself. In the masterful logic of nature, the blood types follow an unbroken trail from the earliest moment of human creation to the present day. Nothing is comparable to the preciousness of human blood. In spite of rapid and remarkable conquests of medical science today, there is no factory that manufactures blood. It is only in human beings that human blood is made and circulated.[8] Each year, more than 100 million people sustain injuries and more than five million die from violence and injury. Road traffic accidents are the second leading cause of all deaths and the primary reason for serious injury in

[6] http://www.who.int/bloodsafety/transfusion_services/blood_systems/en/index.html
[7] Based on WHO Global Database on Blood Safety (GDBS) 2008, with responses received from 164 countries, covering 92 percent of the world's population.
[8] How can reluctance to donate blood in Tanzania be reduced? A protocol for a study in Tanzania by Geofrey Mwaigomole, 2006.

people aged 5 to 29 years.[9] More than 536 000 women die each year during pregnancy or childbirth, 99 percent of them in developing countries.[10] Haemorrhage is the principal cause of maternal deaths worldwide, accounting for up to 44 percent of maternal deaths in some areas of Sub Saharan Africa (SSA).[11] Up to 20 percent of maternal mortality and 15 percent of child deaths have been attributed to severe anemia due to malaria in SSA.[12] Timely access to safe blood transfusion is a life-saving measure in many of these clinical conditions and can also prevent serious illness in these patients.[13]

As part of disaster relief, a component that is often ignored and/or not given the significance it deserves, especially in the developing world is that of the importance of sufficient and safe blood supply when a disaster occurs. The reality for most developing nations is that even during times of normalcy demand always seems to exceed supply.

Blood transfusion is an essential component of health care which saves millions of lives each year. Despite ongoing efforts, it will still be many years before artificial substitutes can routinely replace the need for donated human blood. Even though blood is universally required for the management of patients, the pattern of blood usage differs markedly across the globe. In developed countries, transfusion is most commonly used to support advanced medical and surgical procedures, including trauma, cardiovascular surgery, neurosurgery and transplantation. In countries where diagnostic and treatment options are limited, a much greater proportion of blood is used to treat women with obstetric emergencies and children suffering from severe anaemia, often resulting from malaria and malnutrition.[13]

[9] Injury. A leading cause of the global burden of disease, 2000. Geneva, World Health Organization, 2002.
[10] Maternal mortality in 2005. Estimates developed by WHO, UNICEF, UNFPA and the World Bank. Geneva, World Health Organization, 2007.
[11] WHO analysis of causes of maternal death: a systematic review. Lancet, 2006, 367:1066–1074.
[12] Africa Malaria Report, 2003. Geneva, World Health Organization/UNICEF, 2003.
[13] Universal Access to Safe Blood Transfusion & Global Initiative on Safe Blood for Safe Motherhood, World Health Organization. 2008.

Whatever the degree of development of the health care system, transfusion is the only option of survival for many patients who need blood and or its components. Every country needs to meet its requirements for blood and blood products and ensure that blood supplies are free from HIV, hepatitis viruses and other life-threatening infections that can be transmitted through unsafe blood. Blood safety is integral to the World Health Organization (WHO) Human Immunodeficiency Virus/Acquired Immune Deficiency Syndrome (HIV/AIDS) plan to scale up efforts to prevent HIV infection and for the achievement of the health-related Millennium Development Goals on reducing child mortality, improving maternal health and combating HIV/AIDS.[14]

While the need for blood is universal, millions of patients requiring transfusion do not have timely access to safe blood and there is a major imbalance between developing and industrialized countries in access to safe blood. Out of the estimated 108 million units of blood donated annually worldwide, less than 45 percent is collected in developing countries, home to 80 percent of the world's population. The average number of blood donations per 1,000 population is 10 times higher in high-income countries than in low-income countries. It is generally recommended that the equivalent of 1–3 percent of the population should donate blood to meet a country's needs. Of the 73 countries that had donation rates of less than 1 percent of the population (fewer than 10 donations per thousand people) in 2006, 70 are developing countries. Data from sub-Saharan Africa show that fewer than 3 million units of blood were collected in 2006 for a population of nearly 600 million people.[15] The inequity in the availability of blood is also manifested within countries, with some major urban areas having access to the majority of the available blood.

The prevalence of HIV, hepatitis viruses and other blood-borne infections has been reported to be lowest among voluntary unpaid blood donors who give blood purely for

[14] UN Millennium Development Goals. http://mdgs.un.org/unsd/mdg; http://www.who.int/mdg/goals/en/index.html.
[15] WHO Blood Safety Indicators 2006, preliminary analysis.

altruistic reasons. Higher infection rates are found among family or family replacement donors who give blood only when it is required by a member of the patient's family or community. Worldwide, the highest rate of infection is found among donors who give blood for money or other form of payment. Adequate stocks of safe blood can only be assured by regular donation by voluntary unpaid blood donors. By 2006, only a total of 54 countries reported having achieved 100 percent unpaid voluntary blood donations.[13]

Even where sufficient blood is available, many recipients are exposed to avoidable, life-threatening risks through the transfusion of unsafe blood. Data in 2006 from 132 countries reveals that 31 (23.5%) countries have less than 100 percent screening for at least one of the four infection markers for HIV, HBV, HCV and syphilis with many countries unable to provide complete information regarding screening for infection. Even when blood is tested, often the testing is either incomplete or has inadequate quality assurance. Serious blood shortages and the lack of a reliable donor base also contribute to an increased risk of transfusion-transmitted HIV and viral hepatitis. An inadequate stock of blood forces a reliance on unsafe replacement or paid donors and also increases the risk of the issue of blood without adequate testing. Bacterial contamination during blood collection or processing poses a further risk of infection.[16] In many countries, the risk of transmission of infections through transfusion is further compounded by an insufficient infrastructure and systems for ensuring a safe blood supply. These include a shortage of trained staff, irregular supplies of test kits or use of poor quality test kits and the lack of a reliable supply system and appropriate cold chain facilities. Furthermore, safety measures can also be disrupted by a fragmented blood supply system, with varying technical standards and no central supervision.[15]

[16] Morris Fishbein, M.D., ed (1976). "Blood Banks". *The New Illustrated Medical and Health Encyclopedia*. 1 (Home Library Edition ed.). New York, N.Y. 10016: H. S. Stuttman.

2.2 Disaster management and the importance of blood banks

Emergencies and disaster situations require a rapid and timely response to save lives. The response of health services to disaster situations can be improved when activities to mitigate and reduce vulnerability and to restore and reorganize blood bank services are incorporated into emergency plans.

When a disaster takes place, right from the triage, to the hospital or medical facility -- it is crucial that the disaster event is coordinated among blood centres, hospital blood banks and transfusion services.[17] This will:-

(a) Determine the medical need for blood;
(b) Facilitate the transportation of blood from one facility to another if required; and
(c) Communicate a common message to the national blood community and the public about the status of blood supply in the disaster affected area.

In the context of a blood transfusion service, the word ‘‘disaster’’ generally refers to any situation that temporarily restricts or eliminates the ability of the service to maintain its blood supply or a situation that creates a sudden demand for blood higher than usual or a massive influx of donors posing difficulties to the blood collection system.[18] This definition will be adopted for purposes of this study.

A ‘disaster’ may be a natural or man-made act that[19] creates a sudden need for much larger amounts of blood than usual or temporarily restricts a blood collector to only collect, test, process and distribute blood or temporarily restricts or prevents the local population from donating blood or restricts or prevents the use of the available inventory

[17] The Role of Laboratories and Blood Banks in Disaster Relief, WHO, 2006.
[18] American Association of Blood banks: Disaster operations handbook-Hospital Supplement 2008;118–128.
[19] Definitions from the Disaster Operations Handbook, October 2008 (Association of American Blood Banks).

of blood products and thus requires immediate replacement or resupply of the region's blood inventory from another region. For instance, during civil strife, the population may be restrained to voluntarily donate blood.

Meanwhile, the issue of ''blood system management in disasters'' is a major challenge today for any blood transfusion service. At times of natural hazards such as earthquakes, floods and tsunamis, biological threats such as epidemic outbreaks and pandemic influenza as well as manmade disasters such as destructive acts of terrorism, systematic coordination is required to avert major shortages. Failure of coordination could create undesirable impact and strain on blood donors, blood service staff, volunteers, blood bank processes, logistics and facilities as well as on patients, hospitals and the general public. Therefore an appropriate blood management system must first be identified and the corresponding action plans developed.

This notwithstanding, lack of basic information on the affected area including available medical infrastructure and personnel among others could impact negatively in directing interventions, as well as instituting preventive measures required to manage the effects of such phenomenon appropriately. Therefore organized interventions involving all the key players such as blood banks and hospitals are imperative. In Kenya efforts could be made to reduce the vulnerability of blood banks by integrating the plans with those of hospitals and national emergency plans. This will ensure speedy response times for blood requirements.

It is therefore inevitable that blood banks have emergency plans which are an integral part of the health sector's disaster plans and overall national disaster program. In preparing the emergency plans it is necessary to consider the following factors among others[18]:-

(a) The risk of disaster from natural, technological, social, or biological causes to the country or to a particular region, and identify possible health and needs scenarios based on previous experiences;
(b) Determine the physical and organizational vulnerability of the services;
(c) Assess the vulnerability of the life lines that guarantee the operation of services, i.e. water and electricity supply, communications and transportation;
(d) Evaluate the organizational and institutional response capacity, and identify the roles and duties of the key staff members;
(e) Establish mechanisms for coordination between the network of blood banks and other related institutions such as health services etc.;
(f) Disseminate the emergency plan widely and train the staff that play an important role in its execution;
(g) Conduct periodic simulations to test the viability of the plans;
(h) Develop a budget for disaster preparedness and response activities;
(i) Institutionalize, through ministerial resolutions or directives emergency plans for laboratories in the event of disasters.

As mentioned elsewhere, the minimum blood requirement need is estimated at 440,000 units (1 per cent) of the country's population, but 0.4 percent is donated in Kenya.[20] Further, there is a high donor prevalence of Transfusion Transmittable Infections (TTIs), increasing drug and substance abuse and adoption of unhealthy lifestyles restricting eligibility of adults to donate blood and increasing the disposal of donated blood units, this often results in only the most urgent cases being addressed. Blood comes mostly from primary, high school and university students, patients' relatives, and friends and in the recent past from corporate organizations. It is estimated that 1 in 10 adults donates blood in Kenya. The National Blood Transfusion Services says a big reason for this is because of fear among potential donors that they would find out their HIV status, hepatitis and other STDs.

[20] Kenya National Blood Transfusion Services Report, 2010.

The best practices on blood transfusion services in Kenya are grounded in the National Standards for Blood Transfusion Services in Kenya, 1st Edition, 2007. This document outlines the necessary guidelines in relation to screening, collection and storage of blood and its products. All institutions operating blood banks in Kenya are expected to follow these safety standards to guarantee best practice. Whereas the institutional framework and organization of the Kenya National Blood Transfusion Services (KNBTS) was mapped out in the *Policy Guidelines on Blood Transfusion in Kenya, 2001* document, however, the KNBTS was formed after the 1998 terrorist attack in Kenya.

These two documents outline the best practices and institutional framework for Blood Transfusion Service (BTS) in the country, however, there is no clear and systematic national blood supply mechanism in Kenya and the major medical institutions have sought their own solutions to the problem. The various players e.g. donors, hospitals, recipients, regulators etc. are only linked together by the need for blood. For example the private hospitals such as Nairobi Hospital or Aga Khan University Hospital manage their own supply chain from donation to transfusion to the recipient. Only in times of major crisis do they seek help from the national transfusion services due to higher demands or when there is urgent need for rare blood types. On the other hand the Kenyatta National Hospital (KNH) relies heavily on the KNBTS.[21]

There has been an ongoing debate with regard to the most effective type of blood donation system in the country. According to the blood donation services history of Kenya, prior to the 1998 terror attacks, the country relied on the hospital based decentralized system of blood collection. The introduction of the KNBTS after 1998 meant that the country has since adopted a hybrid system of blood collection with hospitals retaining their decentralized BTUs and also relying on the KNBTS centrally managed system to provide blood as need arises. The hybrid system of blood collection

[21] Kenya National Blood Transfusion Services Overview, 2010.

came into being not by design but by default. Based on expert opinion it appears to be the most advantageous system for a developing country such as Kenya.

The centrally managed system that KNBTS is mandated to implement has many advantages including standard operating procedures, training, competency assessment, policies, quality control, quality assurance, error and accident management, transfusion medicine protocols and quality plans can be standardized across the various Regional Blood Transfusion Centres they oversee. The patient history database, computer system, staff, blood component inventory and medical consultative staff are also centralized. With centralization, staff, blood component inventories, component wastage and equipment can be decreased, resulting in both decreased costs and increased efficiencies.

In addition, centralized testing lends itself to automated testing, which translates to decreased staff and increased productivity. The purchasing of supplies, reagents, blood components and inventory management can be consolidated to decrease costs as a result of high-volume discounts.

However, for a country such as Kenya we are faced with challenges that are unique to a developing nation and fully adopting a centrally managed system poses a risk to our blood collection targets. The health care system in Kenya is still developing and infrastructure is one of the biggest challenges we face. A centrally managed BTS may not reach far flung areas of this country where infrastructure, well equipped hospitals; transport and electricity among other resources are not fully developed. The very quick turn-around time required for emergency testing and processing of collected blood may be affected due to the poor infrastructure if transported by road and increased transportation costs if the option of air lifting collected blood is considered.

The issue of shortage of safe blood cannot be overemphasized. For instance, the 1998 terrorist attack on the American Embassy in Nairobi led to bringing in the country

massive units of blood as far as Israel. The estimated blood requirement at KNH is about 600 units of blood per day in the event of a disaster. Available information from the KNH Blood Transfusion Unit indicates that approximately 80 - 120 units of blood are required in a day at KNH. On any given (normal) day, there is insufficient supply of blood at KNH and demand always exceeds supply since 60 – 80 units are collected each day, which shows that the hospital has a shortage of between 40 – 60 units of blood daily. The medical personnel rely on the Kenya National Blood Transfusion Services KNBTS to meet the shortfall.

2.2 What is blood transfusion?

It is possible to take blood from one person and donate it to another in a process called transfusion. In order for a transfusion to work it is essential that the agglutinogens on the surface of the donor's blood cells match the agglutinogens on the surface of the recipient's blood cells. In other words, the blood type of the donor and the blood type of the person receiving the transfusion must be compatible to avoid adverse reactions. If the blood types don't match, special antibodies in the recipient's blood, called agglutinins will attack the donated blood causing blood clots to form in a reaction called agglutination.[22]

The primary goal of blood transfusion is to ensure that it is done safely and used appropriately for specific clinical conditions, thereby avoiding the unnecessary use of donor blood in clinical practice. As patients rarely require all the components of whole blood, transfusion of the required component is a meaningful and useful alternative to whole blood transfusion. This allows several patients to benefit from one unit of donated whole blood. Blood is a precious and scarce commodity that is dependent on public donations, and should therefore be used effectively in order to avoid misuse and wastage.

[22] http://www.bloodlinkfoundation.org/ (August 18, 2013 at 12:06pm).

Blood transfusion is an essential part of patient care. When used correctly, it saves lives and improves health. However, blood transfusion carries a potential risk of acute or delayed complications and transfusion-transmitted infections and should be prescribed only to treat conditions associated with significant morbidity or mortality that cannot be prevented or managed effectively by other means. Blood is a scarce human resource and ensuring its safety and clinical effectiveness requires investment – both human and financial. The national Blood Transfusion Service (BTS) is responsible for ensuring the provision of an adequate supply of safe blood for all patients requiring transfusion. The national health programme should develop policies and strategies to reduce the need for transfusion, minimize unnecessary transfusions and ensure the safe and appropriate use of blood and blood products.[23]

There are three types of blood donation: voluntary/unpaid donations, family/replacement donations, and paid donations. Donors who give blood voluntarily and for altruistic reasons have the lowest prevalence of HIV, hepatitis viruses and other blood-borne infections, as compared to people who donate for family members or in lieu of payment. Sufficient supplies of safe blood can only be assured by regular donations from voluntary unpaid donors.[24]

Blood donations are divided into groups based on who will receive the collected blood. [25] An 'allogeneic' (also called 'homologous') donation is when a donor gives blood for storage at a blood bank for transfusion to an unknown recipient. A 'directed' donation is when a person, often a family member, donates blood for transfusion to a specific individual.[26] Directed donations are relatively rare when an established supply exists.[27] A 'replacement donor' donation is a hybrid of the two and is common in developing

[23] Aide Memoire for National Health Programmes on the Clinical Use of Blood, WHO, 2003.
[24] http://en.wikipedia.org
[25] M. E. Brecher, Editor (2005), AABB Technical Manual, 15th edition, Bethesda, MD: p.98-103.
[26] "Directed Donation". Mayo Clinic. Archived from the original on 2008-05-24. Retrieved 2008-06-25. Wales PW, Lau W, Kim PC (May 2001). J. Pediatr. Surg. 36 (5): 722–5.
[27] T. Brown "Strengthening Blood Systems In Africa: Progress Under PEPFAR and Remaining Challenges" AABB News. April, 1998: page 30.

countries such as Kenya.[28] In this case, a friend or family member of the recipient donates blood to replace the stored blood used in a transfusion, ensuring a consistent supply. When a person has blood stored that will be transfused back to the donor at a later date, usually after surgery, that is called an 'autologous' donation. Blood that is used to make medications can be made from allogeneic donations or from donations exclusively used for manufacturing.[29]

Blood has many different functions, including[30]:- (a) transporting oxygen and nutrients to the lungs and tissues; (b) forming blood clots to prevent excess blood loss; (c) carrying cells and antibodies that fight infection; (d) bringing waste products to the kidneys and liver, which filter and clean the blood ; and (e) regulating body temperature.

2.3.1 Blood types and components

Everybody has a blood type. The most common blood type classification system is the "A-B-O" system discovered by Karl Landsteiner in the early 1900s. There are four groups of blood in the ABO system: A, B, AB, and O. Blood type is established before one is born by specific genes inherited from one's parents. We receive one gene from each parent and these two combine to establish a person's blood type as is shown in Table 1 (page 28).

There are eight blood types which include: type O positive, O negative, type A positive/A negative, type B positive/B negative and type AB positive/AB negative.

[28] "Autologous (self-donated) Blood as an Alternative to Allogeneic (donor-donated) Blood Transfusion". AABB. Retrieved 2013-06-25.
[29] "Recovered Plasma". AABB. Retrieved 2013-06-25.
[30] http://www.hematology.org/Patients/Blood-Basics/5222.aspx

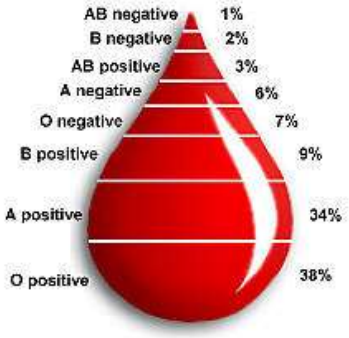
Table 1: Classification of blood types

Blood Type	Received Blood?	Give Blood?
OO	O only	Any type
AB	Any type	AB only
AA, AO	AA, AO, OO	AA, AO, AB
BB, BO	BB, BO, OO	BB, BO, AB

Source: http://www.bloodlinkfoundation.org/blood.html

Figure 1 below shows the percentage distribution of population by blood type. **But the rarest type of blood is the one that is unavailable when needed!**

Figure 1: Blood type percentages



Source: https://www.lstream.org/BloodDonationFacts.aspx

Type "O negative" blood is often called the universal blood type because patients of all blood types can receive type O negative red cells. This is the type that is transfused to patients in an emergency situation. Patients with type "AB positive" blood are often called universal recipients because they can receive red cells of any blood type. And, type AB plasma and platelets are universal in their ability to help any patient.

The blood that runs through the veins, arteries, and capillaries is known as whole blood, a mixture of about 55 percent plasma and 45 percent blood cells. About 7 to 8 percent of your total body weight is blood. An average-sized man has about 12 units of blood in his

body, and an average-sized woman has about 9 units. Blood is made of four components; plasma, red blood cells, white blood cells and platelets.[31]

Plasma: The liquid component of blood is called plasma, a mixture of water, sugar, fat, protein, and salts. The main job of the plasma is to transport blood cells throughout your body along with nutrients, waste products, antibodies, clotting proteins, chemical messengers such as hormones, and proteins that help maintain the body's fluid balance.

Red Blood Cells (also called erythrocytes or RBCs): Known for their bright red color, red cells are the most abundant cell in the blood, accounting for about 40-45 percent of its volume. The shape of a red blood cell is a biconcave disk with a flattened center – in other words, both faces of the disc have shallow bowl-like indentations (a red blood cell looks like a donut).

White Blood Cells (also called leukocytes): White blood cells protect the body from infection. They are much fewer in number than red blood cells, accounting for about 1 percent of your blood.

Platelets (also called thrombocytes): Unlike red and white blood cells, platelets are not actually cells but rather small fragments of cells. Platelets help the blood clotting process (or coagulation) by gathering at the site of an injury, sticking to the lining of the injured blood vessel, and forming a platform on which blood coagulation can occur.

2.4 History of blood banks and blood transfusion services

An early development leading to the establishment of blood banks occurred in 1915, when Richard Lewison of Mount Sinai Hospital in New York City initiated the use of sodium citrate as an anticoagulant. This discovery transformed the blood transfusion procedure from direct (vein-to-vein) to indirect. In the same year, Richard Weil

[31] http://www.hematology.org/Patients/Blood-Basics/5222.aspx

demonstrated the feasibility of refrigerated storage of anti-coagulated blood. The introduction of a citrate-glucose solution by Francis Peyton Rous and JR Turner two years later permitted storage of blood in containers for several days, thus opening the way for the first "blood depot" established in Britain during World War One[32].

In Russia Sergei Yudin pioneered the transfusion of cadaveric blood and performed this successfully for the first time on March 23, 1930. Also in 1930 Yudin organized the world's first blood bank at the Nikolay Sklifosovskiy Institute, which set an example for the establishment of further blood banks in different regions of the Soviet Union and in other countries. By the mid-1930s the Soviet Union had set up a system of at least sixty five large blood centers and more than 500 subsidiary ones, all storing "canned" blood and shipping it to all corners of the country.

News of the Soviet experience traveled to the United States, where in 1937 Bernard Fantus, director of therapeutics at the Cook County Hospital in Chicago, established the first hospital blood bank in the United States.[33] In creating a hospital laboratory that preserved and stored donor blood, Fantus originated the term "blood bank." Within a few years, hospital and community blood banks were established across the United States. Willem Johan Kolff organized the first blood bank in Europe (in 1940).

In 1939 Charles R. Drew researched in the field of blood transfusions, developing improved techniques for blood storage, and applied his expert knowledge in developing large-scale blood banks early in World War II. Oswald Hope Robertson, a medical researcher and U.S Army officer who established the depots, is often regarded as the creator of the first blood bank jointly with the University of Louisville.

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[32] http://en.wikipedia.org

[33] Morris Fishbein, M.D., ed (1976). "Blood Banks". *The New Illustrated Medical and Health Encyclopedia*. 1 (Home Library Edition ed.). New York, N.Y. 10016: H. S. Stuttman.

An important breakthrough came in 1939-40 when Karl Landsteiner, Alex Wiener, Philip Levine, and R.E. Stetson discovered the Rh Blood Group system, which was found to be the cause of the majority of transfusion reactions up to that time. Three years later, the introduction by J. F. Loutit and Patrick L. Mollison of acid-citrate-dextrose (ACD) solution, which reduces the volume of anticoagulant, permitted transfusions of greater volumes of blood and allowed longer term storage.

Carl Walter and W.P. Murphy, Jr., introduced the plastic bag for blood collection in 1950. Replacing breakable glass bottles with durable plastic bags allowed for the evolution of a collection system capable of safe and easy preparation of multiple blood components from a single unit of Whole Blood. An anticoagulant preservative, CPDA-1 was introduced in 1979. It decreased wastage from expiration and facilitated resource sharing among blood banks.

Since World War II, the science of blood reached new heights -- and setbacks. The invention of the plastic blood-collection bag reduced the external contamination of donated blood to unprecedented levels; the commercial introduction of Rh immunoglobin saved the lives of many Rh-positive babies born to Rh-negative mothers; and the development of Factor VIII concentrate offered hemophiliacs a new lease on life. Yet these improvements were soon overshadowed by contaminated blood supplies. Hepatitis and, more drastically and fatally, the HIV virus were transmitted to many transfusion recipients and hemophiliacs -- the very people who had come to rely on the blood of others. As a result of new policies responding to this tragedy, blood supplies are now safer than ever before.[34]

The European Commission´s AIDS Task Force recognizes four patterns of BTS: pattern I, a centrally coordinated national programme; pattern II, hospital based blood banks;

[34] http://www.pbs.org/wnet/redgold/history/index.htm

pattern III, settings where relatives give blood in an emergency; and pattern IV, settings without organized transfusion practices.[35]

Pattern I can be decentralized to regional level and has advantages over the other patterns: it allows better screening of all donated blood units for Human Immunodeficiency Virus (HIV) and other blood borne pathogens; automation can be introduced to increase productivity of staff; the willingness to donate blood is not affected by the quality of services at the hospital which is likely with pattern II-IV; the objectives are relatively quickly achieved; and resources can be better controlled and concentrated. However, the problem with a pattern I BTS is that it constitutes a vertical health programme.

For low income African countries pattern II hospital based blood banks may be the best solutions on economic grounds, although there are disadvantages: competing with other departments for resources; potential problems with the supply of consumables, such as HIV test kits; difficulties in establishing a voluntary blood donor panel because willingness to donate is affected by the quality of services provided by the hospital; and the fact that the in charge of the blood bank often has limited knowledge of BTS. The advantages are that the programme is integrated into the existing health care delivery system and that less capital costs will be required as the majority of the equipment needed will already be present (Jacobs and Mercer, 1999).

Since the establishment of blood banks, it has revolutionized medicine as we know it and saved countless lives all over the world. A well-functioning blood transfusion service or blood bank is dependent on forthcoming blood donors who are willing to donate voluntarily without being instructed.

[35] Beal RW, Bontinck M, Fransen L. (1992). Safe blood in developing countries; a report of EEC`s expert meeting. Brussels; EEC AIDS Task Force.

2.5 World Health Organization (WHO) blood transfusion safety programme

With the goal of ensuring universal access to safe blood, WHO has been at the forefront of the movement to improve blood safety as mandated by successive World Health Assembly Resolutions.

The global need for blood safety and availability has been highlighted in the following WHA and Executive Board (EB) resolutions and regional resolutions that provide specific direction on strategies and activities within individual regions:

- 1975: WHA Resolution WHA28.72: Utilization and Supply of Human Blood and Blood Products
- 1987: EB Resolution EB79.R1: Blood and Blood Products
- 1995: WHA Resolution WHA48.27: Paris AIDS Summit
- 1999: DC-PAHO/AMRO Resolution CD41.R15: Strengthening Blood Banks in the Region of the Americas
- 2000: WHA Resolution WHA53.14: HIV/AIDS: Confronting the Epidemic
- 2001: RC-AFRO Resolution AFR/RC51/R2: Blood Safety Strategy for the African Region
- 2002: WHA Resolution WHA55.18: Quality of Care: Patient Safety
- 2003: WHA Resolution WHA56.30: Global Health Sector Strategy for HIV/AIDS
- 2005: WHA Resolution WHA58.13: Blood Safety: Proposal to Establish World Blood Donor Day
- 2007: WHA Resolution WHA60.24: Health Promotion in a Globalized World
- 2007: WHA Resolution WHA60.29: Health Technologies

The WHO Blood Transfusion Safety Programme at WHO-HQ, Geneva, evolved from the WHO Global Programme on AIDS and the Global Blood Safety Initiative of the late 1980s. In the year 2000, Safe Blood was declared an organization-wide priority and Blood Safety was designated the theme of World Health Day 2000. This was co-

sponsored by the International Federation of Red Cross and Red Crescent Societies and was celebrated by ministries of health, blood transfusion services, blood donor organizations, nongovernmental organizations, professional bodies and community organizations throughout the world.

The WHO strategy for blood safety and availability, endorsed by the World Health Assembly, addresses five key areas:

1. The establishment of well-organized, nationally-coordinated blood transfusion services to ensure the timely availability of safe blood and blood products for all patients requiring transfusion
2. The collection of blood from voluntary non-remunerated blood donors from low-risk populations
3. Quality-assured testing for transfusion-transmissible infections, blood grouping and compatibility testing
4. The safe and appropriate use of blood and a reduction in unnecessary transfusions
5. Quality systems covering the entire transfusion process, from donor recruitment to the follow-up of the recipients of transfusion.

WHO has supported a large number of countries in developing their national blood services through its Blood Transfusion Safety programme, the sole United Nations (UN) programme to provide policy guidance and technical assistance on working towards equitable access to safe blood and blood products and their safe and rational use.

The objectives of the WHO Blood Transfusion Safety programme are to:

- Support Member States in developing and/or strengthening efficient and sustainable national blood programmes with appropriate government commitment, support and regulatory mechanisms, integrated within national health care systems

- Develop norms, standards, best practice guidelines, tools and materials on various steps of the blood transfusion process to ensure blood safety
- Promote the harmonization of national and international efforts to ensure sufficient safe blood products through bilateral and multilateral collaboration and also through global partnerships such as the Global Collaboration for Blood Safety
- Build capacity in countries through structured training activities for the establishment of cost-effective sustainable nationally coordinated blood services, financial management systems, data and quality management systems, voluntary unpaid blood donation, testing of blood, blood cold chain, haemovigilance, education and training programmes in blood transfusion, and the clinical use of blood in medicine, obstetrics, paediatrics, surgery and anaesthesiology, trauma and burns
- Work with partners to observe and promote World Blood Donor Day
- Provide scientific and evidence-based guidance and support on risk assessment
- Collect, analyze and disseminate reliable information on blood safety and availability through the WHO Global Database on Blood Safety and Blood Safety Indicators
- Promote research and development in the provision and appropriate use of safe blood and blood products.

2.6 Worldwide status of blood banks and transfusion services

While the demand for blood is growing in the developed world with longevity of life and increasingly sophisticated clinical procedures, national blood supplies are rarely sufficient to meet existing requirements in the developing countries. Evidence-based strategies for blood safety and availability have been successfully implemented in most developed countries and some transitional and developing nations. However, despite the proven effectiveness of these strategies, many countries are making slow progress towards their implementation.

The challenges and constraints in implementing these strategies include: lack of government support; absence of national blood policies/plans, legislative frameworks,

and effective regulation; fragmentation of blood transfusion services; a lack of clarity of clear roles and responsibilities among multiple national stakeholders; poor institutional coordination; and a lack of integration of blood programmes within national healthcare systems. There is an urgent need to address the challenges in ensuring access to a safe and sufficient blood supply. This can be achieved by 100 percent voluntary blood donation, 100 percent quality assured testing of donated blood and optimizing blood usage for patient health. Additionally, developing quality systems in the transfusion chain, strengthening the workforce, keeping pace with new developments and building effective partnerships will also contribute to blood safety.[36]

Today, more than 30 years after the first World Health Assembly Resolution (WHA28.72)[37] on the utilization and supply of human blood and blood products addressed the issue of blood safety, equitable access to safe blood and blood products and the rational and safe use of blood transfusion still remain major challenges throughout the world. Unless urgent scaled-up action to achieve universal access is taken globally, it will have a direct impact on the achievement of the health-related Millennium Development Goals (MDGs) and the provision of effective support to health care systems in a range of clinical disciplines that are dependent on the availability of a safe and sufficient blood supply.

United States of America. The Association of American Blood Banks (AABB) estimates that 9.5 million volunteers donate blood in America each year, 20 percent of whom are first time donors. According to the 2009 National Blood Collection and Utilization Report about 16 million units of whole blood and red blood cells were donated in the United States in 2008. The need for blood is great. Every day in the U.S., approximately 40,000 units of blood are required in hospitals and emergency treatment facilities for patients with cancer and other diseases, for organ transplant recipients, and

[36] Universal Access to Safe Blood Transfusion & Global Initiative on Safe Blood for Safe Motherhood, World Health Organization. 2008.
[37] Twenty-Eighth World Health Assembly, Geneva 13–30 May 1975 WHA28.72. Utilization and supply of human blood and blood products.

to help save the lives of accident/trauma victims. In 2008, more than 30 million blood components were transfused. And with an aging population and advances in medical treatments and procedures requiring blood transfusions, the demand for blood continues to increase.[38]

Although an estimated 38 percent of the U.S. population is eligible to donate blood at any given time, less than 10 percent do so annually. According to studies, the average donor is a college-educated white male, between the ages of 30 and 50, who is married and has an above-average income. However, a broad cross-section of the population donates every day. Furthermore, these "average" statistics are changing, and women and minority groups are volunteering in increasing numbers to donate. Persons 69 years and older account for approximately 10 percent of the population, but they require 50 percent of all whole blood and red blood cells transfused. Using current screening and donation procedures, a growing number of blood banks have found blood donation by seniors to be safe and practical.

France has been able to treat a million patients with around three million units of locally collected blood and blood products. It is one of the 60 countries collecting 100 percent of its blood supply from voluntary unpaid blood donors. Through its national blood service, the Etablissement Français du Sang, France has promoted voluntary unpaid blood donation – and has been self-sufficient – since the 1950s. A key factor in this achievement has been intensive public awareness campaigns whose focus has more recently shifted from "urgent" calls for donation (the lifespan of blood constituents is short – from 5 to 42 days) through traditional media to more frequent seasonal campaigns, which use widespread publicity as well as Facebook, Twitter, smartphone apps and YouTube to encourage people to give blood. Blood is collected at 153 fixed-site collection areas and via 40 000 mobile sessions a year. [39]

[38] 2009 National Blood Collection and Utilization Report.
[39] http://www.who.int/features/2013/world_blood_donor_day/en/index.html

Sri Lanka. Since the establishment of World Blood Donor Day in 2004, there has been an upsurge in voluntary unpaid blood donations, particularly in low and middle-income countries. Sri Lanka, has achieved remarkable success in reaching a self-sufficient blood supply in just ten years. The National Blood Transfusion Service (NBTS) now collects over 350 000 donations every year, up from just over 150 000 ten years ago. The proportion of voluntary donations has risen from 39 percent to 97 percent since 2003. A key success factor in this rapid rise to self-sufficiency has been the establishment of a centrally- coordinated national transfusion service and people's understanding of the need for blood donation. Sri Lanka's other innovations in recruiting blood donors include a card system (silver/gold/platinum) for milestone achievers in blood donation, a Facebook fan page, free cardiopulmonary resuscitation (CPR) training in target potential donor venues, and annual health checkups for selected donors. Although these incentives have all worked, NBTS has still found that the most efficient way to recruit blood donors is through existing donors and donation organizers acting as personal messengers. [39]

Korea. Excerpts from the Korean Journal of Hematology show that the number of blood donations in Korea showed a decreasing trend for several years after incidents of blood-related accidents in the early 2000s, but these numbers have slowly recovered and have reached a new record of 2.57 million in 2009. In particular, the percentage of "non-group" donors increased from 45.6 percent in 2005 to 62.5 percent in 2009. From 2006 to 2010, there was a significant improvement in blood safety in Korea. Blood safety management has shown a successful outcome since the implementation of the Total Improvement Plan for Blood Safety Management. This plan originally had 5 goals. The first goal was to ensure that safe blood was obtained from the first step of donor recruitment and blood collection. The second goal was to ensure safety by bringing in professionalism in the blood testing system, which was accomplished by establishing a multiple-verification and surveillance system, merger and acquisition of the Blood Testing Centers, and expansion of the infrastructure for blood safety, including test automation and data integration. The third goal was to establish a system for providing

safe and appropriate transfusion management and blood supply. The fourth goal was to secure professionalism and independence of the Korean Red Cross Blood Service Organization. Further, the last goal was to strengthen government surveillance of blood services and to increase financial support. This has resulted in the management of blood safety from blood donation to transfusion showing an improvement; significantly, no transfusion-transmitted infections caused by human immunodeficiency virus (HIV), hepatitis B virus (HBV), or hepatitis C virus (HCV) have been detected since 2005.[40]

India has 2,063 licensed blood-banks. A significant portion of blood-banking activity is carried out by voluntary and private blood-banks. The total recorded blood collection in India is four million units, which meet only 40 percent of need against a least requirement of 10 million units. While the Indian health sector has made some noteworthy achievements over the last 50 years, it has not responded satisfactorily enough to meet the national goals on blood-transfusion services as is witnessed by the substantial negligence to blood-banking services in the country. In India, blood transfusion relies on very fragmented blood-supply systems, where control is exercised by different layers of the Government, making it difficult to assure the quality of blood and blood products. Given the fact that there are a large number of Charitable Trusts and independent commercial and private blood-banks, the control of quality and coordination of all blood-banks to ensure easy access to blood and minimize wastage are a challenging task. This requires much more managerial capacity, skills, and resources within the State Blood Transfusion Councils. The promotion of postgraduate courses in blood-transfusion services will help in getting the trained and skilled human resource in the field of blood-banking. Given the lack of government resources in blood-transfusion services, there has been poor quality of service and periodic shortages of blood. Many blood-banks depend on philanthropic funding for their basic operations. The Government needs to increase its

[40] The Korean Journal of Hematology Volume 45, Number 2 of June 2010.

commitment towards improvement of blood-banking services and ensure that all needy patients get blood on time and free of charge.[41]

2.7 Status of blood banks in Sub – Saharan Africa

2.7.1 Background

The practice of modern blood transfusion in sub-Saharan Africa dates as far back as the 1940s although it may have only been available to privileged individuals such as colonial masters and special African patients at that time.[42] Evidence shows that there was rapid progress in the 1940s, and by 1950, 12 countries had blood transfusion services; this number rapidly rose to 19 by 1955. The post-independence period saw a rapid increase in the service reaching transfusion rates of 718 to 1372 transfusions per 100 000 by 1964.[42]

The civil strife and political turmoil that characterized post-independence Africa resulted in progressive decadence of social services including blood transfusion as part of health service infrastructure in the late 1970s. The blood services therefore continued to decline both in adequacy of the blood supplies and quality of the service. There was also a shortage of information on blood transfusion during the 1980s.[5]

In the early 1980s, there was the realization that HIV could be transmitted by blood transfusion and that the epidemic was widespread in sub-Saharan Africa. However, there was urgent attention by the international community under the auspices of the WHO to support countries to set up blood services in order to safeguard the blood supply against contamination by HIV and other infections transmissible by blood transfusion. The WHO estimated at that time that 5 percent to 10 percent of HIV transmission resulted from transfusion with contaminated blood.[43, 44]

[41] Study of Blood-transfusion Services in Maharashtra and Gujarat States, India, 2009.
[42] William H Schneider and Ernest Drunker, Blood Transfusions in the early years of AIDS in sub Saharan Africa; American Journal of public health.
[43] WHO, Status of Blood Safety in the WHO African Region; report of the 2004 survey. WHO AFRO; 2007.

In September 1994, the WHO Regional Committee for Africa noted with concern that only 10 of the 46 countries could guarantee the safety of blood transfusion in their health care settings. This led to the adoption of Resolution AFR/RC44/R12 which urged Member States to "take urgent steps to enact blood safety policies and mobilize resources for the development of the infrastructure of blood services in central and district hospitals".[45]

In 2001, the Regional Committee for Africa adopted the regional strategy for blood safety. This resolution was based on a strategy with four objectives: to assist Member countries to set up effective systems of recruitment of low-risk donors; to improve the safety of blood and blood products by implementing quality assurance programmes; to map out effective strategies for the screening of blood for all transfusion-transmissible infections; and to promote the appropriate use of blood and blood products by clinicians. It had set four targets to be achieved by 2012, that (i) all Member States will have carried out a situational analysis of blood transfusion safety; (ii) at least 75 percent of all countries will have drawn up, adopted or implemented their national blood policy; (iii) 100 percent of blood units transfused will be screened beforehand for HIV and other transfusion-transmissible infections; and (iv) at least 80 percent of all donations in all countries of the Region will be voluntary and non-remunerated.[46]

2.7.2 Situational analysis

Approximately six million blood transfusions are administered to seriously ill patients in Sub-Saharan Africa (SSA) each year. The estimated need for life saving transfusion in sub-Saharan Africa is 18 million units of safe blood per year.[47]

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[44] World Health Organization, Current and future dimensions of HIV/AIDS pandemic: capsule summary, 1990. WHO/GPA/SF1/90.2. Geneva: WHO 1990.
[45] WHO, Resolution AFR/RC44/R12, AIDS control: current status of AIDS control activities in the African Region. In: Forty-fourth session of the WHO Regional Committee for Africa, Brazzaville, Republic of Congo. World Health Organization, Regional Office for Africa, 1994.
[46] WHO, Blood safety: A strategy for the African Region (AFR/RC51/9 Rev. 1), Brazzaville, World Health Organization, Regional Office for Africa, 2001.
[47] Source: http://www.safebloodforafrica.org/index.htm

Blood transfusion saves lives and improves health; however, millions of people on earth do not have access to safe and timely blood products. This is most evident in developing countries, many that have great transfusion needs due to prevalent maternal morbidity, a high burden of infectious diseases like malaria, childhood malnutrition and trauma casualties.[48] [49] Africa has the highest maternal mortality in the world with ratios estimated at an average of 1000 per 100 000 live births and accounted for 247 000 of the 500 000 maternal deaths in the world in 2000, whereas 16 up to 40 percent of maternal deaths are attributable to haemorrhage.[50] Malaria has an even higher death toll in Africa. Of the estimated annual one million deaths due to malaria in the world, 90 percent occur in Africa south of the Sahara (WHO RBM report 2005). Mortality due to severe malarial anaemia is considerable in the region and accounts for approximately 70 percent of all blood transfusions given to children in sub-Saharan Africa; some children die waiting for transfusions.[51, 52.]

Only 50 percent of worldwide blood donations are made in low income countries where 85 percent of the world's population resides most of whom are in SSA. This disparity is further compounded by the scarcity of volunteer blood donors. Volunteer non-remunerated blood donations carry the lowest risk for transfusion transmitted infection. However, in countries where donation rates are low, hospital blood banks must turn to replacement, family or commercial blood donors to provide blood for patients in need. These types of donations carry higher risks of transmitting infectious disease, especially in regions that have high rates of HIV, hepatitis B and C. Moreover, blood donor recruiters may not have standardized stringent donor screening questionnaires excluding high risk blood donors.[38]

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[48] Progress Toward Strengthening Blood Transfusion Services-14 countries, 2003-2007. *MMWR Weekly*, November 28, 2008; 57(47):1273-1277.
[49] UNICEF: Progress for Children 7 Report: Causes of maternal death (1997-2002) in Africa 2007.
[50] WHO analysis of maternal deaths: A systematic review: The lancet, 367, April 1 2006, 1066–1074.
[51] Akech SO, Hassall O, Pamba A, et al. Survival and hematological recovery of children with severe malaria transfused in accordance to WHO guidelines in Kilifi, Kenya. *Malar J* 2008;7:256.
[52] Bojang KA, Van Hensbroek MB, Palmer A, et a. Predictors of mortality in Gambian children with severe malaria anaemia. *Ann Trop Paediatr* 1997;17:355-359.

Blood safety, however, remains a challenge to many countries in sub-Saharan Africa due to unstable economies, civil strife, natural and manmade disasters, and failure to translate government commitment to practical interventions that would lead to further improvement. Moreover, the African Region does not only have 10 percent of the world's disease burden (World Health Report) but also the highest rates of infectious diseases transmissible through blood transfusion, high HIV prevalence (about 60 percent of the world's total prevalence and 60 percent of the total transmissions in 2006). It has a prevalence of more than 8 percent of the hepatitis B surface antigen (HBsAg) which is a marker of infective carrier state[53] and a prevalence of HCV as high as 2.5 percent to 10 percent in some areas.[54]

Either immediately before or after blood donation, blood must be tested for infectious disease to ensure safety. In Africa, there are high rates of HIV, hepatitis B and C; up to two to twenty-five percent (2-25%).[55, 56] In a 2008 report, 42 of 173 countries reported not all blood transfused is tested for all of these agents.[57] The reasons accounting for the unreliable donor testing is the difficulty to acquire high quality testing supplies, staff shortages and lack of basic laboratory infrastructure. Many countries use point-of-care testing for HIV, HCV and HBV because that's what's available, even though these tests can have long window periods and false negative results. Countries that have a negative stigma attached to HIV diagnosis face the added cultural and logistical challenge of providing donor testing results to positive blood donors.

[53] Francis J Mahoney, Update on diagnosis, Management and prevention of Hepatitis B Infection: Clinical Microbiology Reviews, April 1999, p. 351–366, Vol. 12, No.2; 0893-8512/99.
[54] Cathy Coury, Routes of Infection, Viremia and Liver Disease in Blood donors with Hepatitis C infection; NEJM, 26; 1996; Vol 334: 1691–1696.
[55] Tagny CT, Mbanya D, Tapko JB, et al. Blood safety in Sub-Saharan Africa: a multi-factorial problem. *Transfusion*, 2008;48(6):1256-1261.
[56] Allain JP, Opare-Sem O, Sarkodie F, et al. Deferred donor care in regional hospital blood center in Ghana. *Transfusion* 2009;49(4):669-675.

The HIV epidemic has brought into focus the need for universal access to safe blood transfusion. WHO has provided blood transfusion safety goals supporting creation of sustainable nationalized transfusion programs providing safe blood components for all patients, which are collected from volunteer donors, tested for transfusion transmitted diseases and prescribed and administered appropriately under the auspices of a comprehensive quality system.[57] The U.S. federal government, Centre for Disease Control (CDC), AABB and U.S. blood centers are all working to help developing nations meet these important benchmarks.

Developing countries also struggle with manufacturing blood components (packed red blood cells, plasma and platelets) from whole blood donations. Component therapy allows medical practitioners to tailor transfusion to provide only the necessary blood fraction to treat a patient's disease. It also makes use of a single donation so it may benefit more than one patient. Only 28 percent of low income countries have the laboratory technology such as centrifuges, plasma separators and refrigeration to fractionate and store blood components, compared with 98 percent of high income countries.[57]

Because it is challenging to recruit low risk blood donors and laboratory capabilities for testing are suboptimal, blood transfusion therapy should be used sparingly to avoid transfusion transmitted disease. It is estimated up to five percent of HIV may be transmitted through blood transfusion in some Sub-Saharan countries.[55] Nevertheless, transfusions are prescribed when other less risky medical treatments may be appropriate.[57] This practice increases the risk of infection, transfusion reactions and can contribute to blood shortages for patients who require blood transfusion as part of their care. WHO calls for national collaboration of blood transfusion services and physicians to develop and implement clinical guidelines for the appropriate use of blood transfusion.

[57] World Health Organization: Blood Transfusion Safety: Universal access to safe blood and blood products for transfusion. Available at: www.who.int/bloodsafety/en. Last accessed Sept. 27, 2010.

Over the past ten years, high-income countries in the North have provided considerable financial aid to establish and support national blood transfusion services in low-income countries in sub-Saharan Africa. This action has largely been driven by concerns relating to the contribution of blood transfusion to the HIV epidemic in the region, leading to the overwhelming objective of "safe blood." Development aid to sub-Saharan African blood services has brought benefits but also some unintended negative consequences. Policies and practices from funding countries, particularly exclusive use of volunteer non-remunerated donors, centralization, and systematic preparation of blood components are not necessarily appropriate for sub-Saharan Africa where the vast majority of transfusions are done as emergencies. Implementation of these policies and practices adds significantly to the cost of a unit of blood, making the transfusion services unaffordable in resource poor settings and creating long term reliance on external funding. As a direct consequence of this funding, some of the underlying principles of transfusion services practiced in the high-income donor countries have been applied in sub-Saharan Africa recipient countries. These principles may be based on sound practice in wealthy countries but do not necessarily apply to sub-Saharan Africa at this time.[58]

There are several examples of developed countries providing valuable assistance for improving blood transfusion in developing nations. In 2003, the United States President's Emergency Plan for AIDS Relief (PEPFAR) set out to "expand access to HIV prevention, care and treatment in low-resource settings."[59] Although the majority (78 per cent) of PEPFAR funding was directed to HIV treatment, 15 percent was slated for HIV prevention and two percent was devoted to blood safety. Of the 104 countries named to receive PEPFAR dollars, 14 were selected to get direct support for establishment of, or improvements to, their national blood services and were paired with international organizations to provide them with technical assistance.

[58] External Financial Aid to Blood Transfusion Services in Sub-Saharan Africa: A Need for Reflection, 2012.
[59] The United States President's Emergency Plan for AIDS Relief (PEPFAR). Available at: www.pepfar.gov. Last accessed Sept. 27, 2010.

AABB was assigned South Africa, Mozambique, Kenya, Rwanda and Tanzania; Sanquin was paired with Uganda and Zambia; WHO and the Pan American Health Organization (PAHO) support Ethiopia, Namibia, Haiti and Guyana; Safe Blood for Africa (SBFA) support Botswana and Nigeria, and Social and Scientific Systems Inc. supports Cote d'Ivoire.[9] The PEPFAR undertaking is the largest to date to support African blood safety and infrastructure. The goals set for these countries is to follow the WHO tenants of safe and effective blood transfusion infrastructure by: developing and implementing a national blood policy at the legislative level, recruiting volunteer donors, effectively testing blood for transfusion transmitted infection, setting guidelines for the appropriate use of blood transfusion therapy, guiding and implementing quality laboratory procedures and monitoring programs as well as setting up training activities to sustain these programs.

AABB worked with its partner countries to set the formative policy and establish quality systems for national blood services as the first priority. The Kenyan initiative focused on increasing blood donation from the lowest risk donors. Since project commencement, donation rates have increased from 43,000 to more than 120,000 annually, and HIV rates in blood donors decreased from 4.7 to 1.2 percent.[10]

In Rwanda, three of the country's regional blood services laboratories were rehabilitated, quality standards were developed, and donor notification programs were strengthened.[11]

South Africa already had a strong quality system and donor testing programs. Donor education programs targeted at explaining risk behavior and blood safety, transfusion therapy guidelines as well as implementation of single donor nucleic acid testing were implemented.[12]

Collaboration between AABB and Tanzanian blood services led to significant improvements. Blood collections have shifted from hospital collections to seven zonal centers collecting, testing and distributing blood to hospitals under a quality system.

Moreover, blood collections from volunteer donors has increased significantly from 20 to 80 percent.[10,13]

In Mozambique, a national blood transfusion policy was developed, equipment and buildings were rehabilitated, and personnel training specific to donor testing for infectious disease was completed. Implementation of testing improvements in Mozambique led to commencement of testing for hepatitis B and C and expansion of testing for HIV in provincial blood banks.[14] All PEPFAR countries had training programs initiated or strengthened, which will contribute substantially to the long-term sustainability of the PEPFAR-funded activities.

PEPFAR has had significant positive effects on certain countries; however, those without funding are left in various stages of achieving WHO's recommendations of safe and available blood. The infrastructure of laboratories, hospitals and blood centers continue to hinder blood safety improvements. Service contracts to repair broken equipment are not available in developing nations; thus, equipment can sit unused after it malfunctions. High quality reagents, supplies and diagnostics are not reliably obtainable through current procurement practices. These barriers are difficult, but not insurmountable. Countries with access to these resources have the capacity to share their expertise and resources to provide developing nations with assistance towards national blood safety and ultimately benefit a large section of the population.[55]

The National Policy for the Blood Service of Ghana provides directives to guide the Ministry of Health to ensure safe and adequate blood and blood component supplies and usage to meet the country wide needs of all Government, Quasi-Government, Private and Mission Health Care Delivery Institutions. A situational analysis carried out indicates that the Blood Transfusion Service depends largely on internally generated funds through the cost recovery system which is only partial and government budget is inadequate to cater for all the requirements. Blood donations, which should be based on 100 percent

voluntary non-remunerated, accounts for only 41 percent of the total donations. Blood is screened routinely for HIV 1 and 2, hepatitis B, Hepatitis C and syphilis. The screening has shown HIV prevalence increased from 1.5 percent in 1994 to 3.4 percent in 2004. The BTS also indicates the quality assurance programme is underdeveloped. More than 75 percent of blood in the rural areas and 50 percent in urban areas are transfused to children under five years and women in the child bearing age. Blood banks are not equipped with standby generators, and because of frequent power cuts, the cold chain is often not reliable. The analysis also showed that the communication system is poor and qualified staff are not adequate.[60]

The organization of blood transfusion in Lesotho is loosely diffused in the Central Laboratory Service that supports patient care in hospitals, and there is no formal legislative instrument to guide their operations. There is no organized dedicated programme and the limited laboratory staff in the existing service are also hospital laboratory staff. The existing blood bank is considered as a unit of the Central Laboratory on which it depends on administration, supervision and supplies.[61]

The current shortage of staff and the absence of an organized donor recruitment system results in the regular repeat donors forming only 5 percent of the blood collections. 70 percent of the blood is collected from blood collecting campaigns in institutions all around the country, whilst 25-30 percent is collected at the Lesotho Blood Transfusion Services (LBTS). Replacement/family donors form about 5 per cent. About 20 percent of donors donating at the LBTS are first time donors some of whom are interested in ascertaining their HIV status. The blood collecting campaigns are not planned and are a response to low stocks in the blood bank. Blood donation badges are given to regular donors according to the number of donations and a pen for 10th time donors. There has been a significant decline in the annual total donations in the past 10 years associated with a rise in the incidence of HIV in the population. In 1995 a total of 4178 units were

[60] Ghana National Blood Policy for the Health Sector, 2006
[61] Lesotho National Blood Transfusion Policy, 2006.

collected while in 2003, 2700 units were donated representing about a 40 percent decline. The sentinel surveillance in 2003 showed an HIV prevalence of 29 percent in the general population and 6.2 percent prevalence noted among blood donors.[61]

Since the centralization of blood collection at the LBTS in 1987 all donated blood units are tested for HIV, HBsAg and syphilis and the records are kept. Two (2) ELISA machines are available for HIV and HBsAg, and one Rotator for syphilis. Two blood bank fridges which were bought in 1984 are being used for storage, with one showing a faulty temperature recording chart but the digital temperature indicator is functioning. There is no interaction between the LBTS staff and the hospitals or clinicians to ascertain the real demand or need for blood and monitor the clinical use of blood. Blood is only prescribed by medical doctors but there are no guidelines to ensure proper use. This weakness is made worse by the fact that the LBTS does not have a qualified medical doctor.[61]

2.8 Blood transfusion services in Kenya

The institutional framework and organization of the Kenya National Blood Transfusion Services (KNBTS) was mapped out in the *Policy Guidelines on Blood Transfusion in Kenya, 2001* document, however, the KNBTS was formed after the 1998 terrorist attack in Kenya. There was a massive shortfall of blood, which had to be brought in from as far as Israel. In accordance with this policy the KNBTS has been working towards transitioning from a hospital-based transfusion system to a national one through its network of regional and satellite transfusion centres. Regional transfusion centres were established in Kisumu and Nairobi in 2001; Embu, Nakuru and Mombasa in 2002; and Eldoret in 2003. In addition, satellite centres were identified in Kericho, Naivasha and Voi.[62] The policy is grounded by the understanding that a well-organized national service is safer and more cost effective than a hospital-based system. A national service promotes adherence to quality standards, minimizes duplication, and achieves economies

[62] See Annex 1 Map of KNBTS RBTCs and Satellite Centres throughout Kenya.

of scale through a centralized mechanism for recruiting donors and for screening and processing blood. Additionally, KNBTS has begun to shift from relying on donors who give for a particular patient, such as for a relative, to voluntary, non-remunerated blood donors. Studies worldwide indicate that volunteers produce the safe blood supply.[58] KNBTS aims for zero tolerance in transmitting transfusion related infections to recipients of blood and blood products.

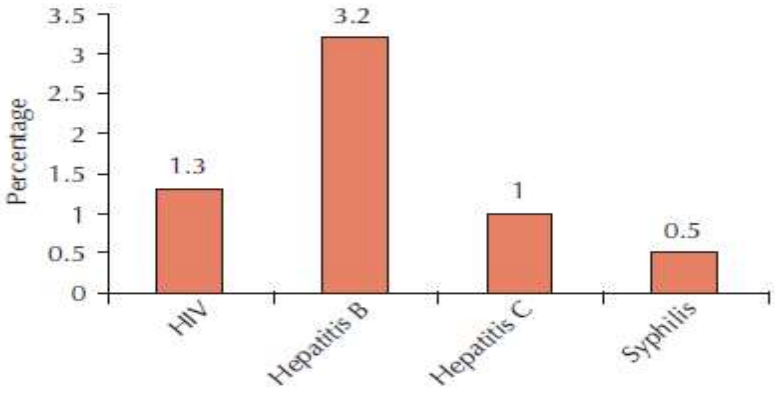
Potential donors are provided with screening criteria to determine if they are at risk for transmitting an infection and are also checked to ensure that they are not anaemic or whether donating will be risky for their health. Only healthy persons are accepted as donors. The examination aims first to protect the potential donor, whose health must not be put at risk by donating blood. Equally important is to protect the recipient, which is achieved by assessing the potential risk of infectious agents in the donor.[63]

A core activity of KNBTS is to increase the country's blood supply. From 2003-2013, the blood supply from voluntary non-remunerated blood donors grew from 40,000 to 169,000 (Figure 4, page 55).

The KNBTS has also produced a gradual decrease in the number of units with TTIs and in particular HIV infection. HIV prevalence in donors has fallen from 7 percent before the national service was established to only 1.3 percent (Figure 2). This has been achieved partly by implementing more stringent donor selection criteria and by education, which will result in overall improvement in blood safety. The national policy on blood transfusion stipulates that all blood must be screened for HIV, hepatitis B virus and syphilis. Since the beginning of 2003 KNBTS has additionally tested all blood for hepatitis C virus.[64]

[63] National Standards for Blood Transfusion Services in Kenya, 1st Edition, 2007.
[64] AIDS in Kenya. Trends, Interventions and Impact. 7th edition, 2005.

Figure 2: Mean prevalence among blood donors of TTIs[64]



Hepatitis B virus is the commonest TTI among volunteer blood donors (Figure 2). Screening methods used are highly sensitive; making it exceedingly unlikely that donors positive for any infectious agent will be missed. All blood units that test positive are discarded. Trends in the prevalence of TTIs among blood donors are a reflection of both the prevalence of infection in the general population and the degree to which low-risk donors are selected. Figure 3 indicates the HIV prevalence rate in six regional transfusion centres and the variation by months. It is evident that HIV prevalence rates are markedly elevated in April, August and December. These are periods when schools are closed and the transfusion centres rely on out-of-school donors. Infection rates are higher in this population group. Efforts are being made to create a pool of low-risk volunteer out-of-school donors.[64]

Figure 3: Hepatitis and syphilis in blood donors, 2003[64]

RBTC	Hepatitis B	Hepatitis C	Syphilis
Eldoret	2.4	—	0.4
Embu	3.3	0.4	0.2
Kisumu	3.9	2.2	0.5
Mombasa	5.4	3.4	1.5
Nairobi	3.9	0.8	0.3
Nakuru	5.4	0.1	0.5

Once the guidelines on BTS in Kenya were in place, the Ministry of Health undertook to ensure that the policy would remain responsive to current needs and issues throughout the country and that it will continue to respond to emerging issues to meet its key goal of providing safe blood whenever it is needed, through creating a strong, efficient and self-sustaining national blood transfusion service capable of meeting all the needs of the country. Progressively 6 regional and 10 satellite centres have been established. The key strategies identified include[65]:-

- Ensure the provision of adequate supplies of safe blood for the whole country;
- Ensure that each recipient receives the most appropriate therapy compatible with maximum possible safety;
- Ensure that blood and blood products are administered for genuine therapeutic needs only, and with no financial motivation on the part of either the prescriber or the health institution;
- Improve and strengthen the procurement, supply, processing, distribution and surveillance systems for blood transfusion through policy guidelines;
- Establish a comprehensive and well-coordinated National Blood Transfusion Service (NBTS) under the general guidance of the Ministry of Health;
- Establish a National Blood Transfusion Management Board, appointed by the Minister of Health which will have wide representation to advise the NBTS on the running and management of the services;
- Define the roles and responsibilities of all stakeholders, who will play their part in ensuring the proper running of the service;
- Ensure high standards of operations and safety through appropriate regulatory and supervisory mechanisms;
- Provide guidelines for a blood donor recruitment system through public education and advertising. This shall be based on voluntary, non-remunerated, potential blood donors;

- Create a self-sustaining financial mechanism that would run the service throughout the country. The government will provide direct funding as well as create an enabling environment for the NBTS to acquire funding from other sources, including local and international development partners and well-wishers. An agreed user fee will also be levied to recover part of the costs of providing safe blood and blood products;
- Enact legislation providing a legal framework for the running of the NBTS;
- Phase out the current hospital-based blood bank systems and replace them with the new NBTS, which will have a network of regional and zonal blood transfusion centres. These will provide adequate and safe blood, and blood products to all hospitals, both public and private within their catchment areas;
- Provide modality for manpower development, training and retention to satisfy the needs of the service;
- Establish a system for data collection and management of blood transfusion, which will form part of the national comprehensive BTS surveillance system; and
- Ensure active basic operational and developmental research into all aspects of blood transfusion.

The Government of Kenya has long recognized the importance of maintaining a safe and adequate supply of blood in Kenya. The country is a signatory to the World Health Assembly Resolution (WHA 28.72 of 1975) which requires each member state to develop a comprehensive, well-coordinated blood transfusion service, based on voluntary, non-remunerated blood donation. Kenya is also a signatory to the Regional Commonwealth Ministers of Health Resolution of 1989 requiring that each member country make the provision of safe blood to the people a national priority. Although this has not yet been fulfilled, the several recent mass disasters in the country have brought home an intensified commitment by the government to accelerate the process and ensure the implementation of the national plan.[65]

[65] Policy Guidelines on Blood Transfusion in Kenya, 2001.

2.9 Challenges in obtaining adequate safe blood in Kenya

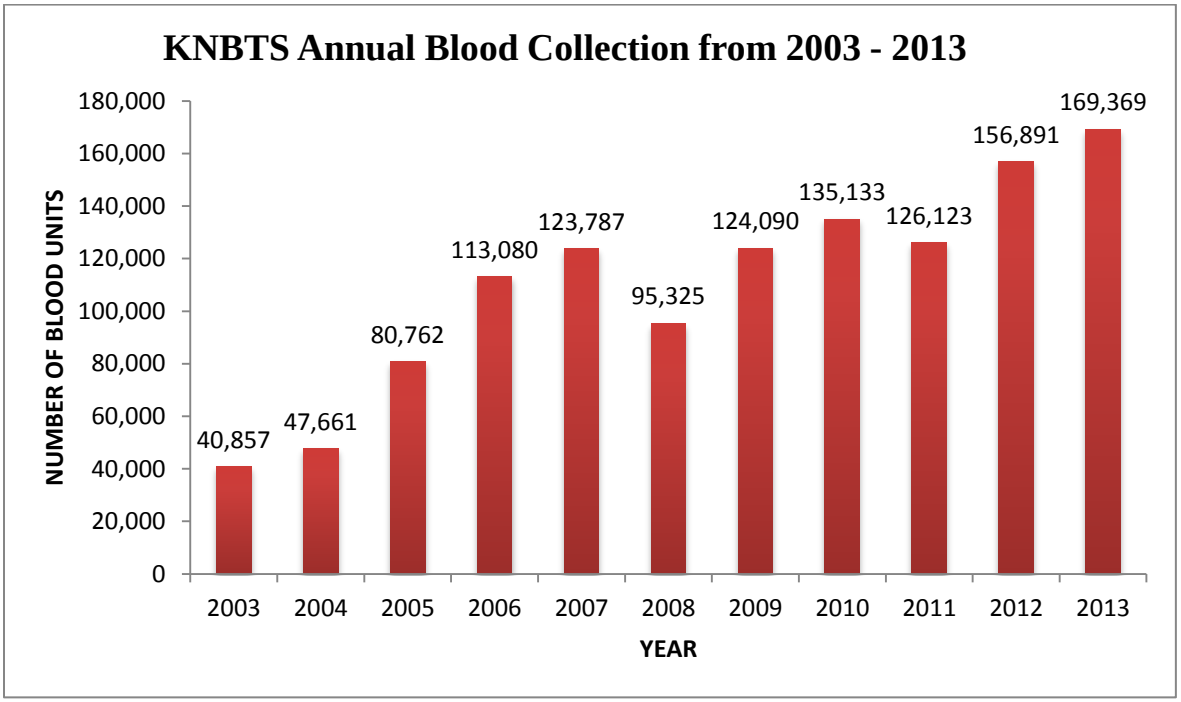
Despite the many improvements and advancements made in health in Kenya, the country continues to exhibit negative trends concerning the health of its people. The population continues to grow at an average rate of 2.9 per cent. After years of improvement, life expectancy has decreased largely due to the AIDS pandemic. Negative trends are also apparent in both the infant and under-five mortality rates. To a very large extent, this is due to the increase in malaria and consequent severe anaemia.[65] Kenya is also experiencing an ever-increasing demand for blood transfusions that cannot be sustained by the blood transfusion service in its present state. While the demand has increased, the supply of blood in Kenya has diminished. This is due to a decrease in donations; a high prevalence of HIV and other blood-borne infections in the population thereby rendering a large amount of donated blood unsuitable for use; and a decrease in resources and funding allocated to blood transfusion services.[65]

Inadequate translation of government commitment of strategies enshrined in the National Blood Policy into realistic interventions on the ground coupled with low expenditure on health due to competing priorities hampers reasonable progress to the development of blood transfusion services in Kenya. Funding for the KNBTS is mainly from the President's Emergency Plan for AIDS Relief with the government only meeting the expenses for half of the staff costs. These donors now feel that Kenya has come a long way and should be able to finance the operations of BTS in the country.

There is need to establish a pool of regular, repeat volunteer blood donors and to establish self-sustaining and self-financed blood donation centers. Emergencies are many, but sufficient supply of life-saving blood is not. The most blood Kenya has ever had on hand is 169,000 units (2013) which is about 38 percent of the country's requirement (440,000 units). This amount collected in 2013 is mainly attributed to several terrorist attacks in the last half of 2013 which necessitated several blood donation campaigns rallying the

public to donate blood. Figure 4 shows annual blood collections by KNBTS in the last ten years.

Figure 4: KNBTS annual blood collection from 2003 – 2013



Source: KNBTS (Figures only relate to collection from KNBTS)

The country has a high prevalence of infections transmissible by blood transfusion; these infections e.g. HIV/AIDS not only require blood products as part of their management but also pose difficulties to selecting donors at reduced risk of infection. The disease burden of non-communicable diseases such as diabetes, hypertension and other complications associated with them such as renal failure also contribute to challenges facing BTS and further reduce the donor pool. Testing of blood against these infections is seldom universal and often lacking in quality. Anecdotal evidence shows that clinical blood usage in the Kenya is usually emergency driven and ad hoc in nature, while unnecessary transfusions are not uncommon.

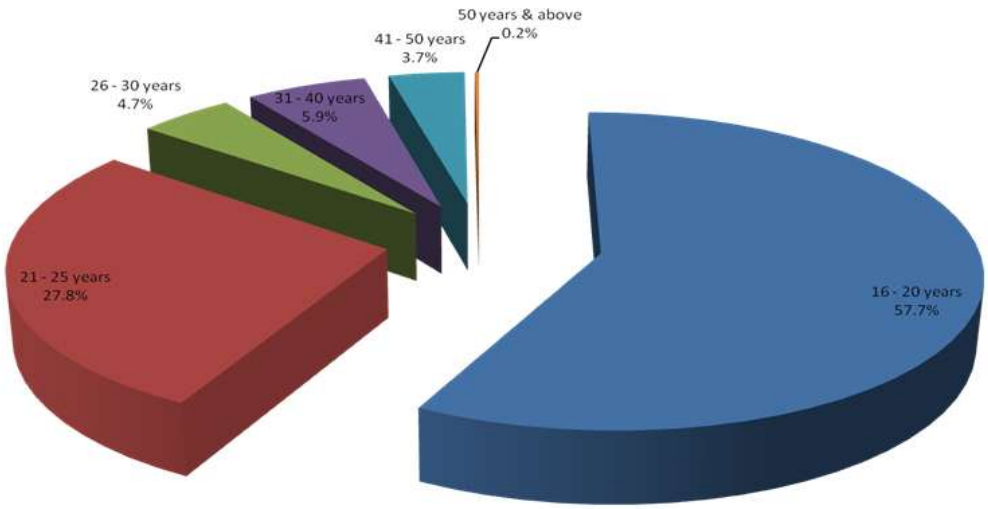
Education, advocacy and awareness are also a major challenge. There is need to increase people's awareness on BTS through continuous education of the public whether through radio, television or in schools.

The poor infrastructure in Kenya also hinders the operations of KNBTS and other institutions who are involved in blood collection. Transportation costs are high and the road network is not in good condition especially in rural parts of the country. This restricts the donor pool as they are unable to reach rural donors who may be willing to donate blood.

The challenge of poor infrastructure also poses blood safety risk as standard operating procedures for blood handling requires the maintenance of a cold chain from donation, screening to transfusion. If the road network is bad, the blood cannot be collected and transported to the point of use in good time and thus will have to be discarded due to safety reasons. Blood is considered a healthy medium for multiplying bacteria thus safety is of utmost importance.

Over reliance on school age donors to sustain the national blood collection levels. Data from the KNBTS shows that there is usually a drastic drop in blood donations during the school holiday periods of April, August and December in any given year. As is evidenced by (Figure 5, page 57) the largest donor group is that of between 16 – 20 years at 57.7%, followed by 21 – 25 years (27.8%). This information clearly shows that there is need to work towards expanding the blood donor population from the 25 – 65 age groups.

Figure 5: KNBTS donor age distribution



Source: KNBTS

Location of Blood Transfusion Services is considered a hindrance to the blood collection levels in the country. Post independent Kenya had BTS located within municipalities, the move to hospital based BTUs affected donation levels as most hospitals are not necessarily centrally located. For example the BTS in Nairobi was originally located at County Hall and could easily be accessed by willing donors.

Unavailability of the exact units of blood collected in Kenya in any given year makes data collection another challenge facing BTS in Kenya. Though KNBTS has data on their blood collection, most other institutions are not required to share this information with KNBTS. The WHO estimates each country requires about 1 percent of collected blood from its population. This puts Kenya's estimated need for blood at about 440,000 units per year but without data to rely on, it is a challenge to determine the exact blood requirement in the country.

2.10 Challenges facing the KNBTS

According to the KNBTS the challenges facing the institution include[20]:-

- *Sustainability:* KNBTS operations are largely supported by PEPFAR. A self-sustainability plan is needed.
- *Meeting the country's blood needs*: KNBTS unable to achieve this due to: (a) inadequate staffing; (b) inadequate funding; (c) inadequate blood storage facilities at the hospitals; and (d) inadequate advocacy and public education.
- *Lack of legal framework* WHO Guidelines requires the establishment of a stand-alone BTS. WHO 28th World Health Assembly, Geneva 13-30 May 1975 WHA28.72 Utilization and Supply of Human and Blood Products urges member states to: (a) promote the development of national blood services based on voluntary non-remunerated donation of blood; and (b) enact effective legislation governing the operation of blood services and to take other actions necessary to protect and promote the health of blood donors and of recipients of blood and blood products.

2.11 The Kenyatta National Hospital Blood Transfusion Unit

The Kenyatta National Hospital (KNH) is the largest referral hospital providing specialized healthcare to over 30 million of the country's population in addition to other referral clients from the East and Central African region. The hospital has a bed capacity of 2,000 with bed occupancy of over 2,500 patient's leading to increased pressure on available resources, including blood. In order to meet the constant blood demand at the hospital, the Blood Transfusion Unit is tasked with managing the hospital's supply of safe blood and its components.

The BTU was created to meet the needs of the hospital and address blood donation gaps. If the hospital was to solely rely on the KNBTS to provide blood and its products, the supply at the hospital would further decrease. The study sought to examine the robustness of the systems and structures put in place by the hospital to address the demand versus blood supply factor.

2.12 Theoretical framework

Theories provide us with different perspectives with which to view our social world. A perspective is simply a way of looking at the world. A theory is a set of interrelated propositions or principles designed to answer a question or explain a particular phenomenon; it provides us with a perspective. Sociological theories help us to explain and predict the social world in which we live.[66] Theory has also been described as a sort of "road map" by which emergency managers orient themselves during the various phases of catastrophe.[67]

Disasters have been studied using formal academic methods only since the 1920s. The conceptual underpinnings of the field are therefore young and perhaps incomplete, and its future evolution depends on the renewed development of theory, as this represents the framework within which events and phenomena are interpreted and provides a guide to the choice of research questions.

2.12.1 Theory of structuration

This theory was developed by Anthony Giddens in The Constitution of Society to explain and integrate **agency** and **structure.** The theory of structuration is a social theory of the creation and reproduction of social systems that is based on the analysis of both structure and agents, without giving primacy to either. *Agency* is the capacity of individuals to act independently and to make their own free choices. *Structure* is the recurrent patterned arrangements which influence or limit the choices and opportunities available.[68]

Simply put, the theory of structuration holds that all human action is performed within the context of a pre-existing social structure which is governed by a set of norms and/or

[66] Understanding Social Problems, by Linda Mooney, David Knox and Caroline Schacht 2011 (Seventh Edition).

[67] Drabek, T.E. 1998. Sociology of disasters course. Federal Emergency Management Agency, Washington, D.C.

[68] Giddens, A. (1984). The constitution of society: Outline of the theory of structuration.

laws which are distinct from those of other social structures. Therefore, all human action is at least partly predetermined based on the varying contextual rules under which it occurs. However, the structure and rules are not permanent and external, but sustained and modified by human action.

Giddens does not think that people are entirely free to choose their own actions; however, while he begins his major theoretical statements with discussion of action, he does not ignore structure. In fact, the connection between structure and action is the central element in his theory of structuration. Giddens' argument is summed up by his phrase "duality of structure." At a basic level, this means that people make society, but are also constrained by it. For Giddens human agency and social structure are not two separate concepts or constructs, but are two ways of considering social action. There is a duality of structure so that on one side it is composed of situated actors who undertake social action and interaction, and their knowledgeable activities in various situations. At the same time, it is also the rules resources, and social relationships that are produced and reproduced in social interaction. Structuration therefore means studying the ways in which social systems are produced and reproduced (Giddens, Constitution of Society: pp 25.26).

Structuration theory aims to avoid extremes of structural or agent determinism. Social structures make social action possible at the same time that social action creates those very structures. As Agents, we are at least partly reflexive that is we monitor our actions and orient them to the behavior of others. Giddens suggests that the proper units of analysis for sociologist are not discrete action but social practice – ongoing streams of action. Giddens argues that we simply cannot act in any meaningful way without drawing upon collective interpretive schemes.

This brings us to the notion of structure. Giddens distinguishes between "structure" and "system" in order to separate these meanings. By system Giddens means the stable

patterns observable in interaction. Systems exist in "time-space", meaning that we can observe them in a particular location and times. Systems here could include families, peers groups, communities or cities, either at the face –to-face level or existing via network over space and time. Erving Goffman's interaction order of face-to-face encounters is one form system. The networks associated with print or electronic communication, or occasional person to person meetings associated with convention or conferences, are examples of systems that have become more common with the development and expansion of communication and transportation.

Giddens defines structure as the "rules and resources" that act as a common interpretive scheme in a particular social system. Giddens argues that structure are related to practices as languages is related to speech in fact, language is an example of what Giddens means by Structure. The notion of structure is important because it emphasizes that structures are not just constraining, they are also enabling. Structure provides the rules that allow new actions to occur. Again language is a good example. A language has rules of syntax that rule out certain combination of words. But in so doing, the rules enables us to create new meaningful sentence. Giddens argument also suggests that structures are generally quite stable but they can be changed. One way this occurs is through the unintended consequences of action. Table 2 captures a representation of the structuration theory.

Table 2: Structuration theory

Structure	**Signification**	**Domination**	**Legitimation**
Modality	Interpretive scheme	Facility	Norm
Interaction	Communication	Power	Sanction
	Structure(s)	System(s)	Structuration
	Rules and resources, or set of transformation relations, organized as properties of social systems	Reproduced relations between actors or collectivizes, organized as regular social practices	Conditions governing the continuity or transmutation of structures, and therefore the reproduction of social systems

Source: Giddens, A. (1984) The Constitution of Society. Berkeley: University of California Press.

For Giddens structure is somewhat more specific and detailed and refers to practices which are structured along certain lines. Structures such as market exchange, class

structures, political organization and processes and educational institutions all have these aspects to them. These structures are formed by structured practices - that is, they do not just exist in and of themselves and they cannot exist without enacted conduct. In some way these structures are reminiscent of Parson in that they provide an all-encompassing theoretical framework that can be used to analyze various aspects of social organization and social change. One major difference though is that Giddens makes unequal distribution of resources and power and more central to his analysis than does Parsons. Giddens structures and systems also appear to be more dynamics and less closed, so that they can accommodate many different forms of power and social change.

The relationship between agency and structure is among the most pervasive and difficult issues in social theory. How are actions of individual agents related to the structural features of society? How are actions structured in everyday contexts? How are the structured features of actions reproduced? To examine the dualism between structure and agency, Giddens departed from the conceptualization of structure as some given or external form. Structure is what gives form and shape to social life, but it is not itself the form and shape. Structure exists only in and through the activities of human agents (Giddens 1989: 256). Similarly, he departed from the idea of agency as something just 'contained' within the individual. Agency does not refer to people's intentions in doing things but rather to the flow or pattern of people's actions. Giddens deeply reformulated the notions of structure and agency, emphasizing that 'action, which has strongly routinized aspects, is both conditioned by existing cultural structures and also creates and recreates those structures through the enactment processes.[69] He suggested that while structural properties of societies and social systems are real, they have no physical existence. Instead, they depend upon regularities of social reproduction (Giddens and Pierson 1998).[70] As a consequence, the basic domain of study in the social sciences consists of social practices ordered across space and time (Giddens 1984: 2).

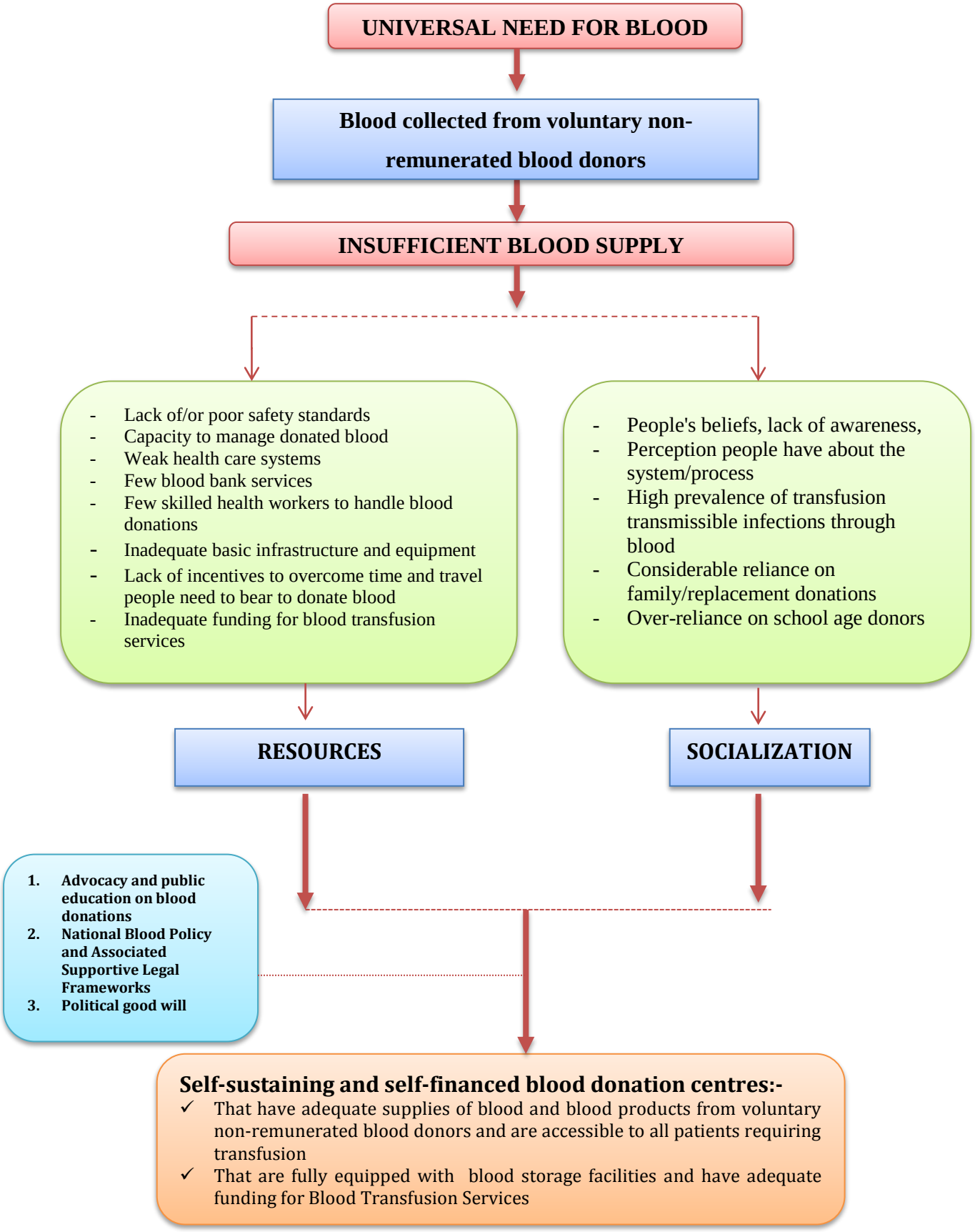
[69] Walsham, G. and Ham, C.K. (1993). Information Systems Strategy Formation and Implementation: the Case of Central Government Agency. Accounting Management and Information Technology, (page 34).
[70] Giddens, A. and Pierson, C. (1998). Conversations with Anthony Giddens – Making Sense of Modernity.

Blood transfusion is a unique technology that blends science with altruism. Though its collection, processing and use are technical, its availability depends entirely on the extraordinary generosity of the blood donor who donates this most precious of gifts – the gift of life. Safe transfusion not only requires the application of science and technology to blood processing and testing, but also social mobilization to promote voluntary blood donation by sufficient numbers of people who are healthy and are at low risk of infections that can be transmitted to the recipients of their blood. In the context of the theory of structuration, this means that people's action **(agency)** to donate blood ensures that blood transfusion services are able to continue functioning and providing services to others in the society. If people were to stop donating blood, the blood transfusion services **(structure)** would no longer be in existence. *Structure exists only in and through the activities of human agents (Giddens 1989: 256).*

2.13 Conceptual framework

The conceptual framework shows the factors that could be contributing to a constrained supply of blood at KNH as conceptualized by the researcher. There is a universal need for blood by human beings to counteract the effects of illness, violence, injury due to accidents, pregnancy and childbirth among other reasons. Blood is only manufactured in the human body and transfusion is entirely dependent on voluntary donations. Unfortunately blood demand seems to always exceed supply and we lack a sufficient and safe supply of blood. There is need to address the causes whether related to constrained resources or socialization by putting in place effective strategies and solutions to guarantee sufficient universal blood supply at the KNH. According to the researcher's school of thought, the independent variables of the study are the factors affecting the supply of sufficient blood at the KNH while the dependent variables are requirements for effective Blood Transfusion Services. The intervening variables include increased advocacy and public education together with full implementation of the National Blood Policy and associated supporting legal frameworks as presented in Figure 6.

Figure 6: Specific conceptual diagram



CHAPTER 3: RESEARCH METHODOLOGY

Introduction

This chapter is aimed at providing information about the research design, the study site, target population, sampling procedure and size, unit of analysis, data collection methods and tools, validity and reliability of the instruments and data analysis & presentation.

3.1 Research design

This study adopted a descriptive research design. It sought to establish what factors significantly contribute to the inability to have supply of safe blood on a sustainable basis with a special focus on the Kenyatta National Hospital. It also sought to offer recommendations that could be used to improve Blood Transfusion Services in Kenya. The research design adopted offered flexibility to report on the many issues affecting BTS in Kenya.

3.2 Study site

The study was carried out at the Kenyatta National Hospital which is the largest teaching and referral hospital in Eastern Africa. It is located in Nairobi City, the capital of Kenya. KNH was built to fulfill the role of being a National Referral and Teaching Hospital, as well as to provide a medical research environment. Established in 1901 with a bed capacity of 40, KNH became a State Corporation in 1987 with a Board of Management and is at the apex of the referral system in the Health Sector in Kenya. It covers an area of 45.7 hectares and within the KNH complex are College of Health Sciences (University of Nairobi); the Kenya Medical Training College; Kenya Medical Research Institute and National Laboratory Service (Ministry of Health). KNH has 50 wards, 22out-patient clinics, 24 theatres (16 specialized) and Accident & Emergency Department. Out of the total bed capacity of 1800, 209 beds are for the Private Wing. There is also a Doctors Plaza consisting of 60 suites for various consultant specialties. The hospital offers a wide range of diagnostic services such as Laboratories, Radiology/Imaging and Endoscopy

among other specialized services. Sometimes, the average bed occupancy rate goes to 300 per cent. In addition, at any given day the Hospital hosts in its wards between 2500 and 3000 patients.[71]

3.3 Target population

The rationale for choosing KNH is that it is a National Referral and Teaching Hospital, as well as a medical research center. On average the Hospital caters for over 80,000 in-patients and over 500,000 out-patients annually. Blood transfusion is a vital component of the health care delivery system and many of these patients at KNH may require whole blood or some of its products as part of their treatment. The target population for this study was comprised 500 of blood donors; medical personnel/officials overseeing blood transfusion services at the KNH.

3.3.1 Inclusion criteria

Adult donors between the ages of 18 – 65 who are willing to be part of the study were included in the study.

Medical personnel at the BTU and those from wards that require higher levels of blood and its products e.g. maternity, general surgery and orthopedic were also included.

3.3.2 Exclusion criteria

Donors below 18 years were excluded from the study as they were legally considered under-age and they should not participate in blood donation exercises without parental consent.

[71] Source: http://knh.or.ke/index.php/ (Retrieved 2013/07/02).

3.4 Data collection sources and methods

Primary sources were relied upon for first-hand information. The primary sources were used as they were systematic and were used to collect information from the respondents on the factors affecting the supply of sufficient and safe blood in our Blood Transfusion Services. It also compared or explained the knowledge, attitudes and behavior of the respondents. Primary data helped in filling the identified gaps and supplement the secondary data in order to draw useful results.

Secondary data included both published and non-published data. In this study, it included but not limited to reports from the Ministry of Health, Kenyatta National Hospital, the Kenya National Blood Transfusion Services, the Kenya Red Cross, WHO blood related reports and the National Disaster Operation Centre among others.

Data was collected from a sample or subset of the entire population and this allowed the researcher to generalize or make inferences. Results were interpreted to determine the probability that the conclusions found among the sample could be replicated within the larger population.

This study employed the observation and interview research methods. The observation method was through the use of an observation checklist whereas the interview method was facilitated by the use of questionnaires and an interview guide.

3.4.1 Data collection tools

The following tools were employed;

1. **The Study Budget** (Appendix No. I) — outlines the study budget as there are various costs associated with the research proposal and the researcher is expected to plan for and ensure provision of the funds.

2. **Letter of introduction** (Appendix No. II) — would act as an ice-breaker and provides the respondents with a short introduction to the research study.

3. **Consent form** (Appendix No. III) — provided respondents with a summary on the study, where it is being undertaken, the contacts of the researcher, among other key information as most might not be able to read the entire proposal. Once understood and signed by the respondents, it gave the researcher the explicit authority to use the data collected since permission was sought from each respondent. It also protected the identity of the respondents as it clearly states that any information provided by the respondents was treated with the utmost of confidentiality.

4. **Observation checklist** (Appendix No. IV) — was used to gather data on the systems and structures that were in place for blood collection at the KNH. The checklist captured the processes and procedures, facilities, equipment and personnel coverage at the KNH blood donation centre.

5. **Questionnaire for donors** (Appendix No. V) — was used to determine the level of blood supply at KNH during normal and/or periods of disaster. The questionnaire has been chosen as the main source of data collection because it provided the researcher with detailed individual feedback from the donor respondents and gave an accurate picture of the issue of blood supply at KNH.

6. **Questionnaire for medical personnel** (Appendix No. VI) — was used to assess the demand for blood at KNH. The researcher wants to outline the views of the medical personnel who on a day to day basis have to make difficult decisions based on availability or non-availability of blood and its components for the patients under their care. Questionnaires were quick to administer since the researcher prepared a large number; distributed and then collected them for data analysis once completed by the doctors.

7. **Interview guide** (Appendix No. VII) — was used in collecting data from handpicked key informants from the KNH, Kenya Red Cross and KNBTS to ascertain that no vital information was omitted in the study. Interviews boosted further probing of questions and therefore helped in capturing information concerning the area of interest. Interviews involved asking respondents a series of closed and open-ended questions. It is anticipated that this generated both standardized quantifiable data and more in-depth qualitative data.

3.4.2 Sampling procedure and size

The study employed probability and non-probability sampling.

Simple random sampling was used to select blood donors from a population of 500. The sample size of 105 donors was generated from a table of random numbers. Each member of the subset had an equal probability of being chosen and it required minimum advance knowledge of the population.

Purposive sampling technique was then used to determine the medical personnel from the maternity, road accident victims, children's cancer ward and some surgical wards which have a higher need for blood and its products. The medical personnel sample size comprised of 35 respondents including those working in the BTU at the hospital.

Five (5) Key informants from the KNH, KRC and KNBTS were therefore handpicked because they were informative and able to provide and fill knowledge gaps on BTS in Kenya. As the population is heterogeneous, both men and women were included in the sample to ensure that gender bias does not skew the results.

3.5 Unit of analysis

The unit of analysis was individuals comprised of blood donors and medical personnel/officials at the KNH. Key informants were also selected and interviewed. The key informants contributed to the richness of the data and strengthened the researcher's findings. They included employees of the Kenya National Blood Transfusion Services, Kenya Red Cross and Kenyatta National Hospital. Based on data obtained from these respondents, the various factors contributing to the lack of a sufficient and safe supply of blood at the KNH were analyzed.

3.6 Validity and reliability of the instruments

The researcher strived to ensure accuracy and meaningfulness of data when conducting the research. In order to improve validity of the results, the questionnaires were reviewed by the supervisor to find out whether the questions were achieving the research objectives or answering research questions.

The researcher used consistent and systematic questions in the questionnaires. The questions were related to the subject of the study and organized into themes of the study area to enhance reliability of the data.

3.7 Data analysis and presentation

The researcher organized the data according to the methodology in the study. This involved scrutiny of questions in order to detect and reduce as much as possible, errors, incompleteness, and misclassification in the information obtained from the respondents.

Qualitative data generated from open-ended questions was analyzed in themes, content analysis and categories identifying similarities and differences that emerged. Qualitative analysis was included on what respondents said in open ended questions.

The results were interpreted using descriptive statistics. Quantitative data was scrutinized for completeness, accuracy and uniformity. Data from questionnaires was analyzed using Statistical Package for Social Scientist (S.P.S.S) also known as Predictive Analytics Software (P.A.S.W). Descriptive statistics such as tables and graphs were used to represent frequencies and percentages resulting from data analysis as appropriate.

3.8 Ethical considerations

This study was conducted in a safe and ethical manner. The researcher adhered to professional practice and universal ethical standards that govern research at both the University of Nairobi and Kenyatta National Hospital including obtaining the approval of the KNH/UON Ethics and Research Committee prior to data collection (Annex II: approval letter from the Ethics and Research Committee at the KNH). The researcher also obtained the approval of the KNH's Research and Programmes Office as is required by the hospital rules. Informed consent was obtained from the respondents prior to conducting interviews and ensured that their rights were not violated in any way by assuring them of complete confidentiality with regard to their responses. Participation in this study was voluntary and there were minimal risks posed to the respondents involved in this study.

CHAPTER 4: DATA ANALYSIS, PRESENTATION AND DISCUSSION

4.1 Introduction

This chapter focuses on data analysis, presentation and discussion. The data was gathered using an observation checklist, questionnaires complemented by selected interviews. The analysis and interpretation was made with reference to the research objectives.

4.2 Response rate

The study targeted 145 respondents drawn from 105 blood donors at the Blood Transfusion Unit at KNH; 35 medical personnel drawn from the KNH Blood Transfusion Unit, maternity, road accidents victims, general surgery and children's cancer wards at the KNH and 5 key informants from the KNH, KRC and KNBTS.

The study recorded an overwhelming response rate of 100%. This was attributed to the enthusiastic participation of the blood donors at KNH including family replacement donors, and the doctors charged with the responsibility of saving lives. The key informants comprised experts working on the area of blood transfusion services in Kenya. The study focused on examining the demographic characteristics of the blood donors and the associated medical personnel as well as facilities and related systems in place. These two groups and the quality as well as the state of condition of facilities play a major role in influencing the stability in supply of blood. The study results are as follows:

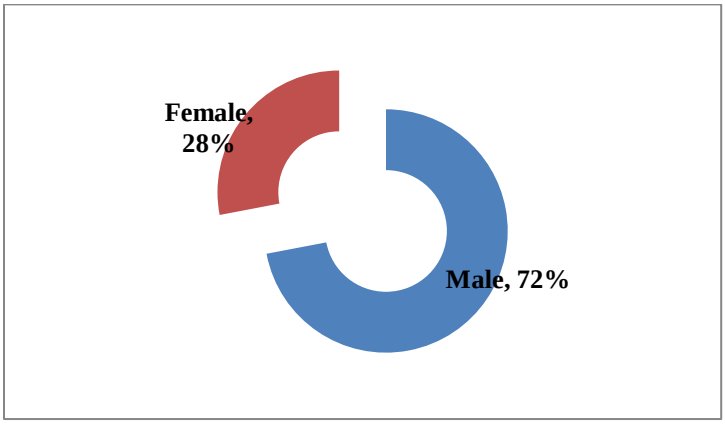
4.3 Demographic characteristics of donor respondents

The demographic characteristics examined included sex, age, level of education and marital status of donor respondents are presented and analyzed below.

4.3.1 Sex of the blood donors

The study results indicated that majority (72%) of the respondents were male and the minority (28%) were female. This is illustrated in Figure 7.

Figure 7: Sex of the donor respondents



The results confirm findings of previous studies in Africa by Nwogoh et al. (2013) which showed that males have fewer reservations to donating blood when compared to female counterparts who are constrained by various challenges which hinder them from not donating blood e.g. pregnancy, menses, and use of medication such as contraceptives. This is further confirmed by data from the WHO Global Database on Blood Safety (2012) which shows that globally 30% of blood donations are given by women versus 70% by their male counterparts. This however contradicts research done in Europe by Bani & Giussani (2010) which concludes a 50/50 split amongst blood donors in most European countries.

4.3.2 Age of the blood donors

Findings in Table 3 shows that respondents who are between 25 - 29 years constitute the group that donates most of the blood accounting for 35 percent; followed by the age group of between 20 and 24 years accounting for 24 percent, while those between 30 and

34 years accounted for 15 percent. Apparently, out of the sample population, respondents of over 45 year did not donate blood.

Table 3: Age of blood donors

Age bracket	Category	
	Frequency	**Percentage**
≤19	9	9
20-24	25	24
25-29	37	35
30-34	16	15
35-39	11	10
40-44	7	7
Total	**105**	**100**

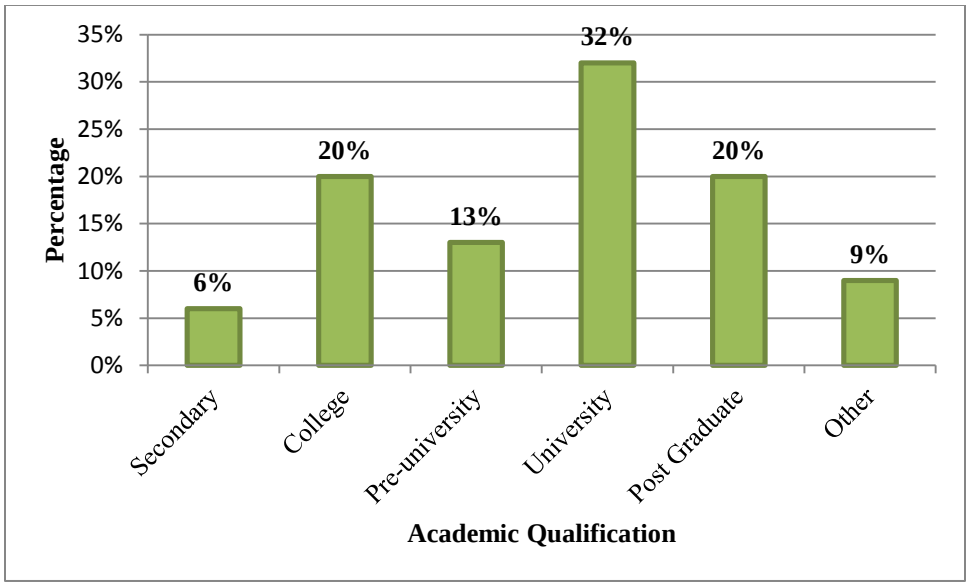
These results concur with data from the WHO Global Database on Blood Safety (2012) which shows that the youth with between 20 – 34 years donate most blood in low- and middle-income countries, proportionally than in high-income countries. These results are useful to policy makers as it informs the age group to be targeted when formulating and monitoring recruitment strategies.

The less significant results on the group with 19 years and below of 9 percent could be explained by the fact that this age group mainly participates in blood donation drives at schools hence unlikely to give blood at the KNH (Figure 5, page 57). The draft Health Bill 2014 proposes the creation of the Kenya National Blood Transfusion Service among other sweeping changes to the Kenyan health sector. A significant proposal that relates to this study is the proposal to either change the minimum donor age from 16 years to 18 years or retain the 16 year minimum age limit but ensure that parental/guardian consent is sought from those between the ages 16 – 18 years. If the Bill is passed into law as currently proposed, it will a negative impact and further reduce the current donor population as KNBTS will be required to obtain consent from donors aged below 18 years.

4.3.3 Level of education

In terms of the level of education, the results show that 32 percent of respondents had university degrees, followed by post graduate 20% and those in colleges at 20% as well. There were no primary level education respondents while only 6 percent of the donor respondents were of secondary level education. The details are illustrated in Graph 1.

Graph 1: Level of education of blood donors



The results concur with findings of a previous study carried out in India by Shenga et al (2010) where it was found that higher educational level and family income are both strong indicators of the probability of someone's donating blood.

4.3.4 Marital status of the respondents

Evidently, the data on table 4 revealed that the singles in the population donated most of the blood at 48 percent when compared to those who are married at 32 percent while the others comprising separated, divorced or widowed population at 20 percent.

Table 4: Marital status of the respondents

Status	Category	
	Frequency	**Percentage**
Single	50	48
Married	34	32
Others	21	20
Total	**105**	**100**

These results reinforce the outcome on blood donation by age, which revealed that youthful population with comparatively less family commitments; presumably youthful and expecting to raise families are the predominant donors of blood as indicated in Table 3 above. These results are also supported by data from the Kenya AIDS Indicator Survey (KAIS), 2007 which reports a ratio of 62 percent for single donors against 34 percent donations by married donors. However, it is worth noting that a considerable proportion (32%) of the donor respondents were married and were also willing to donate blood.

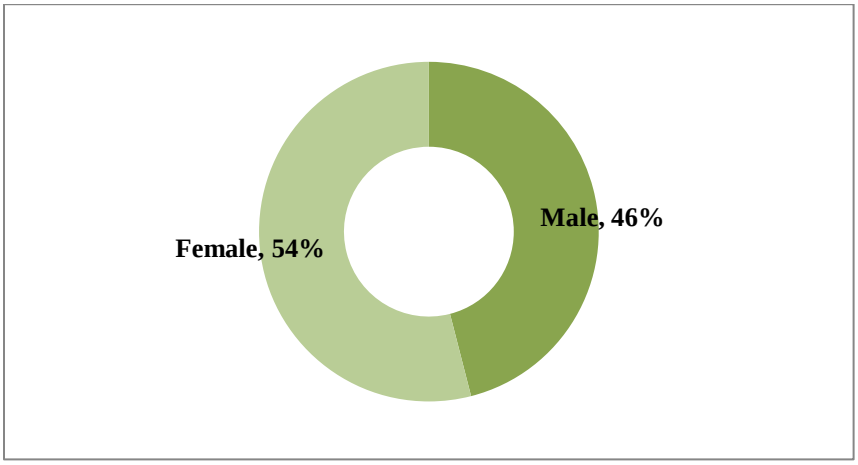
4.4 Demographic characteristics of medical personnel

This section the results on demographic characteristics of medical personnel respondents covering sex, age and education levels of medical respondents are presented. The results obtained are presented below.

4.4.1 Sex of the medical personnel

The respondents comprised 35 medical personnel selected from the blood transfusion unit, maternity, road accident victims, children's cancer ward and some surgical wards. A majority (54%) of the medical personnel were females while the male counterparts accounted for 46 percent. Figure 8 shows the distribution of the respondents by sex.

Figure 8: Sex of the medical respondents



These results can be attributed to more females joining the medical profession as compared to the past; this is supported by figures from the Kenya National Bureau of Statistics (2012) which show a ratio of 59.3 percent females in universities compared to 40.6 percent of males.

4.4.2 Age of the medical personnel

As shown in Table 5 below, a higher proportion of the medical personnel who participated in this research were between 30 and 34 years accounting for 40 percent while those in the 25-29 age group accounted for 22 percent. Therefore those with between 25 – 34 years constituted 62 percent of the respondents.

Table 5: Age of medical personnel

Age bracket	Category	
	Frequency	**Percentage**
20-24	2	6
25-29	8	22
30-34	14	40
35-39	5	14
40-44	2	6
45-49	2	6
≥ 50	2	6
Total	**35**	**100**

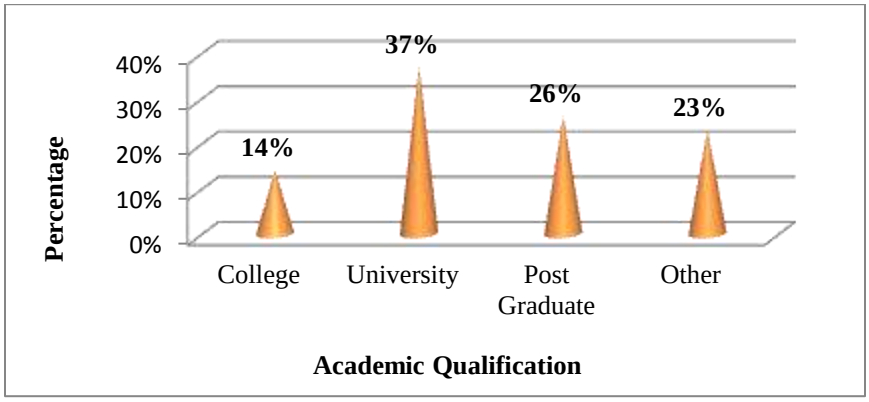
The higher proportion of doctors in the 25 – 34 age category support data from Internews (2013) which indicate that most doctors in Kenya are trained in the public sector, and later emigrate within a few years of completing medical school. The report shows that Kenya has one of the highest net emigration rates for doctors in the world, with 51% leaving to higher paying positions in the private sector, or away from Kenya altogether. This has made retaining qualified health personnel a persistent challenge as the brain drain not only prevents the country from recouping the investment it makes in training the doctors, but also threatens the very existence of the country's health services.

This is further supported by results from the 40 and above age group which shows an average of 6 percent which imply that older and comparatively experienced doctors prefer self-employment and therefore open their own specialized clinics instead of working in government hospitals. Information obtained from the Kenya Medical Practitioners Pharmacists and Dentist Union confirms that 80 percent of doctors quit government practice after three years of practice due to poor working conditions and pay. The details are contained in Table 5.

4.4.3 Education level of the medical personnel

The results from Graph 2 on education shows that a higher proportion of the medical personnel had attained first university degrees accounting for 37 percent followed by post graduates accounting for 26 percent while those working towards diploma (college) comprised 14 percent and certificate courses (other) 23 percent. These results indicate that most medical personnel are well educated and therefore qualified for the occupation.

Graph 2: Education level of medical personnel



There is need to further build the capacity of medical personnel to handle blood and its products efficiently especially during disaster events.

According to a key informant from the University of Nairobi at the KNH:

"There are gains in curriculum development for medical personnel handling blood and its components. Ongoing efforts are being undertaken by the KNBTS in conjunction with the University of Nairobi and with funding from the Center for Disease Control to boost BTS in Kenya through the development of a wholesome curriculum that is targeted at doctors, scientists, nurses, and laboratory technologists etc. who are involved with blood transfusion services in the country. The standardized syllabus ensures that the knowledge and practices gained is of the highest standard and is the same across the board".

"Experts are also working to further build capacity of the medical personnel to handle disaster situations. Even though hospitals have contingency plans to handle disasters, there is need to look at blood transfusion services as stand-alone units and increase the capacity of those working there to better manage the blood transfusion process in times of disasters".

4.5 Systems and structures at the KNH Blood Transfusion Unit (BTU)

The study sought to examine the systems and structures that are in place for blood collection and storage at the KNH Blood Transfusion Unit (BTU). The researcher used an observation checklist to establish the processes, procedures, facilities, equipment and personnel that support the donation and storage of blood. Figure 9 (page 77) shows a diagram of the BTU.

The BTU at the KNH is strategically located at one of the main entrances into the hospital and the signage is clearly visible to the many visitors at the hospital. It can conveniently be accessed from various entry points to the hospital and is most importantly near the main hospital theatres; casualty and the; obstetrics & gynecology departments. The location is away from open sewage, drains, public lavatories or similar unhygienic surroundings. The unit is well ventilated, has air conditioning and has a sterile washing area. This ensures prevention of contamination of the sterilized equipment with a hazardous surrounding and to avoid circulation of polluted air in the BTU working environment.

Strict blood donation criteria to select donors are observed in terms of conditions, qualifications and deferment of the potential donors. Once a donor is selected for the donation process, they are moved to the donor room. This is the area where blood is drawn and can accommodate about four donors at any given time. Once the donation process is completed, the donors rest while under the observation of the medical personnel at the BTU, they are only released once they are considered to be healthy and are not exhibiting any adverse donation related reactions such as dizziness, vomiting etc.

Blood is then moved to the Component Preparation Room. Here unscreened and unprocessed blood is kept while samples are sent to the serology unit for screening of various transmissions related infections such as HIV among others. Once results are returned and they are free from any risks, they blood is then transferred to the

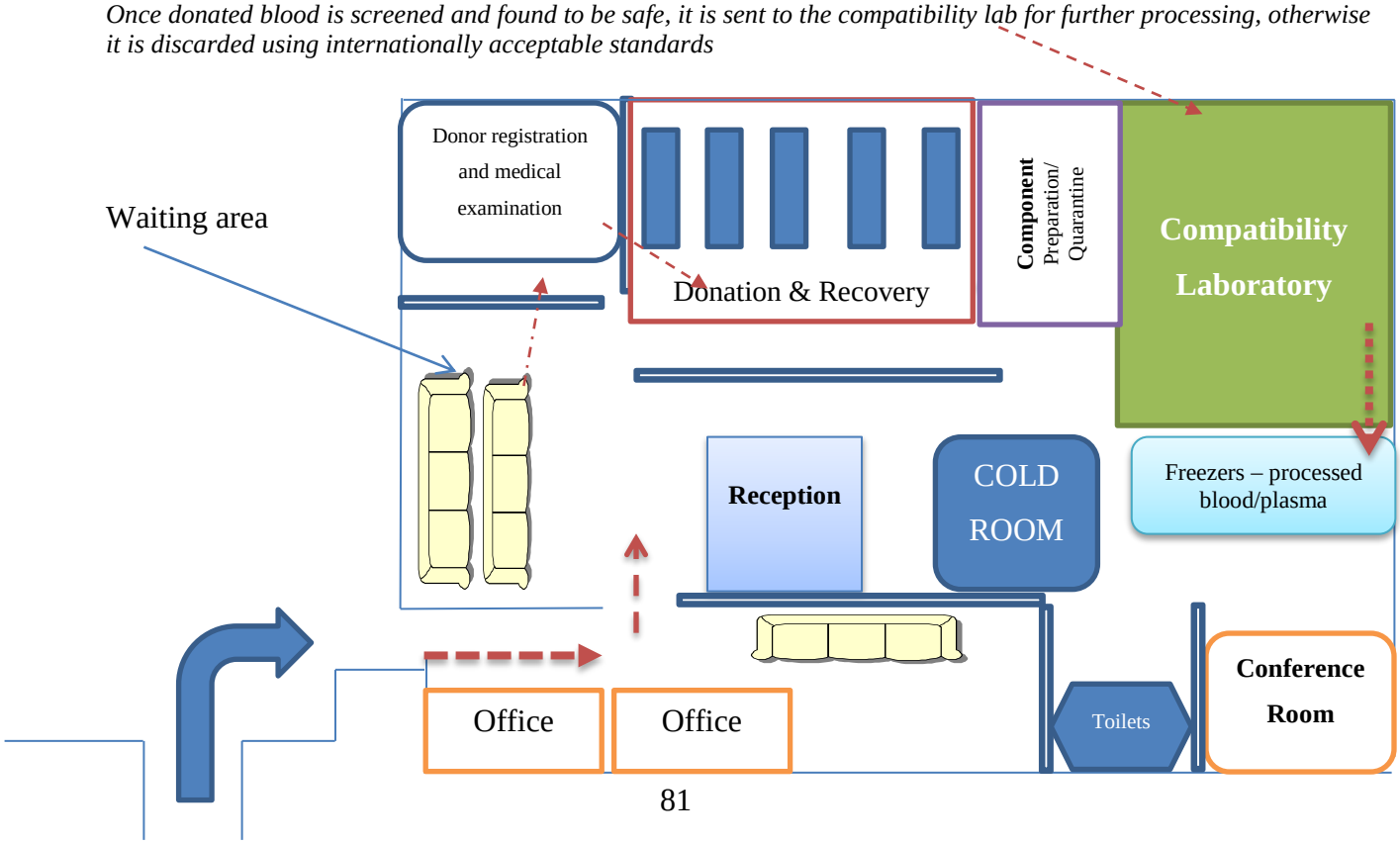
Compatibility Laboratory where tests are conducted to ensure the blood is compatible with the designated patient for whom transfusion is intended through a process called cross-matching. The laboratory also processes blood by separating plasma and also groups the various blood types as received once screened. The plasma once ready is stored in several refrigeration systems which are kept for up to 120 days before expiry.

This information was confirmed by a key informant from the KNH who said that:-

"Preparation of components is considered another key strategy put in place by experts in the country. This is where parts of whole blood is separated through a technique called differential centrifugation in order to obtain blood products such as red blood cells, platelets, fresh frozen plasma among others for use on patients who do not require whole blood. This modern concept of blood transfusion is to transfuse to patients only the component he/she requires. The advantage of preparing components is that from a single donation, many patients can benefit. Component transfusion also minimizes risks associated with whole blood transfusion."

Figure 9: Schematic of the BTU at the Kenyatta National Hospital

Once donated blood is screened and found to be safe, it is sent to the compatibility lab for further processing, otherwise it is discarded using internationally acceptable standards



The study results indicate that the systems and structures are not integrated and fully equipped. A hospital based BTS is not as fully equipped as a stand-alone facility. In the case of the BTU at KNH, it was observed that certain aspects of the blood collection system were robust and sufficient; however, there are constraints for example the lack of a fully functional cold room and blood serology unit being located in a different department which if addressed, would transform the unit into a best-practice centre. The observations are presented below.

a) **Availability of blood.** It was established that the BTU at KNH is always on hand 24 hours, seven days a week to serve patients who require critical care and transfusion would ensure their survival. Hence the expiry rate of donated blood at the BTU is zero as all the blood that is collected once screened and approved for use is set aside for patient use within 12 hours. This demonstrates the prevailing high demand compared to available stocks in the blood bank, and it implies that in the event of a disaster, the hospital is unlikely to meet and respond to such an emergency adequately. This information reaffirms data by KNBTS (2013) indicating that Kenya was unable to meet half of its blood requirements for the country (Figure 4, page 55).

b) **Safety and quality of blood and blood products.** The study indicates that the testing of whole blood in Kenya is done by use of standard diagnostic screening methods, which though internationally accepted the results are not one hundred percent reliable in terms of quality of the blood safety and infections in case of transfusion. Hence, it would be appropriate to move towards using molecular diagnostic testing of blood whose results are one hundred percent reliable.

   Information from WHO (2011) shows that 97 out of 164 countries provide data on whether blood donations are screened in a safe quality assured manner. Overall, 89 percent of donations are screened following basic quality procedures of which (97%) are in high-income countries compared to (82%) in middle-income countries and

(53%) in low-income countries. This is a positive achievement for Kenya considering out of 156 polled countries, 39 of them did not routinely test blood donations for transfusion-transmissible infections (TTIs) including HIV, hepatitis B, hepatitis C and syphilis while 47 percent donations in low-income countries are tested in laboratories without quality assurance.

The researcher noted that the BTU has space for a cold room which is still under construction and once ready will accommodate up to 1000 units of blood. The absence of a fully functional cold room for such a large hospital is an impediment to safe blood especially during disaster events. As recommended by WHO (2002), access to and use of a functioning cold room is essential for the safe storage of blood from donation to transfusion, a process referred to as the blood cold chain. This is an integral component of the WHO strategy for blood safety. WHO estimates that approximately 2% of blood that has been found safe to transfuse may be discarded for various reasons. This percentage varies depending on the management of the inventory and the effectiveness of the blood cold chain, and is a waste of a scarce and valuable resource that the BTU cannot afford to incur due to the demand for blood at the hospital.

"KNH boasts of a high level of expertise with regard to BTS. It has a committee comprised of staff from the KNH, KNBTS and the UoN who oversee the entire blood supply chain at the hospital. The guidelines they have recommended and which has been taught to the medical personnel is based on the blood cold chain process for blood transfusion i.e. adhering to strict timelines and regulations from collection to transfusion. This has resulted in successful screening which has contributed to a decline in Transfusion Transmitted Infections (TTIs) such as HIV/AIDS" – key informant with the UoN at KNH

c) **Key blood donors at BTU.** The revelation in this study is that the BTU relies heavily on family replacement donors. The family/friends of patients are requested to donate at least 2 units of blood and when the hospital undertakes major operation projects e.g. for heart patients, families are then requested to donate 3 units of blood. This is a clear and further indication that blood supply at the KNH is insufficient as there is overreliance on family replacement donations and there is need to create more awareness in the community on the need for regular blood donors who are volunteers and non-remunerated. This information is further reinforced by data from the Kenya Red Cross (2013) which shows that family replacement donors account for 35 percent of donors in Kenya, despite them being more risky.

An adequate and reliable supply of safe blood can be assured by a stable base of regular, voluntary, unpaid blood donors. A study by WHO (2014) shows that there has been an increase of 8.6 million blood donations from voluntary unpaid donors reported from 2004 to 2012. These donors are also the safest group of donors as the prevalence of blood borne infections is lowest among this group. World Health Assembly resolution (WHA63.12) urges all Member States to develop national blood systems based on voluntary unpaid donation and work towards the goal of self-sufficiency. In total, 73 countries collect over 90% of their blood supply from voluntary unpaid blood donors. Out of this 38 are high-income countries, 26 middle-income countries and 9 low-income countries). This includes 60 countries with 100% (or more than 99%) of their blood supply from voluntary unpaid blood donors. However, 72 countries (8 high-income countries, 48 middle-income countries and 16 low-income countries) collect more than 50% of their blood supply from family/replacement or paid donors.

d) **Registration and medical examination Procedures.** The study established that the BTU at KNH procedures are generally consistent with international standards as they are based on a World Health Organization, 'Donor Registration Form' (Annex III)

which captures the critical health related and risk assessment questions that enables the medical personnel to assess the donor's capability to give blood.

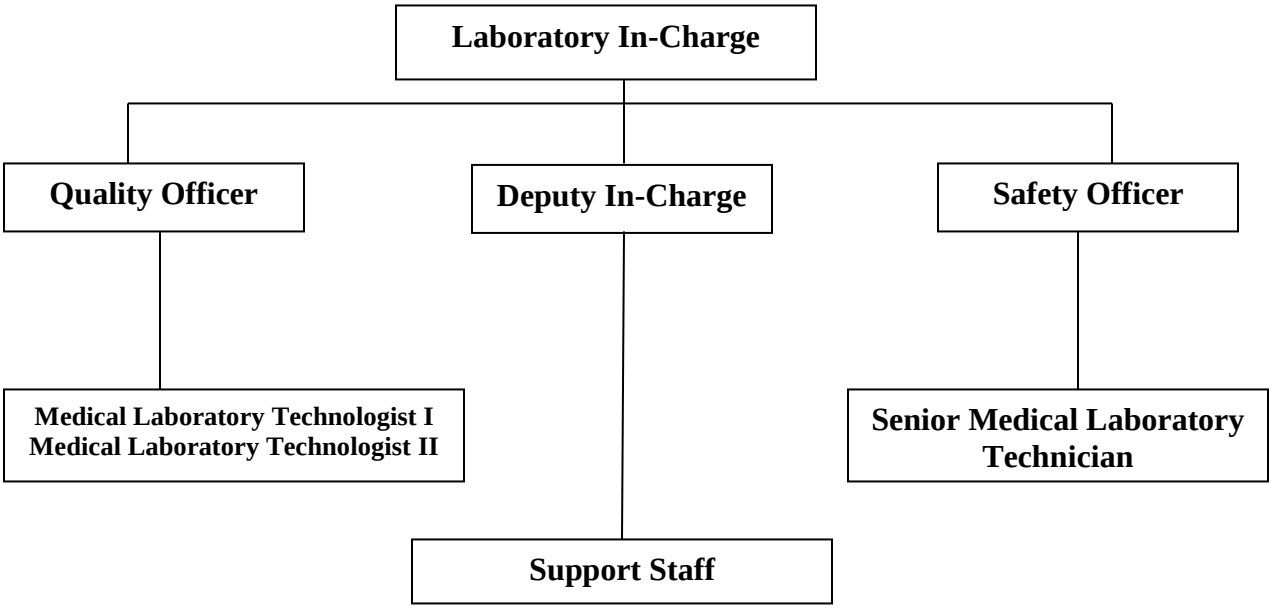
e) **Procedure for Testing and processing of blood.** The findings show that samples of unscreened and unprocessed blood are sent to the serology unit for screening of various transmissions related infections such as HIV among others. Once confirmed that the blood is free from any risks, it is transferred to the Compatibility Laboratory, which has a highly computerized testing machine for cross matching and thereafter preparation of blood components e.g. plasma. This procedure is in line with internationally accepted practices for conducting blood compatibility and component preparation. WHO data (2013) shows only 31 percent of the blood collected in low-income countries is separated into blood components. The capacity to provide patients with the different blood components they require is limited in most developing countries but not the case in Kenya.

f) **Location and access.** The results indicate that the BTU at the KNH is strategically located at one of the main entrances into the hospital and the signage is clearly visible to the many visitors at the hospital. The location is away from open sewage, drains, public lavatories or similar unhygienic surroundings, a favourable environment for a BTU facility. In addition, the results of the study show that the space available is sufficient for its operations on normal days. However, in the event of disaster event with massive casualties, the researcher noted that the operations of the unit are moved to a temporary tent in order to attend to the influx of donors. Therefore, additional space will be required in the immediate foreseeable future in order to eliminate disruptions especially during disaster events when the unit is expected to function efficiently. There is need to conduct an assessment of the highest inflow levels of donors into the BTU and use this information to determine the additional space requirements. This will ensure the BTU is equipped to respond to various emergency situations.

g) **Staffing.** The results indicate that the staffing levels though adequate, in times of emergency situations where there is need to work for additional hours it is overstretched. There are a total of 15 personnel who work at the KNH BTU. The staff work on 8 hour shifts 24 hours, 7 days a week. Based on the 24 hour operations of the BTU, the personnel are not adequate for operations on a normal day, let alone in the event of a disaster event. Hence given the nature of the work involved which calls for precision, there is need to enhancing the staffing capacity to avoid fatigue crippling in while serving donors. As research from the United States has shown (Barger et al. 2006) that extended-duration work shifts were associated with an increased risk of significant medical errors, adverse events, and attention failures amongst medics across the United States.

The team is led by a Laboratory Manager who is in charge of the BTU. There is a deputy in charge; senior laboratory technologists, laboratory technologists and laboratory technicians. Figure 10 captures the organogram being used at the unit.

Figure 10: Operational organogram – KNH Blood Transfusion Unit



h) **Availability of Overall standard operating procedures (SOPs).** It was established that the BTU maintains readily available written Standard Operating Procedures and include all steps to be followed in the collection, processing, compatibility testing, storage and distribution of blood and/or preparation of blood components for homologous transfusion, autologous transfusion and other purposes. There is need however for the BTU to migrate wherever feasible, the procedures that are manual to an ICT based system.

4.6 Study results on factors affecting blood supply and demand at the KNH BTU

This section analyzed the critical factors that influence supply of blood and demand. The respondents were blood donors at the KNH BTU and medical personnel from the KNH Blood Transfusion Unit, maternity, road accidents victims, general surgery and children's cancer wards at the KNH. The study results are summarized below.

4.6.1 Information awareness on blood donations by Donors

According to the findings, majority (54%) of the respondents obtained information on donating and transfusing blood through word of mouth, 17 percent through radio announcements while 10 percent through social media. The least is by email. This implies that except through word of mouth, most of other methods of creating awareness on blood donation by medical personnel have not been fully utilized. Therefore the use of other methods for disseminating information could be enhanced instead of relying mainly on situations that inevitably bring donors and medical staff to interact directly, this is illustrated in Table 6.

Table 6: Awareness on blood donation by donors

Creating awareness	Category	
	Frequency	Percentage
Radio	18	17
Social Media	10	10
Church announcement	8	8
Telephone call	5	5
SMS	5	5
Word of mouth	57	54
Emails	2	1
Total	**105**	**100**

The same question was posed to the medical personnel respondents in order to determine how they gave out information about blood donations and blood transfusion services. According to the findings shown in Table 7, majority (57%) of the medical respondents indicated they disseminated information on blood donations through word of mouth, blood donation campaigns accounted for 34 percent while awareness created through radio was 9 per cent.

Table 7: Dissemination of Information on blood donation by medical personnel

Creating awareness	Category	
	Frequency	Percentage
Radio	3	9
Blood donation campaigns	12	34
Word of mouth	20	57
Total	**35**	**100**

The results show that information awareness on blood donations and blood transfusion services at the KNH was mainly created through word of mouth followed by electronic media such as radio and television. The medical personnel did not disseminate information through social media, church announcements or through the use of telephones. These results confirm that awareness for blood at the hospital level is only created amongst those who are in need of blood indicating a reliance on family replacement donations at the hospital as reported elsewhere in this study. The use of

electronic media usually happens after disaster events and the hospital experiences an influx of patients in urgent need of blood.

These findings call upon the medical personnel and the relevant government agencies to diversify their methods of dissemination by redesigning outreach programs that would cover the wider population. Such programs would include a slogan on a t-shirt, an advertisement on radio or in a newspaper to fliers. The key is to adopt a method that will work for the target audience and for the type of content to be delivered. In order to reach out to the general public, mass media e.g. radio, television or newspapers are effective in reaching a wide audience. However, if the target audience is the youth, with the advent of the internet age, there is great need to take advantage of new communication routes such as Facebook, Twitter and You Tube to create more awareness.

4.6.2 Frequency of blood donation

According to the study findings, the majority (56%) of the respondents indicated that they had donated blood 1 to 3 times in their life time, in the meantime 24 percent indicated that they had donated blood between 4 to 6 times, while 16 percent had donated blood 6 to 8 times as shown in Table 8.

Table 8: Frequency of blood donation

Number of times	**Category**	
	Frequency	**Percentage**
1-3	33	56
4-6	14	24
6-8	10	16
10 times and above	2	4
Total	**59**	**100**

The study deduced that the majority of the respondents had donated blood between 1 to 3 times in their life time. These results are supported by information from Blood Link Foundation (2011), which states that the blood supply situation in Kenya is further aggravated by the fact that over 70 percent of blood donors are first time and one time

donors. However, these findings are not uncommon all over the world. Research from the American Association of Blood Banks (2008) has shown that the United States imports about a quarter million pints of blood a year from Europe as it is unable to meet its blood requirements levels. The clear advantage the United States has over Kenya is that it is able to purchase the blood at market rates and has adequate infrastructure and management capability. Kenya being a developing nation has many challenges key among them being provision of basic health care for its people and unfortunately blood transfusion services has not been given the adequate attention it deserves.

4.6.3 Reason for donating blood

Results from Table 9 indicate that majority (59%) of respondents donated blood to support a friend or family member in need of the donation. Voluntary donations were 27 percent while the minority (14%) was as a result of a blood donation campaign.

Table 9: Reason for donating blood

Reason for donating	**Category**	
	Frequency	**Percentage**
Family/friend replacement donors	35	59
Voluntary donors	16	27
Public campaign	8	14
Total	**59**	**100**

These results reinforce findings in 4.5 (c) which shows that the most common type of donation in Kenya is family replacement. The results on voluntary donations are supported by findings from a report by Musick (2003) which observed the effects of volunteerism on happiness and health and found a strong connection between volunteerism and current and future health and well-being. The same study showed that volunteerism and helping behaviour have not only been shown to improve mental health, but physical health and longevity as well. In another study by Hunter and Hunter (1980), results showed that older adults who volunteered were significantly higher on life satisfaction and will to live, and significantly lower in depression and anxiety.

4.6.4 Reason for not donating blood

Table 10 shows the multiplicity of reasons for not donating blood with a majority (54%) reporting fear of needles, disease or feeling weak post donation as their biggest reason. Other reasons include assumptions e.g. certain blood types are not in demand e.g. O+ as it is the most common or that 'others' were donating enough was captured at 22% while a minority (4%) sighted cultural beliefs as a hindrance to blood donation.

Table 10: Reasons for not donating

Reason for *not* donating	**Category**	
	Frequency	**Percentage**
Fear (contracting a disease, needles, feeling weak post-donation)	25	54
Assumptions (certain blood types not being in demand; that 'others' were donating enough and since one had a rare blood type, they would wait until there was a special need	10	22
Lack of time to donate blood	5	11
Cultural beliefs that hindered respondents from donating blood to nonrelatives	4	9
Poor access to blood transfusion services	2	4
Total	**46**	**100**

These results confirm previous research by Oswalt (1977) which found that the most commonly recorded motivations not to donate were mainly; fear of needles, blood, weakness, medical excuses, deferrals, reactions and inconvenience. Piliavin (1990) suggests that in addition to this, fear of AIDS and other blood transmitted viruses are also strong inhibitors despite the fact that contracting AIDS from donating is unsubstantiated (new sterilized needles are only ever used once before being properly disposed of after every donation).

The same question was posed to the medical respondents in order to establish reasons that hinder people from donating blood; the results are presented in Table 11. A higher proportion (40%) cited infections such as HIV/AIDS, common colds/flu as a main reason. Another common hindrance was non-communicable diseases with 34 percent

while lack of knowledge and awareness or public misconceptions about the transfusion process accounted for 17 percent. The use of medication, pregnancy, women on menses or those who were taking contraceptives showed the least result with only 9 percent.

Table 11: Reasons that hinder blood donation

Reason that hinder people from donating blood	Category	
	Frequency	**Percentage**
Use of medication (contraceptives); pregnancy, women on menses	3	9
Non-communicable diseases (hypertension, diabetes, cancer)	12	34
Lack of knowledge and awareness	6	17
Infections (HIV/AIDS, common colds/flu, etc.)	14	40
Total	**35**	**100**

These results can be attributed to the fact that since independence Kenya has battled with eradicating communicable diseases (HIV/AIDS, Tuberculosis) and is now also experiencing an increase in Non-Communicable Diseases (NCDs) such as diabetes, heart disease and cancer among others. A report by NACC and NASCOP (2012) indicates that as of December 2011, 1.6 million people in Kenya were living with HIV. With HIV-infected individuals living longer as a result of increased treatment access, Kenya projects that the number of people living with HIV will continue to grow, placing continuing demands on health and social service systems. It is estimated that at least half of all hospital admissions and deaths are due to NCDs (Kenya Health Policy 2012-2030) and the leading causes of deaths due to NCDs include cardiovascular diseases (13%), cancers (7%) and diabetes (4%) (Ministry of Public Health and Sanitation, 2010).

4.6.5 Likelihood of donating blood

Data presented in Table 12 shows that majority (70%) of the respondents are highly likely to donate blood for family/friend replacements. It is not surprising that another (60%) of the respondents indicated that they would likely perform a self-donation to save their own life. Meanwhile, 49 percent of the respondents indicated that they are highly

likely to volunteer to donate blood and 44 percent of the respondents preferred a blood drive.

Table 12: Likelihood of donating blood

Reason	Highly likely		Likely		Neutral		Unlikely		Highly unlikely	
	Frequency	Percent-age	Frequency	Percent-age	Frequency	Percent-age	Frequency	Percent-age	Frequency	Percent-age
Family/Friend replacement	73	70	26	24	6	6	-	-	-	-
Self-donation	21	20	63	60	17	16	4	4	-	-
Blood drive	34	32	46	44	17	16	8	8	-	-
Voluntary	49	46	29	28	27	26	-	-	-	-

These results confirm that human beings are altruistic in nature and are willing to donate blood to save a life. The results are supported by the theory on altruism, which has a long history in sociological, philosophical and ethical thought. The term was originally coined in the 19th century by the founding sociologist and philosopher of science, Auguste Comte, and has become a major topic for psychologists. In simple terms, altruism is caring about the welfare of other people and acting to help them. The empathy-altruism *hypothesis* basically states that psychological altruism does exist and is evoked by the empathic desire to help someone who is suffering. Feelings of empathic concern are contrasted with feelings of personal distress, which compel people to reduce their own unpleasant emotions. People with empathic concern help others in distress even when exposure to the situation could be easily avoided, whereas those lacking in empathic concern avoid helping unless it is difficult or impossible to avoid exposure to another's suffering.

The International Encyclopaedia of the Social Sciences defines psychological altruism as "a motivational state with the goal of increasing another's welfare." There has been some debate on whether or not humans are truly capable of psychological altruism (Batson, 2011). Some definitions specify a self-sacrificial nature to altruism and a lack of external rewards for altruistic behaviour (Batson, 2012). However, because altruism ultimately benefits the self in many cases, the selflessness of altruistic acts is brought to question.

The social exchange theory postulates that altruism only exists when benefits outweigh costs (Maner et. Al 2012). Daniel Batson is a psychologist who examined this question and argues against the social exchange theory. He identified four major motives for altruism: altruism to ultimately benefit the self (egoism), to ultimately benefit the other person (altruism), to benefit a group (collectivism), or to uphold a moral principle. Altruism that ultimately serves selfish gains is thus differentiated from selfless altruism, but the general conclusion has been that empathy-induced altruism can be genuinely selfless. (Batson and Hamad, 2011).

4.6.6 Adequacy of donor awareness and education

According to the study findings, majority (56%) of the respondents indicated that there was inadequate education and awareness in encouraging people to donate blood. While a minority (20%) felt there was adequate awareness and education. The results are captured in Table 13.

Table 13: Adequacy of donor awareness and education

Adequate awareness and education	**Category**	
	Frequency	**Percentage**
Very adequate	13	12
Adequate	21	20
Not sure	4	4
Inadequate	59	56
Very inadequate	8	8
Total	**105**	**100**

The same question was posed to the medical personnel and the findings show (Table 14), a majority (54%) felt that there was inadequate education and awareness to encourage people to donate blood. Whereas 29% felt there was very inadequate awareness while a minority (17%) reported adequate awareness.

Table 14: Adequacy of medical personnel awareness and education

Adequate awareness and education	Category	
	Frequency	**Percentage**
Adequate	6	17
Inadequate	19	54
Very inadequate	10	29
Total	**35**	**100**

These results show the need for a deliberate effort to increase donor awareness on blood transfusion services. Potential donors can be motivated through regular blood campaigns, recognition for donating blood and educating the general public on the urgency and importance of blood donations to save lives.

In this regard, the WHO through its report (2010) recommends utilizing information obtained from research for developing education and communication strategies for different target donor populations. This implies that a country should develop donor information and education campaigns and materials on blood donation that are relevant and appealing to the different target donor populations; select the most suitable channels and forms of communication for different messages to target donor populations; and seek professional assistance in planning and developing information and education campaigns from universities, advertising agencies and the marketing departments of large businesses as part of their corporate responsibility activities.

4.6.7 Requirements and blood shortfall at the KNH BTU

The study established from medical respondents that approximately 80 - 120 units of blood were required in a day at KNH. They also reported that on any given (normal) day, there is insufficient supply of blood at KNH and demand always exceeds supply since 60 – 80 units are collected each day, which shows that the hospital has a shortage of between 40 – 60 units of blood daily. The findings from the study show that the medical personnel rely on the Kenya National Blood Transfusion Services KNBTS to meet the shortfall. The results also show an estimated 50 – 60 transfusions are carried out daily though these figures could be higher if supply was sufficient.

These results concur with responses obtained from key informants (KNH, KRC and UoN) which describe inadequate levels of blood supply in the country:

"Unfortunately, there are no clear measures (preparedness and contingency plans) that have been set out to address blood shortfall at the KNH and response during disaster events always seems to be a reactionary one".

4.6.8 Blood donations during disaster or emergency situations

According to the findings, the requirement for blood at the KNH is an estimated 600 units of blood per day in the event of a disaster. The researcher noted that the figures provided for disaster events were estimates (most likely could be higher) and not as accurate as those for daily requirements. This is mainly attributed to the need for blood being different for different types of disasters. Blood donations are usually dependent on the type of disasters; some disaster events seemed to stir up more emotion and good will from the public thus more donations e.g. the West Gate mall event in September, 2013 when the BTU would collect an average of 800 - 1000 units per day.

These results reflect the urgent need to invest in data collection systems that would provide accurate information on blood requirements in the country during disasters. A study by Tabatabaie et al. (2010) reported that in most Tehran earthquake scenarios, a shortage of blood was estimated to constrain the capacity of all blood transfusion centres around the country within first three days, as they would require 2-8 times more than what the country had produced following a previous earthquake (Bam) which had a death toll of 26,271 people and injured an additional 30,000.

CHAPTER 5: SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

The purpose of the study was to assess the effectiveness of the Kenyatta Hospital Blood Bank Unit in responding disasters. The study sought to answer the following questions. What are the systems and structures that are in place for blood collection and storage at the KNH blood transfusion unit? How much blood is required at the KNH blood bank unit and what is the status of demand versus supply during periods of normalcy and in the event of a disaster? and What strategies are in place to address shortfall of blood supply in the event of a disaster at the KNH.

5.2 Summary of the findings

This section presents the summary of the findings according to the study objectives.

5.2.1 Demographic characteristics of the respondents

Blood donors

The study found that a higher proportion of the donor respondents (72%) were males as their female counterparts were constrained by among others, biological challenges. Majority (59%) of those who donate blood at the KNH are between the ages of 22 – 29 years while there was low representation from the below 19 age group even though they constitute the largest donor group for the KNBTS. With regard to educational level, the study found that most respondents had secondary level education and above. Singles in the population donated most of the blood at 48 percent when compared to those who are married at 32 percent.

Medical personnel

According to the findings of this study, females constituted the majority (54%) of the personnel at KNH while the males were 46 percent. Majority (62%) of the medical

respondents were between the ages of 24 – 34 years an indication of the average time it takes a medical doctor to attain their first degree before they can be assigned patients under their care.

5.2.2 Systems and structures at the KNH blood transfusion unit

The findings revealed that the BTU at the KNH is strategically located and can conveniently be accessed from various entry points to the hospital. The unit uses internationally accepted blood donation criteria to select donors and relies on the main hospital's serology unit to screen blood and once declared safe is further processed ready for use by patients. The findings further revealed that the systems and structures at the BTU are not integrated and fully equipped. A hospital based BTS is not as fully equipped as a stand-alone facility. In the case of the BTU at KNH, it was observed that certain aspects of the blood collection system were robust and sufficient. However, there are constraints for example the lack of a fully functional cold room and blood serology unit being located in a different department which if addressed, would transform the unit into a best-practice centre and ensure effective emergency response during disaster events.

On the availability of blood, the findings revealed that the BTU at KNH has a zero expiry rate for blood an indication that demand always exceeds supply. According to the study findings, testing of whole blood in Kenya is done by use of standard diagnostic screening methods, which though internationally accepted, results are not one hundred percent safe and infections could be transmitted during transfusion. It was noted that the BTU has space for a cold room which is still under construction and once ready will accommodate up to 1000 units of blood. The existing blood donation system is less robust and sustainable with heavy reliance on family replacement donations; this has resulted in blood shortages mainly witnessed during disasters. It was further noted that the staffing levels though adequate, in times of emergency situations where there is need to work for additional hours it is overstretched.

5.2.3 Blood requirements at the KNH and the demand versus supply factor

According to the study findings, the demand for blood at the KNH on a normal day is about 120 units of blood and an estimated 600 units of blood per day in the event of a disaster. Considering about 60 – 80 units are collected each day, this would mean that on any given normal day the hospital has a shortage of between 40 – 60 units of blood. This number increases considerably during a disaster event to a shortfall of about 520 units. The study findings show that this shortfall would usually be met with considerable assistance from the KNBTS and the KRC through blood campaigns.

5.2.4 Factors that influence blood supply

The findings of this study revealed that the most effective way to create awareness about blood donations and blood transfusion services was through word of mouth followed by electronic media such as radio and television as it has wide coverage in the country. Unfortunately, the study established that a majority (56%) of those donating blood at the KNH BTU were first time donors while most of those interviewed had only donated blood between 1 – 3 times in their entire lifetime with the main reason (59%) for donating blood being to support a friend or family member. The reasons for not donating blood were varied and key among them (54%) was the fear of catching a disease (e.g. HIV/AIDS) and fear needles. Assumptions about the donation process was another deterrent. The study found that donors were likely to donate blood in the near future but mainly to support a family/friend in need i.e. replacement donations but could also be motivated to donate through regular blood campaigns and awards for donating.

5.2.5 Factors that influence blood demand

From the findings of the study, a majority (57%) of the medical respondents indicated they disseminated information on blood donations through word of mouth but that there was inadequate education and awareness to encourage people to donate blood. The study also found that infections such as HIV/AIDS, common colds, the flu or diseases such as

hypertension and diabetes are most likely to hinder people from donating blood. The study findings also established that there is need to motivate potential donors by allaying their fears or misconceptions about the donation process. The study found that the services for blood transfusion can be further improved by expanding the capacity to enable KNH to store higher volumes of blood to address emergency situations.

5.3 Conclusion

From the findings of the study, it can be concluded that the Ministry of Health in consultation with key stakeholders developed Kenya's first blood safety policy guidelines for the collection, processing, storage, distribution and supply of blood and blood products in 2001. These guidelines have served as a foundation for the entire blood donation programme and guide both policy makers and service providers.

The study concludes that the systems and structures that are in place for blood collection at the KNH are mostly sufficient but are faced with some constraints for example the lack of a fully functional cold room and blood serology unit being located in a different department, which if addressed, would transform the BTU into a best practice centre especially during disaster response.

With regard to blood supply versus demand, the study concludes that supply for blood at the KNH is always exceeded by demand i.e. blood supply is not met both on a normal day and during disaster events. The study further concludes that the KNH has contingency measures put in place to manage disaster events but there are no specific strategies to address short fall of blood supply in the event of disaster.

The study also concludes that lack of awareness and knowledge (misconceptions) on the blood transfusion process has contributed to poor supply of blood which has resulted in low donor turnout and over reliance on family replacement donations. Demand, the study concludes, has also been affected by lack of information on the donation process,

motivation to give blood and a high rate of infections such as HIV/AIDS and non-communicable diseases.

5.4 Recommendations

The following recommendations are made based on the study findings:

5.4.1 Individual level

There is need for more females and those who are married to register as blood donors in in order to increase our pool of non-remunerated blood donors and reduce over reliance on family replacement donations. The study recommends that those who are unable to donate blood could sign up as volunteers and increase awareness in their social circles.

5.4.2 Institutional level

The study recommends that funding be increased toward providing adequate facilities for storage and management of the BTU. For example, there is need for the KNH to invest in a fully functional cold room in order to increase the storage capacity for donated and processed blood to better respond during disaster situations. Another recommendation is the need to create a serology unit within the BTU at KNH. This would reduce the amount of time it takes for blood to be sent out for screening especially during disaster events when time is of great importance due to the influx of casualties.

The standard operating procedures and systems though adequate, could be enhanced by migrating and embracing digitalized or advanced solutions. This relates to record keeping which is currently done manually and investment in molecular blood testing instead of the current standard diagnostic procedures.

5.4.3 Policy level

The study recommends the need to identify and resolve training gaps with regard to blood donation in early childhood education and work towards inculcating a culture of blood

donors by incorporating the information into school curricula. This would ensure that the young grow up understanding the need to register as regular blood donors and with time would boost the national blood levels.

Establish strategies to reduce reliance on school age children as the biggest donor block and seek ways to increase the donor pool of those between 18 to 65 years of age. Strive to increase the number of units collected per 1000 population in order to meet the national demand for blood. The Ministry of Health should explore policy toward encouraging voluntary non-remunerated donors and providing mechanisms to operationalize the same to reduce overreliance on family replacement donations. This can be done by emphasizing the use of existing time-tested blood donation strategies, propose new/innovative ones to improve voluntary blood donation and enhance greater community participation to boost blood supply.

The study further recommends that the Ministry of Health institutes a deliberate effort to disseminate information to the adult population on the importance of blood donation and demystify the myths, fear and unfounded misconceptions on the effects of donating blood.

5.5 Recommendations for further studies

The researcher recommends that a similar study should be done in different public and private hospitals in Kenya to verify the study results. Another linkage that should be explored is the supply chain from the KNBTS to the various medical institutions in the country. There is need to understand why each institution has resorted to operating its own BTS whereas KNBTS is mandated to be the sole supplier of blood in the country. There is also need to look at the demand versus supply factor in each of the 47 counties in Kenya in line with the new constitution dispensation and how the current centrally recognized and managed KNBTS can better serve each county.

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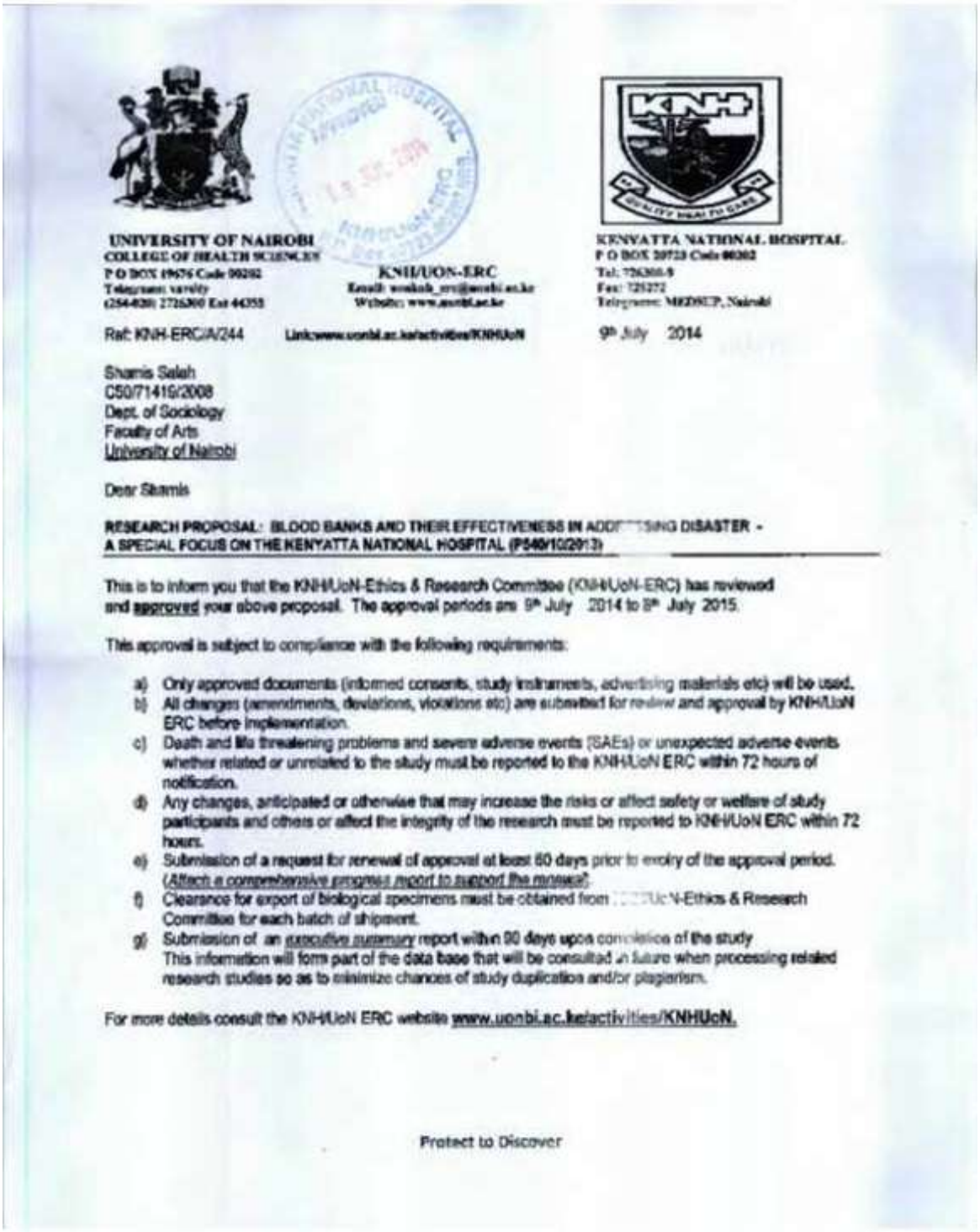
ANNEXES

Annex I: Map of KNBTS Regional Blood Transfusion and Satellite Centres

Annex II: Approval letter from the Ethics and Research Committee at the KNH



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KNH/UON-ERC
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Website: www.uonbi.ac.ke

KENYATTA NATIONAL HOSPITAL
P O BOX 20723 Code 00202
Tel: 726300-9
Fax: 725272
Telegrams: MEDSUP, Nairobi

Ref: KNH-ERC/A/244 Link:www.uonbi.ac.ke/activities/KNHUoN

9th July 2014

Shamis Salah
C50/71419/2008
Dept. of Sociology
Faculty of Arts
University of Nairobi

Dear Shamis

RESEARCH PROPOSAL: BLOOD BANKS AND THEIR EFFECTIVENESS IN ADDRESSING DISASTER - A SPECIAL FOCUS ON THE KENYATTA NATIONAL HOSPITAL (P540/10/2013)

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 9th July 2014 to 8th July 2015.

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 severe 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.

For more details consult the KNH/UoN ERC website www.uonbi.ac.ke/activities/KNHUoN.

Protect to Discover

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
Supervisor: Robinson M. Ocharo, Dept. of Sociology and Social Work, UoN

Protect to Discover

Annex III: Sample donor registration form

KENYATTA NATIONAL HOSPITAL BLOOD TRANSFUSION UNIT

PACK NO.
……

DONOR REGISTRATION FORM (*Donors please complete the section below)*

Surname…… Other Names …….. ……..

Student Number/National ID Number……. Date of Birth ……/…….. Sex F/M ……

Marital Status:	Single:	Married:	Divorced/Separated:	Widowed:

Contact Details: Postal Address (*where you would like to receive your correspondence)* Code: …….

Home Phone Number: …… Cell phone number: …….

Email: …….

Level of Education: None/Primary/Secondary/Tertiary Occupation: ……

When did you last donate blood? …….. Blood Group: ….....

HEALTH QUESTIONNAIRE	**Circle the appropriate answer**	
	Yes	No
1. Are you feeling well and in good health?	Yes	No
2. Have you eaten for the last 6 hours	Yes	No
3. Have you ever fainted?	Yes	No
In the last 6 months, have you:		
4. Been ill, received any treatment or any medication?	Yes	No
5. Had any injections or vaccinations (immunization)?	Yes	No
6. Female Donors: Have you been pregnant/breastfeeding or currently on menses?	Yes	No
In the past 12 months have you?		
7. Received a blood transfusion or any blood products	Yes	No
Do you have or have you ever had:		
8. Any problems with your heart or lungs e.g. asthma?	Yes	No
9. A bleeding condition or a blood disease?	Yes	No
10. Any type of cancer?	Yes	No
11. Diabetes, epilepsy, TB or blood pressure?	Yes	No
12. Any other long term illness?	Yes	No

RISK ASSESSMENT QUESTIONNARE

The lives of patients who receive your blood are totally dependent on your honesty in answering the questions below. Your answers will be treated in a confidential manner.

In the past 12 months have you:		
1. Received or given money, goods or favours in exchange for sexual activities?	Yes	No
2. Had sexual activity with a person whose sexual background you did not know?	Yes	No
3. Been raped or sodomized?	Yes	No
4. Had a stab wound or had an accidental needle stick injury e.g. injection needle?	Yes	No
5. Had any tattooing or body piercing e.g. ear piercing?	Yes	No
6. Had a sexually transmitted disease (STD)?	Yes	No
7. Live with or had sexual contact with someone with yellow skin?	Yes	No
8. Had sexual activity with anyone besides your regular sex partner?	Yes	No
Have you ever:		
9. Had yellow eyes or yellow skin?	Yes	No
10. Injected yourself or been injected, besides in a health facility?	Yes	No
11. Used non-medical drugs such as marijuana, cocaine etc.?	Yes	No
12. Have you or your partner been tested for HIV?	Yes	No
13. Do you consider your blood safe to transfuse to a patient?	Yes	No

DECLARATION:

I declare that the information I have above is correct. I understand that my blood will be tested for HIV, Hepatitis B & C and Syphilis and the results of my tests may be obtained from the Blood Transfusion Unit.

Signature:…… **Date**: …….

For Official Use:

Weight (kg)	Hb>12.5g/dl	BP	Pulse

Donor is Accepted	
Yes:	**No:**

Low Volume	Venepuncture	Haematoma	Faint		
			Mild	Moderate	Severe

Time Needle In		Time Needle Out	

Report

Name of Interviewer: …… Date: …….

APPENDICES

Appendix 1 – The study budget

Item	**Number of items**	**Cost per item, Ksh.**	**Total cost ,Ksh.**
Data analyst	1	10,000	10,000
Research assistants	4	5,000	20,000
Writing pads	5	50	250
Pens	5	20	100
Printing costs	6 - Proposal and Thesis	750	4,500
Report writing	1	2000	2,000
Report binding	2	1000	2,000
Miscellaneous		5000	5,000
Contingency (10 percent of total)			3,385
TOTAL			**47,235**

Appendix II: Letter of introduction

Date: July 29, 2014

TO WHOM IT MAY CONCERN

Dear Sir/Madam:

REQUEST FOR COLLECTION OF DATA

My name is **SHAMIS SALAH**, a post-graduate student at the Department of Sociology and Social Work, Faculty of Arts, University of Nairobi. I am conducting a research study titled "*Blood Banks and their Effectiveness in Addressing Disasters – A Special Focus on the Kenyatta National Hospital".*

You have been selected to form part of this study. Kindly assist by filling in the attached questionnaire. The information given will be treated in strict confidence and will be purely used for academic purposes.

Your assistance and cooperation will be highly appreciated.

Yours Sincerely,

Shamis Salah.

Shamis Salah
(Student)
C50/71419/2008

Appendix III – Consent form

To be read in a language that the respondent is fluent.

Title of the Study: "Blood Banks and their Effectiveness in Addressing Disasters – A Special Focus on the Kenyatta National Hospital".

Institution: Department of Sociology and Social Work, University Of Nairobi, P.O.BOX 30197 00400, Nairobi.

Investigator: Ms. Shamis Salah, P O Box 29299, 00100, Nairobi

Supervisor: Dr. Robinson M. Ocharo, Department of Sociology and Social Work, University Of Nairobi, P.O.BOX 30197 00400, Nairobi.

Ethical Approval: Kenyatta National Hospital/ University of Nairobi Ethical and Research Committee, P.O.BOX 20723-00100, Nairobi. Tel 2726300/ 2726450 Ext 44102.

It is located at the School of Pharmacy buildings, University of Nairobi.

Permission is requested from you to participate in this research study. You should understand the following general principles which apply to all participants in a research.

i. Your agreement to participate in this study is voluntary

ii. You may withdraw from the study at any time without necessarily giving a reason for your withdrawal.

iii. After you read the explanation, please feel free to ask any questions that will enable you understand clearly the nature of the study.

Purpose of the study: To assess the readiness of the Kenyatta National Hospital blood bank service in relation to disaster management.

Procedures to be followed: With your cooperation, you will answer questions related to the objectives of this study. All information obtained will be handled with confidentiality.

Risks : There will be no risks involved in this study to you.

Benefits: There may be no direct benefits to you but the results of this study will be useful in understanding the response by the Kenyatta National Hospital in related to blood donations in the event of a disaster.

Assurance on confidentiality: All information obtained from you will be kept confidential and used for the purpose of this study only. Your name will not be used during data handling or in any resulting publications. Codes will be used instead.

Contacts: In case you need to contact me, my academic department or the Kenyatta National Hospital/ University of Nairobi Ethics and Research Committee concerning this study please feel free to use the contacts provided above.

I now request you to sign the consent form attached

CONSENT FORM

"Blood Banks and their Effectiveness in Addressing Disasters – A Special Focus on the Kenyatta National Hospital".

I _____ give consent to the investigator to use information that I will provide her as part of her study. The nature of the study has been explained to me by the Medical Officer In-Charge at the Kenyatta National Hospital Blood Transfusion Unit.

Signature_____ Date_____

I confirm that I have explained the nature and effect of the study.

Signature_____ Date_____

Appendix IV: Observation checklist

1. Does the blood bank at the KNH have the following general requirements?

Requirement	Comments
1. ***Location and Surroundings*****:** The blood bank shall be located at a place which shall be away from open sewage, drain, public lavatory or similar unhygienic surroundings	
2. ***Building:*** The building(s) used for operation of a blood bank and/or preparation of blood components shall be constructed in such a manner so as to permit the operation of the blood bank and preparation of blood components under hygienic conditions and shall avoid the entry of insects, rodents and flies. It shall be well lit, ventilated and screened (mesh), wherever necessary. The walls and floors of the rooms, where collection of blood or preparation of blood components or blood products is carried out shall be smooth, washable and capable of being kept clean. Drains shall be of adequate size and where connected directly to a sewer, shall be equipped with traps to prevent back siphonage.	
3. ***Health clothing and sanitation of staff:*** The employees shall be free from contagious or infectious diseases. They shall be provided with clean overalls, head-gears, foot-wears and gloves, wherever required. There shall be adequate, clean and convenient hand washing and toilet facilities.	

A. **ACCOMODATION FOR A BLOOD BANK.**

In addition to several rooms for various uses, a blood bank should ideally have an area of 100 square meters for its operations and an additional area of 50 square meters for preparation of blood components. The table below captures the space requirements for a blood bank.

Space Requirements for a Blood Bank	**Comments**
a. Space availability - 100 square meters for blood bank operations; - 50 square meters for preparation of blood components	
b. Registration and medical examination with adequate furniture and facilities for registration and selection of donors	
c. Blood collection (air-conditioned)	
d. Blood component preparation. (This shall be air-conditioned to maintain temperature between 20 degree centigrade to 25 degree centigrade)	
e. Laboratory for blood group serology. (air-conditioned)	
f. Laboratory for blood transmissible diseases like Hepatitis, Syphilis, Malaria, HIV-antibodies (air-conditioned)	
g. Sterilization-cum-washing	
h. Refreshment-cum-rest room (air-conditioned)	
i. Store-cum-records	

B. PERSONNEL

There shall be adequate staff, qualified by education, training and experience who have demonstrated their competence to perform assigned responsibilities. Every blood bank shall have the following categories of full time competent technical staff:-

Personnel	Comments
1. Regional Blood Transfusion Service Director	
2. Medical Officer In-Charge	
3. Blood Donor Service Manager	
4. Administration and Finance Manager	
5. Quality Systems Manager	
6. Information Systems Manager	
7. Medical Officer	
8. Blood Bank Technician(s)	
9. Registered Nurse(s).	

C. MAINTENANCE

The blood bank shall be maintained in a clean and proper manner to ensure adequate cleaning and maintenance of proper operations. The facilities shall include –

Requirement	Comments
1. Privacy and thorough examination of individuals to determine their suitability as donors.	
2. Collection of blood from donors with minimal risk of contamination or exposure to activities and equipment unrelated to blood collection.	

Requirement	Comments
3. Storage of blood or blood components pending completion of tests.	
4. Provision for quarantine, storage of blood and blood components in a designated location, pending repetition of those tests that initially give questionable serological results.	
5. Provision for quarantine, storage, handling and disposal of products and reagents not suitable for use.	
6. Storage of finished products prior to distribution or issue.	
7. Proper collection, processing, compatibility testing, storage and distribution of blood and blood components to prevent contamination.	
8. Adequate and proper performance of all procedures relating to plasmapheresis, plateletpheresis and leucapheresis.	
9. Proper conduct of all packaging, labeling and other finishing operations.	
10. Provision for safe and sanitary disposal of:- a) Blood and/or blood components not suitable for use, distribution.	
b) Trash and items used during the collection, processing and compatibility testing of blood and/or blood components.	

D. EQUIPMENT

Equipment used in the collection, processing, testing, storage and distribution of blood and its components shall be maintained in a clean and proper manner and so placed as to facilitate cleaning and maintenance. The equipment shall be observed, standardized and calibrated on a regularly scheduled basis as described in the Standard Operating Procedures Manual and should operate in the manner for which it was designed so as to ensure compliance with the official requirements (the equipment) as stated below for blood and its components. Equipment that shall be observed, standardized and calibrated with at least the following frequencies:-

	EQUIPMENT	**PERFORMANCE**	**FREQUENCY**	**FREQUENCY OF CALIBRATION**	**COMMENTS**
1.	Temperature recorder	Compare against thermometer	Daily	As often as necessary	
2.	Refrigerated centrifuge	Observe speed and temperature	Each day of use	As often as necessary	
3.	Hematocrit centrifuge	--	--	Standardize before initial use, after repair or adjustments, and annually.	
4.	General lab. centrifuge	--	--	Tachometer. every 6 months,	
5.	Automated Blood typing	Observe controls for correct results	Each day of use	---	
6.	Haemoglo-bihometer	Standardize against cyanamethemo- globulin standard	Each day of use	---	
7.	Refractiometer or Urinometer	Standardize against distilled water.	Each day of use	---	
8.	Blood container weighing device	standardize against container of known weight	Each day of use	As often as necessary,	
9.	Water Bath	Observe Temperature	Each day of use	As often as necessary,	
10.	Rh view box(wherever necessary)	Observe Temperature	Each day of use	As often as necessary,	
11.	Autoclave	Observe Temperature	Each time of use	As often as necessary,	
12.	serologic rotators	Observe controls for correct results	Each day of use	speed as often as necessary	
13.	Laboratory thermometers	--	--	Before initial use	

	EQUIPMENT	PERFORMANCE	FREQUENCY	FREQUENCY OF CALIBRATION	COMMENTS
14.	Electronic thermometers	--	Monthly	--	
15.	Blood agitator	Observe weight of the first container of blood filled for correct results	Each day of use	Standardize with container of known mass or volume before initial use, and after repairs or adjustments.	

E. SUPPLIES AND REAGENTS

All supplies and reagents used in the collection, processing, compatibility, testing, storage and distribution of blood and blood components shall be stored at proper temperature in a safe and hygienic place, in a proper manner and in particular –

Requirement	Comment
1. All supplies coming into contact with blood and blood components intended for transfusion shall be sterile, pyrogen-free, and shall not interact with the product in such a manner as to have an adverse effect upon the safety, purity, potency or effectiveness of the product.	
2. Supplies and reagents that do not bear an expiry date shall be stored in a manner that the oldest is used first.	
3. Supplies and reagents shall be used in a manner consistent with instructions provided by the manufacturer.	
4. All final containers and closures for blood and blood components not intended for transfusion shall be clean and free of surface solids and other contaminants.	
5. Each blood collecting container and its satellite container(s), if any, shall be	

Requirement	Comment
examined visually for damage or evidence of contamination prior to its use and immediately after filling. Such examination shall include inspection for breakage of seals, when indicated, and abnormal discoloration. Where any defect is observed, the container shall not be used or, if detected after filling, shall be properly discarded.	

6. Representative samples of each lot of the following reagents and/or solution shall be tested regularly on a scheduled basis by methods described in the Standard Operating Procedures Manual to determine their capacity to perform as required:-

Reagents and solutions	Frequency of testing Along with controls	Comment
Anti-human serum	Each day of use	
Blood grouping serums	Each day of use	
Lectin	Each day of use	
Antibody screening and reverse and reverse grouping cells	Each day of use	
Hepatitis test reagents	Each run	
Syphilis serology reagents	Each run	
Enzymes	Each day of use	
HIV I and II reagents	Each run	
Normal saline (LISS and PBS)	Each day of use	
Bovine Albumin	Each day of use	

F. GOOD MANUFACTURING PRACTICES (GMPs)/STANDARD OPERATING PROCEDURES (SOPs)

Written Standard Operating Procedures shall be maintained and shall include all steps to be followed in the collection, processing, compatibility testing, storage and distribution of blood and/or preparation of blood components for homologous transfusion, autologous transfusion and further manufacturing purposes. Such procedures shall be available to the personnel for use in the concerned areas.

Requirement	Comment
1. The Standard Operating Procedures shall inter alia include:-	

Requirement	Comment
a) criteria used to determine donor suitability.	
b) methods of performing donor qualifying tests and measurements Including minimum and maximum values for a test or procedure, when a factor in determining acceptability.	
c) solutions and methods used to prepare the site of phlebotomy so as to give maximum assurance of a sterile container of blood.	
d) method of accurately relating the product(s) to the donor.	
e) blood collection procedure, including in-process precautions taken to measure accurately the quantity of blood drawn from the donor.	
f) methods of component preparation including, any time restrictions for specific steps in processing.	
g) all tests and repeat tests performed on blood and blood components during processing.	
h) pre-transfusion testing, wherever applicable, including precautions to be taken to identify accurately the recipient blood components during processing.	
i) procedures of managing adverse reactions in donor and recipient reactions.	
j) storage temperatures and methods of controlling storage temperatures for blood and its components and reagents.	
k) length of expiry dates, if any, assigned for all final products.	
l) criteria for determining whether returned blood is suitable for re-issue.	

Requirement	Comment
m) procedures used for relating a unit of blood or blood component from the donor to its final disposal.	
n) (quality control procedures for supplies and reagents employed in blood collection, processing and re-transfusion testing.	
o) schedules and procedures for equipment maintenance and calibration.	
p) labeling procedures to safe guard its mix-ups, receipt, issue, rejected and in-hand.	
q) procedures of plasmapheresis, plateletphersis and leucapheresis if performed, including precautions to be taken to ensure re-infusion of donor's own cells.	
r) procedures for preparing recovered (salvaged) plasma if performed, including details of separation, pooling, labeling, storage and distribution.	
s) all records pertinent to the lot or unit maintained pursuant to these regulations shall be reviewed before the release or distribution of a lot or unit of final product. The review or portions of the review may be performed at appropriate periods during or after blood collection, processing, testing and storage A thorough investigation, including the conclusions and follow-up, of any unexplained discrepancy or the failure of a lot or unit to meet any of its specification shall be made and recorded.	

G. CRITERIA FOR BLOOD DONATION

Conditions for donation of blood:-

1. The donors shall fulfill the following requirements, namely :-

Requirement	Comment
a) General -No person shall donate blood and no blood	

Requirement	Comment
bank shall draw blood from a person, more than once in three months. The donor shall be in good health, mentally alert and physically fit and shall not be inmates of jail, persons having multiple sex partners or drug-addicts	
b) the donor shall be in the age group of 18 to 60 years	
c) the donor shall not be less than 45 kilograms	
d) temperature and Pulse of the donor shall be normal	
e) the systolic and diastolic blood pressures are within normal limits without medication	
f) haemoglobin which shall not be less than 12.5 grams	
g) the donor shall be free from acute respiratory diseases	
h) the donor shall be free from any skin diseases at the site of phlebotomy	
i) the donor shall be free from any disease transmissible by blood transfusion, insofar as can be determined by history and examination indicated above	
j) the arms and forearms of the donor shall be free from skin punctures or scars indicative of professional blood donors or addiction of self-injected narcotics	

2. Additional qualifications of a donor. -No person shall donate blood, and no blood bank shall draw blood from a donor, in the conditions mentioned in column (1) of the Table given below before the expiry of the period of deferment mentioned in the column (2) of the said Table.

Table: Deferment of blood donation	
(1)	**(2)**
CONDITIONS	**PERIOD OF DEFERMENT**
a) Abortions	6 months
b) History of Blood transfusion	6 months
c) Surgery	12 months
d) Typhoid	12 months after recovery
e) History of Malaria and duly treated	3 months (endemic) 3 years (non-endemic area)
f) Tattoo	6 months
g) Breast feeding	12 months after delivery
h) Immunization (Cholera, Typhoid, Diphtheria, Tetanus, Plague, Gammaglobulin)	15 days
i) Rabies vaccination	1 year after vaccination
j) History of Hepatitis in family or close contact	12 months
k) Immunoglobulin	12 months

3. No person shall donate blood and no blood bank shall draw blood from a person, suffering from any of the diseases mentioned below, namely:-

    a) Cancer
    b) Heart disease
    c) Abnormal bleeding tendencies
    d) Unexplained weight loss
    e) Diabetes-controlled on Insulin
    f) Hepatitis infection
    g) Chronic nephritis
    h) Signs and symptoms, suggestive of AIDS
    i) Liver disease
    j) Tuberculosis
    k) Polycythemia Vera
    l) Asthma
    m) Epilepsy
    n) Leprosy
    o) Schizophrenia
    p) Endocrine disorders

H. GENERAL EQUIPMENTS AND INSTRUMENTS

Requirements	Comments
1. For blood collection room a) Donor beds, chairs and tables: These shall be suitably and comfortably cushioned and shall be of appropriate size. b) Bedside table. c) Sphygmomanometer and Stethoscope. d) Recovery beds for donors. e) Refrigerators, for storing separately tested and untested blood, maintaining temperature between 2 to 6 degree centigrade with digital dial thermometer, recording thermograph and alarm device, with provision for continuous power supply. f) Weighing devices for donor and blood containers.	
2. For haemoglobin determination a) Copper sulphate solution (specific gravity 1.053) b) Sterile lancet and impregnated alcohol swabs. c) Capillary tube (1.3x1.4x96 mm or pasteur pipettes) d) Rubber bulbs for capillary tubings. e) Sahli's haemoglobinometer/Colorimeteric method.	
3. For temperature and pulse determination a) Clinical thermometers.	

Requirements	Comments
b) Watch (fitted with a seconds-hand) and a stop-watch.	
4. For blood containers Only disposable PVC blood bags shall be used (closed system) as per the a) Specifications of IP/USP/BP. b) Anti-coagulants: The anti-coagulant solution shall be sterile, pyrogen-free and of the following composition that will ensure satisfactory safety and efficacy of the whole blood and/or for all the separated blood components. i. Citrate Phosphate Dextrose Adenine solution (CPDA) or Citrate Phosphate ii. Dextrose Adenine- 1 (CPDA-1) ---- 14 ml. Solution shall be required for 100 ml of blood.	
5. Emergency equipment/items a. Oxygen cylinder with mask, gauge and pressure regulator. b. 5 percent Glucose or Normal Saline. c. Disposable sterile syringes and needles of various sizes. d. Disposable sterile I.V. infusion sets. e. Ampoules of Adrenaline, Noradrenaline, Mephentin, Betamethasone or Dexamethasone, Metoclorpropamide injections f. Aspirin.	
6. Accessories a. Such as blankets, emesis basins, haemostats, set clamps, sponge forceps,	

Requirements	Comments
gauze, dressing jars, solution jars, waste cans. b. Medium cotton balls, 1.25 cm. adhesive tapes. c. Denatured spirit, Tincture Iodine, green soap or liquid soap. d. Paper napkins or towels. e. Autoclave with temperature and pressure indicator. f. Incinerator g. Stand-by generator.	
7. Laboratory equipment a. Refrigerators, for storing diagnostic kits and reagents, maintaining a temperature between 4 to 6 degree centigrade (plus/minus 2 degree centigrade) with digital dial thermometer having provision for continuous power supply. b. Compound Microscope with low and high power objectives. c. Centrifuge Table Model d. Water bath: having range between 37 degree centigrade to 56 degree centigra e. Rh viewing box in case of slide technique. f. Incubator with thermostatic control. g. Mechanical shakers for serological tests for Syphilis. h. Hand-lens for observing tests conducted in tubes. i. Serological graduated pipettes of various sizes j. Pipettes (Pasteur) k. Glass slides l. Test tubes of various sizes/micrometer plates (U or V type) m. Precipitating tubes 6mmx50mm of different sizes and glass beakers of different sizes n. Test tube racks of different specifications.	

Requirements	Comments
o. Interval timer electric or spring wound. . p. Equipment and materials for cleaning glass wares adequately. q. Insulated containers for transporting blood, between 2 degree centigrade to 10 degree centigrade temperatures, to wards and hospitals. r. Wash bottles s. Filter papers t. Dielectric tube sealer. u. Plain and EDT A vials v. Chemical balance (wherever necessary) w. ELISA reader with printer, washer and micropipettes.	

I. SPECIAL REAGENTS

Requirement for Special Reagents	Comment
1. Standard blood grouping sera Anti A, Anti B and Anti D with known controls. Rh typing sera shall be in double quantity and each of different brand or if from the same, supplier each supply shall be of different lot numbers.	
2. Reagents for serological tests for syphilis and positive sera for controls.	
3. Anti-Human Globulin Serum (Coomb's serum)	
4. Bovine Albumin 22 percent Enzyme reagents for incomplete antibodies.	
5. ELISA or RPHA test kits for Hepatitis and HIV I & II.	
6. Detergent and other agents for cleaning laboratory glasswares.	

J. TESTING OF WHOLE BLOOD

1. It shall be responsibility of the medical officer in-charge to ensure that the whole blood collected, processed and supplied conforms to the standards laid down by the Government of Kenya.

2. Freedom from HIV antibodies (AIDS) Tests -Every medical officer in-charge shall get samples of every blood unit tested, before use, for freedom from HIV I and HIV II antibodies. The results of such testing shall be recorded on the label of the container.

3. Each blood unit shall also be tested for freedom from Hepatitis B surface antigen, and Hepatitis C Virus antibody VDRL and malarial parasite and results of such testing shall be recorded on the label of the container.

K. RECORDS

The records which the blood bank is required to maintain shall include the following particulars, namely:-

Type of Record	Comment
1. ***Blood donor record:*** It shall indicate serial number, date of transfusion, name, address and signature of donor with	

Type of Record	Comment
other particulars of age, weight, hemoglobin, blood grouping, blood pressure, medical examination, bag number and patient's detail for whom donated in case of replacement donation, category of donation (voluntary/replacement) and deferral records and signature of Medical Officer In-charge.	
2. ***Master records for blood and its components:*** It shall indicate bag serial number, date of collection, date of expiry, quantity in ml. ABO/Rh Group, results for testing of HIV I and HIV II antibodies, Malaria, V.D.R.L., Hepatitis B surface antigen and Hepatitis C virus antibody and irregular antibodies (if any), name and address of the donor with particulars, utilization issue number, components prepared or discarded and signature of the Medical Officer In charge.	
3. ***Issue register:*** It shall indicate serial number, date and time of issue, bag serial number, ABO/Rh Group, total quantity in ml, name and address of the recipient, group of recipient, unit/institution, details of cross-matching report, and indication for transfusion.	
4. ***Records of components supplied:*** quantity supplied; compatibility report, details of recipient and signature of issuing person.	
5. **Records** of A.C.D./C.P.D/CPD-A/SAGM bags giving details of manufacturer, batch number, date of supply, and results of testing.	

Type of Record	Comment
6. ***Register for diagnostic kits and reagents used:*** name of the kits/reagents, details of batch number, date of expiry and date of use.	
7. Blood bank must issue the cross matching report of the blood to the patient together with the blood unit.	
8. Transfusion adverse reaction records.	
9. Records of purchase, use and stock in hand of disposable needles, syringes, blood bags, shall be maintained.	

L. LABELS

The labels on every bag containing blood and/or component shall contain the following particulars, namely:

Labeling		Comment
The proper name of the product in a prominent place and in bold letters on the bag.		
Name and address of the blood bank		
The date on which the blood is drawn and the date of expiry		
A colored label shall be put on every bag containing blood.		
Blood Group	**Color of the label**	
O		
A		
B		
AB		
The results of the tests for Hepatitis B		

Labeling	Comment
surface antigen, and Hepatitis C virus antibody, syphilis, freedom from HIV I and HIV II antibodies and malarial parasite.	
The Rh group.	
Total volume of blood, the preparation of blood, nature and percentage of anti-coagulant.	
Keep continuously temperature at 2 degree centigrade to 6 degree centigrade for whole human blood and/or components as contained under III of Part XII B.	
Disposable transfusion sets with filter shall be used in administration equipment.	
Appropriate compatible cross matched blood without a typical antibody in recipient shall be used.	
The contents of the bag shall not be used if there is any visible evidence of deterioration 1ike haemolysis, clotting or discoloration.	
The label shall indicate the appropriate donor classification like "Voluntary Donor" or "Replacement Donor" in no less prominence than the proper name.	

M. What are the main challenges facing the Blood Bank at the KNH?

_____

N. Any other general comments on the blood bank at the KNH?

_____

Thank you for your time and your responses!

Appendix V: Questionnaire for donors

Please complete each section as instructed. All the information in this questionnaire will be kept in confidence.

1. **GENERAL DETAILS** (please check all that apply)

PARTICIPANT DETAILS	DESCRIPTION
Sex	□ Male □ Female
Age	□ ≤19 □ 20 – 24 □ 25 – 29 □ 30 – 34 □ 35 – 39 □ 40 – 44 □ 45 – 49 □ ≥50
Education Level	□ Primary □ Secondary □ College □ Pre-university □ University □ Post Graduate □ Other _____
Marital Status	□ Single □ Married □ Other _____

1. **How do you get information about blood donations and blood transfusion services? Tick all that apply**

□ Radio
□ Social Media
□ Church announcements
□ Telephone call
□ SMS
□ Word of mouth
□ Emails

□Other _____

2. **Have you donated blood before? If no, go to question 5.**

□Yes □No

3. **If yes, how many times?**

□ 1 – 3
□ 4 – 6
□ 6 – 8
□ 10 times and above
□Other
_____

4. **Why have you donated blood in the past?**

_____

_____

_____

_____

5. **If No, please give the reason for not donating**

_____

_____

_____

_____

6. **What is the likelihood that you will donate blood in the near future**

On a scale of 1 to 5 please rate the following. (5 – Highly likely; 4 – Likely; 3 – Neutral; 2 – Unlikely; 1 – Highly unlikely

Reason	**Highly Likely**	**Likely**	**Neutral**	**Unlikely**	**Highly unlikely**
Family/Friend					

Replacement					
Medical					
Self-donation					
Blood drive					
Voluntary					

7. **In your own view, what would motivate you to donate blood on a regular basis?**

_____

_____

_____

8. **In your own view is there adequate education and awareness to encourage people to donate blood?**

   (a) Very adequate
   (b) Adequate
   (c) Not sure
   (d) Inadequate
   (e) Very inadequate

9. **In your opinion, how can blood transfusions services be improved at the Kenyatta National Hospital?**

_____

_____

10. **Do you have any other general comments on blood donations at KNH?**

_____

_____

_____

Thank you for your time and your responses!

Appendix VI: Questionnaire for medical personnel

Please complete each section as instructed. All the information in this questionnaire will be kept in confidence.

SECTION A: GENERAL DETAILS (please check all that apply)

PARTICIPANT DETAILS	DESCRIPTION
Sex	□ Male □ Female
Age	□ ≤19 □ 20 – 24 □ 25 – 29 □ 30 – 34 □ 35 – 39 □ 40 – 44 □ 45 – 49 □ ≥50
Education Level	□ College □ University □ Post Graduate

1. **How do you create awareness about blood donations at the KNH?** (Tick all that apply)

□ Radio
□ Social Media
□ Church announcements
□ Telephone call
□ SMS
□ Word of mouth
□ Emails
□Other

_____

2. **In your own view is there adequate education and awareness to encourage people to donate blood?**

(a) Very adequate

(b) Adequate
(c) Not sure
(d) Inadequate
(e) Very inadequate

3. **How many units of blood do you require in a day?**

_____

_____

4. **On a normal day, do you always have a sufficient supply of blood for your requirements (does demand exceed supply)?**
   □Yes □No

5. **If no, what is the shortfall in terms of units?**

_____

_____

6. **How many blood transfusions do you perform in a day on average?**

_____

_____

7. **What is the highest volume (in units) of blood donations that you have received in a single day?**

_____

_____

8. **In the unlikely event of a disaster or a major emergency situation do you have an estimate of how much blood you would require?**

_____

_____

9. **In the event of a disaster or an emergency situation are you able to <u>easily</u> obtain additional units of blood?**

_____

10. **If blood is not easily available, how would you cover the shortfall?**

11. **In your opinion, what are the main reasons that hinder people from donating blood?**

12. **What do you think can be done to boost the numbers of voluntary non-remunerated blood donors at KNH?**

13. **Based on your experience, what are the major reasons for rejecting donated blood?**

- Disease/infections
- Contamination
- Other reasons

14. What can be done to further improve the safety standards at the KNH Blood Transfusion Unit?

_____

_____

15. In your opinion, how can blood transfusions services be further improved at the Kenyatta National Hospital?

_____

_____

_____

_____

16. Any other general comments on the blood transfusions services at the KNH?

_____

_____

_____

Thank you for your time and your responses!

Appendix VII: Interview guide for key informants

Instructions:
The Researcher is expected to facilitate informative interviews/discussions covering the following areas:-

Introduction:
- Knowing each other
- Explaining purpose of the interview

Questions:
1. What is your general view of Blood Transfusion Services in Kenya?
2. What will you say are the best practices on Blood Transfusion Services in Kenya?
3. What are the main challenges facing Blood Transfusion Services in Kenya?
4. What recommendations would you give to improve Blood Transfusion Services in Kenya?
5. What are the main challenges facing the BTS at the KNH?
6. What is the requirement for blood at the KNH in the event of a disaster?
7. What is the shortfall, if any?
8. Are there measures in place to ensure demand does not exceed supply in the event of a disaster?
9. In the event of a disaster, is the Blood Transfusion Service at the KNH in a position to respond appropriately?
10. What are the safety standards that have been put in place to ensure safe blood donations at KNH during periods of disaster?
11. Are there any contingency measures that have been put in place to ensure a sufficient supply of safe blood at the KNH in the event of a disaster?
12. How can the BTS at the KNH be further improved to handle disasters?

- **Any other general comments on how blood transfusions services can be further improved during disaster events?**

_____

_____

Thank you for your time and your responses!