ANALYSIS OF BLOOD TRANSFUSION CONTENT IN UNDERGRADUATE CURRICULUM AND THE KNOWLEDGE, PERCEPTIONS, AND TRAINING NEEDS OF MEDICAL DOCTORS IN KENYA

BY

JAPHETH CHEBII KIPKULEI

A THESIS SUBMITTED TO THE SCHOOL OF MEDICINE IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE OF DOCTOR OF PHILOSOPHY

MOI UNIVERSITY

DECLARATION

I declare that this is my original work and has not been submitted in any university for examination.

--------------------------------   **------------------------**

Japheth C. Kipkulei   DATE

Reg. No. PhD/ME/4247/20

Declaration by the Supervisors

This thesis has been submitted with our approval as the university supervisors.

------------------------------   -----------------------

Prof. Simon Kangethe, PhD   DATE

Department of Family Medicine, Community Health

And Medical Education

Moi University.

------------------------------   -----------------------

DR. Geoffrey K. Maiyoh, PhD   DATE

Department of Biochemistry and Clinical Medicine

Moi University.

------------------------------   -----------------------

DR. Richard B. O. Okero, PhD   DATE

Department of Educational Psychology

Moi University.

DEDICATION

I dedicate this work to my lovely wife (Dr. Hellen Jepngetich), my children (Kiptoo, Aengwo, Yatich and Ivy), and my parents (Mr. Kipkulei Ayabei & Mrs, Linah Talaa Kipkulei).

ABSTRACT

Background: Blood transfusion (BT) is essential to modern health care, yet blood is scarce, costly, and associated with risks. Blood therapy prescribers need to have adequate knowledge, skills, attitudes, and confidence for safe and effective use. However, research have indicated that doctors lack these competencies due to inadequacy of BT content in undergraduate curriculum.

Objectives: (1) Assess the adequacy of BT in Kenyan medical school curricula (2) Determine Kenyan medical doctors' BT competencies, confidence, and associated factors

Methodology: The study employed quantitative with a cross-sectional approach. Kenyan medical school curricula and doctors were the target population. Six eligible medical schools and 200 non-specialist doctors were recruited using purposive and stratified sampling, respectively. The doctors were selected from 11 hospitals in Western and North Rift. Data was collected using pre-tested questionnaires and data abstraction forms. Medical school curricular data was analyzed using frequency tables and percentages, while doctors' data was summarized using percentages, mean (SD), and median (IQR), bivariate analysis by way of Mann-Whitney, Spearman's correlation coefficient, and Kruskal-Wallis tests, and multivariate analysis was done using logistic regression, where associations were reported using OR and 95% CI. A $p < 0.05$ was deemed statistically significant.

Results: All the six curricula (100%) analyzed contained topics in BT essential for safe practice and had the content of BT integrated into the haematology course taught during the third year. Only one (16.7%) medical school had the subject incorporated into all the clinical years, but with no explicit learning outcomes and content indicated. The mean age of the medical doctor participants was 29.9±3.6) and 60% were males. The median knowledge score was 53.3 % (IQR: 40.0, 66.7%), and it was independently associated with orientation (AOR = 3.157, 95% CI = 1.194–8.337). About 73.0 % had a positive attitude towards BT, which was associated with participation in training ($z = -1.143$, $p = 0.036$). Only 43.7% of reported practices conformed with recommended best practices. The median self-confidence score was 86% (IQR 76.0, 96.0) and was independently associated only with orientation (AOR = 3.960, 95% CI = 1.314–11.929). There was no association between the medical school attended (curricula) and the medical doctor's knowledge ($p = 0.501$), attitude ($p = 0.627$), practice competency ($p=0.319$), and confidence ($p = 0.132$). The vast majority (96%) of the participants reported that knowledge of transfusion medicine was important to their clinical practice, and all (100%) felt that additional training in BT would be useful.

Conclusion*:* All Kenyan medical schools had fundamental BT concepts, but only one included the subject in all clinical years albeit without explicit learning objectives or content. Despite their suboptimal BT knowledge levels, doctors had a positive attitude towards BT coupled with a high level of self, and less than half of the reported practices conformed to best practices. Both knowledge and confidence among doctors were associated with orientation in BT. Most clinicians regarded the knowledge of BT as important to their medical practice but still felt that their knowledge of the discipline was not good enough and needed more training on the subject.

Recommendations: Kenyan medical schools should enhance the teaching of theoretical and practical clinical aspects of BT and include the content of blood transfusion in all the clinical years of undergraduate medical education with explicit learning outcomes. Orientation in BT should be offered to medical interns, and BT-related continuing medical education activities are recommended to all practicing doctors.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS AND ACRONYMS

AABB	American Association of Blood Banks
ANOVA	Analysis of variance
BT	Blood Transfusion
Hb	Haemoglobin
HTLV-1	Human T-lymphotropic virus 1
ICT	Information Communication Technology
IQR-	Interquartile range
IREC-	Institutional Research and Ethics Committee
JKUAT	Jomo Kenyatta University of Agriculture and Technology
KAB	Knowledge, Attitude, Behaviour
KEMU	Kenya Methodist University
KMPDC	Kenya Medical Practitioners and Dentists Council
KU	Kenyatta University
MBChB	Bachelor of Medicine and Bachelor of Surgery
MKU	Mt. Kenya University
MO	Medical officer
MTRH	Moi Teaching and Referral Hospital

PBL	Problem Based Learning
PBM	Patient Blood Management
SPSS	Statistical Package for Social Scientists
TACO	Transfusion Associated Cardiac Overload
TRALI	Transfusion Related Acute Lung Injury
TTIs	Transfusion Transmitted Infections
UK	United Kingdom
UON	University of Nairobi
WHO	World Health Organization

ACKNOWLEDGEMENTS

I would like to acknowledge the Almighty God for the gift of life and good health. My thanks also go to Moi University, the School of Medicine, and the Department of Family Medicine, Community Health, and Medicine Education for the opportunity accorded to pursue my studies here.

Much gratitude goes to my supervisors, Prof. Simon Kangethe, Dr. Geoffrey Maiyoh, and Dr. Richard Okero, for their valuable advice and guidance during the writing of this work. I acknowledge Dr. Lugulu and my PhD class cohort, especially Ms. Annah Towett, for their encouragement.

I would also like to thank my biostatistician, Dr. Robert Too, and my research assistants for their invaluable support. I also acknowledge the immense support and encouragement I received from my wife and my children.

Last but not least, I convey my appreciation to all those who, in one way or another, contributed to the successful completion of this work.

CHAPTER ONE

1.0 INTRODUCTION

1.1 Overview

This chapter introduces the background of the study and delves deeper into the problem the study addressed and the justification for undertaking the study. In addition, the objectives of the research, the questions to be answered, and the presumptive associations between the study variables are also handled. Finally, the assumptions, limitations, and delimitations of the study and the theoretical and conceptual frameworks underpinning the study are further explored in this chapter.

1.2 Background of the Study

Blood transfusion, also referred to as haemotheraphy or blood therapy, is a medical discipline that deals with the use of blood and blood components in the treatment of patients. The discipline has close links with many specialist areas of medical care. Blood is required in the management of a broad range of medical conditions, including surgical conditions, malignancies, trauma, severe anaemia and complications of pregnancy. It plays a crucial role in reducing maternal and child morbidity and mortality, improving the quality of life and life expectancy of patients with various acquired and hereditary disorders, and supporting complicate surgical procedures such as organ and tissue transplants (World Health Organization, 2020). In fact, according to the World Health Organization (WHO), blood transfusion is the only option for survival for many patients, irrespective of the degree of development of the health care system (World Health Organization, 2008). The significance of blood and blood components is further highlighted by the fact that whole blood, packed red blood cell concentrate, platelet concentrate and fresh frozen plasma (FFPs) is included the essential drugs list of the World Health Organization (World Health Organization, 2021)

Though life-saving, blood is scarce with an increasing demand (Roberts et al., 2019); it is costly (Mafirakureva et al., 2016); and its use is associated with risks (Clevenger & Kelleher, 2014; (World Health Organization, 2020)). The scarcity of blood supply is demonstrated, for example, in Kenya, a total of 300,000 units of blood was collected in the year 2022 against the WHO recommended annual requirements of at least 500,000 units/year (Saya, 2024). The risks associated with blood transfusion include immunological reactions, e.g., allergic reactions, transfusion-related acute lung injury (TRALI), non-immunological transfusion reactions, e.g., transfusion-associated cardiac overload (TACO), and transmitted infections, e.g., HIV, hepatitis B and C, and syphilis (Maxwell & Wilson, 2006). The incidence of the frequent adverse reactions to any blood components is estimated to be about one in 100 transfusions and some reactions can be fatal, although very rare, occurring in about one in 200,000 to 420,000 units (Wang et al., 2022).

According to the WHO, access to sufficient and safe blood that is transfused safely is essential for a strong health system and an important component of efforts towards achieving the goal of universal health coverage (World Health Organization, 2017).

1.2.1 The Process of Blood Transfusion

Blood transfusion is a complex process, as illustrated in Figure 1. It involves obtaining blood from donors, processing it into various components, testing for transfusion transmitted infections and compatibility, making the decision to transfuse, prescribing blood to patients in need, and considering the appropriateness of blood as the best treatment modality. Additional steps entail proper identification of the unit and the recipient, administration, patient monitoring, documentation of the transfusion process, and feedback. This complex process requires medical doctors who are competent in the knowledge and skills of blood transfusion, and the formal training where these competencies are acquired begins in medical school (Garraud et al., 2018; Graham et al., 2014).

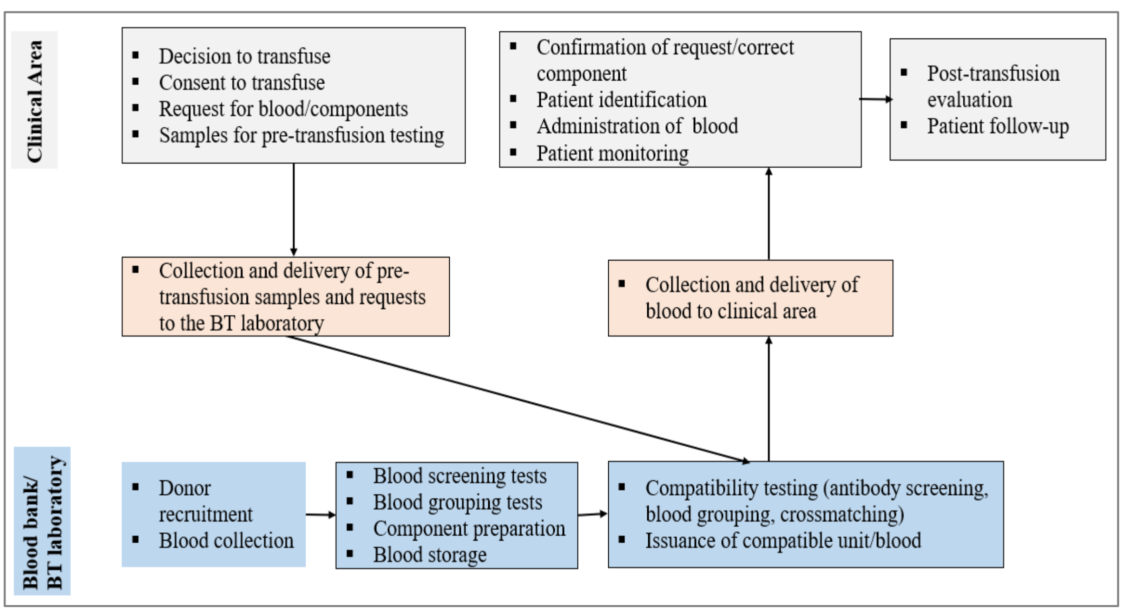


Figure 1: The process of blood transfusion (Adapted from: Mbuthia et al., 2019)

1.2.2 The Structure of Medical Education in Kenya

Learning or training is one of the most important mental functions for people in the field of education, and it depends on the acquisition of various types of knowledge backed by perceptions of information. The result of which is the growth of new abilities, values, comprehension, and preferences. The overall objective of education is to improve abilities and experiences in both individuals and groups (Damanhouri, 2009).

In the field of medical education, the main goal is to equip students with the relevant knowledge, skills, and attitude to enable them to be prepared to begin work on their first day as medical doctors (Schmidmaier et al., 2013). Being prepared implies that the graduates are aware of their capabilities and are confident in their ability to safely begin work (Burford et al., 2014).

In Kenya, undergraduate medical education is characterized by transitions from what is often referred to as the 'pre-clinical phase' to the 'clinical phase' (i.e., working with patients in clinical and community settings) in medical school, and from medical school to an internship. The undergraduate medical education takes six years, whereby the first three are generally pre-clinical and the final three are clinical years (Kenya Medical Practitioners and Dentists Board, n.d.). After undergraduate training, the newly qualified doctors undergo a one-year internship where they practice medicine under supervision. Following their internship, the doctors can practice as medical officers or general practitioners. Thereafter, the medical officers can opt to pursue postgraduate medical education in their area of specialization or continue the path of general practice. After specialist training, the doctors can practice as specialists or consultants, or undertake higher specialization or sub-specialization (Ministry of Health, 2019). This structure is illustrated in Figure 2.

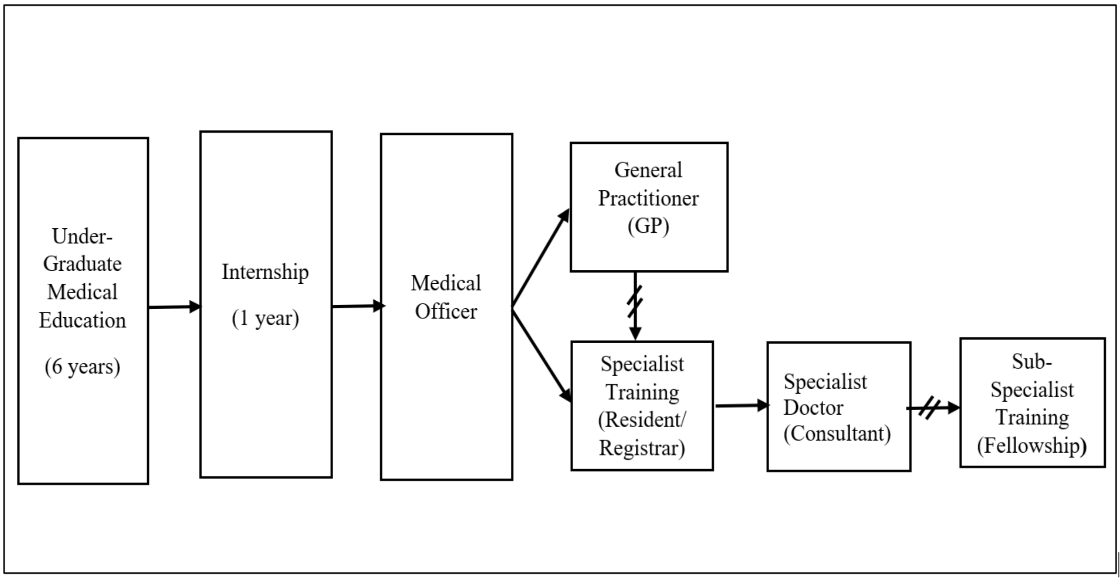


Figure 2: The structure of medical education in Kenya (Source: Author)

Undergraduate medical education is currently offered in Kenya by twelve medical schools accredited by the Kenya Medical Practitioners and Dentists Council (KMPDC), formerly the Kenya Medical Practitioners and Dentists Board (KMBPB) (Kenya Medical and Dentists Council, 2021). of which eight are public (University of Nairobi, Moi University Kenyatta University, Egerton University, Jomo Kenyatta University of Agriculture and Technology, Maseno University, Kisii University, and Masinde Muliro University of Science and Technology) and four are private (Mt Kenya University, Kenya Methodist University, Uzima University, and Aga Khan University). The council has developed a core undergraduate curriculum for medical students that serves as a guide for all the Kenyan medical schools in the development of their undergraduate medical curricula. This core curriculum is also aimed at standardizing undergraduate medical education in Kenya (Kenya Medical Practitioners and Dentists Board, n.d.).

1.2.3 Blood Transfusion Education in the Undergraduate Medical Curricula

It has been shown that formal education in blood transfusion commonly takes place in medical school (Garraud et al., 2018; Graham et al., 2014). However, there is no consensus or standardization of the undergraduate curriculum of blood transfusion in regard to content, duration, methods of delivery, or knowledge assessment (Al-Riyami et al., 2021). This is despite proposals that have been made to standardize undergraduate education in blood transfusion by different experts. An example of these proposals is a comprehensive blood transfusion curriculum for medical students and residents that was developed in the USA by the Transfusion Medicine Transfusion Academic Award (TMAA) programme sponsored by the National Heart, Lung, and Blood Institute in 1991 (Simon, 1989). This was further refined in 1995 (Cable et al., 1995). The aspects of blood transfusion in this curriculum that were believed to be essential for undergraduate medical education were grouped into six major topical areas: scientific basis of transfusion (e.g., blood group systems, role of human leucocyte antigen in transfusion and transplantation, etc.), blood components and derivatives (e.g., blood collection, infectious disease testing, composition and indications of major blood components, administration, compatibility testing), adverse effects of blood transfusion (acute and delayed), alternatives to allogeneic blood transfusion, transplantation, and apheresis. In France, a committee of transfusion medicine professors recommended 13 transfusion medicine topics to be included in training programs for French medical students. The topics included blood components and derivatives, indications for transfusion, pretransfusion testing, medicolegal aspects of transfusion with regard to donors and recipients, immunohematology, transfusion reactions, transfusion-transmitted diseases, donor exclusion criteria, major blood group systems, and accidental blood exposure (Wautier et al., 2005).

The aspects of blood transfusion contained in the Kenyan core MBChB curriculum include the physiology of blood groups and blood group serology, blood groups, blood group serology, blood transfusion service, clinical indications of blood components, compatibility testing, and transfusion complications (Kenya Medical and Dentists Board, n.d.).

1.2.4 Concept of Curriculum Analysis

Curriculum analysis entails segmenting the curriculum to comprehend the cohesive design. It plays a crucial role in evaluating the views, goals, objectives, and content of the curriculum as well as determining the validity of the assumptions underlying it (Jayawickramarajah, 1987; AHMED & ALNEEL, (2017). A curriculum's content is essential, and an analysis of it should focus on whether or not it fulfills the students' short- and long-term learning requirements (National Academy of Sciences, 2004).

The process of teaching medicine is dynamic, and medical schools' curricula must be reviewed and modified frequently to keep up with the ever-changing demands of both the medical field and the educational environment. Evaluations of medical education, both undergraduate and graduate, frequently highlight the "formal curriculum"—that is, the courses that must be taken and the goals that must be clearly stated. Every educational activity has learning objectives, and the goal of the formal curriculum is to assist students in developing the fundamental skills as specified by accreditation authorities.

Furthermore, every instructional session should cover every one of the fundamental competences (Mumbo & Kinaro, 2015)

Rethinking the goals, content, pedagogical development (approaches), and assessment processes would be extremely beneficial in ensuring that medical students are prepared to become doctors who are competent and confident (Field, 2009). The regulations governing medical studies generally apply to the field of transfusion medicine as well (Garraud et al., 2020).

1.3 Statement of the Problem

Blood transfusion is one of the most common procedures performed in hospitals Pfuntner et al., 2011; Whitaker et al., 2016; Smith et al., 2014). For example, in Kenya, seven patients need blood every 10 minutes (Alushula, 2020). However, the medical doctors who prescribe this life-saving, scarce, and costly resource have been found to lack adequate knowledge and awareness of the best practices required for optimal and safe clinical use of blood components.

One of the attributable reasons for the lack of knowledge, awareness, and skills among the prescribers of blood transfusion in most countries has been the inadequacy of the curriculum in blood transfusion and therefore poor training in this. For example, in the majority of African countries, exposure of medical doctors to teaching in blood transfusion is very limited, with usually an hour or two of lecture time provided during undergraduate training Eichbaum et al. (2014). Moreover, the duration and content of such a curriculum vary, and there is no consensus as to what constitutes core competencies in blood transfusion for undergraduate medical training.

These knowledge and practice inadequacies may lead to inappropriate decision-making processes, insufficient consenting of patients prior to transfusion, improper identification of potential transfusion recipients and administration of blood components, poor documentation, and an inability to recognize and manage transfusion reactions. This assertion is supported by haemovigilance schemes, such as the UK Serious Hazards of Transfusion (SHOT), which have continued to report incorrect blood component transfusions and inappropriate and unnecessary transfusions in their annual reports, where a significant proportion of incorrect blood component transfusions were attributable to clinical and ward-based errors (Narayan et al., 2019). These incidences have suggested a lack of knowledge and errors of judgment in clinical staff, particularly non-specialists, as one of the major contributing factors.

To compound the problem, the newly graduated medical doctors and post-internship doctors with these inadequacies in competencies are often left to learn the principles of blood transfusion in actual applied settings while caring for patients with blood component needs, and this is often done without direct supervision by an attending clinician or a consultant (Saidenberg & Pugh, 2014).

1.4 Objectives of the Study

1.4.1 Broad Objective

To determine the adequacy of curriculum content, competencies, confidence, and training needs of Kenyan-trained non-specialist medical doctors in blood transfusion.

1.4.2 Specific Objectives

The specific objectives were to:

1. Analyze the content of blood transfusion in the curricula of medical schools in Kenya.
2. Determine the knowledge of Kenyan-trained non-specialist medical doctors in blood transfusion.
3. Assess the attitude of Kenyan-trained non-specialist medical doctors towards blood transfusion.
4. Establish the self-reported practice of Kenyan-trained non-specialist medical doctors in blood transfusion.
5. Establish the self-perceived level of confidence among Kenyan-trained non-specialist medical doctors in blood transfusion.
6. Determine the factors associated with the knowledge, attitude, self-reported practice, and self-perceived confidence of Kenyan-trained non-specialist medical doctors in blood transfusion.
7. Establish the correlation between the knowledge, attitude, self-reported practice, and self-confidence of Kenyan-trained non-specialist medical doctors in blood transfusion

1.5 Research Questions

The research questions for this study include:

1. What is the adequacy of the content of blood transfusion in the curricula of medical schools in Kenya?

2. What is the level of knowledge of Kenyan-trained medical doctors in blood transfusion?

3. What is the level of attitude of Kenyan-trained medical doctor towards blood transfusion?

4. What is the level of conformance of self-reported practices by medical doctors to best recommended practices in BT?

5. How do Kenyan-trained medical doctors perceive their confidence in blood transfusion practice?

6. Is there a relationship between the medical doctors' background characteristics (age, sex, year of graduation, previous training in blood transfusion, work experience, frequency of transfusions, hospital induction) and their knowledge, attitude, self-reported practice, and self-confidence in blood transfusion?

7. Is there a correlation between the knowledge, attitude, self-reported practice, and self-confidence of Kenyan-trained non-specialist medical doctors in blood transfusion?

1.6 Hypothesis

The following were the hypotheses of the study:

$H0_1$: There is no statistically significant association between the demographic, educational, and site of practice characteristics of the Kenyan-trained medical doctors and their knowledge, attitude, practices, and confidence in blood transfusion.

$H0_2$: There is no statistically significant correlation between knowledge, attitude, practices, and confidence of Kenyan-trained medical doctors in blood transfusion.

1.7 Justification of the Study

The optimal clinical use of blood and blood components requires solid theoretical and practical knowledge of blood transfusion together with positive attitude/behavior (Khatiwada et al., 2022; Vasconcelos Vaena et al., 2016). Furthermore, education is recognized as an effective method to improve appropriate blood usage ((World Health Organization, 2020; Sajwani, 2012; Rothschild et al., 2007). After completion of undergraduate medical education, a large number of non-specialists (medical interns, medical officers, and residents) will be involved in the course of their practice with the prescription of blood components. These practitioners, therefore, ought to be knowledgeable in the finer details of blood and blood component administration in order to make appropriate decisions weighing applicable risks and benefits (Laher& Patel, 2019; Al-Riyami et al., 2020). The need for adequate knowledge among medical doctors is further reinforced by the fact that medical education programmes in many countries, including Kenya, train general practitioners, who should be able to use blood optimally and safely (Vasconcelos Vaena et al., 2016; Karp et al., 2011; Sullivan et al., 2019). and the fact that one method of preventing blood transfusion-related complications is through education and training (Bolton-Maggs & Cohen, 2013). Besides, best clinical practices through optimal and appropriate utilization of blood and blood products leads to improved patient safety and conservation of blood supply in many countries (World Health Organization, 2020).

Additionally, medical doctors also need to be both competent and confident in their medical practice, as confidence is one of the most significant personal elements impacting their clinical decision-making (Hecimovich & Volet, 2011; Kim et al., 2020). However, as compared to knowledge, the confidence of medical doctors in blood transfusion practice has received little attention in the literature (Kim et al., 2020).

It is therefore essential that with the growing complexity of medical practice and the increasing expectations for patient safety necessitates a thorough and consistent approach to blood transfusion education in medical undergraduate curricula. This would ensure that all medical graduates possess the requisite knowledge, skills, attitudes, and confidence to manage blood transfusions effectively, hence maintain high standards of patient care. Addressing gaps in the current curriculum through targeted enhancements, such as incorporating more comprehensive and practical training, can significantly improve clinician preparedness and patient outcomes.

Moreover, to the best of my knowledge, there is no study in our setting that has analyzed how transfusion medicine is incorporated into undergraduate medical education in Kenyan medical schools. Furthermore, a study that examines the status of current knowledge, the scope of self-reported practice (the self-rated performance of procedures in blood transfusion), confidence, and the links between these variables. Therefore, there was a need to determine this information in order to come up with target areas for teaching and patient management.

1.8 Significance of the Study

This study has identified target areas for enhancing blood transfusion education during undergraduate medical training. It has also identified gaps in competencies of medical doctors in blood transfusion that need to be addressed to ensure optimal blood use and hence quality patient care.

1.9 Scope of the Study

This scope of this study entailed analysis of the content of the blood transfusion subject in the undergraduate medical curricula of Kenyan medical schools. It also determined the level of knowledge, attitudes, self-reported practice, and confidence and their correlates in blood transfusion among Kenyan-trained non-special medical doctors from selected hospitals in the North Rift and Western Kenya.

1.10 Assumptions of the Study

One assumption of the study was that the medical doctors in the various hospitals within the study sites graduated from the different medical schools in Kenya. Secondly, since the study used anonymous self-administered surveys, either web-based or on paper, it was also assumed that the study participants did not search through online search engines or inquire from their colleagues for the correct responses to the knowledge question items. Finally, it was assumed that the medical doctors gave honest responses to the questions on perception constructs.

1.11 Theoretical Framework of the Study

A theoretical framework is a foundational review of existing theories that serves as a guide for researchers during the development of the arguments used in their research. In a theoretical framework, researchers explain the existing theories that support their research, and they aim at showing that their work is relevant and grounded in established idea(s). in other words, the theoretical framework justifies and contextualizes the research being undertaken (Imenda, 2014).

The theoretical framework underpinning this study is based on curriculum' theory, Bloom's taxonomy of learning domains, Knowledge-Attitude-Behavior (KAB) theory and Bandura's theory of self-efficacy, and Kirkpatrick Evaluation Model.

1.11.1 Curriculum Theory

Curriculum theory is defined by Beauchamp (1982) is a set of related hypotheses or assertions that offer context for the phenomena surrounding the concept of a curriculum, as well as its development, implementation, and evaluation. According to McCutcheon (1982), curriculum theory is as a system of analyzing, interpreting, and understanding curriculum phenomena. Fundamentally, curriculum theory is concerned with values and curriculum analysis, perspectives on the educational curriculum and policy decisions of the present, and theoretical discussions about future curricula (Kliebard, 1989; Wallin, 2011). According to Scott (2001), the four dimensions of curriculum theory include aims or objectives, content or subject matter, techniques or procedures or pedagogy, and evaluation or assessment. The curriculum serves as a vehicle for resolving important economic, political, social, and cultural issues about the goals, objectives, curriculum, and instructional methods. Some of the notable personalities associated with development of curriculum theory include Franklin Bobbit (1876-1956), Werret Charters (1875-1952), William Kirkpatrick (1871-1965, Harold Rugg (1886-1960), Hollis Caswell (1901-1989), and Ralp Tyler (1902-1994) (Alvior, 2014)

Four theoretical frameworks (Scott, 2001; Smith, 1996; Stabback, 2016) have been put forth to approach curriculum theory and practice:

• Curriculum as content. A curriculum is a body of knowledge or syllabus that should be taught to students in the most efficient way possible. It provides solutions to the concerns of what values, knowledge, and skills should be taught in the curriculum and whether the list of "subjects" that make up a curriculum is sufficient in light of the current paradigm.

• The curriculum as product. The curriculum is viewed as an effort to help pupils reach specific goals; this includes establishing behavioral targets and strategies. It aims to fulfill many societal objectives and governmental policies in addition to providing students with relevant and practical learning outcomes. The curriculum aims to address the question of whether our learners will be able to lead fulfilling and productive lives if they acquire and develop the necessary information, skills, and values as well as the related talent and competencies.

• The curriculum as process. Curriculum is the result of the interaction between educators, learners, and knowledge; it is the culmination of both the preparatory and evaluation activities that take place in the learning environment.

• The curriculum in action. Curriculum is a deliberate, dedicated action. Planning, acting, and assessing are all interrelated and interwoven into the process; it is an active one.

1.11.2 Bloom's Taxonomy of Leaning Domains

Bloom and his associates proposed three categories of overlapping and interrelated learning domains (Figure 4): the cognitive (knowledge) domain (Bloom & Krathwohl, 1956; Krathwohl, 2002); the affective (attitudes) domain (Krathwohl et al., 1964); and the psychomotor (skills) domain (Harrow, 1972; Armstrong & Others, 1970; Simpson, 1966). The taxonomy is a theoretical framework for organizing and categorizing learning goals in higher education. It acts as one of several models for learning and the acquisition of knowledge and skills (Admin, 2017). The model also supports effective student learning by helping teachers determine the appropriate teaching strategies to be used (Bloom et al., 1956; Savickienė, 2010). Acquisition of the requisite knowledge, attitudes, and skills during undergraduate medical education would ensure the provision of safe medical care (Figure 3).

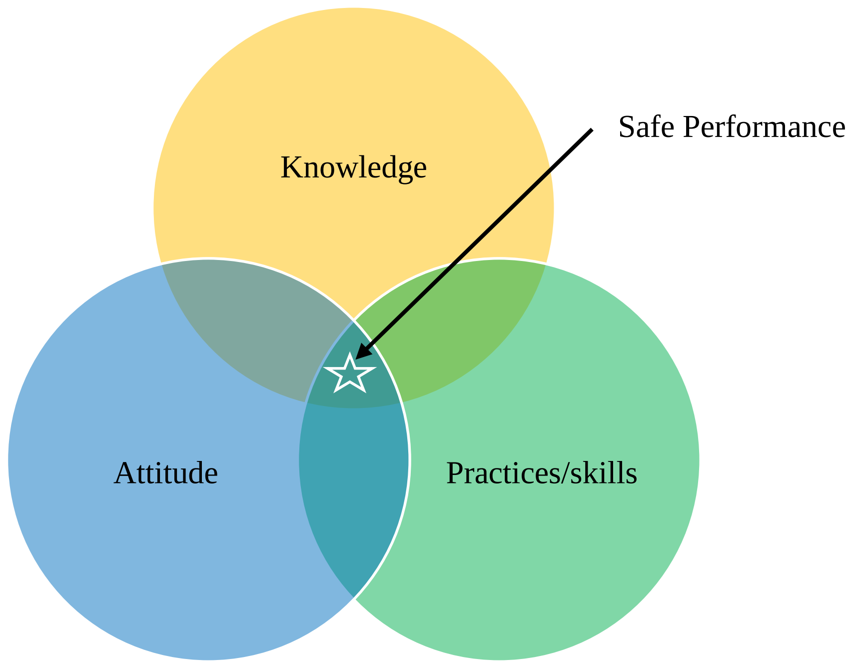


Figure 3: Domains of learning

1.11.2.1 Cognitive domain

The cognitive domain is concerned with the knowledge aspect of the taxonomy. Bloom classified this domain into six hierarchical categories: knowledge (recall of information), comprehension (understanding of meaning), application (use of concept), analysis (deconstruction of concept), synthesis (combination of information to create meaning), and evaluation (judgment of concept) (Bloom & Krathwohl, 1956). The original version of the cognitive taxonomy was revised by Krathwol in 2001, when he used verbs instead of nouns. The new hierarchies are remembering (the ability to recall facts), understanding (demonstrating comprehension), applying (application of knowledge to new tasks), analyzing (the ability to separate a concept into its components and thus better understanding its organization and structure), evaluating (judging the merits of ideas and components), and synthesizing/creating (creating new structures or ideas from the parts of others learned) (Krathwohl, 2002). Krathwohl further classified the knowledge domain into four main categories: factual knowledge (knowledge of terminology, specific details, and elements); conceptual knowledge (knowledge of classification, categories, principles, generalizations, theories, models, and structures); procedural knowledge (knowledge of specific skills, algorithms, specific techniques, and methods; criteria for determining when to use appropriate procedures); and metacognitive knowledge (knowledge of cognition in general as well as awareness and knowledge of one's own cognition).

1.11.2.2 Affective domain

The taxonomy of the affective domain contains five levels, from lowest to highest: receiving (acknowledgement and attention to knowledge), responding (interacting with the learning environment in an appropriate manner), valuing (applying worth or value to specific components learned), organizing (ability to prioritize, compare, and evaluate a topic resulting in organization), and characterizing (the ability to use organized value systems to create a pattern of behavior) (Wu et al., 2019; Krathwohl et al., 1964; Admin, 2017).

1.11.2.3 Psychomotor domain

The psychomotor domain entails the ability to physically perform an activity or task and is learned through the application of knowledge. Several versions of psychomotor taxonomies have been published (Armstrong & Others, 1970; Harrow, 1972) but the original taxonomy categories published by Simpson include: perception (adjust behavior in response to environmental/external clues), set (demonstration of the willingness and readiness to learn), guided response (ability to perform a trained response to a stimuli often previously demonstrated for the learner), mechanism (this is basic proficiency where the learner can perform habitual and learned responses proficiently), complex overt response (expert proficiency in terms and/or speed and/or quality of a task or act with perception during performance of the quality), adaptation (familiarity with the task allows the learner to adapt portions of the task to specific situations), and origination (mastery of the task allows the learner to create new movements and create new routines, teaching programs, and designs) (Simpson, 1966; Admin, 2017).

This theoretical framework is suitable for our research because a well-trained medical doctor ought to have the requisite cognitive knowledge (e.g., the best current practice of medicine), the right attitude to respond to different situations appropriately, and the psychomotor skills to carry out the various procedures safely. In addition, the clinician should be able to provide safe care within the scope of their skills and have good self-evaluation of their own performance strengths and weaknesses so as to recognize the need for help or support, identify learning needs, and reinforce new skills or behaviors in order to improve performance and enhance quality patient care and health outcomes (Smit Sibinga et al., 2021; World Health Organization, 2021a).

1.11.3 Knowledge-Attitude-Behavior (KAB) theory

The Knowledge-Attitude-Behavior (KAB) theory is a paradigm that describes how knowledge, attitudes, and behaviours are connected and can influence a person's actions. Although the KAB model is widely used, it does not have a single proponent or originator. Instead, it has evolved through contributions from multiple researchers and practitioners over time.

The model is developed from the three overlapping domains that were propagated by Bloom and his associates and medical research frequently uses the paradigm to demonstrate how the three domains are interconnected (Liu et al., 2016). According to Schraeder & Lawless., (2004), there is a dynamic and complicated interaction between knowledge, attitude, and behaviour/practice as illustrated in Figure 4. They noted that attitudes can be shaped through behaviours and that attention is affected by attitudes. As a result, attitudes can affect and individual's perception, which in turn affects their ability to learn, and hence knowledge acquisition. A good knowledge of a given subject is expected to raise the person's level of consciousness and, consequently, the level of attitude towards the subject and confidence, thereby leading to good practices (Woromogo et al., 2020; ul Haq et al., 2012).

The interrelatedness between the three domains still holds true in the field of educational sciences, and the framework can be applied to the field (Zulkifli et al., 2022), even though it was first presented in the medical literature on the subject of primary care for HIV/AIDS (Miller et al., 1990).

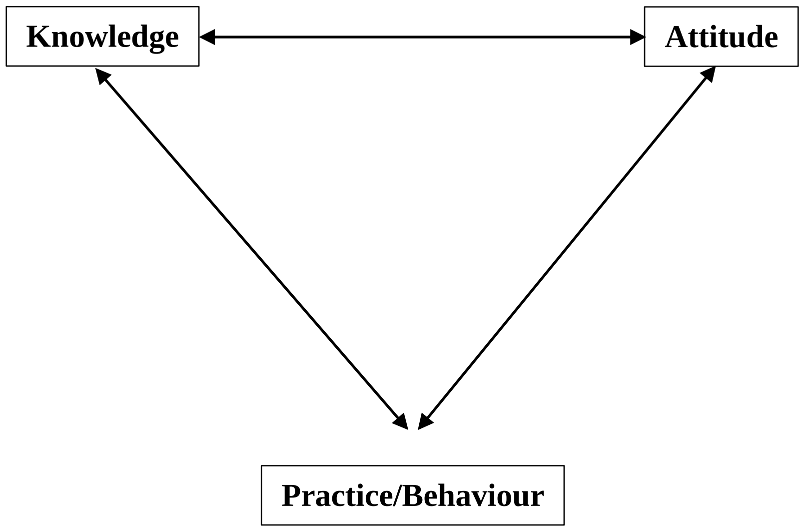


Figure 4 : The Knowledge-Attitude-Behaviour (KAB) model

The framework is also employed to evaluate how well people comprehend, hold certain beliefs, and behave or practice in relation to a given subject, such as blood transfusion. The participants' knowledge of the topic, attitudes towards it, and actual practises or behaviours relating to it are all examined in this approach. To get a complete knowledge of how people are engaging with a certain issue, all three components must be evaluated. Researchers can discover gaps, impediments, and areas for improvement by looking at knowledge, attitude, and practise. These findings can then be used to inform interventions and strategies to achieve positive outcomes in a variety of professions (Wang et al., 2020).

The evaluation of knowledge, attitude, and behavioural patterns has been done using a variety of methodologies. When assessing knowledge, for instance, a variety of strategies have been used, such as self-report scales, conceptual mapping activities, and content measurements. Self-report data on Likert-type scales is an example of attitude evaluation used in knowledge, attitude and behaviour research (Kak et al., 2001; Schrader & Lawless, 2004). Figure 5 shows these evaluation strategies.

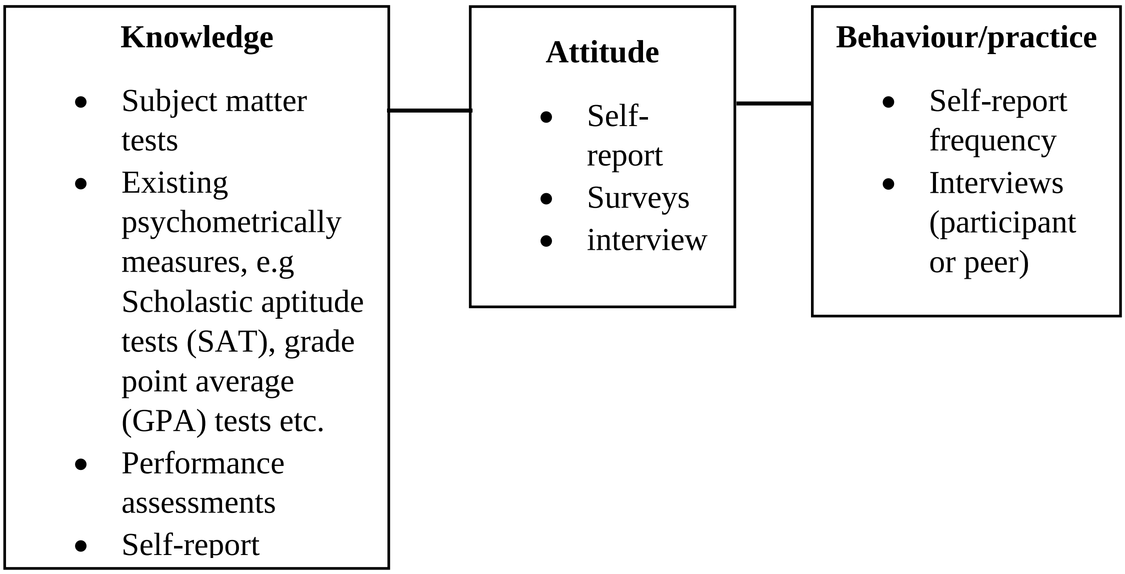


Figure 5: Assessment methods for knowledge, attitude and behaviour (adapted from Schrader & Lawless, 2004)

The theory of knowledge, attitude and behaviours is included as one the theoretical framework for our research because it is closely related to the Bloom's domains of learning and the study aims at assessing the knowledge, attitude and behaviour/practices of the medical doctors in the field of blood transfusion.

1.11.4 Bandura's Theory of Self-Efficacy

The concept of self-efficacy as described by Bandura (1978) is added to the theoretical foundation of this research as many of its constructs mirror andragogy, and higher self-efficacy has been linked to student achievement and work performance (Usher &Pajares, 2008; Fives, 2003; Opacic, 2003; Stajkovic & Luthans, 1998). Self-efficacy is a component of Bandura’s social cognitive theory and is loosely defined as one’s belief in their personal competence (Pajares, 1996) or the level of a person's confidence in his or her ability to successfully perform a behavior (LaMorte, 2019; Artino et al., 2012). Self-efficacy is a system that controls most personal activity, including the appropriate use of professional knowledge and skills (Gavora, 2010). According to Bandura (1984), one's judgments of his or her capability to perform tasks, that is, his or her self-efficacy beliefs, predict one's capability to accomplish such tasks.

This theory is relevant to this study because a medical student needs to have appropriate self-efficacy to accomplish the educational goals and obtain the necessary knowledge, skills, and attitudes for practice (Friedman & Frogner, 2010; Pajares, 1996). Furthermore, in order to effectively interact with patients, doctors must exhibit a certain level of confidence in their abilities, and this confidence should be matched with their competencies (Jaspan et al., 2022). Overconfidence and underconfidence in the clinical setting could result in an unsafe environment for patients (Artino et al., 2012); e.g., low self-efficacy can lead to poor compliance with clinical guidelines and other standards of care (Kak et al., 2001).

1.11.5 Kirkpatrick’s Evaluation Model

Kirkpatrick’s Evaluation Model, developed by Dr. Donald Kirkpatrick (1924 – 2014) in the 1950s is a widely used framework for evaluating the effectiveness of training programs, including those in medical education (Smidt et al., 2009). This model helps assess the impact of educational programmes on medical professionals and ultimately on patient care. The model has four level in which both formal and informal training methods are rated against. These levels of the model are reaction, learning, behavior, and results.

i. Reaction: This level measure how participants respond to the training by assessing medical students' and professionals' satisfaction with the educational program, including their engagement, enjoyment, and perceived relevance. The methods of evaluation for this level include surveys, feedback forms, and immediate post-training evaluations.

ii. Learning: This level measure the increase in knowledge or skills as a result of the training. It evaluates the extent to which medical trainees have acquired the intended knowledge, skills, and attitudes from the educational programme or intervention. The methods for assessment for this level include pre- and post-tests, practical exams, and competency assessments.

iii. Behavior: It measures the extent to which participants apply what they learned during training. This level assesses whether medical professionals are applying the acquired knowledge and skills in their clinical practice and whether there are observable changes in their behavior. The methods of evaluation include observations, 360-degree feedback, self-assessment, and follow-up surveys.

iv. Results: This level measure the final results that occurred because of attendance and participation in a training program and it evaluates the broader impact of the educational program on clinical outcomes, patient care quality, and healthcare systems. The methods of assessment for this level include long-term studies, data analysis of patient outcomes, hospital metrics, and performance reviews.

This model is relevant to this study as it provides a structured approach to evaluating the comprehensive impact of blood transfusion education in the undergraduate medical curriculum. By systematically assessing reactions, learning outcomes, behavioral changes, and clinical results, educators can ensure that medical graduates are well-prepared to handle blood transfusions safely and effectively, thereby enhancing overall patient care and safety.

1.12 Conceptual Framework of the Study

A conceptual framework is a system of concepts, assumptions, expectations, beliefs, and theories that supports and informs research (Yamauchi et al., 2017). It provides a model for relationships between variables that may or may not imply a particular theoretical perspective, with the purpose of describing phenomena (Berman, 2013). Miles & Huberman, (1994), as cited by Yamauchi et al. (2017), stated that a conceptual framework "explains, either graphically or in narrative form, the main things to be studied—the key factors, concepts, or variables—and the presumed relationships among them." (p. 18).

1.12.1 Research Variables of the Study

In this research, the independent variables were grouped into demographic (age, sex), educational background (medical school attended, curriculum offered, whether participated in training on blood transfusion after undergraduate education), and site of practice (designation of clinician, hospital based in, frequency of transfusion prescriptions, whether give pre-internship orientation, number of years after undergraduate medical education) characteristics. Whereas the dependent variables were knowledge, attitude, self-perceived practice, and self-confidence. The conceptual framework for this study is depicted in Figure 6.

Studies evaluating relationships between clinician demographic characteristics, professional characteristics (e.g., designation, years of practice and training), site of practice variables, and knowledge (Sahmoud et al., 2021; Lin et al., 2019; Vaena & Alves, 2019; Alvarado-Navarro et al., 2016; Mayaki et al., 2016; Graham et al., 2014; Kaur et al., 2014; Arinsburg et al., 2012); attitude **(**Lin et al., 2019; Salem-Schatz et al., 1990); practice competency/behaviour (Iqbal et al., 2021; Ray et al., 2022; Jogi et al., 2021; Babo et al., 2018); and confidence (Lai et al., 2007 ; Barnsley et al., 2004; Morgan & Cleave-Hogg, 2002) have been shown but with inconsistent associations.

Transfusion behavior or practices have been shown to be influenced by knowledge (Salem-Schatz et al., 1993; Friedman, 2011; Daichman et al., 2022); attitudes (Adedayo et al., 2021; Salem-Schatz et al., 1993; Islam et al., 2012; Francis et al., 2009) and confidence (Kim et al., 2020; Ratnasari & Andriansyah, 2014). Furthermore, according to Miller (1990), factual knowledge serves as the basis for practical knowledge and the performance of medical actions.

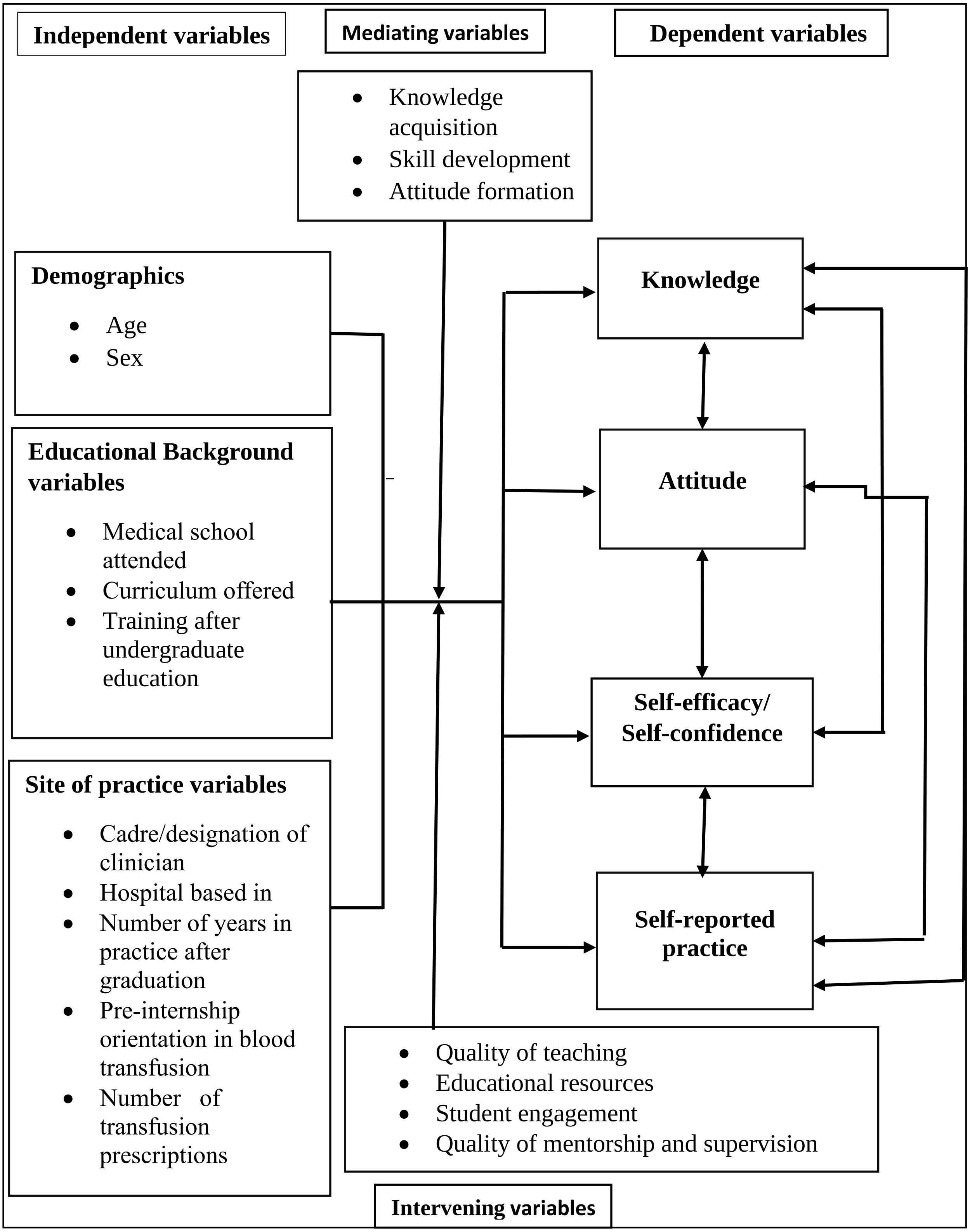


Figure 6: Conceptual framework of the study (Source: Author)

1.12.2 Explanation of presumed relationships between the independent and dependent variables

i. Age**:** Older medical doctors may have more experience, which can positively influence their knowledge, attitudes, practices, and self-confidence regarding blood transfusion procedures.

ii. Sex**:** Gender differences may affect training experiences, opportunities, and confidence levels, potentially impacting knowledge, attitudes, and practices.

iii. Designation of Medical Doctor: Higher designation (e.g., specialist vs. general practitioner) often correlates with more specialized training and experience, leading to better knowledge, attitudes, practices, and self-confidence.

iv. Medical School Attended: The quality and focus of medical education vary by institution. Graduates from schools with strong blood transfusion training may have higher knowledge and confidence levels, positively influencing their attitudes and practices.

v. Curriculum Offered: Curricula emphasizing practical skills and comprehensive blood transfusion training can improve knowledge, attitudes, self-reported practices, and self-confidence.

vi. Number of Years After Graduating from Medical School**:** More years since graduation can correlate with increased clinical exposure and practice, enhancing the knowledge, attitude, self-reported practices, and self-confidence.

vii. Hospital-Based in: The type of hospital (e.g., teaching hospital, community hospital) where the doctor works can influence exposure to blood transfusion procedures, impacting knowledge, practices, and confidence.

viii. Participation in Training in Blood Transfusion After Undergraduate Medical Education**:** Additional training and continuing education significantly improve knowledge, attitudes, practices, and self-confidence.

ix. Pre-Internship Orientation**:** Orientation programs provide crucial practical skills and knowledge, directly affecting doctors' knowledge, attitudes, practices, and self-confidence needed as they transition into clinical practice.

x. Frequency of Performing Blood Transfusion Procedures: Regular practice enhances proficiency, confidence, and positive attitudes, and reinforces best practices, contributing to higher knowledge levels

1.12.3 Explanation of the Presumed Interactions Between Dependent Variables

i. Knowledge and Attitude**:** Higher knowledge levels often lead to more positive attitudes towards blood transfusion procedures. Informed doctors are likely to appreciate the importance and nuances of the procedure, fostering positive attitudes.

ii. Knowledge and Practices**:** Comprehensive knowledge enables doctors to adhere to best practices and guidelines, improving their self-reported practices in blood transfusion.

iii. Knowledge and Self-Confidence**:** In-depth knowledge boosts self-confidence as doctors feel more competent and prepared to handle blood transfusion procedures.

iv. Attitude and Practices**:** Positive attitudes towards blood transfusion procedures encourage adherence to best practices. Doctors who value and understand the importance of these procedures are more likely to follow established protocols.

v. Attitude and Self-Confidence**:** A positive attitude can enhance self-confidence, as doctors who believe in the value of their work are likely to approach procedures with greater assurance.

vi. Practices and Self-Confidence**:** Regular practice builds competence and self-confidence. Doctors who frequently perform blood transfusions develop greater proficiency and confidence in their abilities.

Interactions between the dependent variables in this conceptual framework demonstrate the complex and dynamic nature of clinician competencies. Understanding how knowledge, attitude, skills, and confidence influence each other can inform educational interventions, training programs, and professional development initiatives aimed at enhancing clinician performance and patient outcomes.

1.12.4 Explanation of Relationships of the Intervening and Mediating variables

i. Intervening Variables: The quality of teaching, availability of resources, and student engagement can significantly influence how well the curriculum content is absorbed and translated into practical competence. High-quality teaching and resources, along with active student engagement, can enhance knowledge retention and skill acquisition.

ii. Mediating Variables: Knowledge acquisition, skill development, and attitude formation act as mediators by explaining how the curriculum content leads to improved practices and confidence. Effective teaching methods and comprehensive content help students acquire the necessary knowledge, which in turn influences their attitudes and skills, culminating in confident and competent practice.

1.12.5 Conclusion

This conceptual framework illustrates how demographic characteristics, educational background, and site of practice characteristics influence the knowledge, attitudes, self-reported practices, and self-confidence of medical doctors in performing blood transfusion procedures. The framework also highlights the importance of considering intervening and mediating variables in analyzing these relationships. Understanding these complex interactions can guide improvements in medical education and training programs, ultimately enhancing the proficiency and confidence of medical professionals in blood transfusion.

1.13 Philosophical Paradigm of the Study

Philosophy is a rational inquiry aimed at obtaining knowledge to understand the essence of reality, whereas reality comprises the entirety of what exists in the cosmos. Philosophizing entails utilizing scientific approaches to scrutinize and investigate reality in order to gain further knowledge and understanding of it (Turyahikayo, 2021). A paradigm is a framework that includes a set of theories, assumptions, and beliefs that influence how an individual views and approaches interactions with others or objects (Alele & Malau-Aduli, 2023).

Research paradigms consist of four essential philosophical elements: axiology, ontology, epistemology, and methodology. These components are essential in influencing and directing the design and execution of research projects (Scotland, 2012).

There are four distinct philosophical worldviews or paradigms that govern research: positivism/postpositivism, constructivism/interpretivism, advocacy/participatory/critical theory, and pragmatism. These paradigms are based on the ontological and epistemological components of research.

This research is grounded in the philosophical framework of positivism. This viewpoint is occasionally known as the scientific method or engaging in scientific investigation. Positivism, is linked with collection of quantitative data and it seeks to clarify associations and strives to understand the variables that influence outcomes. This paradigm aims to consolidate ideas into a succinct and restricted set of concepts for the purpose of testing, including the variables that constitute hypotheses and research questions. Because this scientific paradigm seeks to formulate predictions and establish generalizations, the data collection techniques that are commonly employed seek to furnish quantitative data (Creswell, 2009). Furthermore, the data collected are subjected to both descriptive and inferential statistics. Inferential statistics, specifically, facilitate the generalization of sample findings to the general population (Scotland, 2012). In this study quantitative data was collected from the curricula of medical schools and medical doctors' competencies and confidence. In addition, the study sought to determine the factors that influence the knowledge, attitude, competence, and confidence of medical physicians in the field of blood transfusion. Furthermore, descriptive and inferential statistics were utilized in the process of analyzing the data.

1.14 Operational Definitions of Terms

Attitudes/awareness: Is a way of thinking or feeling about something or someone, or a way of behaving that is caused by this. In this study attitude towards blood transfusion meant having a perception that blood transfusion is an essential element of health care, that blood is a scarce and costly resource, and its use is without risks, and therefore, it should be used in an appropriate manner.

Competencies: Refers to the knowledge, skills, abilities, and behaviors that enable individual to perform a particular task. (Kak et al., 2001). In this study, competencies encompassed the knowledge, attitude, and self-reported practices of the medical doctors.

Conformance to best transfusion practices: This was taken to mean self-report of always performing the selected recommended clinical blood transfusion procedures or activities.

Curriculum: All the different subjects comprising a course of study. In this study the subject of interest was blood transfusion and the course of study was MBChB.

Curriculum content: In this study the subject matter is the BT topics and how they are integrated in the undergraduate medical curriculum.

Factual knowledge: The basic information about a particular subject or discipline that students must be acquainted with or solve problems in it (Hew & Cheung, 2014). In this study, factual knowledge is the actual knowledge about blood transfusion that the medical doctors had.

Medical intern: Is a medical doctor who has graduated from university and is completing further supervised training for a period of one year as recognized by the KMPDC.

Medical officer: A medical doctor who does not have formal postgraduate training in the discipline in which they work and they are registered by the KMPDC for independent practice.

Non-Specialist Medical Doctors: Are doctors who do not limit his/her practice to certain disease categories or methods of treatment, and or are undertaking postgraduate training. They include interns, residents/ registrars and career medical officers. They will be referred to as 'medical doctors' in the remainder of this thesis.

Perceived knowledge: Refers to one's self-assessment or feeling of how much he/she knows about a particular subject, for the case of this study the subject is blood transfusion.

Self-confidence: Is the self-perceived ability by the medical doctor to deal with clinical scenarios, for the purpose of this study the clinical scenarios are those related to blood transfusion.

Preparedness: is the state of being prepared for a particular situation. For the purpose of this study, preparedness refers to a qualified doctors' reported sense of how well undergraduate education prepared them for practice in blood transfusion.

Resident/Registrar: A medical doctor who is in the process of training to acquire a specialist qualification endorsed by the KMPDC

Self-reported practice: Self-report is a method of collecting data in which individuals respond to questions about themselves regarding a wide variety of issues such as personality traits, moods, thoughts, attitudes, preferences, and behaviors (Letzring, 2019). In this study the self-report was on the behavior or practice and was the reported frequency of performing selected blood transfusion procedures by the medical doctors.

1.15 Summary of the Chapter

This chapter presented the background of the study, which highlighted the statement of the problem before addressing the justification and the purpose of the study. Furthermore, the objectives of the study along with their corresponding research questions and hypotheses were also outlined. It also illustrated the significance and assumptions of the study. The scope and limitations of the study were also discussed. Additionally, the theoretical and conceptual frameworks underpinning the study were discussed, and lastly the chapter concluded with the operational definitions of terms.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Overview

This chapter contains relevant literature on the subject of undergraduate medical education in blood transfusion and the competencies and confidence of medical doctors in blood transfusion. The topics whose literature was reviewed include the situation of undergraduate education in blood transfusion, the medical doctors perceptions and perspectives about their undergraduate transfusion education, their knowledge, attitude, practice, and self-confidence in blood transfusion, and the training needs of the medical practitioners.

2.2 Situation of Blood Transfusion Education in Undergraduate Curriculum

Formal education in blood transfusion begins at medical school. However, studies have shown variability and inconsistency in the content of blood transfusion in undergraduate medical curricula and approaches to education between continents and countries (Al-Riyami et al., 2020; Vasconcelos Vaena et al., 2016; Panzer et al., 2013). This inconsistency results in sub-optimal knowledge and competencies with regard to the entire transfusion chain from donor to recipient (Garraud et al., 2018).

In Europe, teaching of blood transfusion is included in the undergraduate curriculum of twelve countries (Austria, Belgium, Denmark, Finland, France, Germany, Greece, the Netherlands, Norway, Sweden, Switzerland, and England), while there are no subjects devoted to transfusion medicine during the undergraduate period in five countries: Ireland, Italy, Luxembourg, Portugal, and Spain (Müller, 2005).

In a study by Panzer et al. (2013), information from experts about education in blood transfusion was sought from several countries, including Brazil, Iran, Australia, Sweden, Germany, India, Indonesia, Israel, Japan, and France. The study observed that some education in blood transfusion is offered to medical students in many countries, though the extent and form vary from country to country and between universities/medical schools, and this could be due to the lack of a national curriculum with the exception of Iran. Another observation is that education is given at more than one stage of the curriculum and mostly consists of lectures and may include practical sessions. The main conclusion of the study was that education in blood transfusion should be intensified for both medical students and residents.

In France, the curriculum varies in each medical school, and the organization of the teaching of blood transfusion depends on the university programme. Blood transfusion is not fully an undergraduate discipline but is often a subject included in haematology. The time for lectures and practicals is also variable, with the time devoted to practical training sometimes reduced, if at all. Successful passing of the haematology and blood transfusion examination is necessary to proceed to the next year (Panzer et al., 2013).

In the United Kingdom (UK), formal education in blood transfusion begins at medical school, and according to the undergraduate curriculum "Tomorrow’s Doctor", the medical students are expected upon graduation to be able to follow the correct procedures to give a transfusion of blood into the vein of a patient, including correct identification of the patient and checking of blood groups. They are also required to be able to assess and manage patients who develop complications during or caused by transfusion

(General Medical Council, 2020). In order to acquire these competencies, it is essential that the basics of transfusion practice are covered during undergraduate training (Duguid et al., 2008re; Graham et al., 2014).

In Israel, each organization, university, and medical school prepares its own curriculum for medical students. In one institution, Hadassah Hebrew University Medical Center, education in blood transfusion of medical students is done in the 2nd year and the topics covered include: ABO, Rh blood groups and 'paternity testing' (2 hour lecture), laboratory training (3 hours) and immune-haematology (2 hour lecture), 4th year (blood component preparation, treatment indications, storage lesion, adverse effects of blood transfusion, delivered with a total of 6–8 hours lectures) and 6th year (blood transfusion in emergency situations and trauma, massive transfusion with 2 hour lecture and 1 hour of laboratory work demonstration in routine and emergency situations, as part of 'Trauma course' in emergency medicine) of their curriculum. A seminar on blood transfusion is also offered as part of an elective in haematology and it is approximately 3 hours of seminar and visit to the blood bank. Knowledge of blood transfusion is examined during the relevant medical school years (Panzer et al., 2013).

In 2011, Karp et al. (2011) undertook a study on the use of the TMAA curricula and the status of blood transfusion in American undergraduate medical education. The authors reported that out of the 86 medical school administrators who responded to the survey, 92% were unfamiliar with the TMAA curricula; 17% reported no didactic lectures in blood transfusion; 83% reported didactic lectures, with 48% providing only 1–2 h of lecture-based teaching; and 29% reported small group sessions. The authors concluded that blood transfusion content across undergraduate medical education was heterogeneous.

In Canada, a study done by Saidenberg & Pugh, (2014) at the University of Ottawa showed that medical students get less than 4 hours of transfusion education during medical school.

In a study to assess the content of blood transfusion in the curricula of various Brazilian medical schools, Vasconcelos Vaena et al. (2016) found that out of the 178 medical schools assessed, 74% did not have blood transfusion or haematology disciplines in their curricula, 4% had blood transfusion discipline, 17% had haematology discipline and 4% did not have blood transfusion or haematology disciplines but blood transfusion was mentioned in other disciplines, especially surgery and internal medicine.

A systematic review on the status of education of blood transfusion carried out in Iran by Javadzadeh Shahshahani (2016) established that there was little theoretical and practical training in blood transfusion in medical schools of various universities, and that there were a number of medical professionals with sub-optimal knowledge in the field. The research also showed that the majority of the reviewed articles came to the conclusion that transfusion medicine curriculum ought to be introduced for undergraduate and graduate learners due to its significant significance in clinical practice.

In a study examining education and training in blood transfusion in developing countries, Eichbaum et al. (2014) found that in the majority of African countries, exposure of medical doctors to education in blood transfusion was very limited, with usually only an hour or two of lecture time provided during undergraduate medical education.

2.3 Perceptions and Perspectives of Medical Doctors on the Quality and Quantity of Blood Transfusion Education in Undergraduate Curriculum

Studies have also assessed the perceptions and perspectives of medical doctors on their undergraduate education in blood transfusion. A study by Graham et al., assessed the participants' level of satisfaction with the quality and quantity their formal training in blood transfusion, as well as the methods of education delivery. Regarding education in blood transfusion, 40% and 25%of the participants expressed satisfaction with the quality and quantity of undergraduate transfusion education, respectively.

In a US study by O’Brien et al. (2010), 34.5% of medical interns reported that they had a single lecture as their only transfusion education in medical school; 20.7% reported having lecture series; and 41.4% described having no blood transfusion training at all. Halford et al., 2021 in another US study established that 47% of the respondents acknowledged receiving less than one hour of training in blood transfusion during undergraduate training.

Lim et al., 2017 in their study found that a significant majority (89.9%) of the participants indicated that they received over one hour of blood transfusion teaching throughout their time in medical schools. In addition, a substantial proportion (57.3%) reported having not received any further blood transfusion education after completing their medical school education.

In a Malaysian study, Poh and Jackson (2023) found that their study participants reported a median of two hours of blood transfusion education session during undergraduate training. In addition, of the participants who had received any blood transfusion education during medical school, only 18.9% of them stated that this teaching was ‘very’ or ‘extremely’ helpful.

Alvarado-Navarro et al. (2016) established in their study carried out in Brazil that 8.1% of the study participants reported having received no education in blood transfusion during undergraduate training, while 45.7% and 46.2% indicated they received 1-2 hours and 3-4 hours of education, respectively, in blood transfusion.

2.4 Knowledge and Practice of Medical Doctors in Blood Transfusion

Competency is defined by Graham et al. (2014) as the capacity of an individual to carry out a particular task in accordance with a protocol. They proposed that there are two types of competence: knowledge competence and practical competence. These two types of competencies together make up clinical competence. Various research from throughout the world have revealed that the knowledge and practice competency of medical doctors in blood transfusion are insufficient for optimal practice.

Graham et al. (2014) conducted an assessment of 787 newly qualified doctors (F1 & F2) in the UK to evaluate their competency in blood transfusion. The study assessed factual knowledge, using 33 multiple choice questions, specifically true-false questions, which determined the 'competency score'. These questions addressed topics such as indications for transfusion, special blood requirements, complications associated with transfusion, and guidelines for testing in transfusion. The researchers also analyzed the current practices through an analysis of the frequency and manner in which blood products are prescribed, the handling of acute transfusion reactions (ATRs), and the procedures for administering, collecting from storage, and verifying blood and blood components at the bedside. These processes were assessed by way of a Likert scale that ranged from 1 - 5, with 1 indicating rare or rarely performed and 5 indicating always performing of the activity. The study revealed that the average score for factual knowledge competency was 57% and it was observed that the scores for factual knowledge competency were most significantly associated with having received undergraduate education in blood transfusion and attending hospital induction ($p < 0.01$). The findings from the assessment of practical competency indicated that 98% of the participants prescribed blood components on a monthly basis or more regularly. However, only 49% of them reported prescribing blood at least once a week. The respondents asserted that they always obtain verbal consent from patients prior to transfusion, although they seldom record this consent in the medical records. Approximately 67% of the participants reported that they consistently recording the indication for transfusion in the medical notes.

A study conducted in South Korea by Lim et al. (2017) examined the knowledge and competency in practice among a total of 89 medical interns and residents who were employed in university hospitals. The evaluated domains included blood components, pretransfusion testing, and transfusion reactions. The researchers established that the average score for the respondents' factual knowledge was 65.2%. Specifically, the scores for blood components, pretransfusion tests, and transfusion reactions were 58.2%, 75.7%, and 80.2% respectively. Regarding the doctors' perceived overall knowledge, 43.5%, 53.9%, and 28.1% of them indicated that their knowledge on blood products, pretransfusion tests, and transfusion responses was low or extremely low, respectively. The study concluded that the blood transfusion education provided to medical trainees during undergraduate medical school was inadequate, necessitating additional education on the subject for these trainees.

A cross-sectional study conducted in Sri Lanka aimed to evaluate the knowledge and practices of blood therapy among 57 medical trainees in a specialty health facility. The study utilized questionnaire to collect data and the aspects of blood transfusion assessed included the basic knowledge of blood transfusion, interpretations of laboratory findings, requisition and quantities of blood products, transfusion transmitted infections (TTIs), administration of blood components, and transfusion reactions. The study revealed that the average knowledge scored by the participants was 41.7% where the least score of 19.8 percent was seen in the domain of interpretation of laboratory results, whilst the best score of 56.6 percent was achieved in the field of blood and blood component administration. The study concluded that the participants had inadequate knowledge of blood transfusion, and the authors recommended the need for improvement of the knowledge of this topic (Kumarage et al., 2017).

Arinsburg et al. (2012) conducted a survey in the United States to evaluate the educational needs for medical doctors in blood transfusions. The study involved two hundred and twenty-five participants, including attending physicians, registrars, and third and fourth year undergraduate medical learners, from four hospitals and across various clinical disciplines including pathology, pediatrics, adult haematology and oncology, pediatric haematology and oncology, pediatrics, adult medicine, obstetrics and gynecology, anesthesia, emergency medicine, surgery, urology, orthopedics and radiology. Data was collected via an electronic self-administered questionnaire that had three sections: baseline demographic questions, fourteen knowledge evaluation questions, and views on training needs. The examined knowledge question themes encompassed the selection and utilization of blood components, transfusion reactions, transfusion-transmitted infections (TTIs), and fundamental blood bank laboratory techniques. The study findings indicated that the average score of participants in correctly answering questions related to transfusion knowledge was 31·4% with a standard deviation of 18·3% (4·4 ± 2·6 out of 14 questions). The participants had the highest performance in the laboratory procedures segment, with a score 53.2% (mean of 1.1 out of two questions) of items attracting correct responses. Conversely, they scored poorly in the transfusion reaction section, with only mean score 7.8% (mean of 0.2 out of two questions) of items attracting correct responses. The study also shown a notably higher performance among participants specializing in pathology or hematology (both adult and pediatric), as well as among fellows and participants who reported receiving more than 5 hours of formal blood transfusion education in the last 5 years.

Halford et al. (2021) conducted an investigation in the USA to evaluate the knowledge about blood transfusion among healthcare practitioners based in hospitals. The study participants included 183 attending physicians and advanced practice medical doctors (such as Physician Assistants or Nurse Practitioners) specializing in internal medicine and family medicine. These participants were selected from various regions in the United States. Data was collected using an online questionnaire that included 20 factual knowledge questions based on the Biomedical Excellence for Safer Transfusion (BEST) Collaborative tool and a question on perceived knowledge. The research revealed that the average knowledge score was 52%, ranging from 20% to 85%. The participants were also grouped in three according to their perceived total knowledge: advanced/expert, intermediate, and no knowledge/beginner where 27.3% (50/183) of the participants perceived themselves as advanced/expert, 57.4% (105/183) as intermediate, and 15.3% (28/153) as having no knowledge/beginner level. Physicians exhibited a statistically significant higher mean score (53.5%) compared to advanced practice providers (APPs) who had a lower mean score (40%) with a p-value of < 0.0001. Out of the seven knowledge questions, more than three quarter of the respondents gave correct responses. Five of these questions were specifically concerned with platelet, plasma, and red cell transfusion thresholds. In addition, a total of seven items attracted correct responses from less than 25% of the participants, with five of them being related to transfusion reactions, including septic, allergic, and transfusion-associated lung injury. There was no association between exam scores and perceived overall knowledge of blood transfusion, training hours, and self-perceived relevance of transfusion therapy. The authors concluded that the blood transfusion knowledge of their study participants was inadequate and suggested the implementation of continuing medical education, which has the capacity to enhance patient care.

Haspel et al. (2015) conducted an international study to assess the blood transfusion knowledge of internal medicine residents. The study involved internal medicine residents from various training levels across 23 sites in 9 different nations (Australia, Canada, England, Ireland, Italy, Germany, The Netherlands, Spain, and the USA) The questionnaire included questions regarding demographics, attitudes, and perceived knowledge. Additionally, the actual knowledge exam questions adopted from the Biomedical Excellence for Safer Transfusions (BEST) Collaborative assessment tool were utilized to collect the data. Five hundred and eighteen questionnaires were administered and 474 of them were completed and analyzed in their whole, representing a response rate of 91.5%. The study revealed that the average knowledge score was 45.7%, ranging from 10% to 85%. The questions with the lowest scores, ranging from 8.9% to 13.5%, were primarily about transfusion reactions, namely septic reactions, allergic reactions, and transfusion related lung injury (TRALI). Out of the eight questions, six had correct response rates of less than 25% and were related to transfusion reactions. On the other hand, the questions with response rates of more than 75% were about resuscitation for acute bleeding, management of an acute hemolytic transfusion reaction, indications for irradiated blood products, and platelet transfusions. The proportions of participants who self-assessed their blood transfusion knowledge as beginning, intermediate, and advanced were 47.7% (226/474), 47.7% (226/474), and 4.6% (22/474), respectively (Haspel et al., 2015). The authors' conclusion was that internal medicine residents worldwide displayed inadequate medicine in transfusion medicine and expressed a desire for further training. They suggested the necessity of improving the knowledge of blood transfusion through the development and implementation of efficient educational initiatives.

A Canadian study by Rock et al., (2002) evaluated the knowledge and practice of physicians regarding blood transfusions and it utilized a questionnaire that had fifty-five questions geared towards assessing the basic knowledge on blood and blood components and their clinical utilization. The study found that 52% of the knowledge questions were answered correctly or with additional comments that provided clarification. Additionally, 63% of the practice questions were answered correctly or with qualifying comments. Conversely, basic knowledge questions received accurate responses in 37% of instances. The study concluded that the physician's basic understanding of blood and blood products requires enhancement.

A French study by Gouëzec et al., (2007) assessed the knowledge of blood transfusion of 694 medical staff who prescribe blood components in 14-run state hospitals. The study used a questionnaire that was distributed to all potential users of blood components. The questionnaire contained 35 multiple choice questions about various subjects: blood components, immuno-hematology, prescription of blood components, blood transfusion clinical practice, and bedside procedure. The overall mean weighted score was 62% with a range of 14 to 89. The knowledge scores were higher for those participants that prescribed blood components regularly than for those who only prescribed the blood components occasionally. A statistically significant difference was not found between hospitals.

In another recent French cross-sectional pilot study conducted by Ait Bouchrim et al., (2020), the researchers assessed the knowledge of blood transfusion among 50 first-year medical and surgical specialty residents who were rotating in a French university hospital. The study also analyzed the effectiveness of educational programs in improving this knowledge. The study aimed to assess the participants' basic knowledge, ascertain the achievement of curricular objectives, and propose potential improvements. The study revealed significant deficiencies in the knowledge of residents from different specialties who also exhibited poor and consistent transfusion practices. Most of the participants exhibited challenges in prescribing and administering transfusions, as well as in recognizing and addressing associated complications, while also struggling to understand their respective duties. The researchers proposed the inclusion of a specialized blood transfusion educational program within the existing medical education curriculum to ensure that physicians possess sufficient knowledge of the fundamental aspects of blood transfusion.

A Brazilian study conducted by Vaena and Alves (2019) examined the knowledge, self-perceived knowledge of 106 medical residents regarding blood transfusion, and practice in terms of in terms of the frequency of transfusion prescriptions. The study employed a data collection instrument devised by the Biomedical Excellence for Safer Transfusion (BEST) group to assess the participants' medical knowledge. The study revealed that the average knowledge score regarding transfusion practices was 43.5% (ranging from 15% to 80%). The questions with the highest rates of correct answers were those pertaining to the prescription of blood components, specifically packed red blood cells (99%) and platelets (87%), as well as hemolytic transfusion reactions (80%). Conversely, the questions related to transfusion-related acute lung injury (15%), management of transfusion reactions such as febrile reactions (12%), and transfusion-associated circulatory overload had the lowest rates of correct answers (20%). 41.5% (44 out of 106) of the participants reported prescribing blood components once a month. This was followed by 22.6% who prescribed more than once per week, 19.8% who prescribed once a week, 10.4% who never prescribed, and 5.4% who prescribed once a year. Out of the total respondents, 25 (23.6%) reported having no knowledge of blood transfusion, 61 (57.5%) had basic knowledge, 17 (16.0%) had intermediate knowledge, 2 (1.9%) had good knowledge, and 1 (0.9%) had very good knowledge. The authors concluded that there was a distinct deficiency in the knowledge of transfusion and proposed that there is need for reform in the education in this field.

Alvarado-Navarro et al. (2016) conducted a study in Mexico to evaluate the level of knowledge regarding blood transfusion among physicians in training at a university hospital. The study utilized a descriptive observational cross-sectional design. The aim of the research was to assess the basic knowledge of blood transfusion among medical trainees (registrars) who are responsible for prescribing blood and blood product transfusions, their level of training in blood transfusion, and their perceived knowledge in this area. The researchers employed a questionnaire consisting of multiple-choice questions to assess the level of blood transfusion knowledge among medical residents. A total of 186 residents from various departments participated in the survey. The survey revealed that the average score was 47.2%, ranging from 0 to 100%. Haematology department achieved the highest score of 61.5 among all departments. The score earned by first-year residents was 48.4, which was higher than the scores of advanced years (44.7). Approximately 55% of the participants indicated that they had received prior education in blood transfusion. Additionally, 69.2%, 20.5%, and 10.3% of the participants assessed their perceived knowledge of blood as intermediate, scarce, and advanced correspondingly. Individuals with prior blood transfusion training achieved a higher average score of 55.4% compared to those without training whose score was 44.6%. Furthermore, no correlation was observed between the average score and the number of hours dedicated to transfusion medicine classes during undergraduate education. The topic that received the lowest score pertained to the transfusion of packed red cells and fresh frozen plasma in emergency situations, with a score of 7.5. The authors reached the conclusion that there is a widespread deficiency of knowledge of the study participants in transfusion medicine, and they recommended that the inclusion of more topics pertaining to this subject in both undergraduate and graduate schools is necessary.

In their study, Poh and Jackson (2023) assessed the medical doctors' (residents and specialists) understanding of transfusion medicine at a healthcare center in Malaysia. The study participants included house officers, medical officers, residents or registrars, as well as specialists, consultants, and lecturers who worked in eight different clinical departments at the University Malaya Medical Centre, (UMMC), namely Emergency Medicine, Orthopaedics, Surgery, Internal Medicine, Paediatrics, Obstetrics and Gynecology (ObGyn), Anesthesiology, and Clinical Haematology. Data was collected using a questionnaire that included demographic questions, factual knowledge questions (taken from the Biomedical Excellence for Safer Transfusion (BEST) Collaborative group), perceived blood transfusion knowledge, and information about the amount and attitude of transfusion education received during participants' medical school and post-graduate training. Out of a sample size of 279, 184 participants returned completed questionnaire, giving a response rate of 69.4. The average exam score was 40.1% with a standard deviation of 12.7%. The range of scores varied from 10% to 80%. It was observed that consultants/senior lecturers had the lowest average exam score of 30%, with a statistically significant difference ($p < 0.01$) compared to other groups. The two knowledge questions that received the lowest scores were specifically related to the identification and prevention of transfusion-associated acute lung injury (TRALI). The percentage of correct answers for these questions was 5.4% and 6.5% respectively.

Additional questions with correct answers below 33% encompassed topics such as the reversal of warfarin, the administration of massive transfusions, and various types of transfusion reactions, including septic reactions, transfusion-associated circulatory overload (TACO), and allergic reactions. Participants demonstrated enhanced knowledge of subjects pertaining to fluid management in cases of acute blood loss, the appropriate use of irradiated blood products, and haemolytic transfusion reactions. The participants rated their level of knowledge in blood transfusion using a scale ranging from no knowledge to expert. Specifically, 2.2% (4/184) of the participants rated themselves as having no knowledge, 39.9% (73/184) as beginners, 53.6% (98/184) as at an intermediate level, 4.4% (8/184) as advanced, and none of the individuals rated themselves as experts. The study revealed no significant association between the level of knowledge or exam performance and the extent or quality of blood transfusion education obtained during medical school or postgraduate training, the year of postgraduate training, or the individual's self-perceived knowledge of blood transfusion. The authors' findings indicated a deficiency in blood transfusion practices across all departments and levels of medical staff. Of particular concern was the notably low level of knowledge of the consultants and senior doctors responsible for making critical decisions. The study recommended that all medical trainees undergo blood transfusion training, and specialists doctors should receive regular updates on the subject.

In a 2017 study conducted in Eastern Turkey, Fettah et al., (2017) assessed doctors' blood transfusion-related knowledge. They employed a questionnaire with 20 multiple-choice questions to collect data from 110 medical doctors who were involved in the study (general practitioners, residents, and specialists). The assessment included the following topical areas: blood and blood products, their use in medicine, and a basic knowledge of blood transfusion. The researchers compared the participants scores according to the their departments, ages, and medical experience. The respondents had an average age of 33.1 with a standard deviation of 6 years and 70 (69.3%) of the participants being male. In total, 52% of the questions had correct responses. Regarding basic knowledge, the percentage of correct responses was 52.7%, followed by 54.7% for clinical usage of blood and blood components, and 47.3% for the complications of blood transfusion. The average score for participants' overall knowledge of blood transfusion was 52% with a standard deviation of 10. There were substantial differences (p=0.001) between the three groups' total knowledge scores, which were 55.7 (standard deviation of 10.2), 51.5 (standard deviation of 8.3), and 46 (standard deviation of 10.3), respectively, for adult medicine departments, surgical departments, and emergency medicine. Furthermore, age, and clinical experience were found to correlate with the overall blood transfusion knowledge score. The researchers came to the conclusion that the participants' level of blood transfusion knowledge was low to moderate, and they suggested that further education in blood transfusion is required at every stage of medical practice and in all specializations.

RahavKoren et al. (2017) carried out a descriptive cross-sectional study in Israel to evaluate the potential role of physicians' insufficient knowledge in the excessive use of red blood cell transfusions. Additionally, the study examined how personal background variables may affect physicians' knowledge. The researchers examined a group of 79 physicians employed at the Galilee Medical Center, located in the western Galilee region. The study participants were selected from a total sample size of 141, representing a response rage of fifty six percent. The participants consisted of attending physicians and residents employed in the internal medicine and surgical departments, specifically general surgery, orthopedics, obstetrics & gynecology, and urology. Data was collected through the use of anonymous questionnaires that had sections on personal history, career information, and knowledge. The knowledge questions were on basic understanding of the physiology of blood transfusion, patient blood management, and clinical indications for red blood cell (RBC) transfusion. The study revealed that the average knowledge level of the study population was 47.8% with a standard deviation of 18.6, which was regarded as suboptimal. There was also a lack of knowledge on the basic processes of transfusion of red cells. Internal medicine specialists and senior medical doctors demonstrated considerably higher knowledge ratings and greater familiarity with a restrictive blood transfusion approach compared to surgeons and registrars, respectively. The authors concluded that physicians in non-operating room settings have a deficiency in their overall knowledge of blood transfusion and that this deficiency may contribute to the excessive use of red blood cell transfusions. The researchers recommended that education programs should be implemented to enhance physicians' awareness and ultimately reduce the number of unnecessary transfusions.

In a descriptive study conducted by Philip et al. (2015) at a hospital in India, the researchers examined the level of knowledge regarding blood transfusion among resident doctors in different clinical specialties. The study's aim was to evaluate the basic understanding and practical application of blood transfusion among resident doctors. The study used a self-administered questionnaire consisting of 35 items that encompassed blood bank operations, dosages and uses, transfusion transmissible infections, administration of blood products, and management of transfusion reactions. The study found that the average score for correct responses was 48.53%. The correct response rates for the different sections were as follows: 54.4% for the management of transfusion reactions, 54.35% for the administration of blood components, 49.41% for uses and doses of blood components, 46.35% for transfusion transmitted infections, and 32.9% for blood bank procedures. There were no statistically significant differences in the knowledge of residents from different disciplines. The study found that a significant proportion of resident doctors lacked sufficient knowledge regarding blood transfusion, and recommended that further research should be conducted and emphasized the need for additional training in blood transfusion for all residents specializing in clinical fields.

In another recent Indian study, the knowledge, attitudes, and practices of resident doctors and interns about safe blood transfusion methods was assessed by Ray et al. (2022). The research was a descriptive cross-sectional survey, with a total of 247 residents and interns participating. Among them, 70 were senior residents, 96 were junior residents, and 68 were medical interns. The study employed an online self-administered questionnaire using Google forms. The questionnaire included questions pertaining to various aspects of knowledge (15 questions), such as blood grouping and crossmatching (5 questions), component therapy and storage (6 questions), modification of components (2 questions), and transfusion-transmitted infections and reactions (2 questions). It also covered attitudes towards the use of blood components, pre-medication, and obtaining consent prior to transfusion. Additionally, it addressed practices related to transfusion requests (4 questions), component therapy (5 questions), pre-transfusion checks (2 questions), the use of a blood warmer (2 questions), and the occurrence of transfusion reactions (1 question). The researchers categorized the knowledge score into three groups: scores ≤ 7 (below 50% out of 15) were considered poor, scores between 8 and 11 were considered ordinary, and scores greater than 11 were considered good. The study revealed that senior residents had the greatest median knowledge score, while interns had the lowest. Furthermore, only 16 participants (6.8%) demonstrated good knowledge based on the categorization of their knowledge. In addition, there was no statistically significant differences in knowledge and practice ratings between the different designation groups.

In Oman, Al-Riyami et al., (2018) assessed the level of factual and perceived knowledge of blood transfusions among a total of 130 surgical (51) and non-surgical (79) residents. The researchers used a questionnaire that contained 30 multiple choice questions and was broken up into two categories: component selection and bedside practice (15 questions each), and transfusion safety and transfusion reactions (15 questions each). The researchers found out that the overall mean score obtained for the survey was 11.48 out of 30, with a standard deviation of 6.461. They also found that the highest mean score that was obtained between the two major domains assessed was on the component selection and bedside practice domain, where it was 7.1 out of 15 with a standard deviation of 3.774, and the overall correct score for this domain was 50%. The scores that were achieved in the blood transfusion safety and transfusion reactions area were 4.34 out of 15, with a standard deviation of 3.27. Regarding their own self-perceptions of their overall knowledge of blood transfusion, 53.7 percent of respondents claimed to having fair knowledge in the field of blood transfusion, while 43.8 percent admitted to having poor knowledge. The study concluded that there was a widespread knowledge gap about blood transfusions across a variety of surgical and non-surgical residency specialties as well as at all stages of training.

In Africa, studies on the knowledge of medical doctors in blood transfusion are scarce and have also demonstrated suboptimal knowledge. The study conducted by Yudelowitz et al. (2016) in South Africa was aimed to assessing the level of knowledge among doctors at a tertiary hospital on the appropriate use of blood products in perioperative patients. The objective was to determine the extent of doctors' knowledge pertaining to all aspects of the requisition and administration of blood and blood components for peri-operative patients. The study included 210 physicians with varying degrees of expertise working in the departments of Anesthesiology, General Surgery, Orthopedic Surgery, and reproductive health (OBGYN) at the hospital where the study was conducted. Data was collected using a questionnaire that included questions about complications of blood transfusion, cost implication, requisition procedures, and triggers for red cells, fresh frozen plasma, and platelet concentrate. Out of the 210 questionnaires distributed, 172 fully filled questionnaires were received in total, giving a response rate of 81.9%. The study revealed that the average number of correctly answered questions was 16.76 out of 30 with a standard deviation of 4.58. The distribution by specialty was as follows: Anesthesiology had a mean of 19.98 (±3.84), General Surgery and Trauma had a mean of 16.28 (±4.05), Orthopedic Surgery had a mean of 13.83 (±4.17), and Obstetrics and Gynecology had a mean of 15.63 (±3.51). Anesthesiology demonstrated superior performance compared to other fields with a $p < 0.001$, and senior physicians outperformed junior medical doctors with a $p < 0.001$. 70% of the participants correctly identified the indications for red blood cells transfusion, while 50% properly identified the uses for platelets. The questions on administration methods were correctly answered for 80% of red blood cells and slightly over 50% for platelets and fresh frozen plasma. Questions on cost estimation and procurement attracted scores of less than 30%. The authors concluded that the doctors' knowledge of the complications, blood as a scarce resource, cost implication, and requisition process of blood and blood components for patients who are to undergo surgery was inadequate. The study recommended that consistent and structured education on transfusion risks, cost implication of this scarce resource, blood product ordering, and administration, together with receiving appropriate feedback, could be beneficial.

Laher & Patel (2019) conducted a descriptive observational study in South Africa to evaluate the knowledge of medical practitioners in the department of medicine at affiliated academic hospitals regarding the usage of blood and blood components. The study aimed to evaluate the level of knowledge among medical doctors (including interns, medical officers, registrars, and consultants) on blood and its components. Data collection was done using a self-administered questionnaire. The questionnaire had demographic questions and knowledge questions regarding the appropriate indications, accurate ordering patterns, cost, adverse effects, and safe administration of blood components. Out of the total of over 600 questionnaires that were delivered, 200 were filled out, resulting in a response rate of 33%. The study revealed that the mean overall knowledge score was 61%. Among the different groups, consultants, medical officers, registrars, community service doctors, and medical interns achieved scores of 64%, 63%, 63%, 58%, and 56% respectively. The knowledge scores had a positive correlation with the designation of medical doctors. The participants achieved the highest scores in the area related to 'consent', with an average of 87%. Subsequently, a percentage of 64% was attained for the area pertaining to 'adverse events'. The question pertaining to the utilization of packed red cells and the process of ordering blood products received a score of 60%, but the section focusing on the utilization of platelets achieved a score of 44%. The part on 'plasma product utilization' obtained the lowest score, which was 30%. The authors determined that the medical doctors' knowledge is below the optimal level and suggested implementing a structured and continuous education program on blood and blood product usage for both undergraduate and postgraduate levels.

Another recent study conducted by Barrett et al. (2020) in South Africa employed a descriptive cross-sectional design to assess the understanding of blood transfusion and associated practices among 152 doctors (medical interns, community-based services doctors, medical officers, residents and medical specialists). These doctors were employed at a university hospital and worked in adult departments that regularly do blood transfusions. The study aimed to ascertain the medical professionals' training background, understanding of blood transfusions, and their reported practices in haemovigilance reporting. The researchers employed a self-administered questionnaire as their instrument for data collection. The majority of the participants (31.5%) were registrars and medical officers who had less than 5 years of experience. Specialists accounted for 19.9% of the participants. In addition, it was shown that 43.3% of the participants prescribe blood on a weekly basis or more frequently. Furthermore, nearly one-third (29.9%) of the participants reported never having had any training on transfusion. Moreover, a haemoglobin-based transfusion trigger wass utilized by 76.2% of the participants. Additional findings indicated that over 80% of participants reported utilizing one unit of blood initially, followed by a clinical evaluation, before considering the need for a second unit. The identified barriers to conducting thorough evaluation of anemia were the expenses associated with laboratory tests and a shortage of personnel. Moreover, the survey revealed that 40% of individuals responsible for patient care and who encountered a transfusion-related adverse event actually reported the occurrence to the blood service. The researchers concluded that the study participants who were working in a hospital setting where blood transfusions are common had insufficient training, inadequate understanding of certain basic transfusion concepts, and poor reporting of blood transfusion adverse events. They recommended the development of a hospital-level guideline to standardize the reporting of transfusion reactions.

A cross-sectional study conducted in Uganda, Ddungu et al., (2018) assessed the knowledge, attitudes, and reported practices related to blood transfusion among medical doctors employed at a cancer institution. The study used a self-administered questionnaire consisting of 30 items, with 10 items dedicated to each of the three domains: knowledge, attitudes, and practices. Of the 31 questionnaires distributed, 28 were filled out and returned, resulting in a response rate of 90%. The researchers established that the median knowledge score was 5.3, with a median of 5.5. Additionally, 32% of participants answered at least seven out of ten questions correctly. Furthermore, over 60% of physicians admitted to lacking knowledge in transfusion medicine and expressed a desire for training in this area. Nearly all (96%) recognized the significance of accurate patient identification before to transfusion and identified identification error as the primary cause of fatal transfusion reactions. Many physicians admitted to occasionally altering their decision regarding whether to prescribe a transfusion to a patient based on the opinions of their colleagues. Additionally, they acknowledged that they sometimes administered inappropriate transfusions due to the influence exerted by others. The study concluded that the doctors had a moderate level of knowledge and it recommended that transfusion training and the implementation of evidence-based recommendations would be beneficial in reducing inappropriate transfusions and enhancing patient care.

A study conducted in Mali by Diakité et al. (2012) investigated the extent of awareness and adherence to transfusion medicine among medical workers. The study included specialized practitioners, general practitioners, nurses, and midwives who were employed at three major teaching hospitals in Bamako and Kati, as well as at the six referral health clinics in the Bamako region. The researchers employed a questionnaire as a means of collecting data. The study found that 53.9% of the medical personnel examined lacked adequate knowledge of blood transfusion, while only 42.9% had a strong basic knowledge of blood products, their appropriate uses, and associated complications. The authors' conclusion was that the study participants exhibited inadequate knowledge in blood transfusion and limited practical skills.

In Mozambique, the mean knowledge score of the study participants (health care professionals) in blood transfusion was 58%, and this increased to 74% after a workshop ($p < 0.001$) (Hartford et al., 2015). A Tunisian study that looked at the level of knowledge of blood therapy among physicians established that the participants performed dismally, where the overall knowledge score was 44.4% (2.9/7) (Ben Salah et al., 2013) .

2.4.1 Factors associated with knowledge of medical doctors in blood transfusion

Various studies have found inconsistent relationships between knowledge and the demographic characteristics of medical doctors. Fettah et al. (2017) found in their study that medical doctors' knowledge about transfusion medicine was positively correlated with age. Conversely, age was found by Gharehbaghian et al. (2009) to negatively correlate with knowledge. Furthermore, a study by Kasraian & Tavassoli (2014) found that the mean knowledge score did not correlate with the respondents' age ($r = 0.17$, $P = 0.18$). When it comes to sex, a positive correlation between sex and the mean knowledge score was demonstrated by Kasraian & Tavassoli (2014), where men had a higher score ($r = 0.23$, $P = 0.02$). In another study in Niamey, Niger, by Mayaki et al. (2016), the overall knowledge score was found to be higher among males ($P = 0.0306$). An Indian study by Ruhi & Seema (2016) found that the knowledge score among resident doctors was not statistically different among males and females.

Studies have also tried to establish the association between the knowledge of blood transfusion and the medical doctors' background and professional characteristics like designation, or level of training, participation in additional training, number of years in practice, specialty, and frequency of transfusions. An association between knowledge of medical doctors and participation in additional training in blood transfusion has been demonstrated by several studies (Hagumimana et al., 2023; Lin et al., 2019; Sahmoud et al., 2021; Vaena & Alves, 2019; Alvarado-Navarro et al., 2016; Mayaki et al., 2016; Graham et al., 2014; Kaur et al., 2014; Arinsburg et al., 2012; Nunes da Silva et al., 2017; Sullivan et al., 2019; Konia et al., 2018; Peedin et al., 2019). Lin et al. (2019) in their research showed that a transfusion camp delivered over 5 days led to increased blood transfusion knowledge with an average pre-test mark of 10.3 out of 20 (2.9; n = 286) as compared to a post-test mark of 13.0 out of 20 (2.8; n = 194; p less than 0.001). The study by Kasraian & Tavassoli (2014) showed that knowledge score did not correlate with the number of years of practice of the study participants (r = 0.11, P = 0.3), whereas research findings of Gharehbaghian et al. (2009) and Arinsburg et al. (2012) revealed a negative correlation between the level of blood transfusion knowledge among medical doctors and the number of years in practice. A positive correlation was demonstrated in a Tunisian study between knowledge scores in blood transfusion and an educational intervention using an auto-education with compact disc-read only memory (CD-ROM), where the overall score increased from 2.9 to 5.8/7 (Ben Salah et al., 2013). A Malaysain study by Poh & Jackson, (2023) however, did not find any association between the knowledge scores and the quantity or quality of previous training in blood transfusion. In the same study, the participants in the departments of hematology, anesthesiology and internal medicine had statistically significant higher scores.

2.4.2 Factors associated with practice competency of medical doctors in blood transfusion

According to Salem-Schatz et al. (1993), site-of-practice variables have been shown to be better predictors of the quality of blood transfusion practices than have been the demographic and background characteristics of individual medical doctors. An Indian study by Ray et al. (2022) found a significant relationship between the qualifications of the study population and practice competency in blood transfusion. In another Indian study, a significant association was demonstrated between the practice score of blood transfusion and gender (p = 0.021) and clinical experience (p = 0.006), but no association was found between the practice scores and age (p = 0.098), professional qualification (p = 0.425), the approximate number of blood transfusions performed (p = 0.147), and the in-service programme attended regarding blood transfusion (p = 0.309) (Iqbal et al., 2021). In their French study, Saillour-Glénisson et al. (2002) found that the frequency of transfusion and training were strongly associated with hazardous knowledge and practice scores. Work experience or qualification had no significant relation to their study participants' scores for knowledge- or practice-based questions (Jogi et al., 2021). Neither the years of clinical experience nor being a resident or attending clinician had an influence on the self-perceived transfusion behavior (p = 0.615 and p = 0.053) in a Swiss study by Babo et al. (2018). The three factors that were identified by Hartford et al. (2015) as having the highest level of importance in influencing transfusion practice were education about transfusion indications, increased reliability of the blood supply, and training to assess perfusion. Transfusion behavior has also been demonstrated to be influenced by other factors, such as emotion, perceived goals, and motivation (Islam et al., 2012; Francis et al., 2009), and receptivity to input from colleagues (Adedayo et al., 2021; Salem-Schatz et al., 1993).

2.5 Attitudes of medical doctors towards blood transfusion and associated factors

The term "attitude" describes a person's tendency to respond in a particular way to different circumstances, to see and interpret events in accordance with particular preferences, or to arrange their beliefs and opinions into logical frameworks that are related to one another (Badran, 1995). Attitudes aids in understanding how issues and processes are perceived by individuals. They also determine what the persons consider significant, admirable, acceptable, and pertinent (Price, 2015). Attitudes regarding a particular subject (such as blood transfusion) are determined by beliefs about that subject, and those beliefs have an impact on behaviour (Svenningsson et al., 2018).

There are few studies in the literature on the attitudes of medical doctors towards clinical blood transfusion. In a UK study assessing the current attitudes of orthopaedic surgeons and anaesthetists towards transfusion practice following arthroplasty surgery, a wide variability in attitudes and practices was demonstrated. The surgeons tended to be more aggressive in their attitudes towards haemoglobin threshold for transfusing, with a mean transfusion threshold of 8.3 g/dL compared to 7.9 g/dL for anaesthetists ($p < 0.01$) and 97% of surgeons transfusing two or more units compared to 78% of anaesthetists ($p < 0.01$). This threshold Hb increased if the patient was symptomatic (surgeons 9.3 g/dL, anaesthetists 8.8 g/dL, $p < 0.05$) or was known to have pre-existing ischaemic heart disease (surgeons 9.0 g/dL, anaesthetists 9.2 g/dL, $p < 0.05$) (Young et al., 2008). In a South African study that dealt with doctors' practice and attitude toward red blood cell transfusion, it was demonstrated that there was a lack of awareness of institutional transfusion guidelines, a disagreement on appropriate RBC transfusion thresholds, and that the factors informing decisions to transfuse included advice from senior colleagues, relieving symptoms of anaemia and high product costs. In addition, the study further established that while doctors did abide by some aspects of current transfusion guidelines, their overall practice was influenced mainly by attitudes that may be attributed to institutional culture where ‘practice... [is] handed down from one generation of medical doctors to the next’ (Adedayo et al., 2021). In another Ugandan study, almost all of the study population (96%) strongly agreed that although donated blood was free, there were significant costs associated with its processing and administration. In addition, the study showed that 78% of the participants agreed that they understood the risks and costs of allogeneic blood transfusion and that, because of this, they tried to minimize the use of blood components. Moreover, 90% of the participants in the Ugandan study acknowledged that, in comparison with red blood cells, platelet transfusions were associated with a higher risk of transmission of diseases and that they would use platelets with caution. Regarding the decision of when to transfuse, 61% of medical doctors reported they would not transfuse a patient on the basis of the patient's symptoms of anorexia, cachexia, or pallor. All participants agreed that the formulation and implementation of evidence-based clinical practice guidelines reduced variation in blood use by medical doctors and promoted best practices in blood transfusion (Ddungu et al., 2018).

Another study that assessed medical doctors' perceptions of a variety of clinical and non-clinical influences on their transfusion decision-making, Salem-Schatz et al. (1993), found that apart from medical doctors' attitudes toward input from colleagues, the other variables that included medical doctors' awareness of and attitudes toward patients' concerns, transfusion guidelines, blood availability, or cost were not associated with the quality of their transfusion practice.

2.6 Confidence of medical doctors in blood transfusion and associated factors

There are several transitions that undergraduate medical students must go through in order to become doctors, and each of these transitions is geared towards equipping them with the necessary knowledge, abilities, self-confidence, and professional demeanor. The graduates should not only be adequately trained, but they should also be sufficiently confident to apply the acquired knowledge, skills, and attitudes in their practice (Moro et al., 2019). Clinical confidence is the self-perceived capacity to deal with clinical scenarios. Although it does not always equate to competence, clinical confidence is nonetheless a requirement for medical doctors to be able to fully engage in clinical activities (Moro et al., 2019; McNair et al., 2016).

For several years, there have been concerns that medical graduates in many countries are underprepared for practice (Monrouxe et al., 2018; Surmon et al., 2016; Miles et al., 2017; Muthaura et al., 2015; Moro et al., 2019). Medical students at graduation are anticipated to be able to give immediate medical care, for example, in cases of medical emergencies, e.g., severe blood transfusion reactions (Maxwell & Wilson, 2006). Furthermore, as patients' lives are at stake, the healthcare workforce needs to be prepared for practice from the very start of their working lives.

Studies have also shown that the lack of confidence or preparedness is not global but is concentrated on some of the skills needed for practice (Illing et al., 2008). According to a study by Wall et al. (2006), new doctors were noted to be ill-prepared and ill-equipped, mostly in the area of essential skills in medical care such as making decisions, administration of medications, and procedural skills.

Based on this realization, there has been a rise in the number of studies on the subject of medical graduates' preparedness for practice in certain clinical domains, e.g., safe prescribing (Bertels et al., 2013; Rothwell et al., 2012; Dornan et al., 2009). Nonetheless, studies on preparedness and confidence for practice in the field of blood transfusion are few. In a US study by Peedin et al., (2019) that was aimed at improving blood transfusion knowledge for graduating medical students using a novel lecture, it was demonstrated that the mean self-perceived confidence levels in performing selected transfusion procedures, which included appropriately prescribing blood components, e.g., packed red cells; ordering modified blood components, e.g., irradiated; prescribing blood components in special situations, e.g., massive transfusion protocol; and identifying and managing transfusion reactions, rose significantly pre- and post-lecture (i.e., from a mean of 3.1 to 7.0; $P < 0.0001$).

A UK study by Graham et al. (2014) among first- and second-year residents/registrars assessed their level of confidence in the prescription of the appropriate blood products to the right recipient at the right time and dealing with acute transfusion reactions. The participants' confidence levels in blood transfusion were assessed through personal reflection where a 10-point Likert scale was used. The study found that the junior doctors felt much more confident in the prescription blood products than managing acute transfusion reactions. The study also established that doctors who were confident in the prescription of blood components had higher levels of confidence when handling acute transfusion reactions. Furthermore, the participants with prior orientation perceived themselves as more confident in the prescription of blood components as well as in dealing with acute transfusion reactions.

In a survey conducted among resident medical doctors at nine academic medical centers to assess their perceptions of their knowledge of transfusion medicine, their confidence in using various blood bank resources, and their ratings of the contribution of various learning resources to their knowledge of blood transfusion, Eisenstaedt et al. (1988)

reported that the participants had the greatest confidence in using red cell concentrate, platelet concentrate, and fresh-frozen plasma.

Connick et al. (2009) conducted a study in hospitals located in East Anglia, UK that examined the level of confidence in procedural skills among hospital practitioners. The study also explored the impact of this confidence on the training and practice of doctors at various levels, including Foundation Year 1, Foundation Year 2, Senior House Officers, Specialist registrars, Consultants, and Clinical Fellows. Their study further sought to determine the level of confidence that medical practitioners have in their procedural skills, as well as to establish the specific practical procedures that hold significance in contemporary medical practice. They administered an anonymous questionnaire to 286 medical doctors, with 181 respondents returning completed questionnaires. The study identified five primary clinical procedures (including central line placement, lumbar puncture, pleural aspiration, ascitic aspiration, and intercostal drain insertion) that were frequently performed, considered essential skills, and correlated with the overall number of procedures that can be confidently executed. The factors that were found to influence confidence were gender, the number of clinical practices conducted in the preceding year, and the overall number of procedures performed. They also found that practical self-confidence is influenced by sex, and the frequency of clinical activities done in the preceding year.

In a descriptive cross-sectional study conducted in Kuwait, Karim et al. (2012) evaluated the self-confidence of undergraduate medical learners in clinical years regarding their ability to perform clinical skills and procedures. The research collected data using a questionnaire from 107 students out of a total of 121 students who had finished surgical rotation in their 1st clinical year. The participants documented their degree of self-confidence in performing particular practical competencies or procedures associated with the rotation. The data was presented using frequency tables and percentages. Each student's confidence was assessed and a cumulative score was computed. The Mann-Whitney and Kruskal-Wallis tests were employed to evaluate the correlation between the social and demographic factors of the students and their confidence score. The researchers found that a participants displayed varying levels of confidence in performing the examined surgical procedures, with males and learners with greater monthly income exhibiting significantly higher scores, with p values of 0.021 and 0.002, respectively. The researchers concluded that the participants demonstrated a lack of self-confidence when it came to carrying out clinical skills and procedures. They suggested that curriculum developers should investigate possible factors and strategies to enhance the confidence of undergraduate medical learners in executing the practical competencies and procedures they are required to learn during their surgical rotation.

Browne et al. (2007) conducted a study in Australia to examine the self-confidence and practical competencies of medical doctors (GPs) in managing psychiatric illnesses. The objective was to determine the factors that influence the confidence and practical competencies of medical doctors (GPs) in managing patients with psychiatric disorders. A total of one hundred and thirty-four General Practitioners (GPs) were enlisted for the study, and data was collected through the administration of a questionnaire. The primary focus of the research was to assess the GPs' perceived level of overall knowledge and abilities in identifying and treating prevalent mental health problems. The study revealed that there was no significant correlation between age, years since graduation, and self-reported confidence and competence. Nevertheless, this study determined that previous training was correlated with an individual's level of self-confidence.

A cross-sectional comparative study was conducted by E. H. Wu et al. (2007) in the United States. The study focused on self-confidence and self-reported use of the clinical examination among undergraduate learners, residents, and consultant physicians. Data collection was conducted via a questionnaire, which was issued to 376 individuals participating in the study. These individuals consisted of undergraduate medical learners in their 3rd and 4th year of their studies, internal medicine registrars, and consultant physicians at a teaching health facility. Out of the 376 questionnaires distributed, 302 were returned with all the questions answered. The study employed a Likert scale with five points (1-5) to assess the participants' level of self-confidence. The participants were asked to rate their self-confidence in the entire clinical examination practical competence in addition to their proficiency in fourteen specific competencies. Additionally, they were asked to evaluate the usefulness of the overall physical examination and each individual skill in providing clinically significant information. The research showed mixed results in terms of association between confidence and the level of training among the participants. Specifically, the mean self-confidence rating of third-year students was 3.3 as compared to that of 1st-year residents which was 3.4 with a p of 0.95), but lower than of 4th-year students which was 3.8 with a p value of 0.002), senior registrars who had 3.7 with a p value of 0.01, and consultant physicians who had a mean rating of 3.9 with a p value of 0.001. The researchers concluded that self-confidence in the physical examination does not inevitably rise at every phase of training. Additionally, they observed that the disparities identified between self-confidence and perceived usefulness in various abilities indicate significant areas for educational interventions.

A study assessing the impact of education in confidence by Peedin et al. (2019), showed a statistically significant correlation between confidence and training. In this study, it was demonstrated that the confidence level of the study participants increased from a mean of 3.1 to 7.0 ($P < 0.001$) after attending an educational intervention.

Studies have also explored the effect of induction or orientation on self-confidence. A study conducted in the United States by Antonoff et al. (2010) addressed job-related anxiety among surgery interns by implementing an expanded orientation program. They believed that this anxiety could be linked to interns feeling unprepared, which in turn could negatively impact their job performance. The researchers extended the intern orientation program and also aimed to demonstrate that this enriched curriculum would have a lasting effect on increasing intern confidence. A total of twenty-one surgical interns were recruited for the study and underwent an extensive orientation program. This program included interactive lectures, presentations of case scenarios, and discussions in small groups. Assessments were gathered upon the conclusion of the orientation program, and a follow-up evaluation was conducted one month later. These evaluations measured self-reported levels of confidence in job-related tasks before, immediately after, and one month after the orientation. The statistical analysis was carried out using Student t tests, with a significant level of a p value less than 0.05. The study findings indicated that individuals' self-assessment of confidence in job-related tasks was initially low prior to the orientation sessions. However, participation in the program led to immediate increases in confidence across all domains. Furthermore, evaluations conducted one month later shown that these gains were sustained over time. The authors' findings indicate that the interns experienced significant anxiety in all job-related tasks prior to orientation. However, after attending the orientation sessions, their confidence levels showed a significant and lasting improvement in all areas. They concluded that there was a need for targeted guidance on job-specific duties during a surgical internship and demonstrated the efficacy of an enhanced orientation in enhancing intern self-confidence in performing these duties.

Kamau (2014) carried out a literature review on the effects of experimental inductions for newly qualified doctors on competence at clinical procedures and found that as many as 96% of recently graduated doctors did not pass one or more clinical procedure assessments. Furthermore, they also noted that the entrance of these newly graduated medical doctors into work in hospital has been linked to notable declines in patient safety and an elevation in patient mortality rates. He posited that implementing curricular changed could be one solution, while another alternative could involve introducing clinical skills inductions (orientations) prior to doctors' first day on the job. After reviewing literature, it was noted that the self-confidence and competence of recently graduated medical doctors had a significant and enduring improvement following their participation in an induction program prior to commencing their professional duties. For instance, the rate of unsuccessful outcomes in one or more medical examinations can be decreased from ninety six percent among newly qualified physicians to twenty seven percent over a brief 5-day orientation period. The review concluded that it is valuable to schedule inductions prior to doctors commencing their first day of work.

Other researchers have also examined the level of clinical confidence among various categories of healthcare professionals. In a descriptive cross-sectional study conducted by Yang et al. (2015), the researchers investigated the factors that affect the level of confidence in core clinical abilities among hospital nurses in Korea. The objective of their research was to evaluate the degree of self-confidence in carrying out different clinical procedures and determine the factors that influence the level of confidence among a group of 550 nurses working in hospitals. The researchers assessed the participants' self-perceived competence, frequency of performance, and educational needs by a self-administered questionnaire. The researchers found out that the level of confidence to perform was associated with educational needs, overall job experience, frequency of performance, and the position held by the respondents.

2.7 Felt Training Needs by Medical Doctors in Blood Transfusion

A felt or perceived need is an overall desire for improvement in a certain subject area (Nielson et al., 2017) or a gap between the knowledge, skills, and abilities that a professional believes that they possess and those that they wish to have. It results from a process of self-criticism in which the individual personally determines their needs based on their knowledge, experience, and understanding of the circumstances (Labesse et al., 2009).

Previous studies have highlighted the perceived need for additional training in blood transfusion among medical practitioners. A study by Mitchell et al. (1989) surveyed facility members, transfusion medicine directors, and chief technologists about blood transfusion knowledge deficiencies in residents and practicing medical doctors. They reported that 90% of the respondents felt that additional training in blood transfusion was required for all groups of learners.

In Brazil, Vaena & Alves (2019) carried out research that evaluated the participants' profiles in terms of the importance of the subject to their clinical practice, and their perception of the value of further training. The results indicated that 86% of participants considered knowledge of blood transfusion to be very important or extremely important in their clinical practice, while more than 90% of the respondents said that additional training on the subject would be very useful or extremely useful.

Studies carried out in the USA have also reported medical doctors expressing the need for improved training in blood transfusion. O'Brien et al., (2010) showed that > 90% of the study participants felt that additional training would be very useful for their medical practice. The majority of participants in the study by Arinsburg et al., (2012) believed that additional training in blood transfusion was needed for themselves as well as other medical doctors at all training levels. Haspel et al, (2015) in their study among internal medicine residents demonstrated that almost all the residents would welcome more training in blood transfusion with 93% rating such activity as at least moderately helpful and 65% rating as either very or extremely helpful. Halford et al., 2021 examined their respondents' perceptions of the significance of blood transfusion knowledge to their medical practice and the usefulness of additional training. They found that 4.9%, 35.0%, 42.1%, and 18.0% reported the importance as slightly important, fairly important, very important and extremely important, respectively. The respondents who rated the usefulness of further training in blood transfusion as slightly or not at all helpful, moderately helpful, and extremely/very helpful were 15.9% (29/183), 35.5% (65/183), 48.6% (89/183), respectively.

Most participants in a study by Kumarage et al., (2017) expressed the belief that medical professionals at various stages of their training, ranging from medical students to working medical doctors, would gain from more education on blood transfusion. Furthermore, a significant proportion of participants expressed a need for further education in all four areas of study, including laboratory procedures, proper transfusion practices, blood ordering processes, and selection and utilization of blood components

Al-Ryami et al., 2018 in their study looked at the perspectives the study participants who were medical residents on their prior training in blood transfusion, and their opinions on the necessity of additional education in blood transfusion. They established that about 85.9% of the residents admitted the necessity for more education on the utilization of diverse blood products. The areas in which the participants expressed more education on extended across all of the different laboratory and clinical blood transfusion subjects. Between 75 and 81 percent of respondents acknowledged the necessity for further education on blood bank laboratory procedures and the manner in which components are processed, stored, and selected in response to requests for transfusions. In addition, 74.2 and 81.3 percent of residents, respectively, stated that they required additional education in the areas of transfusion-transmitted infections (TTI) and complications of blood transfusion

In a study that investigated on the educational needs of medical doctors undergoing training found that 76.4% and 86.5% of participants expressed the need for further education in transfusion medicine during and after their undergraduate medical education, respectively (Lim et al., 2017).

The need for additional training in blood transfusion has also been echoed by medical doctors practicing in Africa. In the study by Ddungu et al. (2018), more than 60% of medical doctors acknowledged they lacked knowledge and needed training in blood transfusion. In a South African study, all participants felt that they needed additional educational training with regards to usage of blood and blood components (Laher&Patel, 2019).

2.8 Chapter Summary

This chapter reviewed literature based on the study's objectives, which included the situation of blood transfusion education in undergraduate medical curricula, where literature revealed significant disparities in how this crucial subject is taught in different countries. However, most of these studies were based in developed countries, with very few carried out in our region.

The review also dug into the literature on medical doctors' competencies and confidence in blood transfusion, as well as the associated factors. The various studies analyzed consistently showed that the knowledge and skills of medical doctors in blood transfusion are suboptimal, potentially compromising patient safety and quality of care. But most of the research in this area targeted residents, registrars, and consultants, with only a few studying blood transfusion competencies among medical interns and post-internship doctors (medical officers). Furthermore, most of the studies focused on the level of knowledge of medical doctors on blood transfusion, and a few looked at the doctors' attitudes, practices, and confidence. Finally, the literature revealed that comprehensive training of medical doctors in blood transfusion significantly enhances their knowledge, attitudes, practices, and confidence.

CHAPTER THREE

3.0 METHODOLOGY

3.1 Overview

In this chapter, the design of the study and the methods used for determining and selecting the study participants, collecting and analyzing the data, and presenting and disseminating the study results are addressed. The ethical considerations for the study are also outlined.

3.2 Study Design

This research employed a quantitative design with a descriptive cross-sectional approach. The quantitative approach focuses on acquiring numerical data and using it to explain a specific occurrence or generalize it across groups of individuals. Quantitative research seeks to ascertain the relationship between a certain variable (an independent variable) and another (a dependent or outcome variable) within a population. (Labaree, 2019). In our study, we determined the relationship of the medical doctors' demographics and background variables and their knowledge, attitude, practice, and confidence.

Quantitative research designs are either descriptive or experimental. The descriptive research approach is a basic study method that assesses the scenario as it exists in its present state and involves the identification of attributes of a particular phenomenon based on an observational basis or the exploration of associations between variables (Williams, 2007). Cross-sectional design is a type of descriptive design where it involves data collection on particular variables of interest as they exist in a defined population at one particular time or over a short period of time (e.g., a calendar year) (Aggarwal &

Ranganathan, 2019). Our study collected data from the participants within a period of eight months, from August 2021 to March 2022. The data collected included information on the curriculum content (the extent of inclusion and the adequacy of coverage of the subject of the transfusion medicine in the curricula of medical schools' undergraduate medical teaching); the opinions of the medical doctors about their undergraduate training in blood transfusion; the clinician's variables including the site of practice, demographics, and education background (independent variables), knowledge, attitude, practice, and confidence constructs (dependent variables), and the association between these variables.

3.3 Study Location

The study was carried out at Kenyan medical schools offering undergraduate medical education, MTRH, and selected country hospitals in the North Rift and Western Kenya.

Moi Teaching and Referral Hospital is located in Uasin Gishu County, and it serves as the teaching hospital of Moi University School of Medicine. It is also the referral facility for the hospitals in the North Rift, Western Kenya, and parts of Uganda and Southern Sudan.

The North Rift region of Kenya comprises Turkana, West Pokot, Tranzoia, Uasin Gishu, Nandi, Elgeyo Marakwet, Baringo, and Samburu counties. On the other hand, the western region is composed of Busia, Kakamega, Bungoma, and Vihiga counties. Each of these counties has a county referral hospital.

3.4 Target Population

The target population is the entire set of units a researcher is interested in—the set of units from which the researcher wishes to draw conclusions (Banerjee & Chaudhury, 2010). The target populations for this study were medical schools offering undergraduate medical education in Kenya, and all medical doctors working in MTRH and selected county referral hospitals in the North Rift and Western Kenya

3.5 Study Population

The study population is the accessible part of the target population from which the sample itself is selected (Banerjee & Chaudhury, 2010). The study population for this research were medical schools that have graduated medical doctors and non-specialist medical doctors (medical interns, medical officers, and residents) working in MTRH and selected county referral hospitals.

3.6 Eligibility Criteria

Eligibility criteria specify the details which precisely define what makes an individual, sample or dataset appropriate or not appropriate for participation in a study. Eligibility criteria help define the study population, and ensure the safety and the integrity of the data. Well defined eligibility criteria help make a study safe, ethical and scientifically valid. It entails an inclusion and exclusion criteria.

3.6.1 Inclusion Criteria

These are the characteristics that participants must have to be considered for the study. They ensure that the study population is homogeneous with respect to factors that are relevant to the research question (s). The inclusion criteria for medical schools and doctors are as presented below.

3.6.1.1 Inclusion Criteria for Medical schools

The medical schools included in this study were those who had graduated at least one cohort of undergraduate students.

3.6.1.2 Inclusion Criteria for Medical doctors

The medical doctors included in this study were:

i. Non-specialist medical doctors (medical interns, medical officers and residents/registrars)
ii. Those who completed their full training and graduated from Kenyan medical schools.

3.6.2 Exclusion Criteria

These are the characteristics that disqualify potential participants from the study. They ensure that the study results are not confounded by factors that could interfere with the interpretation of the data. The exclusion criteria for medical schools and doctors are presented below.

3.6.2.1 Exclusion Criteria for Medical Schools

The medical schools excluded from this study were those not offering undergraduate medical training.

3.6.2.2 Exclusion Criteria for Medical Doctors

The medical doctors that were excluded from this study include those who:

i. Did not complete their training from Kenyan medical schools
ii. Did not graduate from Kenyan medical schools

iii. Had prior health care training before joining medical school, e.g., clinical officers, nurses

iv. Were not involved in direct patient care where blood transfusion is required (e.g., psychiatry, radiology, etc.).

3.7 Sample Size Calculation

Sample size is the number of observations or individuals included in a study or experiment. It is the number of individuals, items, or data points selected from a larger population to represent it statistically. The sample size is a crucial consideration in research because it directly impacts the reliability and extent to which you can generalize those findings to the larger population.

For the medical schools, a sample size calculation was not deemed necessary as all the medical schools in Kenya that met the eligibility criteria were invited to participate in the study.

The sample size for the medical doctors was calculated using the Taro Yamane formula (Yamane, 1967; Israel, 2003) with a 95% confidence level.

$$n = \frac{N}{1 + Ne^2}$$

Where:

n = desired sample size

N = population size, in this case the total number of non-specialist medical doctors to be studied which was 400

E = maximum acceptable margin of error (0.05)

1 = theoretical constant

n = 200

3.8 Sampling Techniques and Procedures

A sampling technique refers to the method used to select a subset of individuals or items from a larger population to participate in a study. The chosen sample should ideally represent the larger population as accurately as possible, enabling researchers to make inferences about the population based on the sample. The sampling techniques for the medical schools and the medical doctors are outlined below.

3.8.1 Sampling Procedures for the Medical Schools

Purposive sampling method was used to select the medical schools and the hospitals in which the doctors were based within the North Rift and Western Kenya. The purposeful sampling technique, also called judgment sampling, is a nonrandom technique where the researcher decides what needs to be known and sets out to select the units (e.g., people, cases/organizations, events, pieces of data) that are to be studied (*Purposive Sampling | Lærd Dissertation*, 2012). Though it is typically used in qualitative research, purposive sampling may also be used in quantitative research (Tongco, 2007; Lee & Landers, 2022).

3.8.2 Sampling Procedures for the Medical Doctors

Medical doctors were selected using stratified random sampling technique. Stratified random sampling is a probability sampling method and a form of random sampling in which the population is divided into two or more groups (strata) according to one or more common attributes. It involves dividing the population into different subgroups (strata) and selecting subjects from each stratum in a proportionate manner (Dudovskiy, 2015). In this study, the strata were medical interns, medical officers, and residents. The required sample size in stratum was selected by simple random sampling. This was done by first obtaining a list of the contact details of all the medical doctors in each designation from the in-charges, and then assigning each a number. The numbers were entered into a computer, and random numbers were generated as per the desired sample size of each stratum. Table 1 shows how the study participants from different hospitals were allocated proportionately.

Table 1: Proportionate allocation of the medical doctors

Hospital	Interns		Medical officers		Residents		Total sample
	Total	Sample size	Total	Sample size	Total	Sample size	
Kitale	12	6	12	6	4	2	14
Kapenguria	8	4	9	5	0	0	9
Webuye	6	3	9	5	5	3	11
Bungoma	8	4	8	4	4	2	10
Kakamega	21	10	20	9	4	2	21
Kapsabet	9	5	14	7	0	0	12
Nandi Hills	0	0	8	4	0	0	4
Iten	13	6	9	5	0	0	11
Kabarnet	8	4	8	4	0	0	8
Vihiga	10	5	8	4	0	0	9
MTRH	15	8	39	19	129	64	91
Total	110	55	144	72	146	73	200

3.9 Data Collection Instruments

These are the tools used by researchers to actually collect data in the research process. The instruments used in this study are data abstraction form and questionnaire.

3.9.1 Data Abstraction Form

A data abstraction form is an instrument used to systematically collect data and record specific information by going through records, such as clinical records, documents, or survey responses. In this study, an abstraction form was used to collect data from the medical schools' curricula.

The information collected by way of abstraction forms from the medical schools curricula (see Appendix 1A) was adapted from the tools used by Al-Riyami et al. (2021) (AABB GTF 2019—global undergraduate BT curricula survey), Panzer et al. (2013), and Vasconcelos Vaena et al. (2016). The data collected dealt with educational format, integration of the content of blood transfusion, topics covered, the year(s) the subject of blood transfusion was integrated, time allocated, the teaching techniques used in the implementation, and the assessment methods. The data collection tool used by Al-Riyami et al., (2020) was constructed on the foundation of a previously published global platform for evaluating medical school education. It comprised of 20 items including various aspects such as demographics, educational structure, faculty participation, evaluations, and knowledge assessments. Furthermore, the instrument provided assessments on the sufficiency and need of blood transfusion education. The draft survey was prepared by two experts in blood transfusion from the Global Transfusion Forum (GTF) and was subsequently evaluated and modified with the contributions of members from the Global Transfusion Forum (GTF) Education Subcommittee. The instrument underwent content validity assessment to see if the items effectively represent a specific performance domain, namely the evaluation of the potential of blood transfusion curricula to enhance teaching practices and student performance on a global scale. A panel consisting of two impartial experts from Super Resolution Analytics (SRA), possessing extensive knowledge in qualitative and quantitative survey analysis, assessed the content validity of the survey. They determined whether the survey's items sufficiently represented the relevant domain of interest and concluded that the tool was valid. Specifically, they found that 90% of the survey items aligned with the project's objectives. The questions pertaining to educational format included: the medical school's system of medical education, the inclusion of formal teaching on blood transfusion in the medical degree program, the integration of blood transfusion education into the medical school curriculum, the prevalent education formats for blood transfusion at the medical school, the presence of a standardized curriculum for blood transfusion in the medical school, the mandatory or optional nature of the blood transfusion component in the medical school, and the specific topics covered in the blood transfusion curriculum or education at the medical school. The aspects pertaining to faculty involvement encompassed: the quantity of faculty members instructing blood transfusion in the medical school, the areas of expertise of the faculty members engaged in teaching blood transfusion in the medical school, the exclusive dedication of faculty members to the task of teaching blood transfusion in the medical school, and the additional responsibilities of the teaching faculty apart from instructing blood transfusion. The criteria used for evaluation and assessment included: whether the medical school formally assesses knowledge of blood transfusion, and the specific format of the examination (such as multiple-choice questions, essay questions, case-based discussion, portfolio-based assessment, formative assessment, or other methods.

3.9.2 Questionnaire

A questionnaire is a research instrument that consists of a set of questions or other types of prompts that aims to collect information from a respondent. It is typically a mix of close-ended questions and open-ended questions. In this study a pre-tested questionnaire was used to collect data from the medical doctors. The questionnaire (Appendix 1B) was divided into different areas of interest. The first section covered demographic and background of the respondents, viz., age, sex; educational background-year of graduation, medical school attended, nature of curriculum of undergraduate training, and site of practice variables including designation of the clinician; the second section had questions on factual and perceived knowledge, section three had questions on attitude/awareness, section four had questions on perceived self-confidence, section five had questions on self-reported practice, section six had questions on opinions of the satisfaction with the quality of undergraduate education in blood transfusion, adequacy of the preparedness for practice in blood transfusion and additional education needs.

The factual knowledge was assessed using multiple choice questions, whereas perceived knowledge, attitude, self-reported practice, and self-confidence opinions on the importance of blood transfusion knowledge, satisfaction with the quality of undergraduate medical education in blood transfusion, and the usefulness of more training in blood transfusion were measured using Likert scale items. Multiple choice questions, checklists, and rating scales are recognized methods used to assess theoretical and practice competency in medical education (Al-Wardy, 2010; Kak et al., 2001) and have also been used to assess competences in blood transfusion practice (McClelland & Franklin, 2010; Graham et al., 2014). Rating scales, e.g., the Likert scale, are particularly useful for assessing personal and professional attributes, generic competencies, and attitudes (Al-Wardy, 2010). A Likert scale is a type of rating scale used to measure attitudes or opinions (Stephanie, 2015; Likert, 1932). In addition to measuring statements of agreement, Likert scales can be used to measure other concepts such as confidence, frequency, quality, importance, satisfaction, likelihood, etc. (Sullivan &Artino, 2013; Mcleod, 2008). The Likert scale that was used for assessing the overall perceived knowledge had a rating of 1 to 5 (1 = poor, 5 = excellent); for the attitude, the scale was 1 to 5 (1 = strongly disagree, 5 = strongly agree); and for self-reported practice, the scale was 1 to 5 (1 = never', 5 = always). The Likert scale for self-confidence had ratings ranging from 1 to 10 (1 = not confident', 10 = fully confident'). The importance scale was 1 to 5 (1 = not important, 5 = extremely important), the satisfaction scale was 1 to 5 (1 = very dissatisfied, 5 = very satisfied), and the usefulness scale was 1 to 4 (1 = not useful, 4 = extremely useful).

The questions on factual knowledge were adapted from tools used by previous similar studies that used validated questionnaires, viz: Haspel et al. (2014)- (the (Biomedical Excellence for Safer Transfusion (BEST) Collaborative tool), Laher& Patel, (2019; Kumarage et al., (2017; J. Lim et al., (2017); Yudelowitz et al., (2016); Graham et al., (2014); Lin et al., (2016); and Ruhi& Seema, (2016). The questions selected were based on the World Health Organization clinical transfusion practice standards guideline for newly graduated medical doctors and include careful selection of donors, screening of donations, storage of donations for clinical use, blood components and their appropriate indications including transfusion trigger, compatibility testing, issue of blood units for either routine or emergency use, proper administration of blood supplied or the return of units not needed after issue, recognition and management of transfusion reactions, and documentation of the transfusion (World Health Organization, n.d.) and the Kenyan guidelines for the appropriate use of blood and blood products (Kenya Blood Transfusion and Transplant Service, 2022). The multiple-choice questions had one correct answer that earned a score of 1 and wrong answers were scored as zero. A 'don't know' option was added to the choices to minimize guesswork and this was scored as zero. The question on perceived overall knowledge was adapted from instruments used by Halford et al., (2021); Wheeler et al., (2021); Haspel et al., (2015); Lin et al., (2019).

The attitude questions were adapted from a study by Ddungu et al. (2018). They assessed the doctor's awareness that blood transfusion is an essential element of health care but that blood is a scarce and costly resource and that its use is without risks, and therefore it should be used in a rational manner. They also assessed the importance of informed consent and the role of guidelines and thresholds (triggers) in transfusion practice. There were also four attitude and perception questions on importance or relevance of blood transfusion medicine to clinical practice, satisfaction with the quality of undergraduate medical education in blood transfusion, adequacy of preparation by the undergraduate medical education on blood transfusion practice, and usefulness of additional training on blood transfusion. These questions were adapted from data collection instruments used by Halford et al., 2021; Wheeler et al., 2021; Haspel et al., 2015; Lin et al., 2019).

The questions dealing with perceived self-confidence were adapted from studies by Graham et al. (2014), Peedin et al. (2019), Wheeler et al., 2021, Halford et al., 2021 and Haspel et al., 2015). The questions were based on the World Health Organization clinical transfusion practice standards guideline for newly graduated medical doctors (World Health Organization, n.d.) and the British Society for Haematology guideline on the administration of blood components (Robinson et al., 2018).

The self-reported practice questions were adapted from studies by Ddungu et al. (2018) and Graham et al. (2014) and were based on the recommended best transfusion practices (Robinson et al., 2018; World Health Organization, 2001; Letowska, 2009).

One open-ended question was added that solicited opinions on what areas or topics in blood transfusion should be included or improved during undergraduate medical education. The self-administered questionnaire was slightly revised after feedback from a pilot study done to check for clarity and flow.

3.10 Validity and Reliability of the Data Collection Instruments

This outlines the methods used to ensure the validity and reliability of the data collection instruments.

3.10.1 Validity of the Data Collection Instruments

Validity or accuracy is defined as the extent to which the scores from a measure represent the variable they are intended to measure (Heale & Twycross, 2015). In this study, validity was ensured by sharing the questionnaire and the data abstraction form with experts in the field of blood transfusion for their opinion on the adequacy of content coverage, accurate representation of the constructs, clarity, and proper structuring. The validity was also ensured by adapting questions from similar studies that had used validated instruments.

3.10.2 Reliability of the Data Collection Instruments

Reliability or precision is the extent to which a test or a procedure produces similar results under constant conditions on all occasions. It is the consistency or the stability of the test instrument (Heale& Twycross, 2015). The reliability of the instruments was ensured by carrying piloting them and calculating an internal consistency of the knowledge, attitude, self-reported practice, and self-confidence items.

3.10.2.1 Piloting of the Data Collection Instruments

A pilot or feasibility study is a mini study to test research protocols, Tools for collecting data, sample recruitment strategies, and other research techniques in preparation for a larger study. It is conducted to pinpoint probable issue areas and flaws in the research tools and protocol prior to implementation during the full study (Hassan et al., 2006)**.** In our research, the feasibility study was carried out at Masinde Muliro University Medical School for the document analysis/data abstraction form and among 20 medical doctors working at Kisii County Referral Hospital for the questionnaire. Necessary adjustments were made to the data collection tools. The data collected from the medical doctors was used to determine the reliability of the constructs being studied by calculating a Cronbach's alpha coefficient. In addition, responses to online and paper-based questionnaires were compared, and there was no significant variation between the two that could affect the results of the study.

3.10.2.2 Internal Consistency of Questionnaire

The reliability of the instrument was also ensured by calculating internal consistency of the constructs in the questionnaire by way of Cronbach's alpha from data of a pilot study of 20 medical doctors who shared similar characteristics with the study participants. The coefficients for the constructs- knowledge, attitude, self-reported practice, and self-confidence were 0.543, 0.636, 0.803, and 0.805, respectively. The coefficient for the overall constructs was 0.814. A generally accepted rule is that a Cronbach's alpha of 0.6–0.7 indicates an acceptable level of reliability (Ursachi et al., 2015; Hassan et al., 2017), and an alpha of 0.8 or greater is very good (Ursachi et al., 2015). Low values of the alpha coefficient could be the result of a low number of questions, poor inter-relatedness between items, or heterogeneous constructs (Tavakol & Dennick, 2011b). In our study, the low alpha coefficient for the knowledge construct could be due to the low number of questions; however, according to McCowan & McCowan (1999), reliabilities as low as 0.50 are satisfactory for short tests of 10 to 15 items, hence the alpha coefficient of 0.543 for the knowledge construct in our study is acceptable.

3.11 Data Collection Procedures

This summarizes the data collection activities in the study sites. They included training of research assistants, collection of data from the curricula of medical schools and from the medical doctors.

3.11.1 Training of Research Assistants

Two research assistants were trained. They were informed about the purpose of the research and taught how to administer the paper questionnaires and use the abstraction form to collect data from the curricula. The researcher designed and administered the web-based questionnaire with help from an information and communication technology (ICT) expert.

3.11.2 Collection of Data from Medical School Curricula

The curricula from the eligible medical schools were obtained and analyzed. Three universities provided soft copies of their curricula, and for the remaining three, a visit was made to the universities to analyze the curricula on site. The data collected was entered into data abstraction forms.

3.11.3 Collection of Data from the Medical Doctors

The questionnaires were self-administered via paper and web-based surveys. The study participants were identified from lists of medical doctors working at the selected study sites. The list was obtained from the administrators of the respective health facilities, and it contained contacts (phone numbers) of the doctors. The doctors were contacted, either by phone call or WhatsApp, and informed about the study to ascertain their interest in participating. They were also asked whether they preferred an online or paper questionnaire. The online survey was carried out using Google Forms software. The questionnaires had a consent form, which the participants were to sign before filling them out. Web-based surveys, or e-surveys, are surveys designed and delivered using the internet, and their use is becoming increasingly common in medical research (Maymone et al., 2018). The validity and reliability of web-based surveys have been shown to be comparable to those obtained by classical methods (Eysenbach& Wyatt, 2002). Research assistants who had been trained assisted in the administration of the questionnaires. There was no time limit for filling in the questionnaire, and participants were able to pause or save (in cases of the online questionnaire) and return to the tool later after they had started filling it.

Weekly reminders were sent to the participants. The participants who did not submit the questionnaires were not contacted again after three reminders. It's unlikely that the non-respondents differed substantially from those who responded, and it could be assumed that the non-compliance was because of procedural factors.

3.12 Data Analysis

This summarizes how data collected was analyzed**.** The data collected was entered and analyzed using SPSS version 22.

3.12.1 Analysis of the Data from the Medical Schools Curricula analysis

Data from the analysis of the curricula of medical schools was analyzed using frequency tables and percentages.

3.12.2 Analysis of Data from the Medical Doctors

Data collected from the medical doctors was by way of both descriptive and inferential statistics**.** Categorical variables were summarized using frequency tables and percentages, whereas continuous data was summarized using the mean, standard deviation (sd), median, and interquartile range (IQR). Bivariate analysis was done by using the Kruskal-Wallis test, the Mann-Whitney U test, and Spearman's rank correlation after normality tests (Kolmogorov-Smirnoff and Shapiro-Wilkins tests) showed that the data was not normally distributed for all the constructs. Multivariate analysis was done by multiple logistic regression for variables with $p \leq 0.05$ after the bivariate analysis, and associations were reported by use of Odds ratio (OR) and 95% CI. A p value of < 0.05 was taken as statistically significant.

The scores of the entire items for each of the perceived constructs (perceived knowledge, attitude, self-reported practice, and self-confidence) were combined to generate a composite score (Boone & Boone, 2012; Sullivan &Artino, 2013) which was used for inferential analysis. The study participants were also divided based on their composite scores for the various constructs into those who scored above or below the median (*Analyzing Likert Scale/Type Data*, n.d.). Participants who scored above the median of the knowledge construct were classified as ‘having satisfactory’ or ‘more’ knowledge, those whose practice competency scores above the median were classified as being ‘competent’ or ‘more competent’, whereas those whose confidence scores were above the median were classified as being ‘confident’ or ‘more confident’ and vice versa. According to DeCoster et al., 2011; Iacobucci et al., 2015; Bender & Grouven, 1998) dichotomizing continuous variables by way of cut-off points to analyze the data by use of binary logistic regression models is a valid approach.

3.12.2.1 Measurement of Factual Knowledge

For the factual knowledge construct, the quality of each of the question items was analyzed using the item difficulty index, item discrimination index, and point-biserial correlation coefficient (PBSCC), analytical measures used by Tavakol & Dennick (2011) and Graham et al. (2014). The item discrimination index was computed by selecting 27 percent of the highest and lowest scorers after ranking the knowledge scores. The number of correct answers in the highest 27 percent was subtracted from the number of correct answers in the lowest 27 percent, and the result was divided by the number of people in the larger of the two groups (Kelley, 1939). The percentage of 27 percent is used because "this value will maximize differences in normal distributions while providing enough cases for analysis" (Wiersma & Jurs, 1990, p. 145).

An overall knowledge competency score was calculated by dividing the number of correctly answered questions by the total number of questions and multiplying the result by 100. Measures of central tendency (mean and median) and dispersion (range, standard deviation, and IQR) were also calculated.

3.12.2.2 Measurement of Attitude

This construct was measured using eight Likert items. Four of the items were positively worded, while four were negatively worded. The negatively worded were reverse coded during analysis. The overall level of attitude was categorized using Bloom's cut-off point (Okello et al., 2020; Seid & Hussen, 2018; Bloom & Krathwohl, 1956) as follows: positive if the score was 75–100% (≥30 - 40), neutral if the score was 50–74% (≥20 - <30), and negative for scores less than 50% < 50 (<20).

3.12.2.3 Measurement of Self-reported Practice Competency

The self-reported practice was assessed based on the level of adherence to generally recommended best blood transfusion practices. This construct was assessed using ten Likert-scale question items. The overall practice score was defined as the total score to 10 clinical blood transfusion practice questions and this was expressed as a percentage. The self-report of always performing the selected procedures was taken to indicate higher level adherence to recommended practices. An exception to this was on one item dealing with the use of haemoglobin, where the report was expected to 'never' and this item was reverse coded during analysis.

3.12.2.4 Measurement of Self-confidence

This construct was measured using seven Likert-scale items. The confidence score was defined as the total score to the seven self-confidence questions, and this was expressed as a percentage with a higher score indicating a higher level of perceived self-confidence in performing common blood transfusion procedures.

3.13 Presentation of the Research Results

This refers to the organization of data in order to derive logical and statistical conclusions from the collected measurements. In this study, data is presented in the form of text, tables, graphs, and charts.

3.14 Ethical Considerations

Research ethics is defined as the moral rules and professional codes of conduct applied during the research process, in particular the active acceptance of subjects' rights to privacy, confidentiality, and informed consent (Oxford University Press, 2020). According to the World Health Organization (2016), it is crucial to adhere to ethical principles in order to protect the dignity, rights, and welfare of research participants. In this study, ethical approval was obtained from the institutional research and ethical committee (IREC) of Moi University and MTRH, and permission was sought from the hospital administration of participating hospitals and medical schools, respectively. A permit to carry out the study was also obtained from the National Commission for Science and Technology (NACOSTI). Informed consent was obtained from the individual study participants, and confidentiality was maintained.

3.15 Dissemination of the Research Findings

Dissemination is defined as "the process of communicating information, e.g., research findings, through defined channels and media in order to reach various target groups (e.g., national policymakers, researchers, health professionals, or consumers) (Bauman et al., 2006). The aim of data dissemination is to elicit immediate action, promote behavior change, share new information or insights, solicit support or participation, educate about recent findings or accomplishments, and document the magnitude of a health problem, among others (Centers for Disease Control and Prevention, 2013).

In this study, research findings have been disseminated by presentation of a poster in a conference and publishing two articles in peer-reviewed journals.

The findings will also be deposited at the university’s repositories (the learning resource center and the digital archive) and presented at conferences.

3.16 Summary of Chapter

This chapter provided an overview of the various aspects related to the research design and methods used in this study. Additionally, it addressed the issues of the study sites, target and study population, and sample size calculation while also considering the sampling techniques. It also described the research data collection instruments and their assessment for validity and reliability. The chapter also detailed the analysis of the data, presented the ethical considerations, and outlined a plan for disseminating the study results.

CHAPTER FOUR

4.0 DATA ANALYSIS, PRESENTATION AND INTERPRETATION

4.1 Overview

In this chapter, the results of the study are presented. The findings include characteristics of the study participants, the content of blood transfusion in the curricula of medical schools in Kenya, perspectives and perceptions of medical doctors about their undergraduate medical education in blood transfusion (year the subject was taught, time spend in learning, types of teaching and learning experiences, satisfaction with quality of education, and adequacy of preparation) The results of level of knowledge , attitude, self-reported practice competency, and self-confidence of the medical doctors in blood transfusion are also included. Furthermore, the chapter presents results on the associations between the variables of the study. Finally, the perceptions of medical doctors on blood transfusion practice and training needs (importance of the knowledge of blood transfusion on their practice, the usefulness of further training in blood transfusion, and areas for improvement in the subject of blood transfusion in the undergraduate curriculum) are also covered.

4.2 Characteristics of the Study Participants

The characteristics of the medical schools whose curricula were analyzed are presented. The demographic, educational background and the site of practice characteristics of the medical doctors are also handled.

4.2.1 Characteristics of the Medical Schools

A total of six medical school curricula were analyzed, representing a response rate of 66.7% (6/9). These include the medical schools of Maseno University, Moi University, Uzima University, the University of Nairobi, Kenya Methodist University, and Jomo Kenyatta University of Agriculture and Technology. Of the six curricula, five were traditional or conventional, whereas one was innovative. All the medical schools implement a six-year undergraduate medical education, where the first three years (years 1–3) are pre-clinical and the next three (years 4–6) are clinical.

4.2.2 Characteristics of the Medical Doctors

This outlines the response rate, the demographic, educational, and site of practice characteristics of the medical doctors.

4.2.2.1 Response Rate of the Medical Doctors

The response rate of the medical doctors was 75%. Though the acceptable response rate for survey research can vary depending on the field of study, the target population, and the mode of survey administration, a response rate of 50% or higher is generally considered acceptable, with 60% to 70% considered good and rates above 70% considered very good or excellent (Babbie, 2013; Dillman et al., 2014; Nulty, 2008). According to Fincham (2008), a mixed-mode approach to administering survey instruments (e.g., mailed, email, and internet-based response mechanisms) helps improve the representativeness of the sample, hence the validity of the survey results. Response rates are determined by dividing the number of usable responses returned by the total number eligible in the sample chosen (Fincham, 2008).

4.2.2.2 Demographic Characteristics of the Medical Doctors

Out of the 200 medical doctors that were engaged, a total of 150 returned completed questionnaires, representing a response rate of 75%. The mean age of the participants was 29.9 (SD 3.6) and the median was 29 (IQR: 27, 33) with a range of 25–45 years. Males made up 60% of the doctors. On the educational characteristics, about 37% (n=55) of the participants undertook their undergraduate medical education at the University of Nairobi, followed by Moi University (34%, n=51). The majority (66%, n=99) of the respondents went through a conventional curriculum. About 35% (n= 53) of the participants reported that they had an experience of 2-5 years after graduating from medical school, while the majority (73.3%, n=110) reported that they did not participate in any training on blood transfusion after graduating from medical school. Concerning the site of practice characteristics, the majority of the medical doctors worked in county referral hospitals (62%, n=93), while the rest worked in MTRH. Medical officers comprised 39.3% (n=59), interns 34.7% (n=52) and residents 26% (n=39). About 19% of the participants worked in the obstetrics and gynecology unit. Most of the respondents (84.0%, n=126) reported that they were not give an orientation or induction on blood transfusion before they embarked on their internship, and 46.0 (n=69) reported that they prescribe blood transfusion once in a week. The details of the demographic, educational background, and site of practice characteristics of the study participants are shown in Table 2.

Table 2: The medical doctors' demographic, educational, and site of practice characteristics

Characteristic	N	%
Age (years)		
25-29	81	54.0
30-34	53	35.3
≥35	16	10.7
Sex		
Male	90	60.0
Female	60	40.0
Medical school attended		
Maseno University	4	2.7
University of Nairobi	55	36.7
Uzima University	3	2.0
Kenyatta University	14	9.3
Jomo Kenyatta University of Agriculture and Technology	9	6.0
Moi University	51	34.0
Mt Kenya University	2	1.3
Kenyatta University	2	1.3
Egerton University	10	6.7
Nature of the curriculum of undergraduate training		
Conventional/Traditional	99	66.0
Innovative	51	34.0
Number of years after medical school		
≤ 1 year	52	34.7
2-5 years	53	35.3
> 5 years	45	30.0
Whether participated in training in blood transfusion after undergraduate education		
Yes	40	26.7
No	110	73.3
Hospital		
MTRH	57	38.0
County	93	62.0
Designation		
Intern	52	34.7
Medical officer	59	39.3
Resident/registrar	39	26.0
Ward/specialty based in		
Medicine	21	14.0
Paediatrics	22	14.7
General surgery	27	18.0
Orthopedic surgery	8	5.3
Family medicine	5	3.3
Accident & Emergency	14	9.3
Anesthesia	5	3.3
Obstetrics and Gynecology	29	19.3
Not specified	19	12.7

Whether given pre-internship orientation in blood transfusion		
Yes	24	16.0
No	126	84.0
Frequency of prescribing blood transfusion		
Once a month	25	16.7
Once a week	69	46.0
At least once per day	56	37.3

4.3 Results from the Analysis of Medical Schools' Curricula

The results of the content of blood transfusion in the undergraduate curricula of Kenyan medical schools is presented in terms of how it was integrated into the curricula (availability, the year the subject was included, and the topics included), the time allocated, the methods used in the implementation, and the assessment methods.

4.3.1 Availability and Integration of Content of Blood Transfusion into the Medical Schools Curricula

All the curricula analyzed had a component on blood transfusion, and the content was incorporated into the grids of other disciplines. The subject of blood transfusion was incorporated into the discipline of haematology in all the medical schools' curricula, whereas four schools had the subject integrated into the physiology discipline. The subject was contained in the disciplines of general surgery, paediatrics, and immunology in 33.3% (n=2) of medical schools. Single medical schools had the subject in the disciplines of orthopaedics, internal medicine, and pathology. The distribution of how the subject is integrated into the curricula of the medical schools is shown in Figure 7.

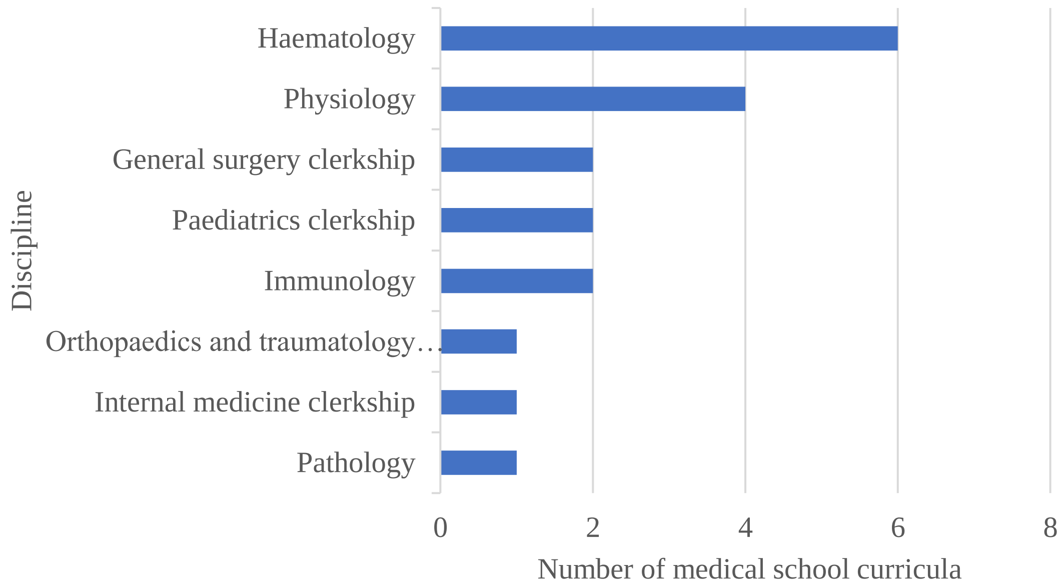
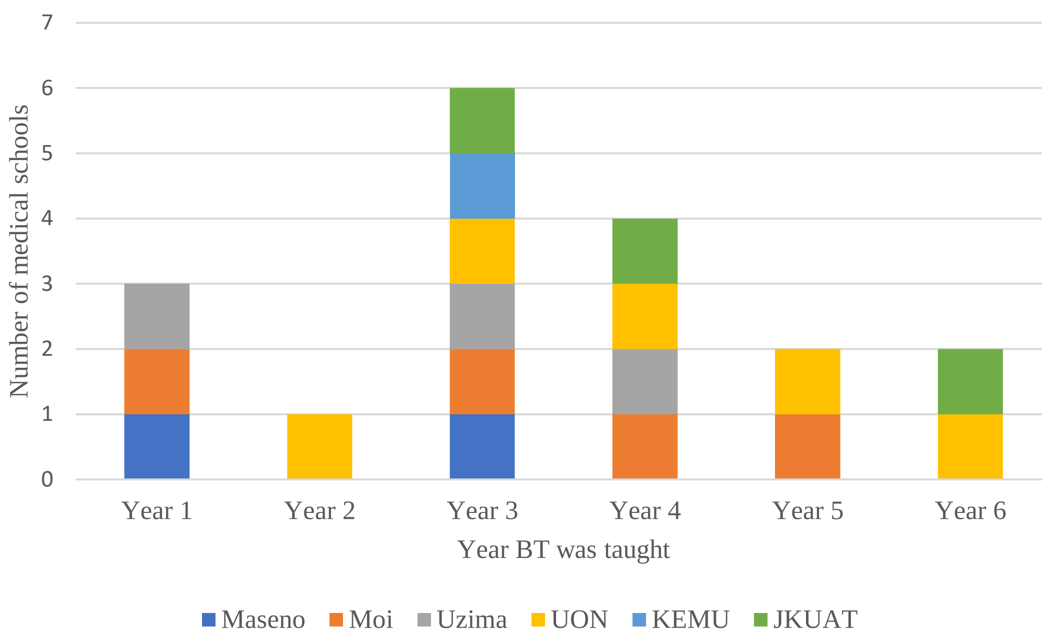


Figure 7: The disciplines by which the subject of blood transfusion is integrated

4.3.2 The Year in The Medical School Curricula in Which the Subject of Blood Transfusion was Included

The subject of blood transfusion was included in the third year of medical training in all of the medical schools. The subject was included in the fourth year of medical training in four (66.7%) medical schools and in the first year in 50% (n=3) of medical schools. One school included it during the third year only. Two medical schools offered it in four years or more. Only one (16.7%) medical school had the subject incorporated into all the clinical years. None of the medical schools had BT integrated into all the years of training. The distribution of the years the blood transfusion content was integrated in medical schools is as shown in Figure 8.



UON- University of Nairobi; KEMU- Kenya Methodist University; JKUAT- Jomo Kenyatta University of Agriculture and Technology

Figure 8: The year of study in medical school curricula in which the subject of blood transfusion was taught

4.3.3 Topics in Blood Transfusion That Were Covered in the Curricula

The topics that were covered in all the medical schools' curricula include the physiology of blood, blood groups, indications and clinical use of blood components, compatibility testing, and complications of blood transfusion. Fifty percent of the medical schools had topics on an overview of the transfusion process (vein-to-vein transfusion process) and the national transfusion service. Single medical schools had topics like alternatives to blood transfusion, blood donation, haemovigilance, and apheresis in their curricula. The distribution of the topics is illustrated in Figure 9.

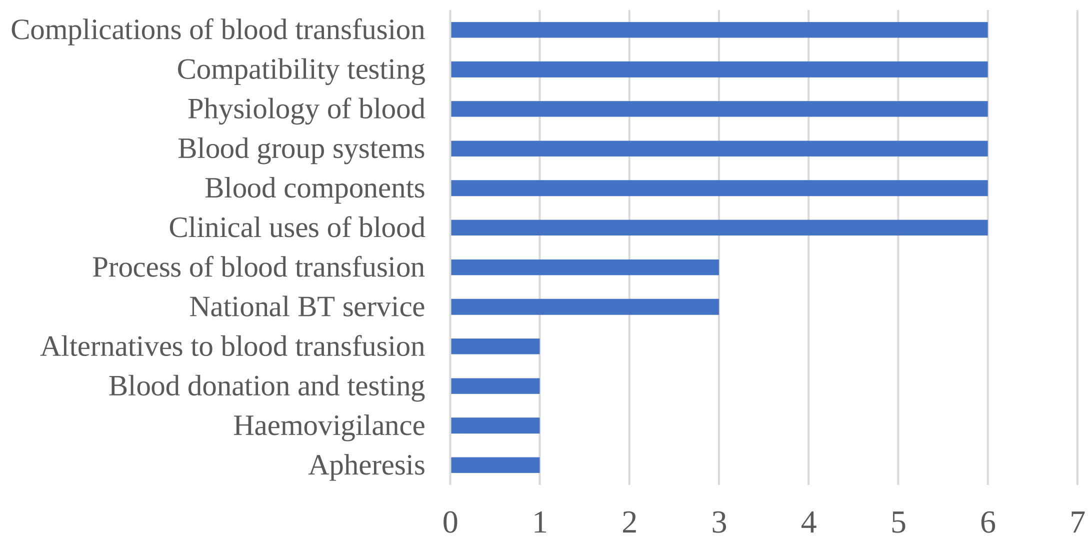


Figure 9: Distribution of the topics in blood transfusion included in the medical schools' curricula.

4.3.4 Time Allocated to The Teaching of Blood Transfusion

The time allocated to teaching blood transfusion in all the medical schools was not apparent. Where the subject was integrated with haematology, the total number of units allocated to both haematology and blood transfusion was three units, or three credits. However, it was not indicated how much of this time was to be devoted to teaching blood transfusion.

4.3.5 Methods of Teaching Blood Transfusion

The curricula of the medical schools had a section outlining the teaching and learning methodologies to be employed in the implementation of the general curriculum. The methods included lectures, overviews, tutorials, large group discussions and seminars, laboratory practicals, clinical demonstrations, and clinical teaching/clerkship, fieldwork, and e-learning. In addition to the above methods, the innovative curriculum had also self-directed learning, problem-based learning (PBL), community-based learning, and electives. Though the methods were not specific to a particular course or subject, it can be assumed that these strategies were also applied while teaching the subject of blood transfusion.

4.3.6 Assessment Methods Used in Blood Transfusion

The curriculum of the medical schools included a part that detailed the assessment procedures to be employed in the execution of the overall curriculum. The curriculum included both formative assessments, which were conducted at the end of each semester or term, and summative assessments, which were conducted at the end of each year. The specified evaluation techniques mentioned encompassed multiple-choice questions, essay questions, laboratory practicals, log books, and viva voce. While the formats and procedures used were not exclusive to any single course or subject, it is reasonable to presume that these strategies were also employed when evaluating students in the field of blood transfusion. We conducted a sampling and analysis of log books from a medical school to assess the presence of blood transfusion activities. However, we found that only logbooks from one clinical department included information on blood transfusion, but without particular procedures related to it.

4.4 The Perspectives of the Medical Doctors on Blood Transfusion Education in Medical School

The medical doctors' perspectives about their education in blood transfusion during medical school are in terms of the year the subject was taught, the time spent learning blood transfusion, and the teaching methods experienced while being taught blood transfusion.

4.4.1 The Year Blood Transfusion was Taught in Medical School as Reported by the Medical Doctors

The majority (80.0%; n = 120) of the medical doctors reported that they were taught BT during the 3rd year of their undergraduate training. Those who stated that the subject was taught in the 1st, 2nd, 4th, 5th, and 6th year of study were 6.7% (n = 10), 22% (n = 33), 24.7% (n = 37), 23.3% (n = 35), and 22% (n = 33), respectively. These findings are summarized in Figure 10.

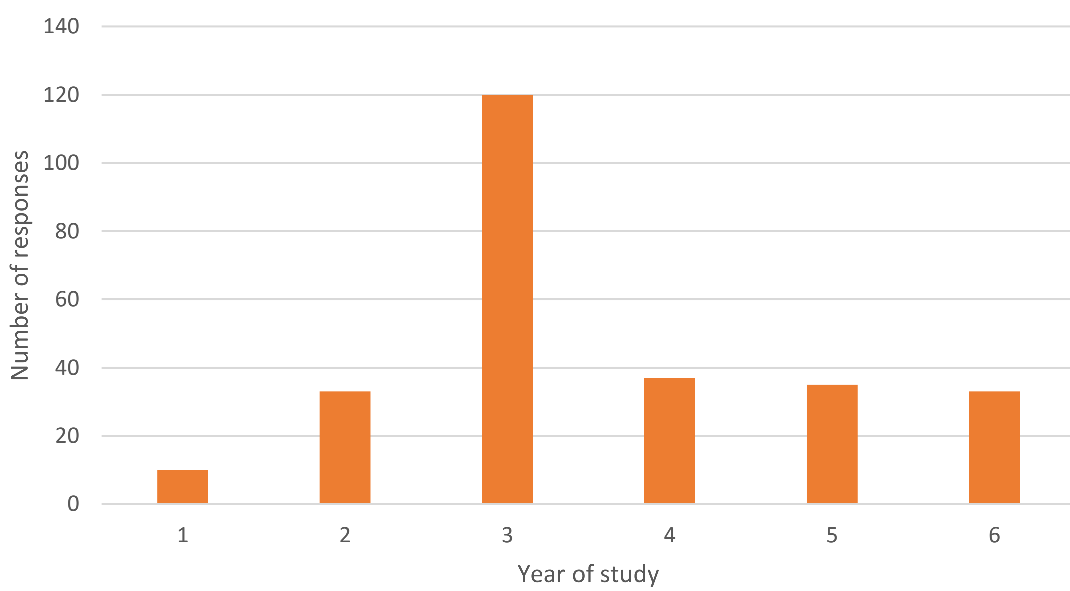


Figure 10: The year blood transfusion was taught in medical school as reported by the medical doctors (multiple responses)

4.4.2 Time the Subject of Blood Transfusion was Taught in Medical School

About 31.3% (n = 47) of the respondents reported that the subject of blood transfusion was taught for more than 6 hours during their undergraduate medical education, while

20.7% (n = 31) and 20% (n = 30) of them stated that they were taught blood transfusion for 5–6 hours and 3–4 hours, respectively. About 17% (n = 25) of the participants reported that they were not sure of the time the subject was taught during medical school. These findings are shown in Figure 11.

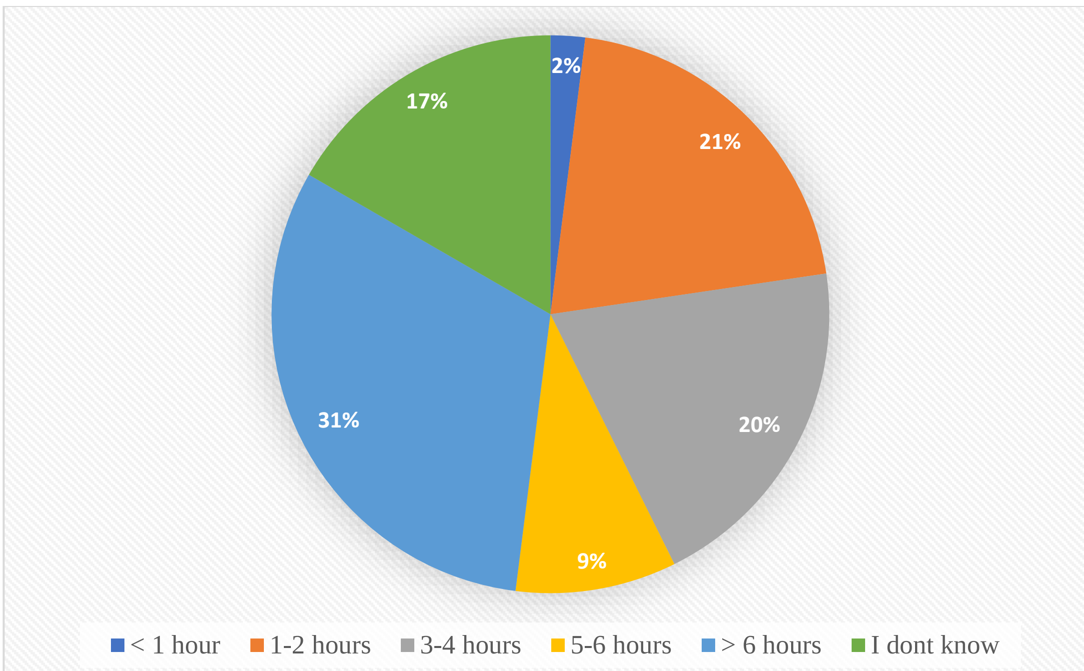


Figure 11: The reported time that was dedicated to teaching blood transfusion during undergraduate medical education

4.4.3 Types of Teaching and Learning Participated During Undergraduate Education in Blood Transfusion

About 92% (n = 139) of the study participants reported that lectures were the main teaching method used in teaching blood transfusion during their undergraduate medical education. This was followed by laboratory practical sessions at 75% (n = 112), and the least used method was online courses (11%, n = 16), as depicted in Figure 12.

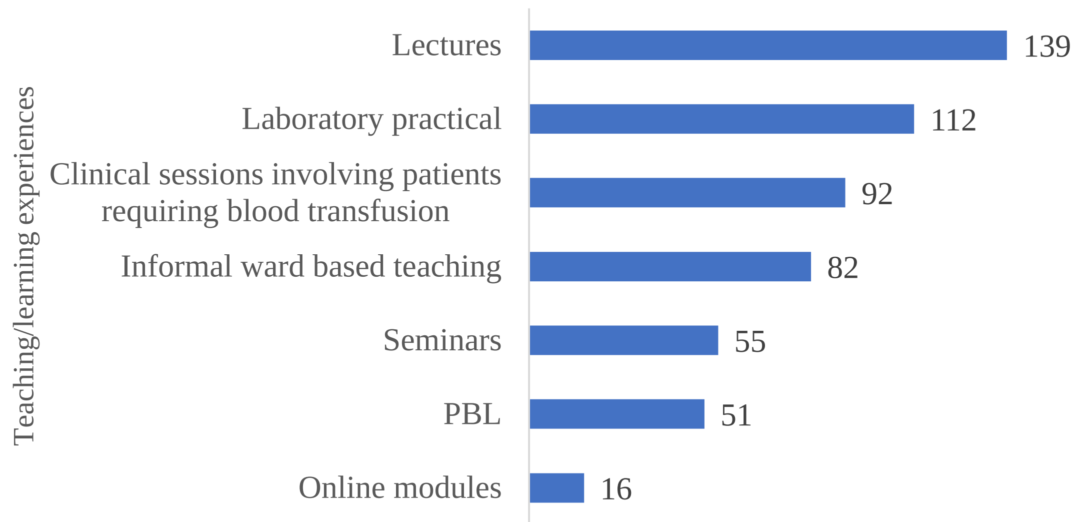


Figure 12: Teaching methods that the medical doctors experienced during education of blood transfusion in medical school (multiple responses, n=150)

4.4.4 The Teaching Methods Experienced During Undergraduate That Were of Great Benefit in Blood Transfusion

The teaching method that was reported to be of greatest benefit in learning blood transfusion was laboratory practical by 62 percent (n = 93). This was followed by the lecture method, where 47.3% (n = 71) of the participants reported that it was of great benefit. The other methods included clinical sessions involving patients being transfused (42%, n = 68), tutorials/PBL (41.3%, n =62), informal ward-based teaching (25.3%, n =38), and online courses (1.3%, n = 2), as depicted in Figure 13.

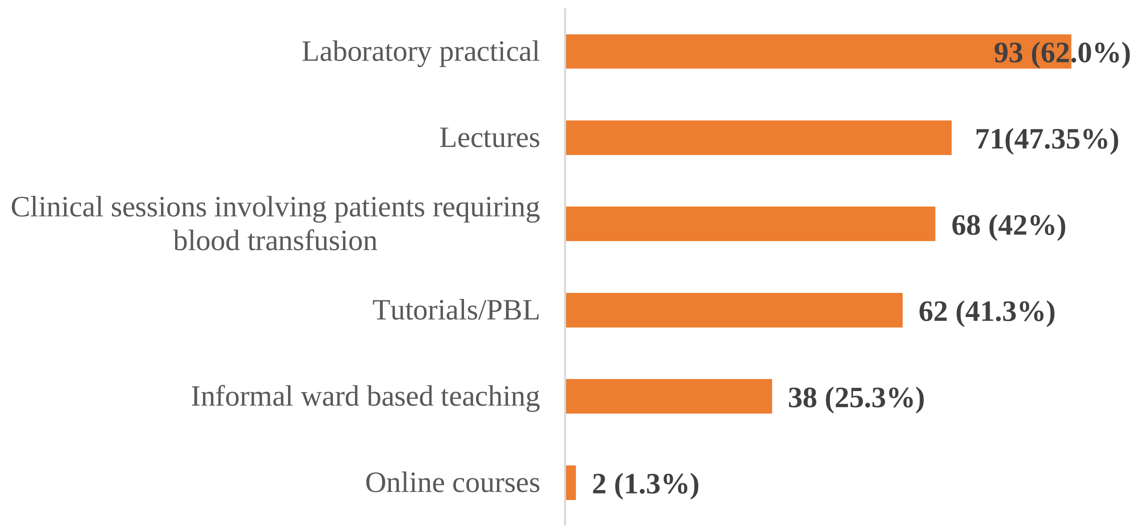


Figure 13: The teaching methods experienced during undergraduate that were reported to be of great benefit in learning blood transfusion (multiple responses)

4.5 Perceptions of the Medical Doctors About Blood Transfusion Education during Undergraduate Medical Education

This summarizes the perceptions and perspectives that the medical doctors had concerning their experiences during blood transfusion during undergraduate medical education. It encompasses opinions on satisfaction with the quality, the time devoted to learning the subject, and the methods used in teaching the discipline.

4.5.1 Satisfaction of the Medical Doctors with the Quality of Undergraduate Education

About 76.0% (n = 114) of the respondents said that they were very satisfied (13.3%, n = 20) or satisfied (62.7%, n = 94) with the quality of the undergraduate medical education they received in blood transfusion. The distribution of satisfaction perceptions with the quality of undergraduate medical education in blood transfusion is shown in Table 3.

Table 3: Satisfaction with the quality of undergraduate medical education in blood transfusion

Level of satisfaction	N	%
Very dissatisfied	3	2.0
Dissatisfied	33	22.0
Satisfied	94	62.7
Very satisfied	20	13.3
Total	150	100.0

4.5.2 Adequacy of the Preparation by the Undergraduate Medical Education for Practice in Blood Transfusion

Majority of the medical doctors (75%) reported that their undergraduate medical education prepared them very adequately (12%) or adequately (64%) for practice in blood transfusion (Figure 14).

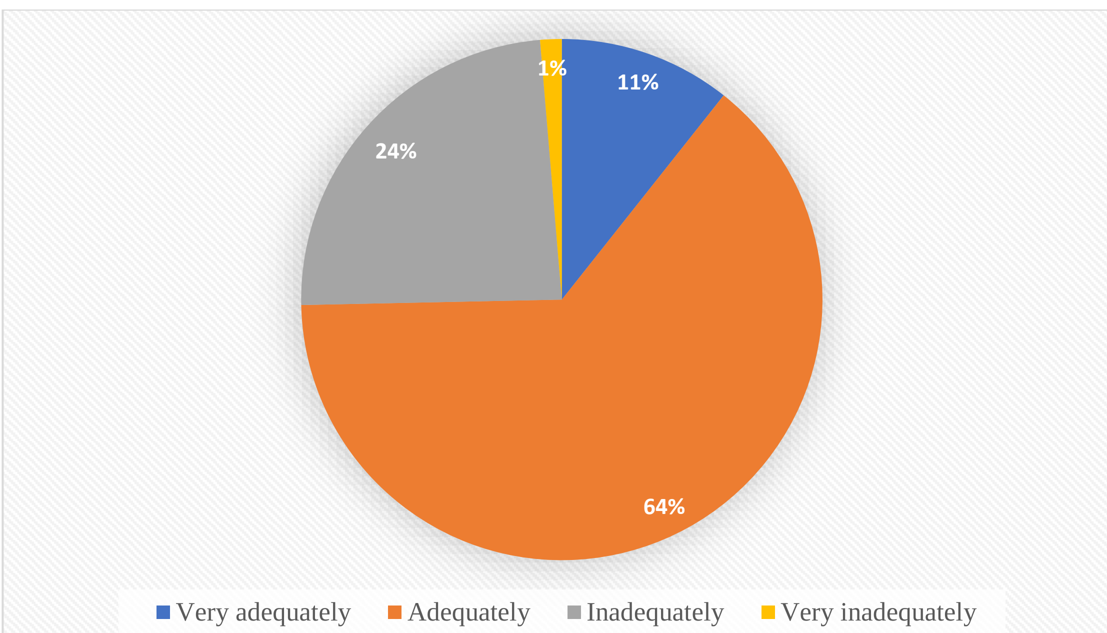


Figure 14: Adequacy of preparation by the undergraduate medication for practice in blood transfusion

4.6 Knowledge, Attitude, Practice Competency, and Confidence Scores of the Medical Doctors in Blood Transfusion

This presents the tests used to assess the normality of the data collected, and summarizes the knowledge, attitude, practice and confidence scores of the medical doctors in blood transfusion.

4.6.1 Normality Tests

Kolmogorov–Smirnov and Shapiro-Wilk tests of normality were conducted to determine whether knowledge score, attitude score, self-reported practical competency score, and self-confidence score data is normally distributed. The Kolmogorov–Smirnov test results indicated p values of 0.003, <0.001, 0.003 and < 0.001 for knowledge score, attitude score, self-reported practical competency score and confidence score, respectively. On the other hand, the Shapiro-Wilk tests showed p values of 0.004, 0.017, 0.001, and < 0.001 for knowledge score, attitude score, self-reported practical competency score, and self-confidence score, respectively. Since the p values for both the Kolmogorov–Smirnov and Shapiro-Wilk tests were less than 0.005 for all the above variables, the null hypotheses were rejected and it was concluded that the data for all the constructs was not normally distributed. Consequently, non-parametric statistical tests (Mann-Whiteny, Kruskall-Wallis and Spearman Rank correlation were used to carry out bivariate analysis. The results for these normality tests are shown in Table 4.

Table 4: Normality tests for the knowledge, attitude, practice and confidence constructs

Tests of Normality						
	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	Df	Sig.	Statistic	Df	Sig.
Knowledge score	0.092	150	0.003	0.972	150	0.004
Attitude score	0.118	150	0.000	0.978	150	0.017
Practical score	0.092	150	0.003	0.964	150	0.001
Confidence score	0.104	150	0.000	0.936	150	0.000

a. Lilliefors Significance Correction

4.6.2 The Knowledge Levels of the Medical Doctors in Blood Transfusion

The knowledge levels of the medical doctors in blood transfusion is presented in terms of factual knowledge scores, the perceived overall knowledge, and their correlation.

4.6.2.1 The Medical Doctors' Factual Knowledge Scores

This summarizes how the quality of the factual knowledge questions was assessed and the analysis, presentation, and interpretation of the scores.

4.6.2.2 Item Difficulty, Item Discrimination Index and Point Biserial Correlation Coefficient of Factual Knowledge Questions

The item difficulty, item discrimination index, and point biserial correlation coefficient were calculated for the entire set of 15 factual knowledge questions to assess their quality. The item difficulty and the discrimination index varied from 25.3 to 92% and 12 to 76, respectively, as shown in Table 5, with a median of 8 (53.3%). Overall, 6 of the 15 questions had more than 50% of the participants giving the correct answer. The item discrimination index (Table 5) and point biserial correlation coefficient (Table 6) were positive for all questions, implying that the chance of a participant obtaining a correct answer depended on the overall score for that individual, indicating that the validity and reliability of the tool were acceptable (Graham et al., 2014; Tavakol & Dennick, 2011; VARMA, n.d.).

Table 5: Item difficulty and item discrimination index of question items

	Item 1	Item 2	Item 3	Item 4	Item 5	Item 6	Item 7	Item 8	Item 9	Item 10	Item 11	Item 12	Item 13	Item 14	Item 15
Item difficulty	49	77	43	85	41	51	41	13	81	48	92	80	43	40	25
Lower 27%	16	19	4	30	3	10	7	1	24	17	34	27	4	13	0
Upper 27%	31	40	35	38	33	38	22	8	40	22	41	38	28	18	27
Lower %	39	46	10	73	7	24	17	2	59	41	83	66	10	32	0
Upper %	76	98	85	93	80	93	54	20	98	54	100	93	68	44	66
IDI	37	51	76	20	73	68	37	17	39	12	17	27	59	12	66

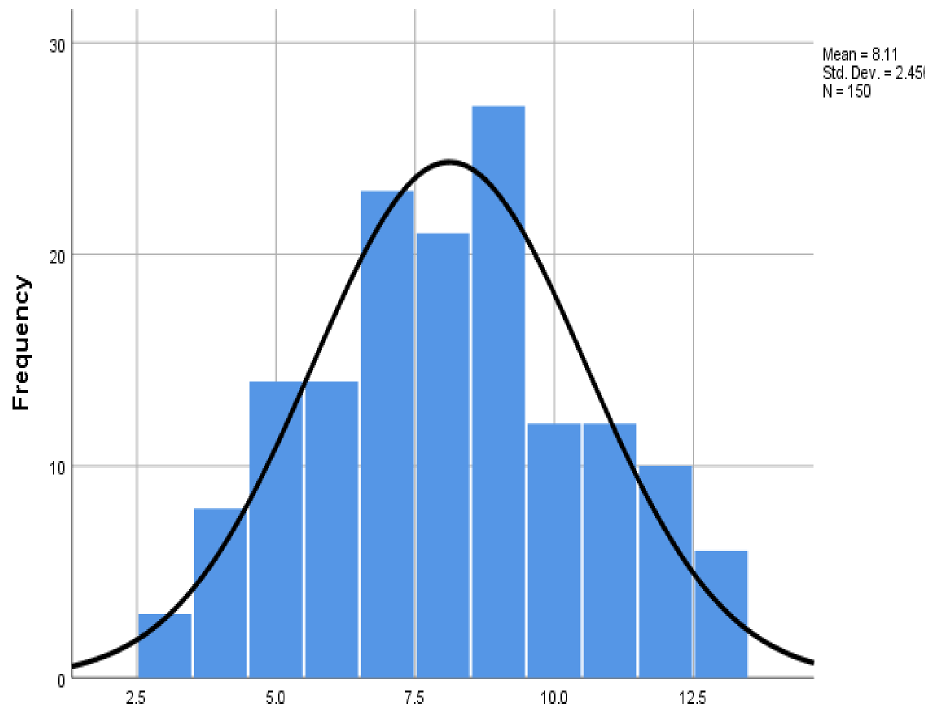
Key: IDI- Item discrimination index

Table 6: Point biserial correlation coefficients of each question item and the overall score

Item/Question	Pearson Correlation coefficient	p-value (2-tailed)
1	0.313	< 0.001
2	0.440	< 0.001
3	0.580	< 0.001
4	0.260	0.001
5	0.571	< 0.001
6	0.540	< 0.001
7	0.321	< 0.001
8	0.148	0.071
9	0.394	< 0.001
10	0.135	0.099
11	0.256	0.002
12	0.298	< 0.001
13	0.492	< 0.001
14	0.119	0.148
15	0.576	< 0.001

4.6.2.3 The Distribution of the Factual Knowledge Scores of The Medical Doctors

The overall mean knowledge score was 8.1 ± 2.5 (54.1 ± 16.4%), with a median score of 8.0 (53.0%), and an interquartile range (IQR) of 6,10 (40.0, 67.0%). The range of the scores was 3–13 (20–87%). The distribution of the overall knowledge score is as shown in Figure 15.



Overall factual knowledge scores

Figure 15: Distribution of the overall knowledge scores of the study participants

On the individual questions, the questions with the highest scores included the one dealing with the action to be taken in the event of an acute haemolytic transfusion reaction (91.4%), the increase in haemoglobin level after transfusion of one unit of packed red cells in a stable non-bleeding patient (84.8%), and the action to be taken after a unit of blood has been delivered to the clinical area (80.8%)). On the other hand, the questions that attracted the lowest scores were those dealing with type and screen (13.2%), the blood component associated with septic transfusion reactions (25.2%), and platelet transfusion threshold in prophylaxis (39.7%). The results for individual questions are presented in Table 7.

Table 7: Distribution of the question scores by topic

Topic	% Correct
Blood donation	49.0
Blood grouping	76.2
Storage of blood components	43.0
Haemoglobin increases after transfusion	84.8
Indication of blood components	40.4
Special blood requirements (irradiation)	51.0
Platelet transfusion (prophylaxis)	41.1
Type and screen policy	13.2
Bedside procedures (administration of blood after receiving in clinical area)	80.8
Appropriate blood use (red blood cell transfusion threshold in chronic anaemia)	47.7
Acute haemolytic transfusion reaction (management)	91.4
Acute haemolytic transfusion reaction (cause)	79.5
Transfusion related lung injury (TRALI)	43.0
Appropriate blood use- red blood cell, platelet and plasma transfusion threshold (procedure prophylaxis)	39.7
Septic transfusion reaction	25.2

4.6.2.4 The Medical Doctors’ Perceived Overall knowledge

The majority of the participants rated their perceived overall knowledge as fair (54%), as shown in Figure 16.

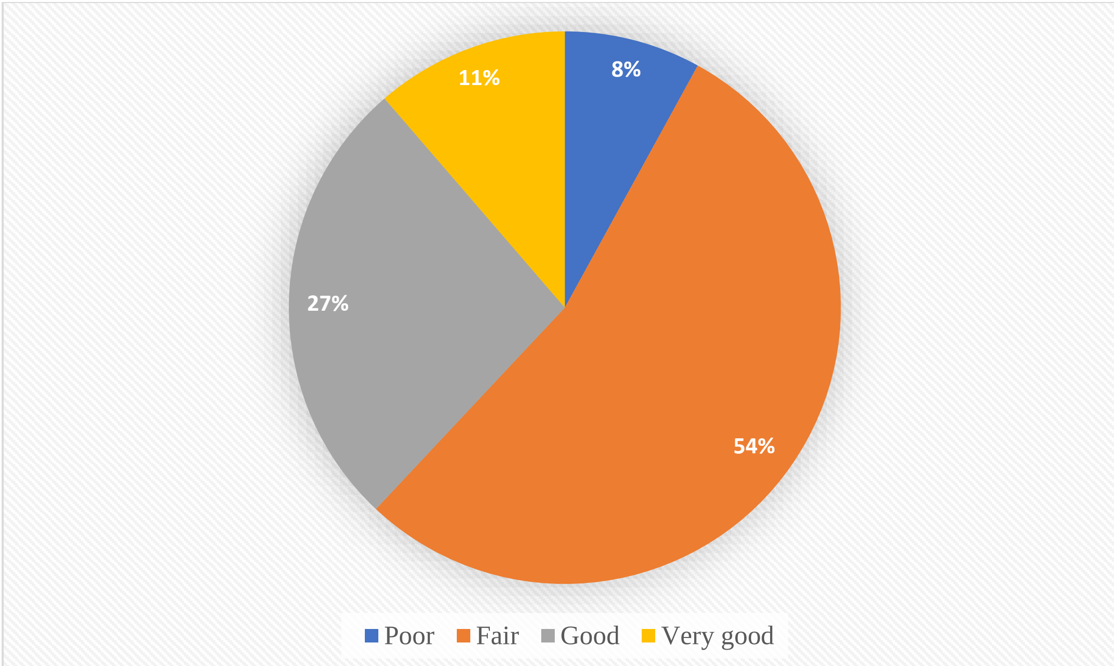


Figure 16: Rating of perceived overall knowledge of blood transfusion

4.6.2.5 Correlation of Factual Knowledge and Perceived Knowledge

When the rating of perceived knowledge was correlated with the factual knowledge score, there was a statistically significant positive correlation with a correlation coefficient of rs = 0.333 ($p < 0.001$). Those who described themselves as having poor knowledge had a median of 7.0, those who considered themselves as having fair knowledge had a score of 7.4; those who rated it as good had a median of 8.8; and those who felt they had very good knowledge had a score of 9.5; and this was statistically significant [H (3) = 18.2, $p < 0.001$] as shown in Table 8. This result suggests that the factual knowledge data collection tool was valid and reliable.

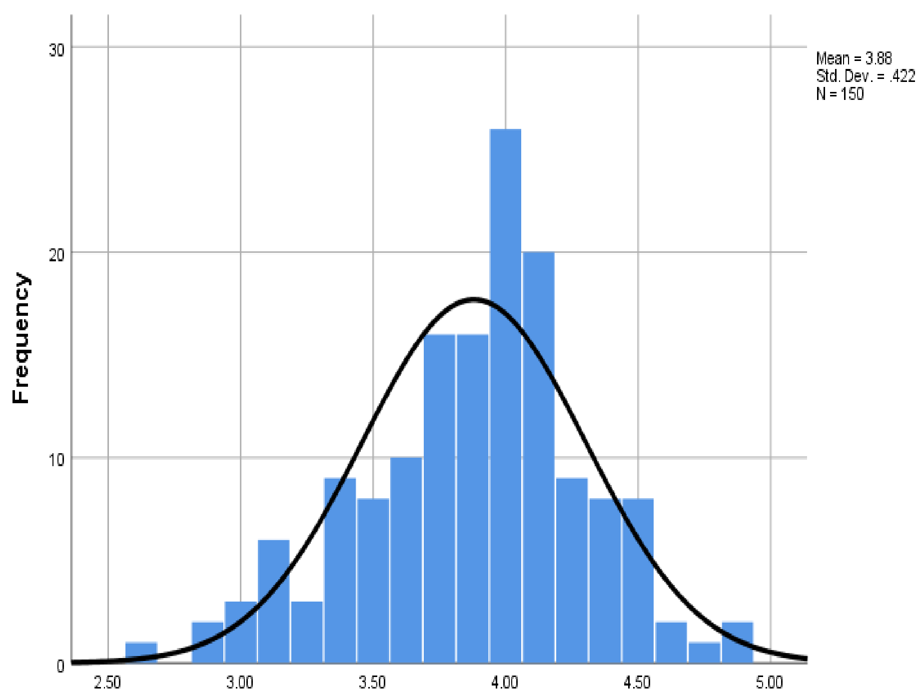
Table 8: Relationship between the overall factual knowledge score and the perceived knowledge in blood transfusion

Perceived knowledge	Overall knowledge score		H (df)	p-value
	N (%)	Median		
Very good	17 (11.3)	9.5	18.2 (3)	**< 0.001**†
Good	40 (26.7)	8.8		
Fair	81 (54.0)	7.4		
Poor	12 (8.0)	7.0		

†Kruskal-Wallis H test

4.6.3 The Attitudes of the Medical Doctors Towards Blood Transfusion

The attitude mean score was 3.8 ± 0.4 (76% ± 8%), and the median was 4.0 (80%) with an interquartile range (IQR) of 3.6, 4.1 (72%, 82%). The range of the scores was 2.6-4.9 (52-98%). The distribution of the overall attitude score is as shown in Figure 17.



Overall attitude scores

Figure 17: Distribution of the overall attitude scores attitude of the study participants

On the specific attitude questions, about 91% (137) of the study participants strongly agreed (54.7%) or agreed (36.7%) that though donors donate their blood freely, there are costs associated with its processing and administration. Whereas, about 73% (109) strongly agreed (28.7%) and agreed (44.0%) that they understand the risks and costs associated with allogeneic blood transfusion, and due to this, they try and minimize the use of blood transfusion.

On the issue of consent, 88.0% (n = 132) strongly disagreed (56.7%) and agreed (31.3%) with the statement that consent is implied and therefore there is no need to obtain one from a patient who required a blood transfusion or their guardians. About 53% (n = 80) of the doctors strongly agreed (20.7%) and agreed (32.7%) that the presence of fatigue, weakness, and pallor is a good indication for a blood transfusion. When it comes to what could influence the clinician's decision to prescribe blood transfusion, about 91% (137) strongly agreed (49.3%) and agreed (42.0%) that the availability of blood components, the cost of a transfusion, and awareness of transfusion guidelines would influence their decision to transfuse a patient. In the same vein, 46% (69) strongly agreed (34.0%) and agreed (12.0%) that a patient with chronic kidney disease and a haemoglobin of 8.8g/dL would make them decide to order a blood transfusion. These findings are depicted in Table 9.

Table 9: The distribution of the ratings of the attitude towards blood transfusion

Item	Strongly disagree n (%)	Disagree n (%)	Not sure n (%)	Agree n (%)	Strongly agree n (%)	Median
Donated blood is free, but there are significant costs associate with blood processing and administration	5 (3.3)	1 (0.7)	7 (4.7)	55 (36.7)	82 (54.7)	4.5
As a clinician I understand the risks and costs of allogeneic transfusion, and because of this, I try to minimize the use of blood transfusion	8 (5.3)	14 (9.3)	19 (12.7)	66 (44.0)	43 (28.7)	4.0
Consent for blood transfusion is implied and therefore there is no need to obtain one from the patient	85 (56.7)	47 (31.3)	7 (4.7)	7 (4.7)	4 (2.7)	4.5
Presence of fatigue, weakness, dizziness, and pallor is a good indication for a blood transfusion.	23 (15.3)	32 (21.3)	15 (10.0)	49 (32.7)	31 (20.7)	2.6
Formulation and implementation of evidence based clinical practice guidelines reduce variation in blood use by medical doctors and promote practices in transfusion medicine	2 (1.3)	2 (1.3)	14 (9.3)	48 (32.0)	84 (56.0)	4.5

Table 9 (Continued)

Item	Strongly disagree n (%)	Disagree n (%)	Not sure n (%)	Agree n (%)	Strongly agree n (%)	Median
The availability of blood components, the cost of a transfusion and awareness of transfusion guidelines would influence my transfusion decision	4 (2.7)	4 (2.7)	5 (3.3)	63 (42.0)	74 (49.3)	4.5
Compared with red blood cells, platelet transfusions are associated with a lower risk of transmission of diseases; hence I can use platelets without worries	1 (0.7)	12 (8.0)	37 (24.7)	56 (7.3)	44 (29.3)	3.9
A patient with chronic kidney disease and a Hb of 8.8g/dL would make me decide to transfuse blood to patient	18 (12.0)	33 (22.0)	30 (20.0)	51 (34.0)	18 (12.0)	3.2

4.6.3.1 Categorization of the Attitudes of The Medical Doctors Towards Blood Transfusion Practice

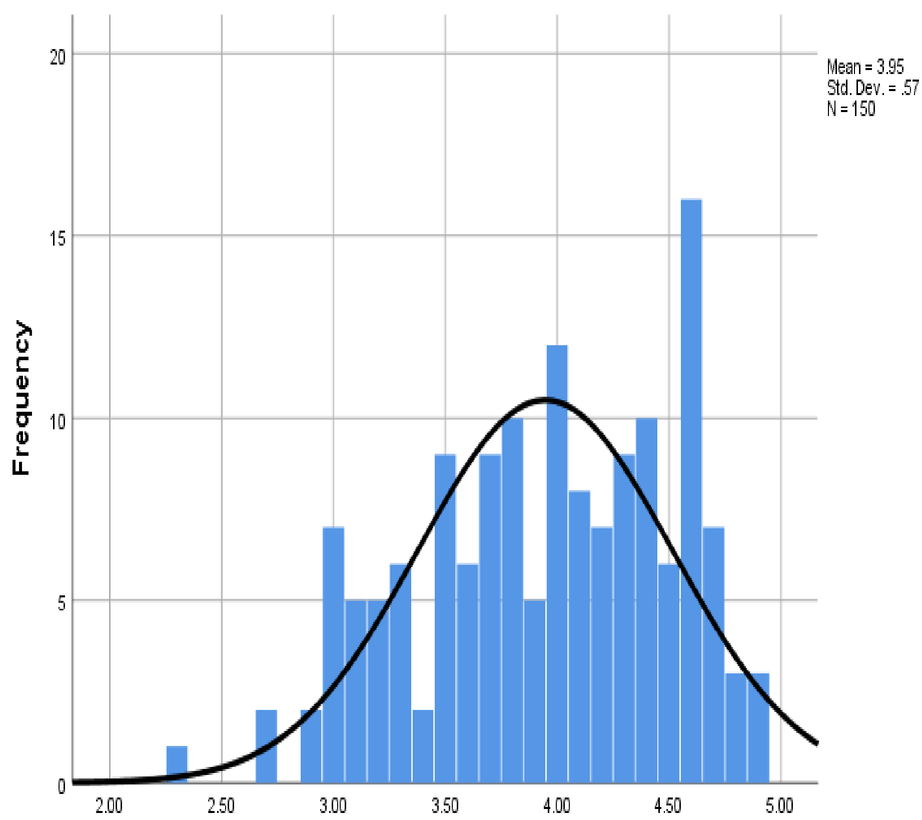
Based on the modified Bloom’s cut-off point criteria, about 73.3% of the participants had a positive attitude towards the practice of blood transfusion, whereas 26.7% were neutral. None of the participants had a negative attitude. These results are shown in Table 10.

Table 10: Categorization of the attitude of the medical doctors towards blood transfusion based on their overall attitude scores

Category	Scores	N	%
Positive	75 - 100%	110	73.3
Neutral	50 - 74%	40	26.7
Negative	< 50%	0	0

4.6.4 Self-Reported Practice Scores of The Medical Doctors

The self-reported practice mean score was 3.9 (78%) ± 0.6 (12%), and the median was 4.0 (80%) with an interquartile range (IQR) of 3.5, 4.4 (70%, 88%). The range of the scores was 46-98. The distribution of the overall practice score is as shown in Figure 18.



Overall practice scores

Figure 18: Distribution of the overall practice scores of the study participants

Overall, about 43.2% (649/1500) of the self-reported practices conformed to the recommended best practices. About 42.0% (n = 63) reported that they always prescribe the right blood component to the right patient at the right time, whereas 23% (n = 35) reported that they never or rarely used haemoglobin as the sole deciding factor before prescribing a blood transfusion. Though 44.7% of the respondents (n = 67) reported that they always obtained consent from patients or their guardians before transfusion, only 22.7% (n = 34) reported that they always record the evidence of the consenting in the patient's medical records. Obtaining and labeling pre-transfusion specimens was the procedure that the majority of the respondents (73.3%, n = 110) reported that they always perform. On the performance of posttransfusion haemoglobin estimation, 51.3% (n = 77) of the medical doctors reported that they carried out this procedure always. About 38% (n = 56) and 46% (n = 69) of the respondents reported that they always documented the clinical and laboratory outcome of the blood transfusion, respectively. The self-reported frequency of performing selected blood transfusion procedures is summarized in Table 11.

Table 11: Self- reported frequency of performing blood transfusion procedures

Items	Never n (%)	Rarely n (%)	Sometimes n (%)	Often n (%)	Always n (%)	Median
Prescribe the right blood component to the right patient at the right time	1 (0.7)	1 (0.7)	16 (44.7)	67 (44.7)	63 (42.0)	4.3
Use of haemoglobin (Hb) level as the sole deciding factor in starting a transfusion	8 (5.3)	27 (18)	54 (36.0)	41 (27.3)	20 (13.3)	2.7
Complete the blood request form accurately and legibly, including the reason for transfusion	2 (1.3)	7 (4.7)	16 (10.7)	40 (26.7)	85 (56.7)	4.5
Document/record the indication and the blood component to be transfused the medical notes and lab requests	0 (0.0)	3 (2.0)	22 (14.7)	45 (30.0)	80 (53.3)	4.4
Obtain verbal consent from each patient prior to transfusion (either yourself of a member of the team)	4 (2.7)	10 (6.7)	25 (16.7)	44 (29.3)	67 (44.7)	4.3
Record evidence of this conversion (verbal consent) in the medical notes	28 (18.7)	32 (21.3)	37 (24.7)	19 (12.7)	34 (22.7)	2.9
Obtain and correctly label blood samples for pre-transfusion compatibility testing	4 (2.7)	2 (1.3)	11 (7.3)	23 (15.3)	110 (73.3	4.7

Table.11 (Continued)

Items	Never n (%)	Rarely n (%)	Sometimes n (%)	Often n (%)	Always n (%)	Median
Perform post transfusion Hb estimation	2 (1.3)	3 (2.0)	23 (15.3)	45 (30.0)	77 (51.3)	4.4
Document the clinical outcome of the transfusion (e.g., improvement in symptoms)	5 (3.3)	12 (8.0)	25 (23.3)	42 (28.0)	56 (37.7)	4.0
Document the laboratory outcome of the transfusion (e.g., Hb increment)	7 (4.7)	8 (5.3)	31 (20.7)	35 (23.3)	69 (46.0)	4.2

4.6.4.1 Use of Transfusion Guidelines by the Medical Doctors to Guide Practice

As shown in Figure 19, majority (89.3%, n=134) of the respondents reported that they had not used transfusion guidelines to guide their practice.

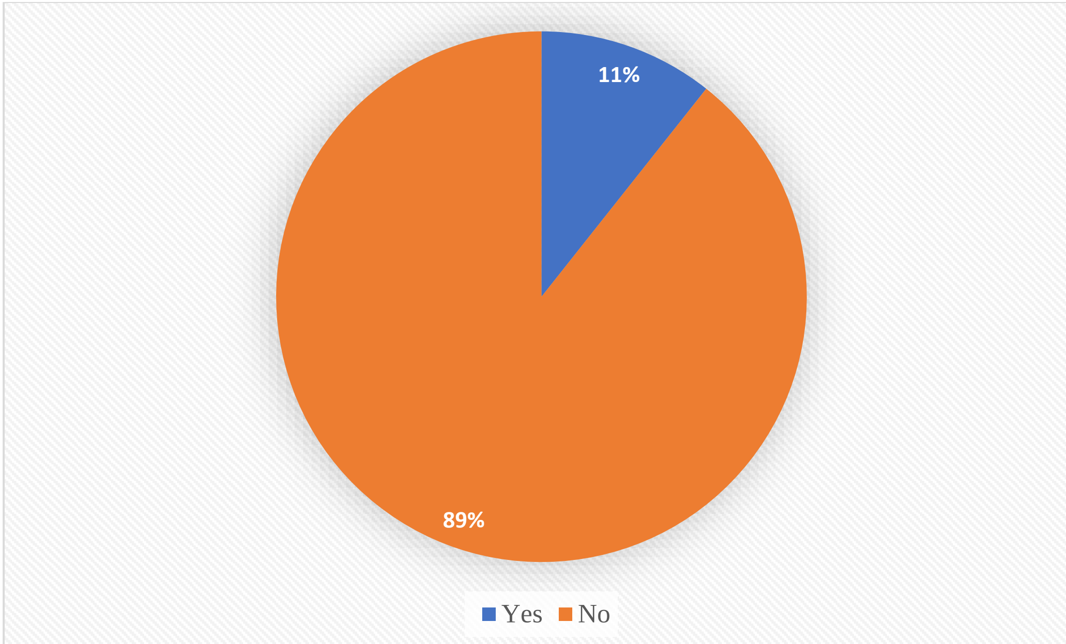


Figure 19: Use of transfusion guidelines to guide practice

4.6.4.2 The Likelihood of Medical Doctors to Use Transfusion Guidelines if Made Available

Majority (93.3%, n=125) of the medical doctors who reported that they had not used transfusion guidelines to guide their practice indicated that they very likely (78.4%) and likely (14.9%) to utilize the guidelines in their decision-making if they were available to them. These findings are depicted in Table 12.

Table 12: The likelihood of the medical doctors to use transfusion guidelines to guide their practice

Likelihood	N	%
Very likely	105	78.4
Likely	20	14.9
Unlikely	3	2.2
Very unlikely	6	4.5
Total	134	100

4.6.5 Self-Confidence Scores of the Medical Doctors

The mean score of the perceived self-confidence was 8.5 (85%) ± 1.2 (12%) and a median score of 8.6 (86%), with an interquartile range of 7.6, 9.6 (76%, 96%). The range of the scores was 4–10 (40–100%). The distribution of the overall confidence score is as shown in Figure 20

On the individual questions, almost 59% (n = 89) of the doctors scored themselves as having a confidence level of 9 or 10 when asked if they always make ‘the right decision to prescribe the right blood component to the right patient at the right time'.

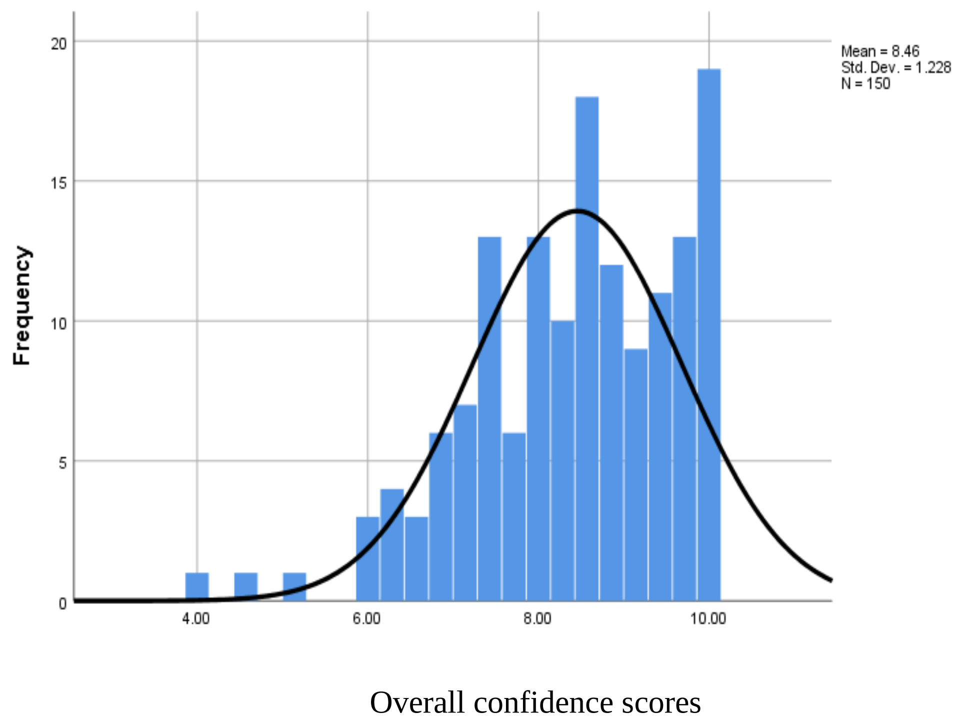


Figure 20: Distribution of the overall confidence scores of the study participants

When asked if they always ‘prescribe the correct dosage of the blood component, nearly 55% (83) scored themselves at confidence level 9 or 10. Whereas 54.7% (82) of the respondents scored themselves as having confidence level 9 or 10 when asked whether they always recognize a patient with an acute transfusion reaction, only 44.7% (68) scored themselves as having confidence level 9 or 10 when asked if they were always confident in managing a patient with an acute transfusion reaction, and this difference was statistically significant ($p < 0.001$). The distribution of the perceived self-confidence scores is shown in Figure 21.

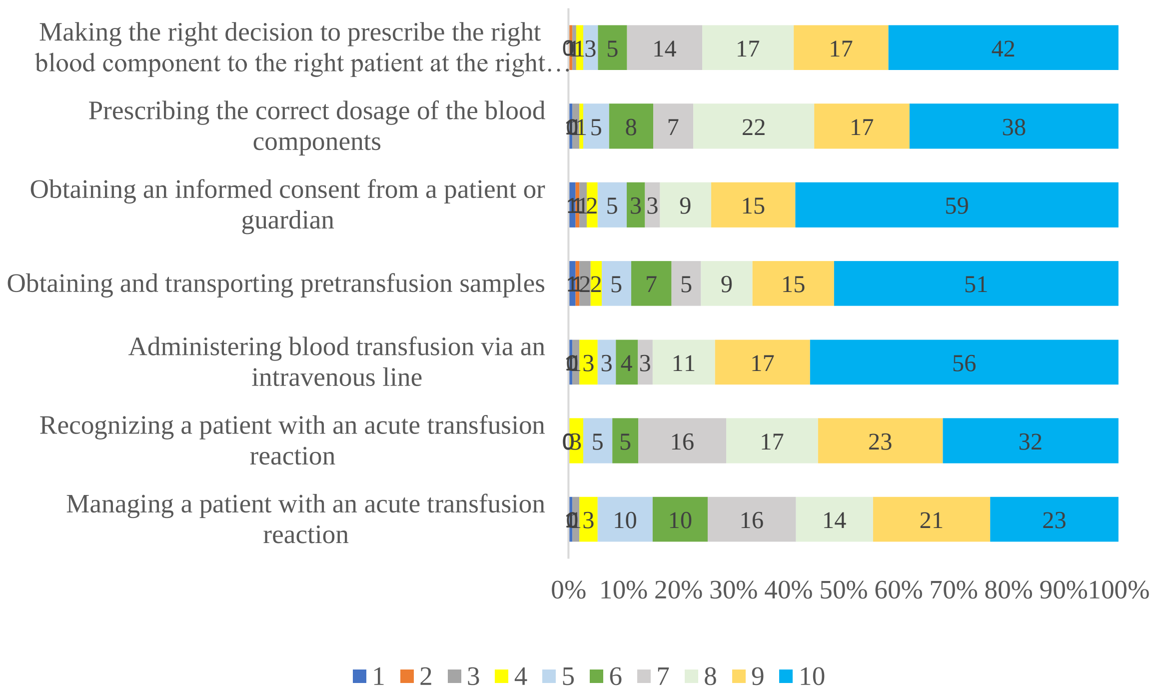


Figure 21: The frequency distribution of self-confidence ratings. The ratings ranged from 1 (not confident) to 10 (fully confident). The participants' ratings of the items assessed are presented as a percentage

4.6.6 Relationship Between Demographic, Educational, and Site of Practice Characteristics of the Medical Doctors and the Dependent Variables

Bivariate and multivariate analysis were used to determine the relationship between the dependent and the independent variables. The independent variables included the demographic, educational, and site of practice characteristics of the medical doctors and the dependent variables were the knowledge, attitude, practices and confidence.

The bivariate analysis was done using Mann-Whiteny U test and Kruskal-Wallis test. Post hoc analysis using Dunn test and Bonferroni adjustment was done for variables that were statistically significant. Multivariate analysis was done using logistic regression.

4.6.6.1 Bivariate Analysis of the Association Between Demographic, Educational, and Site of Practice Characteristics of the Medical Doctors and the Dependent Variables

There was a statistically significant association between knowledge score and having had an induction on blood transfusion before internship and also having participated in training on blood transfusion after undergraduate medical education, where participants who had an orientation on blood transfusion had a higher median score (9.4) than those who did not (7.8), $Z = -2.596$, $p = 0.009$. Likewise, those who had participated in training in blood transfusion had a higher median score (8.9) than those who had not (7.8), $Z = -2.088$, $p = 0.037$. There was also a statistically significant association between attitude scores and having participated in training after undergraduate medical education ($z = -2.096$, $p = 0.036$). On the association between the self-reported practice competency score and the participant characteristics, there was a significant association between practice competency and the hospital ($z = -2.721$, $p = 0.007$) and designation of the doctors [$H(2) = 6.178$, $p = 0.035$], with a mean rank score of 76.88 for medical interns, 83.94 for medical officers and 60.88 for registrars. The self-confidence had a statistically significant association with the hospital ($z = -3.165$, $p = 0.002$); Designation of the medical doctors [$H (2) = 11.584$, $p = 0.03$] with a mean rank of 86.3 for medical interns, 78.80 for medical officers, and 55.94 for registrars, number of years practiced after undergraduate medical education ($\chi^2(2) = 11.683$, $p = 0.015$) with a mean rank score of 89.03 for those with experience of <= 1 year, 70.76 for those with experience of 2-5 years and 60.98 for those with experience of > 5 years; and pre-internship induction (p = 0.001). The details of these findings are depicted in Table 13.

Table 13: Association between medical doctors' characteristics and knowledge, attitude, self-reported practice, and self-confidence in blood transfusion

Variable	N	Knowledge		Attitude		Self-reported Practice		Self-confidences	
		Median	p-value	Median	p-value	Median	p-value	Median	P-value
Age			0.284		0.144		0.075		0.141
25-29	81	8.4		3.9		4.1		8.8	
30-34	53	7.9		4.0		3.9		8.5	
≥35	16	7.8		3.9		3.6		8.1	
Sex			0.082		0.508		0.766		0.664
Male	90	7.9		4.0		4.0		8.6	
Female	60	8.5		3.9		4.0		8.6	
Medical school			0.501		0.627		0.319		0.132
attended	4	8.0		3.9		4.0		9.5	
Maseno University	55	7.8		4.0		4.0		8.6	
UON	3	10.0		3.9		4.5		9.7	
Uzima University	14	9.0		3.6		4.1		8.5	
KU	9	9.4		4.0		4.0		9.6	
JKUAT	51	8.0		4.0		3.9		8.3	
Moi University	2	8.5		4.3		4.2		9.3	
MKU	2	7.5		3.8		4.7		9.2	
KEMU	10	7.5		3.8		3.8		8.1	
Egerton									
Nature of the curriculum of undergraduate training			0.646		0.253		0.165		0.384
Conventional	99	8.2		3.9		4.0		8.7	
Innovative/PBL	61	8.0		4.0		3.9		8.3	
Whether participated in training in BT after graduation			**0.037#**		**0.036#**		0.301		0.112
Yes	40	8.9		4.0		3.9		9.0	
No	110	7.8		3.9		4.0		8.6	

†Kruskal-Wallis test #Mann-Whitney Test A&E- Accident and Emergency

Table 13 (Continued.)

Variable	N	Knowledge		Attitude		Self-reported Practice		Self-confidence	
		Median	p-value	Median	p-value	Median	p-value	Median	P-value
Number of years after graduation			0.382		0.393		0.096		**0.003**†
<= 1 year	52	8.3		3.9		4.1		8.9	
2-5 years	53	8.2		3.9		4.1		8.7	
> 5 years	45	7.9		4.0		3.8		8.1	
Hospital			0.269		0.640		**0.007**$^{\#}$		**0.002**$^{\#}$
MTRH	57	7.9		4.0		3.8		8.1	
County	93	8.3		3.9		4.1		8.9	
Cadre/Designation of			0.540		0.404		**0.035**†		**0.003**†
clinician	52	8.3		3.9		4.0		8.9	
Intern	59	8.2		3.9		4.2		8.7	
Medical officer	39	7.9		4.0		3.7		8.1	
Resident									
Ward/ specialty			0.929		0.609		0.050		0.545
Medicine	21	8.0		3.9		4.1		8.4	
Paediatrics	22	8.0		4.0		3.9		8.2	
General Surgery	27	8.0		4.0		4.2		8.6	
Orthopedic surgery	8	9.5		3.9		4.2		8.8	
Family Medicine	5	11		3.9		3.7		6.7	
A&E	14	8.0		3.8		3.9		9.1	
Anesthesia	5	8.0		4.1		3.1		8.3	
Obstetrics and Gynecology	29	7.0		4.0		4.0		8.3	
Not indicated	19	8.0		3.8		4.1		8.6	
Whether offered induction in BT before internship			**0.009**$^{\#}$		0.514		0.116		**0.001**$^{\#}$
Yes	24	9.4		3.9		4.1		9.6	
No	126	7.8		3.9		4.0		8.5	
Frequency of prescription of blood transfusion			0.111		0.934		0.617		0.610
Once a month	25	8.0		4.0		4.0		9.7	
Once a week	69	8.0		4.0		4.1		8.6	
More than once a week	56	9.0		3.9		4.0		8.6	

†Kruskal-Wallis test $^{\#}$Mann-Whitney Test

Further post hoc analysis was done on the practical competency score versus designations of the medical doctors, confidence score verses the designation and the experience of the medical doctors. The results revealed a significant difference of practical competency between medical officers and registrars (p = 0.030, median 4.2 vs 3.7) (Table 14 and Appendix K). There was also a significant difference of confidence between medical interns and registrars (p = 0.003, median 8.9 vs 8.1) and between medical officers and registrars (p = 0.032, median 8.7 vs 8.1) as depicted in Table 14 and Appendix L. Moreover, there was a significant difference of confidence between those medical doctors who had experience of less or equal to one year and those with experience of more than five years (p = 0.003, median 8.9 vs 8.1). These results are shown in Table 14 and Appendix M.

Table 14: Pairwise multi-comparison of self-reported practice competency and confidence score according to the designation and experience of the doctors

Variables	Groups	p (K-W test)	Comparison groups	Post hoc analysis with Dunn test followed by Bonferroni adjustment		
				Statistic	p	Adjusted p
PS versus Designation	1 (52)	0.035	1-2	-7.056	0.392	1.000
	2 (59)		1-3	16.000	0.02	0.245
	3 (39)		2-3	23.056	**0.01**	**0.030**
CS versus Designation	1 (52)	0.003	1-2	7.636	0.355	1.000
	2 (59)		1-3	30.497	**0.001**	**0.003**
	3 (39)		2-3	22.861	**0.011**	**0.032**
CS versus Experience	1 (52)	0.003	1-2	18.270	0.034	0.103
	2 (53)		1-3	28.054	**0.001**	**0.003**
	3 (45)		2-3	9.787	0.293	0.879

K-W test: Kruskal-Wallis test**,** PS**:** Self-reported practice competency score, CS: Self-confidence score

4.6.6.2 Multivariate Analysis of the Factors Associated with Knowledge, Self-Reported Practice, and Self-Confidence of the Medical Doctors.

A logistic regression analysis was done to assess the association between having had an orientation or induction in blood transfusion and having participated in any training on blood transfusion after undergraduate and the level of knowledge in blood transfusion. The results showed that those who reported having participated in an induction in BT were 3.157-times more likely to have more knowledge than those who did not (Table 15). Multivariate analysis of the effect of designation and hospital on the self-reported practices did not yield any statistically significant associations (Table 16). On the other hand, analysis on the effect of site of practice, designation, years of experience, and having had an orientation on confidence in blood transfusion showed that those who reported having had an orientation were 3.960 times more likely to perceive themselves as confident in performing blood transfusion procedures than those who did not (Table 17).

Table 15: Logistic regression analysis of the association of having had an orientation, and having participated in training and knowledge

Variable	Knowledge		COR (95%CI)	p-value	AOR (95% CI)	p-value
	Sat.	Unsat.				
Whether given pre-internship induction on blood transfusion						
Yes	16	8	3.691 (1.428-9.543	0.007	3.157 (1.194-8.337)	**0.02**
No	52	74	Ref. category		Ref. category	
Whether participated in training in blood transfusion after medical school						

Yes	25	15	2.337 (1.116-4.896)	0.021	1.956 (0.908-4.214)	0.087
No	43	67	Ref. category		Ref. category	

Sat.: Satisfactory; Unsat.: Unsatisfactory; Ref.: Reference; COR: crude odds ratio; AOR: adjusted odds ratio

Table 16: Logistic regression analysis of the association of hospital and designation of the clinician and level of self-reported practice competency

Variable	Self-reported practice competency		COR (95%CI)	p-value	AOR (95% CI\)	p-value
	Comp.	Not Comp.				
Hospital						
County	55	38	3.406 (1.688-6.782)	0.001	1.975 (0.796-0.903)	0.142
MTRH	40	17	Ref. category		Ref. category	
Designation						
MI	30	22	4.545 (1.801-1.475)	0.001	2.649 (0.821-8.546)	0.103
MO	33	26	4.231 (1.712-0.458)	0.002	2.714 (0.921-7.998)	0.070
Resident	9	30	Ref. category		Ref. category	

MI: Medical Intern; MO: Medical Officer; Comp.: Competent; Ref.: Reference; COR: crude odds ratio; AOR: adjusted odds ratio

Table 17: Logistic regression analysis of the association of hospital, designation, years of experience, and having had an orientation and self-confidence

Variable	Perceived Self-confidence		Crude Odds Ratio (95%CI)	p-value	Adjusted Odds Ratio (95% CI\)	p-value
	Conf.	Not Conf.				
Hospital						
County	58	35	3.268 (1.643-6.499)	0.001	2.050 (0.810-5.190)	0.130
MTRH	18	39	Ref. category		Ref. category	
Designation						
Medical intern	32	20	4.250 (1.749-10.33)	0.001	2.652 (0.790-8.905)	0.115
Medical officer	34	25	3.522 (1.493-8.306)	0.004	1.551 (0.473-5.084)	0.469
Resident	10	29	Ref. category		Ref. category	
Years in practice after graduation						
<=1 year						
2-5 years	32	20	4.197 (1.860-9.470)	0.001	2.910 (0.890-9.513)	0.077
>5 years	30	23	1.994 (0.884-4/711)	0.116	1.823 (0.697-4.765)	0.221
	14	21	Ref. category		Ref. category	
Whether given induction pre-internship						
Yes	19	5	3.800 (1.336-0.807)	0.012	**3.960 (1.314-1.929)**	**0.014**
No	57	69	Ref. category			

Conf.: Confident; Ref.: Reference; COR: crude odds ratio; AOR: adjusted odds ratio

4.6.7 Relationship Between Knowledge, Attitude, Practice, And Confidence

Bivariate and multivariate analysis were done to determine the relationship between knowledge, attitude, practice and confidence of the medical doctors in blood transfusion. The bivariate analysis was done using Spearman correlation and the multivariate analysis by logistic regression

4.6.7.1 Bivariate Analysis of the Relationship Between Knowledge, Attitude, Practice, and Confidence

Self-reported practice competency was significantly correlated with knowledge (r_s = 0.197, p = 0.016) and self-confidence (r_s = 0.500, p < 0.001). There was also a positive relationship between knowledge and confidence ($r_{s=}$ 0.285, p < 0.001). Attitude score was not correlated with neither knowledge, practice, nor confidence. These correlations are shown in Table 18.

Table 18: Correlation between knowledge, attitude, self-reported practice competency, and self-confidence

Variables	Correlation coefficient	p-value
Knowledge-attitude	0.121	0.140
Knowledge-practice	0.197	**0.016**
Knowledge-confidence	0.285	**<0.001**
Attitude-practice	0.053	0.521
Attitude-confidence	0.108	0.190
Confidence-practice	0.500	**<0.001**

4.6.7.2 Multivariate Analysis of the Association Between Self-Reported Practice Competency, Knowledge, and Self-Confidence

A logistic regression analysis of the association between self-reported practice competency, knowledge score, and self-confidence was done. The results indicate that, controlling for knowledge score, a unit increase in the level of self-confidence would increase the odds of being competent by 11% (Table 19).

Table 19: Influence of the level of knowledge and confidence on the self-reported practice competency

Variable	Reported practice competency		COR (95%CI)	p-value	AOR (95% CI)	p-value
	Comp.	Not Comp.				
Knowledge score (median, %)	64.8	56.0	1.025 (1.004-1.045)	0.025	1.009 (0.986-1.033)	0.431
Confidence score (median, %)	55.5	52.6	1.109 (1.066-1.153)	< 0.001	1.105 (1.062-1.148)	**< 0.001**

Comp.: Competent; COR: crude odds ratio; AOR: adjusted odds ratio

4.7 Perceptions of The Medical Doctors on Their Training Needs in Blood Transfusion

This summarizes the results of the perceptions of the medical doctors on relevance of the knowledge of blood transfusion to their clinical practice and usefulness of additional training in the subject.

4.7.1 Importance/Relevance of Blood Transfusion to Clinical Practice

As shown in Table 20, 97.3 % (n = 144) of the participants reported that knowledge of transfusion medicine was either very important or extremely important to their clinical practice. Only 2.7% felt that knowledge of the subject was either moderately important or not important to their medical practice.

Table 20: Importance/relevance of blood transfusion to the clinical practice of participants

Importance of blood transfusion knowledge	N	%
Not important	1	0.7
Moderately important	3	2.0
Very important	56	37.3
Extremely important	90	60.0
Total	150	100

4.7.2 Usefulness of Additional Training in Blood Transfusion

All the participants agreed that additional training in blood transfusion is useful, but with varying degrees of perception of its usefulness. Fifty-three percent (n = 80) of the participants reported that additional training is extremely useful, while 44% (n = 66) were of the opinion that the additional training is very useful. Only 3% (n = 4) reported that additional training in blood transfusion is moderately useful (Figure 22).

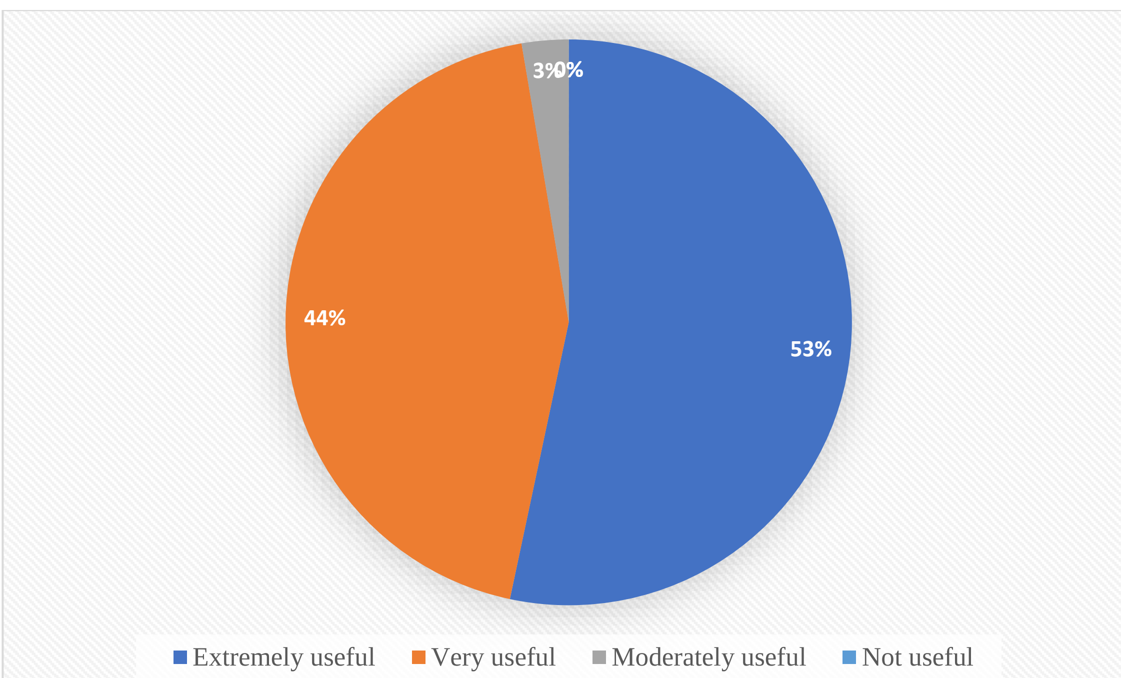


Figure 22: Usefulness of additional training in blood transfusion

4.7.3 Association Between Participants' Characteristics and Perceptions of Undergraduate Education and Importance of Knowledge of Blood Transfusion

Bivariate analysis was carried out to determine the association between the participant's characteristics and their perceptions about undergraduate education and the importance of knowledge of blood transfusion to their medical practice. The results showed that there were no statistically significant relations between selected medical doctors' characteristics (age, sex, designation, nature of curriculum of undergraduate training) and their perceptions of the relevance of the knowledge of blood transfusion to their clinical practice, the quality of the undergraduate education in blood transfusion, adequacy of preparation by their medical schools in blood transfusion, and usefulness of additional training in blood transfusion. These findings are shown in Table 21.

Table 21: Association between medical doctors' characteristics and perceptions of undergraduate education and importance/relevance of blood transfusion

Characteristic	N	Relevance of BT to medical practice		Adequacy of preparation in BT by medical school		Quality of training		Usefulness of additional training	
		Mean Rank	p value	Mean Rank	p value	Mean Rank	p value	Mean Rank	p value
Age (years)			0.892		0.088		0.344		0.629
25-29	81	73.89		78.51		78.17		73.15	
30-34	53	76.22		76.65		75.11		79.54	
≥35	16	71.54		56.44		63.25		74.00	
Sex			0.232		0.364		0.683		0.455
Male	90	72.53		77.73		76.52		73.61	
Female	60	79.95		72.15		73.98		78.33	
Designation			0.951		0.133		0.055		0.400
Medical interns	52	76.82		80.40		78.87		70.52	
Medical officers	59	74.81		77.82		80.69		80.26	
Residents	39	74.79		65.45		63.17		74.90	
Nature of curriculum of undergraduate training			0.093		0.296		0.191		0.140
training	99	71.84		77.76		78.37		72.22	

Conventional Innovative	51	82.60	71.11	69.93	81.87

†Kruskal-Wallis H test

4.7.4 Relationship Between Participants' Perceptions of Relevance/Importance and BT Education and Knowledge, Attitude, Self-Reported Practice, and Confidence Scores

The bivariate analysis showed a statistically significant difference between the participants' knowledge score and their rating of the importance of BT to their medical practice ($\chi^2(3) = 21.064$, $p = 0.006$). A statistically significant difference was also noted between the medical doctors' attitude score and their rating of the importance of BT to their medical practice ($\chi^2(3) = 21.198$, $p = 0.005$). Knowledge score, practical competency score and confidence scores were significantly associated with the participant's rating of their satisfaction with the quality of the education in blood transfusion with p values of 0.001, 0.001 and < 0.001 respectively. Furthermore, practical competency and confidence scores were significantly correlated with the medical doctors' rating of how adequately their medical schools prepared them to apply the knowledge of blood transfusion in their clinical practice, both with p values of < 0.001. These results are shown in Table 22.

Table 22: Relationship between medical doctors' perceptions of relevance/importance and BT education and knowledge, attitude, practical competency, and confidence

Characteristic	N	Knowledge		Attitude		Practice		Confidence	
		Mean Rank	p value	Mean Rank	p value	Mean Rank	p value	Mean Rank	p value
Importance of BT to medical practice			**0.006**†		**0.005**†		0.563		0.206
Not important	1	97.00		87.00		85.50		115.0	
Moderately important	3	91.83		91.83		41.83		49.00	
Very important	56	59.77		60.83		77.82		68.37	
Extremely important	90	84.57		85.33		75.01		80.37	
Satisfaction with the quality of BT training			**0.001**†		0.247		**0.001**†		**<0.001**†
Very dissatisfied	3	14.00		25.67		57.00		54.83	
Dissatisfied	33	65.82		75.80		57.91		56.30	
Satisfied	94	74.83		77.16		77.16		73.31	
Very satisfied	20	103.85		74.65		101.5		120.6	
Adequacy of preparation for BT practice			0.051		0.440		**<0.001**†		**<0.001**†
Very inadequately	2	41.75		116.5		58.00		59.75	
Inadequately	36	65.04		69.19		54.22		50.36	
Adequately	96	76.36		76.36		75.41		81.11	
Very adequately	16	98.06		98.06		126.1		100.38	
Usefulness of additional training in BT			0.555		0.525		0.701		0.581
Moderately useful	4	75.50		55.63		60.00		67.00	
Very useful	66	79.77		73.49		74.22		71.92	
Extremely useful	80	71.98		78.15		77.33		78.88	

†Kruskal-Wallis H test

Post hoc analysis using was done on the variables that showed statistically significant results. The results revealed a significant difference of knowledge score between the group that rated the importance of BT knowledge as very important and those who rated it as extremely important medical (p = 0.004, mean rank of 59.77 vs 84.57) (Table 23) and (Appendix N). There was also a significant difference of attitude score between the group that rated blood transfusion as very important and those who rated it as extremely important ($p = 0.004$, mean rank of 60.83 vs 85.33) (Table 23) and (Appendix O). There was no evidence of a difference between the other pairs. Statistically significant difference of knowledge score was noted between the following pairs of medical doctors according to their ratings of their level of satisfaction with the quality of BT training: very dissatisfied and very satisfied ($p = 0.005$, mean rank14.00 vs 103.85), dissatisfied and extremely satisfied ($p= 0.017$, mean rank65.82 vs 103.85) and satisfied and very satisfied ($p = 0.040$, mean rank 74.83 vs 103.85) (Table 23) and (Appendix P). The only groups that depicted a significant difference in the practical competency score were those who rated their level of satisfaction with BT training as dissatisfied and very satisfied ($p = 0.001$, mean rank 59.91 vs 101.45) (Table 23) and (Appendix Q). There was very strong evidence of a difference of confidence score and the level of satisfaction between the following group: those who were dissatisfied and those who were very satisfied ($p < 0.001$, mean rank 56.30 vs 120.55); and those who were satisfied and those who were very satisfied ($p < 0.001$, mean rank 73.31 vs 120.55) (Table 23) and (Appendix R). A significant difference of practical competence score and rating of adequacy of BT preparation was observed between the following groups: those that rated the adequacy as inadequate and those who rated it as adequate ($p = 0.002$, mean rank 54.22 vs 75.41), and those who rated as inadequate and very adequate ($p = 0.001$, mean rank 54.22 vs 126.09) (Table 23) and (Appendix S). A very strong difference of confidence scores was seen between the group that rated the adequacy of preparation as inadequate and those who rated it as very adequate ($p < 0.001$, mean rank 50.36 vs 100.38) and also those who rated the adequacy ad adequate and very adequate (p < 0.001, mean rank 81.11 vs 100.38) (Table 23) and (Appendix

Table 23: Pairwise multi-comparison of practice competency and confidence score with designation and experience of the medical doctors

Variables	Groups	p (K-W test)	Comparison groups	Post hoc analysis with Dunn test followed by Bonferroni adjustment		
				Statistic	P	Adjusted p
KS versus importance of BT knowledge	1 (1)	0.006	1-2	4.167	0.933	1.000
	2 (3)		1-3	36.455	0.402	1.000
	3 (56)		1-4	11.344	0.794	1.000
	4 (90)		2-3	32.289	0.206	1.000
			2-4	7.178	0.777	1.000
			3-4	-25.111	**0.001**	**0.004**
AS versus importance of BT knowledge	1 (1)	0.005	1-2	36.500	0.464	1.000
	2 (3)		1-3	27.107	0.534	1.000
	3 (56)		1-4	1.917	0.965	1.000
	4 (90)		2-3	-9.393	0.714	1.000
			2-4	-34.583	0.173	1.000
			3-4	-25.190	**0.001**	**0.004**
KS versus satisfaction with the quality of BT education	1 (3)	0.001	1-2	-52.924	0.042	0.250
	2 (33)		1-3	-60.543	0.017	0.100
	3 (94)		1-4	-89.375	**0.001**	**0.005**
	4 (20)		2-3	-7.618	0.383	1.000
			2-4	-36.451	**0.003**	**0.017**
			3-4	-28.83	**0.007**	**0.040**
PS versus satisfaction with the quality of BT education	1 (3)	0.001	1-2	2.091	0.936	1.000
	2 (33)		1-3	-20.798	0.416	1.000
	3 (94)		1-4	-44.450	0.980	0.587
	4 (20)		2-3	-22.889	0.009	0.055
			2-4	-46.54`	**< 0.001**	**0.001**
			3-4	-23.652	0.027	0.161
CS versus satisfaction with the quality of BT education	1 (3)	< 0.001	1-2	-1.470	0.955	1.000
	2 (33)		1-3	-18.450	0.469	1.000
	3 (94)		1-4	-65.714	0.014	0.086
	4 (20)		2-3	-17.011	0.053	0.315
			2-4	-64.247	**< 0.001**	**< 0.001**
			3-4	-47.236	**< 0.001**	**< 0.001**
PS versus adequacy of preparation	1 (2)	< 0.001	1-2	9.389	0.766	1.000
	2 (36)		1-3	-21.359	0.491	1.000
	3 (96)		1-4	-40.28	0.212	1.000
	4 (16)		2-3	-30.748	**< 0.001**	**0.002**
			2-4	-50.014	**< 0.001**	**0.001**
			3-4	-19.266	0.100	0.600
CS versus adequacy	1 (2)	< 0.001	1-2	3.778	0.905	1.000
	2 (36)		1-3	-17.411	0.574	1.000
	3 (96)		1-4	-68.094	0.036	0.218

of	4 (16)	2-3	-21.189	0.012	0.874
preparation		2-4	-71872	< **0.001**	< **0.001**
		3-4	-50.682	< **0.001**	< **0.001**

K-W test: Kruskal-Wallis test, KS: Knowledge score, AS: Attitude score, PS: Self-reported practice competency score, CS: Self-confidence score

4.8 Aspects of Blood Transfusion that the Doctors Felt they Needed Additional Training on

The aspects of blood transfusion that the medical doctors felt that they required more training on are as shown in Figure 23. These aspects included: complications of blood transfusion (78%), alternatives to blood transfusion (78%), appropriate use of blood components (73.3%), haemovigilance (74.7%), special blood requirements (72.6%) and blood components (71.3%). Other aspects include patient blood management (59%), pretransfusion testing (53%), organization of national blood transfusion service (52%), blood donation (51%) and bedside procedures (50%).

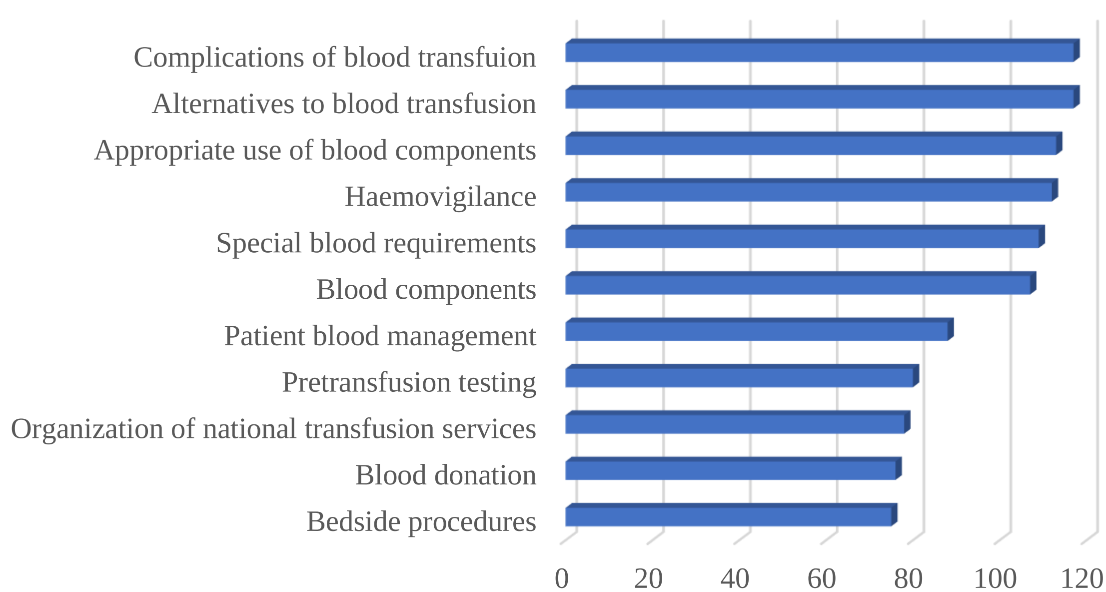


Figure 23: Aspects of blood transfusion for which the participants felt the need for additional training (multiple responses, n = 150)

4.8.1 Preferred Methods for Delivering Additional Training in Blood Transfusion

The majority of the respondents indicated that they preferred CMEs organized by accredited institutions or professional bodies (69.3%, n = 104). The other preferred methods include conferences and workshops, face-to-face lectures, and online courses, as shown in Figure 24.

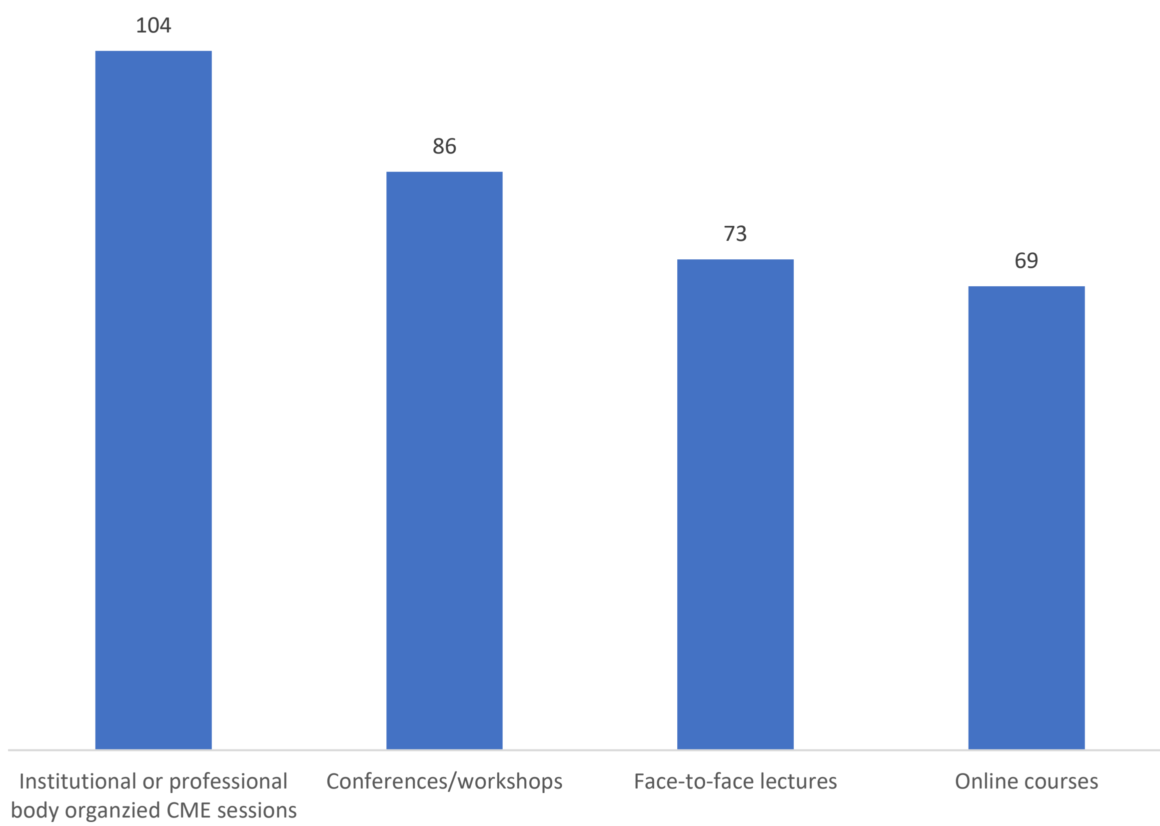


Figure 24: Preferred methods for delivering additional training in blood transfusion (multiple responses, n=150)

4.9 Suggestions on What to Improve or Include in Blood Transfusion During Undergraduate Medical Education

Of all the respondents, 72.7% (n = 109) responded to the open-ended question on the suggestions to improve or include in the curriculum of undergraduate medical education in order to improve the quality of teaching blood transfusion. The suggestions were categorized into different themes, as shown in Table 24. The majority (36.7%, n = 40) recommended that appropriate use of blood components, their indications, triggers or thresholds, dosages of blood components, and guidelines be improved or included in the curricula. The other areas that the participants felt should be improved include complications of blood transfusion and haemovigilance (32.1%, n = 35), actual hands-on practice with patients in the ward (21.1%, n = 23), blood donation/components/collection/preparation/storage/special components (20.1%, n = 22), laboratory practical (13.8%, n = 11), and organization of blood transfusion services (3.7%, n = 4). About 6.4% (n = 7) were of the opinion that all aspects of blood transfusion should be improved in the medical curriculum.

Table 24: Suggestions on what to improve or include in undergraduate medical training in blood transfusion (multiple responses, n = 109)

Theme/area	N=109 (%)
Appropriate use of blood components/Indications/Triggers/Dosages/Guidelines	40 (36.7)
Complications of BT/Hemovigilance	35 (32.1)
Actual hands-on practice with patients in wards/bedside procedures	23 (21.1)
Blood donation/components/collection/preparation/storage/special components	22 (20.1)
Laboratory procedures/practical	11(13.8)
Organization of transfusion services	4 (3.7)
All aspects of BT	7 (6.4)

4.10 Chapter Summary of the Main Findings

This chapter dealt with the data analysis, interpretation, and presentation in accordance with the research objectives. The results revealed that all the curricula analyzed included the subject of blood transfusion, included it during different study years, and integrated it into different disciplines. The findings also demonstrated that only one medical school incorporated the subject into all clinical years without explicitly indicating learning outcomes or content. The results further revealed that medical doctors' level of factual and perceived knowledge of blood transfusion was average and suboptimal. Moreover, the findings indicated the majority of the doctors had a positive attitude toward blood transfusion and that attitude was Concerning the attitude of the medical doctors toward blood transfusion, the study revealed that the majority of doctors had a positive attitude and that it was associated with participation in continuing medical education activities. Concerning the medical doctors' self-reported practices, it was found that less than half of them conformed to the recommended best practices. In addition, the level of self-confidence of the medical doctors in blood transfusion practice was found to be high, and it correlated with induction or orientation. Finally, the research showed a positive correlation between knowledge, self-confidence, and self-reported practice competency, while self-confidence showed a correlation with self-reported practices.

CHAPTER FIVE

5.0 DISCUSSION OF THE FINDINGS

5.1 Overview

This chapter deals with the interpretation of the main findings of the study. It also highlights the strengths and the limitations of the study. The purpose of this study was to analyze the content of blood transfusion subject in the Kenyan undergraduate medical school curricula and also determine the competencies and confidence of Kenyan trained non-specialist medical doctors in blood transfusion. The extent of the content presented in this chapter is as per the objectives and the study findings.

5.2 Blood Transfusion Content in the Undergraduate Medical Curricula

One of the objectives of this study was to determine the integration and adequacy of blood transfusion content in Kenyan medical schools' undergraduate curricula. The interpretation of this objective's findings is presented, focusing on the availability of blood transfusion as a subject in the curricula, its integration, and the amount of time dedicated to it. Moreover, the methods of delivery and assessment are discussed. The perspectives and perceptions of the medical doctors about their education in blood transfusion during undergraduate training is also presented.

5.2.1 Availability of the Subject of Blood Transfusion in the Undergraduate Medical Curricula

All the medical schools studied offered formal education in blood transfusion. Other similar studies (Al-Riyami et al., 2020; Vasconcelos Vaena et al., 2016; Karp et al., 2011; Müller, 2005) have posted mixed results. This variance could be attributed to the fact that educational approaches in transfusion medicine differ widely between continents and world regions (Eichbaum et al., 2014; Panzer et al., 2013) and the lack of a national curriculum (Panzer et al., 2013). In the study by Al-Riyami et al. (2020), almost all participating medical schools from very high human development index (HDI) countries had formal teaching of blood transfusion (94%, 17/18), in contrast to less than half of responding medical schools in medium HDI countries (42%, 5/12). The presence of blood transfusion subject in all the curricula of medical schools in our study could be due to the presence of a national core curriculum, 'Bachelor of Medicine and Bachelor of Surgery Core Curriclum' (Kenya Medical Practitioners and Dentists Board, n.d.).

5.2.2 Integration of the Content of Blood Transfusion into the Undergraduate Medical Curricula

In all the curricula of all the medical schools studied, the subject of blood transfusion was integrated with haematology discipline. In 4/6 medical schools, blood transfusion is contained in the physiology discipline, and 2/6 of the schools had the subject integrated into general surgery, paediatrics and immunology. Single medical school curriculum had the subject of blood transfusion in the internal medicine, orthopedics and traumatology, and pathology disciplines. This finding is inconsistent with the study finding by Scharf & Burger (2014) where teaching in blood transfusion was integrated into cross-curricular topics of interdisciplinary programmes by 28 of 30 medical schools (93%) studied. It is recommended that blood transfusion should not be taught in isolation but should be integrated into other areas of the medical curriculum, as issues related to transfusion medicine are relevant to every discipline or subspecialty of medicine (Karp et al., 2011).

The number of years in which blood transfusion education was available was different between medical schools, and there was no medical school that had the subject integrated into all the years of study. This result is corroborated by the survey of the medical doctors, where the majority (80.0%, n = 103) reported that they were taught BT during the 3rd year of their undergraduate medical education. Previous research has shown that education in BT is given at more than one stage of the curriculum in many countries (Panzer et al., 2013; Al-Riyami et al., 2020; Karp et al., 2011). In the study by Al-Riyami et al. (2020), the subject of blood transfusion was integrated in the third and fourth years of medical training in more than half of all medical schools with mandatory curricula across all education models, and none of the medical schools using the European model had the subject integrated in the medical school curriculum in all the years of training. Only one (16.7%) medical school in our study had the subject integrated in all the clinical years (4th, 5th, and 6th years). This finding mirrors the content in the core MBChB curriculum where the term ‘transfusion’ is mentioned in two clinical year disciplines of orthopedics and general surgery (KMPDC, n.d). This result is similar to the finding by Karp et al. (2011), where fewer than 20% of medical schools offer blood transfusion education during the clinical years. This mirrors a general trend where educational efforts in blood transfusion have historically not targeted medical students in clinical years, despite the fact that these senior students are on the verge of undertaking independent clinical decision-making responsibilities (Peedin et al., 2019). Sadly, it also seems that there hasn't been much work done in transfusion medicine to harmonize learning objectives with clinical activities or practical applications. Conversely, excessive time is devoted to laboratory work, including blood typing and blood matching (Garraud et al 2020; Karp et al 2011)

Many researchers agree that education in blood transfusion is beneficial in all years of undergraduate medical education and suggest that the theoretical aspects of blood transfusion could be implemented during the pre-clinical years and the practical aspects during the clinical or clerkship years because the students during these years would have a deeper appreciation of the importance of blood transfusion, probably because they have a context in which to place this knowledge as they attend to real patients. Moreover, the students at this level of study are also motivated to understand blood transfusion to ensure that they will appropriately prescribe blood and blood components during their internship (Al-Riyami et al., 2020; Peedin et al., 2019; J. E. Graham et al., 2017; Karp et al., 2011).

5.2.3 The Blood Transfusion Topics Included in the Curricula

The main topics included in the curricula of all the medical schools were the physiology of blood, blood grouping, compatibility testing, indications and contraindications of blood and blood components, and complications of blood transfusion. It is worth noting that these are also the main topics included in the core MBChB curriculum (Kenya Medical Practitioners and Dentists Board, n.d). This finding compares with the results of other studies (Al-Riyami et al., 2020; Graham et al., 2014; Karp et al., 2011; Duguid et al., 2008). In the study by Al-Riyami et al. (2020), all the participating medical schools taught the basics of blood testing, blood product indications and contraindications, and the risks of blood transfusions. Inclusion of these crucial aspects of blood transfusion in the curricula of medical schools is important in order to ensure safe transfusion practice.

Blood transfusion experts have come up with recommendations on the topics to be included in the undergraduate medical curriculum. These include the topics proposed by

TMAA curriculum (Cable et al., 1995) and those recommended by the French committee of transfusion medicine professors (Wautier et al., 2005). Recently, Garraud et al. (2020) proposed a competency-based approach to teaching blood transfusion during undergraduate medical education with a ‘know-how’ approach. They recommended that students should be able to know how to deal with the following topical areas in blood transfusion: know how to diagnosis patient conditions in line with the principles of Patient Blood Management (PBM), know how blood components as well as plasma derived medicinal products are made available to the patient, know how to set up a protocol in case of acute blood loss, know how immunological compatibility is verified and why and how alloimmunization must be prevented, know the benefits and consequences of blood transfusion, and be aware that blood and blood components as a precious resource because of their human origin and the huge cost involved in their manufacture and testing.

Smit Sibinga and colleagues have also come up with recommendations for the expected exit outcomes of education for various professionals involved in blood transfusion (medical students during undergraduate education, medical doctors during postgraduate education, laboratory professionals, and nursing staff during both undergraduate and postgraduate education). The recommended outcomes for an undergraduate medical student were grouped into *basic science outcomes* (basic knowledge of blood physiology; basic blood group systems including basic inheritance, antigens and resulting antibodies; roles of IgM and IgG antibodies and complement; difference between clinically significant vs non-significant antibodies; clinically significant blood group antibodies; difference between auto- and allo-antibodies; the history of transfusion medicine and basic blood group systems), *blood banking outcomes* (overview of the vein-to-vein transfusion process; principles of voluntary blood donor motivation, barriers, and facilitators; donor selection procedure, blood donor collection, donor reactions, blood processing; basics of donor testing; different blood products and components used in clinical practice, including their processing, storage temperatures and shelf-life; basic blood banking tests, e.g., blood grouping, antibody screening and detection, serological cross matching and direct antiglobulin test and their application in transfusion practice and safety), *clinical transfusion outcomes* (indications for blood components, namely whole blood, red blood cells, platelets, plasma and cryoprecipitate; procedure for ordering different blood components for adults, paediatrics and neonatal patients; application of coagulation testing for transfusion decision and practice; basic understanding of rational and indications of use of leukocyte reduced and irradiated blood components; basic understanding of principles of patient blood management (PBM); alternatives to blood transfusion; basic understanding of clinical apheresis and indication for plasma exchange/plasmapheresis; understanding of the manufactured blood products and their appropriate utilization; seps required for development and implementation of a massive hemorrhage protocol), *blood safety outcomes* (risks and benefits of transfusion; procedure for obtaining transfusion informed consent; importance of bedside checks and patient identification at time of specimen collection and immediately pre-transfusion; classify transfusion reactions and adverse events, know how to diagnose and manage the common ones, and understand the importance of reporting adverse events to the blood bank; basic pathophysiology of immune and non-immune acute transfusion reactions; transfusion transmitted infections (TTIs); different possible medical errors in blood transfusion and means of prevention; importance of quality systems and quality systems management in blood transfusion and blood safety), *social skills outcomes* (important communication skills utilized in making transfusion decisions; communication with the blood bank with regard to routine, urgent transfusion orders, and transfusion reaction reporting; communication with the public in promotion for blood donation and maintaining a blood supply) and *research outcomes* (an understanding of conducting clinical and quality improvement research in blood bank and blood transfusion) (Smit Sibinga et al., 2021).

It should be noted that the KMPDC MBChB Core Curriculum does not provide a comprehensive learning outcomes or competencies for a newly graduated medical doctor in blood transfusion. The three outcomes related to blood transfusion indicated in the core curriculum are that the student should be able to: 'describe blood groups, blood group serology, and the blood transfusion service', 'apply principles of blood transfusion and use of blood and blood products', and 'discuss the principles and practice of laboratory evaluation in haematology and blood transfusion' (Kenya Medical and Dentists Board, n.d.). The curricula of the medical schools analyzed have similar outcomes. According to WHO, the clinical transfusion practice standards for a newly graduated medical doctor (medical intern) should include: careful selection of donors, screening of donations, storage of blood components for clinical use, appropriate indication, compatibility testing, issue of blood units for either routine or emergency use, appropriate use of blood supplied or the return of units not needed after issue, and recognition and management of transfusion reactions (World Health Organization, n.d.).

5.2.4 Time Allocated to the Subject of Blood Transfusion

In this study, it was not clear from the curricula how much time was allocated towards teaching blood transfusion. However, from the doctors' perspective, 23% and 20% of the medical doctors reported that they were taught BT for 1-2 hours and 3-4 hours respectively in medical school, and only 31.3% of them reported that the subject was taught for more than 6 hours during their undergraduate medical education. This finding is inconsistent with a study by Panzer et al. (2013), whereby in one medical school in Israel, the total time devoted to teaching BT during undergraduate medical education was explicit and it was 19–21 hours (12–14 hours for lectures, 4 hours for laboratory practical, and 3 hours for seminars and a visit to the blood bank). In the US study by Karp et al. (2011), out of 66 medical schools, 21.2%, 27.3%, 13.6%, 15.2%, 6.1%, and 16.7% reported that they devoted 1 hour, 2 hours, 3 hours, 4 hours, 5 hours, and 6+ hours, respectively, to teaching blood transfusion through lectures. On the other hand, out of 23 medical schools, 26.1%, 26.1%, 17.4%, 8.7%, 8.7%, and 13.0% reported that they devoted 1 hour, 2 hours, 3 hours, 4 hours, 5 hours, and 6+ hours, respectively, to teaching blood transfusion through small group discussion.

Different transfusion experts have had varied opinions on the optimal time for teaching the theoretical and practical aspects of blood transfusion. In a study by Panzer et al. (2013), experts from participating medical schools in India, Indonesia, Malaysia, Japan, the USA, and South Korea opined that adequate time for teaching blood transfusion would be 5 hours, 3 hours, 6–8 hours, 15 hours, 3 hours, and 10 hours, respectively. In Germany, there is no strict regulation regarding the minimum lecture time for a given subject, but recent curricula demand 0.6 to 1 ECTS (European Credit Transfer and

Accumulation System) for each particular subject. Al-Riyami et al. (2020), in their study titled 'Global Survey of Transfusion Medicine Curricula in Medical Schools: Challenges and Opportunities, found that of the 22 medical schools that offered formal training in blood transfusion from 17 countries, 50% of the participants (deans and education leaders/officers in blood transfusion) considered 2 weeks as the minimum required contact time in blood transfusion, while five (23%) considered that 1 month would be required. Ten (45%) of the respondents in the same study reported a variable range of time devoted to blood transfusion, from 2 hours to an entire semester. From the literature, it can generally be said that medical schools differ greatly in the amount of education they provide on a given subject and that there are no data on comparative curriculum adequacy (Duguid et al., 2008; Karp et al., 2011; Panzer et al., 2013; Al-Riyami et al., 2020). Moreover, determining the minimum amount of time required to teach blood transfusion at the undergraduate level is difficult (Panzer et al., 2013). Nonetheless, there is evidence of inadequate teaching of blood transfusion in the undergraduate medical school curriculums (Karp et al., 2011; Panzer et al., 2013; Vasconcelos Vaena et al., 2016; Al-Riyami et al., 2020), and the absence of dedicated time for formal transfusion education has been shown to be associated with poor knowledge of blood transfusion.

5.2.5 Teaching Methods Used in Delivery of Blood Transfusion Content in the Undergraduate Curricula

The extent to which the teaching methods indicated in the analyzed curricula are applied in the teaching of blood transfusion could not be ascertained. But from the doctors' perspectives, the commonest method that was used to teach blood transfusion during undergraduate medical education was lectures followed by laboratory practical, and that laboratory practical was the method that they felt to be of more benefit in learning the subject. The teaching and learning methods used in medical education have been shown by previous studies to be varied and ranged from lectures to PBL, with the lecture method being the one commonly mentioned (Al-Riyami et al., 2020; Karp et al., 2011; Panzer et al., 2013; Duguid et al., 2008). A lecture is a conventional method of instruction where a single speaker formally presents and delivers the content to a large group of students. It is an efficient way of transferring knowledge and concepts to a large group of students. However, it is a one-way communication in which students largely remain passive.

In order to address the challenges with knowledge acquisition and retention in already overloaded curricula, innovative instructional strategies are required (Morgan et al., 2015). The innovative teaching methods are student-centered, interactive, flexible, and promote active learning, reflective learning, critical thinking, problem solving, communication skills, teamwork, and life-long learning (Mehta et al., 2013). The innovative strategies include, among others, problem-based learning, simulation, game-based learning, case-based learning, flipped classroom, computer-assisted learning, internet-based learning, blended learning, and the use of videos and social media (Morgan et al., 2015; Huggett & Jeffries, 2014; Krishnamurthy et al., 2022; Rajan & Pandit, 2022; Team, 2016; Sinclair et al., 2015; Blumberg & Pontiggia, 2011; Jones et al., 2015; Thistlethwaite et al., 2012; Davis et al., 2015). These teaching strategies could be adopted by our medical schools as they could have a significant impact, especially in the context of our settings where there might not be enough teaching staff with the necessary level of expertise to adequately teach and train medical students in blood transfusion.

Several researchers have compared various methods in the teaching of blood transfusion (Sullivan et al., 2019; Konia et al., 2018; Doshi, 2017; J. Graham et al., 2020; Morgan et al., 2015). In a US study, Sullivan et al. (2019) used three teaching modalities (didactic lectures, simulation, and a Jeopardy-style game) in an elective course in blood transfusion among final-year medical students. The outcome was that the majority of the study participants (70%) agreed or strongly agreed that all three modalities were useful to learn and retain concepts. According to the authors, the three different modalities served to reinforce important information and knowledge. In another US study by Konia et al. (2018), second-year medical school students were taught about blood transfusion using three different teaching methods: an in-person faculty-led didactic session and simulation; an online-only module; and a hybrid in-person and online strategy. Though the researchers had predicted that the online-only module would produce similar improvements in pre- and post-quiz scores as the didactic session and simulation led by a faculty member, they found out that the students who participated in the didactic session and simulation showed the greatest improvements. They attributed their findings, at least in part, to the fact that beginner learners, like junior medical students, benefit from having an instructor to direct and focus their learning (Bransford et al., 2000). It is crucial to enhance the way blood transfusion education is delivered since junior physicians are frequently involved in clinical transfusion decisions and because prior experience in a particular field does not seem to be a reliable indicator of increased blood transfusion knowledge (Al-Riyami et al., 2020; Karp et al 2011).

5.2.6 Methods Used in the Assessment of Blood Transfusion Content

Upon analysis, it was found that all the curricula utilized both formative and summative assessment methods. These methods included the use of multiple-choice questions, essays, laboratory practical, and viva voce assessments. Although these assessment methods were not explicitly tailored to any particular course or subject, it can be inferred that they were also used to evaluate knowledge of blood transfusion. The research conducted by Al-Riyami et al. (2020) revealed that all the medical schools examined employed multiple-choice questions as a means of evaluating knowledge, irrespective of their educational framework. However, European model medical schools were found to employ a wider range of assessment methods, such as essays, case-based discussions, formative assessment, and portfolio-type cases. In contrast, only one school following the U.S. model reported the utilization of these assessment methods.

Assessment is utilized to verify the attainment of training objectives, provide feedback to students, grant licences and certifications, and screen students for additional training. Assessment ensures quality in training programmes, motivates and directs student's learning (Preston et al., 2020; Shumway & Harden, 2009). Evaluation can take the form of either formative or summative assessment. Formative assessment, also known as assessment for learning, takes place at the conclusion of a course or unit with the primary objective of providing feedback to students. In contrast, summative assessment, also known as assessment of learning or evaluation, takes place at the conclusion of a course, term, semester, or year. The primary goals of summative assessment encompass assessing the whole performance of a candidate, evaluating course outcomes, and facilitating certification and licencing processes (Vageriya, 2018).

Medical education employs a range of assessment methods, such as multiple choice questions, essay questions, oral exams (viva voce), Objective Structured Practical Examination (OSPE), Objective Structured Clinical Examination (OSCE), Objective Structured Long Examination Record (OSLER), short cases, and long cases. Additional approaches that can be employed, particularly in evaluating clinical proficiency, encompass portfolios, logbooks, Direct Observation of Procedural Skills (DOPS), peer assessment, self-assessment, and patient questionnaires (Al-Wardy, 2010). The efficacy of each approach must be assessed based on its reliability, validity, educational impact, objectivity, acceptability, and feasibility (Norcini et al., 2018; Van Der Vleuten, 1996). Education and training in healthcare fields typically necessitate the acquisition of various cognitive, psychomotor, and attitudinal abilities (Norcini et al., 2018) and therefore assessment methods employed must be thorough, reliable, and robust in order to evaluate all these characteristics,

The multiple-choice question evaluates factual knowledge, recall, understanding, and interpretation, aligning with the "knows" and "knows how" levels of Miller's pyramid (Miller, 1990). MCQs come in various formats and are frequently employed in both formative and summative evaluations. The advantages of multiple-choice questions (MCQs) encompass the potential to cover a substantial amount of syllabus content, ensuring a high level of dependability in scoring. Additionally, MCQs are easily marked and scored, with the possibility of computerised marking. Furthermore, they require less time for administration and may effectively assess a wide range of knowledge within a short timeframe. However, multiple-choice questions (MCQs) have certain limitations, which include inability to evaluate other areas of learning, particularly the psychomotor and affective domains. Additionally, they can be challenging to construct, especially in specific subject areas. MCQs do not measure communication and writing abilities, and students may be able to guess the correct answers. Furthermore, if questions are repeated, students can achieve high scores. Various studies have utilized multiple choice to assess the knowledge of blood transfusion among medical students, medical doctors in training and physicians (Lin et al., 2016; Kumarage et al., 2017; Rock et al., 2002; Kasraian & Tavassoli, 2014; Graham et al, 2014; Ruhi & Seema, 2016; Arinsburg et al., 2012; Fettah et al., 2017; Alvarado-Navarro et al., 2016; Philip et al., 2015; Haspel et al., 2015; Gharehbaghian et al., 2009; Vaena& Alves, 2019; Lim et al., 2017; O'Brien et al., 2010; Yudelowitz et al., 2016; Laher& Patel, 2019; Ddungu et al., 2018; RahavKoren et al., 2017; Halford et al., 2021)

Essay questions encompass short answer questions (SAQs), extended essays, and structured/modified essay questions (MEQs). The modification or structuring of lengthy essay questions is intended to enhance their reliability. Essay questions provide the ability to evaluate cognitive domains across all six levels, ranging from simple recollection to complex synthesis. The advantages of essay questions encompass evaluating the students' clinical problem-solving skills, gauging their capacity for articulate expression, assessing their comprehension and aptitude for organizing thoughts and conveying them in written form, and fostering a culture of thorough study among students. The drawbacks of this assessment method are as follows: it only evaluates Miller's levels of "Knows" and "knows how", it necessitates strict adherence to the marking scheme to prevent variation in scores across examiners, and it needs a significant amount of time to assess a wide range of information. One of the studies that used short answer questions (SAQs) to assess the knowledge of blood transfusion is by O'Brien et al., (2010). n their study, O'Brien and colleagues assessed the knowledge of blood transfusion among first year residents using a written quiz. The questions included what to be done in case of a febrile episode in a patient receiving a transfusion, differential diagnosis of a fever after a transfusion, contraindication of platelet transfusion, definition of transfusion related lung injury (TRALI), indication of blood component irradiation, appropriate blood product for a patient with nose bleeding who is having pancytopenia and a history of acute lymphoblastic leukemia (ALL).

The objective structured clinical examination (OSCE) is a method used to evaluate students' proficiency in certain clinical skills. It involves assessing students at multiple stations dedicated to different aspects of clinical practice. Standardized patients (SPs), actual patients, or simulators may be utilized at each station to monitor and quantify the display of specific skills. Objective structured clinical examination stations may also include the evaluation of interpretation, technical skills, communication, and attitudes. Every student is subjected to identical stations and evaluation. Staff members utilize a checklist or a structured marking scheme to evaluate the student's performance (Asani, 2012; Wass et al., 2001). The reliability of objective structured clinical examination is enhanced by its utilization of several stations, multiple assessors, appropriate test time, and a checklist. Additionally, its great validity is attributed to the process of blueprinting. It assesses a diverse array of abilities and provides feedback which is a valuable tool for formative assessment. However, this format is costly and requires a significant amount of manual work. Additionally, it results in a significant emotional burden on actual patients, and its acceptability is a matter of concern among faculty members due to limited familiarity with its principles and reluctance to embrace change (Asani, 2012; Wass et al., 2001). There is evidence for the use of objective structured clinical examinations (OSCEs) as a tool for assessing knowledge in blood transfusion. O'Brien et al. (2010) conducted a study to assess the knowledge about transfusion among first-year trainees in their postgraduate training. The study utilised an objective structured clinical assessment. The investigation revealed that the trainees performed inadequately, with the highest score reaching only 67.1%. A separate investigation conducted in Canada by Saidenberg & Pugh (2014) examined the knowledge of blood transfusion among internal medicine resident doctors using a case-based assessment called objective structured clinical examination (OSCE) with a sample size of seventy-three participants. The findings indicated that the average score for this case was 6.6 out of 10, with 31.5% of examinees failing. Furthermore, the scores did not vary based on the number of years of training. The researchers reached the conclusion that internal medicine trainees possess inadequate information regarding transfusion practices, and this deficiency does not improve with the progression of their training duration. The researchers strongly recommended that there is an urgent need for newer strategies in blood transfusion education, which should be thoroughly evaluated to determine their effectiveness.

The Objective Structured Practical Examination (OSPE) is a way of assessing laboratory practical skills in the field of preclinical sciences. A specified set of exercises is used to objectively assess students' abilities in an organized manner through direct observation (Mard & Ghafouri, 2020). This assessment tool is based on the Objective Structured Clinical Examination (OSCE) developed by Harden and Gleeson. It is used to test the knowledge and skills of students in basic sciences, preclinical, and paraclinical subjects

(Harden & Gleeson, 1979). The OSPE encompasses several key characteristics, including the distinct evaluation of both the process and product by observing performance and assessing the final outcome, sufficient sampling of the skills and content to be tested, an analytical approach to the assessment, objectivity, and the provision of feedback to both teachers and students (Harden & Cairncross, 1980). This approach involves evaluating all candidates using identical stations and awarding marks for each well executed step according to the mark scheme. As a result, it is more inclined towards objective rather than subjective assessment. The candidate is assigned a very particular task that is meticulously designed to incorporate components from all aspects of the curriculum, as well as a diverse set of skills (SAURABH et al., 2021). According to reports, OSPE assesses the third level "shows how" of Miller’s framework by concentrating on evaluating the performance of particular abilities in a controlled environment. Objective structured practical examination (OSPE) has been widely employed by numerous medical institutions worldwide to evaluate students' proficiency in laboratory exercises (Mard & Ghafouri, 2020). Comparative analysis has been carried out to assess the efficacy of the objective structured practical examination (OSPE) and the traditional practical examination in assessing laboratory practical abilities in the field of blood transfusion. In their study, Prasad et al., (2020) conducted a comparison between the two assessment tools for the laboratory estimation of hemoglobin estimation and blood typing by microscpe slide technique. The study involved second year medical students in an Indian university. Additionally, the researchers evaluated the perception of both students and faculty members regarding the Objective Structured Practical Examination (OSPE) using a pre-validated questionnaire. The researchers established that the traditional group achieved an average score of 6.91 (with a standard deviation of 1.08), but the OSPE group got an average score of 8.43 (with a standard deviation of 1.41) and this difference was statistically significant, with a $p < 0.001$. Additionally, they noted that the student's preferences seemed to go towards the OSPE format over the standard examination. In a separate study conducted in India, Lakum et al., (2023) conducted a comparative analysis of conventional/traditional practical examinations and objective structured practical examinations (OSPE) among a cohort of fifty first-year medical students. The students were evaluated using both instruments during the process of measuring hemoglobin levels and determining blood types. Feedback was also solicited from the students and their teachers regarding the two strategies. The findings indicated that individuals who utilized the objective structured practical examination (OSPE) approach achieved notably higher average scores of 12.58 with a standard deviation of 2.74) in comparison to those who were evaluated by the traditional assessment method who scored 8.44 with a standard deviation of 2.13. The statistical significance of the improvement in student performance with OSPE was established by a paired t-test and the value was <0.0001. The survey also found that students expressed a high level of agreement (92%) on the effectiveness of OSPE in promoting practical assessments and serving as an assessment and learning tool. In addition, the teachers unanimously agreed that OSPE is a more thorough assessment instrument, with a 100% consensus. They also found that it is better at identifying both the strengths and shortcomings of students, with a 75% agreement. Furthermore, a significant proportion of teachers (75%) expressed the opinion that OSPE should be integrated into upcoming assessments.

A viva voce, often known as an oral examination, is an evaluation technique in which the candidate is interrogated by one or more examiners in an interview or discussion-style format. This evaluation method can be utilized to evaluate clinical problem-solving abilities, communication aptitude, ethical dilemmas, attitudes, and professionalism. The advantages of oral exams include facilitation of direct interaction between candidates and examiners and it allows for simultaneous assessment by multiple examiners. The format is also flexible, enabling exploration of both the candidate's strengths and weaknesses. Repeated oral exams also enhance candidates' communication skills. Additionally, oral exams provide an opportunity to gain insight into the candidate's learning environment and personal challenges. The limitations of this format of assessment include a proclivity to excessively value candidates with strong public speaking skills, the potential for gender or ethnic bias to arise during personal interactions, a lack of standardization and objectivity, and the intimidation experienced by certain candidates.

A logbook is a comprehensive record documenting the procedures performed, patients attended to or operations executed by a student. It records the breadth of patient care and educational opportunities for medical students. The logbook serves as a valuable tool for directing students' attention towards significant goals that need to be accomplished within a specific timeframe ((Tabish, 2008). A portfolio is a collection of learners’ activity that serves as proof of learning. The documentation involves the systematic recording of knowledge that has been acquired and the progress made in a certain field. The documentation for portfolios may include case reports, recordings of practical processes, videotapes of consultations, project reports, samples of performance evaluations, learning plans, and written reflections on the proof given (Al-Wardy, 2010). Portfolios, regardless of their content and structure, provide a comprehensive account of completed work, received comments, achieved progress, and strategies for enhancing competency. Additionally, it promotes the process of reflective learning (Driessen et al., 2007). It is frequently employed for the purpose of formative assessment. The reliability of the format is compromised by the significant diversity in both the structure and assessment methods (Al-Wardy., 2010).

5.3 The Knowledge of the Medical Doctors in Blood Transfusion

The second objective of this study was to assess the level of knowledge of Kenyan trained non-specialist doctors in blood transfusion**.** A total of 150 Kenyan-trained non-specialist doctors who received their training at a total of nine medical schools based in Kenya participated in the study. These doctors were recruited from a total of eleven hospitals based in the western region of Kenya, all of which were county-level referral hospitals except one (MTRH), which is the only national referral facility in the region. They were distributed across different designations, including medical officers (MOs), interns, and residents. The range of ages of the participants was 25–45 years, and the male-to-female ratio was 3:2, and this is a reflection of the existing age and gender representation of medical doctors in the Kenyan health sector, where 67.5% of the health professionals in the public sector are aged 25–44 years and males form a higher proportion of the healthcare workforce (Okoroafor et al., 2022). Most of the residents were based at MTRH, and the rest were at a few county hospitals. This finding mirrors the current training of medical specialists in Kenya, where the majority are trained at the University of Nairobi and Moi University, whereby they use the Kenyatta National

Hospital and MTRH as their teaching hospitals, respectively. The residents at the county hospitals undergo collegiate based training (Ministry of Health, 2019).

5.3.1 Factual Knowledge of the Medical Doctors in Blood Transfusion

The overall mean factual knowledge score on blood transfusion among the doctors was determined to be average, which is suboptimal and mirrors conclusions from similar studies conducted in different jurisdictions (Sahmoud et al., 2021; Saidenberg & Pugh, 2014; Kaur et al., 2014; Sullivan et al., 2019; Wyssusek et al., 2021; Rock et al., 2002; Eisenstaedt et al., 1988; Kasraian & Tavassoli, 2014; Graham et al., 2014; Fettah et al., 2017; Alvarado-Navarro et al., 2016; Philip et al., 2015; Yudelowitz et al., 2016; Laher& Patel, 2019; Ddungu et al., 2018; RahavKoren et al., 2017; Halford et al., 2021; Lin et al., 2019; Moschidou et al., 2019). This could be due to inadequate time devoted to the educational activities on blood transfusion during the entire undergraduate medical education. Previous studies have reported insufficient time that is dedicated to the teaching of blood transfusion during entire undergraduate medical curriculum and this has been shown to be associated with poor knowledge of blood transfusion (Panzer et al., 2013; Karp et al., 2011; Vasconselos Vaena et al., 2016; Al-Riyami et al., 2020; Ray et al., 2022). This is supported from our study where only 31% of the medical doctors reported that they were taught blood transfusion for more than six hours in medical school.

The specific question with the lowest score was the one dealing with blood grouping/typing and screen policy, where only 13.2% answered it correctly. This finding compares to that of a Ugandan study (Ddungu et al., 2018). However, this differs from the studies in South Africa (Laher& Patel, 2019) and the USA (Arinsburg et al., 2012), where 54.7% and 86.6% of the study participants answered the question correctly, respectively. This variance could be attributed to the fact that most of the blood banks in our country, just like in other developing countries, still follow the blood grouping and crossmatch (GXM) policy, where a major or minor crossmatch is performed and red blood cell units are reserved for a specific patient. These units are then issued as and when actual need arises, for example, surgical blood loss, postoperative blood loss, or symptomatic anemia (Aggarwal et al., 2018). The blood group or type and screen policy entails determining the blood group and antibody screen of a patient who may require a blood transfusion, and when the patient requires the transfusion, a crossmatch is performed and a compatible unit is issued (Setia et al., 2017).

The disadvantages of the GXM policy include the inability of the blood bank to issue a reserved blood unit to another patient in need, additional inventory management as all the red blood cell units reserved have to be labeled and segregated, increased risk of blood unit expiration as a result of outdating due to inadvertent repeated reservation and unreservation, unnecessary workforce and reagent wastage due to an increased number of unnecessary cross-match tests, and hence an increased burden on blood resources and finances. Grouping or type and screen, on the other hand, has several advantages, including a better crossmatch-to-transfusion ratio, a decreased turnaround time for the issue of blood units, and a decrease in the expiration of red blood cell units because there is no reservation of red blood cell units and the units are cross-matched and issued as and when required by the patient. This results in better human resource utilization and cost savings. Implementation of the grouping/typing and screening policy has been shown by several studies to be efficient and beneficial to the blood transfusion practice (Aggarwal et al., 2018).

Questions dealing with septic transfusion reactions and transfusion-related lung injury (TRALI) also attracted low scores. Previous studies have reported that doctors scored poorly on questions concerned with transfusion reactions (Halford et al., 2021; Wheeler et al., 2021; Kafando et al., 2017; Lin et al., 2016; Haspel et al., 2015; Shafiee et al., 2013). This dismal knowledge on transfusion reactions may be attributable to a number of possible factors, including fewer transfusion ordering opportunities and the relatively low frequency at which transfusion reactions occur, which limits hands-on experience in the identification and management of these complications (Halford et al., 2021; Barrett et al., 2020; Kafando et al., 2017). Indeed, in our study, the participants who reported that they prescribed blood once a week or less were 62.7%, and those who prescribed blood less frequently had lower scores on these questions (mean = 3.9) as compared to those who prescribed more frequently (mean = 5.7), and this difference was statistically significant ($p = 0.016$). In addition, the majority (55.3%) of the participants reported that they were not confident in managing a patient with transfusion reactions. The questions related to transfusion reactions that had the highest scores were on knowing when to stop a transfusion (91.4%) and report it in the event of an acute haemolytic reaction and the commonest cause of an acute haemolytic reaction (79.5%). These findings differ from studies by Ddungu et al. (2018) and Haspel et al. (2015), where the participants in the Ddungu et al. (2018) study (medical officers and consultant physicians) scored 75.0% and 64.0%, respectively, while those in the Haspel et al. (2015) study (internal medicine residents) scored 66.0% and 66.7%, respectively. Despite the high scores, it is expected that all medical doctors ordering and administering blood transfusions should answer this question correctly, as knowledge of transfusion reactions and risks is vital for providing appropriate patient care and obtaining informed consent. These findings suggest that the doctors need more training in transfusion-associated reactions. It is critical that medical professionals are able to identify immediate and delayed transfusion reactions, respond quickly to stop the reactions, and report any such reactions (Garraud et al., 2020).

Questions on appropriate use of blood components had scores less than 50%, with those on red blood cell threshold in anemia having a score of 47.7% and platelet threshold for bleeding (prophylaxis) attracting a score of 41.1%. This finding is incongruent with that of the study by Halford et al. (2021), where their study participants had higher scores on questions related to thresholds for red cell transfusions for prophylaxis (96.7%) and platelet thresholds for prophylaxis (76.3%). This difference could be explained by the fact that the study population in Halford et al. (2021) research comprised of attending medical doctors and advanced practice providers (APPs) in internal medicine whereas in our study, the participants were interns, medical officers (general practitioners), and residents distributed in various clinical sections. The attending medical doctors are expected to have more knowledge of these topics (Halford et al., 2021). Inappropriate utilization of blood components can predispose recipients to transfusion reactions, wastage of a scarce resource and unnecessary costs (Ray et al. (2022; World Health Organization, 2020).

5.3.2 Perceived Knowledge of the Medical Doctors in Blood Transfusion

The majority of our study participants rated their overall knowledge of blood transfusion as fair, and this correlated with the factual knowledge score ($p < 0.001$). Those who described their overall knowledge as poor, fair, good, or very good had a median score of 7.0, 7.4, 8.8, and 9.5, respectively, and this was statistically significant ($p < 0.001$). Previous studies have demonstrated comparable results (Haspel et al., 2015; Lin et al., 2019). This finding could also serve to show that the factual knowledge assessment tool used in our study was valid.

5.3.3 Factors Associated with Knowledge of Medical Doctors in Blood Transfusion

The only factor that was found to be associated with knowledge scores was induction ($p = 0.020$). This result is similar to that of other studies (Graham et al., 2014; Philip et al., 2015; Flores et al., 2018). The study by Philip et al. (2015) found that insufficient knowledge among their study population was attributed to a deficiency in orientation or training in various areas of blood transfusion. An Australian study by Flores et al. (2018) found that the orientation tools developed by the Australian Red Cross Blood Service (Australian Red Cross Blood Service, 2017) were perceived by the participants to be useful in that they made them learn something new, feel reassured about their transfusion knowledge, and change or improve their practice. The tools referred to as ‘Transfusion Orientation Pack’ contain a transfusion checklist, haemoglobin threshold table, platelet threshold table, acute transfusion reactions poster, and lanyard cards (acute transfusion reactions card, blood prescribing card, and warfarin reversal card). The majority of the participants reported that they would recommend the use of these tools to complement clinical practice. In another Brazilian study, Alvarado-Navarro et al. (2016) found that the study participants who had read a practical guide on transfusion medicine obtained a better mean knowledge score than those who had not (55.4 vs. 44.6). These studies concluded that attendance at hospital induction improves knowledge competency scores and makes doctors feel reassured about their transfusion knowledge, thus improving their practice.

Although post-internship training was not statistically associated with knowledge scores in multivariate analysis, bivariate analysis showed that those who participated in it had a higher median score than those who did not (9.0 vs. 8.0, $p = 0.037$). Various studies have demonstrated an association between more training in blood transfusion and knowledge level (Graham et al., 2014; Peedin et al., 2019; Arinsburg et al., 2012; Lin et al., 2019; Sahmoud et al., 2021; Vaena & Alves, 2019; Alvarado-Navarro et al., 2016; Mayaki et al., 2016; Kaur et al., 2014; Nunes da Silva et al., 2017; Sullivan et al., 2019; Konia et al., 2018). In the study by Lin et al., (2019), a transfusion camp delivered over 5 days led to increased blood transfusion knowledge (the mean pretest score was 10.3 of 20 (2.9; $n = 286$) compared with posttest score of 13.0 (2.8; $n = 194$; $p < 0.0001$).

The knowledge score was marginally higher among females (median = 8.5) than males (median = 7.9), though not statistically significant, and this compares with that of Ruhi & Seema (2016). Medical interns performed slightly better in their knowledge score (median = 8.3) than the other designations: medical officers (median = 8.2) and residents (median = 7.9), though this difference was not statistically significant. Similar results have been depicted by other studies (Kumarage et al., 2017; Graham et al., 2014; Gharehbaghian et al., 2009).

In our study, there was a general downward trend in knowledge scores with increasing age and years of practice, though it was not significant. The finding is consistent with that of Kasraian & Tavassoli (2014). Other studies have shown a statistically significant decrease in levels of transfusion knowledge among medical doctors with increasing years of practice (Gharehbaghian et al., 2009; Arinsburg et al., 2012). These results show that doctors' understanding of blood transfusions may reduce over time and also suggest that medical doctors should engage in regular refresher training regarding current trends in blood transfusion for more optimal management of blood and blood components and safe practice.

5.4 Attitude of Medical Doctors Towards Blood Transfusion

The majority (73.3%) of the respondents had a positive attitude towards the practice of blood transfusion. A comparable finding was demonstrated by Khatiwada et al., (2022) and Sack et al., (2018). A positive attitude towards blood transfusion is key in ensuring that blood resources are used in a rational manner, thus minimizing risks and costs associated with blood transfusion practice and conservation of a scarce resource. Blood and blood components are classified as essential medicines by the WHO (World Health Organization, 2021c). According to WHO, as cited by Kshirsagar (2016), rational use of medicines involves their correct/proper/appropriate use so that their selection, dose, and duration are according to the guidelines, suitable for clinical needs, at the lowest cost to the provider, community, and patient, and are correctly administered.

Most of the participants strongly agreed or agreed that blood transfusion is a costly procedure, that the practice is associated with risks, and that these factors influence their use of blood transfusion. Previous studies have reported comparable results (Adedayo et al., 2021; Islam et al., 2012; Ddungu et al., 2018; Hartford et al., 2015; Mayaki et al., 2016; Vetter et al., 2014; Francis et al., 2009). The risks associated with blood transfusion include transfusion transmitted infections (HIV, HBV, HCV, syphilis, malaria, West Nile virus (HTLV-1) (Justiz Vaillant & Sticco, 2022), immunological reactions (haemolytic transfusion reactions, allergic reactions, febrile nonhaemolytic transfusion reactions, anaphylactic reactions, transfusion associated graft versus host disease, post transfusion purpura, TRALI, alloimmunization, immunosuppression), non-immune reactions (air embolism, TACO, iron overload) (Khan & Gupta, 2022), and complications associated with massive transfusions – electrolyte abnormalities (hypocalcemia, hypomagnesemia, hypokalemia, hyperkalemia), citrate toxicity, hypothermia, acid-base derangements, and TRALI (Sihler & Napolitano, 2010). The cost of producing safe blood or blood components is between Ksh 10,000 and Ksh 14,000 (about 10 to 14 USD) per unit (Alushula, 2020). These costs are incurred during blood collection, processing, storage, and administration (Mafirakureva et al., 2016; Oge et al., 2014). In addition to these direct costs, indirect costs include those incurred during hospital stays, nursing care (Oge et al., 2014), and adverse events (Ribed-Sánchez et al., 2018). Transfusion-related adverse events increase morbidity and mortality and, therefore, the overall cost of their treatment. The health care workers who utilize blood and blood components in the management of patients must be aware of these risks and costs and should therefore use this scarce resource prudently and rationally.

Other factors that the doctors indicated would influence their decision to transfuse include availability of blood components and awareness of transfusion guidelines. In a study by (Hartford et al., 2015), increased reliability of the blood supply, among other factors, influenced the decision of their study participants (doctors) to transfuse. Similarly, awareness and adherence to guidelines have been reported previously to influence the transfusion behavior of medical doctors (Adedayo et al., 2021; Islam et al., 2012; Francis et al., 2009; Hartford et al., 2015)

The majority (88%) of the doctors agreed that consent is required before administering a blood transfusion. Comparable results have been reported in studies by Alsharidah et al. (2021) and Al-Riyami et al. (2016). In the study by Alsharidah et al. (2021), 129 (95.6%) of the study population agreed that the consent process for blood transfusion was necessary, whereas the remaining 6 (4.4%) thought that consent was not necessary. Al-Riyami et al. (2016) reported in their research that the importance of the consent process was acknowledged by 80% of surveyed medical doctors. Despite these claims by medical doctors about the necessity of consent, deficiencies in the consent process have been noted (Friedman et al., 2012). Indeed, in our study, despite the high acknowledgement of the need for consenting, only 44.7% claimed that they always obtain verbal consent and a paltry 22.7% reported that they recorded evidence of consent in the patient's medical records. In a study in Burkina Faso, only 5% (10/192) of the study participants obtained informed consent from the patient prior to transfusion (Kafando et al., 2017). In another study by Court et al. (2011), 59.1% of the patients interviewed reported that someone explained to them that they might need a transfusion, and of these, only 58.8% felt informed of what a transfusion involves, with 67.0% being told of the benefits and 27.8% informed of the risks. A Nepalese observational study on blood transfusion practice among patients reported that only 8.2% of the patients and/or their relatives were informed about the reasons, associated probable risks (2.4%), and benefits of transfusion (4.7%) (Sapkota et al., 2018).

About 54% of the doctors agreed that the presence of fatigue, weakness, and pallor is a good indication for a blood transfusion, and 46% agreed that a patient with chronic anaemia and haemoglobin of 8.8 g/dL would make them decide to order a blood transfusion. In a South African study, the doctors' decision to transfuse blood was not only based on the level of haemoglobin but also to relieve symptoms attributed to anaemia (Adedayo et al., 2021). In another study in Mozambique, low Hb levels and pallor received a significantly higher level of importance in influencing the clinician's decision to transfuse when compared with tachycardia, planned surgery, slow capillary refill, low blood pressure, malaria, burns, and age ($p < 0.001$) (Hartford et al., 2015). In a study in Switzerland, the study population indicated that their decision to administer blood was influenced by the severity of anaemia and the presence of coronary artery disease (Babo et al., 2018). It is recommended that until more definitive evidence is available, symptomatic patients should only be transfused when symptoms can be attributed to anaemia and not to another pathophysiological process (Adedayo et al., 2021).

With repeated evidence of the noninferiority and sometimes superiority of a restrictive transfusion threshold (Hb < 7 g/dL) versus a liberal one (Hb of 8–10 g/dL) (Sadana et al., 2021; New et al., 2016; Lacroix et al., 2007) and increased awareness of transfusion risks and escalating costs, the traditional transfusion 'trigger' of haemoglobin (Hb) of < 10 g/dL that was first proposed by Adams & Lundy (1942) is no longer justifiable

(Young et al., 2008). Current transfusion guidelines on RBC transfusion recommend a restrictive transfusion strategy where a transfusion trigger of haemoglobin (Hb) threshold of 7-8 g/dL should be used in adults (Carson et al., 2016) and an age-appropriate Hb threshold in children (New et al., 2016; Lacroix et al., 2007). A study by Carson et al. (2021) that reviewed all randomized clinical trials looking at restrictive versus liberal transfusion strategies found that all the trials did not show any evidence suggesting that a restrictive transfusion strategy impacted 30-day mortality, mortality at other time points, or morbidity (i.e., cardiac events, myocardial infarction, stroke, pneumonia, thromboembolism, or infection) compared with a liberal transfusion strategy.

5.4.1 Factors Associated with Attitude of Medical Doctors Towards Blood Transfusion

The only factor that was found to be associated with attitude towards the practice of blood transfusion was participation in training after undergraduate medical education**.** Comparable findings have demonstrated by other studies. In a study by Lin et al. (2019), a transfusion camp for multispecialty postgraduate trainees that took over 5 days fostered a positive attitude toward transfusion medicine. A Scottish study that looked at knowledge and attitude following blood transfusion training showed that attitudes toward transfusion practice changed positively among the study participants as a result of the training. However, it was noted that there was a significant reduction in the degree of emphasis the respondents placed on the importance of understanding aspects of transfusions as time lapsed (Smith et al., 2014). The authors suggested that frequent refresher courses are needed in order to maintain safe practice. In an Indian study that assessed knowledge, attitude, and practices for safe and efficient vein-to-vein transfusion practices among hospital health care workers, it was demonstrated that an educational intervention led to improvement in the knowledge, attitude, and practices of the study population (Pandey et al., 2020).

5.5 Self-Reported Practice Competency of Medical Doctors in Blood Transfusion

Ninety-eight percent of the study participants reported that they prescribe blood monthly or more frequently. This finding concurs with that by Graham et al., 2014 (98%) but differs from studies by Barrett et al. (2020), Vaena & Alves (2019), and Hartford et al. (2015), where the frequency of prescription among their study participants was 81.8%, 83.9%, and 75%, respectively. According to Graham et al. (2014), this level of frequency of prescription among doctors, when combined with appropriate training and reflective practice, should be enough to maintain competency in blood transfusion.

In our study, less than half of the self-reported practices conformed with the recommended best practices. The result compares with that of a study conducted by Salem-Schatz et al. (1990), where only 30% of the study participants appeared to be fully aware of best practices for the clinical utilization of blood and blood components. This could be attributed to the suboptimal level of knowledge, the unavailability of blood transfusion guidelines, or the failure to adhere to them. In this study knowledge was correlated with practice (r_s =0.197, p=0.016) and the majority (89.3%) of the respondents reported that they had not used transfusion guidelines to guide their practice, and nearly all of them (93.3%) indicated that they would utilize the guidelines in their decision-making if they were available to them. The World Health Organization recommends that the prescription of blood and blood components be based on national guidelines on the clinical use of blood while taking individual patient needs into account (World Health Organization, 2001). Clinical guidelines can improve the quality of clinical decisions (Pereira et al., 2022; Sciarra, 2012) and have also been shown to decrease unnecessary transfusions that increase costs and expose patients to potential infectious or noninfectious risks (Carson et al., 2021; Williams et al., 2020; Alagappan et al., 1998). Though they are important in improving the quality of transfusion practice, the challenges of the unavailability of these guidelines and the variability in adherence have been reported (Babo et al., 2018; Tinmouth et al., 2010).

Merriam-Webster dictionary defines best practice as ‘a procedure that has been shown by research and experience to produce optimal results and that is established or proposed as a standard suitable for widespread adoption' (Merriam-Webster, Inc., 2022). In health care, best practices are health practices, methods, interventions, procedures, or techniques based on high-quality evidence aimed at obtaining improved patient and health outcomes (ten Ham-Baloyi et al., 2020). Blood transfusion best practices are based on a set of measures whose primary purpose is to provide health professionals with optimal strategies for enhancing transfusion safety (Kafando et al., 2017). Best practices in blood transfusion include, among others, good manufacturing practices by blood establishments (World Health Organization, 2011), adopting a restrictive transfusion strategy (Carson et al., 2016), a patient blood management approach (Hofmann et al., 2021; World Health Organization, 2021b), prescribing the right blood component to the right patient at the right time (Letowska, 2009), and the use of clinical guidelines (Szczepiorkowski & Dunbar, 2013; World Health Organization, 2001a).

Only 40.0% of our respondents reported that they always prescribe the right blood component to the right patient at the right time. Medical doctors responsible for transfusing blood components are expected, as best practice, to always administer the right blood component to the right patient at the right time to ensure a safe transfusion. This practice entails proper patient identification during sample collection, laboratory testing, collecting the blood component from the blood bank, or administration of the transfusion at the bedside. Haemoigilance reports, especially from the UK Serious Hazards of Transfusion (SHOT) initiative (http://www.shotuk.org) and the Australian Haemovigilance Report (https://www.blood.gov.au/haemovigilance-reporting), have shown that the majority of serious hazards attributed to blood transfusion are as a result of the administration of blood units to the wrong patient. These reports have further demonstrated that these incidents are always caused by human error involving clinical staff, where the root cause is misidentification of the patient and can result in life-threatening haemolytic transfusion reactions and other significant morbidities (Robinson et al., 2018).

About forty percent of our study population reported that they always or often used haemoglobin level as the sole deciding factor before prescribing a blood transfusion. This finding contrasts with a South African study where a haemoglobin-based transfusion trigger was reportedly used by 76.2 % of respondents, 23.1 % reported using a clinical trigger, and one respondent reported using both clinical and haemoglobin-based trigger (Barrett et al., 2020). Good clinical practice requires that both the haemoglobin level and the clinical status of the patient be the basis for the decision to transfuse (Robinson et al., 2018; Carson et al., 2016; World Health Organization, 2001b).

When it comes to making the decision to transfuse a patient, the World Health Organization states that ‘the patient’s haemoglobin value, although important, should not be the sole deciding factor in starting a transfusion. This decision should be supported by the need to relieve clinical signs and symptoms and prevent significant morbidity and mortality' (World Health Organization, 2001b). According to Carson et al. (2016), the clinical variables to be taken into consideration when making the decision to transfuse include the rate of decline in hemoglobin level, intravascular volume status, shortness of breath, exercise tolerance, lightheadedness, chest pain thought to be cardiac in origin, hypotension or tachycardia unresponsive to fluid challenge, and patient preferences.

Though 74.0% claimed that they always or often obtained consent from patients or guardians before transfusion, only 35.4% reported that they recorded this in the medical records of the patients. This finding compares with that of Graham et al. (2014), where the majority of the study population claimed to always obtain verbal consent from patients before transfusion but rarely documented this consent in the notes. However, it is higher than in a Ugandan study, where only 25% of the medical doctors indicated they obtained signed consent from patients before administering a transfusion (Ddungu et al., 2018). The participants in the Ugandan study were medical doctors taking care of oncology patients. It is recommended, as best practice, that the clinician or a registered member of the health team always obtain informed written or oral consent from patients requiring blood transfusion or their guardians. The patients or their guardians should be explained the risks, benefits, consequences, and alternatives of the blood transfusion in a timely and understandable manner. The valid consent obtained should then be documented in the patient's clinical record (Robinson et al., 2018; National Institute for Health and Care Excellence, 2015**;** AABB, 2006; World Health Organization, n.d.).

About 83% claimed that they always (53.3%) or often (30.0%) document the indication and the blood component to be transfused in the medical notes and in the laboratory request form. This result is supported by findings from a study carried out in a teaching and referral hospital in western Kenya, where the indication of the transfusion was documented in 91.1% of the patients' charts (Kipkulei et al., 2019). However, it differs from a UK study where 67% of the non-specialist medical doctors stated that they always document the indication for transfusion in the medical notes (Graham et al., 2014). It is a good practice for the prescribers of blood transfusions to clearly record the reason for the blood transfusion in the patient's medical record (World Health Organization, 2001). According to a British Society for Haematology Guideline, documentation is one of the key principles of safe transfusion, and it should include the clinical indication for the transfusion (Robinson et al., 2018). Proper documentation reduces the risk of treatment errors and improves the likelihood of positive patient outcomes (Malone, 2021). Documentation is also important in that it can prevent future costs resulting from a malpractice claim, as cases of malpractice are frequently decided based on the documentation that occurred (Frank-Stromborg et al., 2001).

About 51% of the medical doctors reported that they always performed post-transfusion haemoglobin estimation, and 38% and 46% of the respondents reported that they always documented the clinical and laboratory outcomes of the blood transfusion, respectively. This finding differs from that of Kafando et al. (2017), where 95% (183/192) of the study population claimed to carry out post-transfusion examinations, including haemogram within 72 hours after transfusion. However, this study involved doctors, nurses, midwives, and students. It also inquired whether the procedure was carried out or not, not the frequency of performing it. The recommended best practice after completion of a blood transfusion is that clinical assessment of the patient as well as follow-up of the post-transfusion laboratory outcomes, e.g., increment in haemoglobin concentration or other blood indices, should always be done and the same documented in the patient's clinical records (Robinson et al., 2018; National Institute for Health and Care Excellence, 2015; Berger et al., 2012). Current best practice guidelines recommend transfusion of one unit of red blood cells at a time in stable adult patients in most clinical situations, with the exception of acute coronary syndromes and chronic renal and haematological malignancies (Heyes et al., 2017; Thakkar et al., 2017; National Institute for Health and Care Excellence, 2015; Berger et al., 2012), and reassessment of the patient clinically and a post-transfusion haemoglobin level check prior to consideration for further transfusion (National Institute for Health and Care Excellence, 2015). Studies have demonstrated that in a stable, non-bleeding patient, transfusion of one unit of packed red blood cells increases the haemoglobin level by 1 g/dl or haematocrit by 3% (Nørgaard & McQuilten, 2022; Shrestha et al., 2020).

5.5.1 Factors Associated with Self-Reported Practice Competency of Medical Doctors in Blood Transfusion

In our study there was a positive correlation between knowledge and self-reported practice scores (r=0.197, p=0.016). Positive correlation between knowledge and self-perception of competence is an indication of the role of knowledge in improving self-concept about a skill, which may consequently lead to improved performance (Katowa-Mukwato & Banda, 2014). Knowledge of transfusion medicine is the key element of better transfusion practices (Kumarage et al., 2017).

Previous studies have demonstrated that knowledge of blood transfusion among the health care providers correlated with improved quality of patient care (Salem-Schatz et al., (1993). According to (Friedman, 2011) the inconsistency in the practice of transfusion shown by many studies could be attributed to inadequate knowledge among medical doctors and he asserted that improvement in the knowledge of the health care providers would enhance the blood transfusion practices. In fact, interventions geared towards enhancing the knowledge of health care providers have demonstrated improvement in the quality of blood transfusion practices, e.g. appropriateness of blood components utilization and reduction in blood product prescribing errors (Lee et al., 2019; Lin et al., 2019; Soril et al., 2018); Joyce et al., 2015; Joubert et al., 2014; Yaffee et al., 2014; Rothschild et al., 2007; Garrioch et al., 2004; Soumerai et al., 1993; Hillman et al., 1979). Despite the positive impact of knowledge enhancement by educational interventions in influencing transfusion practice reported by previous studies, a recent study by (Daichman et al., 2022) failed to demonstrate an impact of training on the unnecessary transfusions. The investigators concluded that an educational intervention alone is not an effective means of influencing the behavior of medical doctors and that a more complex approach is required to prevent unnecessary RBC transfusions. However, this study examined the effect an educational intervention on improving clinician's proficiency of transfusion guidelines on their rates of transfusion of red blood cells (overuse).

Though not statistically significant in the multivariate analysis, there were marginally significant differences in the self-reported practice competency scores among the different designations in the bivariate analysis, where the median scores were 4.0, 4.2, and 3.7 for the medical interns, medical officers, and residents, respectively. Studies by Jogi et al. (2021), Iqbal et al. (2021), Babo et al. (2018) and Ray et al. (2022) have reported similar finding.

5.6 Self-Confidence of Medical Doctors in Blood Transfusion Practice

The self-confidence of the study participants was relatively high, with a median score of 8.6 (86%) and this finding compares well with that of other studies (Kang & Ngissah, 2020; Lin et al., 2016; Graham et al., 2014). For example, in the study by Lin et al., (2016) the median of the composite scores for the population's ratings of their ability to manage various blood transfusion related patient issues was 3.6 out of a maximum of 5. However, it varies from the results from studies by Peedin et al. (2019) and Flores et al. (2018). In the study by Peedin et al., (2019) for instance, the confidence level among the study population (graduating medical students) was 3.1 but this rose to 7 after an educational intervention.

Close to 59% (n = 89) of the doctors scored themselves as having confidence levels 9 and 10 when asked if they always make 'the right decision to prescribe the right blood component to the right patient at the right time. This finding is slightly higher than that found by Graham et al. (2014), where half (49.5%) of the participants scored themselves as having a confidence level of 9 or 10. This variation could be explained by the fact that the Graham et al. (2014) study looked at doctors in their 1st and 2nd year of residency.

The proportions of respondents who scored themselves at confidence level 9 or 10 when asked whether they always recognize and manage a patient with an acute transfusion were 54.7% and 44.7%, respectively, and this difference was statistically significant ($p < 0.001$). This finding varies from a multicentric survey study in Turkey where only 14% of the participants, who were medical students, felt competent in recognizing transfusion complications and applying first-line treatment (Kupesiz et al., 2020). The moderate to low levels of confidence in our study on these aspects could be due to the fact that doctors are rarely involved in the actual monitoring of patients being transfused, a task that is often performed by the nursing staff. However, as the team leaders, doctors should be confident and competent enough to recognize signs and symptoms of an acute transfusion reaction and manage them appropriately if they occur (Garraud et al., 2020).

5.6.1 Factors Associated with Self-Confidence of Medical Doctors in Blood transfusion

The only factor that was found to be associated with self-confidence after multivariate analysis was pre-internship orientation. Previous studies have posted comparable findings, where the confidence levels of the participants significantly and durably improved in all areas after induction sessions (Antonoff et al., 2010; Kamau, 2014**;** Evans et al., 2004). Given the fact that only 16% of the doctors in our study reported having had an induction prior to internship, there is an urgent need for the adoption and implementation of pre-internship orientation sessions in centers offering internship training in order to better prepare the medical interns to offer quality care to patients.

Though not statistically significant in the multivariate analysis, the level of self-confidence among medical interns was marginally higher (8.9) as compared to that of medical officers (8.7) and residents (8.1). The overall median score was also quite high (8.6 out of 10). Studies by Gude et al. (2017), Graham et al. (2014), Marel et al. (2000), Davis et al. (2006), and Friedman et al. (2005) posted comparable findings.

The plausible explanation for this finding, where the medical interns were relatively more confident and yet less experienced than the medical officers and residents, is the Dunning-Kruger effect (Kruger & Dunning, 1999) (Figure 5.1). This phenomenon, which has been shown to impact medical practice (Michailidou, 2020)**,** suggests that individuals with less competence or experience in a given field are more likely to unknowingly overestimate their ability. The effect is illustrated in Figure 25. Medical interns who have just graduated from medical school are less experienced and could exaggerate their level of confidence in their abilities. As they gain experience, they realize that they had been unaware of some intricate aspects of the job, and this realization causes them to lose their confidence. Continued learning on the job and training enable them to acquire more experience and knowledge, which ultimately leads to a rise in their confidence. According to Jaspan et al. (2022), people generally tend to overestimate their knowledge, abilities, and positive attributes relative to others. The study by Friedman et al. (2005) that explored the confidence and competence in diagnostic accuracy between attending medical doctors, senior residents, and medical students found that while most subjects were overconfident, trainees were the most overconfident group, followed by attending medical doctors. The Davis et al. (2006) study was a systematic review looking at the accuracy of clinician self-assessment compared with observed measures of competence. It found that a number of studies demonstrated that medical doctors with the lowest skill levels and those with the highest levels of confidence had the weakest self-reported accuracy. Another possible explanation for the relatively high self-confidence among non-specialists is exaggeration out of fear of being viewed as incompetent or ill prepared (Flores et al., 2018).

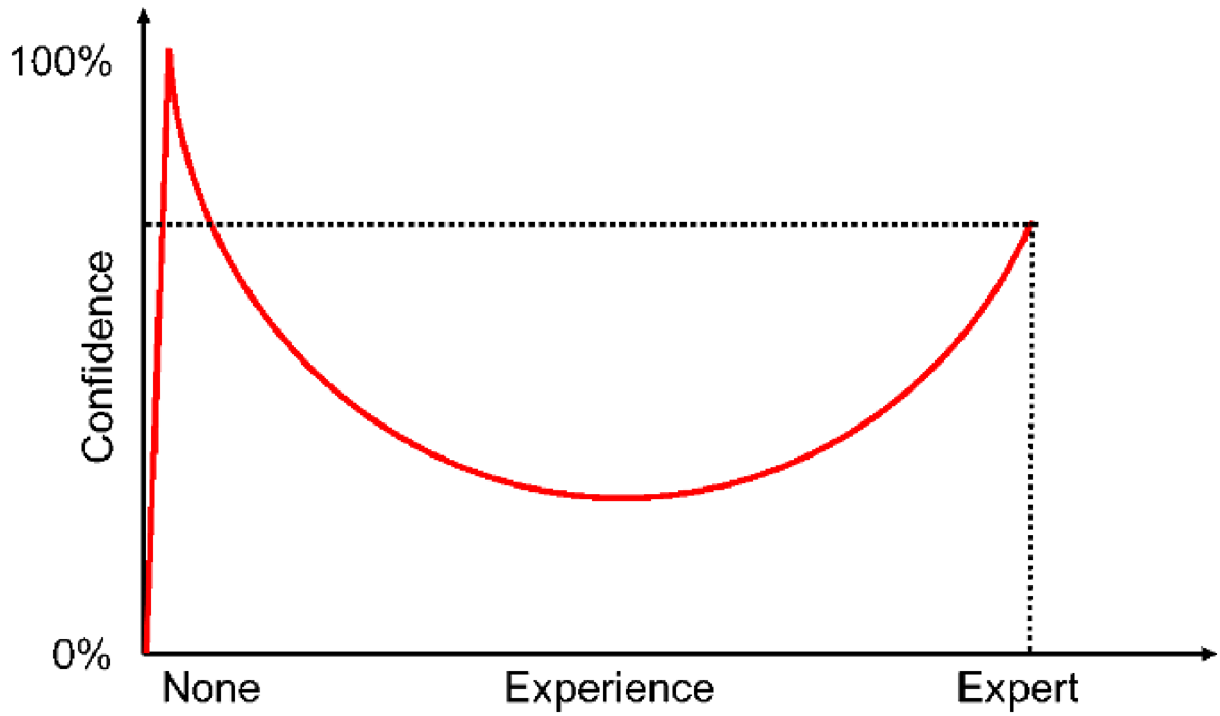


Figure 25: Dunner Kruger effect (Adopted from: Gearon, 2019)

Our study did not find any significant association between sex and self-confidence. A similar finding was reported by Augustine Egwu et al. (2011) and Minter et al. (2005). However, other studies have found that sex is associated with confidence (Karim et al., 2012; Kim et al., 2020; Browne et al., 2007; Connick et al., 2009), with females more often being less confident than their male counterparts, despite equivalent performance between the two genders as assessed by objective external measures (Minter et al., 2005). According to Dickerson & Taylor (2000), men are more confident in their ability to handle obstacles, regardless of their existing capabilities.

5.7 Relationship Between Self-Confidence and Self-Reported Practice Competency of Medical Doctors in Blood Transfusion

In the bivariate analysis, knowledge and self-confidence were positively correlated with practice. However, when knowledge was held constant, it was found that the odds of self-reported performance of good practice increased by about 16% for a unit increase in the level of self-confidence. A comparable finding was established by (Tomić et al., 2007). Several other studies have looked at the correlation between motivated behavior or performance and self-confidence across a range of tasks and settings, and they have shown weak to no association between the two (Lai et al., 2007; Woolliscroft et al., 1993; Barnsley et al., 2004; Morgan & Cleave-Hogg, 2002; Elhadi et al., 2020; O'Donoghue et al., 2018). Unlike in our study, where self-assessment was used for assessing both abilities and practice competency, these studies compared self-assessment of confidence with formal assessment or external measures of their performance (preceptor evaluation). Though self-assessment may not be an accurate measure of abilities and competence, Antonelli, (1997) posited that 'self-assessment of knowledge and accuracy of skill performance is essential to the practice of medicine and self-directed life-long learning'. Nonetheless, reliable and standardized testing methods are necessary to assess the performance and competency of medical students and non-specialists and develop an educational approach that allows students to appreciate the need for self-assessment and to accurately assess their competence and abilities (Elhadi et al., 2020).

In order to effectively interact with patients, doctors must exhibit a certain level of confidence in their abilities, or their confidence and competence should be appropriately matched (Jaspan et al., 2022). Mismatched abilities and confidence may expose individuals to numerous decision-making biases and behaviors, which may lead to poor decision-making. For instance, a doctor who is underconfident may hesitate to take action when it is required, while a doctor who is overconfident may behave carelessly or without regard for the consequences of his or her choices. Both of these scenarios can put the patient in danger (Gottlieb et al., 2022; Jaspan et al., 2022). The factors that contribute to the mismatch between confidence and competence include competence, experience, metacognition, cognition biases, personality, sex, feedback, task difficulty, outcome predictability, and educational methods (Jaspan et al., 2022; Rahmani, 2020). Ensuring an appropriate balance between confidence and competence in order to provide quality health care in a responsible and judicious manner should be an explicit goal of medical education during both undergraduate and postgraduate training (Jaspan et al., 2022; Rahmani, 2020). Some of the suggested approaches to improving the calibration between confidence and competence include simulation, increasing experience, providing feedback, and reflective practice, among others (Jaspan et al., 2022; Rahmani, 2020; Berner & Graber, 2008).

5.8 Relationship Between Knowledge and Self-Reported Confidence of Medical Doctors in Blood Transfusion

A positive but weak correlation was observed between knowledge and self-confidence. Similar finding was reported by Lin et al. (2019), but it differs from results by Wheeler et al. (2021) and Haspel et al. (2015). This variance could be because these studies looked at knowledge of blood transfusion among paediatric and internal medicine residents, respectively. Making professional decisions in the clinical setting requires an increase in both knowledge and confidence. Therefore, training in knowledge and the capacity for critical reflection on one's own knowledge, skills, and abilities is essential, particularly in professions like medicine where knowledge-based decisions made with confidence are crucial (Roeper et al., 2022).

5.9 Participation of the Medical Doctors in Training in Blood Transfusion After Undergraduate Education

The proportion of the participants who stated that they had taken part in any training on blood transfusion after graduating from medical school was 28.7% (40/150). The finding is comparable to that of a Burkina Faso study by Kafando et al. (2017), a South African study by Yudelowitz et al. (2016), and a Malian one by Diakité et al. (2012). However, it differs from another South African study by Barrett et al. (2020), where 70.1% of their respondents had received transfusion training since their graduation from medical school. Those who participated in training on blood transfusion after medical school had more knowledge and confidence, hence the need for continuing medical education for medical doctors.

5.10 Perceptions of the Medical Doctors about the Quality of Undergraduate Education, Relevance, and Usefulness of Additional Training in Bloood Transfusion

The proportion of the participants who were satisfied or very satisfied with the quality of undergraduate medical education received in blood transfusion was 76.0%. A similar finding was reported by Kupesiz et al. (2020), but it was inconsistent with results from studies by Jalili et al. (2008) and Graham et al. (2014), where 28% and 40%, respectively, of their study participants were satisfied with the quality of their undergraduate medical education in blood transfusion, respectively. This variation could be due to the difference in the study participants; in by Jalili et al. (2008), they were newly graduated medical interns, whereas in Graham et al. (2014), they were first- and second year registrars or residents. There was a statistically significant relationship between satisfaction with the quality of undergraduate medical education in blood transfusion and the participants' knowledge score, self-perceived practice competency score, and self-confidence score. This result is consistent with findings from studies by Kang & Ngissah (2020), Lin et al. (2016), and Haspel et al. (2015) ($p = 0.03$). However, it differs from A Malaysain study by (Poh & Jackson, 2023) where the researchers did not find any association between the knowledge scores and the quantity or quality of previous training in blood transfusion. In the same study, the participants in the departments of hematology, anesthesiology and internal medicine had statistically significant higher scores. Even though our study participants had high levels of satisfaction with the quality of education in blood transfusion, the quality and scope of the training in blood transfusion need to be re-examined, and additional time and resources should be dedicated (Stubbs & Kreuter, 2016).

Almost all (99.3%) of the study participants indicated that knowledge of transfusion medicine is important to their medical practice. Comparable results were reported by Halford et al. (2021), Vaena & Alves (2019), and Lin et al. (2016). There was no statistical association between perceived importance of blood transfusion knowledge and knowledge scores ($p = 0.414$), and the finding is consistent with results by Halford et al. (2021) and Stubbs & Kreuter (2016).

On the other hand, all the participants (100%) in our study agreed that additional training in blood transfusion is useful, with 97% reporting that additional training is very or extremely useful. Previous literature has posted similar results (Halford et al., 2021; Vaena &Alves, 2019; Ddungu et al., 2018; Lin et al., 2016; Morris et al., 2016; Arinsburg et al., 2012; O'Brien et al., 2010; Gharehbaghian et al., 2009; Mitchell et al., 1989). These findings are further supported by opinions from experts in blood transfusion or deans of schools, where the majority indicated that education in blood transfusion in medical schools was inadequate and felt that it should be enhanced for both medical students and residents (Al-Riyami et al., 2020; Panzer et al., 2013).

The aspects that the participants indicated that they needed more training on include complications of blood transfusion (78%), alternatives to blood transfusion (78%), appropriate use of blood components (73.3%), haemovigilance (74.7%), special blood requirements (72.6%) and blood components (71.3%). Other aspects include patient blood management, pretransfusion testing, organization of national blood transfusion service, blood donation and bedside procedures. In an Australian study, the highest priority areas in blood transfusion identified by the study population included practical transfusion prescribing, consent, management of transfusion adverse events and assessment of transfusion response (Flores et al., (2018). In a Sri Lankan study, a total of 26% of the study participants required training to help them gain greater knowledge of practical perspectives on blood handling. In a study by Mitchell et al. (1989), the topics of knowledge deficits cited by the respondents were related to the selection and use of blood components, transfusion reactions, the use of blood components to treat hemostatic problems, basic blood bank procedures (e.g., blood grouping and compatibility testing), proper transfusion practices (e.g., collection, processing, storage, and transfusion of blood), administration of blood banks (blood procuring procedures, management of costs, and the need to communicate and consult with blood bank staff), immunohaematology (red blood cell antigen-antibody, graft versus host disease), and apheresis.

These educational needs are a reflection of the participants' performance and perceptions in terms of factual knowledge and self-confidence, respectively. An interesting observation is that the topics in the factual knowledge section that were poorly scored were similar to the ones that the majority of the participants indicated that they needed more training on. However, an exception to this is the topic of blood donation, where the respondents performed poorly, yet only 50% of them reported that they required further training on it. This finding, however, is supported by an Australian study where those surveyed about the topics covered during their medical school education placed less emphasis on voluntary blood donation, the donation process, and requirements for correct storage and transport (Panzer et al., 2013). This observation could be explained by the fact that the doctors may view this aspect of blood transfusion as unimportant and not applicable to direct patient care. Another plausible explanation could be inadequate teaching of the subject in medical school, as few medical schools in our study mentioned the topics of blood donation or collection of blood in their curricula. However, while knowledge of pretransfusion laboratory and blood bank procedures may not be directly applicable to patient care, doctors nonetheless need to have this knowledge in order to communicate appropriately with staff members working in these areas. Additionally, how well doctors use blood transfusion services and, consequently, patient care are impacted by this knowledge or lack of it (Mitchell et al., 1989). Indeed, it has been shown that there is a clear gap in communication between prescribers and blood establishments (e.g., blood banks) and hospital transfusion laboratories (Sibinga, 2022).

The blood transfusion topics that the respondents felt that they needed more training on and they were also relatively less confident on include appropriate use of blood components and complications of blood transfusion. This finding mirrors results by Peedin et al., (2019) where they established that their participants had low mean confidence scores (3.1 out 10) in the appropriate use blood components and recognizing and managing transfusion reactions.

For those participants who felt that they needed more training in blood transfusion, the majority (69.3%) indicated that they preferred CME activities organized by accredited institutions or professional bodies as the method for delivering the training. The other methods include conferences and workshops, face-to-face lectures, and online courses. Previous studies have had mixed results (Flores et al., 2018; Eisenstaedt et al., 1988; Kasraian & Tavassoli, 2014; Graham et al., 2017). In the study by Flores et al. (2018), the study participants' preferred methods for transfusion learning included expert-led face-to-face education; printed tools, for example, lanyard cards; and an online application that covers essential aspects of transfusion practice. Eisenstaedt et al. (1988) showed in their study that the study participants rated senior residents, formal conferences, journals, and library resources as the most useful educational resources. In another study, the majority of participants preferred official seminars as a mode of improving their knowledge, and the least preferred mode was informative brochures (Kasraian & Tavassoli, 2014). In a UK study, the study participants preferred small group and simulation learning based on real-life cases for delivering continuing medical education activities in blood transfusion (Graham et al., 2017)._A South African study found that 35%, 27%, and 14% of the participants would like more teaching in blood transfusion in the form of pamphlets, seminars, and bedside teaching, respectively, and that about 2% would prefer online portals and posters (Laher & Patel, 2019).

5.11 Strengths of the Study

The strengths of our study include the following: First, it accounts for the curricula in more than half of Kenyan medical schools. As such, the results are likely representative of contemporary Kenyan medical education in blood transfusion. Secondly, the medical doctors who participated are also diverse and graduated from both public and private medical schools. Thirdly, while multiple previous studies have attempted to assess the presence or absence of physician transfusion medicine knowledge, this study provides both an assessment of the knowledge, attitudes, practices, and confidence as well as a comprehensive assessment of the source of these competencies, the undergraduate medical school curriculum.

5.12 Limitations of the Study

One of the weaknesses of this study is that one-third of Kenyan medical schools accredited by the Kenyan Medical Practitioners and Dentists Council did not respond. Although a systematic difference between the respondents and the nonrespondents is not suspected, it is possible that institutions with less transfusion medicine curricular content may have been reluctant to respond. If this is the case, the study results would represent an overestimate of the blood transfusion content in the Kenya medical schools' curricula.

Another limitation may include respondents' recall bias in their reflections of their experiences during undergraduate education. This limitation was mitigated by limiting the study participants to those who had graduated from medical school after 2011 (less than 10 years). In addition, the participants were allowed sufficient time for adequate recall of long-term memory.

The use of factual knowledge measure could also be considered as a source of limitation. As this was an anonymous, self-administered online and paper-based survey where the study participants responded to the questionnaire at their own preferred pace and time, it is possible that some might have searched online search engines for the correct responses to the knowledge items. However, there does not appear to be any real evidence that this took place. Most notably, the average number of correct responses was actually comparable to a similar study that investigated knowledge and practices of blood transfusion using similar items based on data collected from a paper questionnaire (Ddungu et al., 2018). Moreover, the distribution of scores on the combined knowledge score can best be described as normal (based on a graphical test), which further suggests the validity of the knowledge measure.

Finally, since self-report/assessment was used to assess various constructs of the study, this could have been affected by social desirability bias (Jones et al., 2002). This was mitigated by ensuring that the questionnaire was anonymous.

5.13 Summary of the Chapter

This chapter provided an interpretation of the main study results, backed by the relevant literature. The chapter also addressed the implications of the study's results. Moreover, the chapter highlighted the study's strengths and limitations.

CHAPTER SIX

6.0 CONCLUSION AND RECOMMENDATIONS

6.1 Overview

The chapter highlights the key findings of the research and the recommendations derived therefrom.

6.2 Conclusion

This study examined the extent to which Kenyan medical undergraduate curricula incorporate blood transfusion content. It also determined the competencies and confidence of Kenyan-trained, non-specialist medical doctors. Overall, the study has demonstrated inadequacies in undergraduate blood transfusion education (as evidenced by a lack of comprehensiveness), suboptimal knowledge of medical doctors, and limited performance of blood transfusion procedures in accordance with the recommended current blood transfusion practices. Based on the study’s objectives and findings, the following conclusions can be drawn:

i. The content of blood transfusion is contained in all the curricula of medical schools in Kenya, though the extent to which it is integrated varies across all the curricula, it was however integrated into the discipline of haematology and taught in the 3rd year of medical training in all of the medical schools. Most of the curricula had the subject integrated into disciplines offered during pre-clinical years.

ii. Although the Kenyan medical schools covered blood transfusion topics that are safe-for-practice, inadequacy was demonstrated by the inclusion of blood transfusion in only one curriculum during clinical years, albeit without explicit learning outcomes or content.

iii. The knowledge of the medical doctors in blood transfusion was suboptimal and nearly all of them reported that they needed more training in blood transfusion. and the topics they require more training on include complications of blood transfusion, haemovigilance, special blood requirements, indications of blood components, and appropriate use of blood components.

iv. The majority of the medical doctors had a positive attitude towards blood transfusion

v. Less than half of the self-reported practices by the medical doctors conformed to the recommended best practices.

vi. The self-confidence of the medical doctors was high, and it correlated, though weakly, with self-reported practice and knowledge.

vii. Both knowledge and confidence of the medical doctors were reinforced by orientation in blood transfusion during internship, while attitude was associated with participation in training in blood transfusion after graduating from medical school.

viii. There was a positive, though weak, correlation between knowledge, self-reported practice, and confidence of the medical doctors in blood transfusion.

6.3 Recommendations

Based on the findings of this study, the following recommendations are suggested for medical schools, hospitals offering internship training, and medical doctors. Recommendations geared towards further research are also proposed.

6.3.1 Recommendations to Medical Schools

Kenyan medical schools should consider reviewing their undergraduate medical curriculum in order to implement the following:

i. Devote more time to teaching of theoretical and practical aspects of blood transfusion during pre-clinical years.
ii. Include the content of blood transfusion subject in all the clinical years of undergraduate medical education with explicit learning outcomes and content, especially in disciplines where blood transfusion is required.
iii. Include topics on haemovigilance, patient blood management (PBM), special blood components, and alternatives to allogeneic blood transfusion in blood transfusion.
iv. Include blood transfusion bedside procedures in students' logbooks during clerkships in the clinical departments where blood is used.

6.3.2 Recommendations to Hospitals

Hospitals that offer blood transfusion services should, through their hospital transfusion committees implement the following:

i. Organize continuing professional development activities related to blood transfusion for medical doctors by way of CMEs, seminars, workshops, online courses, etc., in order to improve their knowledge, attitude, and skills.

ii. Make sure medical doctors have access to transfusion clinical guidelines, and encourage them to use these guidelines to ensure their performance adheres to the best recommended practices.

iii. Introduce structured induction or orientation sessions in blood transfusion for medical interns before they embark on their internship.

6.3.3 Recommendations to Medical Doctors

i. The doctors should undertake blood transfusion related continuing professional development activities in order to enhance their knowledge and skills in blood transfusion practice**.**

6.3.4 Recommendations for Further Research

i. Comprehensive qualitative research to elucidate the views of the medical doctors concerning undergraduate medical education in blood transfusion and practice among the doctors should be considered.

ii. Research comparing the self-assessment of abilities with the actual performance of doctors, using objective assessment tools for procedural skills, should be considered to evaluate the practice competency of doctors in their daily practices.

iii. Future research to evaluate blood transfusion education in nursing and medical laboratory education should be considered, as these cadres are also involved in the blood transfusion process.

REFERENCES AND BIBLIOGRAPHY

AABB. (2006). Guidelines for Informed Consent in Transfusion Medicine. AABB Press. https://www.aabb.org/aabb-store/product/guidelines-for-informed-consent-in-transfusionmedicine-1753

ADAMS, R. C., & LUNDY, J. S. (1942). Anesthesia in Cases of Poor Surgical Risk: Some Suggestions for Decreasing the Risk. Anesthesiology, 3(5), 603–607. https://doi.org/10.1097/00000542-194209000-00032

Adedayo, T., O'Mahony, D., Adeleke, O., & Mabunda, S. (2021). Doctors' practice and attitudes towards red blood cell transfusion at Mthatha Regional Hospital, Eastern Cape, South Africa: A mixed methods study. African Journal of Primary Health Care & Family Medicine, 13(1), Article 1.

Admin, I. B. (2017, March 31). Education Theory Made Practical – Volume 1, Part 8: Bloom's administration. Transfusion, 62(5), 1121–1127. https://doi.org/10.1111/trf.16866

Aggarwal, G., Tiwari, A. K., Arora, D., Dara, R. C., Acharya, D. P., Bhardwaj, G., & Sharma, J. (2018). Advantages of type and screen policy: Perspective from a developing country! Asian Journal of Transfusion Science, 12(1), 42–45. https://doi.org/10.4103/ajts.AJTS_31_17

Aggarwal, R., & Ranganathan, P. (2019). Study designs: Part 2 – Descriptive studies. Perspectives in Clinical Research, 10(1), 34–36. https://doi.org/10.4103/picr.PICR_154_18

AHMED, Y. A., & ALNEEL, S. (2017). Analyzing the Curriculum of the Faculty of Medicine, University of Gezira using Harden's 10 questions framework. Journal of Advances in Medical Education & Professionalism, 5(2), 60–66.

Ait Bouchrim, S.-A., Haddad, A., Bou Assi, T., Oriol, P., Guyotat, D., Bois, C., & Garraud, O. (2020). Residents' knowledge in transfusion medicine and educational programs: A pilot study. Transfusion Clinique Et Biologique: Journal De La Societe Francaise De Transfusion Sanguine, 27(1), 18–24. https://doi.org/10.1016/j.tracli.2019.10.002

Alagappan, A., Shattuck, K. E., & Malloy, M. H. (1998). Impact of transfusion guidelines on neonatal transfusions. Journal of Perinatology: Official Journal of the California Perinatal Association, 18(2), 92–97.

Alele, F., & Malau-Aduli, B. (2023). 1.3 Research Paradigms and Philosophical Assumptions. https://jcu.pressbooks.pub/intro-res-methods-health/chapter/1-3-research-paradigms-and-philosophical-assumptions/

Alvior, M. G. (2014, December 3). Six Famous Curriculum Theorists and their Contributions to Education—Research-based Articles. https://simplyeducate.me/2014/12/03/six-famous-curriculum-theorists-and-their-contributions-to-education/

Al-Riyami, A. Z., Al-Marshoodi, I., Zia, F., Al-Huneini, M., Al-Rawas, A. H., Jose, S., Daar, S., Al-Khabori, M., & Al-Sabti, H. (2016). Transfusion Consent in Oman: Medical doctors' Perception at a Tertiary Care University Hospital. Oman Medical Journal, 31(4), 253–257. https://doi.org/10.5001/omj.2016.50

Al-Riyami, A. Z., Louw, V. J., Indrikovs, A. J., Nedelcu, E., Bakhtary, S., Eichbaum, Q. G., & Sibinga, C. T. S. (2021). Global survey of transfusion medicine curricula in medical schools: Challenges and opportunities. Transfusion, n/a(n/a). https://doi.org/10.1111/trf.16147

Al-Riyami, A. Z., Sm, P., L, W., M, A.-K., K, A.-F., & H, A.-S. (2018). Transfusion knowledge of medical and surgical specialty board residents: A cohort study. Transfusion Medicine (Oxford, England), 28(6). https://doi.org/10.1111/tme.12555

Alsharidah, A. S., Alsuhaibani, H. A., Almansour, B. S., & Alsharidah, M. S. (2021). Perceptions About Blood Transfusion Therapy Among the General Public and Healthcare Professionals in the Qassim Region of Saudi Arabia</p>. Journal of Blood Medicine, 12, 139 145. https://doi.org/10.2147/JBM.S296036

Alushula, P. (2020, September 20). Broke blood banks push Kenyans to social media. Business Daily. https://www.businessdailyafrica.com/bd/data-hub/broke-blood-banks-push-kenyans-to-social-media-2278772

Alvarado-Navarro, D. M., Cázares-Tamez, R., Pérez-Chávez, F., Díaz-Olachea, C. G., Lee-González, B. A., Ramos-García, A. G., Castillo-Macías, A., Díaz-Chuc, E. A., & Domínguez-González, F. N. (2016). Assessment of medical doctors in training's knowledge of transfusion medicine at a university hospital. Medicina Universitaria, 18(72), 139–147. https://doi.org/10.1016/j.rmu.2016.07.004

Al-Wardy, N. M. (2010). Assessment Methods in Undergraduate Medical Education. Sultan Qaboos University Medical Journal, 10(2), 203–209.

Analyzing Likert Scale/Type Data. (n.d.). University of St Andrews. https://www.st-andrews.ac.uk/media/ceed/students/mathssupport/Likert.pdf

Antonelli, M. A. (1997). Accuracy of second-year medical students' self-assessment of clinical skills. Academic Medicine: Journal of the Association of American Medical Colleges, 72(10 Suppl 1), S63-65. https://doi.org/10.1097/00001888-199710001-00022

Antonoff, M. B., Swanson, J. A., Acton, R. D., Chipman, J. G., Maddaus, M. A., Schmitz, C. C.,

Apheresis Science, 59(3), 102739. https://doi.org/10.1016/j.transci.2020.102739

Arinsburg, S. A., Skerrett, D. L., Friedman, M. T., & Cushing, M. M. (2012). A survey to assess transfusion medicine education needs for medical doctors. Transfusion Medicine (Oxford, England), 22(1), 44–49; quiz 49–51. https://doi.org/10.1111/j.1365-3148.2011.01118.x

Armstrong, R. J., & Others, A. (1970). Developing and Writing Behavioral Objectives.

Artino, A. R., Dong, T., DeZee, K. J., Gilliland, W. R., Waechter, D. M., Cruess, D. F., & Durning, S. J. (2012). Development and initial validation of a survey to assess students' self-efficacy in medical school. Military Medicine, 177(9 Suppl), 31–37. https://doi.org/10.7205/milmed-d-12-00240

Asani, M. (2012). Assessment methods in undergraduate medical schools. Nigerian Journal of Basic and Clinical Sciences, 9(2), 53. https://doi.org/10.4103/0331-8540.108463

Augustine Egwu, O., Dimkpa, U., Ogbonnaya Orji, J., Ogbannaya Njoku, C., Ogbonnia Eni, E., & Besong, E. (2011). Medical Students – Self-Assessed Confidence Level Before a Major Physiology Examination: Affective Factors in a Nigerian Medical School. Acta Informatica Medica, 19(3), 153–157. https://doi.org/10.5455/aim.2011.19.153-157

Australian Red Cross Blood Service. (2017). TRANSFUSION ORIENTATION PACK: Promoting safe transfusion practice to junior medical officers. Australian Red Cross Blood Service. https://www.blood.gov.au/system/files/transfusion-orientation-pack.pdf

Babo, M. von, Chmiel, C., Müggler, S. A., Rakusa, J., Schuppli, C., Meier, P., Fischler, M., & Urner, M. (2018). Transfusion practice in anemic, non-bleeding patients: Cross-sectional survey of medical doctors working in general internal medicine teaching hospitals in Switzerland. PLOS ONE, 13(1), e0191752. https://doi.org/10.1371/journal.pone.0191752

Badran, I. G. (1995). Knowledge, attitude and practice: The three pillars of excellence and wisdom, a place in the medical profession. Eastern Mediterranean Health Journal, 1(1), Article 1. https://doi.org/10.26719/1995.1.1.8

Bandura, A. (1978). Self-efficacy: Toward a unifying theory of behavioral change. Advances in Behaviour Research and Therapy, 1(4), 139–161. https://doi.org/10.1016/0146-6402(78)90002-4

Bandura, A. (1984). Recycling misconceptions of perceived self-efficacy. Cognitive Therapy and Research, 8(3), 231–255. https://doi.org/10.1007/BF01172995

Bandura, A. (1986). Social foundations of thought and action: A social cognitive theory. Prentice-Hall, Inc.

Banerjee, A., & Chaudhury, S. (2010). Statistics without tears: Populations and samples. Industrial Psychiatry Journal, 19(1), 60–65. https://doi.org/10.4103/0972-6748.77642

Babbie, E. R. (2013). Survey Research Methods (13th ed.). Wadsworth Cengage Learning. http://catdir.loc.gov/catdir/enhancements/fy1506/2011925964-t.html

Barnsley, L., Lyon, P. M., Ralston, S. J., Hibbert, E. J., Cunningham, I., Gordon, F. C., & Field, M. J. (2004). Clinical skills in junior medical officers: A comparison of self-reported confidence and observed competence. Medical Education, 38(4), 358–367. https://doi.org/10.1046/j.1365-2923.2004.01773.x

Barrett, C., Mphahlele, K., Khunou, I., Mkwanazi, T., Moshoeshoe, P., Mabine, M., Wessels, P.-L., Setlogelo, O., & Joubert, G. (2020). The knowledge of transfusion and related practices among doctors at Universitas Academic Complex, Bloemfontein, South Africa. Transfusion and Apheresis Science, 59(3), 102739. https://doi.org/10.1016/j.transci.2020.102739

L., Setlogelo, O., & Joubert, G. (2020). The knowledge of transfusion and related practices among doctors at Universitas Academic Complex, Bloemfontein, South Africa. Transfusion and Apheresis Science, 59(3), 102739. https://doi.org/10.1016/j.transci.2020.102739

Bauman, A. E., Nelson, D. E., Pratt, M., Matsudo, V., &Schoeppe, S. (2006). Dissemination of Physical Activity Evidence, Programs, Policies, and Surveillance in the International Public Health Arena. American Journal of Preventive Medicine, 31(4), 57–65. https://doi.org/10.1016/j.amepre.2006.06.026

Beauchamp, G. A. (1982). Curriculum theory: Meaning, development, and use. Theory Into Practice, 21(1), Article 1. https://doi.org/10.1080/00405848209542976

Ben Salah, N., El Borgi, W., Aounallah Skhiri, H., Ben Lakhal, F., Mouelhi, H., Zoueri, B., Gouider, E., & Hafsia, R. (2013). Connaissances médicales en matière de sécurité immunologique en transfusion érythrocytaire en Tunisie: Évaluation d'un CD-ROM d'auto-enseignement. Transfusion Clinique et Biologique, 20(4), 448–453. https://doi.org/10.1016/j.tracli.2013.02.001

Bender, R., & Grouven, U. (1998). Using binary logistic regression models for ordinal data with non-proportional odds. Journal of Clinical Epidemiology, 51(10), 809–816. https://doi.org/10.1016/s0895-4356(98)00066-3

Berger, M. D., Gerber, B., Arn, K., Senn, O., Schanz, U., & Stussi, G. (2012). Significant reduction of red blood cell transfusion requirements by changing from a double-unit to a single-unit transfusion policy in patients receiving intensive chemotherapy or stem cell transplantation. Haematologica, 97(1), 116–122. https://doi.org/10.3324/haematol.2011.047035

Berman, J. (2013). Utility of a Conceptual Framework within Doctoral Study: A Researcher's Reflections. Issues in Educational Research, 23(1), 1–18.

Berner, E. S., & Graber, M. L. (2008). Overconfidence as a Cause of Diagnostic Error in Medicine. The American Journal of Medicine, 121(5), Article 5. https://doi.org/10.1016/j.amjmed.2008.01.001

Bertels, J., Almoudaris, A. M., Cortoos, P.-J., Jacklin, A., & Franklin, B. D. (2013). Feedback on prescribing errors to non-specialist: Exploring views, problems and preferred methods. International Journal of Clinical Pharmacy, 35(3), 332–338. https://doi.org/10.1007/s11096-013-9759-y

Bloom, B. S., & Krathwohl, D. R. (1956). Taxonomy of Educational Objectives: The Classification of Educational Goals. Longmans, Green.

Blumberg, P., & Pontiggia, L. (2011). Benchmarking the Degree of Implementation of Learner-Centered Approaches. Innovative Higher Education, 36(3), 189–202. https://doi.org/10.1007/s10755-010-9168-2

Bolton-Maggs, P. H. B., & Cohen, H. (2013). Serious Hazards of Transfusion (SHOT) haemovigilance and progress is improving transfusion safety. British Journal of Haematology, 163(3), 303–314. https://doi.org/10.1111/bjh.12547

Boone, H. N., Jr, & Boone, D. A. (2012). Analyzing Likert Data. Journal of Extension, 50(2), Article 2. https://www.joe.org/joe/2012april/tt2.php

Bransford, J. D., Brown, A. L., & Cocking, R. R. (2000). How People Learn: Brain, Mind, Experience, and School. Expanded Edition. National Academies Press, 2102 Constitution Avenue N.

Browne, M. O., Lee, A., & Prabhu, R. (2007). Self-reported confidence and skills of general practitioners in management of mental health disorders. Australian Journal of Rural Health,
15(5), 321–326. https://doi.org/10.1111/j.1440-1584.2007.00914.x

Burford, B., Whittle, V., & Vance, G. H. (2014). The relationship between medical student learning opportunities and preparedness for practice: A questionnaire study. BMC Medical Education, 14(1), 1–8. https://doi.org/10.1186/1472-6920-14-223

Cable, R. G., Thal, S. E., Fink, A., Calhoun, L., &Petz, L. D. (1995). A comprehensive transfusion medicine curriculum for medical students. Transfusion Medicine Academic Award Group. Transfusion, 35(6), 465–469. https://doi.org/10.1046/j.1537-2995.1995.35695288763.x

Cambridge English Dictionary. (2021). PREPAREDNESS | definition in the Cambridge English Dictionary. https://dictionary.cambridge.org/us/dictionary/english/preparedness

Carson, J. L., Guyatt, G., Heddle, N. M., Grossman, B. J., Cohn, C. S., Fung, M. K., Gernsheimer, T., Holcomb, J. B., Kaplan, L. J., Katz, L. M., Peterson, N., Ramsey, G., Rao, S. V., Roback, J. D., Shander, A., & Tobian, A. A. R. (2016). Clinical Practice Guidelines From the AABB: Red Blood Cell Transfusion Thresholds and Storage. JAMA, 316(19), 2025–2035. https://doi.org/10.1001/jama.2016.9185

Carson, J. L., Stanworth, S. J., Dennis, J. A., Trivella, M., Roubinian, N., Fergusson, D. A., Triulzi, D., Dorée, C., & Hébert, P. C. (2021). Transfusion thresholds for guiding red blood cell transfusion. The Cochrane Database of Systematic Reviews, 12, CD002042. https://doi.org/10.1002/14651858.CD002042.pub5

Centers for Disease Control and Prevention (CDC). (2013). Data Dissemination. Centers for Disease Control and Prevention (CDC); Atlanta, Georgia. Retrieved March 13, 2020, form https://webcache.googleusercontent.com/search?q=cache:DuuoX_iIBkIJ:https://www.cdc.gov/globalhealth/healthprotection/fetp/training_modules/21/datadissemination_ppt_final_09252013.pdf+&cd=13&hl=en&ct=clnk&gl=ke&client=firefox-b-d

Clevenger, B., & Kelleher, A. (2014). Hazards of blood transfusion in adults and children. Continuing Education in Anaesthesia Critical Care & Pain, 14(3), 112–118. https://doi.org/10.1093/bjaceaccp/mkt042

Connick, R. M., Connick, P., Klotsas, A. E., Tsagkaraki, P. A., & Gkrania-Klotsas, E. (2009). Procedural confidence in hospital-based practitioners: Implications for the training and practice of doctors at all grades. BMC Medical Education, 9(1), 2. https://doi.org/10.1186/1472-6920-9-2

Court, E. L., Robinson, J. A., & Hocken, D. B. (2011). Informed consent and patient understanding of blood transfusion. Transfusion Medicine (Oxford, England), 21(3), 183–189. https://doi.org/10.1111/j.1365-3148.2011.01069.x

Creswell, J. W. (2009). Research design: Qualitative, quantitative, and mixed methods approaches, 3rd ed (pp. xxix, 260). Sage Publications, Inc.

Daichman, S., Ostrovsky, D., Dreiher, J., & Pikovsky, O. (2022). Does training make a difference? Proficiency training in transfusion guidelines and its effect on red blood cell administration. Transfusion, 62(5), 1121–1127. https://doi.org/10.1111/trf.16866

Damanhouri, G. A. (2009). The impact of training in transfusion medicine. ISBT Science Series,
4(1), 95-98. https://doi.org/10.1111/j.1751-2824.2009.01217.x

Davis, D. A., Mazmanian, P. E., Fordis, M., Van Harrison, R., Thorpe, K. E., & Perrier, L. (2006). Accuracy of clinician self-assessment compared with observed measures of competence: A systematic review. JAMA, 296(9), 1094–1102. https://doi.org/10.1001/jama.296.9.1094

Davis, W. M., Ho, K., & Last, J. (2015). Advancing social media in medical education. CMAJ : Canadian Medical Association Journal, 187(8), 549–550. https://doi.org/10.1503/cmaj.141417

Ddungu, H., Krantz, E. M., Phipps, W., Naluzze, S., Orem, J., Kiwanuka, N., Wald, A., &Kajja, I. (2018). Survey to Assess Knowledge and Reported Practices Regarding Blood Transfusion Among Cancer Medical doctors in Uganda. Journal of Global Oncology, 4, 1–12. https://doi.org/10.1200/JGO.18.00143

DeCoster, J., Gallucci, M., & Iselin, A.-M. R. (2011). Best Practices for Using Median Splits, Artificial Categorization, and their Continuous Alternatives. Journal of Experimental Psychopathology. https://doi.org/10.5127/jep.008310

Diakité, M., Diawara, S. I., Tchogang, N. T., Fofana, D. B., Diakité, S. A., Doumbia, S., Traoré, K., Konaté, D. S., Doumbouya, M., Keita, A. S., Famanta, A., Baby, M., Doumbia, S., Traoré, S. F., &Tounkara, A. (2012). [Knowledge and attitudes of medical personnel in blood transfusion in Bamako, Mali]. Transfusion Clinique Et Biologique: Journal De La SocieteFrancaise De Transfusion Sanguine, 19(2), 74–77. https://doi.org/10.1016/j.tracli.2012.01.004

Dickerson, A., & Taylor, M. A. (2000). Self-limiting behavior in women: Self-esteem and self
efficacy as predictors. Group & Organization Management, 25, 191–210. https://doi.org/10.1177/1059601100252006

Dillman, D. A., Smyth, J. D., & Christian, L. M. (2014). Internet, phone, mail, and mixed mode surveys: The tailored design method, 4th ed (pp. xvii, 509). John Wiley & Sons Inc.

Dornan, T., Ashcroft, A., Heathfield, H., Lewis, P., Miles, J., Taylor, D., Tully, M., & Val, W. (2009). An In Depth Investigation into Causes of Prescribing Errors by Foundation Trainees in Relation to Their Medical Education—EQUIP Study. General Medical Council. http://psnet.ahrq.gov/issue/depth-investigation-causes-prescribing-errors-foundation-trainees-relation-their-medical

Doshi, N. P. (2017). Effectiveness of team-based learning methodology in teaching transfusion medicine to medical undergraduates in third semester: A comparative study. Asian Journal of Transfusion Science, 11(2), 87. https://doi.org/10.4103/ajts.AJTS_123_16

Driessen, E. W., Muijtjens, A. M. M., van Tartwijk, J., & van der Vleuten, C. P. M. (2007). Web- or paper-based portfolios: Is there a difference? Medical Education, 41(11), 1067–1073. https://doi.org/10.1111/j.1365-2923.2007.02859.x

Dudovskiy, J. (2015). Stratified Sampling—Research Methodology. Retrieved March 1, 2020, https://research-methodology.net/sampling-in-primary-data-collection/stratified-sampling/

Duguid, J., Copplestone, J. A., & CMO's National Blood Transfusion Committee. (2008). Teaching transfusion in UK medical schools: A survey by the National Blood Transfusion Committee. Medical Education, 42(4), 439. https://doi.org/10.1111/j.1365-2923.2008.03022.x

Eichbaum, Q., Shan, H., Goncalez, T. T., Duits, A. J., Knox, P., Reilly, J., & Andrews, D. (2014). Global health and transfusion medicine: Education and training in developing countries. Transfusion, 54(7), 1893. https://doi.org/10.1111/trf.12609

Eisenstaedt, R. S., Glanz, K., & Polansky, M. (1988). Resident education in transfusion medicine: A multi-institutional needs assessment. Transfusion, 28(6), 536–540. https://doi.org/10.1046/j.1537- 2995.1988.28689059026.x

Elhadi, M., Ahmed, H., Khaled, A., Almahmoudi, W. K., Atllah, S. S., Elhadi, A., & Esahli, H. (2020). Informed self-assessment versus preceptor evaluation: A comparative study of pediatric procedural skills acquisition of fifth year medical students. BMC Medical Education, 20(1), 318. https://doi.org/10.1186/s12909-020-02221-2

Evans, D. E., Wood, D. F., & Roberts, C. M. (2004). The effect of an extended hospital induction on perceived confidence and assessed clinical skills of newly qualified pre-registration house officers. Medical Education, 38(9), 998–1001. https://doi.org/10.1111/j.1365-2929.2004.01908.x

Eysenbach, G., & Wyatt, J. (2002). Using the Internet for Surveys and Health Research. Journal of Medical Internet Research, 4(2). https://doi.org/10.2196/jmir.4.2.e13

Fettah, A., Kara, D., Reis, G. P., Certel, A. C., & Kara, S. S. (2017). Assessment of physicians'
knowledge in transfusion medicine in eastern part of Turkey. Med-Science, 6(2), 208–212. https://dx.doi.org/10.5455/medscience.2016.05.8539

Field, S. (2009). Tomorrow's doctors. BMJ, 339, b2696. https://doi.org/10.1136/bmj.b2696

Fincham, J. E. (2008). Response Rates and Responsiveness for Surveys, Standards, and the Journal. American Journal of Pharmaceutical Education, 72(2), 43.

Fives, H. (2003). What is Teacher Efficacy and how does it relate to Teachers' Knowledge? A theoretical review. Retrieved March 3, 2020, http://webcache.googleusercontent.com/search?q=cache:LJjgtTxUqygJ:citeseerx.ist.psu.edu/viewdoc/summary%3Fdoi%3D10.1.1.135.6460+&cd=1&hl=en&ct=clnk&gl=ke

Flores, C. J., Quested, B., Spigiel, T., Thomson, A., & Saxon, B. (2018). Junior doctors' for an implementation trial. Implementation Science, 4(1), Article 1. for Haemapheresis, 59(6), Article 6. https://doi.org/10.1016/j.transci.2020.102879

Francis, J. J., Tinmouth, A., Stanworth, S. J., Grimshaw, J. M., Johnston, M., Hyde, C., Stockton,
C., Brehaut, J. C., Fergusson, D., & Eccles, M. P. (2009). Using theories of behaviour to understand transfusion prescribing in three clinical contexts in two countries: Development work for an implementation trial. Implementation Science, 4(1), Article 1. https://doi.org/10.1186/1748-5908-4-70

Frank-Stromborg, M., Christensen, A., & Elmhurst, D. (2001). Nurse documentation: Not done or worse, done the wrong way--Part I. Oncology Nursing Forum, 28(4), 697–702.

Friedman, C. P., Gatti, G. G., Franz, T. M., Murphy, G. C., Wolf, F. M., Heckerling, P. S., Fine, P. L., Miller, T. M., & Elstein, A. S. (2005). Do medical doctors know when their diagnoses are correct? Implications for decision support and error reduction. Journal of General Internal Medicine, 20(4), 334–339. https://doi.org/10.1111/j.1525-1497.2005.30145.x

Friedman, L. H., & Frogner, B. K. (2010). Are Our Graduates Being Provided with the Right Competencies? Findings from an Early Careerist Skills Survey - ProQuest. https://www.proquest.com/openview/05d01a86f42125794a101a51098c1343/1?cbl=105455&pq-origsite=gscholar&parentSessionId=ppqDgKo2sjJiWww%2FFHqpF7WcDZlQfEsC1I2cBdSiOJ0%3D

Friedman, M. T. (2011). Blood transfusion practices: A little consistency please. Blood Transfusion, 9(4), 362–365. https://doi.org/10.2450/2011.0007-11

Friedman, M., Arja, W., Batra, R., Daniel, S., Hoehn, D., Paniz, A. M., Selegean, S., Slova, D., Srivastava, S., & Vergara, N. (2012). Informed Consent for Blood TransfusionWhat

Do Medicine Residents Tell? What Do Patients Understand? American Journal of Clinical Pathology, 138(4), 559–565. https://doi.org/10.1309/AJCP2TN5ODJLYGQR

Garraud, O., Vuk, T., Brand, A., de Angelis, V., Politis, C., Haddad, A., Vlaar, A. P. J., Lozano, M., Ertuğrul Örüç, N., Laspina, S., & Tissot, J.-D. (2020). Medical student education in transfusion medicine, part II: Moving forward to building up a "Know How" education program in transfusion medicine for under-graduate medical students. Transfusion and Apheresis Science: Official Journal of the World Apheresis Association: Official Journal of the European Society for Haemapheresis, 59(6), 102879. https://doi.org/10.1016/j.transci.2020.102879

Garraud, O., Brand, A., Henschler, R., Vuk, T., Haddad, A., Lozano, M., ErtuğrulÖrüç, N., Politis, C., de Angelis, V., Laspina, S., Tissot, J.-D., & "European and Mediterranean Initiative in Transfusion Medicine" (EMITm) group. (2018). Medical student education in transfusion medicine: Proposal from the "European and Mediterranean initiative in transfusion medicine." Transfusion and Apheresis Science: Official Journal of the World Apheresis Association: Official Journal of the European Society for Haemapheresis, 57(5), 593–597. https://doi.org/10.1016/j.transci.2018.09.002

Garrioch, M., Sandbach, J., Pirie, E., Morrison, A., Todd, A., & Green, R. (2004). Reducing red cell transfusion by audit, education and a new guideline in a large teaching hospital. Transfusion Medicine (Oxford, England), 14(1), 25–31. https://doi.org/10.1111/j.0958-7578.2004.00476.x

Gavora, P. (2010). Slovak Pre-Service Teacher Self-Efficacy: Theoretical and Research Considerations. New Educational Review, 21, 17–30.

Gearon, M. (2019). Cognitive Biases—Dunning–Kruger effect. Medium. https://michaelgearon.medium.com/cognitive-biases-dunning-kruger-effect-ea1419038eb6

Gernsheimer, T., Holcomb, J. B., Kaplan, L. J., Katz, L. M., Peterson, N., Ramsey, G., Rao, S. V., Roback, J. D., Shander, A., & Tobian, A. A. R. (2016). Clinical Practice Guidelines From the AABB: Red Blood Cell Transfusion Thresholds and Storage. JAMA, 316(19), 2025–2035. https://doi.org/10.1001/jama.2016.9185

General Medical Council. (2020). Outcomes for graduates—Practical skills and procedures. https://www.gmc-uk.org/education/standards-guidance-and-curricula/standards-and-outcomes/outcomes-for-graduates/outcomes-for-graduates---practical-skills-and-procedures

Gharehbaghian, A., Shahshahani, H. J., Attar, M., Bonab, M. R., Mehran, M., &Namini, M. T. (2009). Assessment of medical doctors' knowledge in transfusion medicine, Iran, 2007. Transfusion Medicine, 7.

Gottlieb, M., Chan, T. M., Zaver, F., & Ellaway, R. (2022). Confidence-competence alignment and the role of self-confidence in medical education: A conceptual review. Medical Education, 56(1), 37–47. https://doi.org/10.1111/medu.14592

Gouëzec, H., Bergoin, V., Betbèze, V., Bourcier, V., Damais, A., Drouet, N., Ducroz, S., Fialon, P., Huchet, C., Lassale, B., Leo, S., Lovi, V., Le Niger, C., Moron, S., Renom, P., Weiller, J., Groupe des Hémobiologistes et Correspondants d'Hémovigilance (GHCOH), & Turmel, V. (2007). [Assessment of knowledge in blood transfusion of medical staff in 14 state-run hospitals]. Transfusion Clinique Et Biologique: Journal De La Societe Francaise De Transfusion Sanguine, 14(4), 407–415. https://doi.org/10.1016/j.tracli.2007.05.004

Graham, J. E., Narayan, S., & Pendry, K. (2017). Improving transfusion education for non-specialist; exploring UK experiences. Transfusion Medicine (Oxford, England), 27(2), 96–104. https://doi.org/10.1111/tme.12373

Graham, J., Grant-Casey, J., Alston, R., Baker, P., &Pendry, K. (2014). Assessing transfusion competency in non-specialist: A retrospective cohort study. Transfusion, 54(1), 128–136. https://doi.org/10.1111/trf.12274

Graham, J., Hayes, C., & Pendry, K. (2020). Can Team-Based Learning (TBL) Be Used to Deliver Postgraduate Education in Transfusion Medicine for UK Medical doctors? Medical Science Educator, 30(1), 631–642. https://doi.org/10.1007/s40670-019-00844-9

Green, R. A. (2014). The Delphi Technique in Educational Research: SAGE Open. https://doi.org/10.1177/2158244014529773

Gude, T., Finset, A., Anvik, T., Bærheim, A., Fasmer, O. B., Grimstad, H., & Vaglum, P. (2017). Do medical students and young medical doctors assess reliably their self-efficacy regarding communication skills? A prospective study from end of medical school until end of internship. BMC Medical Education, 17, 107. https://doi.org/10.1186/s12909-017-0943-y

Hagumimana, J., Skelton, T., Pendergrast, J., Nizeyimana, F., Masaisa, F., Kanyamuhunga, A., Gashaija, C., Chargé, S., Kapitany, C., Morgan, M., Meirovich, H., & Lin, Y. (2023). Transfusion Camp Rwanda: A prospective feasibility study evaluating the delivery of Transfusion Camp to a multidisciplinary group of postgraduate medical trainees in Rwanda. Transfusion, 63(11), 2170–2178. https://doi.org/10.1111/trf.17568

Harden, R. M., & Cairncross, R. G. (1980). Assessment of practical skills: The objective structured practical examination (OSPE). Studies in Higher Education, 5(2), 187–196. https://doi.org/10.1080/03075078012331377216

Halford, B., Pinheiro, A., & Haspel, R. L. (2021). Hospital Medicine Providers' Transfusion Knowledge: A Survey Study. Transfusion Medicine Reviews, 35(2), 140–145. https://doi.org/10.1016/j.tmrv.2021.04.003

Harrow, A. J. (1972). A taxonomy of the psychomotor domain; a guide for developing behavioral objectives. D. McKay Co.

Hartford, E., Muanantatha, O., Valigy, V. I., Salimo, S., Ziman, A., & DeUgarte, D. A. (2015). Transfusion practice and knowledge in Mozambique. Transfusion, 55(7), 1607–1612. https://doi.org/10.1111/trf.13019

Haspel, R. L., Lin, Y., Fisher, P., Ali, A., Parks, E., & Biomedical Excellence for Safer Transfusion (BEST) Collaborative. (2014). Development of a validated exam to assess clinician transfusion medicine knowledge. Transfusion, 54(5), 1225–1230. https://doi.org/10.1111/trf.12425

Haspel, R. L., Lin, Y., Mallick, R., Tinmouth, A., Cid, J., Eichler, H., Lozano, M., van de Watering, L., Fisher, P. B., Ali, A., Parks, E., & BEST-TEST Investigators. (2015). Internal medicine resident knowledge of transfusion medicine: Results from the BEST-TEST international education needs assessment. Transfusion, 55(6), 1355–1361. https://doi.org/10.1111/trf.12968

Hassan, S., Hod, R., & Faculty of Medicine and Health Sciences, Universiti Putra Malaysia, MALAYSIA. (2017). Use of Item Analysis to Improve the Quality of Single Best Answer Multiple Choice Question in Summative Assessment of Undergraduate Medical Students in Malaysia. Education in Medicine Journal, 9(3), 33–43. https://doi.org/10.21315/eimj2017.9.3.4

Hassan, Z. A., Schattner, P., & Mazza, D. (2006). Doing A Pilot Study: Why Is It Essential? Malaysian Family Clinician : The Official Journal of the Academy of Family Medical doctors of Malaysia, 1(2–3), 70–73.

Heale, R., & Twycross, A. (2015). Validity and reliability in quantitative studies. Evidence-Based Nursing, 18(3), 66–67. https://doi.org/10.1136/eb-2015-102129

Hecimovich, M., & Volet, S. (2011). Development of professional confidence in health education: Research evidence of the impact of guided practice into the profession. Health Education, 111(3), 177–197. https://doi.org/10.1108/09654281111123475

Hew, K. F., & Cheung, W. S. (2014). Enhancing Students' Learning of Factual Knowledge. In K. F. Hew & W. S. Cheung (Eds.), Using Blended Learning: Evidence-Based Practices (pp. 97–107). Springer. https://doi.org/10.1007/978-981-287-089-6_6

Heyes, J., Kelly, P. A., Monaghan, K., Lawn, M., Dhesi, A., & Mijovic, A. (2017). A single unit transfusion policy reduces red cell transfusions in general medical in-patients. QJM: Monthly Journal of the Association of Medical doctors, 110(11), 735–739. https://doi.org/10.1093/qjmed/hcx150

Hillman, R. S., Helbig, S., Howes, S., Hayes, J., Meyer, D. M., & McArthur, J. R. (1979). The effect of an educational program on transfusion practices in a regional blood program. Transfusion, 19(2), 153–157. https://doi.org/10.1046/j.1537-2995.1979.19279160284.x

Hofmann, A., Spahn, D. R., Holtorf, A.-P., Isbister, J., Hamdorf, J., Campbell, L., Benites, B., Duarte, G., Rabello, G., Ji, H., Wei, L., Ivancan, V., Kovac, N., Tomic Mahecic, T., Matsouka, C., Aggeliki, B., Anthi, G., Charalabopoulos, A., Attalah, D., … PBM

Implementation Group. (2021). Making patient blood management the new norm(al) as experienced by implementors in diverse countries. BMC Health Services Research, 21(1), 634. https://doi.org/10.1186/s12913-021-06484-3

Huggett, K. N., & Jeffries, W. B. (2014). An Introduction to Medical Teaching. Springer.

Hurtubise, L., Martin, B., Gilliland, A., & Mahan, J. (2013). To Play or Not To Play: Leveraging

Video in Medical Education. Journal of Graduate Medical Education, 5(1), 13–18. https://doi.org/10.4300/JGME-05-01-32

Iacobucci, D., Posavac, S. S., Kardes, F. R., Schneider, M. J., & Popovich, D. L. (2015). The median split: Robust, refined, and revived. Journal of Consumer Psychology, 25(4), 690–704. https://doi.org/10.1016/j.jcps.2015.06.014

Illing, J., Morrow, G., Kergon, C., Burford, B., Spencer, J., Peile, E., Davies, C., Baldauf, B., Allen, M., Johnson, N., Morrison, J., Donaldson, M., Whitelaw, M., & Field, M. (2008). How prepared are medical graduates to begin practice ? A comparison of three diverse UK medical schools. Final report to GMC April 2008. [Monograph]. Project Report. Newcastle University, Warwick University, Glasgow University. Retrieved February 1, 2020, from http://www.gmc-uk.org/about/research.asp

Imenda, S. (2014). Is There a Conceptual Difference between Theoretical and Conceptual Frameworks? Journal of Social Sciences, 38(2), 185–195. https://doi.org/10.1080/09718923.2014.11893249

Iqbal, U., Wani, D., Annu, S., Hassan, S., Bharti, K., & Nabi, R. (2021). Assessment of Knowledge and Practice regarding Blood Transfusion among Staff Nurses. Trends in Nursing Administration & Education, 10(1), 7–13. https://doi.org/10.24321/2348.2141.202102

Islam, R., Tinmouth, A. T., Francis, J. J., Brehaut, J. C., Born, J., Stockton, C., Stanworth, S. J., Eccles, M. P., Cuthbertson, B. H., Hyde, C., & Grimshaw, J. M. (2012). A cross-country comparison of intensive care physicians' beliefs about their transfusion behaviour: A qualitative study using the theoretical domains framework. Implementation Science, 7(1), Article 1. https://doi.org/10.1186/1748-5908-7-93

Israel, G., D. (2003). Determining Sample Size. University of Florida. Retrieved March 1, 2020, from https://www.tarleton.edu/academicassessment/documents/Samplesize.pdf

Jalili, M., Mirzazadeh, A., & Azarpira, A. (2008). A survey of medical students' perceptions of the quality of their medical education upon graduation. Annals of the Academy of Medicine, Singapore, 37(12), 1012–1018.

Jaspan, O., Wysocka, A., Sanchez, C., & Schweitzer, A. D. (2022). Improving the Relationship Between Confidence and Competence: Implications for Diagnostic Radiology Training From the Psychology and Medical Literature. Academic Radiology, 29(3), 428–438. https://doi.org/10.1016/j.acra.2020.12.006

Javadzadeh Shahshahani, H. (2016). Status of Transfusion Medicine Education in Iran. Archives of Iranian Medicine, 19(6), 439–445.

Jayawickramarajah, P. T. (1987). The Analysis of Medical Curriculum. Medical Teacher, 9(2), 167–178. https://doi.org/10.3109/01421598709089931

Jogi, I. E., Mohanan, N., & Nedungalaparambil, N. M. (2021). Bedside Blood Transfusion - What Nurses Know and Perform: A Cross-Sectional Study from A Tertiary-Level Cancer Hospital in Rural Kerala. Asia-Pacific Journal of Oncology Nursing, 8(2), 197–203. https://doi.org/10.4103/apjon.apjon_50_20

Jones, A., McArdle, P. J., & O'Neill, P. A. (2002). Perceptions of how well graduates are prepared for the role of pre-registration house officer: A comparison of outcomes from a traditional and an integrated PBL curriculum. Medical Education, 36(1), 16–25. https://doi.org/10.1046/j.1365-2923.2002.01105.x

Jones, F., Passos-Neto, C. E., & Braghiroli, O. F. M. (2015). Simulation in Medical Education: Brief history and methodology. Principles and Practice of Clinical Research, 1(2), Article 2. https://journal.ppcr.org/index.php/ppcrjournal/article/view/12

Joubert, J., Joubert, S., Raubenheimer, J., & Louw, V. (2014). The long-term effects of training interventions on transfusion practice: A follow-up audit of red cell concentrate utilisation at Kimberley Hospital, South Africa. Transfusion and Apheresis Science: Official Journal of the World Apheresis Association: Official Journal of the European Society for Haemapheresis, 51(3), 25–32. https://doi.org/10.1016/j.transci.2014.10.013

Joyce, K. M., Byrne, D., O'Connor, P., Lydon, S. M., & Kerin, M. J. (2015). An evaluation of the use of deliberate practice and simulation to train interns in requesting blood products. Simulation in Healthcare: Journal of the Society for Simulation in Healthcare, 10(2), 92–97. https://doi.org/10.1097/SIH.0000000000000070

Justiz Vaillant, A. A., & Sticco, K. L. (2022). Transfusion Transmitted Disease. In StatPearls. StatPearls Publishing. http://www.ncbi.nlm.nih.gov/books/NBK538427/

Kafando, E., Koumaré, A., Sawadogo, S., Nébié, Y., & 1 Simporé, J. (2017). Improving blood transfusion safety: A survey on the knowledge and attitudes of health professionals in blood transfusion at the yalgado ouedraogo university hospital center, Burkina Faso. Hematology & Transfusion International Journal, Volume 4(Issue 1). https://doi.org/10.15406/htij.2017.04.00070

Kak, N., Burkhalter, B., & Ma, C. (2001). Measuring the competence of healthcare providers. /paper/Measuring-the-competence-of-healthcare-providers.-Kak-Burkhalter/a45df25803f8358487cb9867c2feb33c57a47ffc

Kamau, C. (2014). Effects of experimental inductions for newly qualified doctors on competence at clinical procedures. Clinical Medicine, 14(4), 380–385. https://doi.org/10.7861/clinmedicine.14-4-380

Kang, M. J., & Ngissah, R. K. S. (2020). Self-reported confidence and perceived training needs of surgical interns at a regional hospital in Ghana: A questionnaire survey. BMC Medical Education, 20(1), 386. https://doi.org/10.1186/s12909-020-02319-7

Karim, J. A., Marwan, Y. A., Dawas, A. M., & Akhtar, S. (2012). Self-confidence of medical students in performing clinical skills acquired during their surgical rotation. Assessing clinical skills education in Kuwait. Saudi Medical Journal, 33(12), 1310–1316.

Karp, J. K., Weston, C. M., & King, K. E. (2011). Transfusion medicine in American undergraduate medical education. Transfusion, 51(11), 2470–2479. https://doi.org/10.1111/j.1537-2995.2011.03154.x

Kasraian, L., & Tavassoli, A. (2014). A survey of resident physicians' knowledge concerning transfusion medicine in Shiraz, Iran. Asian Journal of Transfusion Science, 8(2), 118–120. https://doi.org/10.4103/0973-6247.137451

Katowa-Mukwato, P., & Banda, S. S. (2014). Medical Students' Knowledge of Clinical Practical Procedures: Relationship with Clinical Competence. Creative Education, 5(21), Article 21. https://doi.org/10.4236/ce.2014.521212

Kaur, P., Kaur, G., Kaur, R., & Sood, T. (2014). Assessment of Impact of Training in Improving Knowledge of Blood Transfusion among Medical doctors. Transfusion Medicine and Hemotherapy, 41(3), 222–226. https://doi.org/10.1159/000362896

Kelley, T. L. (1939). The selection of upper and lower groups for the validation of test items. Journal of Educational Psychology, 30(1), 17–24. https://doi.org/10.1037/h0057123

Kenya Blood Transfusion and Transplant Service. (2022). Guidelines for the Appropriate Use of

Blood, Blood Components and Blood Products. Ministry of Health. Nairobi, Kenya. https://www.ktta.go.ke/wp-content/uploads/2023/01/Appropriate-use-of-Blood-Blood-components-and-products-_-24-June.pdf

Kenya Medical and Dentists Council. (2021). Undergraduate Training – Kenya Medical Practitioners and Dentists Council. https://kmpdc.go.ke/undergraduate-training/

Kenya Medical Practioners and Dentists Board. (2020). Approved Institutions for MBChB and BDS Training. Retrieved February 23, 2020, from https://medicalboard.co.ke/functions/approved-training-institutions/

Kenya Medical Practitioners and Dentists Board. (n.d.). Bachelor of Medicine and Bachelor of Surgery Core Curriculum. Retrieved February 23, 2020, from http://medicalboard.co.ke/resources/mbchb.pdf.

Khan, A. I., & Gupta, G. (2022). Non-infectious Complications of Blood Transfusion. In StatPearls. StatPearls Publishing. http://www.ncbi.nlm.nih.gov/books/NBK574536/

Khatiwada, B., Chaurasia, R., Patidar, G. K., & Pandey, H. C. (2022). Assessment of Transfusion Practices Among Doctors During COVID-19 Pandemic Using

Questionnaire-Based Survey. Indian Journal of Hematology and Blood Transfusion. https://doi.org/10.1007/s12288-022-01613-2

Kim, M. K., Arsenault, C., Atuyambe, L. M., Macwan'gi, M., & Kruk, M. E. (2020). Determinants of healthcare providers' confidence in their clinical skills to deliver quality obstetric and newborn care in Uganda and Zambia. BMC Health Services Research, 20(1), 539. https://doi.org/10.1186/s12913-020-05410-3

Kipkulei, J. C., Buziba, N., Mining, S., & Jepngetich, H. (2019). Demographic and Clinical Profiles of Blood Transfusion Recipients at a Teaching and Referral Hospital in Kenya. Open Journal of Blood Diseases, 9(1), Article 1. https://doi.org/10.4236/ojbd.2019.91004

Kliebard, H. M. (1989). Problems of Definition in Curriculum. Journal of Curriculum and Supervision, 5(1), 1–5.

Knowledge, Skills, and Attitudes—The Peak Performance Center. (n.d.). Retrieved January 17, 2021, from https://thepeakperformancecenter.com/educational-learning/learning/process/obtaining/obtaining-information/knowledge-skills-attitudes/

Konia, M. R., Richtsfeld, M., Johnson, A. D., Lougee, M., Cohn, C., & Morgan, S. (2018). An Observational Study of 3 Different Transfusion Medicine Teaching Methods for Medical Students. Transfusion Medicine Reviews, 32(2), Article 2. https://doi.org/10.1016/j.tmrv.2017.12.001

Krathwohl, D. R. (2002). A Revision of Bloom's Taxonomy: An Overview. Theory Into Practice, 41(4), Article 4. https://doi.org/10.1207/s15430421tip4104_2

Krathwohl, D. R., Bloom, B. S., & Masia, B. B. (1964). Taxonomy of educational objectives: The classification of educational goals / Handbook II, Affective domain / by David R. Krathwohl, Benjamin S. Bloom, Bertram B. Masia. David McKay.

Krishnamurthy, K., Selvaraj, N., Gupta, P., Cyriac, B., Dhurairaj, P., Abdullah, A., Krishnapillai, A., Lugova, H., Haque, M., Xie, S., & Ang, E.-T. (2022). Benefits of gamification in medical education. Clinical Anatomy (New York, N.Y.), 35(6), 795–807. https://doi.org/10.1002/ca.23916

Kruger, J., & Dunning, D. (1999). Unskilled and unaware of it: How difficulties in recognizing one's own incompetence lead to inflated self-assessments. Journal of Personality and Social Psychology, 77, 1121–1134. https://doi.org/10.1037/0022-3514.77.6.1121

Kshirsagar, N. A. (2016). Rational use of medicines: Cost consideration & way forward. The Indian Journal of Medical Research, 144(4), 502–505. https://doi.org/10.4103/0971-5916.200901

Kumarage, S., Fernando, R., &Gunasekara, L. (2017). A Survey of Knowledge and Practices of Transfusion Medicine Among Post Intern Doctors in Specialized Hospital in Sri Lanka. Laboratory Medicine, 48(1), 46–50. https://doi.org/10.1093/labmed/lmw056

Kupesiz, F. T., Ocak, S., Koc, B. S., Evim, M. S., Tufekci, O., Kintrup, G. T., Aygünes, U., Eker, I., Koluman, B. U., Ilhan, G., Andic, N., Toret, E., Akinci, A. B., Gunes, B. T., Yilmaz, F., Gokcebay, D. G., Ozer, T. B., Isik, M., Oymak, Y., … Aydinok, Y. (2020). Evaluation of the knowledge of intern doctors on transfusion medicine in Turke. https://doi.org/10.21203/rs.2.22224/v1

Labaree, R. V. (2019). Quantitative Methods—Organizing Your Social Sciences Research Paper—Research Guides at University of Southern California. Retrieved March 5, 2020, from https://libguides.usc.edu/writingguide/quantitative

Labesse, M. E., & Farley, C. (2009). Terms of reference for training needs analysis: Continuing education component. Recherche, formation et développement, Institut national de santépublique Québec. Retrieved March 13, 2020, from http://collections.banq.qc.ca/ark:/52327/1764235

Lacroix, J., Hébert, P. C., Hutchison, J. S., Hume, H. A., Tucci, M., Ducruet, T., Gauvin, F., Collet, J.-P., Toledano, B. J., Robillard, P., Joffe, A., Biarent, D., Meert, K., & Peters, M. J. (2007). Transfusion Strategies for Patients in Pediatric Intensive Care Units. New England Journal of Medicine, 356(16), 1609–1619. https://doi.org/10.1056/NEJMoa066240

Laher, M., & Patel, M. (2019). Assessment of the knowledge of usage of blood and blood products amongst medical doctors in the Department of Medicine at the Faculty of Health Sciences, University of the Witwatersrand affiliated academic hospitals. Transfusion and Apheresis Science, 58(1), 43–47. https://doi.org/10.1016/j.transci.2018.11.002

Lai, N. M., Sivalingam, N., & Ramesh, J. C. (2007). Medical students in their final six months of training: Progress in self-perceived clinical competence, and relationship between experience and confidence in practical skills. Singapore Medical Journal, 48(11), 1018–1027.

Lakum, N. R., Maru, A. M., Algotar, C. G., Makwana, H. H., Lakum, N. R., Maru, D. A. M., Algotar, D. C. G., & Makwana, H. H. (2023). Objective Structured Practical Examination (OSPE) as a Tool for the Formative Assessment of Practical Skills in the Subject of Physiology: A Comparative Cross-Sectional Analysis. Cureus, 15(9). https://doi.org/10.7759/cureus.46104

LaMorte, W. W. (2019). The Social Cognitive Theory. https://sphweb.bumc.bu.edu/otlt/MPH-Modules/SB/BehavioralChangeTheories/BehavioralChangeTheories5.html

Leblond, V., Muller, J.-Y., Rouger, P., Vignon, D., Waller, C., Lefrère, J.-J., Worms, B., & Vileyn, F. (2005). Programme en transfusion des étudiants en médecine. Transfusion Clinique et Biologique, 12(1), 59–69. https://doi.org/10.1016/j.tracli.2004.11.006

Lee, V., & Landers, R. N. (2022). Sampling Strategies for Quantitative and Qualitative Business Research. In Oxford Research Encyclopedia of Business and Management. https://doi.org/10.1093/acrefore/9780190224851.013.216

Lee, T. C., Murray, J., & McDonald, E. G. (2019). An online educational module on transfusion safety and appropriateness for resident medical doctors: A controlled before-after quality-improvement study. CMAJ Open, 7(3), E492–E496. https://doi.org/10.9778/cmajo.20180211

Letowska, M. (2009). Patient-specific component requirements: 'Right blood, right patient, right time, right place.' ISBT Science Series, 4(1), 52–55. https://doi.org/10.1111/j.1751-2824.2009.01226.x

Letzring, T. D. (2019). Self-Report Method. International Encyclopedia of the Social Sciences. https://www.encyclopedia.com/social-sciences/applied-and-social-sciences-magazines/self-report-method

Likert, R. (1932). A technique for the measurement of attitudes. Archives of Psychology, 22 140, 55–55.

Lim, J., Kim, H., Lim, Y. A., Lim, H. S., Kim, J. N., Choi, S. R., & Kwon, G. C. (2017). Assessment of Medical Trainnees' Knowledge and Their Educational Needs on Transfusion Medicine. https://doi.org/DOI-10.17945/kjbt.2017.28.3.290

Lin, Y., Tilokee, E., Chargé, S., Alam, A., Cserti-Gazdewich, C., Lau, W., Lee, C., Lieberman, L., Nixon, P., Owens, W., Pavenski, K., Pendergrast, J., Saidenberg, E., Shehata, N., Skeate, R., Yi, Q.-L., Conrad, D., Dudebout, J., Hsia, C. C., … Callum, J. (2019). Transfusion Camp: A prospective evaluation of a transfusion education program for multispecialty postgraduate trainees. Transfusion, 59(6), 2141–2149. https://doi.org/10.1111/trf.15284

Lin, Y., Tinmouth, A., Mallick, R., Haspel, R. L., & BEST-TEST2 Investigators. (2016). BEST-TEST2: Assessment of hematology trainee knowledge of transfusion medicine. Transfusion, 56(2), 304–310. https://doi.org/10.1111/trf.13327

Liu, L., Liu, Y.-P., Wang, J., An, L.-W., & Jiao, J.-M. (2016). Use of a knowledge-attitude-behaviour education programme for Chinese adults undergoing maintenance haemodialysis: Randomized controlled trial. The Journal of International Medical Research, 44(3), 557–568. https://doi.org/10.1177/0300060515604980

Mafirakureva, N., Nyoni, H., Nkomo, S. Z., Jacob, J. S., Chikwereti, R., Musekiwa, Z., Khoza, S., Mvere, D. A., Emmanuel, J. C., Postma, M. J., & van Hulst, M. (2016). The costs of producing a unit of blood in Zimbabwe. Transfusion, 56(3), 628–636. https://doi.org/10.1111/trf.13405

Malone, M. (2021). Importance of Medical Documentation. Work - Chron.Com. https://work.chron.com/importance-medical-documentation-6966.html

Mard, S. A., & Ghafouri, S. (2020). <p>Objective Structured Practical Examination in Experimental Physiology Increased Satisfaction of Medical Students</p>. Advances in Medical Education and Practice, 11, 651–659. https://doi.org/10.2147/AMEP.S264120

Marel, G. M., Lyon, P. M., Barnsley, L., Hibbert, E., & Parise, A. (2000). Clinical skills in early postgraduate medical trainees: Patterns of acquisition of confidence and experience among junior doctors in a university teaching hospital. Medical Education, 34(12), 1013–1015. https://doi.org/10.1046/j.1365-2923.2000.00730.x

Maxwell, M. J., & Wilson, M. J. A. (2006). Complications of blood transfusion. Continuing Education in Anaesthesia Critical Care & Pain, 6(6), 225–229. https://doi.org/10.1093/bjaceaccp/mkl053

Mayaki, Z., Kabo, R., Moutschen, M., Albert, A., Dardenne, N., Sondag, D., & Gérard, C. (2016). Knowledge, attitudes and clinical practice of blood products prescribers in Niamey. Transfusion Clinique et Biologique, 23(2), Article 2. https://doi.org/10.1016/j.tracli.2015.11.007

Maymone, M. B. C., Venkatesh, S., Secemsky, E., Reddy, K., & Vashi, N. A. (2018). Research Techniques Made Simple: Web-Based Survey Research in Dermatology: Conduct and Applications. Journal of Investigative Dermatology, 138(7), 1456–1462. https://doi.org/10.1016/j.jid.2018.02.032

Mbuthia, A. N., Mwangi, E. M., &Ong'ombe, M. O. (2019). Organisational management of hospital blood transfusion services in Nairobi County, Kenya: Evidence of implementation. African Journal of Laboratory Medicine, 8(1), 8. https://doi.org/10.4102/ajlm.v8i1.676

McClelland, D. B. L., & Franklin, I., Pirie, Elizabeth. (2010). Manual of optimal blood use: Support for safe, clinically effective and efficient use of blood in Europe. Scottish National Blood Transfusion Service. http://www.optimalblooduse.eu/sites/optimalblooduse.eu/files/blood_use_manual.pdf

McCowan, R. J., & McCowan, S. C. (1999). Item Analysis for Criterion-Referenced Tests. In Online Submission. https://eric.ed.gov/?id=ED501716

McCutcheon, G. (1982). What in the World Is Curriculum Theory? Theory Into Practice, 21(1), 18–22.

Mcleod, S. (2008). [Likert Scale Definition, Examples and Analysis]. https://www.simplypsychology.org/likert-scale.html

McNair, R., Griffiths, L., Reid, K., & Sloan, H. (2016). Medical students developing confidence and patient centredness in diverse clinical settings: A longitudinal survey study. BMC Medical Education, 16(1), 176. https://doi.org/10.1186/s12909-016-0689-y

Mehta, N. B., Hull, A. L., Young, J. B., & Stoller, J. K. (2013). Just Imagine: New Paradigms for Medical Education. Academic Medicine, 88(10), 1418–1423. https://doi.org/10.1097/ACM.0b013e3182a36a07

Merriam-Webster, Inc. (2022). Definition of BEST PRACTICE. https://www.merriam-webster.com/dictionary/best+practice

Michailidou, E. M. (2020). The Dunning-Kruger Effect to residents and young Attendings in Intensive Medicine. Surgery & Case Studies: Open Access Journal, 5(4), 541–543. https://doi.org/10.32474/SCSOAJ.2020.05.000219

Miles, M. B., & Huberman, A. M. (1994). Qualitative data analysis: An expanded sourcebook, 2nd ed (pp. xiv, 338). Sage Publications, Inc.

Miles, S., Kellett, J., & Leinster, S. J. (2017). Medical graduates' preparedness to practice: A comparison of undergraduate medical school training. BMC Medical Education, 17(1), 33. https://doi.org/10.1186/s12909-017-0859-6

Miller, G. E. (1990). The assessment of clinical skills/competence/performance. Academic Medicine: Journal of the Association of American Medical Colleges, 65(9 Suppl), S63-67. https://doi.org/10.1097/00001888-199009000-00045

Miller, T. E., Booraem, C., Flowers, J. V., & Iversen, A. E. (1990). Changes in knowledge, attitudes, and behavior as a result of a community-based AIDS prevention program. AIDS Education and Prevention: Official Publication of the International Society for AIDS Education, 2(1), 12–23.

Ministry of Health. (2019). REPORT OF THE TASKFORCE ON TRAINING OF MEDICAL SPECIALISTS IN KENYA. Ministry of Health, Nairobi. https://www.health.go.ke/wp-content/uploads/2022/02/TASKFORCE-REPORT-ON-TRAINING-OF-MEDICAL-SPECIALISTS-January-2019.pdf

Ministry of Health. (2020). PRESS STATEMENT ON BLOOD SITUATION IN THE COUNRTY. Ministry of Health. Nairobi. https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&cad=rja&uact=8&ved=2ahUKEwjr5Z7kgdz0AhUPCRoKHVufDo4QFnoECAkQAQ&url=https%3A%2F%2Fwww.health.go.ke%2Fwp-content%2Fuploads%2F2020%2F02%2FFINAL-BLOOD-PRESS-RELEASE-converted.pdf&usg=AOvVaw14WU2TokmBS49GHo05heqB

Minter, R. M., Gruppen, L. D., Napolitano, K. S., & Gauger, P. G. (2005). Gender differences in the self-assessment of surgical residents. American Journal of Surgery, 189(6), 647–650. https://doi.org/10.1016/j.amjsurg.2004.11.035

Mitchell, S. A., Strauss, R. G., Albanese, M. A., & Case, D. E. (1989). A survey to identify deficiencies in transfusion medicine education. Academic Medicine: Journal of the Association of American Medical Colleges, 64(4), 217–219. https://doi.org/10.1097/00001888-198904000-00011

Monrouxe, L. V., Bullock, A., Gormley, G., Kaufhold, K., Kelly, N., Roberts, C. E., Mattick, K., & Rees, C. (2018). New graduate doctors' preparedness for practice: A multistakeholder, multicentre narrative study. BMJ Open, 8(8), e023146. https://doi.org/10.1136/bmjopen-2018-023146

Morgan, P. J., & Cleave-Hogg, D. (2002). Comparison between medical students' experience, confidence and competence. Medical Education, 36(6), 534–539. https://doi.org/10.1046/j.1365-2923.2002.01228.x

Morgan, S., Rioux-Masse, B., Oancea, C., Cohn, C., Harmon, J., & Konia, M. (2015). Simulation-based education for transfusion medicine. Transfusion, 55(4), 919–925. https://doi.org/10.1111/trf.12920

Moro, C., Spooner, A., & McLean, M. (2019). How prepared are students for the various transitions in their medical studies? An Australian university pilot study. MedEdPublish, 8. https://doi.org/10.15694/mep.2019.000025.1

Morris, S., Yudin, M. H., Callum, J., Alam, A., Herold, J., & Lin, Y. (2016). Obstetrical transfusion medicine knowledge among faculty and trainee obstetricians: A prospective knowledge assessment study. Transfusion Medicine (Oxford, England), 26(6), 440–447. https://doi.org/10.1111/tme.12360

Moschidou, M., Tzanetakou, I. P., Lamnisos, D., Kontekaki, E., Fasoulakis, Z., &Kontomanolis, E. N. (2019). Knowledge of Blood Transfusion in Medical And Biology Students. Cureus, 11(11). https://www.cureus.com/articles/23609-knowledge-of-blood-transfusion-in-medical-and-biology-students

Müller, N. (2005). Overview of Transfusion Medicine in Europe: Training and education. Retrieved March 3, 2020, from http://www.bloodtransfusion.it/articoli/000028/en/000108.pdf

Mumbo, H. M., & Kinaro, J. W. (2015). Assessment of quality and relevance of curricula development in health training institutions: A case study of Kenya. Human Resources for Health, 13(1), 67. https://doi.org/10.1186/s12960-015-0048-9

Muthaura, P. N., Khamis, T., Ahmed, M., & Hussain, S. R. (2015). Perceptions of the preparedness of medical graduates for internship responsibilities in district hospitals in Kenya: A qualitative study. BMC Medical Education, 15. https://doi.org/10.1186/s12909-015-0463-6

Narayan, S., Poles, P., Addison, J., & Carter-Graham, S. (2019). 2018 Annual SHOT Report. Serious Hazards of Transfusion. Retrieved February 23, 2020, from https://www.shotuk.org/2018-annual-shot-report-published/

National Academy of Sciences. (2004). Read "On Evaluating Curricular Effectiveness: Judging the Quality of K-12 Mathematics Evaluations" at NAP.edu. The National Academies Press. https://doi.org/10.17226/11025

National Institute for Health and Care Excellence. (2015). Recommendations | Blood transfusion | Guidance | NICE. NICE. https://www.nice.org.uk/guidance/ng24/chapter/Recommendations#red-blood-cells-2

New, H. V., Berryman, J., Bolton-Maggs, P. H. B., Cantwell, C., Chalmers, E. A., Davies, T., Gottstein, R., Kelleher, A., Kumar, S., Morley, S. L., Stanworth, S. J., & British Committee for Standards in Haematology. (2016). Guidelines on transfusion for fetuses, neonates and older children. British Journal of Haematology, 175(5), 784–828. https://doi.org/10.1111/bjh.14233

Nielson, B., Publisher, & Editor, M. (2017). Identifying your Organizational Training Needs: https://www.yourtrainingedge.com/identifying-your-organizational-training-needs-1/

Norcini, J., Anderson, M. B., Bollela, V., Burch, V., Costa, M. J., Duvivier, R., Hays, R., Palacios Mackay, M. F., Roberts, T., & Swanson, D. (2018). 2018 Consensus framework for good assessment. Medical Teacher, 40(11), 1102–1109. https://doi.org/10.1080/0142159X.2018.1500016

Nørgaard, A. B., & McQuilten, M. (2022). Single unit Transfusion. The International Society of Blood Transfusion (ISBT. https://www.isbtweb.org/isbt-working-parties/clinical-transfusion/resources/patient-blood-management-resources/6-single-unit-transfusion.html

Nulty, D. D. (2008). The adequacy of response rates to online and paper surveys: What can be done? Assessment & Evaluation in Higher Education, 33(3), 301–314. https://doi.org/10.1080/02602930701293231

Nunes da Silva, K. F., Dagma Duarte, R., Floriano, D. R., Foroni Andrade, L., Lumênia Tavares,

J., dos Santos Felix, M. M., Bonato Zuffi, F., da Silva Pires, P., Barbosa, M. H., Nunes da Silva, K. F., Dagma Duarte, R., Floriano, D. R., Foroni Andrade, L., Lumênia Tavares, J., dos Santos Felix, M. M., Bonato Zuffi, F., da Silva Pires, P., & Barbosa, M. H. (2017). Blood transfusion in Intensive Care Units: Knowledge of the nursing team. Avances En Enfermería, 35(3), 313–323. https://doi.org/10.15446/av.enferm.v35n3.62354

O'Brien, K. L., Champeaux, A. L., Sundell, Z. E., Short, M. W., & Roth, B. J. (2010). Transfusion medicine knowledge in Postgraduate Year 1 residents. Transfusion, 50(8), 1649–1653. https://doi.org/10.1111/j.1537-2995.2010.02628.x

O'Donoghue, D., Davison, G., Hanna, L.-J., McNaughten, B., Stevenson, M., & Thompson, A. (2018). Calibration of confidence and assessed clinical skills competence in undergraduate paediatric OSCE scenarios: A mixed methods study. BMC Medical Education, 18(1), 211. https://doi.org/10.1186/s12909-018-1318-8

Oge, T., Kilic, C. H., & Kilic, G. S. (2014). Economic Impact of Blood Transfusions: Balancing Cost and Benefits. The Eurasian Journal of Medicine, 46(1), 47–49. https://doi.org/10.5152/eajm.2014.08

Okello, G., Izudi, J., Teguzirigwa, S., Kakinda, A., & Van Hal, G. (2020). Findings of a Cross-Sectional Survey on Knowledge, Attitudes, and Practices about COVID-19 in Uganda: Implications for Public Health Prevention and Control Measures. BioMed Research International, 2020, e5917378. https://doi.org/10.1155/2020/5917378

Okoroafor, S. C., Kwesiga, B., Ogato, J., Gura, Z., Gondi, J., Jumba, N., Ogumbo, T., Monyoncho, M., Wamae, A., Wanyee, M., Angir, M., Almudhwahi, M. A., Evalyne, C., Nabyonga-Orem, J., Ahmat, A., Zurn, P., & Asamani, J. A. (2022). Investing in the health workforce in Kenya: Trends in size, composition and distribution from a descriptive health labour market analysis. BMJ Global Health, 7(Suppl 1), e009748. https://doi.org/10.1136/bmjgh-2022-009748

Opacic, D. A. (2003). The relationship between self-efficacy and student clinician assistant clinical performance. Journal of Allied Health, 32(3), 158–166.

Oxford University Press. (2020). Research ethics | Encyclopedia.com. https://www.encyclopedia.com/social-sciences/dictionaries-thesauruses-pictures-and-press-releases/research-ethics

Pajares, F. (1996). Self-efficacy beliefs in academic settings. Review of Educational Research, 66(4), 543–578. https://doi.org/10.2307/1170653

Pandey, P., Setya, D., Suresh, A., George, G., Chaudhary, C., Kumar, P., & Ranjan, S. (2020). Survey to assess knowledge, attitude and practices for safe and efficient vein-to-vein transfusion practices and effect of educational intervention in a hospital setting. Transfusion Medicine, 30(6), 475–484. https://doi.org/10.1111/tme.12710

Panzer, S., Engelbrecht, S., Cole-Sinclair, M. F., Wood, E. M., Wendel, S., Biagini, S., Zhu, Z., Lefrère, J.-J., Andreu, G., Zunino, T., Cabaud, J.-J., Rouger, P., Garraud, O., Janetzko, K., Müller-Steinhardt, M., van der Burg, P., Brand, A., Agarwal, P., Triyono, T., … Reesink, H. W. (2013). Education in transfusion medicine for medical students and doctors. Vox Sanguinis, 104(3), 250–272. https://doi.org/10.1111/j.1423-0410.2012.1661.x

Peedin, A. R., Perjar, I., Mazepa, M. A., Rollins-Raval, M. A., Park, Y. A., &Raval, J. S. (2019). The top 10 things to know about transfusion medicine before intern year: An evidence-based course for graduating medical students. Blood Research, 54(2), 125–130. Https://doi.org/10.5045/br.2019.54.2.125

Pereira, V. C., Silva, S. N., Carvalho, V. K. S., Zanghelini, F., & Barreto, J. O. M. (2022). Strategies for the implementation of clinical practice guidelines in public health: An overview of systematic reviews. Health Research Policy and Systems, 20(1), 13. https://doi.org/10.1186/s12961-022-00815-4

Pfuntner, A., Wier, L. M., & Stocks, C. (2011). Most Frequent Procedures Performed in U.S. Hospitals, 2011—Statistical Brief #165. Retrieved March 4, 2020, from https://www.hcup-us.ahrq.gov/reports/statbriefs/sb165.jsp

Philip, J., Kumar, S., Chatterjee, T., & Mallhi, R. S. (2015). Knowledge of Transfusion Medicine Among Resident Doctors in Clinical Specialities: A Cross-Sectional Study from a Tertiary Care Centre. Indian Journal of Hematology & Blood Transfusion, 31(3), 374–377. https://doi.org/10.1007/s12288-014-0470-5

Poh, K. Y., & Jackson, N. (2023). Transfusion medicine knowledge among medical doctors at a teaching hospital in Malaysia. Malays J Pathol.

Prasad, H. L. K., Prasad, H. V. K., Sajitha, K., Bhat, S., & Shetty, K. J. (2020). Comparison of Objective Structured Practical Examination (OSPE) Versus Conventional Pathology Practical Examination Methods Among the Second-Year Medical Students—A Cross-sectional Study. Medical Science Educator, 30(3), 1131–1135. https://doi.org/10.1007/s40670-020-01025-9

Preston, R., Gratani, M., Owens, K., Roche, P., Zimanyi, M., & Malau-Aduli, B. (2020). Exploring the Impact of Assessment on Medical Students' Learning. Assessment & Evaluation in Higher Education, 45(1), 109–124. https://doi.org/10.1080/02602938.2019.1614145

Price, B. (2015). Understanding attitudes and their effects on nursing practice. Nursing Standard (Royal College of Nursing (Great Britain): 1987), 30(15), 50–57; quiz 60. https://doi.org/10.7748/ns.30.15.50.s51

Purposive sampling | Lærd Dissertation. (2012). Retrieved November 10, 2023, from https://dissertation.laerd.com/purposive-sampling.php

RahavKoren, R., Suriu, C., Yakir, O., Akria, L., Barhoum, M., &Braester, A. (2017). Medical doctors' lack of knowledge—A possible reason for red blood cell transfusion overuse? Israel Journal of Health Policy Research, 6(1), 49. https://doi.org/10.1186/s13584-017-0173-0

Rahmani, M. (2020). Medical Trainees and the Dunning–Kruger Effect: When They Don't Know What They Don't Know. Journal of Graduate Medical Education, 12(5), 532–534. https://doi.org/10.4300/JGME-D-20-00134.1

Rajan, K. K., & Pandit, A. S. (2022). Comparing computer-assisted learning activities for learning clinical neuroscience: A randomized control trial. BMC Medical Education, 22(1), 522. https://doi.org/10.1186/s12909-022-03578-2

Ratnasari, S. D., & Andriansyah, A. S. (2014). Effect of Self Confident and Self Assessment for Performance with Social Skill as Moderating Variables. https://doi.org/10.9790/487X-161164347

Ray, G. K., Mukherjee, S., Routray, S. S., Sahu, A., Mishra, D., Naik, A., & Prakash, S. (2022). Knowledge, attitudes and practices of resident doctors and interns on safe blood transfusion practices: A survey-based study. Hematology, Transfusion and Cell Therapy. https://doi.org/10.1016/j.htct.2022.06.004

Ribed-Sánchez, B., González-Gaya, C., Varea-Díaz, S., Corbacho-Fabregat, C., Bule-Farto, I., & Pérez de-Oteyza, J. (2018). Analysis of economic and social costs of adverse events associated with blood transfusions in Spain. Gaceta Sanitaria, 32(3), 269–274. https://doi.org/10.1016/j.gaceta.2017.10.021

Roberts, N., James, S., Delaney, M., & Fitzmaurice, C. (2019). The global need and availability of blood products: A modelling study. The Lancet Haematology, 0(0). https://doi.org/10.1016/S2352-3026(19)30200-5

Robinson, S., Harris, A., Atkinson, S., Atterbury, C., Bolton-Maggs, P., Elliott, C., Hawkins, T., Hazra, E., Howell, C., New, H., Shackleton, T., Shreeve, K., & Taylor, C. (2018b). The administration of blood components: A British Society for Haematology Guideline. Transfusion Medicine, 28(1), Article 1. https://doi.org/10.1111/tme.12481

Rock, G., Berger, R., Pinkerton, P., & Fernandes, B. (2002). A pilot study to assess physician knowledge in transfusion medicine. Transfusion Medicine (Oxford, England), 12(2), 125–128. https://doi.org/10.1046/j.1365-3148.2002.00363.x

Roeper, J., Reichert-Schlax, J., Zlatkin-Troitschanskaia, O., Klose, V., Weber, M., & Nagel, M.-T. (2022). Patterns of Domain-Specific Learning Among Medical Undergraduate Students in Relation to Confidence in Their Physiology Knowledge: Insights From a Pre–post Study. Frontiers in Psychology, 12. https://www.frontiersin.org/articles/10.3389/fpsyg.2021.562211

Rothschild, J. M., McGurk, S., Honour, M., Lu, L., McClendon, A. A., Srivastava, P., Churchill, W. H., Kaufman, R. M., Avorn, J., Cook, E. F., & Bates, D. W. (2007). Assessment of education and computerized decision support interventions for improving transfusion practice. Transfusion, 47(2), 228–239. https://doi.org/10.1111/j.1537-2995.2007.01093.x

Rothwell, C., Burford, B., Morrison, J., Morrow, G., Allen, M., Davies, C., Baldauf, B., Spencer, J., Johnson, N., Peile, E., &Illing, J. (2012). Non-specialist prescribing: Enhancing their learning in practice. British Journal of Clinical Pharmacology, 73(2), 194–202. https://doi.org/10.1111/j.1365-2125.2011.04061.x

Ruhi, M., & Seema, G. (2016). A Survey for Assessing the Knowledge of Transfusion Medicine Amongst Resident Doctors. Journal of Evolution of Medical and Dental Sciences, 5(31), 1600–1605.

Sabbott. (2013, May 15). Curriculum Definition. The Glossary of Education Reform. https://www.edglossary.org/curriculum/

Sack, F. F. N., Alex, M. S., Chemegni, B. C., Elwige, G. D., Pierre, O. Z., (2018). Evaluation of transfusionnal practices carried out by doctors and paramedics staffs at the Yaounde Central Hospital (Cameroon). The Journal of Medical Research, 4(2), 59–62. https://doi.org/10.31254/jmr.2018.4201

Sadana, D., Kummangal, B., Moghekar, A., Banerjee, K., Kaur, S., Balasubramanian, S., Tolich, D., Han, X., Wang, X., Hanane, T., Mireles-Cabodevila, E., Quraishy, N., Duggal, A., & Krishnan, S. (2021). Adherence to blood product transfusion guidelines-An observational study of the current transfusion practice in a medical intensive care unit. Transfusion Medicine (Oxford, England), 31(4), 227–235. https://doi.org/10.1111/tme.12771

Sahmoud, S., Ashry, E. M., El Kalioby, M., & Kamel, N. (2021). Knowledge Improvement of Blood Transfusion Safety Among Pediatricians: Post Educational Intervention. Transfusion Medicine Reviews, 35(2), 135–139. https://doi.org/10.1016/j.tmrv.2021.03.002

Saidenberg, E., & Pugh, D. (2014). The use of an objective structured clinical examination to assess internal medicine residents' transfusion knowledge. Transfusion, 54(6), 1537–1541. https://doi.org/10.1111/trf.12508

Saillour-Glénisson, F., Tricaud, S., Mathoulin-Pélissier, S., Bouchon, B., Galpérine, I., Fialon, P., & Salmi, L. R. (2002). Factors associated with nurses' poor knowledge and practice of transfusion safety procedures in Aquitaine, France. International Journal for Quality in Health Care: Journal of the International Society for Quality in Health Care, 14(1), 25–32. https://doi.org/10.1093/intqhc/14.1.25

Sajwani, F. H. (2012). Improving blood transfusion practice by regular education in the United Arab Emirates. Transfusion, 52(7 Pt 2), 1628–1631. https://doi.org/10.1111/j.1537-2995.2012.03760.x

Salem-Schatz, S. R., Avorn, J., &Soumerai, S. B. (1993). Influence of Knowledge and Attitudes on the Quality of Medical doctors' Transfusion Practice. Medical Care, 31(10), 868–878. JSTOR.

Sapkota, A., Poudel, S., Sedhain, A., & Khatiwada, N. (2018). Blood Transfusion Practice among Healthcare Personnel in Nepal: An Observational Study. Journal of Blood Transfusion, 2018, 6190859. https://doi.org/10.1155/2018/6190859

SAURABH, M. K., PATEL, T., KHATUN, S., CHAUDHRI, J., & PATEL, P. (2021). Implementation of Objective Structured Practical Examination in Formative Assessment for Undergraduate Practical Pharmacology. Mædica, 16(1), 64–74. https://doi.org/10.26574/maedica.2020.16.1.64

Savickienė, I. (2010). Conception of Learning Outcomes in the Bloom's Taxonomy Affective Domain. Quality in Higher Education. https://www.semanticscholar.org/paper/Conception-of-Learning-Outcomes-in-the-Bloom%27s-Savickien%C4%97/62934719e65798a965344fce3b4c755993b37fbc

Saxon, B., Stanworth, S. J., Van De Watering, L., Yokoyama, A. P. H., Haspel, R. L., & BEST-TEST3 Investigators. (2021). Pediatric resident knowledge of transfusion medicine: Results from the BEST-TEST3 international education needs assessment. Transfusion, 61(8), 2487–2495. https://doi.org/10.1111/trf.16439

Scharf, R. E., & Burger, R. (2014). Academic Training of Medical Students in Transfusion Medicine, Hemotherapy, and Hemostasis: Results of a Questionnaire-Based Status Report in Germany. Transfusion Medicine and Hemotherapy, 41(4), 303–308. https://doi.org/10.1159/000365582

Schmidmaier, R., Eiber, S., Ebersbach, R., Schiller, M., Hege, I., Holzer, M., & Fischer, M. R. (2013). Learning the facts in medical school is not enough: Which factors predict successful application of procedural knowledge in a laboratory setting? BMC Medical Education, 13, 28. https://doi.org/10.1186/1472-6920-13-28

Schrader, P. G., & Lawless, K. A. (2004). The knowledge, attitudes, & behaviors approach how to evaluate performance and learning in complex environments. Performance Improvement, 43(9), 8–15. https://doi.org/10.1002/pfi.4140430905

Shumway, J. M., & Harden, R. M. (2009). AMEE Guide No. 25: The assessment of learning outcomes for the competent and reflective physician. Medical Teacher. https://doi.org/10.1080/0142159032000151907

Sciarra, E. (2012). The Importance of Practice Guidelines in Clinical Care. Dimensions of Critical Care Nursing, 31(2), 84–85. https://doi.org/10.1097/DCC.0b013e3182445f62

Scotland, J. (2012). Exploring the Philosophical Underpinnings of Research: Relating Ontology and Epistemology to the Methodology and Methods of the Scientific, Interpretive, and Critical Research Paradigms. English Language Teaching, 5(9), p9. https://doi.org/10.5539/elt.v5n9p9

Scott, D. (2001). Curriculum Theory. In N. J. Smelser & P. B. Baltes (Eds.), International Encyclopedia of the Social & Behavioral Sciences (pp. 3195–3198). Pergamon. https://doi.org/10.1016/B0-08-043076-7/02420-7

Seid, M. A., & Hussen, M. S. (2018). Knowledge and attitude towards antimicrobial resistance among final year undergraduate paramedical students at University of Gondar, Ethiopia. BMC Infectious Diseases, 18(1), 312. https://doi.org/10.1186/s12879-018-3199-1

Setia, R., Sachdeva, P., Arora, S., Handoo, A., & Kapoor, M. (2017). Making type and screen policy an essential component of pretransfusion testing: Need of the hour in India. https://www.gjtmonline.com/article.asp?issn=2468-8398;year=2017;volume=2;issue=1;spage=34;epage=37;aulast=Setia

Shafiee, A., Nazari, S., Mogharreban, M., & Koupaei, M. T. S. (2013). Evaluating medical interns' knowledge of common blood transfusion complications. Transfusion and Apheresis Science, 48(2), 253–256. https://doi.org/10.1016/j.transci.2013.01.004

Shrestha, R., Basnet, S., & Gami, F. C. (2020). Rise of Haemoglobin after Blood Transfusion in Children Without Active Bleeding. Journal of Nepal Paediatric Society, 40(2), Article 2. https://doi.org/10.3126/jnps.v40i2.26771

Sibinga, C. T. S. (2022). Determining Transfusion Needs: Global Expectations and Realities. Current Innovations in Medicine and Medical Science Vol. 2, 105–113. https://doi.org/10.9734/bpi/cimms/v2/2435A

Sihler, K. C., & Napolitano, L. M. (2010). Complications of massive transfusion. Chest, 137(1), 209–220. https://doi.org/10.1378/chest.09-0252

Simpson, E. J. (1966). THE CLASSIFICATION OF EDUCATIONAL OBJECTIVES, PSYCHOMOTOR DOMAIN. https://eric.ed.gov/?id=ED010368

Simon, T. L. (1989). Comprehensive curricular goals for teaching transfusion medicine. Curriculum Committee of the Transfusion Medicine Academic Award Group. Transfusion, 29(5), 438–446. https://doi.org/10.1046/j.1537-2995.1989.29589284146.x

Sinclair, P., Kable, A., & Levett-Jones, T. (2015). The effectiveness of internet-based e-learning on clinician behavior and patient outcomes: A systematic review protocol. JBI

Database of Systematic Reviews and Implementation Reports, 13(1), 52–64. https://doi.org/10.11124/jbisrir-2015-1919

Smidt, A., Balandin, S., Sigafoos, J., & Reed, V. A. (2009). The Kirkpatrick model: A useful tool for evaluating training outcomes. Journal of Intellectual & Developmental Disability, 34(3), 266–274. https://doi.org/10.1080/13668250903093125

Smit Sibinga, C. Th., Louw, V. J., Nedelcu, E., Al-Riyami, A. Z., Bakhtary, S., Johnson, S. T., Rambiritch, V., Seoraj, V., Callum, J., van den Berg, K., Vermeulen, M., Barrett, C. A., Eichbaum, Q. G., & Forum, S. on E. of the A. G. T. (2021). Modeling global transfusion medicine education. Transfusion, 61(10), 3040–3049. https://doi.org/10.1111/trf.16641

Smith, A., Gray, A., Atherton, I., Pirie, E., & Jepson, R. (2014). Does time matter? An investigation of knowledge and attitudes following blood transfusion training. Nurse Education in Practice, 14(2), Article 2. https://doi.org/10.1016/j.nepr.2013.08.016social-media-2278772

Smith, M. K. (1996, 2008). 'Curriculum theory and practice' The encyclopedia of pedagogy and informal education. https://infed.org/mobi/curriculum-theory-and-practice/

Soril, L. J. J., Noseworthy, T. W., Dowsett, L. E., Memedovich, K., Holitzki, H. M., Lorenzetti, D. L., Stelfox, H. T., Zygun, D. A., & Clement, F. M. (2018). Behaviour modification interventions to optimise red blood cell transfusion practices: A systematic review and meta-analysis. BMJ Open, 8(5), e019912. https://doi.org/10.1136/bmjopen-2017-019912

Soumerai, S. B., Salem-Schatz, S., Avorn, J., Casteris, C. S., Ross-Degnan, D., & Popovsky, M. A. (1993). A controlled trial of educational outreach to improve blood transfusion practice. JAMA, 270(8), 961–966.

Stabback, P. (2016). What Makes a Quality Curriculum? International Bureau of Education, UNESCO. https://unesdoc.unesco.org/ark:/48223/pf0000243975

Stajkovic, A. D., & Luthans, F. (1998). Self-efficacy and work-related performance: A meta-analysis. Psychological Bulletin, 124(2), 240–261. https://doi.org/10.1037/0033-2909.124.2.240

Stephanie. (2015). Likert Scale Definition and Examples. Retrieved March 5, 2020, from https://www.statisticshowto.datasciencecentral.com/likert-scale-definition-and-examples/

Stubbs, J. R., & Kreuter, J. D. (2016). BEST TEST with MEDIOCRE RESULTS (at best!): A "call to arms" to correct clinician knowledge deficits in transfusion medicine. Transfusion, 56(2), 285–289. https://doi.org/10.1111/trf.13456

Sullivan, G. M., &Artino, A. R. J. (2013). Analyzing and Interpreting Data From Likert-Type Scales. Retrieved March 5, 2020, from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3886444/

Sullivan, H. C., Stowell, S. R., Meyer, E. K., Duncan, A. D., & Guarner, J. (2019). Development, Implementation, and Evaluation of a Fourth-Year Medical School Elective Course in Blood Banking and Transfusion Medicine. American Journal of Clinical Pathology, 151(1), 116–121. https://doi.org/10.1093/ajcp/aqy115

Surmon, L., Bialocerkowski, A., & Hu, W. (2016). Perceptions of preparedness for the first medical clerkship: A systematic review and synthesis. BMC Medical Education, 16(1), 89. https://doi.org/10.1186/s12909-016-0615-3

Svenningsson, J., Hultén, M., & Hallström, J. (2018). Understanding attitude measurement: Exploring meaning and use of the PATT short questionnaire. International Journal of Technology and Design Education, 28(1), 67–83. https://doi.org/10.1007/s10798-016-9392-x

Szczepiorkowski, Z. M., & Dunbar, N. M. (2013). Transfusion guidelines: When to transfuse. Hematology, 2013(1), 638–644. https://doi.org/10.1182/asheducation-2013.1.638

Tabish, S. A. (2008). Assessment Methods in Medical Education. International Journal of Health Sciences, 2(2), 3–7.

Target Population. (2008). In Encyclopedia of Survey Research Methods. Sage Publications, Inc. https://doi.org/10.4135/9781412963947.n571

Tavakol, M., & Dennick, R. (2011b). Making sense of Cronbach's alpha. International Journal of Medical Education, 2, 53–55. https://doi.org/10.5116/ijme.4dfb.8dfd

Team, U. (2016, July 11). What's Better: Innovative or Traditional Teaching Methods. Unicheck Blog for Education Junkies. https://unicheck.com/blog/traditional-innovative-teaching

ten Ham-Baloyi, W., Minnie, K., & van der Walt, C. (2020). Improving healthcare: A guide to roll-out best practices. African Health Sciences, 20(3), 1487–1495. https://doi.org/10.4314/ahs.v20i3.55

Thakkar, R. N., Podlasek, S. J., Rotello, L. C., Ness, P. M., & Frank, S. M. (2017). Two-Unit Red Cell Transfusions in Stable Anemic Patients. Journal of Hospital Medicine, 12(9), 747–749. https://doi.org/10.12788/jhm.2806

Thistlethwaite, J. E., Davies, D., Ekeocha, S., Kidd, J. M., MacDougall, C., Matthews, P., Purkis, J., & Clay, D. (2012). The effectiveness of case-based learning in health professional education. A BEME systematic review: BEME Guide No. 23. Medical Teacher, 34(6), e421-444. https://doi.org/10.3109/0142159X.2012.680939

Tinmouth, A. T., Hare, G. M. T., & Mazer, C. D. (2010). The "sticky" business of "adherence" to transfusion guidelines. Intensive Care Medicine, 36(7), 1107–1109. https://doi.org/10.1007/s00134-010-1871-z

Tomić, V., Sporis, G., Nizić, D., & Galinović, I. (2007). Self-reported confidence, attitudes and skills in practical procedures among medical students: Questionnaire study. Collegium Antropologicum, 31(3), Article 3.

Tongco, Ma. D. C. (2007). Purposive Sampling as a Tool for Informant Selection. Ethnobotany Research and Applications, 5, 147. https://doi.org/10.17348/era.5.0.147-158

Triulzi, D., Dorée, C., & Hébert, P. C. (2021). Transfusion thresholds for guiding red blood cell transfusion. The Cochrane Database of Systematic Reviews, 12, CD002042.https://doi.org/10.1002/14651858.CD002042.pub5

Turyahikayo, E. (2021). Philosophical paradigms as the bases for knowledge management research and practice. Knowledge Management & E-Learning: An International Journal, 209–224. https://doi.org/10.34105/j.kmel.2021.13.012

ul Haq, N., Hassali, M. A., Shafie, A. A., Saleem, F., Farooqui, M., & Aljadhey, H. (2012). A cross sectional assessment of knowledge, attitude and practice towards Hepatitis B among healthy population of Quetta, Pakistan. BMC Public Health, 12(1), 692. https://doi.org/10.1186/1471-2458-12-692

Ursachi, G., Horodnic, I. A., & Zait, A. (2015a). How Reliable are Measurement Scales? External Factors with Indirect Influence on Reliability Estimators. Procedia Economics and Finance, 20, 679–686. https://doi.org/10.1016/S2212-5671(15)00123-9

Usher, E. L., &Pajares, F. (2008). Sources of Self-Efficacy in School: Critical Review of the Literature and Future Directions. Review of Educational Research, 78(4), 751–796. https://doi.org/10.3102/0034654308321456

Vaena, M. M. de V., & Alves, L. A. (2019). Assessment of the knowledge and perceptions of Brazilian medical residents on transfusion medicine. Hematology, Transfusion and Cell Therapy, 41(1), 37–43. https://doi.org/10.1016/j.htct.2018.06.002

Vageriya, V. (2018). Assessment and Evaluation- In Perspective of Medical Education. Nursing & Healthcare International Journal, 2(4). https://doi.org/10.23880/NHIJ-16000154

Van Der Vleuten, C. P. (1996). The assessment of professional competence: Developments, research and practical implications. Advances in Health Sciences Education: Theory and Practice, 1(1), 41–67. https://doi.org/10.1007/BF00596229

VARMA, V. (n.d.). PRELIMINARY ITEM STATISTICS USING POINT-BISERIAL CORRELATION AND P-VALUES. EDUCATIONAL DATA SYSTEM, MORGAN HILL CARLIFORNIA. https://jcesom.marshall.edu/media/24104/Item-Stats-Point-Biserial.pdf

Vasconcelos Vaena, M. M. de, Cotta-de-Almeida, V., & Alves, L. A. (2016). Transfusion medicine in medical education: An analysis of curricula grids in Brazil and a review of the current literature. RevistaBrasileira de Hematologia e Hemoterapia, 38(3), 252–256. https://doi.org/10.1016/j.bjhh.2016.05.013

Vetter, T. R., Adhami, L. F., Porterfield, J. R., & Marques, M. B. (2014). Perceptions about blood transfusion: A survey of surgical patients and their anesthesiologists and surgeons.

Anesthesia and Analgesia, 118(6), 1301–1308. https://doi.org/10.1213/ANE.0000000000000131

Wall, D., Bolshaw, A., & Carolan, J. (2006). From undergraduate medical education to pre-registration house officer year: How prepared are students? Medical Teacher, 28(5), 435–439. https://doi.org/10.1080/01421590600625171

Wallin, J. J. (2011). What is ?Curriculum Theorizing: For a People Yet to Come. Studies in Philosophy and Education, 30(3), 285–301. https://doi.org/10.1007/s11217-010-9210-y

Wang, J., Chen, L., Yu, M., & He, J. (2020). Impact of knowledge, attitude, and practice (KAP)-based rehabilitation education on the KAP of patients with intervertebral disc herniation. Annals of Palliative Medicine, 9(2), Article 2. https://doi.org/10.21037/apm.2020.03.01

Wang, H., Ren, D., Sun, H., & Liu, J. (2022). Research progress on febrile non-hemolytic transfusion reaction: A narrative review. Annals of Translational Medicine, 10(24), 1401. https://doi.org/10.21037/atm-22-4932

Wass, V., Van der Vleuten, C., Shatzer, J., & Jones, R. (2001). Assessment of clinical competence. Lancet (London, England), 357(9260), 945–949. https://doi.org/10.1016/S0140-6736(00)04221-5

Wautier, J.-L., Cabaud, J.-J., Cazenave, J.-P., Fialon, P., Fruchart, M.-F., Joussemet, M., Leblond, V., Muller, J.-Y., Rouger, P., Vignon, D., Waller, C., Lefrère, J.-J., Worms, B., & Vileyn, F. (2005). Programme en transfusion des étudiants en médecine. Transfusion Clinique et Biologique, 12(1), 59–69. https://doi.org/10.1016/j.tracli.2004.11.006

Wheeler, A. P., Delaney, M., Fung, M., Gorlin, J., Kutner, J. M., Lam, J. C. M., Robitaille, N., Saxon, B., Stanworth, S. J., Van De Watering, L., Yokoyama, A. P. H., Haspel, R. L., & BEST-TEST3 Investigators. (2021). Pediatric resident knowledge of transfusion medicine: Results from the BEST-TEST3 international education needs assessment. Transfusion, 61(8), 2487–2495. https://doi.org/10.1111/trf.16439

Whitaker, B., Rajbhandary, S., Kleinman, S., Harris, A., & Kamani, N. (2016). Trends in United States blood collection and transfusion: Results from the 2013 AABB Blood Collection, Utilization, and Patient Blood Management Survey. Transfusion, 56(9), 2173–2183. https://doi.org/10.1111/trf.13676

Wiersma, W., & Jurs, S. G. (1990). Educational measurement and testing. Allyn and Bacon.

Williams, C. (2007). Research Methods. Journal of Business & Economic Research, 5(3), 65–72.

Williams, C., Campbell, S., Sadek, I., Cheng, C., & LeBlanc, C. (2020). P004: The impact of transfusion guideline on emergency clinician transfusion orders. Canadian Journal of Emergency Medicine, 22(S1), S65–S66. https://doi.org/10.1017/cem.2020.212

Woolf, S. H., Grol, R., Hutchinson, A., Eccles, M., & Grimshaw, J. (1999). Potential benefits, limitations, and harms of clinical guidelines. BMJ : British Medical Journal, 318(7182), 527–530.

Woolliscroft, J. O., TenHaken, J., Smith, J., & Calhoun, J. G. (1993). Medical students' clinical self-assessments: Comparisons with external measures of performance and the students' self-assessments of overall performance and effort. Academic Medicine: Journal of the Association of American Medical Colleges, 68(4), 285–294. https://doi.org/10.1097/00001888-199304000-00016

World Health Organization. (2001). The Clinical use of blood: Handbook. World Health Organization. https://apps.who.int/iris/handle/10665/42396

World Health Organization. (2001a). Developing a National Policy and Guidelines on the Clinical Use of Blood. World Health Organization, Geneva. https://apps.who.int/iris/rest/bitstreams/1262955/retrieve

World Health Organization. (2008). Universal Access to Safe Blood Transfusion. World Health Organization, Geneva. Retrieved December 14, 2019, from https://www.who.int/bloodsafety/publications/UniversalAccesstoSafeBT.pdf?ua=1

World Health Organization. (2011). WHO guidelines on good manufacturing practices for blood

establishments. World Health Organization, Geneva. https://cdn.who.int/media/docs/default-source/biologicals/blood-products/document-migration/gmp_bloodestablishments.pdf?sfvrsn=34ddd5b6_3&download=true

World Health Organization. (2016). Ethical standards and procedures for research with human beings. WHO; Geneva. Retrieved December 14, 2019, from https://www.who.int/ethics/research/en/

World Health Organization. (2017). Global Status Report on Blood Safety and Availability 2016. WHO, Geneva. Retrieved October 30, 2020, from http://apps.who.int/iris/bitstream/10665/254987/1/9789241565431-eng.pdf

World Health Organization. (2020). Action framework to advance universal access to safe, effective and quality-assured blood products 2020–2023. World Health Organization. https://iris.who.int/handle/10665/331002

World Health Organization. (2020). Blood safety and availability. WHO, Geneva. Retrieved October 30, 2020, from https://www.who.int/news-room/fact-sheets/detail/blood-safety-and-availability

World Health Organization. (2021). WHO model list of essential medicines—22nd list, 2021. https://www.who.int/publications/i/item/WHO-MHP-HPS-EML-2021.02

World Health Organization. (2021a). Global patient safety action plan 2021–2030: Towards eliminating avoidable harm in health care. World Health Organization, Geneva.

https://www.who.int/docs/default-source/patient-safety/global-patient-safety-action-plan-2021-2030_third-draft_january

World Health Organization. (2021b). The Urgent Need To Implement Patient Blood Managemen. World Health Organization, Geneva. https://apps.who.int/iris/bitstream/handle/10665/346655/9789240035744-eng.pdf

World Health Organization. (n.d.). Clinical Transfusion Practice: Guidelines for Medical Interns. https://www.who.int/bloodsafety/transfusion_services/ClinicalTransfusionPracticeGuidelinesforMedicalInternsBangladesh.pdf

Woromogo, S. H., Djeukang, G. G., Yagata Moussa, F. E., Saba Antaon, J. S., Kort, K. N., & Tebeu, P. M. (2020). Assessing Knowledge, Attitudes, and Practices of Healthcare Workers regarding Biomedical Waste Management at Biyem-Assi District Hospital, Yaounde: A Cross-Sectional Analytical Study. Advances in Public Health, 2020, e2874064. https://doi.org/10.1155/2020/2874064

Wu, E. H., Fagan, M. J., Reinert, S. E., & Diaz, J. A. (2007). Self-confidence in and perceived utility of the physical examination: A comparison of medical students, residents, and faculty internists. Journal of General Internal Medicine, 22(12), Article 12. https://doi.org/10.1007/s11606-007-0409-8

Wu, W.-H., Kao, H.-Y., Wu, S.-H., & Wei, C.-W. (2019). Development and Evaluation of Affective Domain Using Student's Feedback in Entrepreneurial Massive Open Online Courses. Frontiers in Psychology, 10. https://www.frontiersin.org/articles/10.3389/fpsyg.2019.01109

Wyssusek, K., Taylor, K., & Concha-Blamey, S. (2021). Focused educational intervention improves intern knowledge of perioperative patient blood management principles. BMJ Open Quality, 10(4), e001390. https://doi.org/10.1136/bmjoq-2021-001390

Yaffee, D. W., Smith, D. E., Ursomanno, P. A., Hill, F. T., Galloway, A. C., DeAnda, A., & Grossi, E. A. (2014). Management of blood transfusion in aortic valve surgery: Impact of a blood conservation strategy. The Annals of Thoracic Surgery, 97(1), 95–101. https://doi.org/10.1016/j.athoracsur.2013.09.057

Yamane, T. (1967). Statistics: An Introductory Analysis (2nd ed.). Harper & Row.

Yamauchi, L. A., Ponte, E., Ratliffe, K. T., & Traynor, K. (2017). Theoretical and Conceptual Frameworks Used in Research on Family-School Partnerships. School Community Journal, 27(2), 9–34.

Young, S. W., Marsh, D. J., Akhavani, M. A., Walker, C. G., & Skinner, J. A. (2008). Attitudes to blood transfusion post arthroplasty surgery in the United Kingdom: A national survey. International Orthopaedics, 32(3), Article 3. https://doi.org/10.1007/s00264-007-0330-0

Yudelowitz, B., Scribante, J., Perrie, H., & Oosthuizen, E. (2016). Knowledge of appropriate blood product use in perioperative patients among medical doctors at a tertiary hospital. Health SA Gesondheid, 21, 309–314. https://doi.org/10.1016/j.hsag.2016.06.003

Zulkifli, A. Z. B., Ibrahim H. Yeter, & Farhan Ali. (2022). Examining K-12 Singaporean Parents' Engineering Awareness: An Initial Study of the Knowledge, Attitude, and Behavior (KAB) Framework (Fundamental). Excellence Through Diversity, Paper ID #37357. https://peer.asee.org/examining-k-12-singaporean-parents-engineering-awareness-an-initial-study-of-the-knowledge-attitude-and-behavior-kab-framework-fundamental.pdf

APPENDICES

APPENDIX A: DATA ABSTRACTION FORM/CHECKLIST

1. What curriculum is being implemented in the medical school?
   - Traditional/conventional ☐
   - Innovative/PBL ☐
   - Other………..
2. Does the undergraduate medical curriculum have a blood transfusion component?
   - No ☐
   - Yes ☐
3. If yes, how is the content presented in the curriculum?
   - As a standalone discipline ☐
   - Content is mentioned in the grid of another discipline ☐ ☐
4. If content is mentioned in the grid of another discipline, what are the specific disciplines?
   - Physiology Discipline ☐
   - Immunology Discipline ☐
   - Biochemistry Discipline ☐
   - Pathology Discipline ☐
   - Internal medicine Clinical Clerkship ☐
   - Paediatrics and Child Health Clinical Clerkship ☐

- Surgery Clinical Clerkship ☐
- Obstetrics and gynaecology Clinical Clerkship ☐
- Anaesthesia ☐
- Other……………………………………………………………………

……………………………………………………………………………

……………………………………………………………………………

……………………………………………………………………………

………………………

5. In what year of the curriculum is the content of blood transfusion covered?

<u>Note: May select more than one</u>

- 1st Year ☐
- 2nd Year ☐
- 3rd Year ☐
- 4th Year ☐
- Year 5 ☐
- Year 6 ☐

6. What topics in blood transfusion are covered in the undergraduate curriculum?

<u>Note: Indicate all that apply</u>

Topic	✔
History of blood transfusion	
Basic physiology of blood	
Overview of the vein-to-vein transfusion process	

Blood groups (red blood cell antigens and antibodies)	
Blood donation- donor selection, donor counseling, and blood collection	
Donor blood screening for TTIs	
Blood component preparation and storage	
Blood components and derivatives	
Clinical use of blood components- indications, transfusion trigger, dosages, contraindications	
Special blood products (leucocyte depleted, CMV Negative, irradiated, washed)	
Pretransfusion testing- crossmatching and blood typing	
Administration of blood components (bedside procedures)	
Risks and types of blood transfusion reactions	
Alternatives to blood transfusion	
Transfusion practice in paediatrics	
Transfusion practice in trauma and surgery	
Transfusion practice in obstetrics and gynaecology	
Transfusion practice in medical set ups	
Haemovigilance	
Therapeutic apheresis	
Haematopoietic stem cell transplantation	
Appropriate use of blood components	
Organization of blood transfusion service	

Other -- -- --

7. What type (s) of teaching and learning experience (s) are commonly employed during undergraduate education in blood transfusion in the medical school curriculum? (***Indicate all that apply)***

Method of Teaching and Learning	✔
Lectures	
Problem Based Learning (PBL)/Tutorials	
Laboratory practical/demonstrations	
Clinical sessions involving patients which require transfusion	
Blood bank visit/Fieldwork	
Simulation	
Clinical demonstrations	
E-learning	
Other-- -- -- --	

8. How much time/many units are devoted to training in blood transfusion in the medical school curriculum?

	Total units/ hours	Not apparent
1st Year		
2nd Year		
3rd Year		
4th Year		
5th Year		
6th year		

9. (a) How is the knowledge of blood transfusion assessed/examined in the curriculum?

   i. Formative assessment ☐

   ii. Summative assessment ☐

   (b) What is/are the assessment format (s) that are indicated in the curriculum for:

   (**may select more than one)**

	✓
Multiple choice questions	
Short answer questions	
Modified essay questions	
Long essay questions	
Laboratory practical	
Viva voce (oral examination)	

Log book	
Portfolio-based assessment	
Other (specify)--- --------------------------- -- -- ---	

APPENDIX B: QUESTIONNAIRE

SECTION 1: DEMOGRAPHICS

1. What is your age (years) ----------------------------------?

2. What is your sex?

   - Male ☐
   - Female ☐

SECTION 2: EDUCATIONAL BACKGROUND

1. Which Medical School did you attend?

   - Maseno ☐
   - Nairobi ☐
   - Uzima ☐
   - KU ☐
   - JKUAT ☐
   - Moi ☐
   - Mt Kenya ☐
   - KEMU ☐
   - Egerton ☐
   - Other___________________________________

1. Which year did you graduate from medical school?

    - 2013 ☐
    - 2014 ☐
    - 2015 ☐
    - 2016 ☐
    - 2017 ☐
    - 2018 ☐
    - 2019 ☐
    - 2020 ☐
    - 2021 ☐
    - Other---

2. Which curriculum did your medical school using during undergraduate training?

    - Conventional/traditional ☐
    - Innovative/PBL ☐
    - Other---

3. What year(s) of study in medical school were you taught the subject/topic of blood transfusion? (Select all that apply)

    - 1st year ☐
    - 2nd year ☐
    - 3rd year ☐
    - 4th year ☐
    - 5th year ☐

- 6th year ☐
- I was not taught blood transfusion ☐

4. What was the approximate total time (hours) you spend during your undergraduate medical education in blood transfusion (lectures/tutorials/practical/bedside sessions)
    - < 1 hour ☐
    - 1-2 hours ☐
    - 3-4 hours ☐
    - 5-6 hours ☐
    - > 6 hours ☐
    - I don't know ☐
    - Not applicable ☐
5. What type(s) of teaching and learning experience (s) did you participate in during undergraduate education in blood transfusion? (Select all that apply)
    - Lecture ☐
    - Tutorials/PBL sessions ☐
    - Laboratory practicals ☐
    - Clinical sessions involving patients which require transfusion ☐
    - Informal ward-based teaching ☐
    - Online learning modules ☐
    - Other---

6. Of the type(s) of teaching and learning experience (s) you indicated in Q13 above, which one(s) do you feel was/were of most benefit to your education in blood transfusion? (Select all that apply)
    - Lecture ☐
    - Tutorials/PBL sessions ☐
    - Laboratory practicals ☐
    - Clinical sessions involving patients which require transfusion ☐
    - Informal ward-based teaching ☐
    - Online learning modules ☐
    - Other--
7. Have you participated in any training touching on blood transfusion after graduating from medical school?
    - Yes ☐
    - No ☐
8. If your answer to Q18 is yes, how was the training delivered? (Select all that apply)
    - During postgraduate/residency training ☐
    - Seminars/conference/workshops ☐
    - CME/CPD session ☐
    - Online course ☐
    - Other (specify) ☐

SECTION 3: QUALITY OF EDUCATION AND PREPAREDNESS IN BLOOD TRANSFUSION PRACTICE

1. How would you rate your satisfaction in regards to the QUALITY of education in blood transfusion you received during your undergraduate training?
    - Very dissatisfied ☐
    - Dissatisfied ☐
    - Satisfied ☐
    - Very satisfied ☐
2. How adequately do you believe that your medical School prepared you for practice in blood transfusion?
    - Very inadequately ☐
    - Inadequately ☐
    - Adequately ☐
    - Very adequately ☐

SECTION 4: SITE OF PRACTICE CHARACTERISTICS

1. Which hospital are you based in?
    - County Referral ☐
    - MTRH ☐

2. What is your designation?
    - Medical intern ☐

- Medical officer ☐
- Resident/registrar ☐

3. Which ward/field of your specialty are you based in?
   - Medicine ☐
   - Paediatrics ☐
   - General surgery ☐
   - Orthopaedic surgery ☐
   - Family medicine ☐
   - Acc. & Emergency/casualty ☐
   - Anesthesia/Critical care ☐
   - Obstetrics/Gynecology ☐
   - ICU ☐
   - Other________________________________

4. How many years have you practiced since graduating from medical school?
   - < 6 months ☐
   - 6 months to 1 year ☐
   - 2-5 years ☐
   - > 5 years ☐

5. Were you given induction or orientation in blood transfusion before you started your internship?
   - Yes ☐
   - No ☐

SECTION 5: KNOWLEDGE ON BLOOD TRANSFUSION

Please answer the following questions by choosing the one correct answer/response

1. In Kenya, the minimum age for donating blood is:
   - 14 years ☐
   - 16 years ☐
   - 18 years ☐
   - I don't know ☐
2. Forward blood grouping is done by mixing the donor's/recipient's red blood cells and known anti-sera
   - True ☐
   - False ☐
   - I don't know ☐
3. What is the storage temperature of fresh frozen plasma?
   - 2-6^{0}C ☐
   - 20-24^{0}C ☐
   - - 30^{0}C ☐
   - I don't know ☐
4. What would be the increase in the haemoglobin level after transfusion of 1 unit of packed red blood cells in a patient who is not actively bleeding?
   - 0.5g/dL ☐
   - 1g/dL ☐
   - 3g/dL ☐
   - I don't know ☐

5. Appropriate indication for cryoprecipitate includes all of the following EXCEPT?
    - Treatment of haemophilia A ☐
    - Treatment of haemophilia B ☐
    - Treatment of bleeding due to hypofibrinogenemia or dysfibrinogenemia ☐
    - I don’t know ☐
6. Irradiated blood components are transfused in order to prevent which complication?
    - Transfusion associated graft vs host disease ☐
    - Allergic transfusion reaction ☐
    - Cytomegalovirus infection ☐
    - I don’t know ☐
7. In a situation of an adult patient with thrombocytopaenia without bleeding, at what threshold platelet count should transfusion be considered to prevent haemorrhage?
    - 10,000/µL ☐
    - 50,000/µL ☐
    - 100,000/µL ☐
    - I don’t know ☐
8. If a patient with acute leukemia is admitted with anaemia, but no immediate transfusion is anticipated, what would be the appropriate course of action?
    - Order blood grouping and crossmatch ☐
    - Order grouping and screening ☐

- Avoid drawing specimen in an anaemic patient and use uncross-matched group O negative product if an emergency bleed occurs ☐
- I don't know ☐

9. After a blood bag of packed red blood is received in the ward. What should be done to the unit?
   - Wrap it in a blanket, bedsheet or place it under patient's arm to warm it ☐
   - Transfuse it immediately and complete the transfusion within 4 hours ☐
   - Transfuse it immediately and complete the transfusion within 8 hours ☐
   - I don't know ☐
10. A patient presents with clinical features of anaemia but is otherwise hemodynamically stable. Complete blood count shows Hb of 6 g /dL and MCV of 60fl. What is the most appropriate action you would undertake?
    - Reassure the parents and send the patient home ☐
    - Transfuse with packed red celss and start oral iron ☐
    - Order iron studies and start oral iron ☐
    - I don't know ☐
11. When a patient develops signs and symptoms of an acute blood transfusion reaction, what would be the most appropriate action that you would undertake?
    - Administer antipyretics/corticosetroids, reduce the infusion rate and continue the transfusion ☐
    - Stop the transfusion immediately ☐
    - Administer antibiotics and continue the transfusion ☐

- I don't know

12. Which of the following is the most common cause of an acute hemolytic transfusion reaction?
    - Transfusion of emergency release uncrossmatched blood
    - Drug interaction with the blood product
    - Human error e.g Identification error of patient or mislabelling or specimens
    - I don't know
13. Which of the following statements accurately describe transfusion-related acute lung injury (TRALI) as a complication of transfusion?
    - TRALI has only been associated with products containing large amounts of plasma (e.g. platelets, fresh frozen plasma etc)
    - TRALI is most commonly associated with HLA or granulocyte antibodies in the transfusion recipient
    - By definition, TRALI occurs within 36 hours of transfusion
    - I don't know
14. A 53-year-old 75 kg man with liver failure has a Hb of 10g/dL, an INR of 1.5 and a platelet count of 150,000. The patient requires a thoracentesis. Which of the following is the best course of action prior to the procedure?
    - Transfuse PRBCs and FFP transfusion preoperatively
    - Transfuse platelet concentrate preoperatively
    - Proceed with the thoracentesis with no further action
    - I don't know

15. Which blood component has the highest risk of causing a septic transfusion reaction?
    - Platelets ☐
    - Packed red blood cells ☐
    - Whole blood ☐
    - I don't know ☐
16. How would you rate your overall level of knowledge in blood transfusion?
    - Poor ☐
    - Fair ☐
    - Good ☐
    - Very good ☐
    - Excellent ☐
17. How important for your practice/patient care is the knowledge on blood transfusion?
    - Not important ☐
    - Slightly important ☐
    - Moderately important ☐
    - Very important ☐
    - Extremely important ☐

<u>SECTION 6: ATTITUDE ABOUT BLOOD TRANSFUSION</u>

Please rate/ tick (✓) your level of agreement about the following statements on blood transfusion:

1= Strongly disagree, 2=Disagree, 3=Not sure/Undecided, 4=Agree, 5=Strongly agree

		Strongly	Disagree	Not sure	Agree	Strongly
i.	Donated blood is free, but there are significant costs associate with blood processing and administration					
ii.	As a clinician I understand the risks and costs of allogeneic transfusion, and because of this, I try to minimize the use of blood transfusion					
iii.	Consent for blood transfusion is implied and therefore there is no need to obtain one from the patient					
iv.	Presence of fatigue, weakness, dizziness, and pallor is a good indication for a blood transfusion.					
v.	Formulation and implementation of evidence based clinical practice guidelines reduce variation in blood use by medical doctors and promote practices in transfusion medicine					
vi.	The availability of blood components, the cost of a transfusion and awareness of transfusion guidelines would influence my transfusion decision					
vii.	Compared with red blood cells, platelet transfusions are associated with a lower risk of transmission of					

	diseases; hence I can use platelets without worries					
viii.	A patient with chronic kidney disease and a Hb of 8.8g/dL would make me decide to transfuse blood to patient					

SECTION 7: SELF REPORTED PRACTICE IN BLOOD TRANSFUSION

1. In your current practice, approximately, how often do you prescribe transfusion of blood components?
   - Never ☐
   - Once a year ☐
   - Once a month ☐
   - Once a week ☐
   - At least once per day ☐
2. *With regards to your current practice of blood transfusion, please indicate/ tick (✓)* ***the approximate frequency*** *with which you perform the following blood transfusion procedures*

1=Never, 2=Occasionally, 3=Sometimes, 4=Often, 5= Always

		Never	Occasionally	Sometimes	Often	Always
i.	Prescribe the right blood component to the right patient at the right time					
ii.	Use of haemoglobin (Hb) level as the sole deciding factor in starting a transfusion					
iii.	Complete the blood request form accurately and legibly, including the reason for transfusion					
iv.	Document/record the indication and the blood component to be transfused the medical notes and lab requests					
v.	Obtain verbal consent from each patient prior to transfusion (either yourself of a member of the team)					
vi.	Record evidence of this conversion (verbal consent) in the medical notes					

vii.	Obtain and correctly label blood samples for pre-transfusion compatibility testing					
viii.	Perform post transfusion Hb estimation					
ix.	Document the clinical outcome of the transfusion (e.g. improvement in symptoms)					
x.	Document the laboratory outcome of the transfusion (e.g. Hb increment)					

3. Have you used transfusion guidelines to guide your blood transfusion practice?
   - Yes ☐
   - No ☐
   - No sure ☐
4. If you have not used transfusion practice guidelines, how likely are you to use them if they are made available
   - Highly likely ☐
   - Likely ☐
   - Unlikely ☐
   - Very unlikely ☐

SECTION 7: CONFIDENCE IN PERFORMING BLOOD TRANSFUSION PROCEDURES

On a scale of 1-10, where 1 is not at all confident and 10 is totally confident, please tick (√) the number which best represents how confident you are in carrying out the following

		1	2	3	4	5	6	7	8	9	10
i.	Making the right decision to prescribe the right blood component to the right patient at the right time										
ii.	Prescribing the correct dosage of the blood components										
iii.	Obtaining an informed consent from a patient whom you have prescribed blood transfusion										
iv.	Obtaining and transporting pretransfusion samples										
v.	Administering blood transfusion via an IV line										
vi.	Recognizing a patient with an acute transfusion reaction										
vii.	Managing a patient with an acute transfusion reaction										

SECTION 9: ADDITIONAL TRAINING IN BLOOD TRASNFUSION

1. How useful for your practice would an additional training on blood transfusion be?
    - Not useful ☐
    - Slightly useful ☐
    - Moderately useful ☐
    - Very useful ☐
    - Extremely useful ☐

2. Which specific areas of blood transfusion would you like an additional training on? (Choose all that apply to you)
    - Blood donation- donor selection, donor counselling, donor deferral etc ☐
    - Blood components-types, preparation, storage, indications, triggers, dosage, contraindications ☐
    - Pre transfusion laboratory procedures e,g, blood grouping, crossmatching ☐
    - Bed side procedures prior to transfusion ☐
    - Complications of transfusion ☐
    - Appropriate use of blood components ☐
    - Alternatives to blood transfusion ☐
    - Patient blood management ☐
    - Special blood transfusion requirements ☐
    - Haemovigilance ☐
    - Organization of blood transfusion services in Kenya ☐

- Other____

  ____

  ____

  ____

  ____

3. Which mode of further training would you prefer to use for the additional training? (Choose all that apply to you)
   - Conferences/Workshops/Symposia ☐
   - Online short courses ☐
   - Face-to-face short courses ☐
   - CME/CPD ☐
   - Other--

     ----

4. Which aspects of blood transfusion would you recommend to be improved/included during undergraduate training?

   ……………………………………………………………………………………

   …………

   ……………………………………………………………………………………

   …………

   ……………………………………………………………………………………

   …………

…………………………………………………………………………………………

…………………………………………………………………………………………

……………………...

APPENDIX C: CONSENT

You are invited to participate in a study titled: ***Education in Blood Transfusion: AN Analysis of Curriculum Content and Knowledge, Perceptions, and Training Needs of Kenyan-Trained Medical Doctors***

The study is aimed at establishing the training needs for medical doctors in blood transfusion. Consent to participate will be implied by agreeing to complete the questionnaire and this is entirely voluntary. Please note that you are free to withdraw from the study at any time without having to provide a reason. Not taking part in or withdrawing from the study caries no penalty or repercussion of any sort.

The questionnaire is NOT MARKED IN ANY WAY FOR IDENTIFICATION AND NO IDENTIFYING DATA WILL BE COLLECTED. THE RESPONSES WILL BE TOTALLY ANONYMOUS and no one will be able to link your answers back to you. The questionnaire should only take approximately 10-20 minutes to complete. Once completed, the questionnaire will be returned to the principal investigator or research assistants and the contents of the completed questionnaire will only be viewed by our research assistant and the investigators.

Results published will have no identifying data and will be made available to participants. The study offers no benefit to participants, but may result in positive changes for the future geared towards quality training of medical doctors in blood transfusion and care of patients.

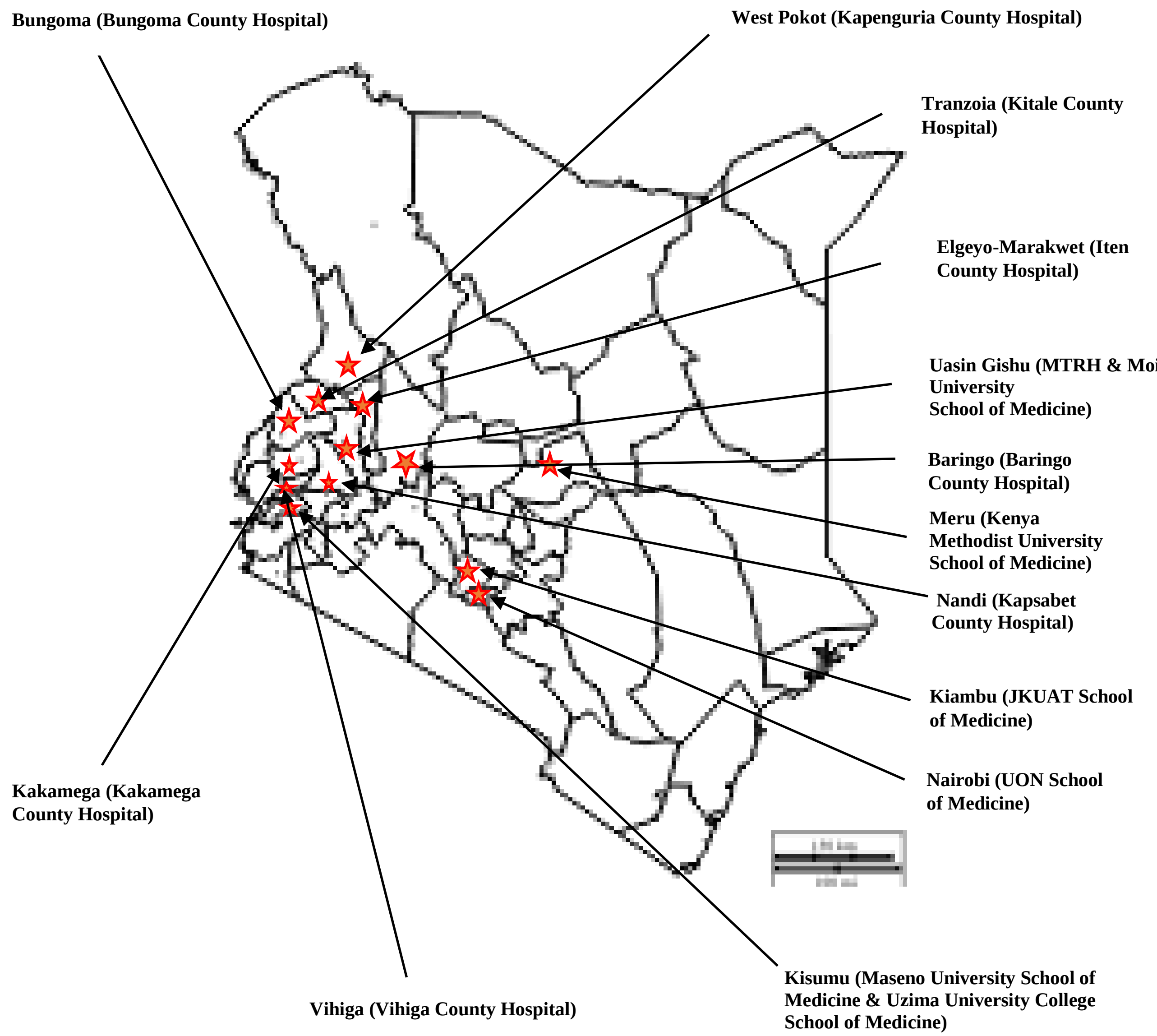
If you have any questions or concerns pertaining the survey please do not hesitate to contact Dr Japheth C. Kipkulei, 0714491991, jkipkulei@gmail.com

If you want to participate in the study, please sign below or click the **yes** button to start the survey.

__________________________ _______________

Signature Date

APPENDIX D: MAP SHOWING STUDY LOCATIONS



APPENDIX E: IREC CONTINUING APPROVAL LETTER

MTRH/MU-INSTITUTIONAL RESEARCH AND ETHICS COMMITTEE (IREC)

MOI TEACHING AND REFERRAL HOSPITAL
P.O. BOX 3
ELDORET
Tel: 33471/2/3

MOI UNIVERSITY
COLLEGE OF HEALTH SCIENCES
P.O. BOX 4606
ELDORET
Tel: 33471/2/3

25th August, 2021

Reference: IREC/2020/48
Approval Number: 0003650

Dr. Japheth Kipkulei,
Moi University,
School of Medicine,
P.O. Box 4606-30100,
ELDORET-KENYA.

Dear Dr. Kipkulei,

RE: CONTINUING APPROVAL

The Moi Teaching and Referral Hospital/Moi University College of Health Sciences- Institutional Research and Ethics Committee has reviewed your request for continuing approval to your study titled:-

"Education in Blood Transfusion: An Assessment of the Curriculum Content, Perspectives and Training Needs of Junior Medical Doctors in North Rift and Western Kenya".

Your proposal has been granted a Continuing Approval with effect from 25th August, 2021. You are therefore permitted to continue with your study.

Note that this approval is for 1 year; it will thus expire on 24th August, 2022. If it is necessary to continue with this research beyond the expiry date, a request for continuation should be made in writing to IREC Secretariat two months prior to the expiry date.

You are required to submit progress report(s) regularly as dictated by your proposal. Furthermore, you must notify the Committee of any proposal change (s) or amendment (s), serious or unexpected outcomes related to the conduct of the study, or study termination for any reason. The Committee expects to receive a final report at the end of the study.

INSTITUTIONAL RESEARCH & ETHICS COMMITTEE
25 AUG 2021
APPROVED
P.O. Box 4606-30100 ELDORET

Sincerely,

PROF. E. WERE
CHAIRMAN
INSTITUTIONAL RESEARCH AND ETHICS COMMITTEE

cc:	CEO	-	MTRH
	Principal	-	CHS
	Dean	-	SOM
	Dean	-	SPH
	Dean	-	SOD
	Dean	-	SON

APPENDIX F: IREC APPROVAL LETTER

INSTITUTIONAL RESEARCH AND ETHICS COMMITTEE (IREC)

MOI TEACHING AND REFERRAL HOSPITAL
P.O. BOX 3
ELDORET
Tel: 33471/2/3

MOI UNIVERSITY
COLLEGE OF HEALTH SCIENCES
P.O. BOX 4606
ELDORET
Tel: 33471/2/3

Reference: IREC/2020/48
Approval Number: 0003650

25th August, 2020

Dr. Japheth Kipkulei,
Moi University,
School of Medicine,
P.O. Box 4606-30100,
ELDORET- KENYA.

INSTITUTIONAL RESEARCH & ETHICS COMMITTEE
25 AUG 2020
APPROVED
P. O. Box 4606-30100 ELDORET

Dear Dr. Kipkulei,

EDUCATION IN BLOOD TRANSFUSION: AN ASSESSMENT OF THE PERCEPTIONS AND TRAINING NEEDS OF MEDICAL DOCTORS IN NORTH RIFT AND WESTERN KENYA

This is to inform you that ***MU/MTRH-IREC*** has reviewed and approved your above research proposal. Your application approval number is ***FAN: 0003650.*** The approval period is **25th August, *2020 – 24th August, 2021.***

This approval is subject to compliance with the following requirements;

i. Only approved documents including (informed consents, study instruments, MTA) will be used.
ii. All changes including (amendments, deviations, and violations) are submitted for review and approval by ***MU/MTRH-IREC***.
iii. Death and life threatening problems and serious adverse events or unexpected adverse events whether related or unrelated to the study must be reported to ***MU/MTRH-IREC*** within 72 hours of notification.
iv. Any changes, anticipated or otherwise that may increase the risks or affected safety or welfare of study participants and others or affect the integrity of the research must be reported to ***MU/MTRH-IREC*** within 72 hours.
v. Clearance for export of biological specimens must be obtained from relevant institutions.
vi. 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.
vii. Submission of an executive summary report within 90 days upon completion of the study to ***MU/MTRH-IREC.***

Prior to commencing your study; you will be required to obtain a research license from the National Commission for Science, Technology and Innovation (NACOSTI) https://oris.nacosti.go.ke and other relevant clearances. Further, a written approval from the CEO-MTRH is mandatory for studies to be undertaken within the jurisdiction of Moi Teaching & Referral Hospital (MTRH), which includes 22 Counties in the Western half of Kenya.

Sincerely,

DR. S. NYABERA
DEPUTY-CHAIRMAN
INSTITUTIONAL RESEARCH AND ETHICS COMMITTEE

cc	CEO	-	MTRH	Dean	-	SOP	Dean	- SOM
	Principal	-	CHS	Dean	-	SON	Dean	- SOD

APPENDIX G: NACOSTI RENEWAL LICENSE

REPUBLIC OF KENYA

NATIONAL COMMISSION FOR
SCIENCE,TECHNOLOGY & INNOVATION

Ref No: **743822**

Date of Issue: **09/April/2022**

RESEARCH LICENSE

This is to Certify that Dr.. Japheth Chebii KIpkulei of Moi University, has been licensed to conduct research in Baringo, Bungoma, Elgeyo-Marakwet, Kakamega, Kiambu, Kisumu, Meru, Nairobi, Nakuru, Nandi, Transnzoia, Uasin-Gishu, Vihiga, Westpokot on the topic: Education in Blood Transfusion: Assessment of Curriculum Content, Perceptions, and Training Needs of Medical Doctors in North Rift and Western Kenya for the period ending : 09/April/2023.

License No: **NACOSTI/P/22/16809**

743822

Applicant Identification Number

Director General
NATIONAL COMMISSION FOR
SCIENCE,TECHNOLOGY &
INNOVATION

Verification QR Code

NOTE: This is a computer generated License. To verify the authenticity of this document, Scan the QR Code using QR scanner application.

APPENDIX H: NACOSTI LICENSE

REPUBLIC OF KENYA

NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

Ref No: **803608**

Date of Issue: **02/December/2020**

RESEARCH LICENSE

This is to Certify that Dr.. Japheth Chebii KIpkulei of Moi University, has been licensed to conduct research in Baringo, Bungoma, Elgeyo-Marakwet, Kakamega, Nandi, Uasin-Gishu, Vihiga, Westpokot on the topic: Education in Blood Transfusion: An Assessment of Perceptions and Training Needs of Medical Doctors in North Rift and Western Kenya for the period ending : 02/December/2021.

License No: **NACOSTI/P/20/7875**

803608

Applicant Identification Number

Director General
NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

Verification QR Code

NOTE: This is a computer generated License. To verify the authenticity of this document, Scan the QR Code using QR scanner application.

APPENDIX I: RESEARCH PEERMIT FROM KEMU

Kenya Methodist University

P. O. Box 267-60200, Meru, Kenya, Tel: (+254) 724 256 162, 064-3131279/097 Email: vice.chancellor@kemu.ac.ke, Website: www.kemu.ac.ke

OFFICE OF THE VICE CHANCELLOR

REF: KeMU/A/VC/GEN.EXT.107/1 October 1, 2021

Dr. Japheth C. Kipkulei
Moi University
School of Medicine
College of Health Sciences
Mobile No: 0714 491 991
Email: jkipkueli@gmail.com

Dear Dr. Kipkulei

RE: <u>**REQUEST FOR INFORMATION FOR RESEARCH PURPOSE**</u>

Reference is made to the above subject matter.

Your request to be allowed to collect data from Dean and Faculty of the School of Medicine and Health Sciences for your research titled, *"Education in Blood Transfusion: An Assessment of the Perceptions and Training Needs of Medical Doctors in North Rift and Western Kenya"* at Kenya Methodist University has been approved.

Please note that only approved data forms are to be used in the enrollment of participants with their individual consent. All consent forms signed by subjects and/or witnesses should be retained on file. Further, any substantial changes in the scope of your research from what is presently provided will require an approval from the University.

For you request to access the MBChB curriculum, you are required to liase with the Dean, School of Medicine and Health Sciences for the Dean to determine the mode of access.

If the terms are acceptable to you, please sign a copy of this letter and return it to the Directorate of Research, Innovation and Extension as soon as possible.

Yours sincerely,

<u>PROF. DAVID GICHOYA, Ph.D</u>
VICE CHANCELLOR

I, the undersigned hereby confirm acceptance of this offer and the conditions stated herein.

Signed..Date....2/10/2021

APPENDIX J: RESEARCH PERMIT FROM UON

UNIVERSITY OF NAIROBI
OFFICE OF ASSOCIATE VICE-CHANCELLOR
(Research, Innovation and Enterprise)

P.O. Box 30197-00100
Nairobi, Kenya
Website: dvcrie@uonbi.ac.ke

Fax: +254-2-2317251
Email: avcrie@uonbi.ac.ke

UON/RIE/3/5/Vol.XX /

October 5, 2021

Dr. Japheth Kipkulei
Moi University
College of Health Sciences
School of Medicine
P.O Box 4606 – 30100
ELDORET
E-mail: jkipkueli@gmail.com

Dear Dr. Kipkulei,

PERMISSION TO COLLECT DATA

I refer to your request to collect data at the University of Nairobi, for your project entitled: **"Education in Blood Transfusion: An Assessment of the Perceptions and Training Needs of Medical Doctors in North Rift and Western Kenya".**

I write to inform you that your request has been approved, **but** for the MBChB curriculum you are advised to use already available in the public domain in our website.

You are however required to share the findings of your study with the University of Nairobi by depositing a copy of your findings with the Director Library & Information Services on completion of your study.

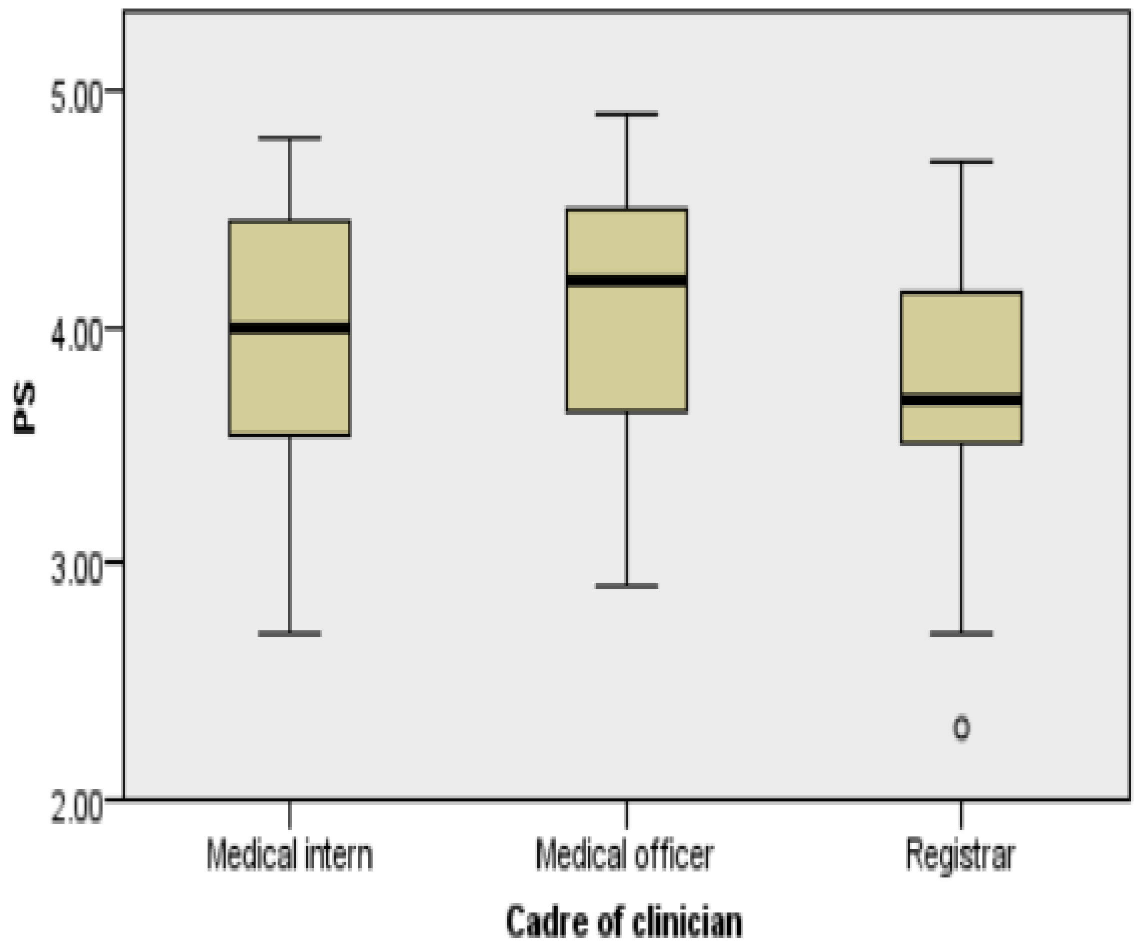
Yours sincerely,

MJHutchinson

PROF. M. JESANG HUTCHINSON
ASSOCIATE VICE-CHANCELLOR (AG.)
(RESEARCH, INNOVATION AND ENTERPRISE)
AND
PROFESSOR OF HORTICULTURE

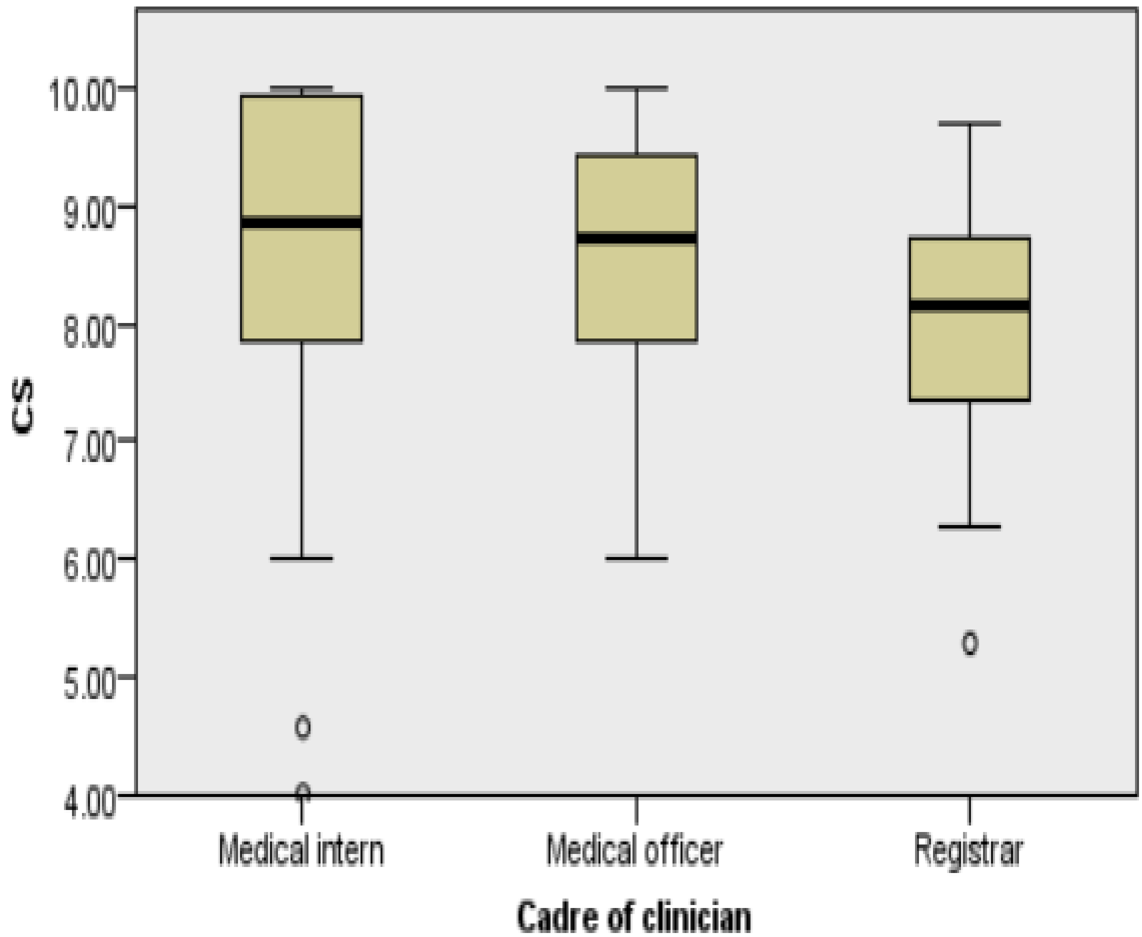
Copy to: Deputy Vice-Chancellor (AA)
Chairman, Department of Human Pathology
Dean, Faculty of Health Sciences
Director, Library and Information Services

APPENDIX K Box plot showing the distribution of self-reported practice scores according to the designation of the medical doctors



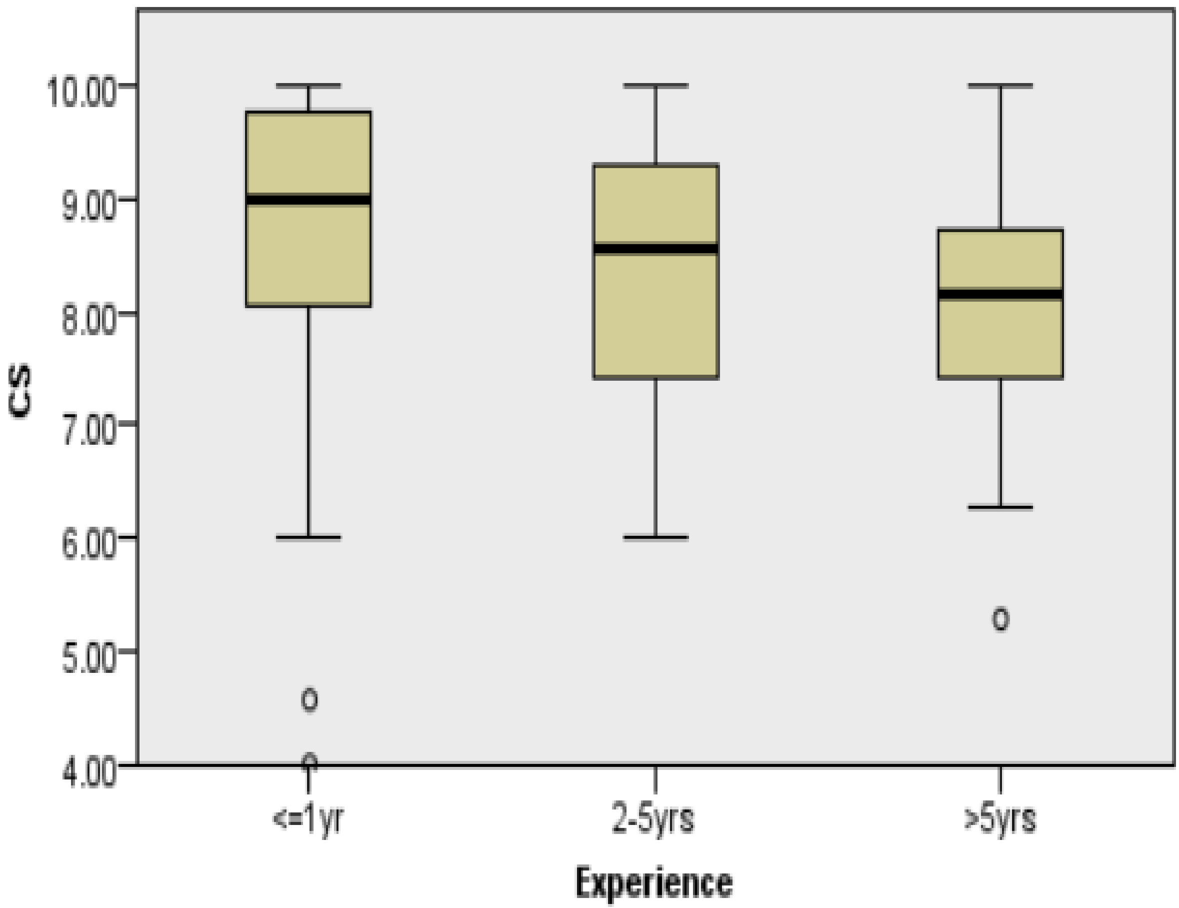
CS: Self-confidence score

APPENDIX L Box plot showing the distribution of self-confidence scores according to the designation of medical doctors



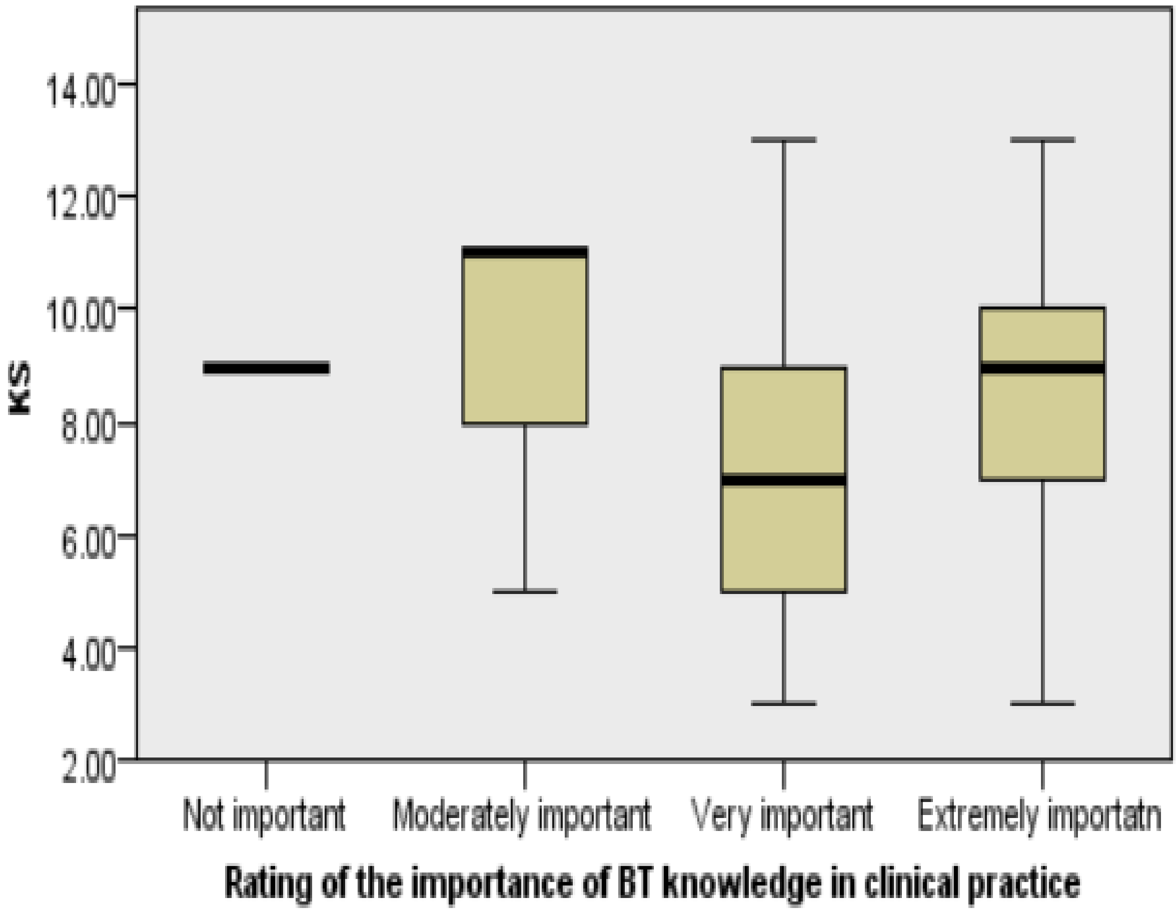
CS: Self-confidence score

APPENDIX M Box plot showing the distribution of confidence scores according to the experience of medical doctors



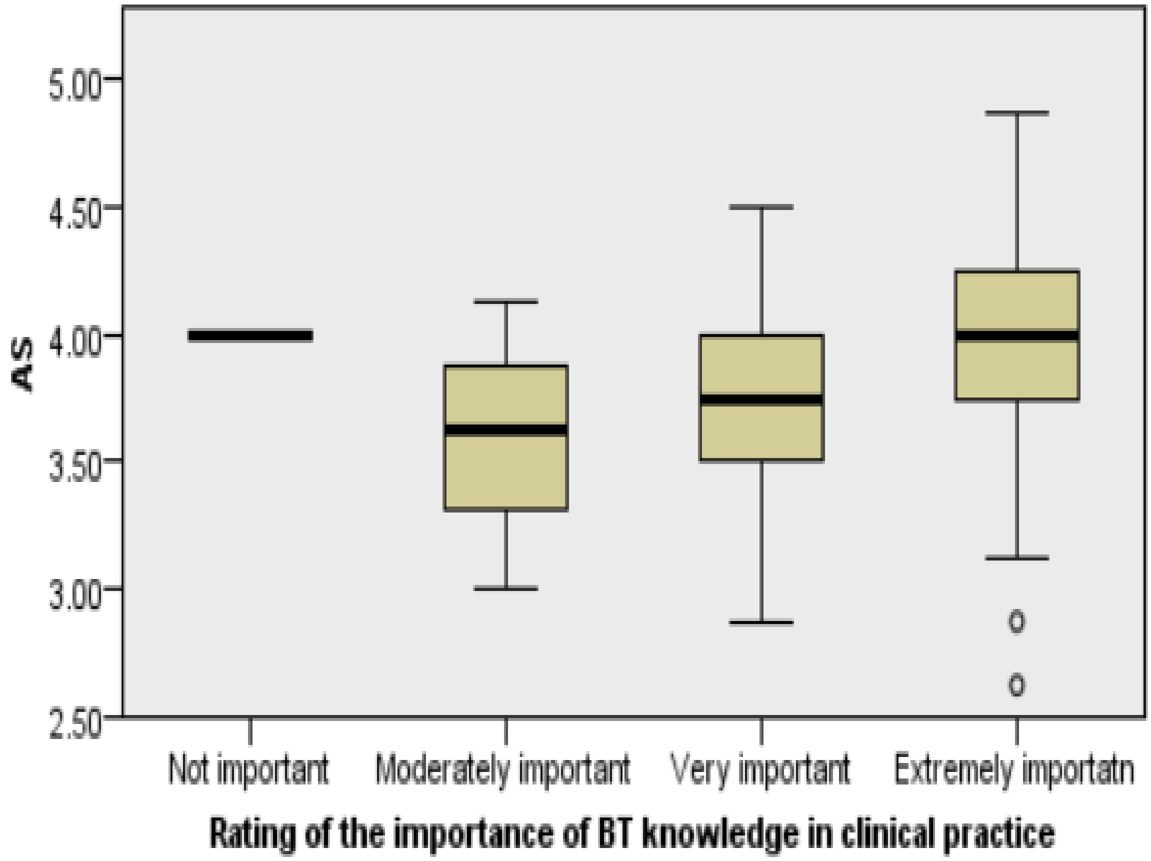
CS: Self-confidence score

APPENDIX N Box plot showing the distribution of knowledge scores according to the medical doctors rating of the importance of BT knowledge in clinical practice



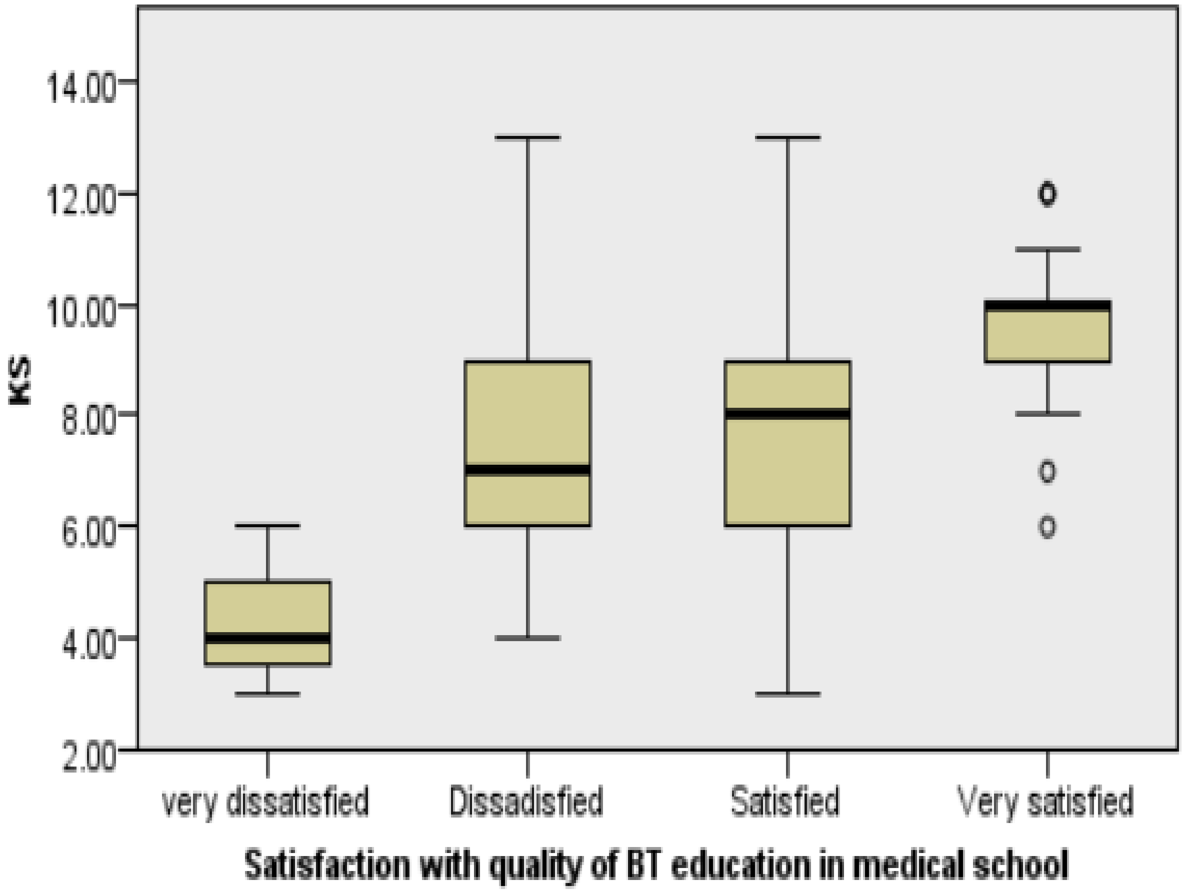
KS: Knowledge Score

APPENDIX O Box plot showing the distribution of attitude scores according to the medical doctors rating of the importance of BT knowledge in clinical practice



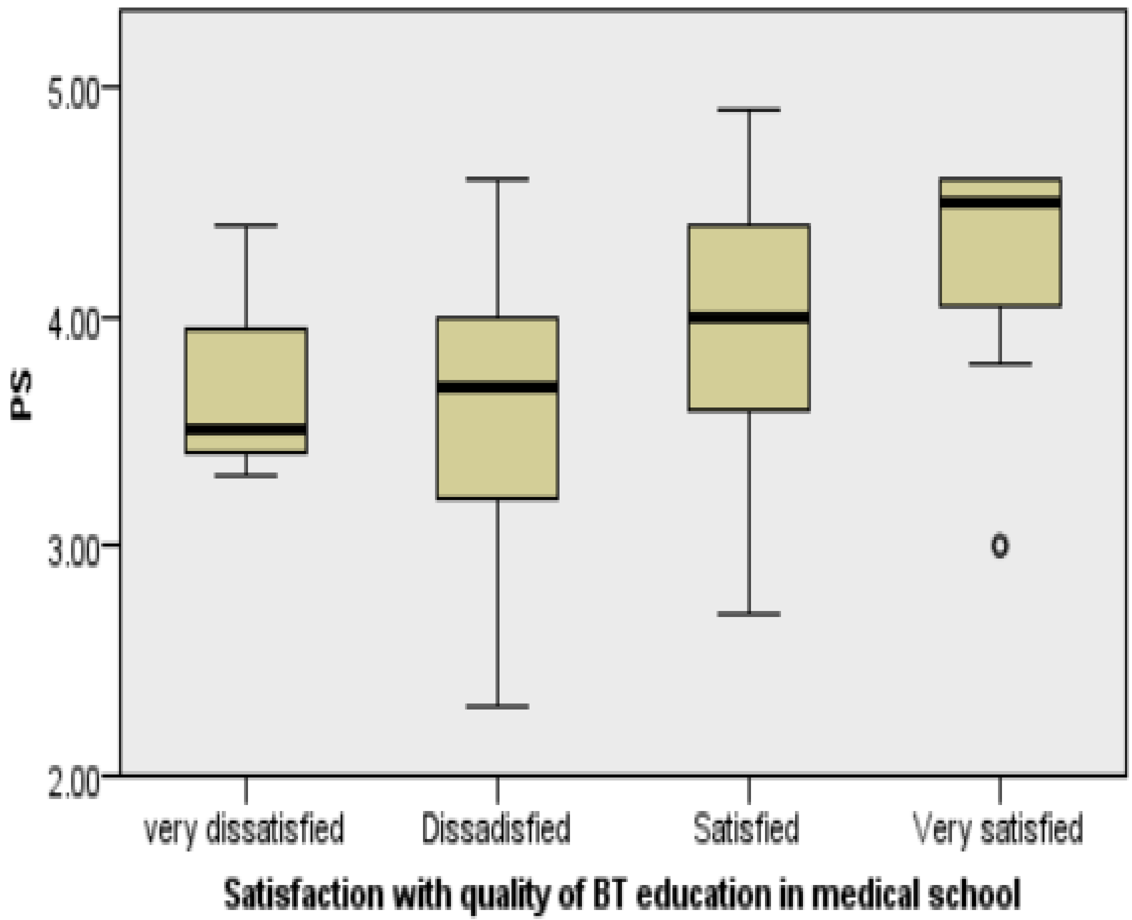
AS: Attitude Score

APPENDIX P Box plot showing the distribution of knowledge scores according to the medical doctors rating of their satisfaction with the quality of BT education in medical school



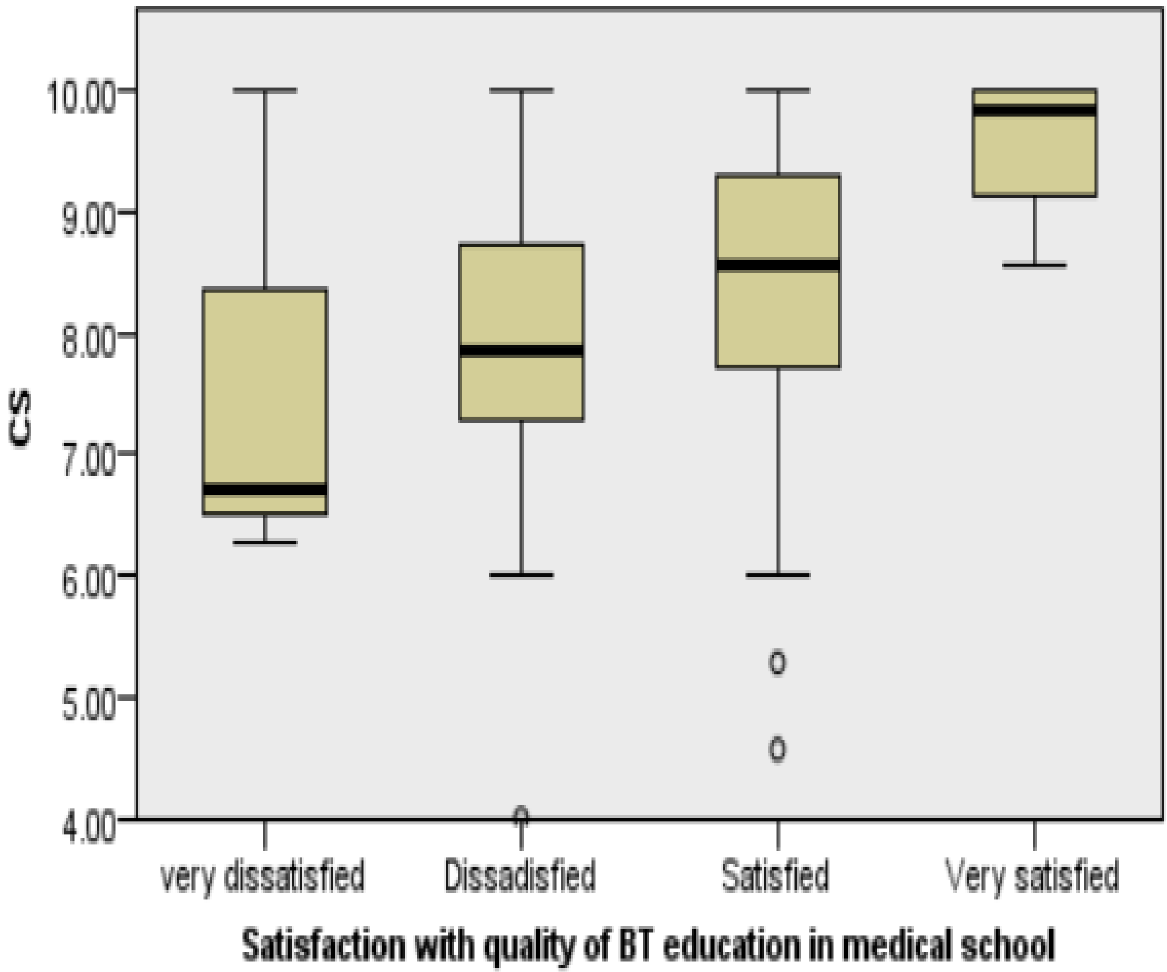
KS: Knowledge Score

APPENDIX Q Box plot showing the distribution of practice scores according to the medical doctors rating of their satisfaction with the quality of BT education in medical school



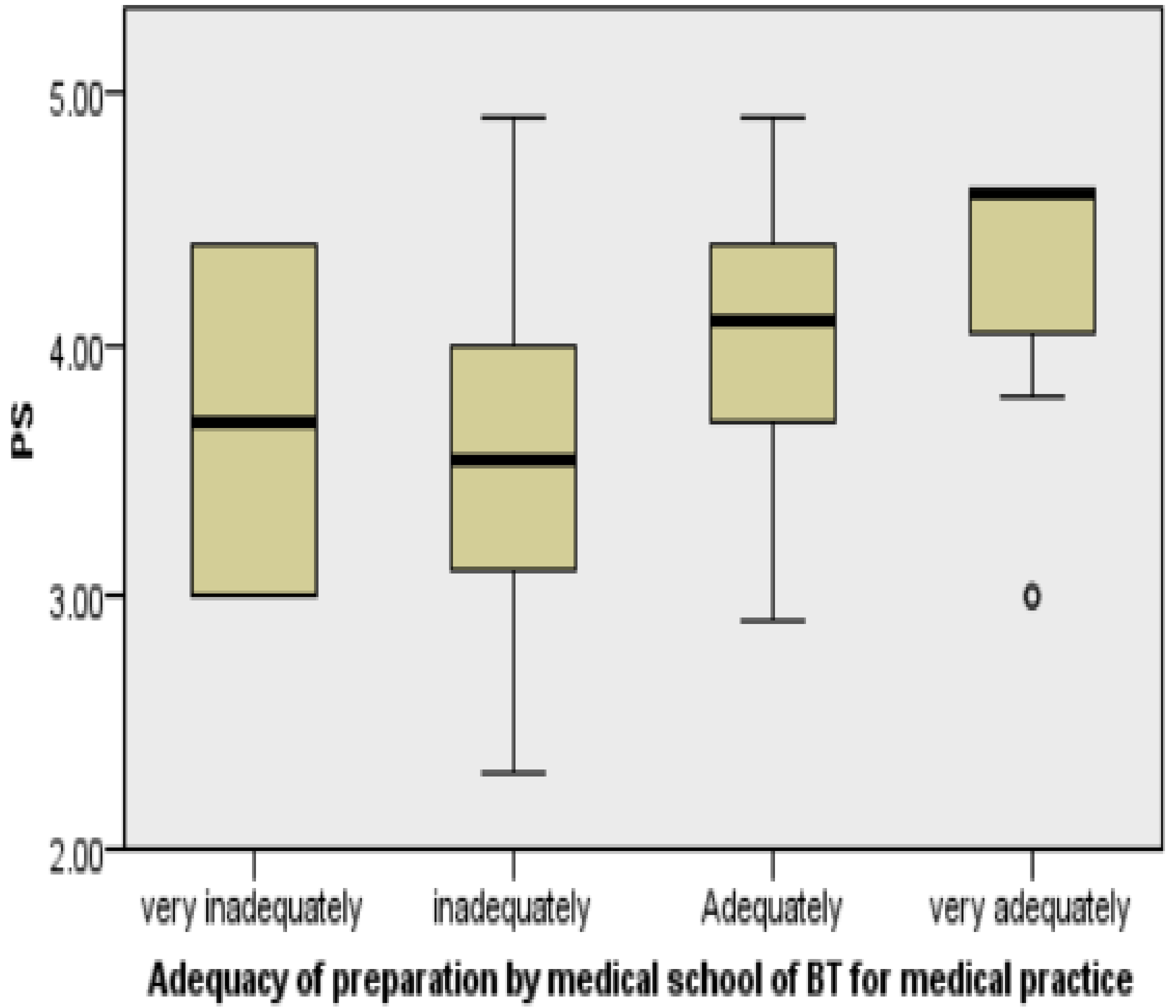
PS: Practice Score

APPENDIX R Box plot showing the distribution of confidence scores according to the medical doctors rating of their satisfaction with the quality of BT education in medical school



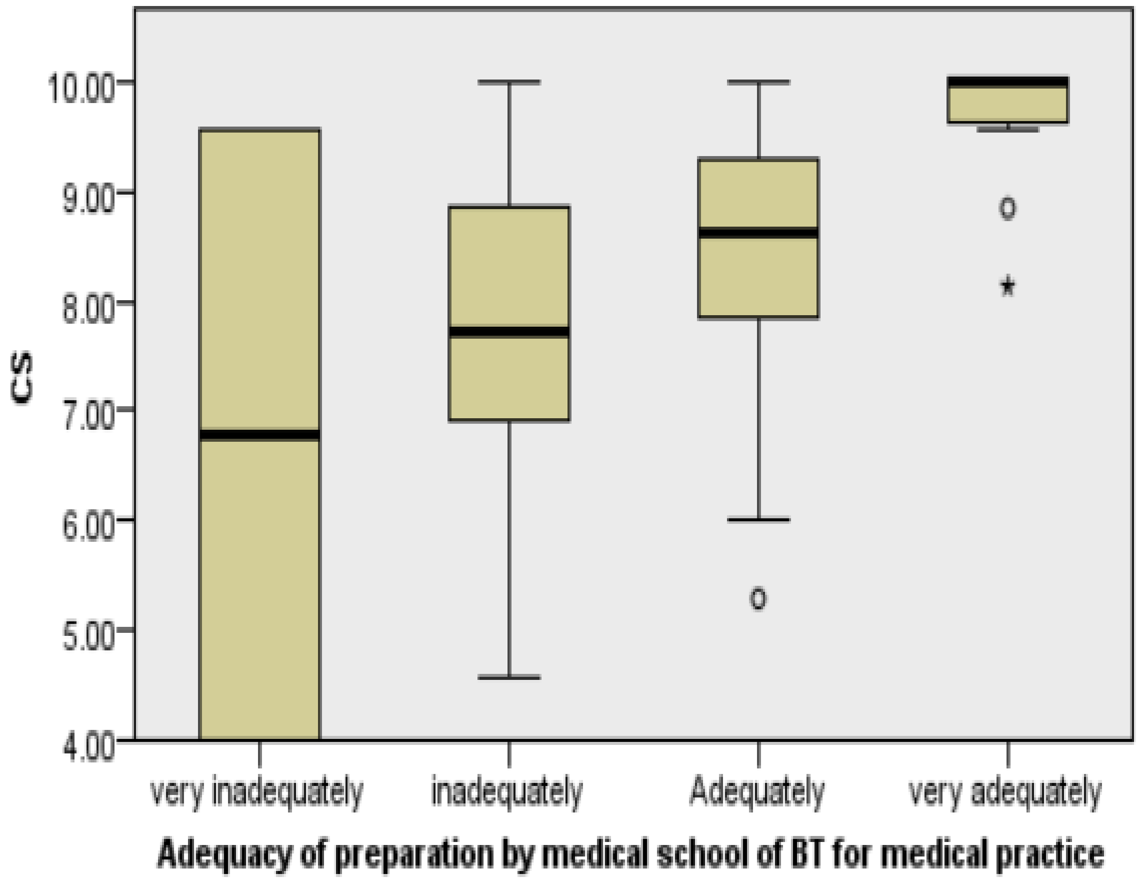
CS: Confidence Score

APPENDIX S Box plot showing the distribution of self-reported practice scores according to the medical doctors rating of the adequacy of preparation by medical of BT for medical practice



PS: Practice Score

APPENDIX T Box plot showing the distribution of confidence scores according to the medical doctors rating of the adequacy of preparation by medical school of BT for medical practice



CS: Confidence Score

APPENDIX U: ABSTRACT OF PUBLICATION 1

> Transfus Clin Biol. 2023 Nov;30(4):393-401. doi: 10.1016/j.tracli.2023.06.005. Epub 2023 Jun 29.

Education in blood transfusion: Adequacy of the content in the Kenyan undergraduate curricula and medical doctor's perspectives and perceptions

Japheth C Kipkulei [1], Richard B O Okero [2], Geoffrey K Maiyoh [3]

Affiliations + expand

PMID: 37392818 DOI: 10.1016/j.tracli.2023.06.005

Abstract

Background: Although blood transfusion (BT) service is important in modern health care, blood is scarce, costly, and without risks. Medical education should therefore play a role in equipping medical doctors with the necessary BT knowledge, skills, and attitudes for optimal utilization of blood. This study aimed at determining the adequacy of curriculum content of Kenyan medical schools and the clinicians' perceptions of undergraduate education in BT.

Methodology: A cross-sectional study was conducted among non-specialist medical doctors and the curricula of Kenyan medical schools. Data was collected using questionnaires and data abstraction forms and analyzed using descriptive and inferential statistics.

Results: Curricula from six medical schools and 150 clinicians were studied. All six curricula covered topics that are essential in BT and had the content integrated into the haematology course taught during the third year. The majority (62%) of the doctors perceived their knowledge of BT as being either fair or poor, and 96% reported that knowledge of BT was important to their clinical practice. The rating of perceived knowledge in BT was significant between the different cadres of clinicians ($H(2) = 7.891$, $p = 0.019$), and all participants (100%) acknowledged the usefulness of additional training in BT.

Conclusion: The Kenyan medical schools' curricula covered topics that are essential for safe BT practice. However, the clinicians felt that their knowledge of BT was not good enough and that they needed more training in the subject.

Keywords: Blood Transfusion; Curriculum; Medical Doctors; Perception; Undergraduate Medical Education.

APPENDIX V: ABSTRACT OF PUBLICATION 2

Open Access Library Journal
2023, Volume 10, e10330
ISSN Online: 2333-9721
ISSN Print: 2333-9705

Self-Reported Blood Transfusion Practices and Attitudes of Kenyan Medical Doctors

Japheth C. Kipkulei[1*], Geoffrey K. Maiyoh[2], Richard B. O. Okero[3], Simon Kangethe[4]

[1]Department of Pathology (Thematic Section of Haematology and Blood Transfusion), School of Medicine, Moi University, Eldoret, Kenya
[2]Department of Biochemistry and Clinical Chemistry, School of Medicine, Moi University, Eldoret, Kenya
[3]Department of Educational Psychology, School of Education, Moi University, Eldoret, Kenya
[4]Department of Family Medicine, Community Health and Medical Education, School of Medicine, Moi University, Eldoret, Kenya
Email: *jkipkulei@gmail.com, kattam@mu.ac.ke, okerorichard@gmail.com, simonkangethe12@gmail.com

How to cite this paper: Kipkulei, J.C., Maiyoh, G.K., Okero, R.B.O. and Kangethe, S. (2023) Self-Reported Blood Transfusion Practices and Attitudes of Kenyan Medical Doctors. *Open Access Library Journal*, **10**: e10330.
https://doi.org/10.4236/oalib.1110330

Received: June 2, 2023
Accepted: August 15, 2023
Published: August 18, 2023

Abstract

Background: Blood transfusion (BT) is important in modern health care. However, the clinicians who prescribe this life-saving, scarce, and costly resource have often been found to lack awareness of the best practices required for optimal and safe clinical use of blood components. This study aimed at determining the self-reported practices and attitudes of Kenyan-trained medical doctors in BT. **Methodology**: A cross-sectional study was carried out among eligible medical doctors, who were selected using a stratified random sampling technique. A questionnaire was used to collect data that was analyzed by way of percentages, mean and median, Kruskal-Wallis H, Mann-Whitney U, and Spearman correlation. **Results**: A total of 150 participants were studied, with a mean age of 29.9 ± 3.6 and a male to female ratio of 3:2. About 73.3% of the participants had a positive attitude towards the practice of BT with attitude being associated with having participated in training after undergraduate medical education ($p = 0.036$). Overall, only 43.7% of the self-reported procedures conformed to the recommended best practices, and practice competency was associated with the site of practice ($p = 0.007$) and the cadre of the clinicians ($p = 0.035$). There was no correlation between attitude and practice competency scores ($r_s = 0.053$, $p = 0.521$). **Conclusion**: The majority of the clinicians had a positive attitude towards BT, yet just above a third of their reported practices conformed to the best recommended practices. Participation in training after undergraduate medical education was associated with attitudes towards BT. There is therefore a need for additional education in BT in order to improve clinicians' awareness of the best practices in the field.