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

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A research report submitted to the Faculty of Health Sciences, University of the Witwatersrand, in partial fulfilment for the degree of Master of Medicine in Internal Medicine

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DECLARATION

I, Muhammad Laher, declare that this research report is my own work. It is being submitted for the degree of Master of Medicine in Internal Medicine in the Faculty of Health Sciences, University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination at this or any other University.

13 November 2017

DEDICATION

To Azraa, Asmaa and Aisha

ETHICS COMMITTEE APPROVAL

This research was approved by the Human Research Ethics Committee (Medical), University of the Witwatersrand on the 6th October 2014.

Clearance Certificate number: M140622 (see Appendix F).

ABSTRACT

Background

Rational and appropriate use of blood and blood products is important in a resource limited setting. Proper education is required in decision-making and management with regard to blood transfusion. Current knowledge status is required in order to identify target areas of teaching.

Objective

To assess the knowledge regarding blood and blood products among doctors of varying ranks at the University of the Witwatersrand affiliated academic hospitals.

Research design and methods

This is an observational, descriptive study using a self-administered questionnaire. The questionnaire was divided into sections covering areas of red blood cells, platelets, plasma products, consent, blood ordering and side effects with a total of 40 questions, approximately equally distributed in each of the above sections. A section on the demographics of the participants as well as an opinion section of how to impart further information was also included comprising of 2 questions each.

Results

A response rate of 33% was obtained from the distributed questionnaires. The average score obtained for the questionnaire was 61% amongst all the doctors. The consultants achieved the highest score of 64%. In comparison, the interns, who averaged 56%, achieved the lowest score. The medical officers and registrars both averaged 63%. The community service doctors averaged 58%. A similar gradient was seen across the different sections of the questionnaire.

Participants scored the best in the section pertaining to 'consent' with a score of 87%. The next best score (64%) was achieved for the section regarding 'side effects'. The section regarding 'red blood cell usage' and 'blood product ordering' was scored at 60%. The section with regards to 'platelets usage' achieved a score of 44%. The lowest score was achieved in the section regarding 'plasma product usage', i.e. 30%.

A statistically significant gap in knowledge was noted from intern up to medical officer level, after which the increase in knowledge up to consultant level was not found to be statistically significant.

Conclusions

The overall results obtained appear to be suboptimal and can be improved upon significantly. Formalized and on-going teaching around blood and blood product usage is required at the University of the Witwatersrand affiliated hospitals, at all levels, from interns through to consultants to ensure that this scarce, but invaluable resource is used judiciously and appropriately.

In addition, knowledge about ‘blood and blood product transfusion’ should be introduced into the medical curriculum and reinforced particularly in the clinical years. Postgraduates should receive on-going and more detailed education and training as they progress from interns to specialists in the different fields / branches of medicine.

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ABBREVIATIONS

2,3 DPG	2, 3 diphosphoglycerate
ABO	Blood groups
ATP	Adenosine Triphosphate
BRB	Blood on returnable basis
CCI	Corrected count increment
CHBAH	Chris Hani Baragwanath Academic Hospital
CMJAH	Charlotte Maxeke Johannesburg Academic Hospital
CMV	Cytomegalovirus
CNS	Central Nervous System
DIC	Disseminated Intravascular Coagulopathy
FFP	Fresh Frozen Plasma
HIV	Human Immunodeficiency Virus
HJH	Helen Joseph Hospital
HLA	Human Leucocyte Antigen
HPCSA	Health Professions Council of South Africa
IgA	Immunoglobulin A
IgM	Immunoglobulin M

ITP	Immune Thrombocytopaenia
IV	Intravenous
LDH	Lactate Dehydrogenase
RCC	Red Cell Concentrate
Rh	Rhesus factor
SANBS	South African National Blood Service
SHOT	Serious Hazards of Transfusion
TACO	Transfusion Associated Circulatory Overload
TRALI	Transfused Related Acute Lung Injury
TTP	Thrombotic Thrombocytopenic Purpura
VAT	Value Added Tax

CHAPTER 1: LITERATURE REVIEW

1.1 Introduction

The introduction of blood products into the field of Medicine is undoubtedly a landmark in scientific history. After a long and gruelling path of trial and error, experimentation and discovery dating as far back as the 17th century, the science of blood transfusion has reached advancements and achievements that have saved millions of lives over the years and has now become commonplace in modern Medicine (1).

Blood and blood products are prescribed for use in patients often without hesitation. However, like any other medical prescription, consideration has to be given to a host of factors surrounding its usage including adverse effects, cost, availability and administration complexities. These are not always advertised and easily referenced in a package insert. In order to make appropriate decisions weighing in applicable risks and benefits, knowledge of these finer details of blood and blood product administration should be (and is thought to be) known to the practitioners prescribing them. However, this project will investigate how accurate this belief is (in our local setting).

In a third world setting, appropriate management of this precious resource is particularly vital. South Africa has a host of challenges affecting blood supplies. To further compound low levels of voluntary blood donation and thus short blood supply

reservoirs, is the high demand of blood products owing to high rates of trauma, maternal morbidity and the scourge of blood borne diseases, particularly HIV and hepatitis infections, and to lesser extent other infections (2). These blood transmitted diseases have resulted in the adoption of donor screening and blood safety policies by the South African National Blood Service (SANBS), which limits the donor pool as well as the amount of blood deemed safe for transfusion after screening (2,3). Clinically significant cytopaenias are also more common in the HIV population, adding to the demand of blood products (4). These factors make it more important for practitioners to be cautious in the responsible and appropriate use of blood products.

In a 'rainbow society' such as South Africa, practitioners must always be mindful of ethical issues and contraindications that might obstruct the use of blood products and suitable alternatives must be considered. Supported by the National Health Act of 2003, which states that every patient has the right to participate in any decision affecting his or her personal health and treatment, practitioners need to be mindful of patient autonomy and diverse religious and cultural beliefs including Jehovah's Witnesses (5).

It is taken for granted as to when, how, and how much blood and blood products need to be prescribed by the doctor. Although there are no fixed criteria available to apply in decision making with regard to transfusions, there are always new guidelines being formulated to assist in this regard, as new information comes to the fore (6). This project plans to investigate whether medical doctors are keeping up to date with

current practice or if they are still practicing that which they have learnt and may be out-dated.

Transfusion medicine is gaining popularity as a sub-specialty throughout the world. The development of specialised transfusion medicine departments demonstrates the importance of having a basic understanding of blood products and it's usage. Introduction of transfusion protocols is an important step in standardizing management of blood and blood products. Many protocols and guidelines are in place for obstetric and surgical disciplines, but blood and blood product usage in internal medicine is rapidly growing and guidelines are being formulated, made available, and updated, especially in the developed world (6). In South Africa, the University of Free State now offers a post-graduate diploma in transfusion medicine. Despite this, currently there is limited information regarding publications on the knowledge of blood and blood product use in the South African context (7).

In conclusion, rational and appropriate use of blood and blood products is important in a resource limited setting. Proper education is required in decision-making and management with regard to blood transfusion. This project will investigate the adequacy in knowledge among medical doctors working at the University of the Witwatersrand affiliated teaching hospitals, in an attempt to identify if there is a need for undergraduate and postgraduate training in transfusion medicine.

1.2 Legal framework

Blood services and administering facilities are currently regulated in terms of Section 68 of the National Health Act 61 of 2003. This Act encompasses issues related to the use of licensed blood services, the standards of functioning and the regulation thereof; as well as the appropriate requisition and administration of the products (8).

1.3 Batho Pele Principles

The principle of Batho Pele ('People First') is an initiative of the South African government from the Mandela administration to ensure quality of public health services (9). These principles can be applied to all aspects of health care. Health care workers should be aware of these principles as it pertains to the use of blood and blood product transfusion.

- CONSULTATION: Patients should be consulted and their choices respected regarding transfusions.
- SERVICE STANDARDS: Clinicians should follow recommended guidelines where applicable.
- ACCESS: Blood and blood alternatives should be available for use.
- COURTESY: Patients should be treated with courtesy and consideration for their beliefs.
- INFORMATION: Patients should be given full and accurate information regarding transfusions.
- OPENNESS AND TRANSPARENCY: Patients should be aware of the things that are happening with their management.

- REDRESS: Complaints should be attended to and remedied effectively especially if the level of service is not achieved.
- VALUE FOR MONEY: Responsible usage of allocated resources to ensure that as many citizens as possible are treated.
- ENCOURAGING INNOVATION AND REWARDING EXCELLENCE: Blood product alternatives should be considered and sought when necessary.

1.4 Ethical considerations

Attention of the reader is drawn to the information provided in the Health Professions Council of South Africa (HPCSA) booklet. Written and verbal consent should be taken for all medical procedures, including all types of blood or blood product transfusion, as per guidelines provided by the HPCSA and in accordance to Chapter 2, Section 7 of the National Health Act 2003 (8, 10).

Informed consent implies that the patient be of sound mind and be appraised of all possible risks, benefits, methods, potential side-effects, and alternatives in a language the patient understands. Thus the doctor needs to be knowledgeable and keep up to date with all aspects of transfusion medicine to assist the patient through the process (10).

Doctors should accept the patients' decisions and be mindful of specific patients and their beliefs. For example, it is acceptable to some Jehovah's Witnesses to receive blood derivatives such as albumin, cryoprecipitate, coagulation factors and

immunoglobulin. However, they do not accept primary blood products such as red cells, platelets, and plasma (11). It is important to discuss the details with each patient in order to ascertain their personal beliefs and recognize and offer acceptable alternatives to blood transfusion (12).

1.5 Blood and blood products

Donated blood (whole blood) is packaged in a sterile technique into a sodium citrate containing container. This acts as an anticoagulant and pH buffer. Samples are centrifuged to separate red cell concentrates, the buffy coat layer (rich in leukocytes and platelets) and plasma (12). Centrifugation physically separates the plasma from the rest of the blood components. Blood products are usually separated both for different uses and for storage purposes as they have different lifespans ex-vivo (13). Additives such as adenine, glucose, saline and mannitol are added to red cell concentrates to increase the viability for extended storage (12).

Plasma components such as fresh frozen plasma and cryoprecipitate are obtained through centrifugation (14). Plasma derivatives such as albumin, immunoglobulin and factor VII and IX are obtained from multiple plasma donations (pooled plasma) through complex processing (12).

Red cell concentrates can be further filtered to remove more leucocytes after removal of the buffy layer. Leucodepletion helps to decrease the risk of febrile non-haemolytic transfusion reactions, to decrease the risk of Cytomegalovirus (CMV)

transmission and should be used in chronic transfusion regimens, massive transfusions, transfusions in infants and transfusions in patients at risk for CMV infection (12). Whole blood is rarely used nowadays. Indications include massive transfusions where all components are required.

1.6 Red blood cell Transfusion

1.6.1 Background

An understanding of the human circulation recorded as early as 1260 AD by an Arab scholar and physician Ibn Al Nafis, who, amongst various other medical subjects, documented vital descriptions of the pulmonary circulation (15). It was not until over two centuries later that William Harvey published descriptions of the human circulation. The earliest recorded attempts of transfusion were in the 1600's with animal experimentation and were soon prohibited due to fatal reactions. This gradually progressed to the first human-to-human transfusion in 1818 by James Blundell. The breakthrough discovery of blood groups (ABO) in 1900 and subsequently the suggestion of cross matching in 1907 heralded the beginning of safer transfusion practices. Rhesus (Rh) identification was another vital turn-point, occurring in 1939. The first blood bank was instituted in the United States in 1940 (16).

1.6.2 Aim

The aim of transfusion of red blood cells is to improve oxygen delivery to tissues when the demand for oxygen is not met (12). This can be due to acute blood loss or acute decompensation in a chronic anaemia.

1.6.3 Physiology

Impaired oxygen delivery due to hypovolemia or anaemia is initially tolerated through compensatory mechanisms, such as:

i. increased cardiac output
ii. increased oxygen offloading at the tissues due to increased red cell 2,3 diphosphoglycerate and due to decreased pH at the hypoxic tissues
iii. increases in plasma volume
iv. redistribution of blood flow to vital organs (12).

The use of crystalloids and colloids are usually the first choice in replacement fluids and are a vital alternative. However, when this form of intravenous fluid replacement is inadequate, red blood cell transfusion is often necessary. One unit of packed red cells can increase the haemoglobin level by 1-2 g/dl (12).

1.6.4 Indication

There are no well-defined criteria to describe the ideal level of haemoglobin at which to transfuse, and the use of a 'transfusion trigger' (i.e. haemoglobin concentration below which there is an indication for a transfusion) is variable and cannot be used as

the sole indicator of the need for transfusion (6). Most studies in particular involve pre- or post-operative or surgical cases. Data with regard to medical cases are fewer. General considerations are whether the patients are pre- or post- operative cases, prior to certain procedures, the chronicity of the anaemia and risks of cardiac failure or overload (12). A 2011 Cochrane systematic review of prospective randomized trials compared high versus low haemoglobin concentration thresholds of 19 trials including 6264 patients (17). The findings favoured a more restrictive approach i.e. the use of lower haemoglobin thresholds, in general less than 7 g/dl. The approach was well tolerated and decreased the need for transfusion thereby decreasing the risks and costs associated with it. There is little evidence of transfusing to haemoglobin levels above 10 g/dl. Haemoglobin levels between 8-10 g/dl are associated with low risks of hypoxic damage; however, the clinical picture should also be considered (12).

1.6.5 Apheresis and storage

About 300-350 ml of red blood cells are obtained from a single donor (18). The blood is stored in approved refrigerating units between 2 °C to 6 °C for up to 42 days (18). The 'storage lesion' refers to the changes that occur in the red cells during refrigeration and these include reduced life span, changes in red cell shape (due to reduction in ATP), reduced rigidity (due to reduced lipid content in the cell membrane), increased lactate and potassium in the solution, decreased pH, and increased free iron and haemoglobin in the solution. 2, 3 diphosphoglycerate (2, 3 DPG) is an organic phosphate that binds haemoglobin and facilitates oxygen delivery. Levels of 2, 3 DPG decline in storage, thereby increasing the oxygen affinity of haemoglobin, making it less likely to release the oxygen particles. This suboptimal

oxygen delivery in ill patients is thought to be a mechanism behind multi organ dysfunction, but is clinically unproven (13).

1.6.6 Administration

ABO and Rh compatible units are screened for irregular antibodies, cross-matched and issued. Informed consent should be obtained and careful monitoring should take place during and after the transfusion. The unit should be checked prior to transfusion for leaks and verifying the patient's details and the red cell details (including expiry date). Transfusion should be started within 30 minutes of removal from the refrigerator under aseptic technique through a blood administration set (12, 18).

The rate of transfusion depends on the clinical condition of the patient, where rapid transfusion may be appropriate for acute blood loss and slow transfusion (about 2ml/min) with the use of intravenous diuretics, may be applicable for patients likely to develop fluid overload (12). A relatively slow rate of 5 ml/min for the first 30 minutes is advised to check for reactions. Transfusion should occur over 2-4 hours and be completed within 6 hours of commencement of the transfusion (18).

Warming is indicated for massive or rapid transfusions, transfusions through central lines, hypothermia, patients with high titre cold haemagglutinins and for neonates undergoing exchange transfusion. Special blood warmers should be used. Blood should never be warmed above 37°C in order to prevent it haemolysing and causing renal failure. No medications or fluid should be given in the same line as the blood transfusion, in order to prevent reactions with the blood. The only fluids safe to

administer are calcium free solutions such as normal saline, modified Ringers lactate, Balsol, 4% albumin, compatible plasma and plasma protein fractions (12).

1.6.7 Red blood cell alternatives

No product to date has been found to replace blood in carrying out its function. The following have been tried with varying results:

- Intravenous or oral iron supplementation
- Haemopure
- Erythropoiesis stimulating agents with iron supplementation
- Autologous blood donation
- Blood salvage techniques

1.6.8 Products available and costs

The 2014 (19) and 2016 (20) pricelist is shown in Appendix A.

1.7 Platelet Transfusion

1.7.1 Background

Duke made a compelling discovery in 1910 describing the haemostatic effect of whole blood donations in thrombocytopenia (21). Platelet transfusions were recognized in the treatment of acute leukaemia from the 1950s (16). Advancements in medical knowledge and technology have led to better collection, preparation, storage, and infection control.

1.7.2 Aim

The aim of a platelet transfusion is to stop or prevent bleeding in patients with low platelet counts (usually severe thrombocytopaenia) or dysfunctional platelets.

1.7.3 Physiology

Therapeutic platelet transfusions should occur at a dose that would enable adequate haemostasis in active bleeding and efficacy measured by the clinical picture. Prophylactic platelet transfusions occur conventionally at a platelet level of less than $10x10^9$/l. The best measure of effectiveness is a 1 hour post transfusion platelet count, which should rise by at least 5 x 10^9 /l or rise above the threshold or 'transfusion trigger' (12).

Corrected count increment (CCI) can be calculated as:

$$\frac{\text{Platelet increment } x10^9 \text{ x body surface area } (m^2)\ x10^{11}}{\text{Platelet dose } x10^{11}}$$

A CCI greater than 7,5 – 10 x 10^9/l from a sample drawn 10 minutes to 1 hour after, or a CCI greater than 4.5 x 10^9/l 18-24 hours post transfusion is considered acceptable (i.e. not indicative of refractoriness). Anything less than these values will be considered ineffective.

Causes of refractoriness to transfusion can be divided into immune and non-immune causes. Non-immune causes include fever, sepsis, disseminated intravascular coagulopathy, drugs (such as vancomycin, amphotericin, heparin), hypersplenism, and age of the product/viability, veno-occlusive disease and bleeding.

Immune mediated causes include antibodies to ABO groups (also expressed by platelets), platelet specific antibodies and HLA allo-immunisation (usually in patients requiring multiple platelet transfusions). The risk of HLA allo-immunisation can be reduced by leucodepletion, UV-B irradiation of platelets, and by using single donor platelets, thereby limiting donor exposure. When allo-immunisation does occur, HLA matched platelets may be necessary (22).

1.7.4 Indication

A transfusion trigger that is generally recommended is a platelet count of less than 10 x 10^9 /l. This is however, for stable patients and this threshold may be higher in certain cases such as fever, sepsis, or rate of drop of platelet count. Procedures such as lumbar puncture, epidural anaesthesia, gastroscopy, or liver biopsy usually require counts above 50 - 70 x 10^9 /l. CNS and ocular procedures require levels above 100 x 10^9 /l (22).

1.7.5 Apheresis and storage

Platelets can either be collected from multiple whole blood donations or from single donor apheresis, which limits the donor exposure thereby decreasing the risk of HLA-alloimmunisation (12). This is useful in patients requiring chronic transfusions.

An important aspect of platelet transfusion is the continuous agitation of units during storage and transport. This is to prevent sedimentation, which would decrease the amount of oxygen accessible to platelets (22). Oxygen is vital to platelet metabolism. Platelets are stored at temperatures between 20-24°C, as temperatures below this cause cell damage (18). These temperatures however, increase the likelihood of

bacterial growth; therefore storage is limited to 3-5 days. The short storage period is also related to the short lifespan of platelets (12,18).

1.7.6 Administration

The platelet bag should be inspected and the contents should be a cloudy yellow/straw colour (12). It should be administered immediately after it is collected from the blood bank through a platelet administration set over a period of 15-30 minutes (17). Lines previously used for red cell concentrate transfusions should ideally be avoided. No medications or fluid should be given in the same line to prevent reactions with the platelets (12).

1.7.7 Platelet transfusion alternatives

The following have been investigated in the use for patients with low platelets but no definitive data is yet available on its efficacy.

- Microspheres
- Infusible platelet membranes
- Cryopreserved/lyophilized platelets

1.7.8 Products available and costs

The 2014 (19) and 2016 (20) pricelist is shown in Appendix A.

1.8 Plasma Transfusion

1.8.1 Background

The 1960's heralded the recognition of coagulation factor concentrates in the treatment of Haemophilia. By the 1980's, advances in medical knowledge and technology allowed the use of plasma components / products and exchange transfusion in the treatment of various coagulation and autoimmune disorders (16).

Because viruses are still transmissible via plasma, plasma donations in South Africa are 'donor retested' donations, which means that only blood from donors who donate subsequent donations are used as plasma products. Plasma components are derived from the centrifugation process. It is then rapidly frozen to -18°C to produce fresh frozen plasma with the normal constituents of blood in the body: coagulation factors, solutes. Plasma may be treated with methylene blue or ultraviolet light to inactivate transmissible viruses (12).

Cryoprecipitate is formed by thawing to 4°C and re-suspending in a small volume of plasma. It contains half the amount of factor VIII and fibrinogen when compared to whole blood. Six or more donors may be pooled for preparation of cryoprecipitate. The remainder is referred to as cryo-poor FFP or cryo-supernatant and is used for plasma exchange in Thombotic Thrombocytopaenic Purpura (TTP) (12,18).

1.8.2 Aim

Plasma products are used in cases of active bleeding to replace factor deficiencies, which may be single or multiple factor deficiencies. Plasma is also used to replace fibrinogen in cases of acquired coagulopathies such as Disseminated Intravascular

Coagulopathy (DIC) and in plasma exchange which may be a therapeutic modality in TTP and a myriad of autoimmune disorders.

1.8.3 Physiology

Fresh frozen plasma (FFP) is a hyperosmolar solution and care should be taken to prevent overload in at risk patients. The constituents of FFP include (12):

Table 1.1 Constituents of Fresh Frozen Plasma

Glucose	24.8 mmol/L
Potassium	3.2 mmol/L
Sodium	165 mmol/L
Chloride	79 mmol/L
Osmolarity	322 mmol/L
pH	7.9
Fibrinogen	500 mg/unit of FFP
Factor II	1.03 IU/mL
Factor V	0.64 IU/mL
Factor VII	1.21 IU/mL
Factor VIII	0.85 IU/mL
Factor IX	0.95 IU/mL
Factor X	1.25 IU/mL
Factor XII	0.79 IU/mL
Anti-thrombin III	104 IU/mL
Plasma pseudo-cholinesterase	3000 - 10000 IU/mL

Cryopreciptate contains:

- Factors VIII
- von Willebrands Factor
- Fibrinogen
- Fibronectin
- Factor XIII.

1.8.4 Indications

FFP: may be used to treat coagulation deficiencies such as in liver failure, massive transfusions or warfarin toxicity. It may also be used in DIC and TTP with active bleeding and abnormal coagulation tests (12,18). FFP may also be used in single factor deficiencies if specific factors are not available (12).

Cryoprecipitate: may be used in patients with congenital or acquired hypofibrogenaemia (laboratory value less than 1g/l) or dysfibrinogenaemia (12,18).

Cryopoor FFP: may be used in plasma exchange in TTP (12).

Pathogen reduced plasma: should ideally be used for massive or repeated transfusions to decrease the risk of transmissible diseases (12,18).

1.8.5 Apheresis and storage

Plasma from single donors is collected and frozen within 6 hours. It is stored at -25°C or lower for up to 1 year (18).

1.8.6 Administration

Plasma is usually clear to straw coloured (12). It must be infused within 6 hours of thawing, at temperatures between 30°C to 37°C through a blood administration set, as rapidly as possible (18).

The usual dose of FFP is 10-15ml/kg. However, in TTP a dose of 30-40ml/kg is used.

The dose of cryoprecipitate is 1 unit/10kg body weight (18). It is usually available in 15 ml units.

1.8.7 Plasma transfusion alternatives

A variety of recombinant factors are now available, such as factor seven, eight, nine, etc., with many still in development.

1.8.8 Products available and costs

The 2014 (19) and 2016 (20) pricelist is shown in Appendix A.

1.9 Important points regarding the ordering of blood and blood products

Due to resource limitations and possible risks of transfusions, practitioners have the responsibility to order and administer blood appropriately. This means that once it has been ascertained that the transfusion is necessary or could become necessary, after obtaining consent, the right blood should be ordered and administered to the right patient, at the right time, in the right setting.

1.9.1 Ordering

When ordering blood or blood products, the practitioner should be mindful of how soon the product is needed and weigh the benefits and risks of issuing blood that is not cross-matched. Blood specimens, colloquially referred to as a 'compat', is sent to the blood bank for typing (determining ABO and Rh blood group), screening (for irregular antibodies) and cross matching (patient serum with donor red cells to check compatibility) for blood transfusion (12, 13).

Emergency blood consists of Group O blood that is not screened or cross-matched and can be issued immediately within 5-10 minutes. Emergency cross-match consists of ABO and Rh typing and minimum irregular antibody screening requires 20 - 30 minutes to issue. Standard cross-match consists of ABO and Rh typing, screening for irregular antibodies as well as cross-matching with donor blood and is done within 2 hours. It can be kept for up to 24 hours. Type and screen blood is only screened for ABO, Rh and irregular antibodies and not yet cross-matched until it is requested. It can be kept for up to 72 hours (23).

Platelets also express ABO antigens and transfusions should ideally be ABO compatible. However, ABO incompatible platelets may be used if the patient is unlikely to receive repeated transfusions. Repeated transfusions result in an increase of anti-A and anti-B titres and a resultant decrease in post transfusion platelet count (12).

Plasma should preferably also be ABO compatible. If compatible blood is

unavailable, blood from a different blood type can be used if there are low titre antibodies (12). Only Group O plasma should be used for blood type O patients.

1.9.2 Administration

Care should be taken to administer the blood to the right patient. The patient should be identified verbally if possible as well as by the hospital identification tags. The blood or product bag should be checked for leaks or suspected contamination, and the information label inspected to confirm that it is the right blood. The blood type should be compared with previous transfusions, and the expiry date should be checked. It should be given at the correct temperature in the correct time frame and through an appropriate administration set. The patient should be monitored before, during and after transfusion by charting the temperature, pulse rate, respiratory rate and general condition (12, 13).

1.10 Potential adverse effects of blood transfusion

An adverse transfusion reaction can be defined as any undesirable event related to the transfusion of blood or blood products either as a direct result or as an interaction between the recipient and the product (12). Haemovigilance is a vital component in transfusion medicine and encompasses monitoring of the entire chain of events from donation to transfusion; as well as surveillance of adverse events and reactions related to transfusion of blood and blood products. Ensuring 'blood safety' is key to the ethical concept of 'do no harm' and haemovigilance is a legal requirement in terms of the National Health Act 61 of 2003 (8). The South African Haemovigilance system is a relatively young system, which was initiated in 1999-2000. As such, it has shown

increasing levels of reporting over the years as the amount of issues increase as well as education and collaboration between all involved parties improve (24).

In 2014, at the time of the distribution of the questionnaire, about 1 million units of blood and blood products were issued in South Africa. The reported rate of transfusion reactions was 83.5 per 100 000 issues. Acute events were the most common (67.6%). Below is a table reflecting the distribution of adverse events secondary to blood transfusions as per the SANBS, for the year 2013 (24).

Table 1.2 Distribution of Adverse Events due to Blood Transfusions in South Africa for 2013 (24)

Adverse event	Rates per 100 000 units issued
Acute Transfusion Reactions - total	78.2
Acute Haemolytic Transfusion Reaction	0.9
Allergic Reactions	19.8
Severe Allergic Reactions	2.0
Anaphylactic Reactions	4.6
Febrile Non-haemolytic Transfusion Reactions	30.1
Transfusion Associated Circulatory Overload	0.3
Transfusion Related Acute Lung Injury	0.2
Transfusion Associated Dyspnoea	6.9
Hypotensive Reactions	4.9
Unclassifiable (Incomplete information)	8.3
Unclassifiable (No forms)	0.3

Delayed Transfusion Reactions – total	0
Delayed Haemolytic Transfusion Reactions	0
Delayed Serological Reactions	0
Incorrect blood components transfused - total	3.0
ABO Incompatible Transfusions	1.0
Misdirected Transfusions	0.6
Patient Misidentifications	0.9
ABO + Rh Incompatible Transfusions	0.5
Other reactions – total	2.3
Near Miss	0.7
Transfusion Associated Graft versus Host Disease	0.0
Transfusion Transmitted Infections	0.2
Post Transfusion Purpura	0.0
Mortality	1.4
TOTAL	83.5

Of note, the United Kingdom Serious Hazards of Transfusion (SHOT) Haemovigilance report for 2013 found that 77.8% of reactions occurred due to avoidable errors at any point of the transfusion chain, whereas SANBS recorded only 3.6% due to incompatibilities or misidentifications (24). This implies that better surveillance is required across the entire process of blood donation, processing and transfusion.

On suspicion of a reaction, one should:

- Stop the transfusion immediately.
- Maintain IV access, but change the administration set.

- Investigate further by returning the unit/bags/administration set to the blood bank, filling out an adverse event form and sending blood and urine specimens to the blood bank.
- Monitor and treat any resulting complications.
- Any serious or life threatening event must be reported to the Director-General by the blood bank in terms of the National Health Act (12).

Adverse reactions can be grouped into acute or delayed reactions, and immune or non-immune reactions, as shown in table 1.3.

Table 1.3 Classification of adverse reactions to blood transfusions

Reaction	Immune	Non-immune
Acute (less than 24 hours)	Acute haemolytic transfusion reactions	Bacterial contamination
	Febrile non-haemolytic transfusion reactions	Transfusion-associated circulatory overload
	Anaphylactic reactions	Thrombophlebitis
	Allergic reactions	Air embolism
	Transfusion-related acute lung injury	
Delayed (more than 24 hours)	Delayed Haemolytic Transfusion reaction	Transfusion transmissible infections
	Post transfusion purpura	Iron overload
	Transfusion associated graft versus host disease	

1.10.1 Acute reactions

These are reactions that occur up to 24 hours of receiving a blood or blood product transfusion (18). Fevers, chills, pruritus or urticaria are most commonly encountered and usually resolve without intervention (6).

1.10.1.1 Acute intravascular haemolysis

The transfused red blood cells are destroyed, either intravascularly or extravascularly. Accidental transfusion of incompatible products is the most common cause (ABO mismatch) (6). There is a spectrum of clinical effects ranging from fever, back pain, anxiety, hypotension and chest pain as well as DIC and renal failure (6,12). These systemic manifestations are thought to occur due to the complement activation by the IgM antibodies and thus causing red cell lysis. Laboratory evidence may show a fall in haemoglobin, raised lactate dehydrogenase (LDH) and a positive Coombs test (25).

1.10.1.2 Febrile non-haemolytic transfusion reaction

There is an increase in body temperature of $> 2^{o}C$, or an isolated fever $> 38^{o}C$, with no features of allergy or haemolysis. This may be caused by passively transfused cytokines or a reaction to the recipient's antibodies or leukocytes from the donor's blood. This is commonly found in multiparous or multi-transfused patients. They present very similar to a patient with acute haemolysis but have no laboratory evidence of haemolysis (6).

1.10.1.3 Anaphylaxis

Anaphylaxis may be suspected when one of the following is associated with hypotension: urticaria, rash, dyspnoea, angioedema, stridor, wheeze or pruritus. This is associated with antibodies to IgA (6). Adrenalin and steroids may be required (6,12). When muco-cutaneous symptoms occur without the above-mentioned symptoms, it is called an allergic reaction. This can be treated with antihistamines (12).

1.10.1.4 Bacterial contamination

Rapid onset of signs of sepsis, such as fever, hypotension, gastroenteritis, renal failure and shock, may suggest contaminated blood products, most commonly platelets, due to aforementioned high storage temperatures favouring bacterial growth (12).

1.10.1.5 Transfusion associated lung injury (TRALI)

Within four hours of initiating the transfusion, recipients develop fever, hypotension, tachypnoea and dyspnoea. A chest x-ray shows diffuse bilateral pulmonary infiltrates with a clinical impression of non-cardiogenic pulmonary oedema. Acute hypoxia is associated without left atrial hypertension (6). It is far more severe than pulmonary oedema. This is due to leukocyte agglutinins, which is present in donor blood (6, 12). A two-hit hypothesis is suggested for this to occur: first the neutrophils need to adhere to the pulmonary endothelium, and then activation of the neutrophils causes endothelial damage. The acute parenchymal damage caused is reversible. Supportive management is sufficient but ventilation might be required in severe cases.

Multiparous female donors increase the risk for the development of TRALI, but screening to exclude such at risk donors is difficult to implement practically (25).

1.10.1.6 Transfusion associated circulatory overload (TACO)

TACO occurs when the patient cannot cope with the rapid volume expansion due to underlying cardiac pathology or chronic anaemia. Four of the following features are required for the diagnosis of TACO:

- Acute respiratory distress
- Tachycardia
- Increased blood pressure
- Pulmonary oedema
- Positive fluid balance

Fluid overload needs to be managed appropriately. This can be prevented by slower infusion rates in suspected individuals as well as use of diuretics during transfusion (12).

1.10.2 Delayed reactions

These are reactions that occur after 24 hours of receiving a blood or blood product transfusion.

1.10.2.1 Delayed intravascular haemolysis

Delayed intravascular haemolysis is caused by destruction of transfused red blood cells, due to exposure to atypical IgG antibodies (anti-Kell, anti-Duffy, etc.) from the donor (12). It usually presents with a drop in haemoglobin after the transfusion, which can also have other clinical implications such as auto-immune haemolytic anaemia, renal failure and occult bleeding. It usually occurs in individuals that have been immunized to red cell antigens, making its occurrence more common in females and previously transfused males. This can occur up to 28 days after the transfusion. Treatment is of a supportive nature (25).

1.10.2.2 Transfusion associated graft vs. host disease

transfusion of blood from a related donor can lead to bone marrow hypoplasia developing within a month after receiving the transfusion. This is due to allogeneic lymphocytes from the donor that share an HLA haplotype with the recipient (12). Lymphocytes proliferate and destroy host cells (18). Irradiating the blood of close family member donors can prevent this condition, as leucodepletion is not considered adequate in preventing this reaction (12,18). Patients present with jaundice, maculopapular rash, bone marrow hypoplasia and diarrhoea and will require specialized oncological / haematological care.

1.10.2.3 Post transfusion purpura

Mucosal bleeding, haemorrhage and purpura on pressure areas that occur due to thrombocytopenia developing approximately 2 weeks after transfusion is known as post transfusion purpura. This is due to recipient alloantibodies against donor platelet

antigens directed against the Human Platelet Antigen system (12). It is more common in females. Immunosuppressive therapy in the form of intravenous gamma globulin and steroids is required in the treatment of this condition (25).

1.10.2.4 Transfusion Transmissible Infections

The blood bank screens all donations for HIV, Hepatitis B and C, and syphilis (12). Only 2 cases of transfusion-transmitted infections were reported in 2014.

Any infection in which a microbe circulates in the blood stream and is able to survive in stored blood components can be transmitted by transfusion. Of note are the following infections (25):

Viral: Cytomegalovirus, Ebstein-Barr virus, Parvovirus, Human T-cell lymphotropic virus 1 & 2.

Bacterial: Yersinia Enterolitica, Staphylococcus epidermidis, Pseudomonas.

Parasites: Malaria, Trypanosoma, Babesia, Borrelia.

Prion: Creutzfeldt-Jacob disease.

1.10.2.5 Massive transfusion

A massive transfusion is defined as one of the following (26):

- Infusion of five or more red blood cell concentrates within 4 hours
- Infusion of six or more red blood cell concentrates within 12 hours
- Infusion of 10 or more red blood cell concentrates within 24 hours

Due to the biochemical and functional characteristics of the red cell concentrate units the following potential complications can occur:

Coagulopathy: The platelet count is inversely proportional to the number of units transfused. This is due to the dilutional effect of the transfused blood. In order to try and achieve haemostasis, the body also consumes platelets and coagulation factors (25).

Hypothermia: The transfusion of large amounts of rapidly infused cold blood causes the energy requirements to be increased in an effort to raise the body temperature. This increases the oxygen affinity of the haemoglobin, impairing citrate and lactate metabolism and promoting potassium release from the intracellular space. Warming blood in this instance is thus imperative (25).

Hyperkalaemia: This is usually secondary to large transfusions of whole blood or blood older than 5 days, due to the inactivity of sodium-potassium-ATPase pump at storage temperatures and resultant gradual increase in extracellular potassium (18).

Hypocalcaemia: This is due to citrate toxicity in large transfusions. It occurs due to the citrate additive that acts as a chelator of calcium (18).

Hyperglycaemia: This is due to the glucose additives in the blood bag (12,18).

Acid-base balance: Due to the presence of lactic acid and citric acid in the stored blood, there is a high acid load, which may exaggerate an already present metabolic acidosis from the bleeding and shock. Alkalinizing agents give a high sodium load, which can further impair oxygen release and thus these agents need to be administered based on results rather than arbitrarily (25).

Assessment of learning needs is an integral part of furthering education, but each group of people have their own learning needs, with the outcome needing to reach the same end point (27). Identifying what the needs are is helpful in planning further education in a way that recipients find appropriate.

A recent study was conducted at Chris Hani Baragwanath Academic Hospital in the surgical specialties including Obstetrics and Gynaecology, Anaesthetics, Orthopaedics and General Surgery. It set out to assess the knowledge and competencies related to blood and blood products among this group of clinicians and found significant deficits in awareness of risks, consent, costs, ordering and administration protocols (28). This study aims to assess similar themes in the Medicine department (see section 2.2, page 31).

Knowledge regarding transfusion medicine is deficient in both first and third world countries (29). Very few questionnaires have been validated although many have been formulated. The questions in this study have been extrapolated from a validated questionnaire to make it comparable to international studies (30).

CHAPTER 2: METHODS

A carefully formulated questionnaire, identifying key areas of knowledge around usage of blood and blood products, was circulated among the doctors in the Department of Medicine at the three University of the Witwatersrand affiliated hospitals, i.e. Charlotte Maxeke Johannesburg Academic Hospital, Chris Hani Baragwanath Academic Hospital and Helen Joseph Hospital. Doctors were then given an opportunity to complete the questionnaire, after agreeing to participate, and to return the completed questionnaire for review and collection. Participant's responses were collated using Microsoft Excel spread sheets. This was then analysed and put into graphs and tables to facilitate interpretation of the answers.

2.1 Study Design

A prospective, descriptive, contextual study design was used.

2.2 Aims and objectives of the study

- To determine the knowledge that exists about blood and blood products, including indications for its use, the correct ordering patterns, cost, side effects, and safe administration using a self-administered questionnaire. Understanding and consideration of ethical issues surrounding administration of blood and blood products, and available alternatives were also included in the questionnaire.

- To assess gaps in knowledge of doctors with regard to factors mentioned above and to identify targets of potential education and improvement.

2.3 Study Population

The study population included doctors at all levels of qualifications, namely interns, community service doctors, medical officers, registrars and consultants, in the Department of Medicine at the University of the Witwatersrand affiliated hospitals, i.e. Charlotte Maxeke Johannesburg Academic Hospital, Chris Hani Baragwanath Academic Hospital and Helen Joseph Hospital.

A convenience sampling method was used. Questionnaires were distributed to the different categories of doctors mentioned above. The returned questionnaires were collected and collated. From a statistical point of view, approximately two hundred questionnaires were required, thus this was the aim.

2.4 Questionnaire Development

The literature was reviewed in order to develop a questionnaire that was relevant and comparable. Some of the studies in the literature used questionnaires while others did not. Questions could further be extrapolated from the results. This was used as a preliminary guide (30). Questions were formulated using the South African Blood Service Clinical Guidelines for the use of Blood Products in South Africa as well as previous surveys found in the literature search (11 - 26).

The questionnaire was divided into three sections (see Appendix B).

The first section was in regard to demographics i.e. the professional rank of the participant as well as the hospital at which they worked.

The second section was further divided into sub-sections, as this was the section related to the blood and blood products. A number of questions on different aspects of blood transfusion related to this section were included in the questionnaire.

The questions with regard to the usage of red blood cells, platelets and plasma products also included pricing of the product. Indications for ordering the various products as well as the duration over which the different products need to be transfused were also asked in the study questionnaire.

With regard to the section on consent, the questions centred around how to obtain consent; from whom should consent be obtained, as well as what to do should a person refuse consent for personal or religious reasons.

The section that covered ordering patterns of blood and blood products was meant to show the close liaison between the doctor and the blood bank. The different methods of ordering blood and what they mean, what is required when ordering the different products as well as how to return blood is captured in this section.

Side effects of blood products should be considered whenever one decides to administer them. Recognition and appropriate management of these side effects are vital and life saving. This aspect was also included in the questionnaire.

A panel of doctors, namely an anaesthetist, physician, emergency medicine physician and a haematologist, validated the questionnaire. Their different backgrounds would allow reliability and validity of the questionnaire both in content and reproducibility. The panel was also requested to grade the questions according to difficulty; easy, average and difficult; as well as importance; all doctors should know, should be known at registrar level or at specialist level. They assessed it individually and all had similar responses. Table 2.1 depicts the scoring system allocation for the questionnaire.

Table 2.1 Grading of questions

Question	Difficulty	Importance
Red blood cells		
Cost	Average	All doctors
Storage duration	Easy	All doctors
When to use a blood warmer	Average	All doctors
Transfusion duration	Average	All doctors
Haemoglobin increase	Easy	All doctors
Transfusion level	Easy	All doctors
When to use leucodepleted blood	Average	Registrar level

Platelets		
Cost	Average	Registrar level
Storage duration	Average	All doctors
Storage temperature	Average	All doctors
Transfusion duration	Easy	All doctors
Transfusion level	Easy	All doctors
When to use apheresis platelets	Average	Registrar level
Plasma products		
Cost	Average	Registrar level
Shelf life	Average	All doctors
Transfusion duration	Average	All doctors
DIC dose	Average	Registrar level
TTP dose	Average	Registrar level
When to use cryo-poor FFP	Difficult	Specialist level
When to use cryoprecipitate	Difficult	Specialist level
Consent		
Products requiring consent	Easy	All doctors
Type of consent	Easy	All doctors
Who can give consent	Easy	All doctors
Who should take consent	Easy	All doctors
What information to give for consent	Easy	All doctors
What to do if consent unavailable	Average	Registrar level
Non-blood alternatives	Difficult	Registrar level
Ordering of blood		
When compat needed	Average	All doctors
How long a compat should be kept for	Average	All doctors
How long to wait for other blood products	Average	All doctors
What is understood by type, screen	Average	All doctors

and hold		
How long is blood kept once ordered	Average	All doctors
Transfusion sets	Average	All doctors
Blood returns	Average	Registrar level
Side-effects		
Delayed transfusion reactions	Average	Registrar level
Routine investigations	Average	All doctors
What to do in a suspected transfusion reaction	Easy	All doctors
Monitoring during transfusion	Easy	All doctors
Massive transfusion reactions	Average	All doctors
Clinical scenario	Average	Registrar level

The third section related to how the participant would like education to be conferred with regards to blood and blood products.

2.5 Statistical analysis

Completed questionnaires where collected. The responses were entered by the researcher into an excel spreadsheet for interpretation, based on study numbers to maintain anonymity of the participants. The researcher, supervisor and statistician viewed the data allowing them to appropriately analyse and interpret the responses, with the assistance of statistical software.

Questions were allocated a mark of one to get a base mark for answered questionnaire. In order to get a mark for the difficulty grading, a mark of one was

given for easy questions, two for average questions and three for difficult questions. A mark of one was awarded for questions that all doctors should know, two for questions registrars should know and three for the questions that the specialists should know. An average score was thus obtained for comparison as a percentage.

A student t test with two-tails was used to for statistical significance within the various groups that were compared. The two-tail method was used as participants could have a score higher or lower than the mean. The groups that were compared were the doctors of different levels of qualification. A comparison was also done between the different scoring systems. A p score < 0.05 was deemed to be statistically significant.

2.6 Ethical considerations

Written consent was obtained from the Heads of Departments of Internal Medicine as well as the Chief Executive Officers of the University of the Witwatersrand affiliated hospitals, i.e. Charlotte Maxeke Johannesburg Academic Hospital, Chris Hani Baragwanath Academic Hospital and Helen Joseph Hospital, to carry out the study at their facilities (see Appendices D – F).

Approval was also received from the University of Witwatersrand Post-Graduate Committee as well as the Human Research Ethics Committee (see Appendix G).

Doctors were then invited to participate in the study. A questionnaire together with a consent form was given. The consent form was required to be signed by willing participants prior to completing the questionnaire (see Appendix C). Questionnaires had study numbers and did not include the names of participants, in order to maintain anonymity. The researcher and supervisor had access to the questionnaires, while the statistician had access to the data.

The study was conducted in accordance and with adherence to the principles of the Declaration of Helsinki 2008 (31) and South African Good Clinical Practice Guidelines (32).

CHAPTER 3: RESULTS

3.1 Overview

Of the approximately six hundred questionnaires distributed, two hundred questionnaires were completed within the six-month period giving a response rate of thirty-three percent. Forty-three percent of the questionnaires were from Charlotte Maxeke Johannesburg Academic Hospital (i.e. 85 questionnaires), thirty-one percent from Chris Hani Baragwanath Academic Hospital (i.e. 62 questionnaires) and twenty-six percent from Helen Joseph Hospital (i.e. 53 questionnaires). There was a total of fourteen percent from consultants (i.e. 28 questionnaires), thirty-five percent from registrars (i.e. 70 questionnaires), nine percent from medical officers (i.e. 18 questionnaires), ten percent from community service doctors (i.e. 20 questionnaires) and thirty-two percent from interns (i.e. 64 questionnaires) that participated in the study, having answered the study questionnaire. This is depicted in Table 3.1 below:

Table 3.1 Breakdown of study participants

Participants	CMJAH	CHBAH	HJH	TOTAL
Intern	21	23	20	64
Community Service Doctor	12	4	4	20
Medical Officer	4	9	5	18
Registrar	32	21	17	70
Consultant	16	5	7	28
TOTAL	85	62	53	200

3.2 Results

3.2.1 Red blood cell products

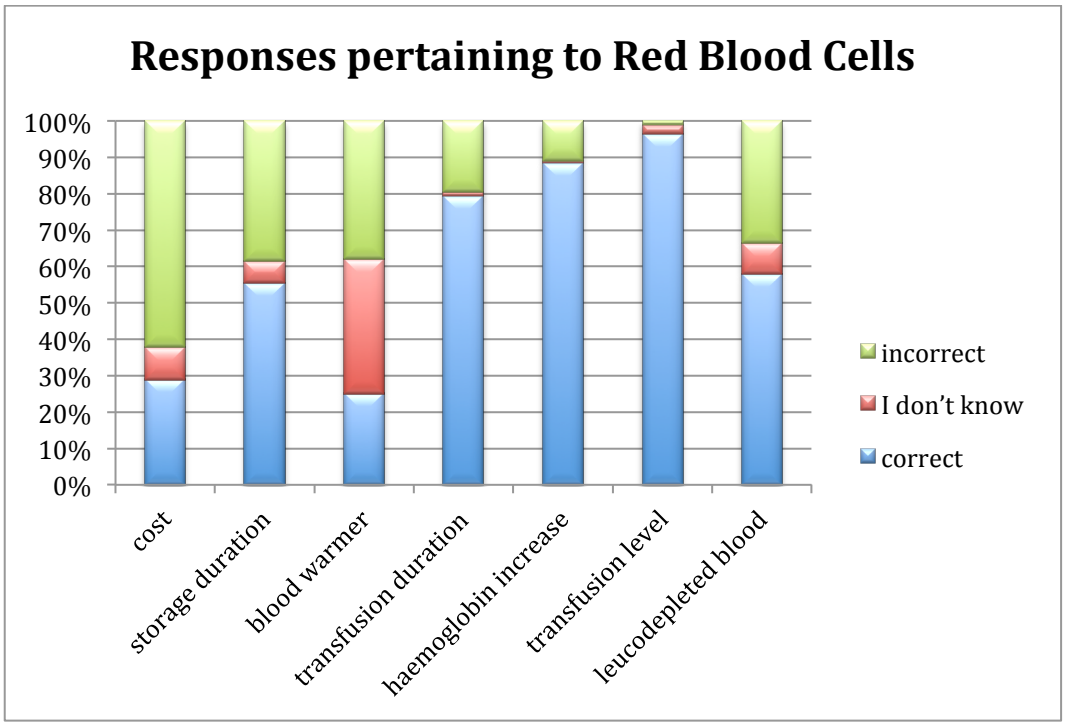

Figure 3.1 Responses pertaining to Red Blood Cells

The above figure depicts all the answers across the various groups of doctors for questions pertaining to red blood cells. More than fifty percent was achieved in five of the seven questions. Twenty-nine percent of respondents knew the correct price of a unit of blood. The majority that had incorrect answers had underestimated the correct price of the product. Fifty-five percent knew the correct storage duration of red blood cells with those getting it incorrect underestimating its viable period. Thirty-seven percent did not know when a blood warmer was required, while thirty-eight percent had the wrong indication for its use. Eighty percent knew the correct period over which blood needs to be transfused. Eighty-eight percent knew the expected haemoglobin increase with each unit of blood transfused, while ninety-seven percent

knew the correct threshold level at or below which patients require blood. Fifty-eight percent knew the true indication for leucodepleted blood. Of those that answered incorrectly, thirty-three percent gave an answer that related to a specific condition. Although it may be used in those specific conditions, the correct answer is a universal one incorporating the various conditions.

3.2.2 Platelets

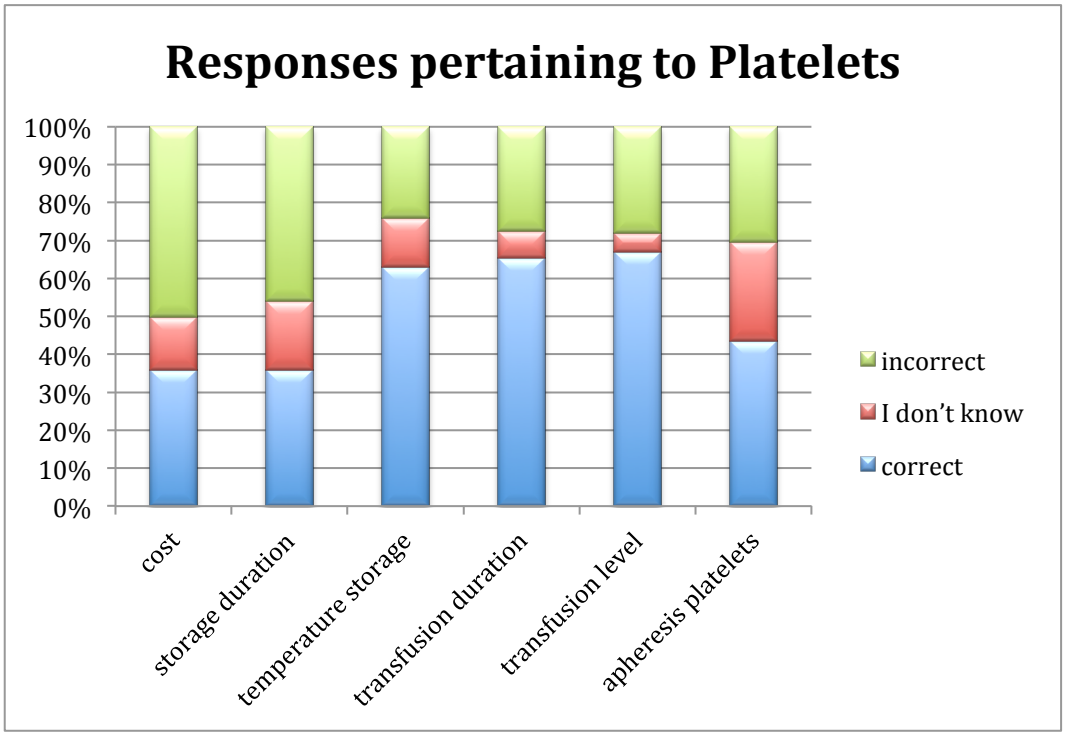

Figure 3.2 Responses pertaining to Platelets

More than fifty percent of the responders were able to answer half of the questions correctly. Thirty-six percent knew the correct price of platelets, with forty-five percent underestimating its value. The correct storage duration was known by thirty-six percent, while sixty-four percent did not know the answer or provided the incorrect answer. This poses a great problem, as this is an expensive product that has

a short expiry date and needs to be used judiciously and appropriately. Sixty-three percent were aware that platelets should be stored and transported at room temperature, with the majority of the remainder being unsure. Two thirds were aware that platelets could be transfused in less than an hour and also knew the correct transfusion level for platelets. Transfusing platelets inappropriately poses an unnecessary risk to the patient without any significant benefit. The indication for the use of apheresis platelets was known by forty-four percent, with a further thirty percent assuming it only has a place in treating a haematological condition.

3.2.3 Plasma products

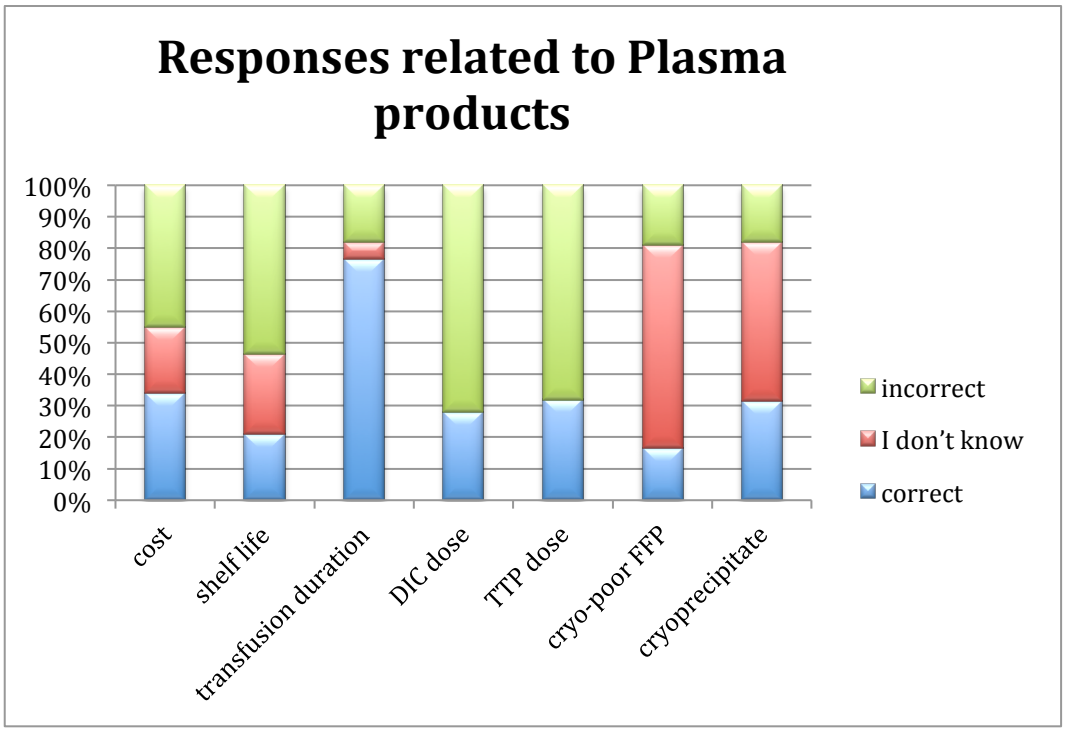

Figure 3.3 Responses pertaining to Plasma products

Six of the seven questions were correctly answered by a third of the participants. The correct price of a unit of fresh frozen plasma was known by a third of the participants,

with forty-five percent underestimating its price. Fifty-four percent underestimated the period for which plasma is viable. Seventy-seven percent knew how long to transfuse the plasma over. Twenty-eight percent knew the correct dose for prescribing plasma in DIC, and thirty-two percent for TTP, which is related to the weight of patient. The majority of those that were incorrect approximated the dose for the weight of an average person. More than fifty percent of participants did not know the indication for the use of alternative plasma products.

3.2.4 Consent

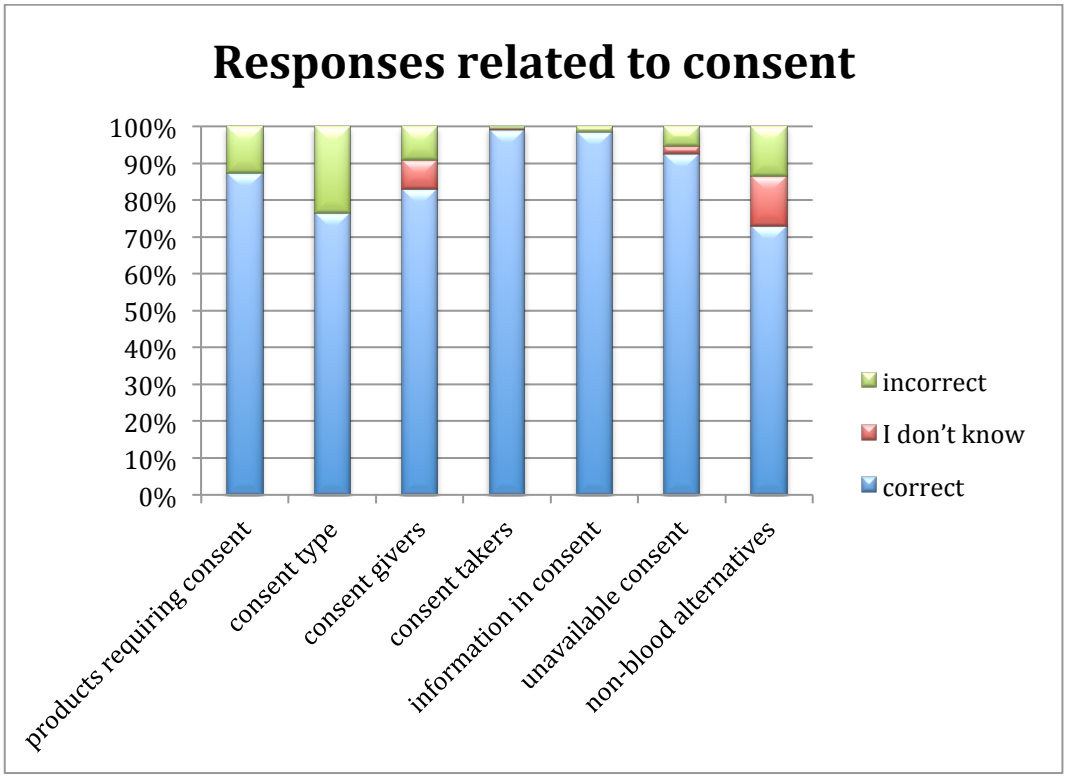

Figure 3.4 Responses related to consent to blood product transfusion

Correct responses were achieved by more than three quarters of the respondents for all seven of the questions. Inadequate consent was taken by twenty-three percent of participants, while twelve-and-a half percent were unaware that consent needs to be

taken for any blood or blood product administered. Thirteen percent of participants were unaware of the available blood and blood products, while the same proportion did not know what a blood alternative was.

3.2.5 Blood ordering

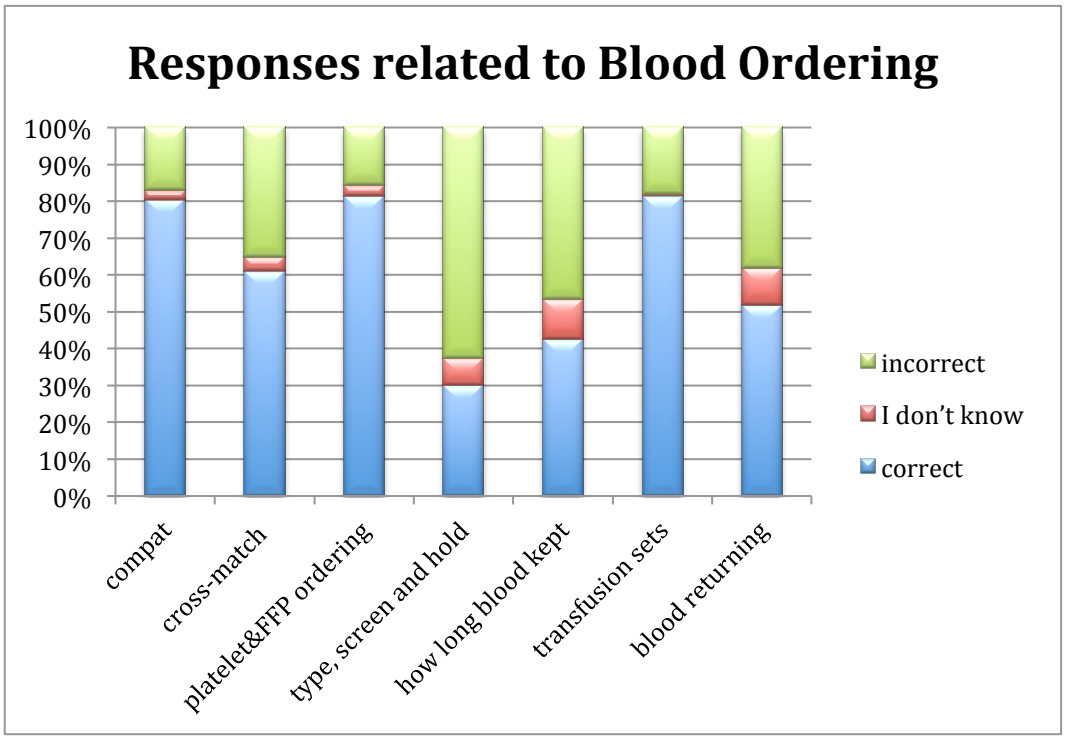

Figure 3.5 Responses related to Blood Ordering

Fifty percent of the respondents answered five of the seven questions correctly. Twenty percent were unaware that only blood requires a compat tube, while thirty-five percent overestimated the amount of time an order takes to be ready once initiated. This may be a more accurate measure in clinical practice, due to the high ordering rate. Fifty-seven to seventy percent of participants were unaware of how long a specimen would be kept before being discarded by blood bank. Platelet filters are different from a blood filter. Eighty-two percent were aware of this. Blood that is

not used should be returned to the blood bank. The returned blood cannot be used for another patient. However, another patient can use blood ordered in a BRB (blood on returnable basis) hamper, where the cold chain is not broken and the blood is returned within twelve hours. About half, i.e. forty-eight percent were unaware of this.

3.2.6 Side effects

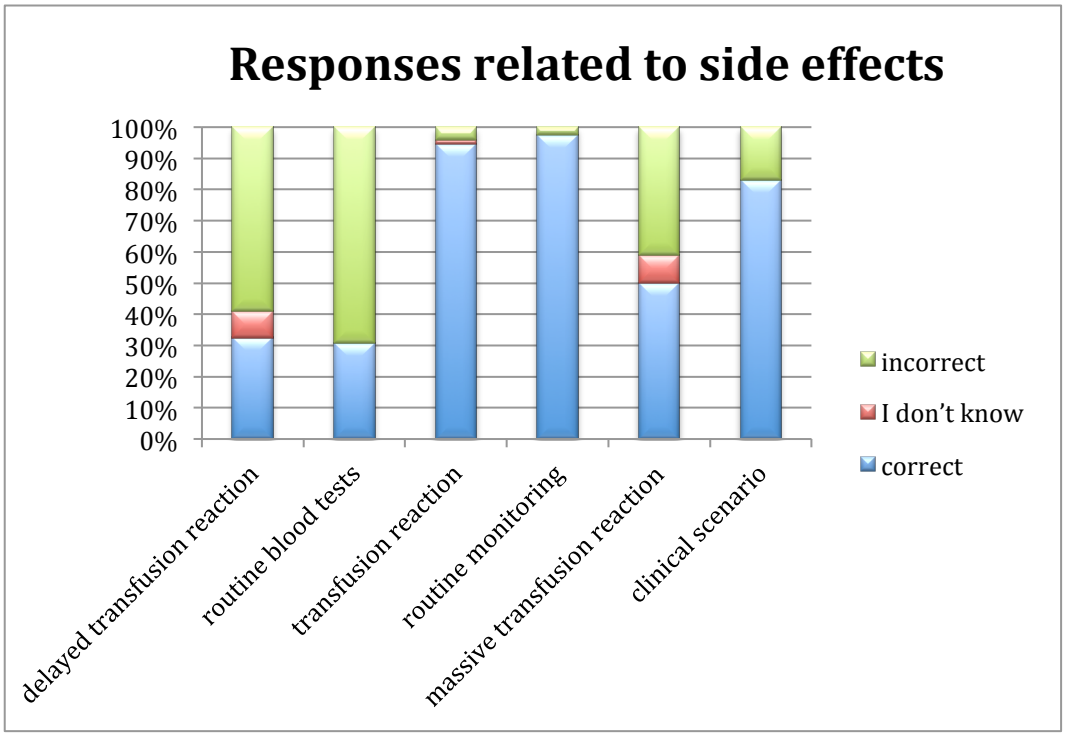

Figure 3.6 Responses related to side effects of blood and blood products

Fifty percent of participants correctly attained four of the six questions correct. Two thirds were unaware of what a potential delayed transfusion reaction would present like, while fifty percent were unaware of the effects of a massive blood transfusion. Ninety-five percent were able to follow the correct procedure should a transfusion reaction be suspected; while ninety-seven percent knew the correct observations to be monitored for a person on a blood transfusion, ensuring reactions are picked up

sooner. Knowing the infections that are screened by the blood bank helps identify a potential source, should a patient develop these bodily fluid spread infections namely: HIV, Hepatitis B, Hepatitis C and Syphilis. This was known by thirty-one percent of the participants. Eighty-four percent made the correct diagnosis in the reported clinical scenario question.

3.2.7 Summary of sections

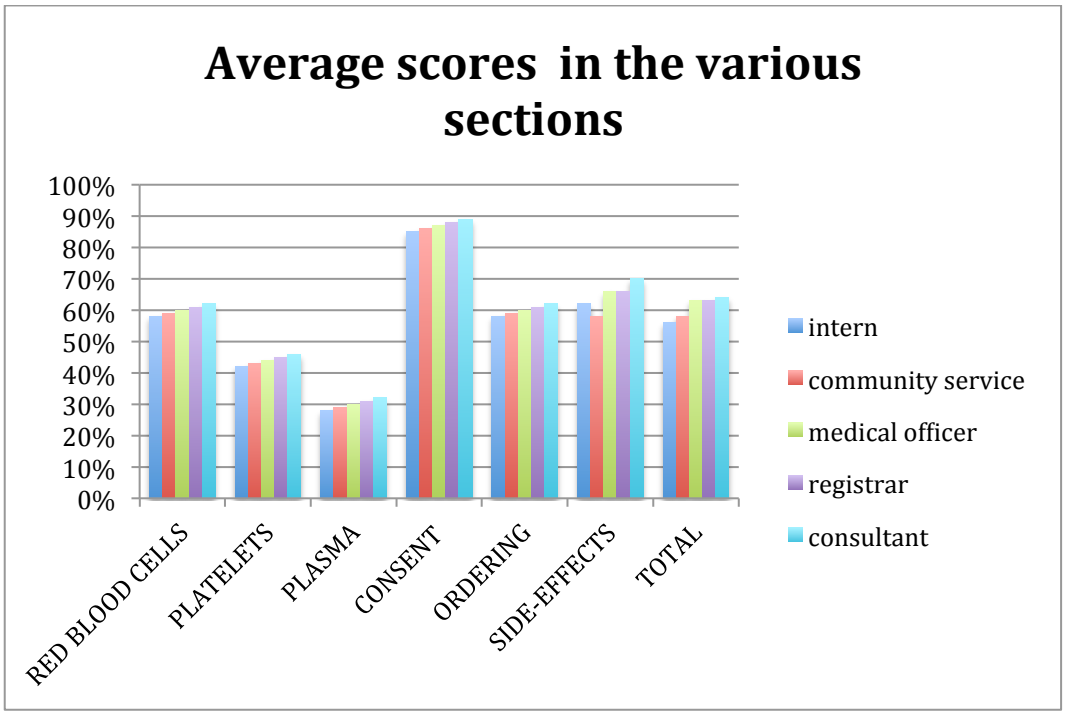

Figure 3.7 Average scores achieved in the various sections

More than fifty percent was achieved in four of the six sections with an average total of fifty-six percent for interns, fifty-eight percent for community service doctors, sixty-three percent for medical officers and registrars and sixty-four percent for consultants. This reveals that there is a stepwise increase in knowledge, but there is minimal difference from registrar level onwards.

A score greater than fifty percent is regarded as having satisfactory knowledge. All the groups achieved this satisfactory level with regards to red blood cells, consent, ordering of blood products and side effects of blood products. Knowledge with regards to platelets was between forty to fifty percent, while knowledge with regards to plasma ranged between twenty-five to thirty-five percent. Knowledge in these latter two sections is quite poor and requires much needed attention and intervention.

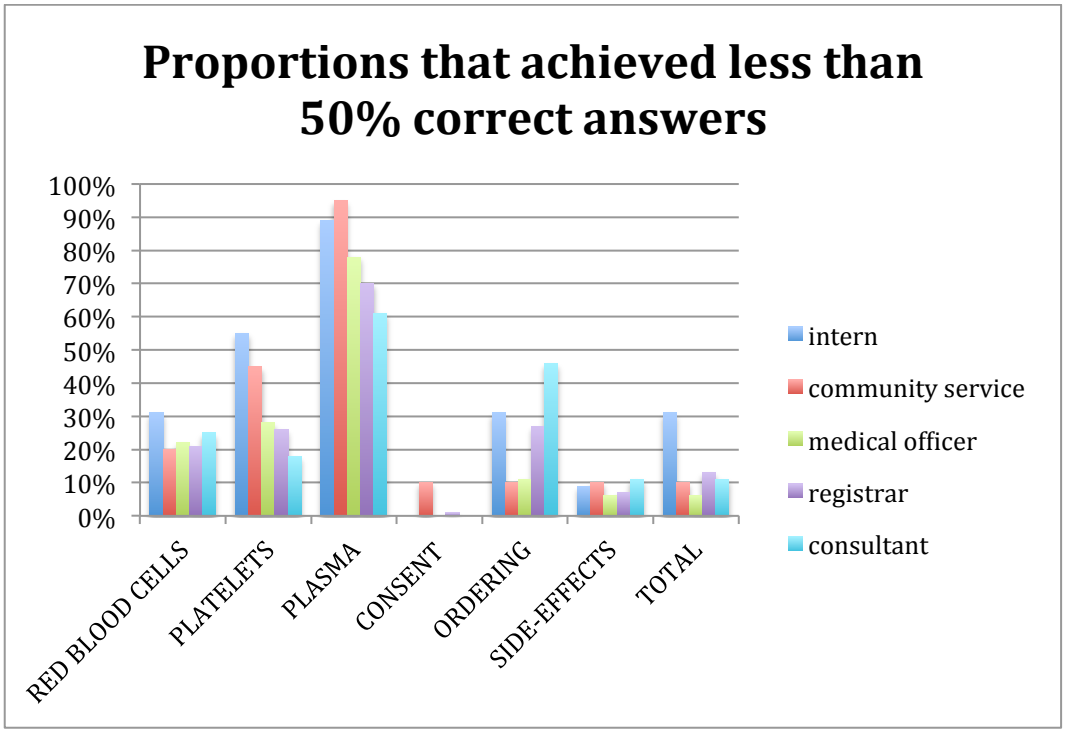

Figure 3.8 Proportions of groups that achieved less than 50% correct answers

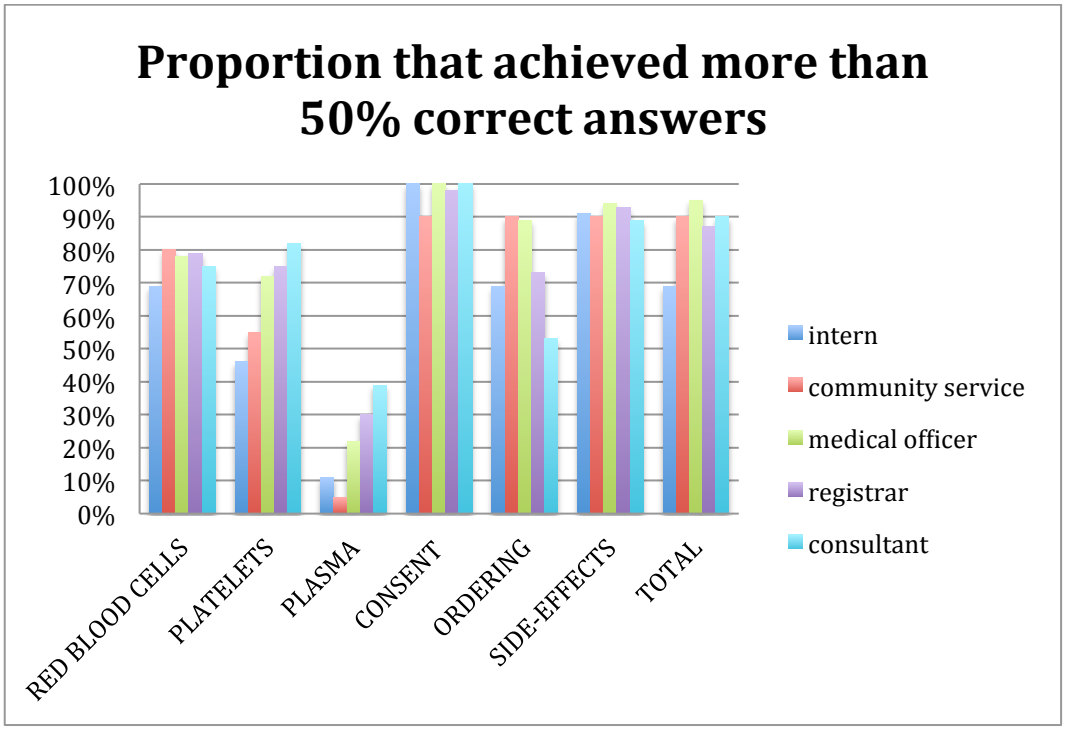

Figure 3.9 Proportions of groups that achieved more than 50% correct answers

The most significant area where the participants achieved less than fifty percent is in regards to plasma products. Sixty-one percent of consultants, seventy percent of registrars, seventy-eight percent of medical officers, eighty-nine percent of interns and ninety-five percent of community services doctors all got less than fifty percent in this section. These are quite significant numbers and therefore this area needs special attention.

Another area that needs attention is with regard to platelet transfusion. Fifty-five percent of the interns did not do well in this section, as well as forty-five percent of community service doctors, twenty-eight percent of medical officers, twenty-six percent of registrars and eighteen percent of consultants.

Less than ten percent of participants got questions related to side effects and consent wrong.

Forty-six percent of consultants failed the ordering section. This is probably due to the fact that they do not usually order the blood products. Of concern is the thirty-one percent of interns that do not know this, as they are the ones that do most of the ordering of blood and blood products and the twenty-seven percent of registrars who in most circumstances give the instruction for the intern to carry out the order.

3.2.8 How to impart information

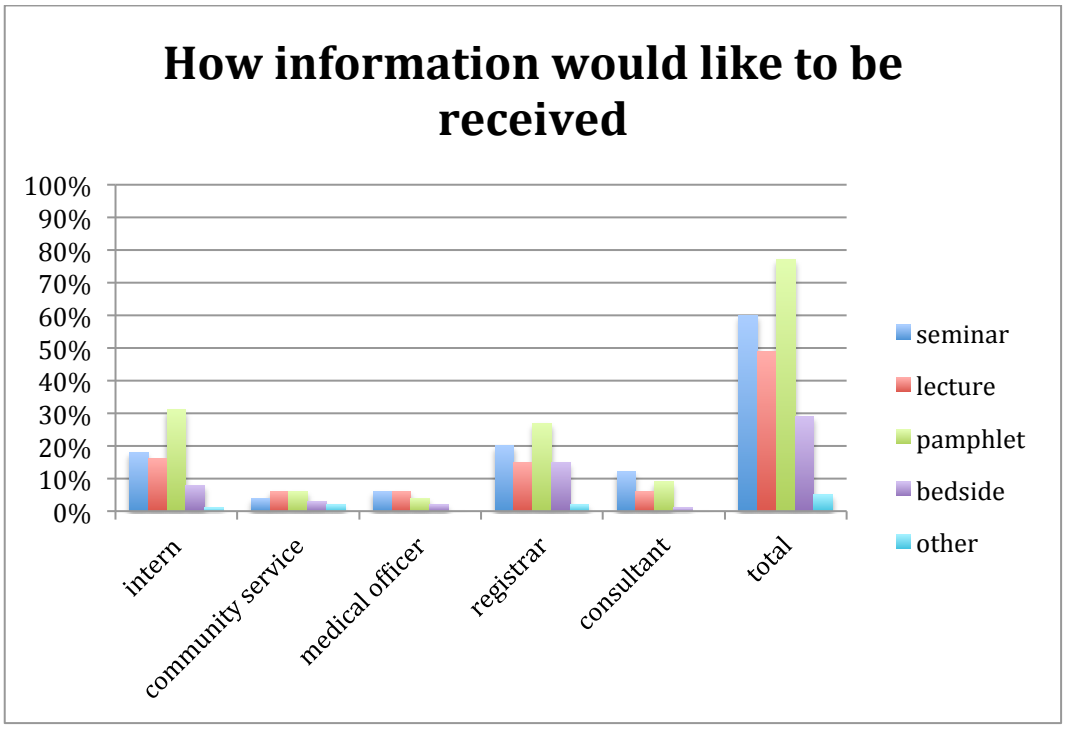

Figure 3.10 How information would like to be received

A hundred percent of participants agreed that they would like further educational information with regards to blood and blood product usage. Thirty-five percent would like teaching in the form of pamphlets, twenty-seven percent would like seminars in this regard, and fourteen percent would like bedside teaching with two percent making other suggestions such as online portals and posters. A combination of these

different methods would be of benefit in improving the knowledge of blood and blood product usage amongst the medical doctors in the Department of Medicine at the Faculty of Health Sciences, University of the Witwatersrand affiliated academic hospitals.

3.2.9 Comparing the different groups

Statistical significance was looked for among the various groups to ascertain if there is a significant gap in knowledge. Below is a table showing the results using the double tail method.

Table 3.2 P-values from different student t-tests among the various groups

	p-value (two-tail)
Intern vs. Community Service Doctor	0.4700
Intern vs. Medical Officer	0.0139
Intern vs. Registrar	0.0012
Intern vs. Consultant	0.0039
Community Service Doctor vs. Medical Officer	0.1683
Community Service Doctor vs. Registrar	0.1502
Community Service Doctor vs. Consultant	0.1014
Medical Officer vs. Registrar	0.8321
Medical Officer vs. Consultant	0.8026
Registrar vs. Consultant	0.5936

The significant p-values are highlighted in the table above. Statistical significance is noticed from the level of interns compared to medical officers (p=0.0139), registrars (p=0.0012) and consultants (p=0.0039).

3.2.10 Comparing the scoring of different scoring systems

Comparing the results using the difficulty scale system revealed an average score of fifty-six percent by the participants, while the sample using the importance scale system yielded a fifty-four percent average score. This is much lower than the sixty-one percent achieved with no scoring system. A statistically significant difference was found when comparing the base score (no scoring system) to importance (p=0.0000596) as well as difficulty (p=0.0000049). No statistically significant difference was shown between the importance and difficulty grading system. A similar stepwise increase in knowledge was seen in the various grading systems.

Table 3.3 P-values from comparing the different scoring systems

	base vs. importance	base vs. difficulty	importance vs. difficulty
p-value (two-tail)	0.0000596	0.0000049	0.4801303

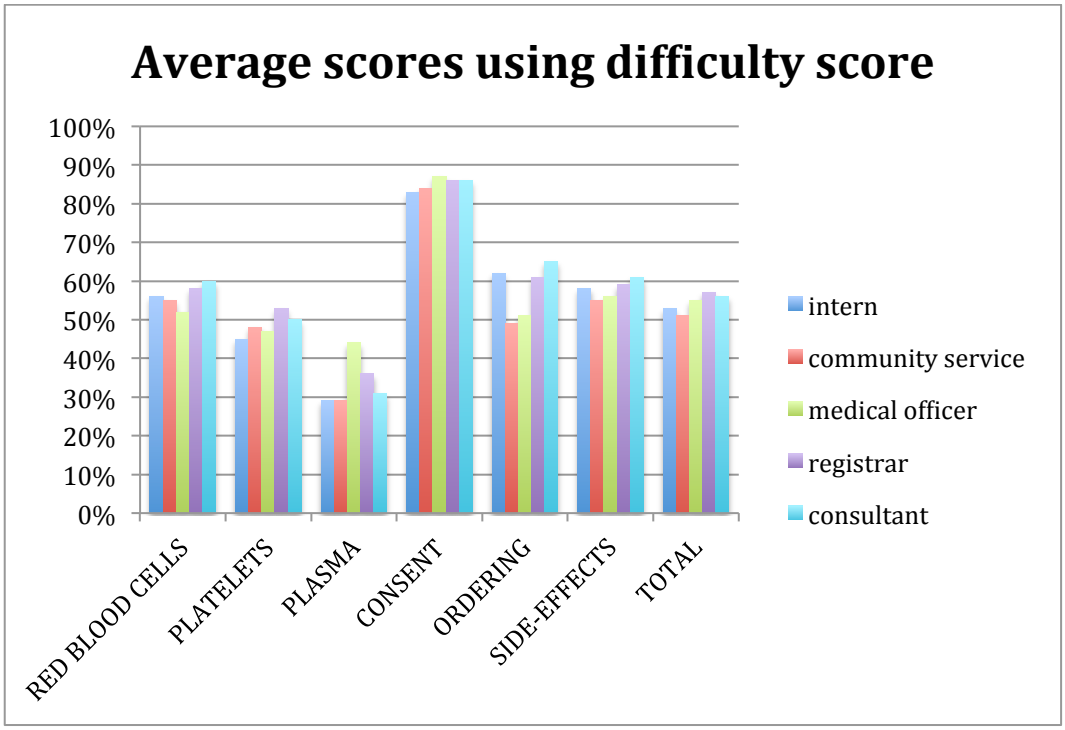

Figure 3.11 Average score using difficulty score

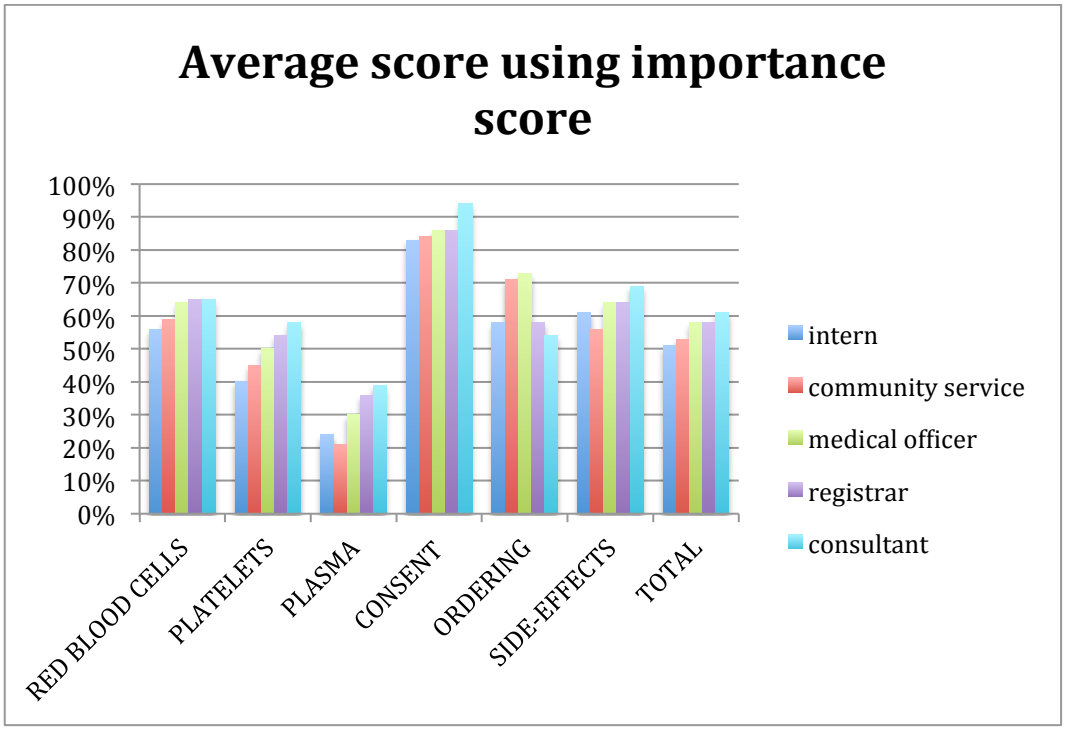

Figure 3.12 Average scores using importance score

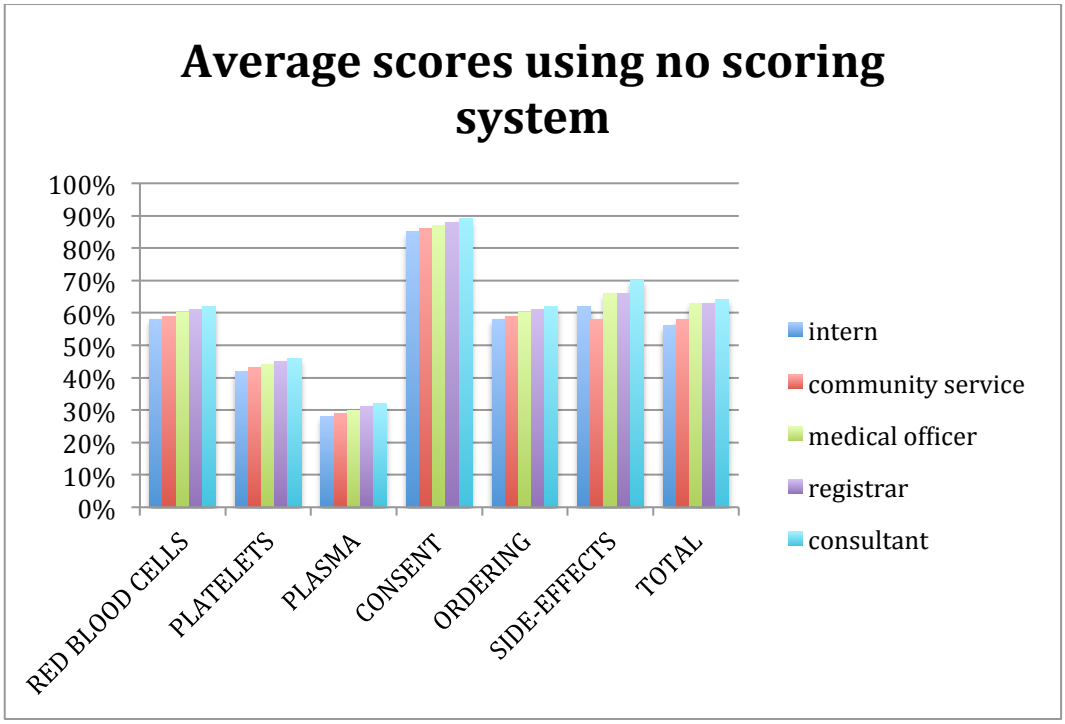

Figure 3.13 Average score with no scoring system

The average for the questionnaire was sixty-one percent. The consultants achieved the highest score of sixty-four percent. The interns who averaged fifty-six percent achieved the lowest score. The medical officers and registrars both averaged sixty-three percent. The community service doctors averaged fifty-eight percent. A similar gradient was seen across the different sections.

There is an eight percent difference between interns and consultants. Medical officers have a similar score to the consultants, with a one percent difference. There is a statistical difference ($p=0.0139$) when comparing interns with medical officers. Mere progression from interns to medical officers or registrars is not enough to ensure

adequate knowledge of blood and blood products. An effort needs to be made in this regard to learn and study different aspects of blood transfusion.

The best score was achieved in the section regarding consent with a score of eighty-seven percent. The next best score was for the section regarding side effects, i.e. sixty-four percent. The section regarding red blood cell usage and blood product ordering averaged sixty percent. The lowest score was achieved in the section regarding plasma product usage, i.e. thirty percent. The section with regards to platelet transfusion usage also achieved a score of less than fifty percent, i.e. forty-four percent.

CHAPTER 4: DISCUSSION

4.1 Introduction

Blood and blood product usage has changed over the centuries and have proven vital in the treatment plan of many patients. A package insert is not always available for these products, thus knowledge about these products are vital for the attending clinician in order to be able to use the products appropriately. Blood is not manufactured in a laboratory or factory, but rather gained from the generous, non-remunerated donations of our citizens and should be used judiciously as availability can vary and is more often than not, limited. We thus set out to ascertain the level of knowledge present in doctors working in the Department of Medicine at the University of the Witwatersrand affiliated academic hospitals.

4.2 Data interpretation

A large number of questionnaires were circulated in order to achieve the desired two hundred questionnaires for the study. This number includes having given some doctors more than one questionnaire, as the first questionnaire was lost or misplaced and therefore not completed and returned. It also includes participants rotating in and out of the various departments in Medicine, as part of their training.

The number of questionnaires received from the different hospitals is not a true reflection of the size of the workforce at the various hospitals. Convenience sampling

was used in collection of the questionnaire. This may explain the discrepant collection rates.

It was thought to be important to study the knowledge of a range of academic ranks, as all are involved in the ordering and administering of blood and blood products. Responses from a spectrum of doctors are also more likely to reveal deficiencies and strengths in this broad group of doctors. Interns contributed to thirty-two percent of the cohort. This population are still considered to be in training, however they are often the subset administering blood and blood products (in conjunction with medical officers and community service medical officers). Thus, their understanding of blood transfusion and its complexities is vital. However, the largest proportion of the group studied comprised of registrars in Medicine, i.e. thirty-five percent. This population is most often the subset making the clinical decision to order the blood or blood products. Registrars are also usually in the process of studying, thus they should be expected to have more detailed knowledge of blood transfusions. Any deficits in this group could indicate a need for further training in the relevant sections that were assessed. Consultants contributed to fourteen percent of the cohort. Consultants are often used as a measure of the knowledge of the people at the pinnacle at the profession.

The three hospitals attached to the University of Witwatersrand were included as the sites from which the various doctors were selected. This provides for broader variability that such a study requires. Moreover, teaching methods at the different

facilities vary and registrars rotate through the different facilities during their training period.

Responses to the different questions were analysed and are shown in the results section. This revealed that the gap in knowledge is statistically significant until doctors reach the level of a medical officer, after which the increase in knowledge is not statistically significant ($p>0.05$). This finding was consistent with a previous study done by Yudelowitz et al (28). This gradient is expected, as the further along a doctor progresses, so should their knowledge and experience.

By grouping the questions together, we were able to get a better insight into what the baseline knowledge and areas of deficiency were in the participants. The use of platelets and plasma products requires most attention, not only as the lowest scores were achieved in this section but also the fact that scores of less than fifty percent were achieved. This was true for all levels of training, from interns to consultants.

4.3 Comparison to South African data

There is a paucity of studies in the South African setting, especially within the department of Medicine. Previous studies were conducted within the department of Anaesthesiology (28, 33). A comparison will be drawn between the study of Yudelowietz et al. and this study, as his study was also conducted at Chris Hani Baragwanath Academic Hospital (in the surgical and anaesthesiology departments) (28). However, the indications and amount of blood product use are not always

consistent in stable medical patients as compared to peri-operative patients that are dealt with by Anaesthesiologists.

The questions in this study that were of a similar nature, to the Yudelowietz et al. study, is detailed and compared in table 9.1 below:

Table 4.1 Comparisons of our study to Yudelowitz et al. study (28)

Question	Yudelowitz et al. (28) (Percentage correct)	Our study (Percentage correct)
Red cell concentrate cost	29	29
Haemoglobin transfusion level	72	97
Haemoglobin increase	91	89
Platelet cost	30	36
Platelet transfusion temperature	52	63
Platelet transfusion level	24	67
FFP cost	27	34
FFP dose	34	30
Type of consent	31	83
Cross match definition	55	82
Type, screen and hold definition	48	42
Blood hamper	38	34

The results between the two groups are fairly similar in certain areas. The significant areas of discrepancy (difference of greater than ten percent) is noted in the haemoglobin and platelet transfusion levels, with a difference of twenty-five and

forty-three percent respectively, between the two groups. This is in keeping with a previous study showing variable use of platelet transfusion triggers (22, 34).

The knowledge of the cost of the various blood products was comparable in the two groups, demonstrating that the knowledge regarding this aspect is was very poor. Only approximately a third of the participants knew the cost of these products.

There is a global trend of increasing FFP use, with inappropriate indications for its use at times (34, 35). This is further compounded by not knowing the correct dose of FFP to be used (as evident in the correct response being noted in approximately one third of the participants in both studies).

Doctors in Medicine faired best in the section with regards to knowledge of consent with an average score of eighty-seven percent for this section. This is surprisingly different to the lower figure of thirty-one percent in the other study (28).

Blood can be ordered in different ways from the blood bank. This has significant implications on cost as well as availability of blood for transfusion (12, 19). Thirty-four percent of the participants were aware that blood could be returned if ordered in a hamper to prevent wastage, should blood not be used. Forty-three percent were aware of the type, screen and hold (TSH) format of ordering blood. These results were consistent with the study by Yudelowitz et al. (28).

4.4 Comparison to International data

Knowledge regarding blood and blood products or transfusion medicine is deficient worldwide, in both first and third world countries. This makes education in this regard of paramount importance to ensure safe and efficient practices globally (29).

Many questionnaires have been formulated but very few validated. The questionnaire in this study has many questions similar to those validated by Haspel et al. in terms of addressing needs assessment. Thus the questions used in this study can be assumed to be of a good quality. Taking in to account that the exact questions were not asked, questions covering the same areas of concern are highlighted in table 4.1 below (30):

Table 4.2 Comparison of questions to validated questionnaire by Haspel et al. (30)

Question area in validated questionnaire, Haspel et al. (30)	Corresponding question in our questionnaire
Transfusion threshold	6
Irradiated blood indication	7, 13
Platelet transfusion threshold	12
Platelet transfusion	8-13
Acute transfusion reaction	35 (delayed transfusion reaction included)
Managing a reaction	37, 38
Plasma transfusion threshold	19, 20
Reporting of reaction	37
Infection risk	36
Massive transfusions	39
Correct identification	28, 29

TRALI	40
Haemoglobin increase	5

The opinion that almost all doctors worldwide feel that they require further teaching with regards to transfusion medicine is also an indication that this is an area of concern. Many different approaches have been adopted in different countries with varying results. In the United States studies it is felt that transfusion medicine requires sub-speciality training, while in Malaysia, Korea and Japan training should be included as part of the residency program. Training should however, be initiated at medical school level, as junior staff require knowledge in this field (29).

The level of competency of junior doctors in the setting of this study was fifty-six per cent compared to sixty per cent when compared to that in the United Kingdom (36). Although the type of assessment used in the study by Graham et al. was different, there is great deficiency in the teaching that is provided at medical school in the field of transfusion medicine and this needs to be addressed in order to improve competency in transfusion medicine (37). Recent studies have shown a level of competency of forty-two per cent among doctors (post-internship) in Sri Lanka and forty-eight per cent among residents in India (38). This is much lower than the sixty-one per cent in our study. Varying questionnaires make it difficult for direct comparison, but the general impression is that significant improvement in education is required in this field of medicine globally (39).

4.5 Summary

The SANBS endeavours to ensure that their products are on par with international standards, regarding safety (2). Despite this, there are still risks involved with administering a transfusion. It is thus important to know what these risks are, and how to recognize and appropriately minimize and manage these risks. Ninety-five percent of the participants were aware of the procedure to follow when suspecting a transfusion reaction, while ninety-eight percent were aware of the correct monitoring of patients. However, more detailed knowledge of transfusion reactions was variable, ranging from thirty to eighty percent. This is in keeping with previous studies and is an area that should be targeted, when planning an education program (33).

Experience in a field does bring about greater knowledge. This may not always be correct should adherence to current literature and guidelines not be followed. Although consultants faired better than the junior staff, on-going teaching and teaching from a junior level will help in improving the understanding and better use of blood and blood products (28). By setting the bench mark knowledge around blood and blood products at a higher level than it currently is, the knowledge base will improve and will be higher than that of the level of the current interns, and is likely to improve further in the upward career path of the doctor. Only forty-three percent of doctors reported training at medical school about blood and blood products. Thus, there is a clear need for education commencing at the undergraduate level.

Various hospitals have adopted a local blood committee at their facility in order to audit the use of blood and blood products (use / wastage / costs / returns etc.). This

has been used to great effect in improving the correct utilization of this scarce resource (40). The committee is also instrumental in providing appropriate education and haemovigilance (reviewing untoward reactions etc.).

An annual blood transfusion seminar is held at Chris Hani Baragwanath Academic Hospital where the trends of usage of blood and blood products at the facility are highlighted. Basic aspects of transfusion including safety, indications, costs, side effects and monitoring are discussed. In addition, 'state of the art' advances and alternatives to the use of blood and blood products are highlighted at these seminars.

Various modalities of teaching (such as seminars, lectures, provision of booklets and pamphlets, practical training etc.) are required to maintain and improve current knowledge and practices. All this is an attempt to optimize the appropriate and judicious use of this valuable, but scarce and expensive resource (27). Advances in technology can be used for this purpose as well, with promising results as shown with virtual patient cases (41, 42).

4.6 Limitations

Limitations of the study can be found within the convenience sampling method that was used. Equal numbers of the various sub groups were not obtained, which may contribute to bias. Doctors were also based at different University of the Witwatersrand affiliated hospitals. The undergraduate studies of the different doctors vary as they may have been undertaken at various Universities across the country

where the teaching varies from institution to institution. Doctors up to registrar level usually rotate through the different departments and may even rotate through the various hospitals, which in some way removes some of the bias mentioned above. As junior doctors often obey the instruction of their 'seniors', their knowledge base may be influenced by the knowledge of their seniors.

Another limitation is the fact that as a multiple-choice format was used for the questionnaire, respondents may have chosen one of the given options rather than an answer based on their inherent knowledge. This could also lead to bias.

4.7 Recommendations

Implementation and impact of any intervention would need to be assessed. Awareness around blood and blood products among doctors will also help improve knowledge in this field. Research into the cause of lack of knowledge among doctors may also be of value.

4.8 Conclusion

On-going teaching around blood and blood product usage is required at the University of the Witwatersrand affiliated hospital at all levels, from interns through to consultants to ensure efficacious use of this scarce, but most valuable resource. Certain areas require more attention than others, i.e. platelet and plasma product usage, but a refresher on all sections will be of benefit. Various methods can be employed, but a combination of different methods is likely to be more beneficial.

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Blood product pricelist

2014 (19)

BLOOD AND PLATELET PRODUCTS

SANBS-BHF CODES

Red Cells	Nappi Codes	Description	Price Excl Vat 2014	Price Incl Vat 2014
78040	708800-001	Red Cell Concentrate	R 1,355.88	R 1,545.70
78051	708802-001	Red Cell Conc. Leucocyte Depleted	R 2,215.44	R 2,525.60
78043	708803-001	Red Cell Conc. Paed. Leucodepleted	R 1,253.08	R 1,428.52

Platelets	Nappi Codes	Description	Price Excl Vat 2014	Price Incl Vat 2014
78124	708804-001	Platelet Conc. Single Donor Apheresis	R 7,858.28	R 8,958.44
78125	708805-001	Platelet Conc. Leucocyte Depleted, Pooled	R 7,192.34	R 8,199.27
78127	708808-001	Platelet Concentrate (Paediatric)	R 1,724.02	R 1,965.38
78122	708806-001	Platelet Concentrate Pooled	R 5,712.46	R 6,512.21

Whole Blood	Nappi Codes	Description	Price Excl Vat 2014	Price Incl Vat 2014
78001	708807-001	Whole Blood	R 1,561.56	R 1,711.78
78059	708809-001	Whole Blood Leucocyte Depleted	R 2,361.13	R 2,691.69
78011	708810-001	Whole Blood Paediatric	R 1,253.08	R 1,428.52

Plasma	Nappi Codes	Description	Price Excl Vat 2014	Price Incl Vat 2014
78103	708811-001	Cryoprecipitate (Fibrinogen Rich)	R 786.38	R 873.67
78174	708812-001	Frozen Plasma - Cryo Poor Donor Retested	R 875.06	R 997.57
78179	716662-001	Fresh Frozen Plasma - Donor Retested (Paediatric)	R 629.94	R 718.13
78176	708813-001	Fresh Frozen Plasma - Donor Retested	R 1,084.69	R 1,236.54

Blood and Administration Sets	Nappi Codes	Description	Price Excl Vat 2014	Price Incl Vat 2014
78199	440415-002	Blood Filters : 1 Units	R 788.19	R 898.54
78200	406059-001	Blood Filters : 2 Units	R 1,511.12	R 1,722.67
78197	628761-001	Platelet Filter 3 - 6 Unit PL2VAE	R 1,459.07	R 1,663.33
78201	470471-001	Set, Blood and plasma Recipient Set	R 16.79	R 19.14
78202	470474-001	Set, Platelet Recipient	R 79.26	R 90.36
78609		Cryo Preservation Bag	R 638.44	R 727.82

ADDITIONAL SERVICES AND SURCHARGES

	Nappi Codes	Description	Price Excl Vat 2014	Price Incl Vat 2014
78050		Irradiation Fee	R 290.82	R 331.53
10210		Transfusion Crossmatch	R 603.32	R 687.79
10333		Type and Screen	R 270.16	R 307.98
78400		Routine Collection Fee	R 147.62	R 168.29

2016 (20)

2016 BLOOD AND PLATELET PRODUCTS PRICES

SANBS- BHF CODES

Red Cells	Nappi Codes	Description	Price Excl. VAT 2016	Price Incl. VAT 2016
78040	708800-001	Red Cell Concentrate	R1,466.52	R1,671.84
78051	708802-001	Red Cell Conc. Leucocyte Depleted	R2,396.22	R2,731.69
78043	708803-001	Red Cell Conc. Paed. Leucodepleted	R1,355.33	R1,545.07

Platelets	Nappi Codes	Description	Price Excl. VAT 2016	Price Incl. VAT 2016
78124	708804-001	Platelet Conc. Single Donor Apheresis	R8,499.51	R9,689.45
78125	708805-001	Platelet Conc. Leucocyte Depleted, Pooled	R7,779.23	R8,868.33
78127	708808-001	Platelet Concentrate (Paediatric)	R1,864.68	R2,125.73
78122	708806-001	Platelet Concentrate Pooled	R6,178.60	R7,043.60

Whole Blood	Nappi Codes	Description	Price Excl. VAT 2016	Price Incl. VAT 2016
78001	708807-001	Whole Blood	R1,624.09	R1,851.46
78059	708809-001	Whole Blood Leucocyte Depleted	R2,553.80	R2,911.33
78011	708810-001	Whole Blood Paediatric	R1,355.33	R1,545.08

Plasma	Nappi Codes	Description	Price Excl. VAT 2016	Price Incl. VAT 2016
78103	708811-001	Cryoprecipitate (Fibrinogen Rich)	R852.92	R944.96
78174	708812-001	Frozen Plasma - Cryo Poor Donor Retested	R946.46	R1,078.97
78179	716662-001	Fresh Frozen Plasma - Donor Retested (Paediatric)	R681.34	R776.73
78176	708813-001	Fresh Frozen Plasma - Donor Retested	R1,173.20	R1,337.45

Blood and Administration Sets	Nappi Codes	Description	Price Excl. VAT 2016	Price Incl. VAT 2016
78199	440415-002	Blood Filters : 1 Units	R852.51	R971.86
78200	406059-001	Blood Filters : 2 Units	R1,634.43	R1,863.25
78197	628761-001	Platelet Filter 3 - 6 Unit PL2VAE	R1,578.13	R1,799.07
78201	470471-001	Set, Blood and Plasma Recipient Set	R18.16	R20.70
78202	470474-001	Set, Platelet Recipient	R85.73	R97.73
78609		Cryo Preservation Bag	R690.54	R787.21

APPENDIX B: QUESTIONNAIRE

study number

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 Witwatersrand affiliated academic hospitals

Questionnaire of the study

In each of the following questions, please circle the answer/option you think is correct

A Demographics

1 What is your current designation?

a intern b community service doctor c medical officer d registrar year 1 2 3 4 e consultant

2 Which hospital are you currently working at?

a CMJAH b CHBAH c HJH

B Study Questionnaire

The following questions pertain to **red blood cells**

1 What is the approximate cost of a unit of (adult) packed red cell concentrate?

a R 750 - 00 - R 1 000 - 00 b R 1 000 - 00 - R 1 250 - 00 c R 1 250 - 00 - R 1 700 - 00 d R 1 750 - 00 - R 2 000 - 00 e I don't know

2 What is the approximate storage duration after preparation, before blood will expire?

a 1 day b 1 week c 1 -2 month d 1 year e I don't know

3 In which of the following circumstances will you **not** use a blood warmer?

a cold agglutinin disease b massive blood transfusion c neonatal exchange transfusion d routine transfusions e I don't know

4 Over what duration of time does each unit of blood need to be transfused in an uncomplicated patient who is not actively bleeding?

a 1-2 hours b 2-6 hours c 6-8 hours d >8 hours e I don't know

5 By how much will the haemoglobin increase with each unit of blood?

a 0.5 g/dl b 1.5 g/dl c 2 g/dl d 3 g/dl e I don't know

6 At what haemoglobin level will you routinely consider transfusing an uncomplicated patient?

a <8 g/dl b <10 g/dl c <12 g/dl d <14 g/dl e I don't know

7 When will you use leucodepleted red cell concentrate?

a no other blood available b patients needing repeated transfusions c only for haematology patients d only in renal patients e I don't know

The following questions pertain to **platelets**

8 What is the approximate cost of a unit of (adult) platelet concentrate?

a R 1 500 - 00 - R 2 500 - 00 b R 2 500 - 00 - R 5 000 - 00 c R 6 500 - 00 - R 9 000 - 00 d > R10 000 - 00 e I don't know

9 What is the approximate storage duration (on a platelet adgitator) before the platelet concentrate will expire?

a <1 day b 3-5 days c 10 days d 1 month e I don't know

10 At what temperature do platelet concentrates need to be transported and transfused?

a 1-6˚C b room temperature c body temperature d in a blood warmer e I don't know

11 Over what duration of time does each unit of platelets need to be transfused?

a < 1 hour b 1-2 hours c 2-4 hours d 4-6 hours e I don't know

12 At what platelet count will you routinely consider transfusing platelet concentrates?

a <10 x 10^9/l b <50 x 10^9/l c <70 x 10^9/l d <100 x 10^9/l e I don't know

13 When will you use single donar apheresis platelet concentrates?

a when no platelets are available b for all bleeding patients c needing repeated platelet transfusions d only in haematology e I don't know

The following questions pertain to **plasma products**?

14 What is the cost of a unit of fresh frozen plasma (FFP)?

a R 200 - 00 b R 400 - 00 c R 750 - 00 d R 1 200 - 00 e I don't know

15 What is the shelf life of FFP?

a 1 day b 1 week c 1 month d 1 year e I don't know

16 Once FFP is thawed, it should be transfused within what period of time?

a <6 hour b 6-12 hours c 12-24 hours d 48 hours e I don't know

At what dose will you use plasma in the following situations:

17 Disseminated Intravascular Coagulopathy (DIC)?

a 15ml/kg b 30-40ml/kg c 2 units d 4 units e 8 units

18 Thrombotic Thrombocytopaenic Purpura (TTP)?

a 15ml/kg b 30-40ml/kg c 2 units d 4 units e 8 units

When will you consider the use of the following plasma products:

19 Cryo-poor fresh frozen plasma?

a alternate with normal FFP in DIC b TTP c DIC with hypofibrinogenaemia d haemophillia B e I don't know

20 Cryoprecipitate?

a alternate with normal FFP in DIC b TTP c DIC with hypofibrinogenaemia d haemophillia A e I don't know

The following questions are related to **consent** around blood products?

21 Ideally, which products require patient consent for administration?

a	blood	b	platelets	c	plasma	d	none	e	all blood products

22 Ideally, what type of consent should be taken?

a	informed & verbal	b	verbal & written	c	informed & written	d	informed verbal & written	e	none

23 Who **cannot** give consent?

a	patient	b	super-intendant	c	parent / guardian	d	doctor	e	I don't know

24 Ideally, who should be taking informed consent from the patient?

a	nurse	b	intern	c	consultant	d	prescribing doctor	e	I don't know

25 What information should be discussed with the patient before administering a transfusion?

a	why products administered	b	benefits of receiving	c	harms of receiving	d	agreement to take product	e	all of the above

26 If an adult patient needs blood and blood products electively, but does not consent, what do you do?

a	sedate and give the blood	b	get consent from the super-intendant	c	respect the patients wishes and don't give anything	d	respect patient wishes and offer an alternative option, if available	e	I don't know

27 Which one of the following options are not acceptable to Jehova's Witness patients?

a	Erythro - poeitin	b	Haemopure	c	recombinant factor 7	d	fresh frozen plasma	e	I don't know

The following questions are related to **ordering** of blood products

28 Which product generally requires a compat together with the request form?

a	blood	b	platelets	c	plasma	d	all products	e	I don't know

29 How long will you need to wait for blood ordered in a standard cross-match format?

a	30 min	b	1 - 2 hour	c	4 - 6 hours	d	1 day	e	I don't know

30 How long will you need to wait for platelets/FFP if available at blood bank?

a	<1 hour	b	2 - 4 hours	c	4 - 6 hours	d	1 day	e	I don't know

31 How long will blood be secured for a patient if it is ordered on a Type, Screen and Hold (TSH) format?

a	24 hours	b	48 hours	c	72 hours	d	96 hours	e	I don't know

32 How long will blood be secured for a patient once ordered on a standard format?

a	24 hours	b	48 hours	c	72 hours	d	96 hours	e	I don't know

33 Is a platelet administration set required for transfusion of platelets?

a	yes	b	no	c	I don't know

34 When can blood be returned to blood bank?

a	within 1 hour if in a brown paper bag	b	within 12 hours in a brown paper bag	c	within 1 hour in a temperature controlled hamper	d	within 12 hours in a temperature controlled hamper	e	I don't know

The following questions pertain to **side-effects** of blood products

35 Which of the following is regarded as a delayed reaction to blood product usage?

a	intravascular haemolysis	b	post transfusion purpura	c	fluid overload	d	anaphylaxis	e	I don't know

36 Which infections are routinely tested for by the blood bank?

a	HIV, Hep B, Syphillis	b	HIV, Hep B, Hep C, Syphillis	c	HIV, Hep B, Hep C	d	HIV, Hep B, Hep C, CMV	e	HIV, Hep b, Hep C, CMV, Syphillis

37 What do you need to do if you suspect a transfusion reaction?

Please choose the correct set of options

i stop the transfusion immediately
ii remove the line and return it together with the blood to blood bank
iii draw blood specimens and a urine sample and send it to blood bank, together with a completed transfusion reaction form
iv monitor the patient closely and treat and problems appropriately
v give steroids and continue transfusion
vi wait 30 min and restart the tranfusion
vii wait for the transfusion to complete before doing anything

a	i, ii, iii, iv	b	i, v	c	i, vi	d	vii, i	e	I don't know

38 What routine monitoring is needed when administrating blood?

a	temperature	b	blood pressure and pulse	c	general condition	d	respiratory rate	e	all of the above

39 Which of the following is **not** regarded as a complication of a massive blood transfusion?

a	hyper calcaemia	b	fluid overload	c	hyper kalaemia	d	thrombo cytopaenia	e	I don't know

40 A 40 year old male presents with acute respiratory distress two hours after receiving blood from his multiparous younger sister. Clinically he is tachypnoeic, pyrexial, hypotensive and cyanosed. His JVP is not raised. His chest x-ray shows bilateral pulmonary infiltrates. What is the most likely diagnosis?

a	transfusion related acute lung injury (TRALI)	b	pulmonary oedema	c	pulmonary thrombo-embolic disease	d	broncho-pneumonia	e	febrile non-haemolytic transfusion reaction

C <u>General</u>

1 When have you last had teaching about blood and blood product usage?

a	never	b	medical school	c	during internship	d	within the past 2 years		

2 Would you like teaching about blood and blood products and its usage?

a yes b no

If YES, how would you like this teaching to be conducted?

a	seminars	b	formal lectures	c	pamphlets / booklets	d	bedside teaching	e	other

if option e chosen, please specify

_____

_____

any further comments you would like to add

_____

_____

_____

Please return the completed questionnaire to one of the following sites:
A) A collection box at the medicine secrataries' offices at the respective hospitals
B) Post completed forms to P O Box 909, Randfontein, 1760

APPENDIX C: INFORMATION AND CONSENT FORM

Study Details

Study Number:

Study Doctor: Muhammad Laher

Site Address: Helen Joseph Hospital, Chris Hani Baragwanath Academic Hospital and Charlotte Maxeke Johannesburg Academic Hospital

Contact Details:

Cell: 084 581 2418

Email: laherm@msn.com

Participant Information Sheet

My name is Muhammad Laher. I am currently a medical registrar in the Department of Medicine at the Faculty of Health Science; University of Witwatersrand affiliated academic hospitals.

I would like to invite you to participate in a research study, to try and ascertain the knowledge that medical doctors have with regard to various aspects of blood transfusion. Before agreeing to participate in this study, it is important for you to read and understand the explanation of the study. If you have any questions, please do not hesitate to ask me.

The study has been submitted to the University of Witwatersrand Human Research Ethics Committee (HREC) and written approval has been granted. The study number is M140622.

Your participation in the study is voluntary. If you decide to participate, you are free to withdraw from the study at any time. If you choose to participate, you will be asked to sign a consent form. Your refusal to participate, or your early withdrawal, will not affect you in any way.

What is the purpose of this study?

This study is intended to assess the knowledge about blood and blood products and its usage, costs, side effects, administration, available alternatives and ethical considerations. Gaps in knowledge of the participants will hopefully be identified and possible areas of redress in regard to teaching/education will be made in an attempt to solve the problems areas identified.

How will this affect me?

You will be asked to complete a questionnaire designed to cover knowledge about various aspects of blood transfusion. The questionnaire should take approximately 20 – 30 minutes of your time. The data obtained in this questionnaire will be kept strictly confidential. You will be allocated a study number thus keeping your personal details anonymous. The study number will be the only identifier used to analyse the results of the study.

There are no known risks to you if you participate in the study.

By participating, you will help in allowing me to assess the knowledge base of medical practitioners related to blood and blood products and identify whether there are gaps or possible areas of deficiency, which can then be subsequently addressed.

Informed Consent Form

By signing this form, I confirm that

1. I have read the information provided above and the study has been explained to me.
2. I have been given enough time to make my decision and an opportunity to ask questions. All of my questions have been answered to my satisfaction.
3. I agree to participate in this study voluntarily.
4. I understand my right to refuse or withdraw from the study at any stage.

_____

Name of participant

_____ _____

Signature of participant Date

_____

Witness

_____ _____

Signature of witness
Date

APPENDIX D: PERMISSION LETTER FROM CHRIS HANI BARAGWANATH ACADEMIC HOSPITAL

GAUTENG PROVINCE
HEALTH
REPUBLIC OF SOUTH AFRICA

MEDICAL ADVISORY COMMITTEE
CHRIS HANI BARAGWANATH ACADEMIC HOSPITAL

PERMISSION TO CONDUCT RESEARCH

Date: 03 September 2014

TITLE OF PROJECT: Assessment of knowledge of usage of blood and blood products among medical doctors in the Department of Medicine at the Faculty of Health Sciences, University of the Witwatersrand affiliated academic hospitals

UNIVERSITY: Witwatersrand

Principal Investigator: M Laher

Department: Internal Medicine

Supervisor (If relevant): M Patel

Permission Head Department (where research conducted): Yes

Date of start of proposed study: September 2014
Date of completion of data collection: December 2015

The Medical Advisory Committee recommends that the said research be conducted at Chris Hani Baragwanath Hospital. The CEO /management of Chris Hani Baragwanath Hospital is accordingly informed and the study is subject to:-

- Permission having been granted by the Committee for Research on Human Subjects of the University of the Witwatersrand.
- the Hospital will not incur extra costs as a result of the research being conducted on its patients within the hospital
- the MAC will be informed of any serious adverse events as soon as they occur
- permission is granted for the duration of the Ethics Committee approval.

.....
Recommended
(On behalf of the MAC)
Date: 03 September 2014

.....
Approved/Not Approved
Hospital Management
Date: 03/09/14

APPENDIX E: PERMISSION LETTER FROM HELEN JOSEPH HOSPITAL

health and
social development
Department: Health and Social Development
GAUTENG PROVINCE

PERMISION FOR RESEARCH

DATE: 3/6/2014

NAME OF RESEARCH WORKER: Dr Muhammad Luhar

CONTACT DETAILS OF RESEARCH (INCLUDE ALTERNATE RESEARCHER):

luharm@msn.com 084 581 2418 (52494)

mussa.patel@wits.ac.za

TITLE OF RESEARCH PROJECT Assessment of the knowledge of usage of blood and blood products amongst medical doctors in the department of medicine at the Faculty of Health Science, University of Witwatersrand affiliated academic hospitals

OBJECTIVES OF STUDY (Briefly or include a protocol): See attached protocol

METHODOLOGY (Briefly or include a protocol): See attached protocol

THE APPROVAL BY THE SUPERINTENDENT IS STRICTLY ON THE BASIS OF THE FOLLOWING:

(i) CONFIDENTIALITY OF PATIENTS MAINTAINED: Yes

(ii) NO COSTS TO THE HOSPITAL: Yes

(iii) APPROVAL OF HEAD OF DEPARTMENT: Yes

(iv) APPROVAL BY ETHICS COMMITTEE OF UNIVERSITY: ethics pending approval of hospital committee

SUPERINTENDENT PERMISION

Signature: [signature] Date: 2/6/14

SUBJECT TO ANY RESTRICTIONS: Financial impact on the H.J. hospital's budget

Helen Joseph Hospital
Perth Road
Tel: 011 489 1011

Private Bag X47
Auckland Park
2006

APPENDIX F: PERMISSION LETTER FROM CHARLOTTE MAXEKE JOHANNESBURG ACADEMIC HOSPITAL

GAUTENG PROVINCE
HEALTH
REPUBLIC OF SOUTH AFRICA

CHARLOTTE MAXEKE JOHANNESBURG ACADEMIC HOSPITAL

Enquiries:
Ms. L. Mngomezulu
Office of the Clinical Director
Tell: (011): 488-3365
Fax: (011): 488-3753
05th June 2014

Dr. Muhammad Laher
Internal Medicine
CMJAH

Dear Dr. Laher

RE: "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 Witwatersrand affiliated academic hospitals"

Please note that permission to conduct the above mentioned study is provisional approved. Your study can only commence once ethics approval is obtained. Please forward a copy of your ethics clearance certificate as soon as the study is approved by the ethics committee for the CEO's office to give you the final approval to conduct the study.

Supported / ~~not supported~~

Dr. M.I. Mofokeng
Clinical Director
DATE:

Approved / not approved

Ms. G. Bogoshi
Chief Executive Officer
DATE: 7/6/2014

APPENDIX G: ETHICS APPROVAL LETTER

R14/49 Dr Muhammad Laher

HUMAN RESEARCH ETHICS COMMITTEE (MEDICAL)

CLEARANCE CERTIFICATE NO. M140622

NAME: (Principal Investigator)	Dr Muhammad Laher
DEPARTMENT:	Internal Medicine Helen Joseph Hospital, Charlotte Maxeke Johannesburg Hospital Chris Hani Baragwanath Academic Hospital
PROJECT TITLE:	Assessment of the Knowledge of Usage of Blood and Blood Products amongst Medical Doctors at the Department of Medicine at the Faculty of Health Sciences, University of Witwatersrand Affiliated Academic Hospitals
DATE CONSIDERED:	27/06/2014
DECISION:	Approved unconditionally
CONDITIONS:	
SUPERVISOR:	Prof M Patel
APPROVED BY:	Professor P Cleaton-Jones, Chairperson, HREC (Medical)
DATE OF APPROVAL:	06/10/2014

This clearance certificate is valid for 5 years from date of approval. Extension may be applied for.

DECLARATION OF INVESTIGATORS

To be completed in duplicate and **ONE COPY** returned to the Secretary in Room 10004, 10th floor, Senate House, University.

I/we fully understand the conditions under which I am/we are authorized to carry out the above-mentioned research and I/we undertake to ensure compliance with these conditions. Should any departure be contemplated, from the research protocol as approved, I/we undertake to resubmit the application to the Committee. **I agree to submit a yearly progress report.**

Principal Investigator Signature Date 2/10/2014

PLEASE QUOTE THE PROTOCOL NUMBER IN ALL ENQUIRIES

APPENDIX H: POSTGRADUATE COMMITTEE APPROVAL LETTER

GAUTENG PROVINCE
HEALTH
REPUBLIC OF SOUTH AFRICA

CHARLOTTE MAXEKE JOHANNESBURG ACADEMIC HOSPITAL

Enquiries:
Ms. L. Mngomezulu
Office of the Clinical Director
Tell: (011): 488-3365
Fax: (011): 488-3753
05th June 2014

Dr. Muhammad Laher
Internal Medicine
CMJAH

Dear Dr. Laher

RE: **"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 Witwatersrand affiliated academic hospitals"**

Please note that permission to conduct the above mentioned study is provisional approved. Your study can only commence once ethics approval is obtained. Please forward a copy of your ethics clearance certificate as soon as the study is approved by the ethics committee for the CEO's office to give you the final approval to conduct the study.

Supported / ~~not supported~~

Dr. M.I. Mofokeng
Clinical Director
DATE:

Approved / not approved

Ms. G. Bogoshi
Chief Executive Officer
DATE: 7/6/2014

APPENDIX I: TURN-IT-IN LETTER

Division of Haematology, Department of Medicine, Chris Hani Baragwanath Academic Hospital, University of the Witwatersrand, Johannesburg
Chris Hani Road, Diepkloof, Soweto. Tel: +27 11 9339377, Fax: +27 11 9339449, email: moosa.patel@wits.ac.za

23 October 2017

The Chair

Postgraduate Studies Committee

Faculty of Health Sciences

University of the Witwatersrand

Re: Turn-it-in report: Dr Muhammad Laher – M140622. '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'.

As the supervisor of Dr Laher's MMed, I have reviewed the Turn-It-in report of the revised dissertation. The report identifies a similarity index of 9%. I am satisfied that this is within the acceptable limit for such a report.

Thank you

Yours sincerely

Moosa Patel MBChB, FCP(SA), MMed(Wits), FRCP(Lond.), PhD(Wits)

Professor and Head of Clinical Haematology, Department of Medicine, Chris Hani Baragwanath Academic Hospital and the Faculty of Health Sciences, University of the Witwatersrand, Johannesburg, South Africa