

**BLOOD REQUESTS, CROSSMATCH AND
TRANSFUSION PRACTICES FOR ELECTIVE
SURGERY IN KENYATTA NATIONAL HOSPITAL**

**A DISSERTATION SUBMITTED IN PART FULFILLMENT OF THE
REQUIREMENTS FOR THE AWARD OF MASTER OF MEDICINE DEGREE IN
ANAESTHESIA,
UNIVERSITY OF NAIROBI.**

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ACKNOWLEDGEMENTS

I wish to thank the Kenyatta National Hospital and the University of Nairobi research and Ethics committee for allowing me to carry out this study.

I express my gratitude to my supervisors Dr. Patrick Olang Ragot and Professor Walter Mwanda for their patience, invaluable input and counsel.

I would also like to appreciate my research assistant Mr Wanjala for his time and Patience and My statistician Miss Michelle Hassan for her expert guidance.

Finally I am especially grateful to My fiancée Dr Muthoni for being by my side in all the highs and lows of this research work.

DEDICATION

To my parents, Kagunga Kibara and Mary Kibara for raising me with devotion and affection.

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LIST OF ABBREVIATIONS

A-P	Antero-Posterior.
ASA	American Society of Anesthetists
C/S	Caesarian Section.
C/T	Cross-match/transfusion ratio
EBL	Estimated Blood Loss
GS	Group and Save.
Hb	Hemoglobin
HTRs	Hemolytic Transfusion Reactions
I & D	Incision and Drainage.
KNH	Kenyatta National Hospital
MSOBS	Maximum Surgical Blood Ordering Schedule
ORIF	Open Reduction and Internal Fixation
PDA	Patent Ductus Arteriosus
PSARP	Posterior Saggital Anorectoplasty
SBOE	Surgical Blood Ordering Equation
SPSS	Statistical Package for the Social Services
TAS	Transfusion Associated Sepsis.
TRALI	Transfusion Related Acute Lung Injury.
UON	University of Nairobi
V-P	Ventriculo-Peritoneal
VVF	Vesico-Vaginal Fistulae

SUMMARY

This study was carried out over a period of ten weeks between June and August 2011 at the KNH theatres. A total of 370 patients scheduled for elective surgery whose blood had been cross-matched prior to being taken to theatre were recruited into the study.

Majority of requests in the study period were requests for whole blood while requests for other blood products were rarely made. Most surgical teams made requests for two units of blood for the adults for most surgical procedures. Cross-matching of one unit of blood per patient however predominated followed by cross-matching of two units per patient.

Single unit transfusions for adult patients were the most common despite requests for two units being the majority. However in the category of children the average blood volume transfused was 18.9ml/Kg. The overall Cross-match to Transfusion ratio during the study period was 1.42.

Most of the blood that was cross-matched (64.8%) was transfused of the patients was transfused to them. The mean estimated duration blood products were kept out of the cold chain was 17 minutes.

The methods mainly used to reduce the need for pre-operative blood transfusions included use of diathermy, pre-operative hemodilution and use of hypotensive anesthesia. The main transfusion triggers were estimated blood loss, conjunctival pallour and change in haemodynamic status. In the study subjects above 14 years, the mean estimated blood loss triggering transfusion was 750 mls.

The study established that all patients received peri-operative fluids with crystalloid infusions predominating. There was a highly significant relationship($P < 0.001$) between the type of surgery and the total fluid volume infused, the estimated blood loss, number of units requested, units cross-matched, units transfused and units not utilized in theatre. There was a highly significant relationship ($P < 0.001$) between the estimated blood loss and the total volume of fluids infused and a significant relationship ($P = 0.05$) between the pre-operative hemoglobin level and the total volume of fluids infused.

BACKGROUND

Over-ordering of blood for elective surgeries is a common practice. This can be decreased by changing the blood cross-matching and ordering schedule. The ready availability of blood and blood components has resulted in liberal use of blood transfusions. The increasing demand for blood and blood products together with rising costs and transfusion associated morbidity led to a number of studies in the late 1970s reviewing blood ordering and transfusion practices. These studies showed gross over-ordering of blood much in excess of actual or anticipated needs.

Many units of blood routinely ordered by surgeons and anesthetists are not utilized but are held in reserve and thus are unavailable for other needy patients. This can impose inventory problems for blood bank, loss of shelf life and wastage of blood. Recently there has been a growing demand for blood and blood products. This demand has often exceeded the resources of the local blood bank and thereby disrupting both the planning and nature of surgical lists.

Elective surgery commits valuable supplies and resources both in technician time and reagents by demanding large quantities of blood each day. The criteria for ordering blood are often vague and established policies, where they exist, may be outdated since the amount transfused for a given procedure has fallen over the years as surgical and anesthetic techniques evolve. There also exists considerable variability in perioperative transfusion practices. The decision to transfuse should be determined by concerns for tissue oxygenation. Other factors such as to accelerate wound healing and to promote graft uptake are often quoted without a sound scientific basis. Rarely, if ever, is a pre-transfusion haematocrit test performed to aid in the decision to transfuse and rarely is there a post-transfusion haematocrit. Single unit transfusions are still quite common despite evidence that they are seldom necessary.

It is, therefore, necessary to streamline blood ordering and transfusion practices. The use of the C/T (Cross-match/Transfusion) ratio was first suggested by Boral Henry in 1975. C/T ratio is useful for evaluating blood transfusion practices and a ratio of 2.5 was suggested to have been indicative of significant blood usage. A C/T ratio of more than 2.5 means that less than 40% of cross-matches are transfused.

LITERATURE REVIEW

According to Mann and Russell in Bailey and Love's 'A Short Practice of Surgery', indications for transfusion of blood and blood products include to improve oxygen delivery to the tissues and to replace coagulation factors as in some bleeding disorders [1]. Although blood transfusion today is relatively safe, there remain some hazards associated with storage of blood and its transfusion. Machin et al reported the leading causes of transfusion related mortality, in the order of reported number of deaths, as, transfusion-related acute lung injury (TRALI), ABO and non-ABO hemolytic transfusion reactions (HTRs), and transfusion-associated sepsis (TAS). Other than TAS, the infectious causes of death have been declining as a proportion of all deaths caused by allogeneic blood transfusions over the past three decades [2].

Blood is a precious commodity and its proper utilization is the key to efficient management of blood bank resources. Blood and blood components are critical in patient care but are in limited supply and carry numerous risks and significant cost. A careful assessment of the risks and benefits of allogeneic transfusion is essential for a good patient outcome. The risk of transfusion transmitted infections, such as the human immunodeficiency virus (HIV) and hepatitis B and C, malaria, as well as emerging infections, such as the new variant of the Creutzfeldt-Jacob disease, pose a significant threat to those patients needing transfusion. The estimated risks of transfusion have dramatically decreased in recent years as increased test sensitivity has reduced infectious window periods[3]. Advanced blood screening techniques, such as the nucleic acid test, have been introduced to improve the quality of blood products. Hence, it is essential that the usage of blood and blood products be rationalized and they are saved for crisis situations only. Bhutia et al in 1997 while calculating an MSOBS for a major Indian hospital noted that there was gross over-ordering of blood in 10 out of the 21 procedures studied. Three hundred and seventy (40%) of the cross-matches performed were unnecessary. Sixty per cent of the patients studied had blood loss of less than 10% of the total blood volume, therefore, 90% of the cross-matches performed for this group was unnecessary [4].

The preoperative assessment of blood requirements is often an over-assumption as shown by blood bank registers. The consequences of such misuse include expiry of blood, overburdening of blood bank personnel, depletion of blood bank resources, and wastage of time [5-6]. When a blood bag is taken out of the blood inventory for preoperative cross-match, it becomes

unavailable for other patients' use. Many a times the newer blood bags get issued earlier than the older bags, which are kept cross-matched and reserved for elective surgeries.

Considerable variability in transfusion practices exists, both between and within institutions [7-9]. The SANGUIS study, which examined blood product use in 43 European hospitals, found that transfusion rates depended more on physicians than on type of procedure, patient population or hospital [10]. Studies reviewing the appropriateness of red-cell transfusion, based on a variety of criteria, estimate that the proportion of unnecessary transfusions ranges from 4 to 66% [11]. Reasons for the large variability in transfusion practice remain elusive, but clinicians' practices and attitudes may be entrenched and slow to change [12]. Many clinicians continue routinely to transfuse patients to achieve hemoglobin levels greater than 10 g.dl^{-1} [13, 14], despite little scientific evidence to support this practice [15-17].

Blood transfusion is not entirely risk free. The risks of allogeneic transfusions include viral transmission and immunomodulation with implications for tumour recurrence and postoperative infection [18-20]. Operational transfusion errors are a significant cause of morbidity and mortality [21]. Inappropriate blood transfusions expose patients to unnecessary risks and have a considerable economic impact [22]. Up to 70% of all red-cell transfusions are administered to surgical patients during the peri-operative period. Anesthetists and surgeons are responsible for the decision to transfuse in over two-thirds of hospital inpatients. The basis on which they make these decisions is therefore of fundamental importance in determining the use and administration of blood.

The maximum surgical blood ordering schedule (MSBOS) is a list of common elective surgical procedures for which the maximum number of units of blood are cross-matched pre-operatively for each procedure[23,24]. It is basically designed to order enough blood for 85%-90% of patients for each surgical procedure. The ratio of the number of units cross-matched to the number of units actually transfused, that is, C: T ratio should not exceed 2:1 [25]. Although MSBOS have improved the efficiency of blood utilization in many institutions, there are certain drawbacks, the most significant one being the absence of accountability for individual differences in transfusion requirements between different persons undergoing the same surgical procedure[26].

Surgical blood ordering equation (SBOE) is an extended MSBOS incorporating patient and surgical variables, such as pre- and post-operative hemoglobin (Hb) levels of the patient and the amount of surgical blood loss during each surgical procedure[27,28]. By establishing such an SBOE, each surgical team can develop its own transfusion system and set its own transfusion limits. They can also audit the operative blood loss for each procedure [29].

In 2002, a total of 862 survey responses were completed by members of the American Society of Anesthesiologists who provided or directly supervised anesthesia for patients who may have required transfusions. The results were compared to an earlier survey in 1981. In a given week, 62% rarely or never transfused 3 or more units of blood to the same patient. The percentage of anesthesiologists who responded that it is never or rarely (1% or less of the time) necessary to cancel elective surgery because of unavailability of blood products was 96% in 2002. In 1981, 92% responded that it was rarely necessary, and 8% said that it was occasionally necessary. The percentage of anesthesiologists who required patients undergoing elective surgery to have a hemoglobin concentration of at least 10 g/dl decreased from 65% in 1981, to 9% in 2002. 89% of respondents performed hemoglobin or hematocrit determinations either 'routinely' or 'sometimes' before intra-operative blood transfusion. Intra-operative autologous transfusion equipment availability increased from 39% in 1981 to 95% in 2002 ($P < 0.001$) and awareness of the ASA transfusion Guidelines was 72% in 2002 [30].

STUDY JUSTIFICATION

Many elective surgical lists are cancelled due to unavailability of blood in the blood bank or a low pre-operative hemoglobin (Hb) count. A safe Hb is generally considered to be above 10g/dl; usually without considering other patient factors yet there is evidence that most operations can safely be carried out without prior cross-matching or with a pre-operative Hb lower than 10g/dl [14, 30].

Single unit transfusions are also common during elective surgery in KNH although effective transfusion requires a minimum of two units of blood for an adult. According to the national guidelines for the appropriate use of blood and blood products, transfusion of one unit or less in an adult often suggests the transfusion was not necessary[31].

Mugenya in a Masters degree in Surgery thesis (1995) came up with a proposed MSOBS for most of the elective surgical procedures done then in KNH [32]. Even though surgical skills and haemostatic techniques have since improved, a formal MSOBS for KNH was not established.

Thus many patients come to theatre for elective surgery with blood that is kept at room temperature and often returned to the blood bank after the operation that may have lasted many hours. The decision to transfuse is usually made by the anesthetist or surgeon based on an estimate of the blood loss or hemodynamic parameters and sometimes based on an intra-operative haematocrit level. There is great variability between individuals on the decision to transfuse or not.

By studying the blood ordering and transfusion practices at KNH we hope to come up with recommendations that will help standardize the practices, improve efficiency at the blood bank and reduce theatre cancellations.

RESEARCH QUESTIONS

1. What are the current blood requests, cross-match and transfusion practices in elective surgery at KNH?
2. What is the current Cross-match/Transfusion ratio for elective surgery at KNH?

OBJECTIVES

Broad Objective

To determine blood ordering and transfusion practices for elective surgery in KNH.

Specific Objectives

1. To determine blood ordering practices for elective surgery..
2. To determine the Cross-match to Transfusion ratio for elective surgery in KNH.
3. To determine transfusion triggers for elective surgery in KNH
4. To audit any transfusion reactions experienced during transfusion for elective surgery.

MATERIALS AND METHODS

Study Design.

This was hospital based cross-sectional observational study with a consecutive sampling method.

Study Area.

The study was conducted in Kenyatta National Hospital, the largest referral Hospital in Eastern Africa performing about 8500 elective surgeries annually. The Hospital is located in Nairobi City, Kenya.

Study Population.

All patients scheduled for elective surgery who had their blood grouped and cross-matched prior to their surgery. There were categorized as children if they were 14 years and below or adults if they were above 14 years.

Inclusion Criteria

All consenting patients scheduled for elective surgery that came to theatre with cross-matched blood on the day of surgery.

Exclusion Criteria

Patients whose blood had not been grouped and cross-matched pre-operatively.

Patients undergoing emergency surgery..

Eligible patients who opted not to participate in the study.

Sample Size

The sample size was determined using Fisher's formula.

$n = z^2 pq / d^2$ if the study population is $> 10,000$.

Where:

n = Sample size

z = Units of standard deviation corresponding to 95% confidence interval. In this case it is 1.96

q = Prevalence of the population without the characteristic

d = Margin of error. 0.05

p = Prevalence of the characteristic of interest. In the absence of local studies our prevalence of cross-matching for elective surgery was taken to be 50% (0.5).

$$n = (1.96^2) * 0.5 * 0.5 / 0.05^2$$

$$n = 384.16$$

$$n = 384.$$

According to KNH data, about 8500 elective surgeries are performed per year.

$$Nf = n/1 + n/N$$

Where

Nf = The desired sample size (when the population is less than 10,000)

n = The desired sample size (when the population is more than 10,000).

N = Estimate of the population to be studied

$$\text{Therefore, } Nf = 384/1 + 384/8500$$

$$Nf = 384/1.05$$

$$Nf = 365$$

Study Duration

This study was carried out for a duration of 10 weeks, from June to August, 2011 after approval by the KNH/UON Ethics and Research Committee.

Data Collection, Management and Analysis.

Informed consent from study participants and the anesthetists administering anesthesia was obtained on the day of the surgery. Once patients arrived at the theatre receiving area, the principal investigator got consent for the study after ensuring they met the minimum inclusion criteria. He then got informed consent from the patients' anesthetist and explained the questionnaire to him/her. The anesthetists then filled in the questionnaire appropriately.

Data collected included age, gender, pre-operative hemoglobin (Hb) level, estimated blood loss, method used to determine Estimated Blood Loss (EBL), Number of units of blood ordered for, Number of units cross-matched, Transfusion trigger, number of units transfused, types and volume of fluid given before transfusion and the type of surgery performed.

In the estimation of blood loss, the methods used were those routinely used in KNH, namely swab count and suction apparatus reservoir level. It is estimated that a fully soaked gauze roll contains about 150mls of blood while a fully soaked swab contains about 25mls of blood.

The filled questionnaires were then collected at the end of each day by the principal investigator for data entry and analysis.

The anesthesia providers were requested to complete a data sheet which was then collected by the principal investigator on the same day the surgery was done. Additional data on post-operative hemoglobin was collected by the principal investigator 24 hours after the day of surgery. Data analysis was done using SPSS (Statistical Package for the Social Sciences) version 11.5 software.

Assumptions

1. That the methods of estimating intra-operative blood loss were reproducible between different clinicians.
2. All the blood cross-matched for elective surgery accompanied the patient to theatre.

Quality Assurance Measures.

Sampling Bias

Study participants were all consenting elective surgical patients who came to theatre with cross-matched blood. These patients were then consecutively enrolled in the study and they all stood equal chances of being included in the study.

Measurement Bias

The questionnaire was simple and clear. Anesthesia practitioners were trained on the filling of the questionnaires.

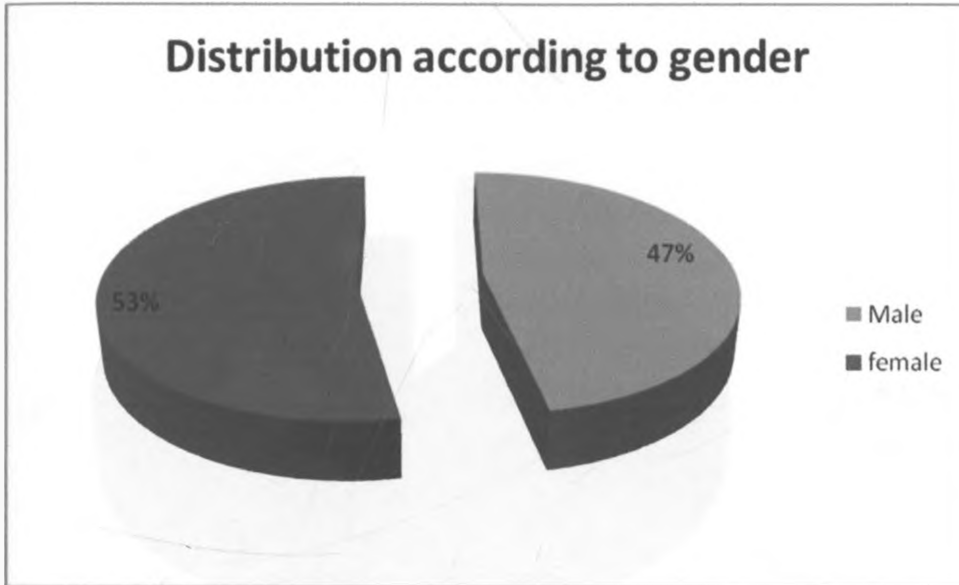
Information Bias

This was minimized through strict adherence to inclusion and exclusion criteria.

STUDY RESULTS

A total of 370 study subjects scheduled for elective surgery were recruited into the study, 47% being male and 53% female.

Figure 1: Pie chart showing sex distribution of the study cases.



Children aged below 14 years were 35 comprising 9.5% of the study subjects with a mean age of 6 years. The study subjects above 14 years were 335 comprising 90.5% of the sample size. Their mean age was 40.7 years.

Figure 2: Pie Chart Showing the Age Category of Study Cases.

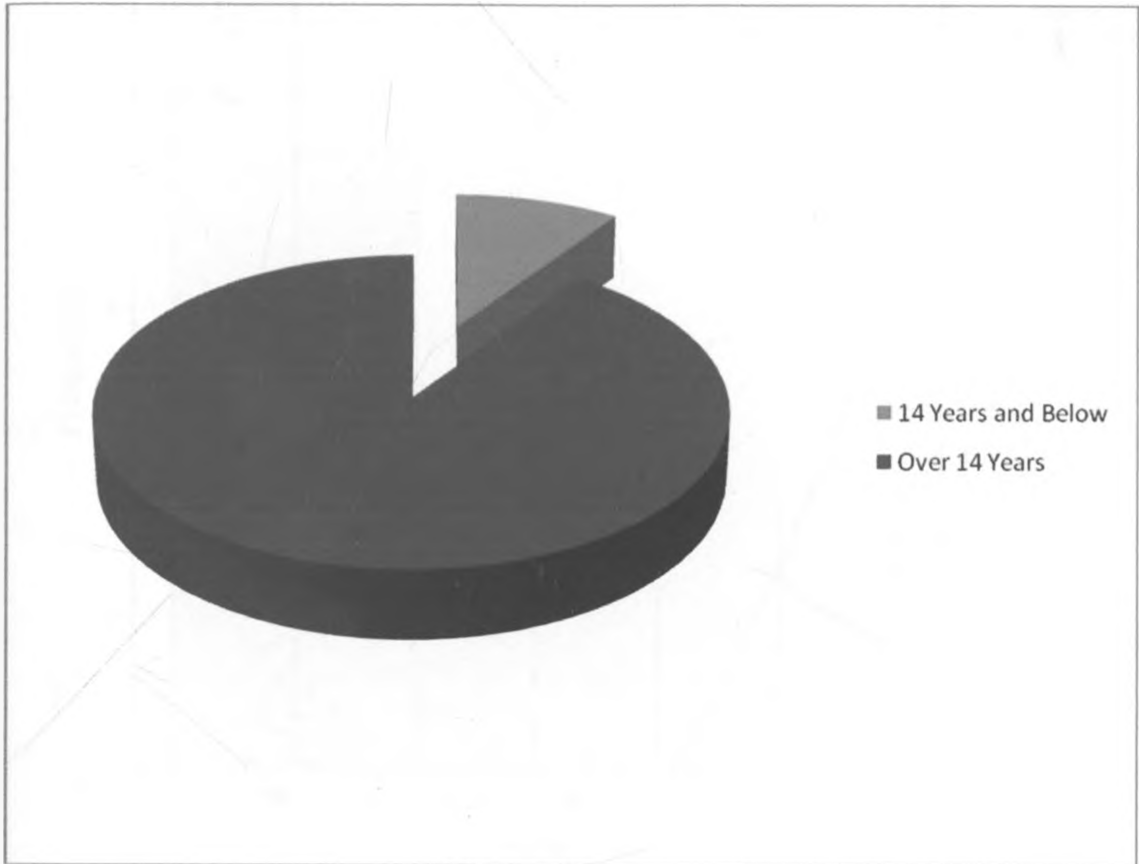


Figure 3: Histogram of age distribution (14 years and below)

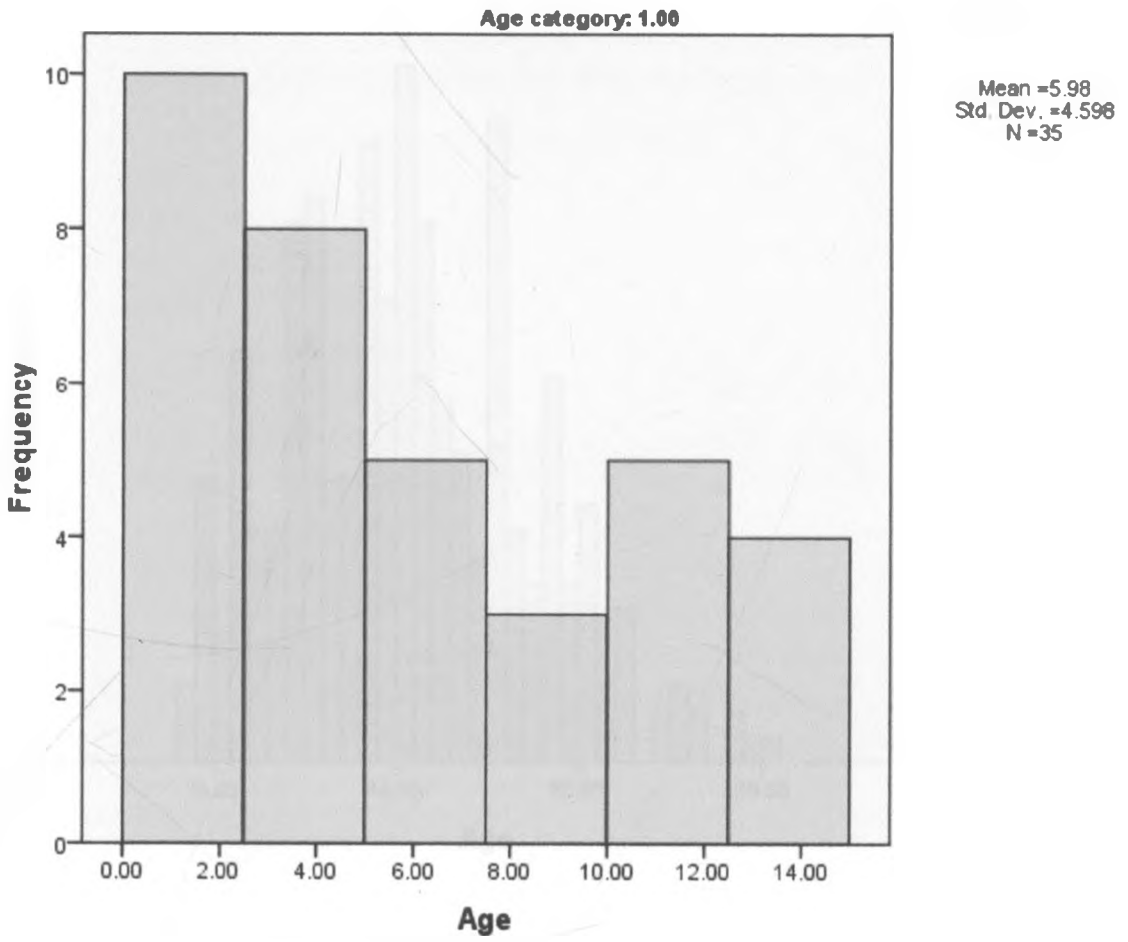
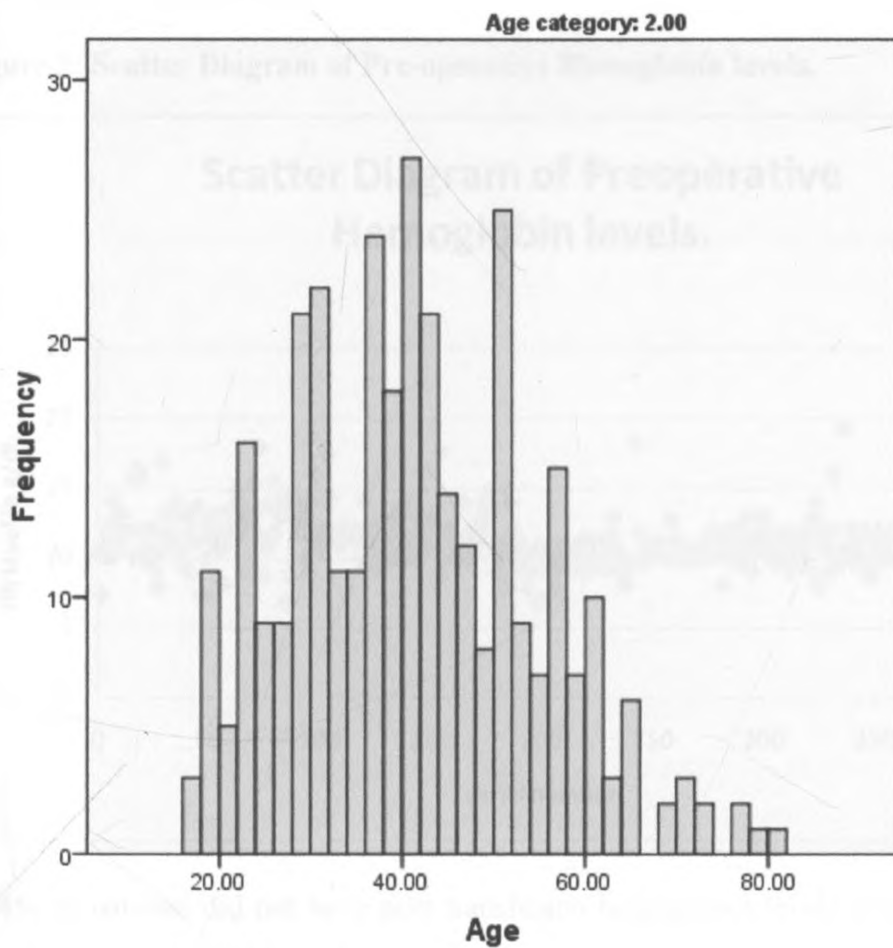


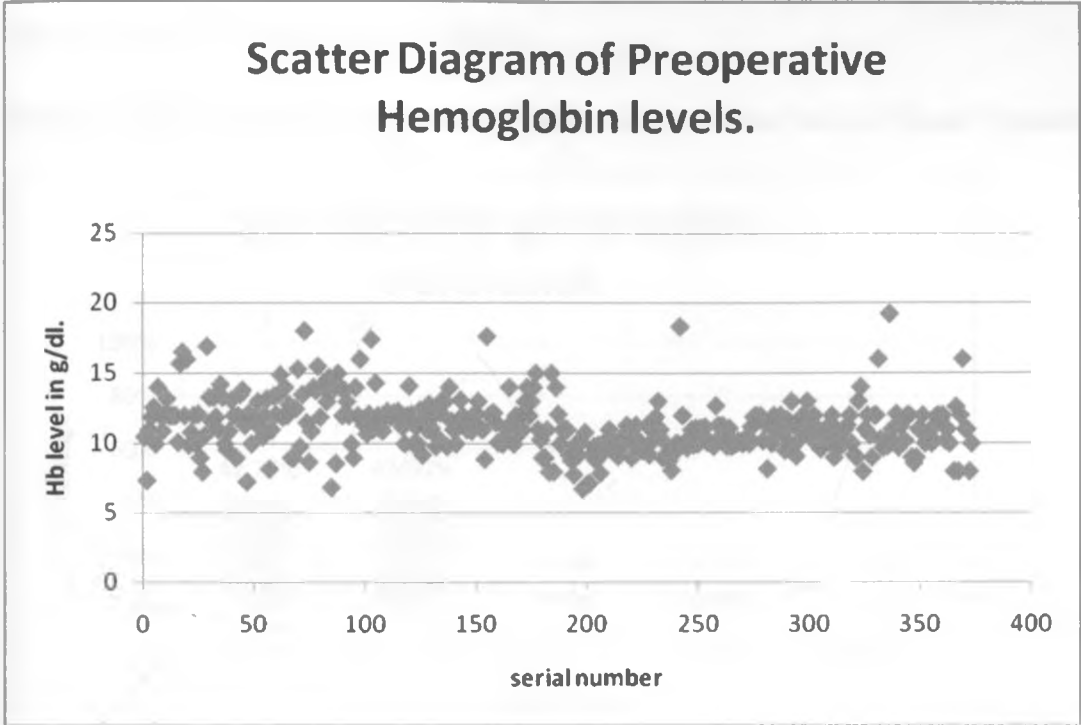
Figure 4: Histogram of Age Distribution (Greater than 14 Years)



Mean =40.71
Std. Dev. =13.205
N=335

The mean preoperative hemoglobin level was 11.2g/dl with a range of 6.8to 19.2 g/dl as shown in the scatter diagram below.

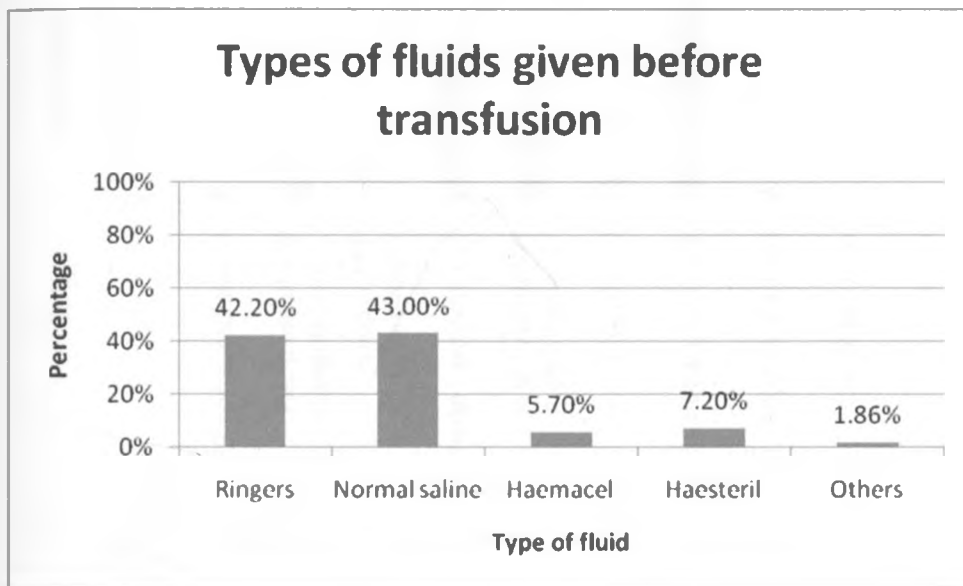
Figure 5: Scatter Diagram of Pre-operative Hemoglobin levels.



92.4% of patients did not have post transfusion hemoglobin levels done soon after their blood transfusions while 85.9% of the transfused patients did not have a check hemoglobin level done 24 hours after transfusion.

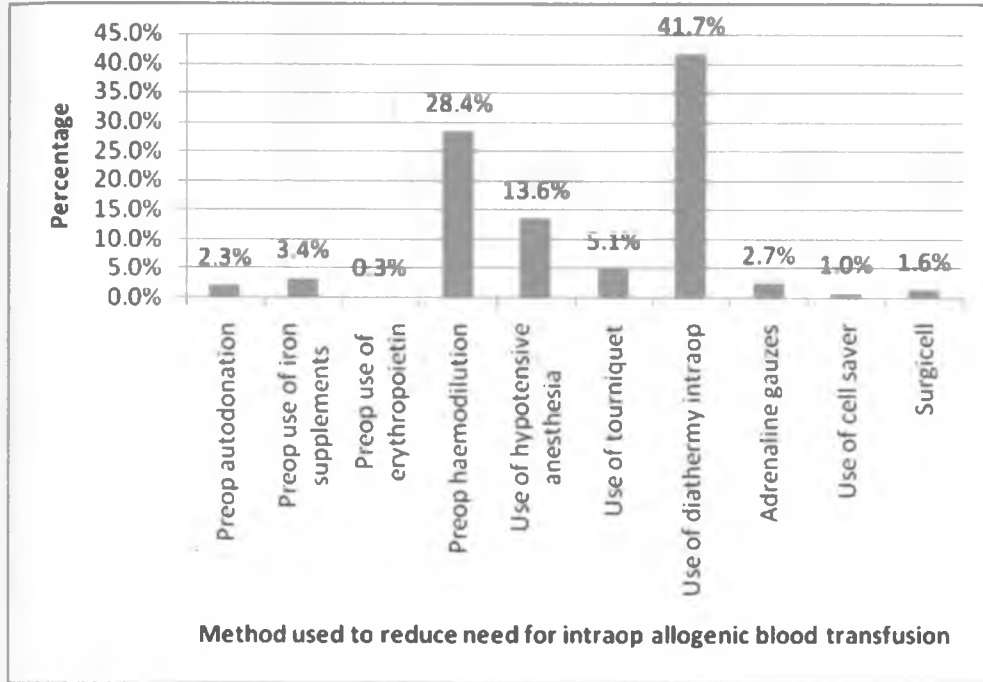
43% of the subjects received Normal saline and 42.2% receive ringers lactate before transfusions. A smaller proportion of study subjects, 12.9%, received colloids. The average volume of crystalloids infused pre-operatively in the adults was 1.5 litres and the average volume for colloids was 0.5 litres in the adult study subjects while the average fluid volume infused in children below 14 years was 17.8 mls/Kg.

Figure 6: Histogram of Intravenous Fluids Administered before Blood Transfusion



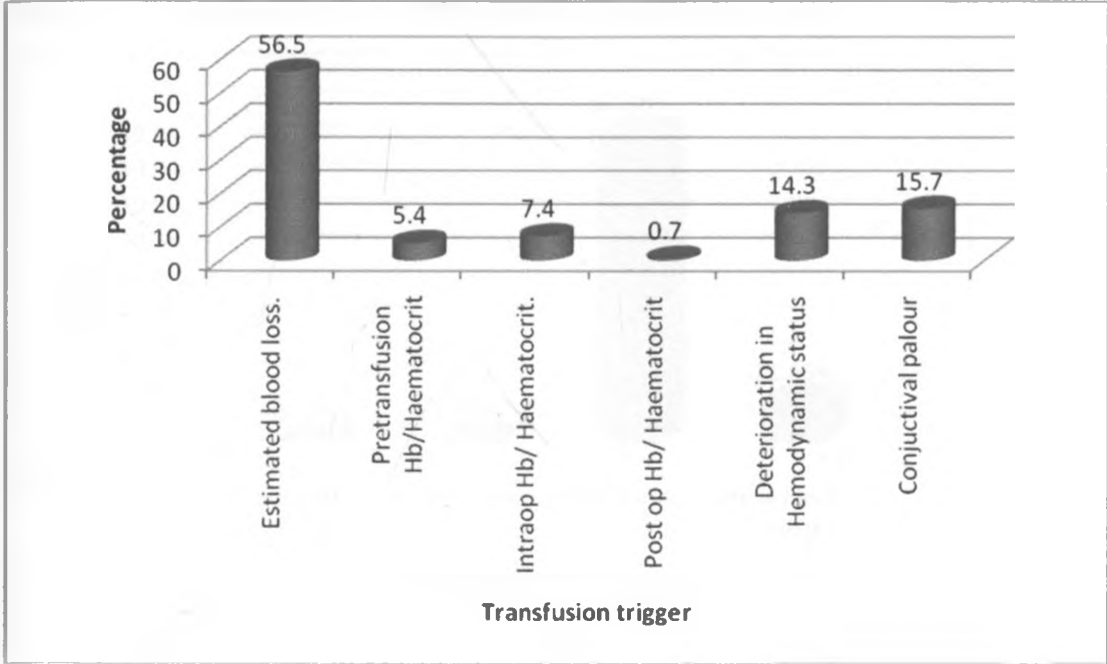
Methods used to reduce the need for pre-operative blood transfusions were sampled in the study. The methods were as shown below.

Figure 7: Histogram of Methods used to reduce the need for intra-operative allogeneic blood Transfusions



During the study, different transfusion triggers were reported. The bar graph below shows the different transfusion triggers as recorded in the study.

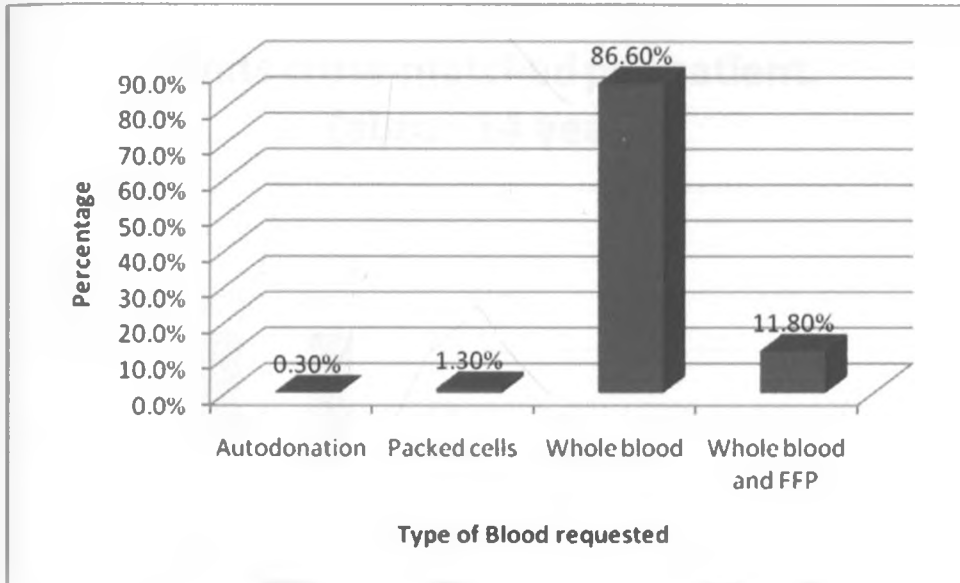
Figure 8: Histogram of The Transfusion Triggers Recorded.



The mean estimated blood loss triggering transfusion in the above 14 years population was 750mls representing approximately 15% of plasma volume. The minimum intra-operative blood loss among these patients was 50mls with the maximum being 4litres.

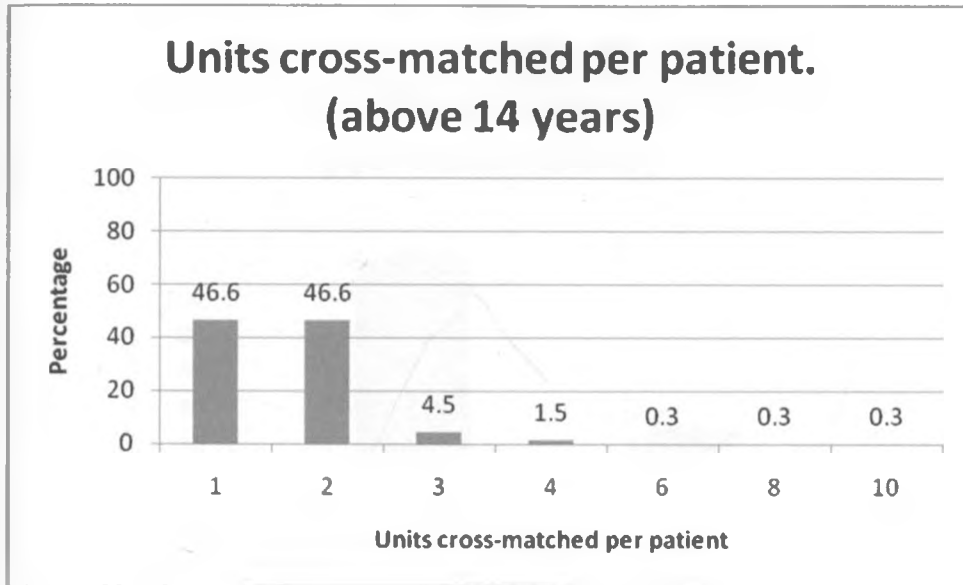
Whole blood was the main type of blood product requested for and transfused. Requests for whole blood and fresh frozen plasma were also common. There was only one request for auto-donated blood.

Figure 9: Histogram of the Type of Blood Products Requested



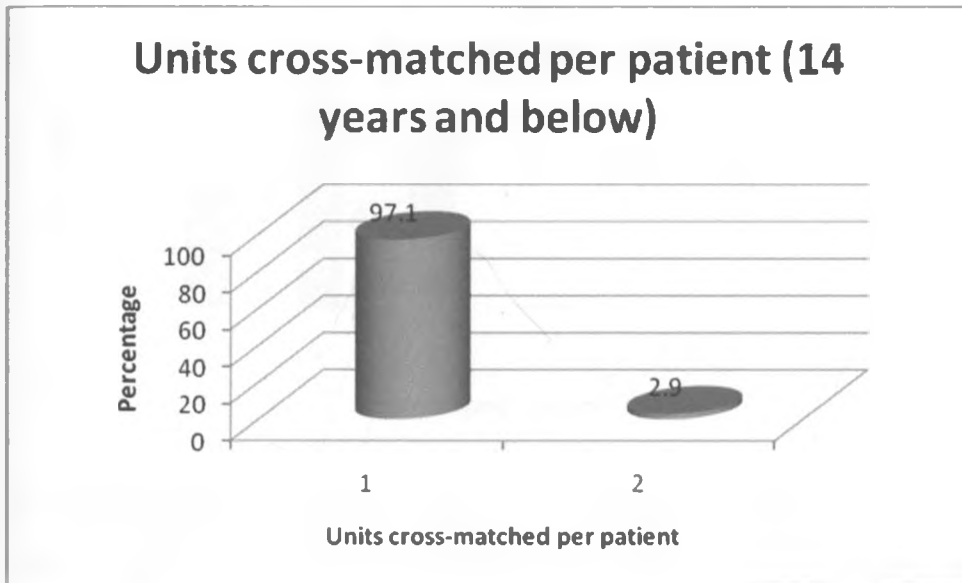
The number of units of blood cross-matched per patientt in the above 14 years population were as shown in the bar graph below.

Figure 10: A Bar Graph Showing the Units of blood cross-matched per patient for the over 14 age category



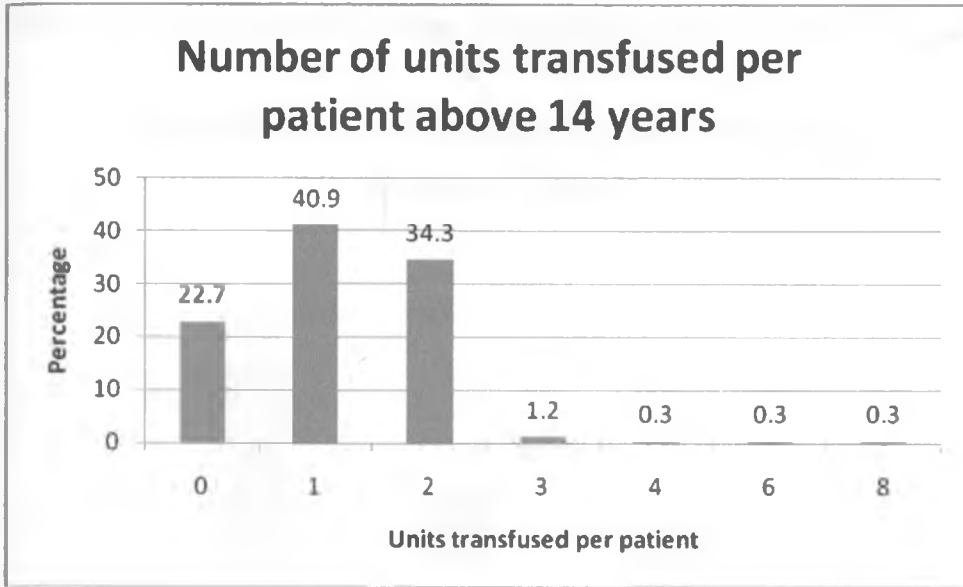
The number of units cross-matched per patient for the under 14 years were as shown in the bar-graph below.

Figure 11: A Bar Graph Showing the Units of blood cross-matched per patient for the 14 years and under age category



The number of units of blood products that were transfused per patient above 14 years are represented in the graph below.

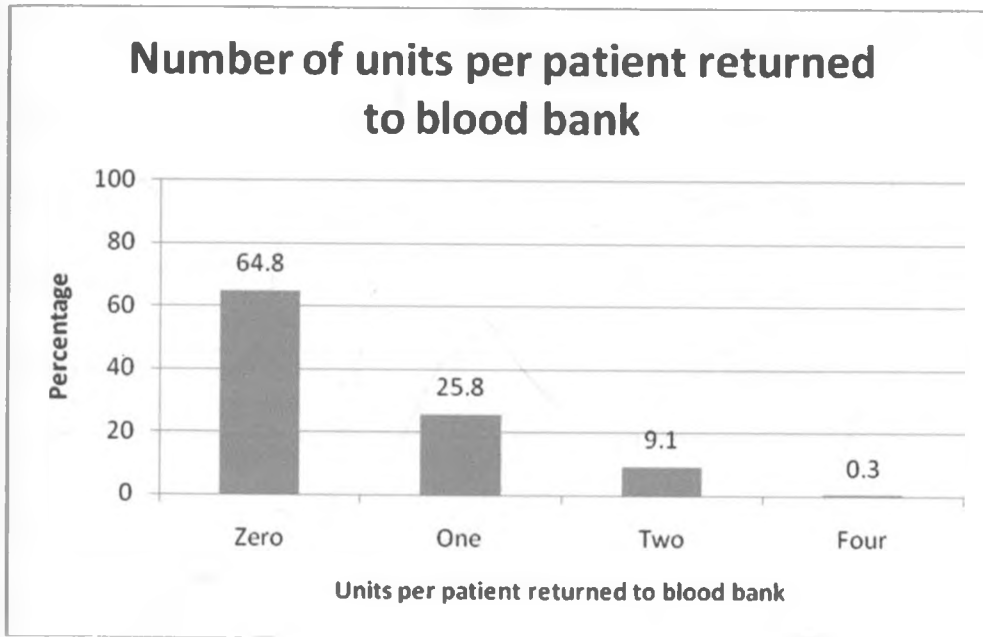
Figure 12: Histogram of units of blood transfused per patient in patients over 14 years



In the children below 14 years of age, the average volume of blood transfused was 18.9 mls/Kg body weight with the minimum volume being 5mls/kg and a maximum volume of 31.25mls/Kg being transfused.

Some of the prepared blood products were not utilized in theatre and were, therefore, as per protocol returned to the blood bank. The numbers of units per study subject returned to the blood bank were as shown.

Figure 13: Histogram of Number of units per patient returned to the blood bank



Blood should be kept refrigerated at 2-8 degrees Celsius. This study audited the duration blood products were kept out of the cold chain. The results were as shown in the table below.

Table 1: A table showing the Duration Blood Products were Kept Out of Cold Chain Storage.

	Duration out of the cold chain
Mean	17.06 seconds
Median	10 seconds
Minimum	0 seconds
Maximum	180 seconds

Table 2: A Summary of C/T Ratios for different Procedures as Calculated from the Study

	Type of operation	Frequen cy	Average number of units cross- matched	Average number of units transfused	C:t ratio	MSBOS recommended in standard haematology practice
1	Above knee amputation	1	1.00	1.00	1.00	GS
2	Adenotonsilectomy	1	1.00	0.00	1.00	0
3	Annuloplasty	1	4.00	2.00	2.00	2
4	A-P resection	1	2.00	0.00	0.00	2
5	Appendicectomy	2	1.00	1.00	1.00	0
6	Below knee amputation	1	2.00	2.00	1.00	2
7	Bone Grafting	1	2.00	2.00	1.00	0
8	Burr hole drainage	4	1.00	0.67	1.50	GS
9	C/S	11	1.55	0.73	2.13	GS
10	Cataract surgery	1	2.00	0.00	0.00	0
11	Colostomy	5	1.40	1.00	1.40	GS
12	Craniotomy	24	1.58	1.04	1.52	2
13	Cystectomy	3	1.67	1.00	1.67	GS
15	Cystoscopy	1	2.00	0.00	0.00	0
16	Debulking of pelvic tumour	10	2.20	2.10	1.05	2
17	Spinal decompression	2	1.50	1.50	1.00	GS
18	Decortication	1	2.00	2.00	1.00	GS
19	Dilatation and curettage	1	1.00	1.00	1.00	GS
20	Urinary diversion	1	1.00	0.00	0.00	2
21	Elevation of depressed skull Fracture	3	1.33	1.00	1.33	GS
22	Escherectomy	24	1.17	0.92	1.27	2
23	Excision of chest wall mass.	1	1.00	1.00	1.00	GS
25	Free flap Reconstruction	1	1.00	0.00	0.00	2
26	Partial gastrectomy	2	1.00	0.00	0.00	2
27	Skin Grafting	8	1.75	1.38	1.27	GS
28	Haemorrhoidectomy	2	1.00	1.00	1.00	0
29	Herniotomy	1	2.00	1.00	2.00	0
30	Hysterectomy	37	1.68	1.32	1.27	GS
31	I & D	5	1.00	0.80	1.25	0

32	Laminectomy	2	1.50	0.00	0.00	GS
33	Laparotomy	38	1.58	1.21	1.30	GS
34	Laryngectomy	3	2.00	2.00	1.00	2
35	Mastectomy	7	1.14	0.86	1.33	0
36	Maxillectomy	1	2.00	2.00	1.00	2
37	Myomectomy	5	1.80	1.40	1.29	2
38	Neck dissection	1	2.00	2.00	1.00	2
39	Nephrectomy	5	1.60	0.40	4.00	2
40	Oesophagectomy	1	2.00	2.00	1.00	2
41	Open Heart Surgery	8	3.50	1.50	2.33	4
42	ORIF	52	1.42	1.02	1.40	GS
43	Osteotomy	1	1.00	1.00	1.00	GS
44	PDA ligation	3	4.00	2.67	1.50	4
45	Perineal Tear Repair	1	2.00	2.00	1.00	GS
46	Prostatectomy	25	1.52	1.36	1.12	2
47	PSARP	3	1.00	0.33	3.00	GS
48	Pull through	2	1.00	1.00	1.00	GS
49	Reconstruction	1	1.00	1.00	1.00	
50	Renal transplant	3	3.00	1.33	2.25	2
51	Sigmoidoscopy	2	2.00	2.00	1.00	0
52	Stenting of ureter	1	1.00	0.00	0.00	GS
53	Thoracotomy	3	1.67	0.33	5.00	GS
54	Lobectomy	1	2.00	2.00	1.00	GS
55	Thyroidectomy	3	1.67	0.33	5.00	GS
56	Total Hip Replacement	1	1.00	0.00	0.00	2
57	Total knee replacement	1	2.00	2.00	1.00	2
58	Total laryngectomy	1	2.00	0.00	0.00	2
59	Tracheostomy	2	1.00	0.50	2.00	0
60	Tuboplasty	13	1.62	0.92	1.75	GS
61	Tumour excision	20	1.70	1.15	1.48	2

1. C: T- ratio. Cross-match to transfusion ratio.
2. MSBOS - Maximum Surgical Blood Ordering Schedule.
3. GS - Group and Save.
4. C/S – Caesarian Section.
5. I & D – Incision and Drainage.
6. PSARP – Posterior Saggital Anorectoplasty
7. PDA – Patent Ductus Arteriosus

The overall Cross-match /Transfusion Ratio for elective surgery in KNH was calculated to be 1.42.

DISCUSSION

Many changes have occurred in transfusion practices in Africa and in Western countries over the years. Blood transfusion remains a key component in the resuscitation of surgical patients suffering from operative losses, trauma, GI bleeding, or obstetrics causes. Nothing has replaced the life saving potential of appropriate transfusion. Increased clinical evidence surrounding appropriateness of transfusion, increased understanding of the risks of transfusion, and better ways of managing these risks have been active topics of discussion in the literature[12,18,22].

In this study there was a slightly higher number of female patients than male patients, perhaps contributed by obstetric and gynecological procedures. The age of the study participants ranged from 10 days to 80 years with a normal distribution curve.

The mean hemoglobin level of 11.2 g/dl could be attributed to the fact that the study only included patients scheduled for elective surgery and therefore most of them had been worked up pre-operatively. It is also important to note that this hemoglobin level is normal for the largest proportion of the population in Kenya. It may be possible, however, that many patients with hemoglobin levels lower than 10g/dl were not included in the elective lists stemming from previous practices where only patients with hemoglobin levels of 10g/dl or higher were considered fit for elective surgery. It has been shown, however, that patients with hemoglobin levels of up to 7g/dl have sufficient oxygen carrying capacity and will withstand most operative procedures not associated with significant blood loss.

Limited scientific evidence on optimal intra-operative fluid management has resulted in large variations in administered fluid regimens in daily practice. Currently, there is a tendency toward liberal peri-operative fluid administration [33]. The stress response to surgery profoundly alters fluid homeostasis leading to fluid conservation. Primary mediators are aldosterone, antidiuretic hormone, and the renin-angiotensin system. However, the effect of different fluid regimens on these hormonal responses to surgery is largely unknown [33]. Although peri-operative administration of high volumes may be deleterious in connection with major surgical procedures[33,34], studies in minor (ambulatory) surgery suggest that fluid substitution aiming to correct pre-operative dehydration may improve some parameters of recovery such as drowsiness and dizziness[35]. Studies done on patients show that restriction of peri-operative

intravenous crystalloid fluid is associated with reductions in morbidity and length of post-operative hospital stay after major abdominal operations [36]. In this study there was a tendency towards liberal fluid administration with an average of 1.5 litres of crystalloids administered per patient. The intra-operative management of fluid therapy has great potential for influencing intra-operative and post-operative morbidity and mortality. Awareness of pre-operative hemodynamic status, particularly as it influences the ventricular output, is critical in avoiding serious cardiovascular complications early in the course of anesthetic induction and maintenance. The implications of anesthetic pharmacology, positioning, thermoregulation, ventilatory support, surgical manipulation, operative site, duration, tissue trauma, and blood loss must be appreciated in determining how much fluid to be administered. Providing sufficient intravenous volume and pre-load is essential for adequate vital organ perfusion. Although quantitative considerations are of primary concern in fluid management, qualitative considerations involving oxygen-carrying capacity, coagulation, electrolyte and acid-base balance, and glucose metabolism are also of critical importance. Chappell et al in a review article published in 2008 concluded thus, "We believe that a classic third space does not exist. Crystalloid overload, as well as iatrogenic deterioration of the vascular permeability barrier, can induce impressive fluid and protein shifting toward the interstitium. Consequently, and in accord with clinical studies, pre-operative volume loading in normovolemic patients and routine replacement of high insensible and third space losses should be abolished in favor of demand-related fluid regimens. An adequate replacement of fluid needs seems to have the power to improve patient outcome and should be considered the therapy of choice to minimize peri-operative fluid shifting." [37]. A definitive answer as to the best solution and volume for resuscitation and maintenance does not exist. Personal preference, cost, and most importantly, individualized physiologic evaluation and approaches will guide clinical practice.

Use of diathermy was the commonest method of reducing intra-operative blood loss. Sheen Chen et al in 1993 demonstrated the effectiveness of diathermy in reducing intra-operative blood losses and numerous studies have since confirmed this finding [38]. Peri-operative hemodilution and hypotensive anesthesia were also commonly employed. Other strategies employed to reduce the need for allogenic transfusions included use of tourniquet, adrenaline gauzes and surgicel (a hemostatic agent made of an oxidized cellulose polymer). Pharmacological methods which included pre-operative use of iron supplements and erythropoietin were also utilized to optimize

pre-operative hemoglobin levels. Despite overwhelming evidence of its effectiveness in reducing the need for allogenic blood transfusion[28,31], autologous blood transfusions were rarely employed in this study. The KNH lacks conventional cell savers in its operating theatres except for the open heart surgery theatre thus perhaps explaining the low use of cell saver in reducing the need for allogeneic blood transfusions.

In this study the commonest transfusion trigger was the estimated blood loss. The minimum estimated blood loss that triggered a transfusion in the study was 20mls. This was in a 3day old neonate undergoing thoracotomy for repair of a tracheo-esophageal fistula. The average estimated blood loss triggering transfusion in the adults was 750 mls represented approximately 15% plasma volume loss in an average adult weighing 70kg. An estimate of blood loss in KNH is derived from the volume of fluid in the suction apparatus and counting of gauzes and swabs soaked with blood after the surgery. Although weighing of gauzes gives a more accurate assessment of blood loss, this is not practiced in KNH. The main shortcoming of this method is its inaccuracy considering that some blood may spill to the floor, be contained within the drapes and that the suction apparatus reservoir will also contain irrigation fluids. Conjunctival pallour and the patients' hemodynamic status were used as transfusion triggers in 15.7% and 14.3% of the cases respectively. Intra-operative hemoglobin level ranked fourth in importance as a transfusion trigger, possibly owing to the lack of laboratory facilities within the operating theatres for hemoglobin testing. Pre-operative hemoglobin level was used to guide transfusion in 5.4% of the patients while a hemoglobin level at the end of the operation was rarely used to prescribe transfusion.

Lena M. N. et al in a review article to develop a clinical practice guideline for RBC (red blood cell) transfusion in adult trauma and critical care recommended thus, "The use of only Hb level as a trigger for transfusion should be avoided. Decision for RBC transfusion should be based on an individual patient's intravascular volume status, evidence of shock, duration and extent of anemia, and cardiopulmonary physiologic parameters"[39]. The European Surgical Society's guideline explicitly states that the hematocrit is not to be used as an indication of resuscitation level. A normal hematocrit can be drawn from a rapidly bleeding patient. It is only once the shock state has been treated, and the vital signs are stable, that hemoglobin levels enter into decisions about further transfusions. With a stable patient, the guidelines both prefer

conservative transfusion triggers, with the European Surgical Society's guideline stating that the target for RBC transfusion is to maintain a hemoglobin of 7 to 9 g/dL and the Eastern Association for the Surgery of Trauma (EAST) guideline stating that a transfusion trigger of 7g/dl is as effective as a transfusion trigger of 10g/dl. It is important to remember that the risk of ongoing bleeding, the patient's ability to tolerate anemia, and the requirements for further surgery all enter into decisions around these guidelines or trigger.

The commonest requests were for whole blood which comprised 86.6% of all requests. Requests for whole blood together with fresh frozen plasma followed at 11.8% of all requests. Requests for packed cells were a paltry 1.3% with even fewer requests for auto-donated blood (0.3%). The World Health Organization reports large differences in the amount of blood collected and transfused worldwide. Annual rates of using blood are 45.4 units per 1000 population in high income countries, 10.1 units per 1000 population in middle income countries, and 3.6 units per 1000 people in low income countries. In high income countries 97% of the blood is processed and used as separate components (i.e. Red cells, platelets, fresh frozen plasma or cryoprecipitate) whereas in low income countries only 28% of donated blood is used as component therapy, and whole-blood transfusion is the norm. Component therapy requires more expensive infrastructure and systems than whole- blood therapy, but it makes more efficient use of a the valuable donated blood by allowing a single unit to address specific needs of multiple patients. This efficiency pertains more to medical than surgical indications. Medical patients may have a specific anemia, thrombocytopenia, or lack of clotting factors whereas surgical patients are typically acutely losing large volumes of whole blood. The greater the blood losses the more necessary it is to restore all components (red cells, platelets, and plasma) in order to prevent coagnj iuulopathy. Blood transfusion in Africa will move towards blood component therapy as time passes by, but from the perspective of blood for surgical use a larger and safer supply is probably the more pressing concern as demonstrated in this study.

In the above 14 years group, requests for two units of whole blood per patient were the majority comprising 67.2% of the requests. Requests for a single unit per patient were 13.7% and requests for 3 and 4 units of blood per patient were 11.9% and 6.3% of all requests respectively. Requests for 6, 8 and 10 units of blood making up 0.3% of the requests were also present. In children below 14 years, requests for a single unit comprised 57.1% of all the requests, requests for two

units comprised 40% of the requests and in one instance in a child who was undergoing open heart surgery, four units of whole blood were requested for. The pattern of requests for children could be attributed to the fact that blood in the KNH blood bank is available in 450 mls packaging only and it is therefore not possible to request smaller quantities of blood. There was a highly significant relationship, ($P < 0.001$) between the type of surgery and the number of units requested, the number of units cross-matched and the number of units eventually transfused. The amount of blood actually cross-matched followed a slightly different pattern with single unit cross-matches per patient in 51.5% of the cases. 2 units per patient were cross-matched in 41.4% of the cases while 3 units and 4 units per individual were cross-matched in 4% and 1.3% of the cases. One unit per child was cross-matched in 97.1 % of the children below 14 years while cross-matching of two units per child was done in 2.1% of the instances. The discrepancy between blood requests and actual cross-matches could be explained by the unavailability of blood forcing blood bank personnel to cross-match less blood than was requested by the surgical teams.

Single unit transfusions predominated in this study comprising 40.9% of all the transfusions done intra-operatively to individuals aged 14 years and above. Transfusion of two units per patient comprised 34.3% of the study sample in that age category. 22.7% of patients who had cross-matched blood ready were not transfused at all. 1.2% of the transfusions were of 3 units and 0.3% of the transfusions, comprising one patient, were of 6 units and 8 units of whole blood respectively. Single unit transfusions therefore continue to be practiced in our institution despite evidence showing that they are seldom useful in adults[31]. In the age category of 14 years and below, an average of 18.9 ml/Kg was transfused with a minimum of 5ml/Kg and a maximum of 31.25ml/Kg being transfused. This is in keeping with standard hematological practice that advocates a minimum of 20ml/Kg of whole blood or 10ml/Kg packed cells for an effective transfusion[31]. A quarter of all cross-matched blood for elective surgery ended up not being transfused to the patients highlighting the need for a strict MSBOS in the institution.

The patient who received 8 units of whole blood intra-operatively was undergoing surgery to repair a right sided arterio-venous malformation of the external jugular vein and the external carotid artery. She had massive bleeding with an estimated blood loss of 4litres. She received 8 litres of crystalloid infusion, 2.5 litres of colloids and 4 litres of blood in theater. She was taken

to the ICU and kept ventilated for at least 24 hours. There were no documented adverse effects from the massive fluid infusions or the blood transfusions and she was eventually discharged from the hospital.

Blood products were out of the cold chain system for a mean duration of 17 seconds and a median duration of 10 seconds with a standard deviation of 21 seconds. A break in the cold chain leads to inactivation of clotting factors and hemolysis as well as encouraging bacterial growth. The national guidelines advocate for a maximum of 30 minutes in which blood should be out of the cold chain storage[31]. Blood products in the duration of this study were transported from the blood transfusion center in ice boxes and then kept in the ice boxes till they were required for transfusion. This means any blood that was eventually not used in theatre was still viable for future use.

There were no documented adverse transfusion reactions from this study. ABO transfusion reactions could have been minimized by the stringent checks in place. Blood from the blood transfusion center is signed out by a nurse from the ward after cross checking with the patients details to ensure it's the right pack. The ward nurse then hands over the blood to the theatre reception nurse who ensures it's the right pack. The theatre reception nurse then hands over the blood to the anesthesia staff in the specific operating room the patient will go to, who will also countercheck the pack. This triple checking virtually eliminates the chances of clerical errors that are the commonest causes of incompatible blood transfusions. The data sheet did not include hemodynamic charting during transfusion and this could have led to acute febrile reactions being missed out. It is however important to note that no platelets, the commonest cause of febrile reactions[18], were transfused in the study.

An overall Crossmatch-Transfusion ratio of 1.42 was calculated from this study

CONCLUSIONS

The Crossmatch-Transfusion ratio for elective surgery at the Kenyatta National Hospital is 1.42.

The transfusion practices for elective surgery at the KNH are largely comparable to internationally expected standards.

Post transfusion Hb level is not routinely done after transfusions during elective surgery at the KNH.

Autologous blood transfusions are under-utilized at KNH for elective surgery.

Estimated blood loss in isolation was the commonest transfusion trigger.

Single unit transfusion is common in elective surgery in KNH

There is efficient use of the cold chain system for transport and storage of blood and blood components.

RECOMMENDATIONS

The hospital transfusion committee should come up with a MSBOS based on this and a previous study as well as available resources to guide blood requests, cross-match and transfusion practices in future.

Similar studies targeting specific disciplines such as orthopedics, cardiothoracic or paediatric surgery will aid the hospital transfusion committee in setting up the MSBOS.

There is a need for clinicians to familiarize themselves with the 'Guidelines for the Appropriate Use of Blood and Blood Products' to standardize transfusion practices

There is need step up the use of autologous transfusions in KNH.

Equipment such as rapid hemoglobin meters and cell savers in theaters will aid in making rational decisions to transfuse and in reducing the need for allogenic blood transfusions.

LIMITATIONS OF THE STUDY.

A shortage of blood in the month of July led to many cancellations of scheduled surgeries prolonging the study duration.

Some transfusion reactions may have been missed due to lack of temperature monitoring equipment in theaters and lack of post-operative follow up.

Absence of post transfusion hemoglobin levels made it difficult to analyze the effectiveness of the transfusions that were done.

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Table 3: Proposed MSOBS for KNH. Dr. George W. O. Mugenya 1995.

Type of operation	Average number of units crossmatched	Average number of units transfused	C:t ratio	Msobs calculated from study	Msobs recommended in standard haematology practice
Cholecystectomy	0	0	0	GS	GS
Exploratory laparotomy	0.9	0.4	2.5	GS	GS
Vagotomy and drainage	0	0	0	GS	GS
Haemorrhoidectomy	0	0	0	GS	GS
Appendicectomy	0	0	0	GS	GS
Closure of colostomy	0	0	0	GS	GS
Fissurectomy	0	0	0	GS	GS
A-P resection	3	3	1	3	2
Herniorrhaphy	0	0	0	GS	GS
Thyroidectomy	0	0	0	GS	GS
Hydrocoelectomy	0	0	0	GS	GS
Urethroplasty	0	0	0	GS	GS
Orchidopexy/Orchidectomy.	0	0	0	GS	GS
Open prostatectomy	2	0.9	2	2	2
Cystotomy	0.5	0	0	GS	GS
Repair of VVF	0.5	0	0	GS	GS
Nephrectomy.	2.2	0.8	2.7	2	2
Thoracotomy (Exploratory, biopsy)	1.7	0.3	4.9	GS	GS
Thoracotomy & Decortication	2.5	1.8	1.4	2	2

Oesophagectomy	2.2	1.7	1.3	2	5
Hellers myotomy	1.2	0.6	2	1	GS
Aortic aneurysm repair	3	1.8	1.7	3	6
Closed valvotomy	1.5	0.3	6	GS	
Craniotomy	3.4	2.1	1.6	3	2
Burr holes	0	0	0	GS	GS
V-P shunt	0	0	0	GS	GS
Laminectomy	0.3	0.3	1	GS	GS
Skin grafting/ Flaps	0	0	0	GS	GS
Varicose vein stripping	0	0	0	GS	GS
Arthroscopy	0	0	0	GS	
Open reduction	0	0	0	GS	
ORIF (With Screws)	0	0	0	GS	
Hip joint prosthesis	2	1	2	2	2
K-nail (femur)	1.4	0.5	2.7	1	2
Plating (femur)	1.7	0.9	1.3	1	2
Plating (Humerus/radius)	0.6	0.4	1.7	GS	
Plating (Tibia/fibula)	0	0	0	GS	
Removal of K-nail (Femur)	0	0	0	GS	GS
Removal of plates (Femur/humerus)	0	0	0	GS	
Amputation (arm/leg/thigh)	0.6	0.5	1.1	GS	GS
Hip joint arthrodesis	2	1	2	2	2
Arthrodesis (other joints)	0	0	0	GS	

Shoulder joint surgery	1	0	0	GS	
Tendon repair	0	0	0	GS	
Osteotomy/Bone excision	0.3	0	0	GS	GS
Meniscectomy	0	0	0	GS	
Sequestrectomy	0	0	0	GS	
Mastectomy	0	0	0	GS	GS

APPENDIX 1: QUESTIONNAIRE

Serial number.....

Patients Particulars , Initials,..... Inpatient number.....Age.....

Gender..... Weight(if known).....

Pre op Hb ,.....g/dl or PCV,%

Pre op diagnosis.....

Intraop diagnosis.....

Type of surgery.

(Eg,laparotomy,herniorrhaphy).....

Type and volume of fluid
given before transfusion,

Fluid type	Volume (mls)
Ringers Lactate	
Normal Saline	
Haemacel	
Haesteril	
5%,10% dextrose solution	
25% dextrose.	
Others.....	

Transfusion trigger. (Tick as appropriate,)

Estimated blood loss.

Pretransfusion Hb/Haematocrit.

Intraop Hb/ Haematocrit.

Post op Hb/ Haematocrit..

Deterioration in Hemodynamic status.

Conjunctival palour

Others (specify).....

Estimated blood loss in mls.

Type of blood product requested.....

Number of units requested.

Number of units cross-matched.....

Number of units transfused.....

Number of units returned to blood bank.....

Estimated duration blood/blood product was in anesthetic tray(Minutes).....

Any transfusion reactions noted.....

Post transfusion Hb.....g/dl or PCV.....%

APPENDIX II: CONSENT EXPLANATION TO THE PATIENT

My names are Dr. Antony Gatheru. I am currently pursuing a Postgraduate degree in Anesthesia and Critical Care.

The Study

You will be undergoing elective surgery and blood has been prepared to be transfused to you if necessary. I am doing a study whose purpose I would like to explain to you.

The purpose of my study is to determine the transfusion practices among our surgical medical staff and see how we compare to International guidelines. To achieve this, data on your age, weight, gender, hemoglobin level and disease condition will be recorded without revealing your identity. We shall also record how much blood loss you experience, how much fluids are administered and how much blood if any is transfused to you.

The results of this study will help us to improve on our transfusion practice during surgery. The results of this study will be made available to you on request.

Participation in the study

Your participation in this study will be voluntary and you may decide to withdraw from it at any stage without any penalty. The study is purely observational, non-invasive and will not attract any additional cost to your treatment. Your participation will not interfere with the regular management of your condition before, during or after surgery. There will be no monetary benefit to you for participating in the study.

Study Approval

This study is being conducted with the approval of The Kenyatta National Hospital /University of Nairobi's Ethical and Research Committee.

Study Procedure

I, the principal investigator, will give you the explanation of the study. The Anesthetist who will administer anesthesia will collect and record the data on my behalf. He /she will also be in a position to offer clarifications to you.

Confidentiality

Your identity will be protected with utmost confidentiality during the study and only your initials and inpatient number will be recorded for purposes of follow up.

Contacts

For any clarifications or queries you may contact me on the telephone numbers 0721654806 or 0733832774.

Thank you.

APPENDIX III: CONSENT EXPLANATION TO THE PATIENT (SWAHILI VERSION)

Mimi naitwa Dkt Antony Gatheru. Ninasomea masomo ya udaktari katika chuo kikuu cha Nairobi.

Utafiti

Unafanyiwa upasuaji leo na damu imetayarishwa kutumiwa kwako kama itahitajika. Utafiti wangu ni wa kuchunguza jinsi madaktari katika hospitali yetu wanatumia damu wakati wa upasuaji. Kuwezesha huu utafiti tutahitaji kujua umri, uzito na jinsia yako. Pia tutaandika kiwango cha damu katika mwili wako na maradhi unayougua, kiwango cha damu utakayopoteza katika upasuaji na maji utakayoongezwa wakati wa upasuaji. Haya mambo yote yatajazwa kwa fomu ya utafiti.

Matokeo ya huu utafiti yatasaidia kuinua kiwango cha matibabu katika hii hospitali na tutaweza kukukabidhi hayo matokeo ya utafiti ukitaka kuyaona.

Kujumuishwa kwako

Kujumuishwa kwako katika huu utafiti kunafanywa kwa hiari yako na unaweza kujiondoa kwa wakati wowote utakao. Utafiti huu hautakugharimu pesa zozote na hautaongeza ada yako ya hospitali. Utafiti hautaingilia matibabu yako kwa vyovyote vile na wala hautapata marupurupu yoyote kwa kujumuishwa katika huu utafiti.

Idhini ya utafiti

Utafiti huu umeidhinishwa na Kenyatta National Hospital/ University of Nairobi Ethics and Research Committee.

Utafiti

Mimi ninayeendeleza utafiti nitakueleza juu ya utafiti. Daktari wako katika chumba cha upasuaji atajaza fomu ya utafiti kwa niaba yangu. Huyo daktari ataweza kukueleza zaidi na kujibu maswali kuhusu utafiti.

Siri

Majina yako, ugonjwa unaougua na mambo yote tutakayojua kukuhusu yatabaki siri.

Kuwasiliana Nami

Kwa maelezo zaidi au malalamishi yoyote, waweza kuwasiliana nami kwa nambari za simu 0721654806 ama 0733832774.

Asante kwa wakati wako.

APPENDIX IV: CONSENT FORM FOR THE PATIENT

I..... (Initials only) have understood the explanation of this study,
**BLOOD CROSS-MATCH AND TRANSFUSION PRACTICES FOR ELECTIVE
SURGERY AT THE KENYATTA NATIONAL HOSPITAL.**

It has been explained to me by Dr. Antony Gatheru, the Principal investigator.

I have freely chosen to participate in this study and understand that whether or not I participate, the care I receive will not be compromised in any way whatsoever.

I also understand that I may choose to withdraw from the study at any stage without any penalty.

Signed..... (Patient)

Signed..... (The Principal Investigator)

Date/...../2011.

APPENDIX V: CONSENT FOR THE ANESTHETIST

Consent explanation.

My names are Dr Antony Gatheru, currently pursuing a postgraduate degree in Anesthesia and Critical Care.

The Study

You will be administering anesthesia for elective surgery and blood has been prepared to be transfused to the patient if necessary. I am doing a study whose purpose I would like to explain to you.

The purpose of my study is to determine the transfusion practices among our surgical medical staff and see how we compare to International guidelines. To achieve this, I am requesting you to fill a questionnaire that I shall explain to you.

The results of this study will help us to improve on our transfusion practice during surgery.

Participation in the study

Your participation in this study will be voluntary and you may decide to withdraw from it at any stage without any penalty. The study is purely observational, non-invasive and will not attract any additional cost to the patient's treatment. Your participation should not influence the regular management of the patient before, during or after surgery. There will be no monetary benefit to you for participating in the study.

Study Approval

This study is being conducted with the approval of The Kenyatta National Hospital /University of Nairobi's Ethical and Research Committee.

Study Procedure

I, the principal investigator, will give you the explanation of the study. You the anesthetist who will administer anesthesia will collect and record the data on my behalf. I will be in a position to offer any clarifications to you.

Confidentiality

Your identity will be protected with utmost confidentiality during the study and at no time will your personal details be recorded in the questionnaire.

Contacts

For any clarifications or queries you may contact me on the telephone numbers 0721654806 or 0733832774.

Thank you.

APPENDIX VI: CONSENT FORM FOR THE ANESTHETIST

I.....(Initials only) have understood the explanation of this study,

BLOOD CROSS-MATCH AND TRANSFUSION PRACTICES FOR ELECTIVE SURGERY AT THE KENYATTA NATIONAL HOSPITAL.

It has been explained to me by Dr. Antony Gatheru, the Principal investigator.

I have freely chosen to participate in this study and understand that whether or not I participate, the care I give will not be compromised in any way whatsoever.

I also understand that I may choose to withdraw from the study at any stage without any penalty.

Signed.....(Anesthetist)

Signed.....(The Principal Investigator)

Date/...../2011.

APPENDIX VII: STUDY APPROVAL



KENYATTA NATIONAL HOSPITAL
Hospital Rd along Ngong Rd
P.O. Box 20723, Nairobi.
Tel 726300-9
Fax 725272
Telegrams: MEDSUP, Nairobi.
Email: KNHplan@KenHealthnet.org
9th June 2011

Ref: KNH-ERC/ A/124

Dr. Gatheru Antony Peter
Dept. of Surgery
School of Medicine
University of Nairobi

Dear Dr. Gatheru

RESEARCH PROPOSAL: "BLOOD REQUEST, CROSS-MATCH AND TRANSFUSION PRACTICES IN ELECTIVE SURGERY AT THE KENYATTA N. HOSPITAL." (P68/03/2011)

This is to inform you that the KNH/UON-Ethics & Research Committee has reviewed and **approved** your above revised research proposal. The approval periods are 9th June 2011 to 8th June 2012.

You will be required to request for a renewal of the approval if you intend to continue with the study beyond the deadline given. Clearance for export of biological specimens must also be obtained from KNH/UON-Ethics & Research Committee for each batch.

On behalf of the Committee, I wish you a fruitful research and look forward to receiving a summary of the research findings upon completion of the study.

This information will form part of the data base that will be consulted in future when processing related research study so as to minimize chances of study duplication.

Yours sincerely,

PROF. A. N. GUANTAI
SECRETARY, KNH/UON-ERC

c.c. The Deputy Director CS, KNH
The Dean, School of Medicine, UON
The Chairman, Dept. of Surgery, UON
The HOD, Records, KNH
Supervisors: Dr. Patrick Otieno Ragot Olang, Dept of Surgery, UON
Prof. Walter Mwanda, Dept. of Pathology, UON