Journal of Health, Medicine and Nursing
ISSN 2422-8419 An International Peer-reviewed Journal
Vol.40, 2017

Evaluation of the Pattern and Outcome of Blood Transfusion in Severely Injured Patients Admitted to a Trauma Intensive Care Unit in Nigeria: Report of Early Results

Dr. S.E.B. IBEANUSI[a], Dr. Z. D. Songden[b],
[a]S.E.B. IBEANUSI[a]. FRCSEd, FWACS, FMCS, MSc (Trauma Surg.),MSc (Crit. Care)
Trauma Surgery Unit, Department of Surgery, University of Port Harcourt Teaching Hospital, Port Harcourt, Nigeria.
[b]Dr. Z. D. Songden FWCAS
Department of Trauma & Orthopaedics, University of Abuja Teaching Hospital Gwagwalada, Nigeria.

Abstract:
Background
Anaemia often necessitating blood transfusion is common in critically ill trauma patients admitted into the Intensive Care Unit. The aetiology of the anaemia in trauma patients is often multi-factorial. It may result from the trauma event, from subsequent investigations and treatment, and or from complications of the injury. Presently, there is limited number of quality studies on blood transfusion and outcome among trauma patients admitted into the intensive care units in Nigeria.
Aim: To evaluate the pattern and outcome of red blood cell transfusion in severely injured adult patients admitted into a trauma ICU in Nigeria.
Method
Prospective observational study without intervention on transfusion pattern and outcome in adult patients admitted to the trauma ICU between October 1, 2010 and July 31, 2011.
Results
One hundred and twenty-two adult patients (31.3%) amongst the 390 patients admitted to the trauma ICU received 357 units of RBC. Most of the transfused patients were between the ages of 20 and 39 years (n = 48 {12.4 %}). The need to receive blood transfusion was strongly related to the severity of injury as assessed by Injury Severity Score (ISS) and Simplified Acute Physiology Score II (r = 0.13, p = 0.013). There was a strong correlation between the units of blood transfused to each patient and the severity of injury (R = 0.3708, $P < 0.00001$) but that association was weakly correlated with the Simplified Acute Physiology Score II Spearman's correlation rho = 0.056, $P = 0.61$). Blood transfusion was also significantly associated with a higher risk of developing a complication (OR {CI} = 6.57 {4.05 – 10.67}) and a statistically insignificant higher risk of death Chi- sq. = 3.703, p = 0.054).
Conclusions: Blood transfusion is a common intervention in severely injured patients admitted to the trauma ICU. Red cell transfusion was directly related to the severity of the injury and was associated with poorer outcome.
Keywords: Anaemia, Trauma, Trauma ICU, RBC transfusion, Outcome.

INTRODUCTION

Background

Blood transfusion has been identified as a potential life saving intervention in properly selected cases. Unfortunately, early transfusions in the 15th century were associated with some catastrophes. James Blundell, an English obstetrician, performed the earliest successful human blood transfusions in the 17th century which resulted in the death of about half of his first ten transfusion recipients Almac &, Ince (2007). Blundell then cautioned that blood transfusion should be reserved for emergencies Blundell (1828) Klein et al (2007).

The practice of blood transfusion since then has been associated with identifiable adverse consequences such as immunological reactions, infection transmissions, haemodynamic overload and biochemical disturbances Vincent et al (2002) Hill et al (2003) Corwin et al (2004) Croce et al (2005). Over the years, with new and growing knowledge on the benefits and observed adverse consequences of blood transfusion, various changes have been made in the practice of blood transfusion Dellinger et al (2008).

The identification of different blood groups by Landsteiner helped to overcome the initial rejections and some of the adverse consequences associated with allogenic transfusion Schwarz & Dorner (2003). Subsequently, concerns relating to the risks of infection transmission of blood borne pathogens such as bacteria (Syphilis), protozoa (malaria), and viruses such as hepatitis viruses and especially the Human Immune Deficiency Virus (HIV) to recipients of blood transfusion came to the fore Love et al (2002) Jackson et al (2003). The risks of the new variant Creutzfeldt–Jakob disease (vCJD) and prion disease associated with blood transfusion have been a growing concern Stoneham & Iqbal (2007). Furthermore, issues of immune modulation

and increased morbidity from transfusion of blood administered to critically ill patients who already have borderline immunity are now matters of concern Vincent et al (2002) Hill et al (2003)Corwin et al (2004) Opelz et al (1997).

Blood transfusion is often inevitable in the critically ill patients in whom anaemia is a common finding Vincent et al (2002), Garrioch et al (2002). Studies confirm that up to 40% of critically ill patients received red blood cell (RBC) transfusion during admission to the intensive care units (ICU) even with the implementation of restrictive transfusion protocols Vincent et al (2002) Garrioch et al (2002). Chohan et al, in an audit found that 55% of patients admitted to the ICU for more than 24 hours have haemoglobin concentrations [Hb] levels less than 90g/L necessitating transfusion in a good number of the patients in an attempt to keep the [Hb] above 100g/L Chohan et al (2003).

The tendency to transfuse blood to critically ill patients in the ICU increases with increased length of stay in the ICU. This has been confirmed by Corwin et al who reported that between 73% and 85% of patients with prolonged stay in the ICU received blood transfusion Corwin et al (1995). MacIver et al derived a mean transfusion requirement of 0.34 units of RBC per day in the ICU MacIver et al (2002). An audit in Scotland found that 90% of patients admitted to the ICU were anaemic at the time of ICU discharge Walsh et al (2006).

Anaemia in critically ill trauma patients may result from overt or occult blood loss, decreased RBC production, increased RBC destruction or spurious anaemia from large volume infusion of resuscitation fluids Mc Lellan et al (2003). Other identified important causes of anaemia in critically ill patients include sepsis Vincent et al (2002) Rogiers et al (1997), decreased production of endogenous erythropoietin and immune associated functional iron deficiency Vincent et al (2002). It has been observed that critically ill patients in the ICU also lose a significant amount of blood during their ICU admission through various other sources von Ashen et al (2001). Phlebotomy for various investigations has been identified as a common source of blood loss in patients admitted to the ICU as patients can lose an. average of 41mls in 24 hours in ICU. Other identified sources of blood loss in critically ill patients include, gastrointestinal bleeding from stress ulceration von Ashen et al (2001), identified bleeding from repeated change of dressings, bleeding from surgical interventions and loses from extra corporeal renal support as other sources of anaemia in critically ill patients Mc Lellan et al (2003).

Reduced life span of RBC in critically ill patients has been suggested Machiedo et al (1989), but there is limited evidence to support this. Impaired erythropoiesis attributed to persistent inflammatory state has been identified in critical illness Danielson (1995)Jongen-Lavrencic et al (1996). This inhibition of RBC formation can be corrected by administering high doses of recombinant human erythropoietin (rHuEPO) Corwin et al (1999).

This article is aimed at evaluating the pattern and outcome of blood transfusion in severely injured and critically ill patients admitted into the trauma ICU of a dedicated trauma centre in Nigeria. The objectives are aimed to determine the pattern of blood transfusion in a trauma ICU in Nigeria, to determine the relationship between blood transfusion and various variables as injury severity, length of hospital stay and mortality in severely injured and ill patients admitted into the trauma ICU.

METHODOLOGY

This is a prospective observational research without intervention between October 1, 2010 and July 31, 2011 at the Teme Hospital Nigeria, following approvals from the relevant Hospital Authorities and Ethical Committee to undertake the study. Since this study was designed as an observational survey without direct intervention or interaction with the patients, waiver for informed consent from the patients was obtained. However, patients' identity remained confidential throughout the study. Information including demography of severely injured patients admitted into the Trauma ICU of the hospital requiring blood transfusion was collected and entered into the case report form designed for the study. The Simplified Acute Physiology II (SAP II) score and Injury Severity Score (ISS) used as objective tool to determine severity of illness was calculated for each patient. This was to ascertain that blood transfusion is not just a marker for severity of injury in the transfused cohort.

All adult patients admitted to the Trauma ICU during the study period were included whereas patients below the age of 18 years, and patients who had received blood transfusion for any reason within the 90 days preceding admission into the ICU were all excluded in the study.

Blood transfusion in this study included patients that received whole blood, sedimented red cell and packed red blood cell (RBC) when available. No patient received blood components such as fresh frozen plasma, platelet component or cryoprecipitate since blood component therapy was not available in the centre or region at the time of this study. All the blood transfused to the patients in this study were duly screened for HIV, HBV, HCV, malaria and Syphilis according to the hospital blood transfusion protocol and World Health Organisation (WHO) Guidelines.

A calculated sample size of 196 patients including the provision for potential 20% attrition was considered adequate to detect significant differences between the patients admitted into the ICU that received blood

transfusion and those that did not. The patients were followed from the ICU through till their discharge from the hospital and up until their trauma and surgical wounds were fully healed.

The outcome measures included the length of ICU stay, length of hospital stay, all cause in-hospital mortality; identified complications among the cohort of patients in the two groups such as sepsis, multiple organ dysfunction syndrome (MODS), wound infection and complications necessitating readmission. Data was managed using Microsoft Excel ® version 2010 (Microsoft Headqtrs Redmond WA, USA) and analysed with statistical package for windows version 20 (IBM SPSS Statistics for Windows, Version 19.0. Armonk, NY: IBM Corp.).

Categorical data were presented with proportions and percentages whereas continuous variables were presented as averages such as in means with standard deviations and median with inter quartile range as considered appropriate. Chi square (X2) was used to test for observed differences for categorical data while Student t-test was used to compare observed differences in means. Correlation analysis was done using Spemann's (rho) and Pearson's correlations as deemed necessary. A p-value of ≤ 0.05 is considered statistically significant.

RESULTS

Evaluation of the collected data shows that a total of 466 patients with severe injury were admitted into the Trauma ICU of the Hospital. Of this figure, only 390 patients who met the inclusion criteria were recruited. One hundred and twenty-two (31.3%) of the included patients were transfused with a total of 357 units of blood. Some of the patients had multiple blood transfusions.

Twenty-eight persons among the recruited patients, who presented with severe head injuries and burns were resuscitated and transferred to other hospitals for more advanced care which is not available in the centre where the study is undertaken. Among this group, 2 patients received blood transfusion before transfer while 26 patients did not.

Age Distribution

Table1. Age distribution

Age group in years	Transfused pts (%)	Non-transfused pts (%)	Total (%)
<20	14 (3.6)	17 (4.4)	31 (8.0)
20 – 29	41 (10.5)	109 (28)	150 (38.5)
30 – 39	31 (8.0)	77 (19.7)	108 (25.7)
40 – 49	17 (4.4)	27 (7.0)	44 (11.4)
50 – 59	6 (1.5)	22 (5.6)	28 (7.1)
>60	13 (3.3)	16 (4.1)	29 (7.4)
Total	122 (31.3)	268 (68.7)	390 (100)
Mean Age	34. 3 ± 11.5	33.8 ± 10.1	

Age range versus average number of units transfused per patient

The age distribution of the patients showed that the age group (20 to 29) years had the highest admission (n = 150 {38.5%}) as well as the highest transfusion rates (n = 41{10.5%}) in the ICU, followed closely by patients between the ages of (30 to 39) years (n = 108 {29.7%}). Only 57 (14.5%) amongst the patients admitted into the Trauma ICU were older than 50 years. Among the patients older than 50 years, 19 persons (4.8%) received blood transfusion (table 1).

Age range	Units transfused per patient
(Age range ≤45)	2.8 ± 1.7 units
(Age range >45)	3.8 ± 2.1 units

Distribution of pre-transfusion [Hb] among the admitted patients

Table 2. Distribution of the pre-transfusion [Hb]

[Hb]	No.	%
< 70 g/L	264	74%
70 – 100 g/L	82	23%
> 100 g/L	11	3%
Total	357	100%

Mean pre-transfusion [Hb] for all patients = 64 g/L ± 11 g/L.

The mean transfusion trigger for patients younger than 50 years = (61 +/- 11) g/L.

The mean transfusion trigger for patients older than 50 years = (64 +/- 14) g/L.

The lowest recorded [Hb] in the ICU for patients that were non-transfused = (107 ± 23) g/L.

Simplified Acute Physiology (SAP) II Score of the patients

Table 3. Distribution of SAP II Score of admitted patients

SAP Score	Transfused (%)	Non- transfused (%)	Total (%)
> 10	51 (13.1)	123 (31.5)	174 (44.6)
10 - 20.	40 (10.3)	98 (25.1)	138 (35.4)
21-30	20 (5.1)	30 (7.7)	50 (12.8)
31 - 40	6 (1.5)	13 (3.1)	19 (4.6)
> 40	5 (1.3)	4 (1.0)	9 (2.3)
TOTAL	122 (31.3)	268 (68.7)	390 (100)
Mean SAP II Score	16.1 ±7.6	13.8 ± 6.1	P = 0.03
Median SAP II Score	13 (8 - 50)	10 (8 - 49)	

The mean SAP II Score for the transfused patients was 16.1 ± 7.6 while that of the patients that did not receive blood transfusion was 13.8 ± 6.1. (P = 0.03)

The median SAP II Score for the transfused groups was 13 (IQR {8 – 50}) while that of the group that did not receive blood transfusion was 10 (IQR {8 – 49}).

Relationship between SAPII Score and nos. of units of blood transfused to patients

SAP II Score	Av. Unit of blood transfused per patient
Less than 15	2.9 units
Greater than 15	3.3 units
P = 0.52	

There was some positive association between the SAP II Score and number of units received by the patients that were transfused - Spearmans correlation rho = 0.056, *P* = 0.61.

Relationship between the Units of blood transfused and severity of injury

The distribution of the Injury severity score (ISS) shows that over half (71 {58.2%}) of the patients admitted into the Trauma ICU who received transfusion had very severe injuries as assessed by ISS greater than 25; and this finding was statistically significant compared to those with ISS ≤25 (p=0.03) (table 4). Also, there was a statistically significant difference in the mean ISS of the transfused patients (24.4 ± 9.3) and of the patients that were not transfused (22.1 ± 7), p = 0.002.

Amongst the group that were transfused, the patients that had very severe injuries (ISS >25) received significantly more units of transfusion per patient (3.5 units), as compared to the patients with ISS less or equal to 25 (2.2 units), p = 0.01. In addition, there was a strong association between Injury Severity Score and the number of units transfused Pearson's Coefficient R = 0.37 R2= 0.138, P = 0.00001

Table 4. Relationship between Injury Severity and blood transfusion

Injury severity status	**Patients Transfused (n, %)**	**Patients Not Transfused (n, %)**	**Total (n, %)**	*p-value*
ISS range ≤25	51 (41.80)	146 (54.48)	197 (50.51)	
ISS range >25	71 (58.20)	122 (45.52)	193 (49.49)	*0.03**
Total	**122 (100.0)**	**268 (100.0)**	**390 (100.0)**	
Mean ISS ± SD	24.4 ± 9.3	22.1 ± 7.0		*0.002**
Median ISS (IQR)	25 (4-57)	20 (4- 50)		

Average frequency of transfusions by ISS	**Nos of units per patient**	
(ISS ≤25)	2.2±0.9 units	
(ISS >25)	3.5±1.1 units	*0.001**

Correlation between ISS and the units of Transfused to each patient

Pearson's coefficient: R = 0.3708, R^2 = 0.1375, P < 0.00001

Frequency of Blood transfusions

A total of 357 units of blood were transfused to the 122 patients that required blood transfusion. Eighty-three patients (68%) received between 1 and 3 units of blood whereas 11 patients (9%) received more than 6 units of blood. Amongst the patients that received more than 6 units of blood only 2 patients qualified into the description of massive blood transfusion as units were given over a longer period. The average frequency of transfusions was 3.3 Units per patients (figure 1).

Relationships between Blood transfusion and lengths of Admission in the Hospital.

As shown in table 6 below, the mean length of stay in the ICU (LOIS) for the patients that received transfusion was 4.4 ± 4.1 days and 3.7 ± 3 days for those that did not receive transfusion. This difference was not statistically significant (p =0.67).

The mean duration of hospital stay (LOS) for the transfused patients and those that had no transfusion were

(21.5 ± 18.7) days and (9 ±7.7) days respectively. This observed difference was statistically significant (p < 0.00001). A review of the length of hospital stay (LOS) showed that 221 patients (56.7%) who were not transfused had LOS less than two weeks as compared with 48 patients (11.3%) who were transfused. Thirty-seven (9.5%) of the patients that had transfusion stayed longer than 28 days, as compared to 22 patients (5.6%) of the patients that were not transfused.

Table 6: Length of ICU admission (LOIS) and Hospital stay (LOS)

LOIS(days)	Transfused	Non- transfused	Total
Mean	4.2 ± 4.1 days	3.7 ±3.0 days	p>0.05
Median LOIS (IQR)	2 days (0.5 – 47)	2 days (0.5 - 65)	

LOS(days)	**Transfused (%)**	**Non-transfused (%)**	**Total (%)**
< 14	44 (11.3)	221 (56.7)	265 (68)
14 -28	41 (10.5)	25 (6,4)	66 (16.9)
29 -42	11 (2.8)	14 (3.6)	25 (6.4)
>42	26 (6.7)	8 (2.0)	34 (8.8)
Total	**122 (100.0)**	**268 (100.0)**	**390 (100.0)**
Mean	**21.5 ± 18.7 days**	**9 ±7.7 days**	

$X^2 = 89.9389$, $P < 0.00001$

Distribution of complications and mortality recorded among the patients

The patients that received blood transfusion in the ICU had more complications as compared to the group that did not receive blood transfusion. The Odd ratio (CI) of having a complication between the patients that received transfusion and those that were not transfused was 16.82 (9.7421 to 29.0614). Some of the observed complications included wound infection (OR = 5.20, CI = 2.9368 - 9.1938), sepsis and septic syndrome (OR = 5.22, CI = 2.0728 - 13.1810), chronic osteomyelitis (OR = 5.90, CI = 1.8100 to 19.1858), and readmission (OR = 4.58, CI = 2.1197 - 9.9007). The risks for the listed complications were significantly higher amongst the patients that were transfused as compared to those that did not receive blood transfusion (p < 0.001) (p = 0.12). Other complications included pneumonia, compartment syndrome, neuropathic pain and blood transfusion reactions (table 7).

Table 7. Distribution of recorded complications and risk of death among the patients.

Complication	Transfused	Non-transfused	Total	Odd ratio	Confidence Interval	P -value
Sepsis / septic syndrome	15	7	22	5.22	2.0728 - 13.1810	< 0.0001
Wound infection	40	23	63	5.20	2.9368 - 9.1938	< 0.0001
Chronic osteomyelitis	10	4	14	5.90	1.810 - 19.186	0.003
Readmission	20	11	33	4.58	2.1197 - 9.9007	<0.0001
Others	15	12	27	2.99	1.3547 - 6.6023	<0.001

Table 8. Relationship between blood transfusion and mortality among the patients

Status of patient	Transfused	Not –Transfused	Total
Dead	3	1	4
Survived	119	267	386
Total	122	268	390

$X^2 = 3.593$, $P = 0.058$

DISCUSSION

The result of this study shows that 31.3% of the patients (n= 112) admitted into the trauma ICU received red blood cell (RBC) transfusion at various times during the course of their admission. Reasons for transfusion in trauma patients may be related to acute blood loss from the initial injury, post trauma interventions for investigations and treatment, continuing blood loss related to the injury and development of complications such as severe sepsis or organ failure Vincent et al (2002) Rogiers et al (1997).

The result from this study corroborates the findings of Corwin et al Corwin et al (2004) which reported that 55% of trauma patients admitted into the ICU had transfusion as compared to non-trauma subsets. Vincent et al had reported that 37% of patient admitted into the 1CU had blood transfusion during their first 28 days of ICU admission Vincent et al (2002). Hebert et al reported that 25% of their patients were transfused in the ICU Hébert et al (1999). Dasta et al had reported a transfusion rate of 44% Dasta et al (2008), while Vincent et al in Sepsis Occurrence in Acutely ill Patients (SOAP) study, reported a transfusion rate of 33% in patients admitted

into the ICU in European hospitals Vincent et al (2008).

Various authors had reported transfusion rates ranging from 25% to 44% in patients admitted into the ICU Vincent et al (2002), Hébert et al (1999), Dasta et al (2008), Vincent et al (2008). Transfusion in patients admitted to the ICU in most centres is often dictated by the "pre-transfusion trigger" which is the [Hb] level set to initiate blood transfusion by various ICU and hospitals as part of transfusion protocol. The mean pre-transfusion [Hb] observed in this study (64 ± 11g/L) was in keeping with the recommendations of Napoliteno et al that transfusion should be considered when the [Hb] drops below 70g/L in stable patients admitted to the ICU Napolitano et al (2008), but contrasts with the suggestions by Czer et al who hypothesized 32% as an optimal haematocrit for transfusionCzer et al (1978). Simon and colleagues even recommended that until [Hb] dropped to 60 g/L, transfusion should be withheld Ahmed et al (2007). The pre-transfusion [Hb] of 64 g/L recorded in this study conforms well to the recommendation of Simon and colleagues Ahmed et al (2007) and indicates a more prudent and pragmatic approach to transfusion in critically ill trauma patients admitted into the ICU. The reasons for this lower transfusion trigger in this study may be attributed to the relative scarcity in the availability of quality allogenic blood in the region Wahl et al (2008) and to the fact that most of the patients in the study group are younger as evident by the lower mean age of the patients as such fewer of patients in the study group had associated co-morbidities. In addition, the hospital insist on strict adherence to the implementation of the hospital's protocol which recommends transfusion only in those with a [Hb] lower than 70g/L, patients with symptomatic anaemia, or in cases of ongoing blood loss.

The age distribution of the patients in this study clearly demonstrated that the young and active males constituted the majority of those admitted into a trauma ICU because of higher risk exposure. This may not be the case in the medical ICU where the patients are usually older and admitted for chronic medical conditions. The results showed that the older patients admitted into the ICU were more likely to receive blood transfusion. There was also an observed trend towards higher dose and frequency of transfusion among the patients older than 45years (table 1). This observed trend was not statistically significant ($p > 0.05$). Amongst the group that received blood transfusion, the patients older than 45 years had an average transfusion of 3.8 ± 2.1 units per patient as against 2.8 ±1.7 units per patient for persons younger than 45 years ($p = 0.15$). This pattern was also the common observation by various studies Vincent et al (2002), Corwin et al (2004), Wahl et al (2006).

The total number of transfusions recorded was 357 units among the 122 patients that received blood transfusion and the mean number of RBC transfusions was 3 units per patients. In a similar study, Cohen et al reported a mean transfusion frequency of (3 ± 2.9) units per patient Wahl et al (2006). Shapiro et al had reported a mean transfusion frequency of 4.8 units per patient Shapiro et al (2003) while Vincent et al had reported a mean transfusion frequency of 2.2 per patient Vincent et al (2008). The patients in Shapiro et al Shapiro et al (2003) and Vincent et al Vincent et al (2008) were older, had more co-morbidity and were made up of persons with conditions other than trauma.

The adoption of SAP II Score and ISS as objective toll for comparison of the two groups was an attempt to ensure that patients with similar characteristics are compared. It also allowed for the determination of the variation in the transfusion requirements among the patients with different severity of illness as assessed by ISS and SAP II score. There was no statistically significant difference in the mean SAP II score between the cohorts that received blood transfusion and the group that did not (16.1 ± 7.6 versus 13.8 ± 6.1, $p = 0.03$), however there was a weak correlation between the SAP II score and the number of transfusions among the group that received blood transfusion (Spearman's correlation coefficient = 0.06, $p > 0.05$).

Amongst the patients that had transfusion, the patients with SAP II scores higher than 15 received higher numbers of transfusions with a mean number of transfusions of 3.3 units per patient as compared to the 2.9 units per patients for the groups with SAP II score less than 15. This observed difference was not statistically significant, $p = 0.52$. This observed pattern was similar to that reported by Vincent et al Vincent et al (2008) which showed significantly higher SAP II score for patients who were transfused as against those that were not transfused (40.2 Versus 34.7, $p < 0.001$). The patients studied by Vincent et al were older and more ill Vincent et al (2008).

In this study, the risk of having a complication such as wound infection, septic complications such as septic shock and multiple organ dysfunction or readmission for re-intervention was strongly related to blood transfusion, $p < 0.001$. The odd ratio (OR) and CI of having any particular complication between the group that were transfused and those that were not was 16.82 (9.7421 to 29.0614). Similar results had been reported by Corwin et al Corwin et al (2004), Vincent et al (2002), and Vincent et al (2008).

The occurrence of infective complications among the transfused patients confirmed the results from the meta- analysis by Hill et al Hill et al (2003) which reported an association between allogenic blood transfusion and the risk of developing post-operative bacterial infection (OR 3.45; CI = 1.43- 15.15). Hill and colleagues had concluded that this risk of infection is greater in trauma patients that received allogenic blood transfusion than patients with elective surgical condition Hill et al (2003). What was more striking is that all the 28 studies included in that meta-analysis by Hills et al Hill et al (2003) recorded higher infection rates among patients that

received allogenic blood transfusion. Hills and colleagues therefore suggested that allogenic blood transfusion may be an additional factor in the immune-suppression commonly observed in the post-operative trauma victims Hill et al (2003).

Some of the complications had been attributable to presence of leucocytes and some cytokines in the transfused blood Klein et al (2007) Vincent et al (2008). Vincent et al in the SOAP study Beale et al (2006) utilized the similar approach and methods as in their earlier study Vincent et al (2002) but found different results. The authors attributed the difference in the results as partly due to the use of leuco-depleted blood in most of the transfusions (76%) in the later study Vincent et al (2008) as compared to 46% in their earlier study Vincent et al (2002) Since this current study utilized whole blood and sedimented RBC which were not leuco-depleted, it would imply higher complication rates if leuco-depletion was the reason for the differences in the outcome between two studies by Vincent and his colleagues.

The lower infection and sepsis rates recorded in this study as compared to the results of Vincent and colleagues Vincent et al (2008) may be attributed to the fact that the recruited patients were less ill as assessed by mean SAP II score of 13 and 10 for transfused and non-transfused patients respectively as compared to 40.2 and 36.5 for transfused patients respectively in Vincent et al Vincent et al (2008). In addition, the patients in Vincent et al were older (mean age, 61± 17 years) as compared to (34 ± 11) years in this study. In addition, up to 50% of the patients in the study by Vincent and colleagues had associated co-morbidity Vincent et al (2008). A closer look at the incidence of complications showed that occurrence of wound infection, septic complications and other infections was strongly associated with the number of units of blood transfused (Pho – correlation = 0.690, $p < 0.001$). This is similar to the results reported by other authors Wahl et al (2006) Beale et al (2006). Whether the observed higher complications and mortality among the transfused patients as compared to the non-transfused patients is actually due to the blood transfusion and not because the transfused patients were more severely injured as such more ill, cannot be categorically ascertained from this study because of the inherent weakness in the study design. Better designed study preferably randomized clinical trial is recommended to determine the cause and effect relationship between blood transfusion and outcome.

CONCLUSION

Anaemia is a common findings necessitating allogenic blood transfusion in about 30% of injured patients admitted to a trauma ICU in Nigeria. Patients with higher severity of injury as assessed by ISS and SAPII Scores among the patients admitted to the trauma ICU and patients older than 45years have higher tendency to receive blood transfusion both in dose and frequency of transfusion.

Blood transfusion was significantly associated with poorer outcome as evidenced by longer in-hospital stay, longer ICU stay, occurrence of complications such as wound infection, septic complications, higher risk of readmission and death.

In view of the risk of poorer outcome associated with blood transfusion, higher cost of care, and potential risk of transfusion transmitted infection, there is every need to re-evaluate the current transfusion practices especially in regions of scarce resources and limited availability of quality allogenic blood like Nigeria.

DECLARATIONS:

The authors wish to categorically state that this manuscript, including related data, figures and tables has not been previously published and the manuscript is not under consideration elsewhere.

All the information contained in this manuscript are original except otherwise clearly stated and duly acknowledged.

Ethics approvals and consent to participate: Study was approved by the Research and Ethical Review Committee of Teme Hospital Limited.

Consent for Publication: Not applicable

Availability of data and material: The data that support the findings of this study are available from the authority of International Centre for Advanced Medical Care and Development (ICAMCAD) but restrictions apply to the availability of these data, which were used under license for the current study, and so are not publicly available. Data are however available from the authors upon reasonable request and with permission of the authority of International Centre for Advanced Medical Care and Development.

Funding: None

Conflicting interests: None

Authors' contributions: All the authors made substantial contributions in the study design, study implementation and write up.

Acknowledgements:

We acknowledge the Board and Management of International Centre for Advanced Medical Care and Development for allowing us access to the data from their trauma registry.

REFERENCES

Ahmed SG, Ibrahim UA, Kagu MB. (2007). The burden of HIV and AIDS on blood bank reserves in northeast Nigeria. *Transactions of the Royal Society of Tropical Medicine and Hygiene*, 101: 618—620.

Almac E, Ince C. (2007). The impact of storage on red cell functions in blood transfusion. *Best Practice & Research Clinical Anaesthesiology* 21(2): 195–208.

Beale E, J Zhu, L Chan, et al (2006). Blood transfusion in critically injured patients: A prospective study. *Injury*, 37: 455 – 465.

Blundell, T (1828). Experiments on the transfusion of blood by the syringe. M. Clin. Tr. *9*:56.

Chohan SS, NcArdle F, McClelland SJ, et al (2003). Red cell transfusion practice following the transfusion requirement in critical care (TRICC) study: prospective observational cohort study in a large UK intensive care unit. *Vox Sang*, 84: 211 – 8.

Corwin HL, Gettinger A, Pearl RG, Fink MP, Levy MM, Abraham E, MacIntyre NR, Shabot MM, Duh MS, Shapiro MJ. (2004). The CRIT Study: anemia and blood transfusion in the critically ill-current clinical practice in the United States. *Critical care medicine*. 32(1):39-52.

Corwin HL, Gettinger A, Rodriguez RM, et al (1999). Efficacy of recombinant human erythropoietin in the critically ill patient: a randomized, double-blind, placebo-controlled trial. *Crit Care Med*, 27: 2346–2350.

Corwin HL, Parsonnet KC, Gettinger A. (1995). RBC transfusion in the ICU: Is there a reason? *Chest* 108: 767–771.

Croce MA, Tolley EA, Claridge JA, et al. (2005). Transfusions result in pulmonary morbidity and death after a moderate degree of injury. *J Trauma*. 59: 19 –23.

Czer LS, Shoemaker WC. (1978). Optimal hematocrit value in critically ill postoperative patients. *Surg Gynecol Obstet*. 147: 363–368.

Danielson B. (1995). R-HuEPO hypo responsiveness – who and why? Nephrol Dial Transplant, 10 (2): 69 – 73.

Dasta J, Mody SH, McLaughlin T, LeBlanc J, Shen Y, Genetti M, et al. (2008). Current management of anemia in critically ill patients: analysis of a database of 139 hospitals. *American journal of therapeutics.* 15(5):423-30.

Dellinger RP, Levy MM, Carlet JM, Bion J, Parker MM, Jaeschke R, Reinhart K, Angus DC, Brun-Buisson C, Beale R, Calandra T. (2008). Surviving Sepsis Campaign: international guidelines for management of severe sepsis and septic shock: 2008. *Intensive care medicine*. 34(1):17-60.

Garrioch M, Walsh TS, McIver C, et al, (2002). Red blood cell use in Intensive Care in Scotland (the ATICS study). *Transfus Med*, 12(1): 6 – 14.

Hébert PC, Wells G, Martin C, Tweeddale M, Marshall J, Blajchman M. (1999). Variation in red cell transfusion practice in the intensive care unit: a multicentre cohort study. *Critical Care*. 3(2):1.

Hill GE, Frawley WH, Griffith KE, Forestner JE, Minei JP. (2003). Allogeneic blood transfusion increases the risk of postoperative bacterial infection: a meta-analysis. *Journal of Trauma Injury Infection And Critical Care*. 54(5):908-14.

Jackson BR, Busch MP, Stramer SL, AuBuchon JP. (2003). The cost‐effectiveness of NAT for HIV, HCV, and HBV in whole‐blood donations. *Transfusion*. 43(6):721-9.

Jongen-Lavrencic M, Peeters HR, Rozemuller H, Rombaths WJC, Martens ACM, Vreudgenhill G, et al. (1996). IL-6 Induced anaemia in rats: possible pathogenetic implications for anaemia observed in chronic inflammations. Clin Exp Immunol, 103: 328 – 334.

Klein HG, Spahn DR, Carson JL. (2007). Red blood cell transfusion in clinical practice. The Lancet. 10;370(9585):415-26.

Love E, Soldan K, Jones H. et al: (2002). The Serious Hazards of Transfusion Steering Group. Serious Harzards of Transfusion. 2000/2001 Annual Report. London.

Machiedo GW, Powell RJ, Rush Jr BF, et al. (1989). The incidence of decreased red blood cell deformability in sepsis and the association with oxygen free radical damage and multiple-system organ failure. *Arch Surg* 124: 1386–1389.

MacIver C, Walsh TS, Lee RJ, et al. (2002). Pre-transfusion haemoglobin concentration in critically ill patients. *Vox Sang*, 83(2): 134 – 139.

Mc Lellan S A, McClelland DBL, Walsh TS. (2003). Anaemia and red blood cell transfusion in the critically ill patient. *Blood Reviews*, 17: 195–208.

Napolitano LM, Kurek S, Luchette FA, et al. (2009). Clinical practice guideline: red blood cell transfusion in adult trauma and critical care. *Crit Care Med*, 7: 3124 – 57.

Opelz G, Vanrenterghem Y, Kirste G, Gray DWR, Horsburgh T, Lachance J-G, et al. (1997). Prospective evaluation of pretransplant blood transfusions in cadaver kidney recipients. Transplantation, 63: 964–967.

Rogiers P, Zhang H, Leeman M, et al. (1997). Erythropoietin response is blunted in critically ill patients. *Intensive Care Med*, 23:159 – 162.

Schwarz HP, Dorner F. (2003). Historical review: Karl Landsteiner and his major contributions to

haematology. Br J Haematol. 121:556-565.

Shapiro M J, Gettinger A, Howard L. et al. (2003). Anemia and Blood Transfusion in Trauma Patients Admitted to the Intensive Care Unit. *J Trauma*, 55: 269 –274.

Stoneham M, Iqbal R. (2007). Clinical strategies to avoid blood transfusion. *Anaesth Intens Care Med* 8(2): 52 – 55.

Vincent JL, Baron JF, Reinhart K, Gattinoni L, Thijs L, Webb A, Meier-Hellmann A, Nollet G, Peres-Bota D, ABC Investigators. Anemia and blood transfusion in critically ill patients. Jama. 2002 Sep 25; 288(12):1499-507.

Vincent JL, Sakr Y, Sprung C, Harboe S, Damas P. (2008). Are blood transfusions associated with greater mortality rates? Results of the Sepsis Occurrence in Acutely Ill Patients study. *The Journal of the American Society of Anesthesiologists*. 108(1):31-9.

von Ahsen N, Müller C, Serke S, Frei U, Eckardt KU. (2001). Important role of nondiagnostic blood loss and blunted erythropoietic response in the anemia of medical intensive care patients. Critical care medicine. 29(9):141-50.

Wahl WL, Hemmila MR, Maggio PM, et al (2008). Restrictive red blood cell transfusion: not just for the stable intensive care unit patient. *Am J Surg*, 195: 803–806.

Walsh TS, Lee RJ, MacIver C, et al, (2006). Anaemia during and at discharge from the Intensive Care Unit (ICU): Impact of restrictive transfusion policy. Intensive Care Medicine, 32(1): 100 – 109.

Figure 1. Distribution of frequency of transfusion per patient