Original Article

Pattern of Blood Procurement and Utilization in a University Hospital in Southeast Nigeria

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Abstract

Background: Blood is a scarce commodity and every effort needs to be made to use it judiciously and avoid wastage. This study reviewed the pattern of blood procurement, ordering, and utilization at a hospital-based blood bank. **Materials and Methods:** This was a retrospective study in which data on blood procurement methods, pattern of requisition of blood, and outcome of issued blood were obtained from blood bank registers over a 2-year period at the Nnamdi Azikiwe University Teaching Hospital blood bank. **Results:** Approximately, 99% of donors were family replacement donors. In 2014, total blood donated was 4003 which exceeded the request for red blood cell (RBC) transfusion by 921 units. The highest request for blood was from the accident and emergency and 90% of blood issued were used. Overall percentage wasted of RBCs was 19.8% and the major contributors to these were antenatal clinic and labor ward both having 80% and 55.8% issued blood returned to blood bank unused. **Conclusion:** The proportion of wasted units of RBC is high. Designing and adhering to maximum blood ordering schedule and blood transfusion guidelines with efforts toward converting family replacement donors to voluntary blood donors will help in maintaining a steady supply of safe blood.

Keywords: Blood donors, transfusion-transmittable infections, wastage

Introduction

Globally, the demand for blood or blood component transfusion is ever increasing either due to increasingly sophisticated surgical procedures, traumatic injuries, cancer care, obstetric complications, blood-related disorders, and many medical advances requiring blood transfusion for patient survival.[1] The supply of blood is, however, often not commensurate to its demand, especially in the developing countries. The average donation rate in Africa is 4.3 donations/1000 populations which are 10 times less than it is in the developed countries, and in 2006, the WHO reports showed that only 41.5% of demand for blood was met.[2,3]

Ten donations per a 1000 population is required to meet a nation's blood supply demand.[1] At our current level of healthcare delivery in Nigeria, an estimated 1.5 million units of blood is required annually, howbeit at the present donation rate of 0.2 donations/1000 population, this cannot be met.[2,4] This implies that available blood must be used judiciously to avoid wastage. Many studies have looked at waste that comes from overordering leading to unnecessary crossmatch with minimal utilization.[5-9] This includes waste of technical time, reagent, and unnecessary cost to the patient. However, real wastage of blood can be incurred when crossmatched blood is actually dispatched from the blood bank and subsequently returned unused to the bank. Timely availability of blood in health-care facilities is essential for patient survival; therefore, a very robust blood transfusion service with efficient strategies for blood procurement and mechanisms for reducing blood wastages is critical to the attainment of quality healthcare delivery.

This study aimed to review the methods of blood procurement, pattern of demand, and the effective use of blood in the blood transfusion service of the Nnamdi Azikiwe University Teaching Hospital (NAUTH) to provide recommendations for improvement.

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Materials and Methods

This study was a retrospective review of blood bank records of NAUTH Nnewi for a 2-year period from January 2013 to December 2016. The information collected included donor data which included sex, age, blood group, type of donor, hematocrit of donors, and Transfusion-Transmitted Infections (TTI) status of donated blood. Information on blood transfusion request, units from which request were made, units of red blood cells (RBCs) issued, and the units of RBCs returned unused were retrieved from blood bank registers.

Ethical approval was obtained from the Hospital Ethics and Research Committee. Strict confidentiality was maintained throughout the research as participants' names were represented by initials alone and unauthorized persons were not allowed access to information of study that may reveal the identity of any of the participants. In addition, information gathered from this research was not used for any other purpose aside to increase the body of knowledge on the subject matter of the research and possibly to enable policy formulation that will further improve blood availability and safety in Nigeria.

Data management and analysis

Details of participants were stored in a computer, access to which was limited to the researchers, or other duly authorized persons Statistical Package for the Social sSciences, SPSS Inc. Released 2007. SPSS for Windows, Version 16.0. Chicago, SPSS Inc. and Microsoft Excel computer software were used for all data analyses. Descriptive and inferential statistics were used as appropriate to show the patterns of blood procurement and utilization in the hospital within the study period.

Results

The study reviewed the data in blood bank over a 2-year period from January 2013 to December 2014. A total of 6689 pints of blood was donated over the 2 years. The median age of the donors was 25 years (interquartile range: 22–32) with a male-to-female ratio of 8:1. The majority (66.1%) of donors was blood group O positive and 98.8% were family replacement donors. The mean packed cell volume of donors was 0.41 ± 0.03 L/L [Table 1]. The proportion of male donors was significantly higher in 2014; however, there was no significant change in types of donor in the 2 years studied [Table 2].

The prevalence of TTIs was HIV (0.38%), hepatitis B surface antigen (HBsAg) (0.65%), hepatitis C virus (HCV) (0.41%), and Venereal Disease Research Laboratory (0.21%) [Table 3]. The rate of seropositivity for HIV, HBsAg, HCV, and syphilis was significantly higher in 2014 compared to 2013 [Table 3].

The total blood request was 5868 over the 2 years. The number of units of blood donated increased by almost 50% from 2013 to 2014. In 2013, request outnumbered supply. However, in 2014, the blood supply was sufficient for the request [Table 4]. Approximately, 80% of blood requested was used, 19.8% were returned to the blood bank unused in median time of 2.27 h from the time of dispatch [Table 5]. The demand for blood type O Rhesus D positive was the highest [Table 6]. The highest request (51.5%) for blood was from the emergency unit;

Table 1: Demographic data of donors

Variable	Frequency (%)
Donor age (years) (valid surveys=6689)	
Median age (IQR) years	25 (22–32)
Age group (years)	
≤20	1101 (16.5)
21-30	3713 (55.5)
31-40	1379 (20.6)
41-50	393 (5.9)
>50	103 (1.5)
Donor sex (valid surveys=6673)	
Female	763 (11.4)
Male	5910 (88.6)
Donor blood group (valid surveys=6675)	
A Rhesus D positive	1255 (18.8)
A Rhesus D negative	45 (0.7)
B Rhesus D positive	645 (9.7)
B Rhesus D negative	29 (0.4)
AB Rhesus D positive	24 (0.4)
AB Rhesus D negative	0 (0.0)
O Rhesus D positive	4415 (66.1)
O Rhesus D negative	262 (3.9)
Donor type (valid surveys=4125)	
F/R	4074 (98.8)
Voluntary donor	51 (1.2)
Donor PCV	
Mean PCV±SD (L/L)	0.41±0.03
Females (L/L)	0.37±0.02
Males (L/L)	0.41±0.03
P	<0.001

IQR: Interquartile range, SD: Standard deviation, PCV: Packed cell volume, F/R: Family replacement

Table 2: Comparing the demographic characteristics of donors in 2013/2014

Characteristics	2013, *n* (%)	2014, *n* (%)	Total, *n* (%)	*P*
Sex				
Male	2445 (91.0)	3465 (86.9)	5910 (88.6)	<0.001
Female	241 (9.0)	522 (13.1)	763 (11.4)	
Type of donor				
Voluntary	27 (1.0)	24 (1.7)	51 (1.2)	0.068
F/R	2656 (99.0)	1418 (98.3)	4074 (98.8)	
Donor blood type				
A Rhesus D positive	474 (17.7)	781 (19.5)	1255 (18.8)	0.125
A Rhesus D negative	20 (0.7)	25 (0.6)	45 (0.7)	
B Rhesus D positive	269 (10.0)	376 (9.4)	645 (9.7)	
B Rhesus D negative	10 (0.4)	19 (0.5)	29 (0.4)	
AB Rhesus D positive	5 (0.2)	19 (0.5)	24 (0.4)	
AB Rhesus D negative	0 (0.0)	0 (0.0)	0 (0.0)	
O Rhesus D positive	1798 (67.1)	2617 (65.5)	4415 (66.1)	
O Rhesus D negative	104 (3.9)	158 (4.0)	262 (3.9)	
Total	2680	3995	6675	

F/R: Family replacement

accident and emergency (A/E) accounting for 32.4%, children emergency room 5.4%, and labor ward 13.7% [Table 7]. The highest proportion of unused blood returned to the blood bank was from antenatal clinic (ANC) (80.0%), labor ward (55.5%), and surgery outpatient (SOP) (54.5%). However, regarding numbers, the labor ward had the highest number of blood units (446) returned to the blood bank unused. The longest median time for the return of unused blood to blood bank was from the ANC (12.03 h), followed by SOP (9.02 h) [Table 7].

Table 3: The prevalence of Transfusion-Transmitted Infections (TTI) among donors in 2013/2014

TTI	2013, *n* (%)	2014, *n* (%)	Total, *n* (%)	*P*
HIV				
Negative	2685	3612	6297	<0.001
Positive	0	24 (0.66)	24 (0.38)	
HBsAg				
Negative	2645	3959	6328*	<0.001
Positive	0	41 (1.04)	41 (0.65)	
HCV				
Negative	2671	3610	6281	<0.001
Positive	1 (0.04)	25 (0.69)	26 (0.41)	
VDRL				
Negative	2683	3628	6311	0.048
Positive	2 (0.07)	11 (0.30)	13 (0.21)	

*Data for 276 individuals were missing here. HBsAg: Hepatitis B surface antigen, HCV: Hepatitis C virus, VDRL: Venereal Disease Research Laboratory

Table 4: Total number of blood donated/blood requested for in 2013/2014

Years	Total blood donated (%)	Total blood dispatched (%)
2013	2686 (40.2)	2786 (47.5)
2014	4003 (59.8)	3082 (52.5)
Total	6689	5868

Table 5: Status of blood requested and dispatched in 2013/2014: used or returned to blood bank unused

Years	Status of blood requested for, *n* (%)		Total, *n* (%)	Median time of return of used blood (hh:mm)
	Used	Unused		
2013	2244 (80.5)	542 (19.5)	2786	2.32 (1.11–12.01)
2014	2460 (79.8)	622 (20.2)	3082	2.22 (0.03–10.030)
Total	4704 (80.2)	1164 (19.8)	5868	*P*=0.065

P=0.485. (value comparing status of blood requested for 2013 and 2014)

Discussion

The provision of safe blood is a major component of modern medicine and the goal of every blood procurement program is to have 100% voluntary donors. However, in this study, we found that 98.8% of the donors were family replacement. Despite this, the prevalence of transfusion-transmittable infections (TTI) was still low. The overall prevalence of seropositivity for HIV, HBsAg, HCV, and syphilis was 0.38%, 0.65%, 0.41%, and 0.21%, respectively. These are quite lower than most reported prevalence of TTI documented among blood donors in Nigeria;[10-17] furthermore, the reported prevalence of HIV among blood donors varies from one geographical location to another and may reflect the prevalence rate in each region. Similarly, low prevalence of HIV among blood donor has also been reported in Yola (0.7%)[18] and Port-Harcourt (0.45%)[19] Aside from Port-Harcourt, these two cities are in states with one of the lowest HIV prevalence (<2%).[20] Earlier studies in Nnewi support this low prevalence of TTI among blood donors.[21] Howbeit, an increase in the prevalence of HIV in blood donor was noted in this study from 0% in 2013 to 0.66% in 2014. This may be related to the usage of a comprehensive questionnaire for screening of blood donors which was stopped in 2013. Pointing to the fact that proper donor selection is very important in controlling TTI.

Global prevalence of anti-HCV is estimated at 1.6%.[22] However, the prevalence among blood donors is diverse ranging from 0.1 in England[23] to as high as 19% in Egypt.[24] The higher prevalence of HCV in Egypt is probably a reflection of the prevalence in its general population. Egypt has the highest prevalence (17.5%) of HCV in the world.[25] In Nigeria, documented prevalence of HCV among blood donors varies from 0.86% in Ife,[26] to 2.4% in Yola, 5.71%–6% in Benin and Jos,[17,27] and as high as 8.0% in Ibadan.[14] These donor prevalence of HCV also reflect the general prevalence in the various states[28] as affected by the prevalent lifestyle in that area. The highest request for blood was from the A/E, and the majority of blood issued to this unit was used.

RBC component wastage in hospitals has been reported to range from 0.1% to 25%.[29,30] Eighty-seven percentage of these

Table 6: The demand of various blood types

Blood type	2013, *n* (%)	2014, *n* (%)	Total, *n* (%)	*P*
A Rhesus D positive	475 (17.4)	536 (17.2)	1011 (17.3)	0.070
A Rhesus D negative	19 (0.7)	7 (0.2)	26 (0.4)	
B Rhesus D positive	247 (9.0)	259 (8.3)	506 (8.7)	
B Rhesus D negative	8 (0.3)	8 (0.3)	16 (0.3)	
AB Rhesus D positive	5 (0.2)	5 (0.2)	10 (0.2)	
AB Rhesus D negative	0 (0.0)	0 (0.0)	0 (0.0)	
O Rhesus D positive	1871 (68.4)	2196 (70.6)	4067 (69.6)	
O Rhesus D negative	109 (4.0)	101 (3.2)	210 (3.6)	
Total	2734 (100.0)	3112 (100.0)	5846 (100.0)	

Table 7: Proportion of blood returned by various units and time to return

Department/unit	Total request (%)	Status (%)		Median time in hours to return unused blood
		Used	Returned	
Wards				
Surgical				
MSW	427	348 (81.5)	79 (18.5)	3.22 (1.22–10.04)
FSW	582	447 (76.8)	135 (23.2)	2.46 (0.46–12.00)
PSW	2	1 (1.0)	1 (1.0)	-
Orthopedics	8	6 (75)	2 (25.0)	4.42 (0.37)
Medical				
MMW	499	461 (92.4)	36 (7.6)	1.15 (0.0–9.07)
FMW	380	358 (94.2)	22 (5.8)	3.22 (0.18–10.46)
PMW	216	182 (84.3)	34 (15.7)	2.58 (0.08–5.21)
Gynecology ward	102	68 (66.7)	34 (33.3)	2.45 (0.44–3.36)
Renal/dialysis	83	79 (95.2)	4 (4.8)	1.50 (0.23–6.09)
Lying-in	66	44 (66.7)	22 (33.3)	2.0 (0.19–3.18)
Emergency				
A/E	1885	1696 (90.0)	189 (10.0)	2.55 (0.25–12.03)
Labor	799	353 (44.2)	446 (55.8)	2.10 (1.14–10.31)
CHER	313	272 (86.9)	41 (13.1)	1.54 (0.00–11.32)
Intensive care				
ICU	72	54 (75.0)	18 (25.0)	10.02 (2.29–15.03)
SCBU	189	148 (78.3)	41 (21.7)	2.29 (0.00–13.15)
Outpatient				
MOP	5	4 (80.0)	1 (20.0)	-
SOP	11	5 (45.5)	6 (54.5)	9.02 (7.47–16.01)
POP	9	7 (77.8)	2 (22.2)	-
ANC	10	2 (20)	8 (80.0)	12.03 (1.48–13.03)
HOP	4	3 (75.0)	1 (25.0)	-
Others	163	127 (77.9)	36 (22.1)	6.28 (0.40–16.01)
Total	5825	4665 (80.1)	1160 (19.9)	
Overall median time				2.27 (0.51–12.00)
P		<0.001		<0.013 (Kruskal–Wallis)

Median time to return of unused blood in 2013 was not significantly different from 2014. MSW: Male surgical ward, FSW: Female surgical ward, PSW: Pediatric surgical ward, MMW: Male medical ward, FMW: Female medical ward, PMW: Pediatric medical ward, A/E: Accident and emergency, CHER: Children emergency, ICU: Intensive care unit, ANC: Antenatal clinic, SOP: Surgery outpatient, MOP: Medical outpatients, POP: Paediatric out patient, HOP: Haematology out patient, SCBU: Special care baby unit

wastages were from blood units issued out but not transfused.[29] In the present study, approximately 20% of blood units issued out were returned unused with a median time of return of 2.27 h. This median time far exceeds the "30 min rule" which states that RBC left out of control temperature storage for more than 30 min should not be returned to storage for reissue. This implies that 1350 units of blood will have been wasted over the review period. Current policies in the hospital blood bank, however, are to inspect all returned blood which has been stored in household refrigerators for lyses and puncture. If these are absent, blood bags are returned to the bank and subsequently reissued. Although this "30 min rule" has been challenged by several studies,[31-33] the fact still remains that the longer RBCs are kept out of optimal temperature of 2°C–6°C the higher the risk of bacterial contamination. Blood is an excellent milieu for bacteria growth, and hence strict temperature control is essential to avoid bacterial contamination and hence the likelihood of adverse blood transfusion reactions.

The department with the highest proportion of blood returned unused and the longest mean time to return is Obstetrics (ANC = 80% and labor ward = 55.8%). Meantime to return of blood from ANC being approximately 12 h. This may suggest a lack of blood ordering schedule and probably absence or lack of adherence to hospital guidelines on blood transfusion. The long median time to return of unused blood to the blood bank may also be due to dependency on household refrigerators available in various units for storage. However, these refrigerators cannot provide optimum temperature-controlled storage for RBC.

Conclusion

The prevalence of TTIs among blood donors is low which reflects the state prevalence. It can be kept low by reintroducing proper donor selection using appropriate questionnaires. However, there is a high probability that donated blood may be wasted which will impact the negatively on blood transfusion services in the hospital.

It is recommended that maximum blood ordering schedule for each unit in the hospital be designed and disseminated to relevant personnel. Hospital policy on RBC issuing and time to return of unused blood should also be developed and adhered to. Attempts should be made at converting family replacement donors to voluntary donors.

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Conflicts of interest

There are no conflicts of interest.

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