Pattern of blood procurement, ordering and utilization in a University Hospital in Eastern Saudi Arabia

Layla A. Bashawri, *MBBS, FCP(KFU).*

ABSTRACT

Objectives: The main objectives of this study were to review blood procurement, ordering, utilization, and causes of discarding blood in a University hospital and provide recommendations for improvement. The study was also aimed at sheding light on the frequency of seropositivity for certain disease markers in blood donors.

Methods: This review comprised a retrospective 5-year analysis from January 1996 to December 2000 at King Fahad Hospital of the University, Al-Khobar, Kingdom of Saudi Arabia.

Results: In this study, the most common donors were replacement (46%) and statutory donors (35%), while volunteer blood donors comprised a lower percentage (19%). There was a high crossmatch transfusion ratio (2.96:1) and similarly a high percentage of cancelled transfusions after crossmatching (66.2%). The 2 most commonly ordered blood components were packed red blood cells (45.7%) and random platelet concentrates (19.2%). The infective causes for discarding blood were: hepatitis B core antibody seropositivity (16.9%), hepatitis B surface antigen seropositivity (2.4%) followed by hepatitis C antibody seropositivity (1.5%), and rapid plasma reagin (serological test for syphilis) positivity (1%). The common non-infective causes of discarding blood in descending order or frequency were: expired unit shelf life (3.6%), positive donor antibody screen (0.7%), red blood cell morphological abnormalities (0.4%), and blood unit insufficient quantity (0.3%). Release of emergency uncrossmatched blood ranged at 0.6% during the study period.

Conclusion: Performing blood bank internal audits and reviewing statistics are vital tools for a successful blood transfusion service. Implementing policies such as type and screen and the maximum surgical blood-ordering schedules will lead to monetary savings and more effective blood utilization. Drives for enhancement of volunteer blood donors are recommended.

Keywords: Crossmatch transfusion ratio, effective blood utilization, maximum surgical blood ordering schedule, type and screen.

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Blood Banking or transfusion medicine is a close chain of events embracing all procedures from blood procurement, component preparation, storage, to blood transfusion. Proper attention to all of these procedures leads to optimal functioning of blood transfusion service. Important tasks of blood transfusion services include continuous monitoring and improvement of blood transfusion safety as well as setting guidelines and policies aimed at efficient use of blood products. The ultimate goals are to provide safe blood, to have an adequate inventory, to reduce wastage of blood products, and to reduce unnecessary use of laboratory services without jeopardizing patient safety. Transfusion practices

From the Department of Medical Laboratory Technology, King Faisal University, Dammam, Kingdom of Saudi Arabia.

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Address correspondence and reprint request to: Dr. Layla A. Bashawri, Consultant Hematopathologist, Assistant Professor Pathology, King Faisal University, PO Box 1334, ARAMCO Dhahran 31311, Kingdom of Saudi Arabia. Tel./Fax. +966 (3) 8910472.

vary among institutions due to differences in the number and types of patients being treated as well as laboratory support services and availability of blood products. There has been concern from our institution,[1] other institutions in the Kingdom of Saudi Arabia (KSA)[2] as well as different parts of the world[3-6] that excessive ordering of blood for elective surgical procedures can lead to an unintentional misuse of blood bank services. It appears that physicians order crossmatched blood on the basis of habit or hospital routines and there is a tendency in most surgical departments to request more units of blood than actually required. The resulting unnecessary crossmatching is costly and wasteful. Blood banking services in the Kingdom are hospital based, and most government hospitals derive blood from relatives and friends of the patients and less frequently from the volunteer donors.[7] This can put a strain on blood banks where the resources are limited. Review of blood ordering habits and blood utilization statistics (blood bank audits) can help in improving these services and initiate measures to regulate blood ordering and utilization. However, a strong institutional commitment is required for implementation of new policies. The blood bank of King Fahd Hospital of the University (KFHU), Al-Khobar, KSA provides the transfusion needs of a busy teaching hospital. The main sources of blood in KFHU are replacement donors and statutory donors (for drivers' license or employment) and to a lesser extent volunteer blood donors. Blood collection is not easy, and blood banks are different from pharmaceutical companies since people donate the material dealt with. Thus, blood banks are in a unique position with an obligation to serve patients by providing an adequate supply of blood and ensuring that the donation process and donated blood is strictly safe. Due to the concern about transfusion-transmitted diseases and the cost of blood products and their limited availability, many measures have been suggested to improve blood utilization and monetary savings. These include guidelines, workshops, revision of blood bank data (blood bank audits), and implementation of new blood ordering policies like type and screen (T/S) and maximum surgical blood ordering schedule (MSBOS) for surgical procedures where blood is actually seldom needed, and rarely if ever transfused.[8-12] The main aims of this study were to assess blood procurement, ordering and utilization, discuss issues regarding blood utilization, and suggest strategies to improve donor recruitment. The study was also aimed to shed light on the frequency of seropositivity for certain disease markers in blood donors.

Methods. This study was a retrospective review of blood bank records of KFHU for a 5-year period from January 1996 to December 2000. The information collected included types of donors, crossmatch transfusion (C:T) ratio (number of units crossmatched divided by number of units transfused), components ordered, components transfused, and infective and non-infective causes of discarding blood. The surveyed infective causes included positivity for: antibody to hepatitis B core antigen (HBc), hepatitis B surface antigen (HbsAg), antibody to hepatitis C, antibodies to human immunodeficiency viruses 1 and 2 (HIV 1 and 2), antibodies to human T-cell lymphotrophic viruses I and II (HTLV I/II) and rapid plasma reagin (RPR) for syphilis. The surveyed non-infective causes included: unit quantity insufficiency, busted bag, appearance of the unit, positive antibody screen, donors anti-globulin test (DAT) positive, red blood cells (RBCs) morphological abnormalities, pre-warmed or unsuitable units returned to the blood bank after 30 minutes, and expired unit shelf life. The information collected also included the results of screening of donor blood for malaria parasites.

Results. The total number of individuals who donated blood in the period from January 1996 to December 2000 was 17,442 donors. The main source of blood was patients' relatives (number [N]=8040; 46%) followed by statutory donors (N=6100; 35%), while volunteer blood donors comprised the lesser group (N=3302; 19%) as shown in **Table 1**. The most frequently ordered blood components for the whole study period were packed RBCs including pediatric units, and washed RBCs (N=14,860 units (62.3%) and random platelet concentrates (N=4,595 units; 19.2%) (**Table 2**). The average C:T ratio was found to be 2.96:1 varying from 2.73:1 - 3.17:1 (**Table 3**). The percentage of cancelled blood transfusions has been consistently more than 60% (mean = 66.2%) (**Table 3**). Emergency release of uncrossmatched blood occurred in 94 cases (0.6%) of all blood transfusions (**Table 4**). These orders were mostly from the emergency room (ER), delivery room (DR) and intensive care unit (ICU). The infective and non-infective causes for discarding blood are shown in **Table 5**.

Discussion. ***Blood donation.*** Issues concerning the safety of blood during the past 15 years have been associated with changes in blood use[13] and triggered reevaluation of the clinical practices of blood collection and transfusion. The present study shows that the volunteer donor pool is the least source and that replacement and statutory donors constitutes the major source of blood. When the volunteer blood pool constitutes a small percentage of blood donors, many problems, like poor inventory control and the risk of transfusion transmitted infections[7,14-17] could be encountered. Reliance on replacement donors raises some ethical dilemmas, for example. the case of expatriates who may have no

relatives in the country, migrant nationals, and the continuous pressure on relatives and friends of patients who frequently need blood, for example, patients with congenital chronic anemia. Moreover, some conflicts can occur between physicians, blood bank staff and patients when the blood bank inventory is low. Therefore, there is a need to evaluate and develop strategies to improve the volunteer donor pool. The high percentage of volunteer donors in the year 2000 is explained by our recent donor campaigns to a local womens society and an educational institution in Al-Khobar, KSA. Donor campaigns constitute an important source of blood and have been conducted in other parts of KSA.[18,19] Volunteer donated blood is known to be the safest source of blood worldwide.[7,15-17] Methods to improve donor recruitment through retention programs for volunteers and encouragement of new donors have to be identified. The use of incentives other than monetary to attract donors to blood centers may be considered. In the United States of America some blood banks give time-off, as an incentive to blood donors.[20] Adequate educational material concerning blood donation and transfusion should be provided. Understanding donor demographics, personality characteristics and constraints against donation are very important aspects.[21] It has been claimed that the reasons for abstaining from donating blood include fear of needles, finger pricking, fear of blood sight, preconceived ideas regarding blood donation, inconvenience, and fear of contracting acquired immunodeficiency syndrome (AIDS).[21] These reasons underline the importance of the educational element with regard to blood donation.

Table 1 - Types of blood donors (number and percentages per year).

Year	Patients relatives N (%)	Statutory N (%)	Volunteer N (%)	Total N (%)
1996	1815 (48.7)	1186 (31.9)	723 (19.4)	**3724 (100)**
1997	1472 (44.5)	1257 (38)	578 (17.5)	**3307 (100)**
1998	1410 (41.7)	1446 (42.8)	523 (15.5)	**3379 (100)**
1999	1394 (40.8)	1405 (41)	615 (18)	**3414 (100)**
2000	1949 (53.9)	806 (22.3)	863 (23.9)	**3618 (100)**
Total	**8040 ($\bar{x}$=46.0)**	**6100 ($\bar{x}$=35)**	**3302 ($\bar{x}$=18.9)**	**17442 (100)**

N - number, $\bar{x}$ - mean.

Table 2 - Ordered blood and blood components.

Year	Whole blood N (%)	Packed RBCs N (%)	Pediatric RBCs units N (%)	Washed RBCs N (%)	Fresh frozen plasma N (%)	Cryoprecipitate N (%)	Random platelet concentrates N (%)	Total
1996	253 (4.8)	2279 (43.4)	659 (12.5)	187 (3.5)	846 (16.1)	195 (3.7)	825 (15.7)	**5244**
1997	168 (3.9)	2112 (49.3)	695 (16.2)	58 (1.3)	507 (11.8)	60 (1.4)	677 (15.8)	**4277**
1998	142 (3.1)	2048 (45)	711 (15.6)	184 (4)	607 (13.3)	47 (1)	808 (17.7)	**4547**
1999	83 (1.9)	2199 (51.3)	508 (11.8)	229 (5.3)	467 (10.8)	42 (0.9)	764 (17.8)	**4292**
2000	74 (1.3)	2279 (41.5)	509 (9.2)	203 (3.7)	861 (15.6)	39 (0.7)	1521 (27.7)	**5486**
Total	**720 ($\bar{x}$=3.0)**	**10917 ($\bar{x}$=45.7)**	**3082 ($\bar{x}$=12.9)**	**861 ($\bar{x}$=3.6)**	**3288 ($\bar{x}$=13.7)**	**383 ($\bar{x}$=1.6)**	**4595 ($\bar{x}$=19.2)**	**23846**

All values are given in blood units, $\bar{x}$ - mean, RBCs - red blood cells, N - number

Table 3 - Transfusion and cancellation of blood components after crossmatching and the crossmatch transfusion ratio.

Year	Crossmatches	Transfusions (after crossmatching)		Cancelled transfusions (after crossmatching)		C:T ratio
		N	(%)	N	(%)	
1996	10373	3358	(32.3)	7015	(67.6)	3.09:1
1997	9655	3043	(31.5)	6612	(68.4)	3.17:1
1998	8580	3085	(35.9)	5495	(64)	2.78:1
1999	8253	3019	(36.5)	5234	(63.4)	2.73:1
2000	9227	3065	(33.2)	6162	(66.7)	3.01:1
Total	**46088**	**15570**	**($\bar{x}$=33.7)**	**30518**	**($\bar{x}$=66.2)**	**$\bar{x}$=2.96:1**

All values are given in units of blood, N - Number, C:T - crossmatch transfusion ratio, $\bar{x}$ - mean.

Table 4 - Units of transfused uncrossmatched blood.

Year	Department	Whole Blood	RBCs	Total N of emergency transfusions		Total N of transfusions
1996	ER	0	2	2		
	DR	3	0	3		
	ICU	4	3	7		
	Others	0	1	1		
	Sub-Total	7	6	13	(0.3)	3358
1997	ER	8	6	14		
	DR	0	1	1		
	ICU	0	0	0		
	Others	0	0	0		
	Sub-Total	8	7	15	(0.4)	3043
1998	ER	1	4	5		
	DR	2	6	8		
	ICU	0	0	0		
	Others	0	5	5		
	Sub-Total	3	15	18	(0.5)	3085
1999	ER	5	15	20		
	DR	0	2	2		
	ICU	1	8	9		
	Others	0	5	5		
	Sub-Total	6	30	36	(1.1)	3019
2000	ER	2	6	8		
	DR	1	2	3		
	ICU	0	0	0		
	Others	0	1	1		
	Sub-Total	3	9	12	($\bar{x}$=0.3)	3065
	Total	**27**	**67**	**94**	**($\bar{x}$=0.6)**	**15570**

N - number, RBCs - red blood cells, ER - emergency room, DR - delivery room, ICU - intensive care unit, $\bar{x}$ - mean.

From our experience, the volunteer pool was markedly increased when the donation center was opened at a more convenient time, for example in the evening and extending to late night. Implementation of donor recruitment strategies that overcome the above cited difficulties, as well as measures to increase the interest and awareness regarding blood donation among the youth have been recommended.[22,23] Hence, by increasing the volunteer donor pool, we can help overcome some of the problems associated with a low blood bank inventory that may occur at specific times for example during national holidays, as well as improve the cost effectiveness of blood procurement in KSA.

Efficiency of blood ordering. The C:T ratio has long been considered an index of blood ordering efficiency.[24] Our results revealed that the C:T ratio has been constantly more than 2:1 with a percentage of cancelled transfusions over 60%. This observation indicates over-ordering of blood preoperatively that leads to holding up of blood bank reserve as crossmatched blood is considered reserved blood. Patients who may need blood immediately or with legitimate blood requirements may be deprived of it. This leads to aging of blood units and wastage of blood bank resources. The highest C:T ratios were found in the departments where elective surgery is being carried out, due to the usual ordering policy of 2 units being crossmatched and being available for the surgical procedure despite the fact that this blood is seldom, if ever, transfused. There appears to be many causes for a high C:T ratio including medico-legal, habit or outdated policies, lack of a clear blood ordering policy in hospitals, lack of clinical audits, and lack of communication between clinicians and blood bank physicians. A review of the C:T ratio from our institution during 1991 and 1992 gave an overall figure of 3.9:1.1, and from Riyadh, KSA high C:T ratios of 2.4:1 and 10.9:1 were observed in surgical and obstetric/gynecology departments.[2] The MSBOS is a list of commonly performed elective surgical procedures with a maximum number of units of blood to be crossmatched preoperatively[10,11,24] and procedures in which T/S may only be needed. The goal of the MSBOS is to make preoperative blood orders coincide more closely with the actual number of units that will be transfused to patients during or immediately after surgery. It has been reported that MSBOS is the most effective method of reducing excessive preoperative crossmatching.[10,11] An MSBOS however, will not be successful if the physicians' compliance is poor. This is the reason for which each institution should have a strong commitment to implement this and other policies that could lead to more appropriate blood ordering and utilization. The type and screen (T/S) policy as mentioned earlier consists only of an ABO-Rh typing performed by conventional methods plus a screen for unexpected antibodies. The blood sample is then

Table 5 - Causes of discarding blood.

Non-infective causes									Infective causes								
Year	**Unit QNS**	**Bag busted**	**Appea-rance of the unit**	**Anti-body screen positive**	**DAT pos.**	**RBCs morpho-logical abnor-malities**	**Pre-warmed/ returned after 30 minutes**	**Expired unit shelf life**	**Anti HBc**	**HBs Ag**	**Anti HCV**	**Anti HIV 1 and 2**	**Anti HTLV I/II**	**RPR**	**Malaria**	**Total N of discarded units (%)**	**N of donors**
1996	16	4	0	37	7	37	7	116	584	100	69	0	2	43	0	1022 (27.4)	3724
1997	12	6	0	33	11	15	5	88	592	86	49	2	1	29	0	929 (28.1)	3307
1998	7	4	2	28	12	10	3	133	566	74	42	0	3+1*	34	0	918 (27.2)	3379
1999	8	9	2	15	3	8	6	130	606	87	54	0	1+2*	44	0	973 (28.5)	3414
2000	11	10	1	23	8	8	4	168	589	72	55	0	4+1*	30	0	983 (27.2)	3618
Total $\bar{x}$	**54** (0.31)	**33** (0.19)	**5** (0.03)	**136** (0.78)	**41** (0.24)	**78** (0.45)	**25** (0.14)	**635** (3.65)	**2937** (16.86)	**419** (2.40)	**269** (1.54)	**2** (0.012)	**11+4*** (0.063)	**180** (1.03)	**0** (0)	**4825** (27.7)	**17422**

All values given are in units of blood, N - number, QNS - quantity not sufficient, DAT pos - positive donors anti-globulin test, * - indeterminate, RBCs - red blood cells, HBc - hepatitis B core, HBsAg - hepatitis B surface antigen, HCV - hepatitis C virus, HIV 1 and 2 - human immunodeficiency viruses 1 and 2, HTLV I/II - human T-cell lymphotrophic viruses I and II, RPR - rapid plasma reagin, $\bar{x}$-mean.

reserved in the blood bank in case a crossmatch is later needed. Should a transfusion be required for that patient (who had a negative antibody screen), crossmatching can be carried out in 20 minutes and there is a 99.9% chance of finding compatible blood.[10,11,24] The T/S, however, is a policy that can be acceptable only for the surgical procedures that seldom need blood transfusion for example cholecystectomy, thyroidectomy[10,11,24] and so forth. However, if an antibody is detected during the screen, it has to be further identified by a panel of cells and the surgeon or physician should be informed. Our data also showed that a high percentage of transfusions were cancelled after crossmatching. Annually, cancelled transfusions after crossmatching were estimated to cost approximately 312,000 Saudi Riyals (SR) in one hospital.[2] Many other reports have stressed the fact that if the blood ordering habits by clinicians were rationed, savings could be made without causing harm to patients.[3,4,10,11] The present results showed great demand for platelet concentrates, a frequently ordered component needed for oncology patients as well as other patients with thrombocytopenia, Disseminated intravascular coagulation (DIC) and the prophylactic uses and so forth. Occasionally we face low inventories especially for oncology patients and this is one of the situations where increasing blood supply is important. The most frequently requested component was packed RBC due to the very common indication of anemia, in various clinical conditions in this region of the country, as well as its needs in surgery.

Causes of discarding blood. Expired shelf life was the most common non-infective cause of discarding blood. This can be due to the current donor policy with replacement and statutory donors being the larger donor source. Blood may be taken when the blood bank is not in need of these blood groups. The 2nd non-infective cause for discarding blood is a donor positive antibody screen. Other causes for discarding blood are rare and include RBC morphological abnormalities, for example. marked crenation and poikilocytosis and so forth. There are other interesting RBC morphological abnormalities like hypochromasia, target cells, basophilic stippling and sickle-like cells which could be noted while examining the peripheral blood smear for malaria. In many donors, thalassemia trait and sickle cell anemia traits were identified, as these are common in the Eastern Region of KSA.[25] Other rare causes for discarding blood include appearance of the unit, pre-warmed and returned units to blood bank after 30 minutes, bag busted, and insufficient quantity due to stopping of the donation because of any encountered donor reactions. The most common infective cause for discarding blood was seropositivity for anti-HBc and accounted on the average for 16.8% of all blood donations since the test was introduced in 1996. This is similar to the figure of 17.4% found in a previous study from our hospital.[7] Other reports from the

Kingdom have figures ranging between 14% and 28%.[26] The 2nd common infective cause of discarding blood was seropositivity for HbsAg (2.4%), the prevalence in the Kingdom ranges from 2.7% to 9.8%[26,27] with regional and nationality variations.[27] Hepatitis C seropositivity accounted for a 1.5% rate for discarding blood. Seroprevalence of this marker in blood donors in KSA ranges from 1% to 2.2%.[28,29] Rapid plasma reagin positivity (1%) was a less common cause for discarding blood, and was comparable to the 1.6% rate reported among Saudi individuals.[7] The highest prevalence of this marker in blood donors was found among Indians and Pakistanis.[7] The rejection rate for HIV 1 and 2 of 0.012%, found during this study period is relatively lower than other figures reported from KSA, namely. 0.09% and 0.5%.[7,26,30] The percentage of HTLV I/II seropositivity among all donors during the 5-year period was 0.063% (11 confirmed positive and 4 indeterminate). The test for HTLV I was introduced in 1995, while the test for HTLV I/II was introduced in 1998. The nationalities for these positive donors included 8 Saudis and 3 Indians, and it seems that there are differences due to the different nationalities. Another study from our institution revealed a seropositivity rate of 0.14% for HTLV I/II.[7] Confirmed positivity rates ranging between 0.026%[31] to 0.19%[32] for HTLV I/II have been found in the country, while a prevalence rate for HTLV I was found to range from 0.017%[33] to 0.022%.[34] There have been conflicting views on the relevance of screening of donated blood for HTLV I/II in non-endemic countries.[31-32] However, a continued surveillance, blood donor screening and reporting of positive cases is needed and will help to provide a more precise idea of the frequency in KSA. The above mentioned cases of HIV 1 and 2 and HTLV I/II were confirmed by western blot technique. Screening of HIV p.24 antigen was started from October 2000, as it is a mandatory screening test introduced by the Ministry of Health, KSA since July 2000. There have been no positive donors since its introduction. In our institution, we do not screen routinely for cytomegalovirus (CMV) antibodies. The frequency for release of emergency uncrossmatched blood was only 0.6% of all blood transfusions, in the extreme situations when it is needed, such as trauma casualties and severe bleeding like the case of obstetrical, surgical and ICU patients.

In conclusion, although blood transfusion is a life saving measure for many patients, it should be restricted to patients who are in real need for blood replacement. Blood transfusion is safer today than previously due to the measures practiced to improve the quality of blood supply and reduce the risk of transfusion-transmitted diseases, yet important issues still remain. These include conservation of limited resources and cost, strategies for motivation of volunteer donors, and improved methods for blood ordering and utilization to limit wastage of blood and laboratory resources. National guidelines on blood ordering routines for all those concerned are recommended. An important role is to be played by hospital based transfusion committees composed of representatives of the clinical departments that frequently order blood for transfusion. Such committees should be responsible for developing blood utilization guidelines and audit criteria for the respective institution. The review and approval by the medical staff and hospital administration are necessary for the implementation of any adopted policies.[35]

Recommendations. 1. Performing blood bank audits routinely to improve the efficiency and appropriateness of transfusion. These audits should enable transfusion committees to set guidelines for rationalization of usage of blood and blood components for the optimal benefit of patients. 2. Motivation of voluntary donors in KSA and the youth should be targeted as prime potential donors. 3. Encouragement of autologous blood donation which is a safer alternative but underutilized in KSA[36, 37] although approaches to it have been proven to be successful.[38] 4. Educating physicians on the appropriate use of blood components to unify the views on the concept of appropriate use. Several reports have proven the success of approaches such as the continuous medical education transfusion guidelines[39,40] and the improved relationships between the transfusion medicine specialists and clinicians.[41] In our institution, this approach has also proven to be successful as the results of a forum on blood utilization in 1997 had shown a decrease in the C:T ratio relative to the years before 1997.

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