Research Article

Discard rate in blood transfusion service – A critical tool to support blood inventory management

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ABSTRACT

Background: Blood and blood component plays a key role in health-care management. Even after enormous efforts, there is no substitute available. Blood is a scarce resource and blood wastage could impose a very serious impact on health care. **Objective:** The current study was conducted to determine rate and reasons for wastage of blood and its blood components. **Materials and Methods:** A retrospective study was conducted in one of the largest standalone blood centers of West India. Data were retrieved from indigenous Integrated Blood Bank Management System software. The data were analyzed for a period of 12 months, from January 1, 2019, to December 31, 2019. **Results:** The total collection of blood units during the study period was 30,960 units. As per the policy of blood center, all the blood units were subjected to component separation with preparation with 88,973 components, including red cells, platelet concentrates (PLT), fresh frozen plasma (FFP), cryoprecipitate (CRYO) cryo-poor plasma (CPP), and single donor platelet (SDP). A total of 2637 blood and blood components (2.96%) were discarded during the study period. Discard rate among blood and blood component as per separation was found whole blood 0.99%, red blood cells 2.28%, FFP 1.88%, PLT 4.66%, CRYO 3.88%, CPP 1.25%, and SDP 0.47%, respectively. Among total discard rates, the major reason is seroreactivity of blood donor (1.11%), followed by expiry (0.67%), quality checks (0.29%), clotted bag (0.03%), Direct antiglobulin test (DAT/DCT) positivity (0.00%), and other causes (0.06%). **Conclusion:** Worldwide comprehensive standards have been formulated to ensure better quality control in each step of blood transfusion service including collection, storage, testing, and distribution of blood and components. To prevent wastage of rare commodity, continued medical education for technical staff, self-audit, and tracking quality indicators for the blood components is highly recommended.

KEY WORDS: Blood; Blood Component; Discard Rate; Quality Indicator; Quality Control; Audit

INTRODUCTION

Blood transfusion service (BTS) is an integral part of modern-day management, especially high-end transplant procedures, without which efficient medical care is impossible. The aim of BTS should be to provide effective blood and blood component which are as safe as possible and adequate to meet patients' need. Recent day advances in medical technology require more of safe blood for the effective management of patients. Many modern surgical procedures could not be carried out without use of blood and blood components. As there is no substitute of blood available currently, BTS depends on blood donors to manage inventories. To deal with the increasing demand and supply of blood and its components in resource constraint settings such as ours, more stringent criteria should be applied for blood donations and for proper utilization of blood.

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It has been estimated that every 2 s, someone need blood.[1] Many chronic medical conditions such as chemotherapy and thalassemia depend on continuous supply of blood from

healthy donors. Each unit of blood is precious and has to be utilized properly with minimal wastage. The stress should be given to need of proper utilization of blood and its components with preferably no or minimal wastage.[2] The rate of discarded blood components or "wastage rate" is one of the 10 quality indicators recommended by National Accreditation Board for Hospitals and Healthcare Providers (NABH).[3]

The present study was designed to analyze the various reasons for the discard of whole blood (WB) and blood components in a standalone blood bank. It is also intended to suggest various possible strategies for optimum utilization of blood and reduction in its wastage.

MATERIALS AND METHODS

A retrospective study was conducted in a standalone blood center of West India over a period of 12 months from January 2019 to December 2019. Data were retrieved from Integrated Blood Bank Management System software.

Inclusion Criteria

The present study includes blood unit discarded for different reasons which include transfusion transmitted infection (TTI) seroreactivity, expired component, less quantity (LQ), leakage/breakage, clotted bag, unit sent for quality checks (QC), and DCT positive. Blood components such as red blood cells (RBCs), platelet concentrate (PLT), fresh frozen plasma (FFP), cryoprecipitate (CRYO), normal human plasma (cryo-poor plasma [CPP]), and single donor platelet (SDP) were prepared regularly from 450/350 ml blood bag under all aseptic condition as advised by Food and Drug Administration guideline and NABH 3rd edition, International Organization for Standardization (ISO) 9001: 2015, National AIDS Control Society (NACO) as demand and workforce available in blood bank.

Statistical Tool

Data were compiled and analyzed using Microsoft Excel.

Ethical Clearance

The present study was retrospective study. Donor details were made confidential. Donor's consent was obtained at the time of donation regarding research. Local management's clearance was taken before data compilation.

RESULTS

During the study period, 30,960 units of WB collected from 100% voluntary non-remunerated blood donors. Blood were collected at different sites such as voluntary blood donation camps (21,072), blood mobile van sessions (3341), and in-house donations (6547). During the study period, 30,960 WB units were collected and separated into components such as RBCs (30,937), FFP (30,937), PLT (16,961), CRYO (4684), and CPP (5037) [Table 1].

It was observed that the average discard rate among component separation was 2.96%, of which the discard rate for components varies such as WB (0.99%), RBCs (2.28%), FFP (1.88%), PLT (4.66%), CRYO (3.88), CPP (1.21), and SDP (0.47%) [Table 1]. There were various reasons for discarding the WB or components such as seroreactivity, expiry, breakage/damage, LQ, QC, clotted bag, DCT positive, and various other causes. Among total discard rates, the major reason is seroreactivity of blood donor (1.11%), followed by expiry (0.67%), QC (0.29%), clotted bag (0.03%), DCT positivity (0.00%), and other causes (0.06%) [Table 2].

The overall prevalence of HIV, HBV, HCV, and syphilis for all blood was 1.10%. Among total component separated, the reason for discard was HIV in 129 (0.14%), HBV in 490 (0.55%), HCV in 150 (0.16%), syphilis in 218 (0.24%), and malarial parasite (MP) in none. Among seropositive units, hepatitis B surface Ag positivity was the most common (49.64%), followed by syphilis (22.08%), HCV (15.91%), and HIV (13.06%). None of the units tested were detected positive for MP [Table 3].

A total number of WB discarded mainly due to LQ 290 (0.93%) and breakage/leakage 17 (0.05%). For components, the discard reason was different as compared to WB such as TTI, QC, clot, and expiry and average discard rate was 2.96% [Table 2]. As far as different components are concerned, more discard rate is observed with PLT (4.66%), RBC (2.28%), and FFP (1.88%).

DISCUSSION

Blood transfusion is an essential element of modern-day health-care system. Blood collection is most important and essential function of BTS. Blood component therapy has

Table 1: Discard rate whole blood and blood component

Blood component	No. of unit prepared (%)	No. of unit discarded (%)
WB	30,960	307 (0.99)
RBCs (packed cell volume)	30,937 (99.92)	707 (2.28)
FFP	30,937 (99.92)	583 (1.88)
Platelet	16,961 (54.78)	792 (4.66)
CRYO	4684 (15.14)	182 (3.88)
CPP	5037 (16.28)	64 (1.25)
SDP	417	2 (0.47)
Total	*88,973	*2637 (2.96)

*Inclusive of whole blood. CPP: Cryo-poor plasma, SDP: Signal donor platelet. RBCs: Red blood cells, FFP: Fresh frozen plasma, CRYO: Cryoprecipitate, WB: Whole blood

Table 2: Reason for discard of blood component

Reason	WB	RBC	FFP	PLT	CRYO	CPP	SDP	Total	% for total blood component
LQ (%)	290	44	4	4	1	0	0	343 (13.11)	0.39
Clotted bag (%)	0	26	0	0	5	0	0	31 (1.18)	0.03
DCT positive (%)	0	4	0	0	0	0	0	04 (0.15)	0.00
Expiry date (%)	0	191	0	399	0	0	2	592 (22.45)	0.67
RBC contamination (%)	0	0	0	5	1	1	0	07 (0.27)	0.01
Seroreactive (%)	0	392	392	203	0	0	0	987 (37.43)	1.11
QC (%)	0	0	1	177	79	0	0	257 (9.75)	0.29
Other (%)	0	32	15	4	0	0	0	51 (1.93)	0.06
Breakage damage (%)	17	18	171	0	96	63	0	365 (13.84)	0.41
Total (%)	307 (11.6)	707 (26.8)	583 (22.1)	792 (30.0)	182 (6.9)	64 (2.4)	2 (0.07)	2637 (2.96)	2.96

RBC: Red blood cell, FFP: Fresh frozen plasma, PLT: Platelet concentrate, CRYO: Cryoprecipitate, CPP: Cryo-poor plasma, SDP: Single donor platelet, QC: Quality check, WB: Whole blood, LQ: Less quantity

Table 3: Reason for discard of blood component due to seroreactive

Blood component	HIV	HBsAg	HCV	Syphilis	Total
RBCs (%)	49 (12.5)	194 (49.48)	63 (16.07)	86 (21.93)	392
FFP (%)	49 (12.5)	194 (49.48)	63 (16.07)	86 (21.93)	392
PLT (%)	31 (15.27)	102 (50.24)	24 (11.82)	46 (22.66)	203
Total components discarded (%)	129 (13.06)	490 (49.64%)	150 (15.91)	218 (22.08)	987 (1.10)
% of components discarded for total separation	0.14%	0.55	0.16	0.24	1.10

RBCs: Red blood cells, FFP: Fresh frozen plasma, PLT: Platelet concentrate, HBsAg: Hepatitis B surface Ag

facilitated optimum role in BTSs. By this means, optimal use of every blood donation can be managed. At the same time, need for blood and its component is presently increasing due to improved and accurate diagnosis of complex diseases and various transplantation procedures requiring transfusion. Proper blood inventory management in blood bank can be managed by reduction in unnecessary wastage of blood and its components.[2] The self-audit of WB and blood components discard over period of time gives an idea about various reasons of discard. By limiting the factors influencing discard, a blood center can manage blood inventory properly and use scare resource in very judiciary way.

The present study showed that on an average, 2.96% blood components were discarded. Discard rate varied for different reasons. Discard rate for seroreactivity was 35.6%, expiry of blood components (mostly common platelet) 21.6%, LQ of collected volume 13.11%, breakage damage/ leakage blood and blood component (plasma components) 13.84%, and miscellaneous reasons (clotted/hemolyzed blood unit, DCT positive, QC [blood component used for quality control]) 13.0%.

While going through various studies, the varied range in discard rate is observed ranging from 2.3% to 20.6% [Table 4]. Discard rate was observed as 2.3% by Morish *et al*. (Kuala Lumpur),[4] 4.3% by Kora and Kulkarni (Bagalkot, Karnataka),[5] 8.4% by Kumar *et al*. (Sevagram, Wardha, Maharashtra),[6] 3.6% by Thakare *et al*. (Aurangabad, Maharashtra),[7] 7.0% by Suresh *et al*. (Tirupati, Andhra Pradesh),[1] 20.6% by Patil *et al*. (Sawangi, Wardha, Maharashtra),[8] 7.0% by Kanani *et al*. (Jamnagar, Gujarat),[3] 3.30% by Gupta *et al*. (Ahmadabad, Gujarat),[2] and 4.6% by Anitha *et al*. (Nellore, Andhra Pradesh).[9] The vast variation is observed in the reasons for discard. Discard rate for seroreactivity in the present study was 35.6% which was lower than observed by Kora and Kulkarni (Bagalkot, Karnataka) 83.6%,[5] Kumar *et al*. (Sevagram, Wardha, Maharashtra) 33.8%,[6] Thakare *et al*. (Aurangabad, Maharashtra) 68.86%,[7] Suresh *et al*. (Tirupati, Andhra Pradesh) 37.9%,[1] and Anitha *et al*. (Nellore, Andhra Pradesh) 63.3%, respectively.[9] Discard rate for expired blood component (most commonly platelet) in the present study was 21.6% while the same in Kumar *et al*. (Sevagram, Wardha, Maharashtra) was 57.8%,[6] Thakare *et al*. (Aurangabad, Maharashtra) 31.3%,[7] Patil *et al*. (Sawangi, Wardha, Maharashtra) 53.0%,[8] Kanani *et al*. (Jamnagar, Gujarat) 43.4%,[3] and Anitha *et al*. (Nellore, Andhra Pradesh) 21.9%.[9] Discard rate for LQ in the present study was 13.11%, Suresh *et al*. (Tirupati, Andhra Pradesh) 30.6%[1] and Kanani *et al*. (Jamnagar, Gujarat) 25.4%, respectively.[3] Discard rate for breakage damage/leakage blood and blood component in the present study was 13.84%, Morish *et al*. (Kuala Lumpur) 25.7%,[4] Gupta *et al*. (Ahmedabad, Gujarat) 22.7%,[2] and Kanani *et al*. (Jamnagar, Gujarat) 13.7%, respectively.[3] Discard for all blood and blood component was observed for other miscellaneous reasons such as clotted/hemolyzed blood unit, DCT positive, and QC (blood component used for quality control). In the present study, the units discarded due

Table 4: Comparison of reasons for discarding whole blood unit and component: In various published studies with present

Study	Study period	No. of component prepared	No. of unit discarded (%)	Reasons for discarding WB and components				
				TTI pos. (%)	Expired (%)	LQ (%)	Leakage (%)	Others *(%)
Morish et al. (Kuala Lumpur)[3,4]	January 7–December 7	39,0634	8968 (2.3)	---	--	353 (3.9)	2306 (25.7)	6309 (70.4)
Kora and Kulkarni (Bagalkot, Karnataka)[3,5]	January 9–December 10	6129	263 (4.3)	220 (83.6)	38 (14.4)	5 (2.0)	---	----
Kumar et al. (Sevagram, Wardha, Maharashtra)[3,6]	November 9–May 11	10,582	888 (8.4)	300 (33.8)	513 (57.8)	18 (2.0)	27 (3.0)	20 (3.4)
Thakare et al. (Aurangabad, Mah.)[3,7]	2005–2007	24,547	879 (3.6)	604 (68.86)	275 (31.3)	----	---	---
Suresh et al. (Tirupati, Andhra Pradesh)[1,3]	January 13–June 14	24,847	1747 (7.0)	663 (37.9)	131 (7.5)	536 (30.7)	28 (1.6)	78 (4.5)
Patil et al. (Sawangi, Wardha, Maharashtra)[3,8]	January 13–June 15	14,026	2888 (20.6)	953 (33.0)	1531 (53.0)	48 (1.7)	97 (3.4)	186 (6.4)
Kanani et al. (Jamnagar, Gujarat)[3]	January 14–December 16	66,255	4604 (7.0)	520 (11.3)	1997 (43.4)	1169 (25.4)	631 (13.7)	163 (3.5)
Gupta et al. (Ahmedabad, Gujarat)[2,3]	February 17–December 17	94,816	3132 (3.30)	971 (31.0)	-----	---	712 (22.7)	214 (6.8)
Anitha et al. (Nellore, Andhra Pradesh)[3,9]	January 18–June 19	16,277	759 (4.6)	483 (63.6)	166 (21.9)	27 (3.6)	82 (10.8)	1 (0.1)
Present study (Ahmedabad, Gujarat)	January 19–December 19	88,973	2637 (2.96)	987 (35.06)	592 (21.06)	343 (13.11)	365 (13.84)	*343 (13.00)

*Includes clotted/hemolyzed, DCT positive, QC (quality checking blood component). QC: Quality check, WB: Whole blood, TTI: Transfusion transmitted infection, LQ: Less quantity

to such miscellaneous reasons were 13.0% while by Morish *et al*. (Kuala Lumpur), it was about 70.40%.[4] According to AABB blood survey report of 2013, outdated components as a percentage of the total number of units of each component distributed for transfusion in 2013, the overall percentage of outdated components for WB/RBCs were 3.4%, apheresis platelet 11.0%, platelets concentrates 23.7%, plasma 1.8%, and CRYO 2.6%.[10]

According to the WHO status report, in upper middle-income group countries, total blood donation discards the median range 6.7% (0.5–21.7), total reactivity rate 3.9 (0.01–16.0), and donation discarded due to outdates/expiry is 4.7% (0.04–25.8). In the present study, the discard rates were 2.96%, 1.10%, and 0.67%, respectively, very less than the benchmark for the upper middle-income group countries and nearer to high-income group countries.[11] According to National Blood Transfusion Council (NBTC) norms for discard of blood and blood components, for upper middle-income group country like India, median percentage of total donation discarded should be 6.7%, median parentage discards due to seroreactivity 3.9% and median percentage of discard due to outdate/expiry 4.7%. In the present study, all above are very less than criteria laid down by NBTC.[12] According NACO Blood Bank QMS Training Manual, sero-reactivity bench mark limits for various TTI are defined as follows HIV 0.28%, HBV 2-3%, HCV 0.4-2%, Syphilis 0.11% and malaria 0.03%. In the present, seroreactivity for HIV (0.14%), HBV (0.55%), HCV (0.16%), and malaria is observed less than NACO benchmark while for syphilis (0.24%), it is higher than benchmark.[13]

The present study was carried out in one of largest blood centers with more than 30,000 voluntary donors and having 100% component separation. The data analyzed were stretched over 1 year period to avoid bias in the data collection.

CONCLUSION

A number of reasons are responsible for blood wastage including TTIs seroreactive, leakage, RBCs contamination, LQ, time expiry, hemolysis, or miscellaneous reasons. Over a period of time, BTS has observed significant advancements in various areas including donor management, storage of blood, newer blood components, cross-matching techniques, use of blood components, and distribution. To improve the standards of BTS, comprehensive standards have been formulated to ensure better quality control in collection, storage, testing, and distribution of blood and its components. Stringent donor screening criteria have also been into existence. Process improvement at various steps in BTS can prevent wastage of blood component such as technical expertise advocated in phlebotomy to prevent collection of LQ, expert hand in component separation to prevent RBC contamination during platelet and FFP preparation, precaution while thawing

of FFP to prevent leakage/breakage, and increased use of apheresis technique. Continued medical education and more hands on training for technical staff to maintain self-audit, tracking quality indicator of processing, and preparation of the blood components have been advised to minimize the discard rate and ultimately save scarce resource.

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