Reasons for Discarding of Whole Blood/Red Cell Units in a Regional Blood Transfusion Centre in Western India

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Abstract To analyze the reason for discarding whole blood and red cell concentrates in a Regional Blood Transfusion Centre in India. Retrospective analysis of electronic data on collection of blood and reason for discard of whole blood and red cell concentrate between January 2012 and December 2016. 1,70,431 units of blood were collected between January 2012 and December 2016 in various blood donation camps. On an average 6.60% whole blood or red cell units were discarded because of various reasons. Out dating was the single important cause for discarding such units leading to loss of 6.7–7 million rupees (USD 1,00,000) to the blood bank. Infective units, haemolysed units, insufficient amount collected units and leakage were other important causes for discarding the units. Using multiple approaches of donor selection, staff training rescheduling of blood camps and sharing this precious resource with other blood bank can significantly minimize the discard rate. The reasons for discard of blood units varied not only from one blood centre to other but also from one country to another.

Keywords Wastage of blood · Seropositivity · Outdating · Leakage · Hemolysis · Six sigma · Lean technology

Introduction

Wastage of red cell concentrate/whole blood unit has important impact on blood supply and financial stability of the blood centre. It has been calculated that discarding of red cell units in hospitals ranges from 0 to 6.7% [1, 2]. The reason for discarding a unit of whole blood or red cell concentrate will vary in hospital based blood banks and stand alone Regional Blood Transfusion Centre which supplies blood to many hospitals. Several studies are available from western countries on red cell/whole blood wastage in different blood banks [3, 4] but there are paucity of data on the degree and nature of wastage of red cell/whole blood units in blood banks in India [5–7]. Particularly hardly any data is available on red cell or whole blood discard from any big regional blood centre in India. The present study describes discard rate of red cell units/whole blood units in a big regional transfusion centre from western India and discussed ways any means to reduce the discard rate.

Materials and Methods

Electronic data of the regional blood transfusion centre were mined from 2012 January to 2016 December to extract following parameters (1) Month-wise collection of blood (2) Month-wise discard of blood bags due to positive infectious markers (HIV, Hep B, Hep C, Syphilis and Malaria) (3) Month-wise discard of whole blood bag due to inadequate quantity (4) Month-wise discard due to blood clots (5) Haemolysis (6) Leakage in the bag and finally out dating. Rest of the red cell units were taken up by different hospitals in Surat. We are also in a position to account the financial loss due to these discards as Government of India

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has a fixed rate for blood bags. The centre started Nucleic Acid Amplification testing as an additional layer of safety [8]. Hence from 2014 there were additional discard of blood bags which were seronegative but NAT positive.

Results

Table 1 given the details of Month-wise collection and discard of blood units under different heading. It may be noted that there are three blood peaks of collection i.e. December–January, March–April and September–October. These higher collection were followed by high number of discards due to outdating. Summary of the month-wise data in year-wise format has been provided in Table 2. Where it can be seen that total amount of collection varied between 31,653 and 37,195 blood bags a year and total discards ranged between 1648 and 2609 bags a year. Discard due to positive infectious disease serology varied between 202 and 360 bags/year this number was increased by additional 12–21 units due to NAT positivity. Maximum seropositivity and NAT positivity was contributed by Hep B virus [9]. If we convert discard rate as widely acceptable WAPI i.e. wastage as percentage of issues then the wastages (Discard rate) over the 5 year assessment period was 5.08, 5.21, 7.09, 6.96 and 8.98% respectively. The average discard rate is 6.60%.

The major cause of the discard units is increasing number of expired units since 2012 every year and smaller increase in infectious markers. Discarding due to blood clot in the bag was negligible between 2 and 13 units, leakage of bag varied between 101 and 282 units. However insufficient amount collected varied between 181 and 223 units i.e. around 0.5% of the collected units. Haemolysis in the bag (visual) was the reason for discard for 33–161 units (average around 0.3%). Only outdating (Total 6777 units) over 5 years were responsible for 4.24% WAPI. If the cost of each blood bag at Rs. 1000/- (USD 15) is considered then due to expiry of blood bags this blood bank has incurred a loss of 6.7 million rupees (i.e. 1,00,00 USD) ever last 5 years. This is a substantial sum in our country.

Discussion

Discarding of collected blood units is an important cause of wastage of precious resources including financial resources in a transfusion centre. However from India there has been relatively less attention given to these facts by blood bankers [5–7]. However the reason for discard of blood units in India seems to be different in different blood banks. A blood bank in central India found their discard rate of whole blood bags at 3.38% of WAPI but 74% of the

discarding was due to seropositivity [5]. In another study from South India [6] the discard rate was 5.7% of 5261 units collected and a large amount that is released to seropositivity (49% of the discarded bag) and only one-third of the discarded bag is due to expiry. Similarly another study from Western India analyzing the inventory over 3 years involving 24,547 units of blood had a discard rate of 3.58 and 68.86% of the discarded units was an account of positive serology [7]. Yet in another study from Western India 10% discard rate was reported [8]. In all these studies the evaluation was done in a hospital based blood bank where patient bring their donors (Directed donation) hence there is no question of expiry as inventory is low and for whom the blood is given is known. As a result of the above mentioned factors the major cause of whole blood/red cell concentrate discarded is positive infections serology.

There are many hospital based blood banks in India where yearly turnover of whole blood/red cell concentrate reaches more than 30,000 units. Some data from these hospital based blood banks could have enlightened us on the major reasons for discard blood units.

In a hospital in sub-Saharan Africa the discard rate was found to be only 1.8% and the discard was mainly due to supply of only a portion of blood to pediatric patient and rest going waste [9]. The other might not have analyzed the discard rates due to outdating or infectious markers or some other cause of discard. A small portion of the discarded unit in present series is also due to wastage of blood as one or two small pediatric aliquots were used.

Discarding of blood units outside positive infectious markers ideally should never occur. However 1% discard of blood units have been considered optimum in certain studies [10]. The discard rate in the present regional transfusion centre has varied from 5.08 to 8.98% way beyond the optimum or idealized rates for western transfusion centres. Though addition of NAT testing in the blood bank since 2014 did add a small addition discard rate of only 47 bags over 3 years but the major reason of discard in the present study is outdating (Expiry). This blood bank has 18 storage centre in remote tribal areas in the state of Gujarat where an inventory assorted ABO and RhD grouped red cell units needs to be stored and replaced from time to time to meet the emergencies related to accidents or hemorrhage during delivery of pregnant mothers in those areas.

In addition it may be noted from Table 1 that this centre receives large number of blood donors in blood camps in December–January, March and in September–October months of every year and 65–70% of the discarding due to outdating follow those months. In addition in recent year 3 more additional blood banks have come up the city of Surat where the present transfusion centre is located. In addition

Table 1 Month-wise collection and discard of blood units 2012–2016

Month	Collection	HIV	HBs Ag	HCV	NAT			Syphilis	MP	QNS	Clotted	Hemolysed	Expiry	Leakage	Total
					HIV	HBV	HCV								
Jan. 12	3594	3	15	2				0	0	29	0	8	134	25	216
Feb.	2869	5	17	2				0	1	21	0	9	41	11	107
March	2969	1	19	0				2	1	20	2	28	288	11	372
April	2933	0	24	1				0	6	18	2	3	36	19	109
May	2710	2	19	2				1	3	16	0	6	24	1	74
June	2466	1	13	1				3	6	5	2	2	14	6	53
July	3138	1	20	1				2	11	14	1	4	17	12	83
Aug.	2564	1	10	2				2	5	20	0	2	28	7	77
Sept.	5279	1	37	3				1	6	27	0	4	15	15	109
Oct.	2334	2	11	3				0	2	20	0	21	233	11	303
Nov.	1500	1	9	4				1	2	9	1	9	168	13	217
Dec.	4839	2	29	1				1	2	24	3	0	13	3	78
Jan. 13	2596	1	14	3				1	0	43	0	2	147	12	223
Feb.	3287	1	25	1				1	5	11	1	1	94	6	146
March	3241	2	26	0				2	1	7	3	11	78	14	144
April	3380	1	21	1				2	8	18	0	10	80	30	171
May	1901	0	6	2				2	0	12	0	23	271	3	319
June	2306	1	13	1				1	1	12	0	9	38	4	80
July	2500	0	7	0				1	2	8	2	3	5	6	34
Aug.	2477	1	13	0				1	0	7	0	10	14	11	57
Sept.	4034	1	30	1				1	0	12	2	13	9	0	69
Oct.	2585	2	8	2				0	0	28	0	35	156	16	247
Nov.	1345	2	9	1				0	1	6	1	14	49	15	98
Dec.	3631	1	16	1				0	1	17	0	7	4	13	60
Jan. 14	2973	4	16	2	0	2	0	2	1	38	3	4	53	22	147
Feb.	2865	2	14	0	0	0	1	1	1	18	0	11	140	31	219
March	3214	0	21	3	0	0	0	1	0	7	1	14	194	26	267
April	2988	1	11	0	0	1	0	1	3	9	0	22	101	24	173
May	2483	2	10	0	0	0	0	0	3	7	0	16	144	24	206
June	3019	0	16	2	0	6	0	1	5	4	0	4	54	36	128
July	2869	4	18	1	0	1	0	1	0	37	1	0	39	6	108
Aug.	2371	0	6	2	0	0	0	1	3	14	0	1	84	16	127
Sept.	4400	3	31	7	0	1	0	1	3	19	7	7	29	24	132
Oct.	2245	2	13	2	0	0	0	0	1	10	0	17	469	37	551
Nov.	2363	4	17	1	0	0	0	3	1	9	0	18	102	30	185
Dec.	3594	1	17	0	0	2	0	0	1	13	1	7	46	16	104
Jan. 15	3101	2	19	1	1	3	0	1	0	25	0	96	286	16	450
Feb.	1732	2	16	3	0	0	0	0	3	6	0	23	59	6	118
March	3966	8	40	20	0	0	0	0	10	11	1	31	185	19	325
April	2411	6	23	9	0	0	0	2	4	23	0	3	203	16	289
May	2114	1	12	9	0	0	0	0	7	7	0	1	141	5	183
June	2068	1	16	7	0	0	0	0	2	18	0	0	24	3	71
July	3756	2	27	5	0	4	0	2	6	13	0	1	53	18	131
Aug.	2381	1	17	2	0	2	0	0	5	13	0	0	178	3	221
Sept.	3168	1	9	2	1	0	0	1	4	16	0	4	38	6	82
Oct.	1976	4	10	2	0	0	1	0	0	21	0	2	30	2	72
Nov.	2341	2	12	0	0	0	0	1	1	10	1	0	41	14	82

Table 1 continued

Month	Collection	HIV	HBs Ag	HCV	NAT			Syphilis	MP	QNS	Clotted	Hemolysed	Expiry	Leakage	Total
					HIV	HBV	HCV								
Dec.	3902	1	15	1	0	0	0	0	1	31	0	0	22	5	76
Jan. 16	3740	3	16	1	0	0	0	2	1	19	2	0	90	5	139
Feb.	2445	2	14	0	0	3	0	1	2	20	0	2	376	5	425
March	3004	0	21	0	1	1	0	0	2	10	1	2	415	12	465
April	2241	0	12	0	0	0	0	1	0	9	0	6	133	14	175
May	1853	0	9	2	0	3	0	0	0	4	0	7	106	8	139
June	2359	3	12	1	0	1	0	0	2	8	0	2	23	10	62
July	3338	1	9	2	0	1	0	0	0	13	0	0	66	10	102
Aug.	1953	1	5	3	0	0	0	0	5	13	0	3	188	3	221
Sept.	4429	3	24	4	1	6	0	2	1	28	0	4	42	14	129
Oct.	1881	0	7	1	0	1	0	0	0	15	0	2	274	11	311
Nov.	1136	4	2	4	0	0	0	0	0	8	1	4	377	2	402
Dec.	3274	0	10	3	0	3	0	3	0	34	1	1	16	7	78
	170,431	104	958	137	4	41	2	53	142	964	40	549	6777	770	10,541

Table 2 Discard of Whole blood/Red cell bags at Surat Raktadan Kendra and Research Centre between 2012 and 2016 (5 years)

Year	Collection	HIV	HBs Ag	HCV	NATtest			Syphilis	MP	QNS#	Clotted	Hemolysed	Expiry	Leakage	Total
					HIV	HCV	HBV								
2012	37,195	20	22	223	0	0	0	13	45	223	11	96	1011	134	1798
2013	33,283	13	13	188	0	0	0	12	19	181	9	138	945	134	1648
2014	35,384	23	20	191	2	1	13	12	22	185	13	115	1455	282	2304
2015	32,916	31	61	216	1	1	9	7	43	194	2	161	1306	119	2140
2016	31,653	17	21	142	1	0	19	9	13	181	5	33	2060	101	2608
5 years total	1,70,431	104	137	958	4	2	41	53	142	964	40	549	6777	770	10,541

Quantity not sufficient

this centre also faced not so infrequent leakage of blood bags (770 units) this was related to failure to seal the tubes properly and trained the staffs may reduce this types of discard. In addition the leakage was caused by supply of defective bags by a company and after we stopped buying bags from them leakage reduced substantially.

964 units over least 5 years were collected as insufficient quantity. Hence if we combine discard due to leakage and insufficient quantity then almost 1734 bags were discarded causing a loss of 1.74 million rupees (USD 28000) to the centre. A large part of this wastage seems to be preventable. However regarding outdated or expiry what else can be done? This is a precious human resource and presently attempts are on to stagger the blood camps in busy months and use different techniques some of which has been discussed in lean sigma methodology for blood banking [11–13]. This essentially improves on five part lean sigma process i.e. Define, measure, analyse, improve

and control concentrating on Stock levels and order patterns, Replenishment orders i.e. for our case scheduling the blood donation camps with some control on possible number of donors, Inventory management principles like transparency of inventories and making the procedure simple i.e. first come first out, no unnecessary holding the product for particular patients etc., inventory tools and equipments, allocation of units to the patients, human resource training, focusing on freshness of stocks. Moreover discussing with another blood bank and transferring some of the blood bags early during storage to those blood banks where they may be used up particularly at a time when such transfers have become legal in this country. In addition using digital data information and management system wherever possible [12].

If we consider that we collect about 11 million units of blood every year across the country and a 6% or more discard rate will bring the amount of wasted blood to more

than 60,000 units/year. If we put a cost of 1000 rupees per unit of red cells (The cost fixed by NACO) then this discard amounts to a whopping 6 crore rupees/year. Moreover many donors who donated blood out of sheer good will, will not feel good that this amount of blood is wasted every year. Though we cannot prevent all the wastage yet we can substantially reduce it through proper inventory management techniques.

It may not be out of place to mention here that some of the reason for blood discard in Western countries like 30 min rule, committed inventory were not applicable in this stand alone regional transfusion centre. But collecting blood in blood camps where the number of donors can reach mammoth proportions, overwhelming the staffs collecting blood and causing several areas of failure i.e. improper sealing leading to leakage, blood outdating even if first come first go techniques in used, in adequate blood in blood bag, clots in blood bag. Some of these challenges can be mitigated by proper staffing (taking additional staff on a particularly during increased donor load) and training them properly.

Arrival of new blood centres in the city, increased cost of blood at this centre because of the blood is NAT tested are some of the factors which cannot be easily addressed. Providing a small fraction of a bag of blood for pediatric patients leading to outdating of rest of the bag is also an important component of outdating. If is not easily solved in this blood bank even if all the blood is distributed in 5 small pediatric connecting bags as the patient may not require any more transfusion than one or two units. Experienced staffs in the transfusion services often leaves for better opportunities or on account of marriage and the blood centre has to do with less experienced technical staff leading to some of the discarding due to technical flaws. Retaining experienced staff in blood centre is a challenge.

In our centre 549 blood bags were reported to have contained haemolysed blood on visual inspection, it is not clear whether with experienced technician, less number of such bags would have been discarded as studies have shown that visual assessment of haemolysis in red blood cells units and segment may be deceptive and can result in unnecessary wastage of blood [14]. Techniques are also developing to show that red cells from under collected units can also be utilized [15]. But legal permission is needed to be able to do so. Hence it is possible even in our resource constrained situation to improve blood wastage if all the challenges are adequately addressed..

Compliance with Ethical Standards

Conflict of interest None of the authors have any conflict of interest to declare.

Ethical Approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed Consent All participants gave informed consent during donation.

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