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A Retrospective Study on Factors Accounting for Donor Blood Discard at the Cape Coast Teaching Hospital, Ghana

Grace Wemochigah[1], Edward Morkporkpor Adela[1], Daniel Edem Azumah[1], Rebecca Peniel Storph[1], Endorah Fotwe Blankson[1], Evans Duah[1], Francis Britwum[2]

[1]Laboratory Department, Cape Coast Teaching Hospital, Cape Coast, Ghana

[2]Department of Education and Psychology, University of Cape Coast, Cape Coast, Ghana

Email address:

mamsibraim@gmail.com (G. Wemochigah), e.adela@ccth.gov.gh (E. M. Adela), azudemus4@yahoo.com (D. E. Azumah), beck.p.storph@gmail.com (R. P. Storph), endybee79@gmail.com (E. F. Blankson), ivanprecy@gmail.com (E. Duah), francisbritwum@gmail.com (F. Britwum)

*Corresponding author

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Abstract: Blood transfusion is an essential part of modern medicine, which helps save millions of lives every year. Blood is life and blood transfusion is an essential part of medical therapeutic practice. Transfusion of whole blood and blood components such as packed red blood cells (RBCs), white blood cells (WBCs), fresh frozen plasma, cryoprecipitate and platelets concentrate are needed in modern medicine. Therefore, the main purpose of the study was to examine factors accounting for donor blood discard at the Cape Coast Teaching Hospital, Ghana. The descriptive cross-sectional survey design was employed in the study. This study included blood units discarded for different reasons at CCTH immunohematology unit between the period of January 2014 to December 2020 which amounted to 33,896 whole blood. The study revealed that out 33,896 whole blood, 2231 (6.6%) units were discarded, while 1700 (76.2%) of the discarded units were voluntary donations and 53 (23.7%) were from replacement donations. The study again showed that the most common blood group that was discarded was O Rh "D" Positive. The study again revealed that 1225 (54.9%) blood unit were discarded due to seropositivity of transfusion transmissible infections (TTI), 288 (12.9%) were discarded because the expiry date was due, 259 (11.6%) were discarded as a result of transfusion reactions, 84 (3.8%) and 25 (1.1%) were discarded for hemolysis and bag leaks respectively. The study again, indicated that among the units discarded seropositivity to transfusion transmissible infections was the most prevalent with hepatitis B infections (HBV) being the highest with 553 (45.1%), followed by syphilis infections with 400 (32.7%), hepatitis C (HCV) with 156 (12.6%) and HIV with 116 (9.5%). The study further revealed that blood group that expired the most was B Rh "D" Positive representing 24.7%. The study recommends that donor blood collection, processing, handling, storage and monitoring should be handled by qualified technical personnel with the right expertise in order to reduce causes of blood discard that are associated with these steps.

Keywords: Blood Donor, RBC, WBC, HBV, HCV, TTI and FFP

1. Introduction

Blood transfusion is an essential part of modern medicine, which helps save millions of lives every year. Blood is life and blood transfusion is an essential part of medical therapeutic practice [1]. Transfusion of whole blood and blood components such as packed red blood cells (RBCs), white blood cells (WBCs), fresh frozen plasma, cryoprecipitate and platelets concentrate are needed in modern medicine [1]. There are several types of blood donation, but the most common type is the whole blood donation. Whole blood is a term used in transfusion medicine for a standard (500 ml) blood donation as opposed to plasma and platelet [2]. Fresh Frozen Plasma (FFP), cryoprecipitate and platelets concentrate are needed in modern medicine [1]. Human blood to date has no substitute and, hence there is the

need to make effective use of blood that are donated so as to get the most out of it and avoid wastage.

In Ghana, more than 31,000 blood donations are needed every week, and products derived from these donations are used in various medical treatments, such as cancer and blood diseases, and surgical procedures [3]. Voluntary donation and family replacement donations are the main source of blood supply in most of the blood banks in Ghana. In family replacement donation, patient relatives or friends are made to donate blood for the patient to undergo an elective procedure. Meanwhile, during emergencies, the relatives or friends are made to replace the unit (s) given to the patient to ensure continuity of blood supply in the blood bank. Family replacement sometimes come with an advantage as family members are willing to donate blood if they are asked to without receiving any incentives because they have a motive to save their loved ones. They may sometimes accept repeated donations and eventually become voluntary donors thereby constituting a legitimate and important source to improve the blood supply in Sub-Saharan Africa [4]. Africa, and Central Asia, constitute approximately 20% of global blood collections in most middle and low human development index countries [5].

Similar to other countries, such as the United Kingdom and the Netherlands, Ghana collects blood products from voluntary non-remunerated donors. This is consistent with the global action framework developed by [6] to achieve 100% voluntary non-remunerated blood donation. Currently, there are 62 countries with 100% of their blood supply collected from voluntary non-remunerated donors, with more countries attempting to reach this target [7]. For example, between 2013 to 2018 there was an increase of 7.8 million donations from voluntary non-remunerated donors in 156 countries [7].

Voluntary non-remunerated blood donation is quite the odd behaviour. First, the donor must be healthy and meet certain health requirements (e.g., free from major diseases) to donate. Passing the health requirements, the donor then sacrifices their own time losing vital biological resources (i.e., blood). This giving of a biological resource adds a dimension to the donation that is unique to substances of human origin [8] and outside of the donation context loss of this biological resource is associated with injury and even death [9]. The blood product is then passed on to a stranger who will never learn the identity of 'their' donor. As such, there is no way for the recipient of the blood product to directly repay the donor for their good deed. Further to this, in voluntary non remunerated systems, there are no immediate benefits for the blood donor that outweigh the total cost of donating blood (losing blood, time and energy). Together, these aspects make it difficult to understand why people would donate blood voluntarily.

After these donors have donated the blood, the blood is transported to the laboratory for investigation, some of the blood units end up being discarded despite the difficulties associated with mobilizing blood donors. This therefore, calls for the need to examine the factors accounting for discarding donor blood units in the Cape Coast Teaching Hospital (CCTH).

2. Statement of the Problem

Blood donation is one of the most noble gestures humans can give to save life and it has been estimated that every two seconds someone needs blood or its components in order to survive [10]. Generally, the demand for blood and its components keep increasing and the supply is outpaced in meeting the increasing demand [11]. Amid rising demand for blood and its products, some units of blood are discarded due to certain reasons. Though blood and its products are vital in health care, it can be a major source of infection and pose other life-threatening conditions to its receivers if not properly processed [12] and this has resulted in discarding of some blood units which could otherwise save lives.

The adaptation of blood component preparation was in a bid to make maximum use of blood and increase its availability to specific patient needs; thus, the component separation increases the utility of one whole blood unit [13]. This emphasizes the need for proper utilization of blood and its components to reduce and avoid wastage and discard.

By analyzing the reasons why blood is discarded in the blood bank the researchers can identify problems associated with blood discard and implement policies that would improve the whole performance of blood bank services to reduce the average rate of discard in the blood bank. Centered on the dominant literature, some issues arise: (1) majority of the preceding studies on blood donor were conducted in Western world and their findings are likely to be less applicable in the Ghanaian context because donor blood among pupils are likely to differ between Ghana and these countries due to diverse cultures, values, religion, beliefs and among others [45-46], (2) relating to the Ghanaian context, little is known about blood discard in the various teaching hospitals in Ghana specifically, Cape Coast Teaching Hospital (CCTH). To fill this gap in the existing literature, the present examination proposed the following research questions:

1) What are the general description of discarded blood and blood products in the CCTH?
2) What are the blood group distribution of discarded blood and blood products in the CCTH?
3) What are the reasons for discarding blood and blood products in the CCTH?
4) What are the transfusion transmissible infections associated with donor blood discard in the CCTH?
5) What are the blood group distribution of blood discarded due to expiration in the CCTH?

3. Theoretical Framework

The Theory of Planned Behavior (TPB) served as the foundation for the educational strategy. The TPB, derived from the Theory of Reasoned Action, was developed in the 1985 by Icek Ajzen. This theory, widely used and accepted in behavioral sciences, asserts that there are four major constructs or concepts that contribute to a change in behavior, subjective norms, attitude, intent, and behavioral

control [14]. Specifically, subjective norms, attitude, and behavioral control contribute to one's intent to make a behavior change which ultimately results in an actual change in behavior. The TPB [14] postulates that "people should be able to act on their intentions to the extent that they have the information, intelligence, skills, abilities, and other internal factors required to perform the behavior and to the extent that they can overcome any external obstacles that may interfere with behavioral performance" (p. 446). The TPB is commonly cited in blood donor research. There have been positive outcomes of predicting intent to donate by assessing the TPB's major constructs. Prior studies have shown that 70% of the variance intent to donate can be attributed to attitudes related to blood donation, the influence of subjective norms, and perceived behavioral control [15]. The constructs of the TPB underpine the proposed study. The strategy included previously cited barriers to blood donation, knowledge of the donation process, and specific reasons why blood is needed, with the expectation of improving attitudes toward, and increasing intent to donate.

A subjective norm refers to social pressures that persuade individuals to engage in or refrain from a behavior [16]. The TPB literature typically suggests the pressure of family, friends, and respected individuals when referring to subjective norms; however, it can also refer to what is deemed as a more acceptable behavior in a particular group Perceived behavioral control describes an individual's perception of their ability to perform a behavior [17].

4. Methodology

4.1. Research Design

For the purpose of this study, the descriptive cross-sectional survey design was employed. It is posited that descriptive survey involves collecting data in order to test hypotheses or to answer research questions concerning the current status of the subject of the study [18]. It also describes and predicts phenomena without manipulating factors that influence the phenomenon [19]. It is of the view that descriptive survey predominantly aims at describing, observing and documenting aspects of a situation as it naturally occurs [20]. It is noted that descriptive survey entailed acquiring information on one or more cohorts or groups of people probably on the subject of their uniqueness, views, character or prior occurrence or understanding by making enquiries and pictorially presenting their feedbacks [21].

According to [22], descriptive survey is concerned with describing, recording, analyzing and reporting conditions that exist or existed. It is argued that descriptive survey is widely used to obtain data useful in evaluating present practices and providing basis for decisions [23]. The descriptive survey was considered the most appropriate design for conducting this study because the design had an advantage of providing the researchers with a lot of information obtained from quite a large sample [24]. Descriptive survey design is helpful in indicating trends in attitudes and behaviours, and enables generalisation of the findings of the research study to be done [25]. The descriptive survey is also appropriate for conducting this study because information gathered from the descriptive research can be meaningful or useful in diagnosing a situation since it involves describing, recording, analyzing and interpreting conditions that exist.

4.2. Study Population

The study was carried out in the Immunohematology unit of the Cape Coast Teaching Hospital in the Central Region of Ghana.

4.3. Inclusion Criteria

This study included blood units discarded for different reasons at CCTH immunohematology unit between the period of January 2014 to December 2020.

4.4. Exclusion Criteria

This study excluded discarded blood units that were not recorded between the study period of January 2014 to December 2020.

4.5. Data Collection

The data was collected from the immunohematology data records for blood discard from January 2014- December 2020. These included the total amount of blood collected, the number of units of various components discarded, reason for the discard, and discarded date of each blood unit.

4.6. Data Analysis

The data extracted from the CCTH immunohematology data records for blood discard was cleaned and entered into Microsoft Excel 2016. The data were analyzed with Stata IC version 16. Descriptive statistics were performed for frequencies and percentages based on the research questions. The

4.7. Ethical Consideration

Ethical clearance was obtained from the Cape Coast Teaching Hospital Ethical Review Committee and the management of the Laboratory of the Cape Coast Teaching Hospital before the study was conducted.

5. Results

5.1. Research Question 1

What are the general description of discarded blood and blood products?

The main aim of this research question was to examine the general description of discarded blood and blood products. Descriptive statistics (frequency and percentages) was used to test the research question. Table 1 present the results.

Table 1. *General description of discarded blood and blood products.*

Variable	Total N=2231 n (%)	Year 2014 N=185 n (%)	2015 N=135 n (%)	2016 N=190 n (%)	2017 N=417 n (%)	2018 N=361 n (%)	2019 N=460n (%)	2020 N=483 n (%)
Type of Donor								
Family replacement	530 (23.7)	0 (0.0)	0 (0.0)	183 (96.3)	85 (20.4)	51 (14.1)	51 (11.1)	160 (33.1)
Voluntary	170 (76.2)	184 (99.5)	135 (100.0)	7 (3.7)	332 (79.6)	310 (85.9)	409 (88.9)	323 (66.9)
Blood Product								
FFP	36 (1.6)	2 (1.1)	1 (0.7)	0 (0.0)	10 (2.4)	5 (1.4)	17 (3.7)	1 (0.2)
Platelets	1 (0.1)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	1 (0.3)	0 (0.0)	0 (0.0)
Whole blood	219 (98.3)	183 (98.9)	134 (99.3)	190 (100.0)	407 (97.6)	355 (98.3)	443 (96.3)	482 (99.8)
Discard rate	6.6%	14.9%	2.6%	2.4%	8.2%	6.3%	8.9%	10.0%

Source: Field Data (2022)

From Table 1, a total of 33896 blood units were collected in the study period of which 2231 (6.6%) units were discarded. 170 (76.2%) of the discarded units were voluntary donations while 53 (23.7%) were from replacement donations. The total number of FFP and whole blood discarded within this period was 36 (1.6%) and 219 (98.3%) respectively. The average blood discard rate from 2014 to 2020 was 6.6%.

5.2. Research Question 2

What are the blood group distribution of discarded blood and blood products?

The purpose of this research question was to examine blood group distribution of discarded blood and blood products. Frequency and percentages were used to test the research question. The result is presented in Table 2.

Table 2. *Blood group distribution of discarded blood and blood products.*

Variable	Total N=2231 n (%)	Year 2014 N=185 n (%)	2015 N=135 n (%)	2016 N=190 n (%)	2017 N=417 n (%)	2018 N=361 n (%)	2019 N=460 n (%)	2020 N=483 n (%)
Blood group								
A Rh "D" Negative	12 (0.5)	0 (0.0)	1 (0.7)	0 (0.0)	2 (0.5)	4 (1.1)	2 (0.4)	3 (0.6)
A Rh "D" Positive	251 (11.3)	20 (10.8)	22 (16.3)	20 (10.5)	58 (13.9)	47 (13.0)	59 (12.8)	25 (5.2)
AB Rh "D" Negative	4 (0.2)	3 (1.6)	1 (0.7)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
AB Rh "D" Positive	74 (3.3)	7 (3.8)	9 (6.7)	13 (6.8)	8 (1.9)	14 (3.9)	6 (1.3)	17 (3.5)
B Rh "D" Negative	26 (1.2)	2 (1.1)	1 (0.7)	7 (3.7)	4 (0.9)	4 (1.1)	6 (1.3)	2 (0.4)
B Rh "D" Positive	273 (12.2)	13 (7.0)	21 (15.6)	30 (18.8)	49 (11.8)	62 (17.2)	57 (12.4)	41 (8.5)
O Rh "D" Negative	51 (2.3)	4 (2.2)	4 (2.9)	4 (2.1)	13 (3.1)	5 (1.4)	10 (2.2)	11 (2.3)
O Rh "D" Positive	1540 (69.0)	136 (73.5)	76 (56.4)	116 (61.1)	283 (67.9)	225 (62.3)	320 (69.6)	384 (79.5)
Unknown Blood Group	226	-	-	-	-	-	-	-

Source: Field Data (2022)

In Table 2, it was observed that the most common blood group that was discarded during the study period was O Rh "D" Positive representing 69.0% of total blood groups discarded and this was mainly because O Rh "D" Positive was the most common blood groups amongst the study population.

5.3. Research Question 3

What are the reasons for discarding blood and blood products?

This question examined the reasons for discarding blood and blood products. The results are presented in Table 3.

Table 3. *Reasons for discarding blood and blood products.*

Variable	Total N=2231 n (%)	Year 2014 N=100 n (%)	2015 N=84 n (%)	2016 N=113 n (%)	2017 N=239 n (%)	2018 N=233 n (%)	2019 N=262 n (%)	2020 N=234 n (%)
TTI	1225 (54.9)	114 (61.6)	86 (63.7)	88 (46.3)	189 (45.3)	173 (47.9)	226 (49.1)	349 (72.3)
Expired	288 (12.9)	32 (17.3)	16 (11.9)	26 (13.7)	50 (12.0)	71 (19.7)	41 (8.9)	52 (10.8)
Incomplete Transfusion	259 (11.6)	21 (11.4)	14 (10.4)	28 (14.7)	48 (11.5)	36 (10.0)	45 (9.8)	67 (13.9)
Suboptimal volumes	220 (9.9)	15 (15.0)	14 (16.6)	5 (4.4)	81 (33.8)	47 (20.1)	42 (16.0)	16 (6.8)
Hemolysis	84 (3.8)	0 (0.0)	2 (1.5)	9 (4.7)	26 (6.2)	7 (1.9)	35 (7.6)	5 (1.0)
Clot	57 (2.5)	0 (0.0)	1 (1.2)	4 (3.5)	14 (5.9)	9 (3.8)	24 (9.1)	5 (2.2)
Broken cold chain	47 (2.1)	0 (0.0)	1 (1.2)	0 (0.0)	0 (0.0)	18 (7.7)	23 (8.7)	5 (2.2)
Bag leaks	25 (1.1)	1 (0.5)	1 (0.7)	0 (0.0)	9 (2.2)	3 (0.8)	11 (2.4)	0 (0.0)
Other reasons	26 (1.2)	2 (2.0)	0 (0.0)	0 (0.0)	2 (0.8)	0 (0.0)	15 (5.7)	7 (3.0)

Source: Field Data (2022)

From Table 3, out of the 2231 units that were discarded during the study, 1225 (54.9%) were discarded due to seropositivity of transfusion transmissible infections (TTI), 288 (12.9%) were discarded because the expiry date that was due, 259 (11.6%) were discarded as a result of transfusion reactions, 84 (3.8%) and 25 (1.1%) were discarded for hemolysis and bag leaks respectively

5.4. Research Question 4

What are the transfusion transmissible infections associated with donor blood discard at CCTH?

The aim of this research question was to examine transfusion transmissible infections. The results are presented in Table 4.

Table 4. *Transfusion transmissible infections.*

TTIs	Total N=1225 n (%)	Year 2014 N=114 n (%)	2015 N=86 n (%)	2016 N=88 n (%)	2017 N=189 n (%)	2018 N=173 n (%)	2019 N=226 n (%)	2020 N=349 n (%)
HIV	116 (9.5)	18 (15.8)	2 (2.3)	9 (10.2)	18 (9.5)	9 (5.2)	24 (10.6)	36 (10.3)
HBV	553 (45.1)	55 (48.2)	59 (68.6)	44 (50.0)	95 (50.3)	71 (41.0)	68 (30.1)	161 (46.1)
Syphilis	400 (32.7)	27 (23.7)	22 (25.6)	26 (29.6)	63 (33.3)	60 (34.7)	110 (48.7)	92 (26.4)
HCV	156 (12.7)	14 (12.3)	3 (3.5)	9 (10.2)	13 (6.9)	33 (19.1)	24 (10.6)	60 (17.2)

Source: Field Data (2022)

Amongst the units discarded in this study, seropositivity to transfusion transmissible infections was the most prevalent with hepatitis B infections (HBV) being the highest with 553 (45.1%), followed by syphilis infections with 400 (32.7%), hepatitis C (HCV) with 156 (12.6%) and HIV with 116 (9.5%) as shown in Table 4.

5.5. Research Question 5

What are the blood group distribution of blood discarded due to expiration?

The aim of this question was to examine the expired blood group distribution in this study. The results are presented in Table 5.

Table 5. *Blood group distribution of expired blood.*

Expired	Total N=288 n (%)	Year 2014 N=32 n (%)	2015 N=16 n (%)	2016 N=26 n (%)	2017 N=50 n (%)	2018 N=71 n (%)	2019 N=41 n (%)	2020 N=52 n (%)
Blood Group								
A Rh “D” Negative	1 (0.3)	0 (0.0)	0 (0.0)	0 (0.0)	1 (2.0)	0 (0.0)	0 (0.0)	0 (0.0)
A Rh “D” Positive	47 (16.3)	4 (12.5)	1 (6.3)	8 (30.7)	14 (28.0)	12 (16.9)	2 (4.8)	6 (11.5)
AB Rh “D” Negative	2 (0.6)	0 (0.0)	1 (6.3)	0 (0.0)	0 (0.0)	1 (1.4)	0 (0.0)	0 (0.0)
AB Rh “D” Positive	59 (20.5)	9 (28.1)	4 (25.0)	10 (38.4)	6 (12.0)	10 (14.0)	4 (9.7)	16 (30.7)
B Rh “D” Negative	6 (2.1)	1 (3.1)	0 (0.0)	0 (0.0)	0 (0.0)	1 (1.4)	2 (4.8)	2 (3.8)
B Rh “D” Positive	71 (24.7)	4 (12.5)	4 (25.0)	6 (23.0)	12 (24.0)	32 (45.0)	5 (12.2)	8 (15.3)
O Rh “D” Negative	5 (1.7)	1 (3.1)	2 (12.5)	0 (0.0)	0 (0.0)	0 (0.0)	1 (2.4)	1 (1.9)
O Rh “D” Positive	65 (22.6)	13 (40.6)	3 (18.7)	1 (3.8)	11 (22.0)	11 (15.5)	14 (34.1)	12 (23.1)
N/A	32 (11.1)	0 (0.0)	1 (6.3)	1 (3.8)	6 (12.0)	4 (5.6)	13 (31.7)	7 (13.4)

Source: Field Data (2022)

Amongst the units discarded in this study, the blood group that expired the most was B Rh “D” Positive representing 24.7%. This was followed closely by O Rh “D” Positive blood with 22.6%, AB Rh “D” Positive blood with 20.5% and A Rh “D” Positive blood representing 16.3%. The least blood group that was discarded were the rhesus negative blood groups of A Rh “D” Negative, AB Rh “D” Negative, O Rh “D” Negative and B Rh “D” Negative representing 1%, 2%, 5% and 6% respectively. However, there were other blood units that were discarded with their blood groups not stated in the data and this represented 11.1% of the units of blood that was discarded due to expiry.

6. Discussions

In this study, 2231 out of 33896 whole blood and blood products prepared were discarded. The various reasons for the discard included seropositivity for Transfusion Transmissible Infections (TTIs), expired units, breakage/leakage of units, suboptimal volumes (underbled/overbled), hemolyzed units, clots, cloudy units and breaks in cold chain after it has been issued from the blood bank. The average discarde rate for this study was 6.6% compared to the average discard rate in the studies by [11, 26, 27, 1, 28, 29, 30, 31] which were 3.2%, 2.3%, 4.3%, 8.4%, 3.6%, 7.0%, 6.63%, and 8.69% respectively.

The findings of our study indicated that the most common blood group that was discarded during the study period was O Rh “D” Positive representing 69.0% of total blood groups discarded and this was mainly because O Rh “D” Positive was the most common blood groups amongst the study population. The study is in line with a study conducted by [32] in Tanzania which centered on the rate and reasons for discarding blood and blood products at the Northern zone, Blood Transfusion Centre. In their study, they found out that

the total number of blood discarded, n=504 majority of the blood discarded were of the O blood type, 260 (51.6%) [32].

It was observed in this study that 54.9% of whole blood units that were discarded were due to seropositivity to TTI and this was the highest cause for blood discard at the Cape Coast Teaching Hospital blood bank. In a study by [29] which is comparable to our study, 49% of whole blood discard were due to seropositivity to TTIs. Other studies done by [33] and [28] showed 25.5% and 68.9% respectively of blood units discarded were also due to seropositivity.

Amongst all these studies, seropositivity to Hepatitis B Virus (HBV) was the highest recording 64.4%, 49.8% and 32.5% respectively. Similarly, 45.1% HBV seropositivity and 23.0% HBV seropositivity was the highest TTI cause for discarding blood in the African region which had a high prevalence of hepatitis B infection (10-20%) with the carrier state being above 8% in sub-Saharan Africa as a whole [34]. Syphilis (VDRL) infections was the second highest cause of TTI discard in this study of 32.7%. VDRL infections are treatable and hence donors should be encouraged to go for treatment if they test positive and when necessary be educated on the ways to prevent STDs so that they will be able to donate safe blood at all times. Hepatitis C Virus (HCV) was the third cause of TTI discard of 12.7% and this was followed by HIV with 9.5%. To reduce blood discard associated with TTIs it has been proposed that strategies such as improvements in blood donor selection algorithms and the use of more effective and sensitive TTI detection techniques should be considered [35].

Expiry of whole blood and blood components were the third highest reason for discard in this study representing 12.9% of total units discarded, and majority of the blood group that had expired the most was B Rh "D" Positive representing 24.7% followed closely by O Rh "D" Positive blood with 22.6%. The least blood group that was discarded were the rhesus negative blood groups. In a study by [36] which is comparable to our study, expiry of blood and blood products was the second cause of discard accounting for 21.5%. platelet concentrates contributed to 52-94% of total blood discard due to expiry and this was mainly due to the short half-life of platelet concentrates. In a study by [37] and [38] whole blood and blood products that were discarded due to expiration were 82.87% and 86.52% respectively. According to WHO, the donation rate is only 4.6% in low-income countries per 1000 citizens [7] and this is highly inadequate to meet the increasing demand for blood in these countries, as such wastage due to expiry needs to be adequately evaluated by practicing first-in-first out (FIFO) or first-expire-first-out (FEFO) so as to prevent good blood from going to waste.

Blood discarded due to incomplete transfusion was 11.6% of the total units discarded within the study period. Incomplete transfusions were mostly as a result of transfusion reactions, medical decision to stop the transfusion process or patient changing their decision to receive the blood during the transfusion process. All units discarded due to incomplete transfusions were whole blood and transfusion reactions were the most common. These reactions normally present as fever, chills urticaria etc. during the transfusion stage or within 24 hours post blood transfusion [39] the blood components being foreign to a patient may produce antibodies that will trigger adverse reactions that may range from mild allergic manifestations to fatal reactions. Such reactions are usually caused by plasma proteins, leucocytes, red cell antigens, plasma and other antigens. To avoid and reduce such complications, whole blood should be modified and prepared into components such as packed RBCs, leukoreduced products, platelets concentrate, saline wash cells and fresh frozen plasma [40] which patients can safely receive and thereby prevent transfusion reactions. Also, complete compatibility testing profiles should be performed on all blood units for patients before they are transfused, to be able to identify any alloantibodies that might cause transfusion reactions.

Suboptimal volumes accounted for 9.9% of total discards this mainly occurs during the bleeding stage where the blood can be under bled or over bled for a lot of reasons. A discontinuation of the bleeding process where the donor may have had reactions such as chills, dizziness, profuse sweating, deep breathing, weakness, fall in blood pressure and vomiting can result in under bled units. Wrong venipuncture procedure can interfere with blood flow during bleeding of donor and result in under bled volumes and possible clots in the blood bag. Failure to properly monitor the bleeding process of the donor will lead to over bleeding and exceeding the maximum volume of the blood required in the blood bag. These suboptimal volumes contain a higher or lower amount of anticoagulant that does not make the blood suitable for transfusion and hence is discarded. In this regard studies are still on going to determine whether or not red blood cells from suboptimal volumes can be prepared for transfusion for some specific diagnosis [41].

Clots in bags accounted for 2.5% of other reasons for blood discarded. Over bleeding of donors lead to inappropriate anticoagulant to blood ratio which initiates the clotting process. Other causes which may lead to clot formation include poor vein selection, poor phlebotomy technique, poor mixing of blood units during the bleeding stage and some clotting abnormalities in the donor [42]. It is therefore empirical to adhere to proper bleeding techniques and guidelines so as to prevent clot formation in blood donor units to increase availability of blood in our facilities.

Breaking the cold chain after blood units have been issued accounted for 2.1% of blood discards. Ideally blood is to be returned immediately to the blood bank if it is not used as planned, storing these blood units in the ward or unregulated and uncontrolled environment/ refrigerators leads to the loss of the blood integrity and makes it unsafe for transfusion. These blood units are returned mostly hemolyzed and contaminated which results in a waste for the blood bank and hence is discarded.

Hemolyzed units and bag leaks accounted for 3.8% and 1.1% respectively in this study. All units that had bag leaks and breakages were FFPs and these leakages were mostly detected after thawing. A study by [29, 36, 26] discards due

to leakage/breakage of FFP bags were 28.7%, 19% and 43% respectively. These breakages emanate from mishandling of units during collection, processing and storage of FFP units, hence, frozen FFPs should be handled with care especially during the thawing process as it is a major cause of FFP bag breakages.

Studies done by [43] showed that 4.0% of whole blood units discarded were due to hemolysis as compared to our findings of 3.8%. RBC hemolysis occurs during blood collection, processing, handling and storage of units. Bacteria contamination and fluctuations in temperature greatly affects membrane deformability and stability of RBCs during storage and processing into components by centrifugation which may lead to hemolysis [43]. According to [44] reduction of everyday activities that interrupt with optimal storage conditions of RBCs such as removal and re- entry of blood units in and out of refrigerators, centrifuging blood at the appropriate speed and correct temperature will go a long way to maintain the integrity of RBCs and prevent hemolysis.

7. Conclusion and Recommendation

Donor blood discard continues to remain a major concern in the field of blood transfusion science. Hence, the effective use of blood and its components is veritably important and essential such that it should not be taken for granted. Reviewing factors that affect blood donor discard at the immunohematology unit, serves as a good quality index that will go a long way to improve the processes and workflow of the blood bank. Donated blood units that are seropositive to TTIs are sources of wastage of whole blood and therefore proper donor screening, using more effective and sensitive TTI detection techniques, and strict adherence to donor selection algorithms should be practiced to prevent the collection of blood from such donors that do not qualify. Proper inventory management of blood units, applying first-in-first-out or first-to-expire-first out and preparation of whole blood into components will increase the life span of blood and maximize its use to prevent expiry.

The study recommends that donor blood collection, processing, handling, storage and monitoring should be handled by qualified technical personnel with the right expertise in order to reduce causes of blood discard that are associated with these steps. Phlebotomist should be trained and retrained on proper venipuncture techniques and there should be authorized supervision and implementation of quality management systems in the various stages from blood collection, component/products preparation, storage and to issuance of the blood units.

Proper enactment of procedures, processes and policies at the immunohematology unit will ensure that blood and blood products are maximized and used effectively to reduce gratuitous blood discard and wastage in the blood bank.

Authors Contributions

G. Wemochigah, E. M. Adela, D. E. Azumah, R. P. Storph, E. F. Blankson, E, Duah and F. Britwum conceived the idea. G. Wemochigah and E. M. Adela gathered the data and literature search. E, Duah and G. Wemochigah performed the analysis. G. Wemochigah, E. M. Adela, D. E. Azumah, E. F. Blankson and F. Britwum prepared the initial draft of the manuscript. F. Britwum and R. P. Storph revised the final manuscript. All the authors have read and agreed to the published version of the manuscript.

Informed Consent

Written informed consent was taken from the respondents before data collection.

Conflicts of Interest

The authors declare no conflict of interest.

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