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## Brief Report

### Blood Product Management: Operating Room Emerges Most Wasteful

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#### Abstract

Blood and blood product wastage is a costly issue in hospitals nationwide. This study analyzed the rate and major causes of blood product wastage at a Central Florida hospital using de-identified data from the hospital blood bank. In summer 2018, this Central Florida hospital and associated programs achieved a fourth-consecutive Magnet designation by the American Nurses Credentialing Center (ANCC) - the profession's top recognition for quality patient outcomes and nursing excellence. Only 8 percent of hospitals and health systems nationwide have received Magnet designation, and only 41 out of 500 hospitals have four consecutive awards. It was deemed an appropriate setting for this study based on their exceeding qualifications and patient admissions in comparison to other hospitals in the community thus utilized for this study.

A retrospective study design during a randomly selected month in 2016 analyzed blood bank data on 600 patients. This was an average number of patients for each month during this & previous years. Demographic characteristics were not inclusion or exclusion criteria. Clinical units; types of blood products wasted and waste risk factors were categorized. Analysis of unit usage relative to unit wastage revealed two factors contributing to blood product wastage: unit expiration (37.9%) and out of temperature range units returned to the blood bank (32.2%). Broken bags (from external/internal transport), incorrect dose ordering, and irradiation without usage were infrequent causes for waste. The operating room accounted for the highest level of total wastage at 36.8%. Discovery of the major contributing factors and the location of highest wastage in the hospital is critical. Quality improvement strategies aimed at reducing blood product wastage is aimed at contributing to cost savings for hospitals.

**Keywords:** Blood bank; Blood components; Blood product wastage; Blood usage; Transfusions

#### Description of the Problem

Blood and blood product transfusions play an important, life-saving role in patient care in the hospital setting particularly the operating room. Currently, blood product wastage increases hospitals' operating costs, ultimately, impacting the consumers' health care expenses [1,2]. Blood products are valuable, lifesaving, and prophylactic resources in healthcare. According to the National Heart, Lung, and Blood Institute [3], approximately five million Americans need blood transfusions every year. Blood transfusion rates have steadily increased over the years due in part to our aging

populations' more chronic illnesses and more advanced surgical procedures [4]. This increased prevalence of blood transfusions necessitates the need to conserve the blood products that are available. There are different indications for receiving blood, including acute blood loss from trauma, surgical procedures relating to but not limited to; cancer, bleeding disorders, chronic kidney or liver disease [3,5,6].

Blood is typed A, B, AB, or O according to the presence of major antigens on the red blood cells' surface. When an allogenic blood transfusion is needed it is essential that the antigens be identified and compatible because the transfusion recipient's body will produce antibodies against blood types not compatible with their own [7]. More than seventy steps are in the blood transfusion

process. Each step is time intensive due to the precision required in order to prevent fatalities related to incompatibility during blood transfusion. The acquisition and processing of blood costs approximately three hundred dollars per unit depending on the region and availability of blood donors [8]. Blood and blood component waste is a problem of great consequence in many hospitals despite previous efforts to limit or prevent occurrence. Contributing factors to blood product wastage include damaged blood product bags, expired units, clotted blood, broken seals, improper storage, untimely transport, blood products aged over thirty minutes and unnecessary perioperative cross matching [9,10].

### **Description of the Original Process**

Leadership at the Central Florida hospital in this quality improvement study identified blood bank wastage as a significant and ongoing problem. Previous broad educational efforts to affect the more efficient management of blood products once outside the blood bank department were unsuccessful.

### **Rationale for Change**

Current annual health care costs are approximately 2.9 trillion dollars and this cost is expected to rise by 5.7% each year until 2022 [11]. It is estimated that more than 50% of the health care spending in the United States is avoidable and/or unnecessary [12]. Efforts to curb spending are needed nationwide in order to decrease the financial burden healthcare costs are placing on the country. According to Berwick and Hackbarth [12], the potential for healthcare savings from even minimal waste reduction are far greater than changing standards of care or insurance coverage requirements. Therefore, reducing waste of blood and blood products outside this Central Florida hospital's blood bank department has the potential for substantial cost savings.

### **Brief, Focused Review of Relevant Evidence**

Literature was reviewed in order to examine the known contributing factors to blood product wastage and its consequences. A literature search was conducted using electronic databases CINAHL, PubMed, and Cochrane Library. The following terms were used in the data base searches: blood bank wastage, blood transfusion cost, healthcare costs and medical waste. The literature search resulted in 21 articles from 2012 to 2019 from which 10 were selected for review. The review focused on blood product management, associated costs and causes of blood product wastage. Literature reviewed included retrospective and observational cohort studies, and case control studies.

### **Blood Product Wastage**

Generally, a certain level of waste due to blood product expiration is expected and accepted due to the need to have a steady supply available. However, a large amount of wastage is

preventable. Research indicated [13] the causes and contributing factors of the preventable wastage vary by facility and healthcare organization. Blood product wastage primarily occurred while it is being handled outside the blood bank department after collection and storage [14]. Kurup, et al. [11] noted the major causes of wastage were broken bag or seal, expiration of unit, return of products due to non-compliance with thirty-minute window temperature regulation, and clotted blood. A 10-year observational study in a large teaching hospital [15]. Identified the following additional causes of wastage: inadequate transport containers, lack of temperature monitoring and unwarranted ordering of blood and blood products by providers [12]. Data was collected from eight hospitals of varying sizes in a regional health system in order to determine the most frequent causes of blood product wastage. It was noted that blood product waste was attributed to inadequate transportation systems and the required temperature not being maintained among all hospitals in this health system [16]. The review of the literature suggests inadequate handling of blood and blood products by hospital staff was a major contributor to wastage.

### **Cost and Healthcare Impact**

It is well documented that healthcare costs are continually rising nationwide. Unnecessary expenses are a major contributing factor to the increasing healthcare costs, including medical errors and medical waste. Data retrieved from Vanderbilt University Medical Center showed the cost of intraoperative blood product wastage to be \$249,314 in one year at their facility [16]. Researchers emphasize that this figure did not include the expenses incurred when obtaining, storing, and dispensing the blood products. This cohort study estimated the cost savings of eliminating blood product wastage to be approximately \$225 per unit of leukocyte-reduced packed red blood cells.

The cohort study discussed earlier, that identified inadequate transportation as a main cause of wastage, also implemented interventions to combat this problem. After intervention, a net cost savings of \$131,520 occurred in the regional health system [1]. In addition, there were ethical and financial considerations in regards to blood donation to consider when blood products are wasted. Studies have shown that blood product wastage can be decreased through the use of targeted interventions that are inexpensive and easy to implement [17]. This project has identified the contributing factors of blood product wastage at this Central Florida hospital. Once the contributing factors were identified, alternative targeted interventions could be developed and then implemented in an attempt to decrease prevalence of wastage occurring at this hospital and thus decrease healthcare costs.

### **Limitations**

Overall, the most frequently identified factors contributing to wastage across most research studies were return of blood

products after the 30-minute window and lack of temperature monitoring. There is a sufficient amount of research on this subject with moderate strength of evidence; however, at this facility this problem continues to occur focusing on the operating room as one of the highest contributing factors to blood product wastage. A limitation of this literature review was the lack of previous available randomized controlled trial studies, systematic reviews and meta-analyses reviews which to compare to.

## **Projects Methods**

### **Overall Design of the Project or Approach to Improvement**

The project presented was a practice change, focused on identifying the major contributing factors to blood product wastage at a Central Florida hospital. The goal was to change healthcare providers' actions and eliminate unnecessary wastage. A retrospective study design was used to evaluate the causes of blood product wastage through data collection and analysis. Once the data was analyzed to determine the major contributing factors and/or correlations that exist, this data could be used to create targeted interventions to eliminate unnecessary waste. The major outcomes of interest in this study are the factors that are identified, such as the operating room setting as being the highest contributor to blood product wastage. These particular identified factors along with the other contributing factors are classified as the independent variables in the study.

### **Description of Sample and Sampling Techniques**

The study was conducted at a hospital located in Central Florida. The blood bank at this hospital was the setting of interest. The population consists of randomly selected, de-identified wastage data from a Central Florida hospital blood bank department. Of interest were those cases in which there was a delay or other problem that arose during the transfusion process, at risk of wastage or resulting in wastage. The data included the type of product and number of units issued, the clinical unit/floor issued to, whether or not the blood product was transfused or wasted, and if wasted, documentation of the reason the blood product was wasted. Data was obtained from the hospital blood bank department with permission from the blood bank director. A one-month period of time was randomly selected as the time frame for the study. The investigator included the first 600 episodes of blood products issued during that month, which were also deemed by the director, as a mean number of episodes for each month during the year which was studied. No specific patient demographic characteristics were specified as inclusion or exclusion criteria for this sample.

### **Protection of Human Subjects**

All participating researchers have completed the required HIPAA and Institutional Review Board (IRB) training. IRB approval was obtained through the University of Florida IRB-

01 (UFIRB#201701641). All data was de-identified by the blood bank prior to collection by researchers and there were no patient identifiers entered into SPSS. The data is secured through secure communications and password protection. These demographic characteristics do not influence the sample and are not retrievable by study investigators. As per IRB requirements the data is securely stored for a minimum of three years.

### **Data Collection and Methods**

Using data from the blood bank at a Central Florida hospital, one month of blood products transfusion records were randomly selected from the 2016 calendar year. 600 data points were compiled based on type of blood product, number of units issued, clinical unit, including operating rooms, specialized clinical units issued to, and whether or not the product was transfused or wasted. Finally, if the unit of blood was wasted, the wastage reason was coded with information collected regarding the reasons for the wastage. This information was securely kept in the blood banks department at the facility.

### **Data Analysis Methods**

The data was analyzed using the IBM Statistical Package for the Social Sciences (SPSS). No patient-specific identifiers were included in entry into SPSS or in this analysis. The major contributing factors to blood product wastage were identified and then coded for entry into SPSS. Data analysis included creating categorical data on clinical units, types of blood product wasted and major reasons for waste. Descriptive statistics clarified volumes of usage relative to wastage. Researchers have intentionally omitted factors six & seven (Figure 1).

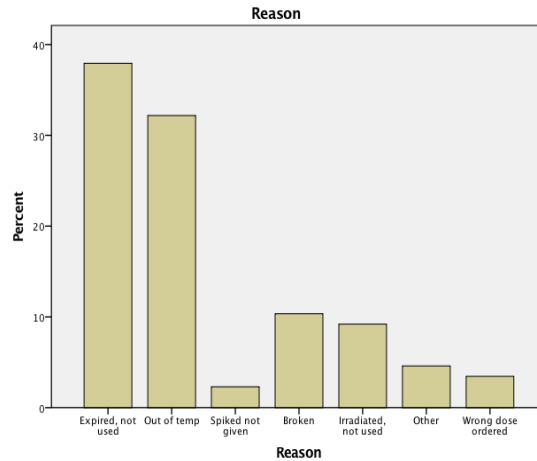
### **Results**

Approximately six hundred patients were transfused during the sample period. The sample period was a randomly selected month in the 2016 calendar year. The month and year was randomly selected by the blood bank director at this hospital and was undisclosed to the investigator. It is unknown whether or not this was a low or high-census time in the hospital. The sampling method did not change over the course of the study. Random selection was used in order to better generalize the results to the target population. 2954 total units were accounted for in the sample. 2867 blood product units were successfully transfused and 87 units were wasted. There were no inclusion or exclusion criteria specified.

### **Demographics**

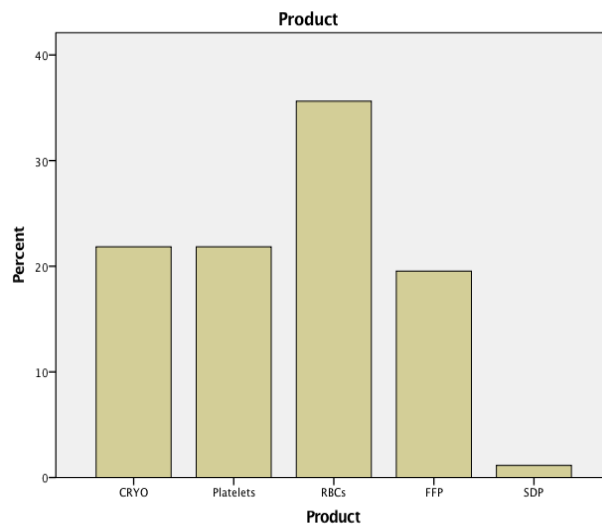
The sample consisted of de-identified patient data considered representative of blood transfusion recipients at this Central Florida hospital. There is no demographic, diagnostic or acuity data available for analysis or comparison. The initial data analysis was aimed to reveal the major contributing factors to blood product

wastage at this Central Florida hospital. Analysis exhibited two major contributing factors, expiration of the unit (37.9%) and the unit being returned out of temperature range (32.2%). Other factors included broken bags, incorrect dose ordering, and irradiation without usage were also identified as reasons for waste; however, these values were not significant (Figure 1).



**Figure 1:** Cause of wasted Products. This figure illustrates the factors contributing to blood product wastage.

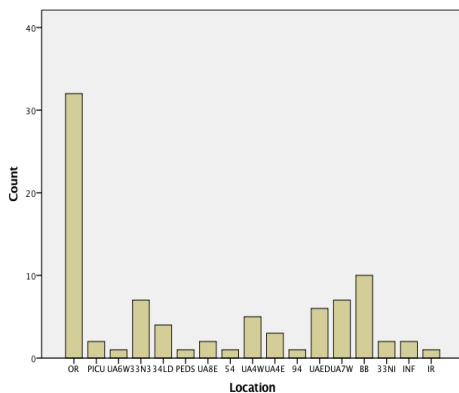
A unit of blood is considered expired if the blood is outside the blood bank for greater than four hours, or after six hours if stored in an appropriate cooler container. If a transfusion cannot be completed within four hours of time issue, return of the blood component is indicated, otherwise the unit of blood is considered expired and must be discarded. Cryoprecipitate must be transfused within six hours of thawing. Each different blood product type has regulations for designated temperature ranges and handling guidelines during storage and transport. Temperature is monitored and the unit must be discarded from use if the temperature range is exceeded [2,5,6,10]. Blood product types were categorized and descriptive statistics used in order to reveal the frequency of wastage of each type of product. Red Blood Cells (RBCs) were the most commonly wasted blood product, representing 35.6% of the total sample. Cryoprecipitate (Cryo) and platelets were each responsible for 21.8% of the waste and Fresh Frozen Plasma (FFP) accounted for 19.5% of the waste (Figure 2).



**Figure 2:** Frequency of blood product wastage. This figure illustrates the frequency of blood product wastage by type of blood product.



Seventeen patient care areas were included in this analysis. The operating room was identified as being responsible for the greatest frequency of total wastage at 36.8% (Figure 3). The second highest frequency area identified was the blood bank (11.5%) with 80% of their waste due to broken bags possibly related to internal/external shipping issues. The type of product wasted was analyzed within each patient care location. The operating room was responsible for 63.2% of cryoprecipitate waste. In addition, 36.8% of platelets, 29% of the red blood cells, and 23.5% of fresh frozen plasma were wasted in the operating room either due to expiration (59.4%), returning out of temperature range (31.3%), or other (9.3%). The major contributing factors of wastage in the operating room were expiration (59.4%) and units being returned out of temperature (31.3%). Finally, the volumes of usage relative to wastage were compared. The volumes of usage relative to wastage were 32.9:1.



**Figure 3:** Blood product wastage: This figure illustrates blood product wastage by hospital location.

## Discussion

Blood product wastage has been continually identified as an issue at this Central Florida hospital. The study revealed that 2.9% of all blood products ordered to be transfused resulted in waste during this randomly selected month in calendar year 2016. Major contributing factors to wastage were blood unit time expiration and blood units out of the required temperature range. Some wastage is expected due to expiration because of the need to have a minimum available amount; however, this does not account for temperature violations. These results align with current known causes of wastage. Kurup et al. [11] identified some major causes of wastage, including broken bag or seal, expiration of unit, return of products after the thirty-minute window resulting in non-compliance with temperature regulations, and clotted blood. Following this study in 2019, a policy was incorporated for surgeons to follow. This policy stated they could no longer routinely order, preoperatively, more than one unit of a blood product verses, for example, their typical two units of packed cells prior to all surgical procedures. Thus far,

this policy has been recognized as an improvement by the blood bank director related to blood wastage in the operating room.

## Conclusion

In this review, the operating room was responsible for significantly higher rates of wastage compared to other patient care areas. Red blood cells were the most commonly wasted type of blood product. 29% of all red blood cell waste occurred in the operating room. In addition, the operating room was responsible for 63.2% of cryoprecipitate waste. Time expiration of unit and temperature violations accounted for the majority of the wastage and is consistent with current knowledge. A variety of factors can account for this waste, including excessive ordering of blood and blood products by a specific provider or providers in the perioperative setting [10-12]. The results of this review were shared with the blood bank supervisor and feedback was provided to directors & administrators of the hospital to use as a means of implementing educational modalities to all members of the hospital particularly the operating room directors, surgeons & staff members.

## Limitations

Random selection methods were employed; however, it is hard to generalize these findings after analyzing one single data set. Even though the data set was a good representation of the mean monthly number of blood product wastage for that hospital, this data analysis would have possibly been more significant if repeated with other samples during different periods. Nonetheless, these findings did align with current knowledge regarding causes of blood product wastage nationally and worldwide.

## Future Recommendations

It would be beneficial to compare the current standards of practice within this facility related to blood product management and ordering. Providers' knowledge and questions regarding appropriate blood product ordering should be assessed. After collecting this information, educational activities should be created and updates to practice guidelines within the facility should be performed in order to meet national recommendations. Physicians who place blood product orders, nurses & staff members who handle blood products should also be continually assessed for knowledge about adequate transport containers, temperature monitoring, and handling techniques. Expansion of this project by conducting an assessment of the current protocols and knowledge of staff at this facility would be greatly beneficial.

After the assessment, healthcare could create and implement practice changes that are targeted towards the major identified causes of wastage and the major offending patient care areas. In addition, researchers conduct a follow up study to evaluate effectiveness of the implementation plan. Projects which include

assessing knowledge of hospital staff including implementation of a practice change can require a considerable amount of time and personal motivation [18]. It must also be considered that some providers and staff may be resistant to change regarding typical and customary practice techniques. Methods to overcome these potential barriers should be planned prior to beginning of any important project such as this one [19].

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