

How Do I Forestall Platelet Stockpiling? Experience from a Tertiary Care Center

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Abstract— Among all the blood products, platelets had been reported to have a high rate of outdates due to its unpredictable demand and short shelf life of only 5 days. Researchers have applied techniques of management science and inventory theory to develop a model for inventory management. However, they failed to be implemented due to the variations in the demand and supply and complex computational models. The present study was aimed to analyse the usefulness of daily monitoring and ordering of platelet components against formula based platelet inventory management with respect to wastage of platelet components. **Aim:** To analyse the utilization pattern of platelet concentrates and discuss the method of optimal inventory management. **Methods:** We conducted a prospective observational study on platelet inventory practice at our center from January to December 2014. The number of units to be prepared is decided on daily basis by the transfusion medicine faculty or the resident. The utilization, wastage, expiry and the day's cover are calculated for the study period. Future requirement is estimated based on the usage in the previous quarter, discard rare, average increase in usage and an additional 1% for managing disasters. **Results:** During this period a total of 6241 and 5706 units of platelet concentrates were prepared and issued respectively. The wastage rate was 5.1% and expiry rate was 3.5%. The average day's cover of platelet units at our center was found to be 3 days using average monthly stock available and issued platelets. We observed that holding a stock of 45 units of platelets per day we had a cover for about 3 days for issue. Calculation of future requirement (6309) gave a high prediction when compared to the actual platelets prepared (6241). **Conclusions:** Understanding and regularly monitoring the inventory, setting up an optimum inventory level, follow of first in first out policy and to have an alternate management plan in times of shortage, like usage of apheresis products are some of the strategies which would benefit in best inventory practices of platelet components.

Keywords— platelets, inventory, wastage, day's cover

1. Introduction

Blood products are perishable with limited availability and an unpredictable demand. The inventory level of blood components in a blood center will depend upon the type of center and also the

hospitals that it supplies. Inventory levels at a transfusion service should be maintained in a way to balance the demand against the age at issue and wastage of the blood products. Other factors such as potential national crises may also influence stock holding [1]. Among all the blood products, platelets had been reported to have a high rate of outdates at approximately 20% due to its unpredictable demand and short shelf life of only 5 days [2].

Platelet transfusions are usually done in patients undergoing chemotherapy for leukemia, multiple myeloma, during cardiac surgeries, organ transplant surgeries which can be planned well. There can also be unpredictable demand arising from trauma and accident cases. At the same time this demand would lead to preparation of more units and might lead to wastage due to sudden decrease in demand. For maintaining optimal stock of platelet concentrates, one must know the availability of units by current age (i.e., 1 day, 2 days, up to the maximum shelf life of 5 days) [3]. Various factors influence the stock management of blood products and these include the supply and demand, inventory levels within the blood service, inventory management practices and distribution of the products [4].

Many studies have utilized mathematical calculations and simulation models for developing an inventory management of blood products' in a blood bank. There are many approaches implemented to improve platelet inventory management. One of the early approaches considered was to use historical demand data to determine an optimal target level at which platelet stock can be maintained. This is known as an "order-up to" approach [5]. Though these systems demonstrated marked improvements they are restricted for use because of the requirement of computing power. At the same time, these formulations fail to be implemented due to the variations in the demand and supply.

In the present study we have analysed the utilization pattern of platelet concentrates at our center and discussed the approach to optimal inventory management system.

2. Methods

We conducted a prospective observational study on platelet inventory practice at our center from January 2014 to December 2014. At our center, platelet concentrates are mainly derived from whole blood donations. The number of units to be prepared is decided on daily basis by the transfusion medicine faculty or the resident posted in the inventory management section of the department. The total number of units available and their age distribution as well as the utilization of platelets in previous 2 days will be noted. The camps that are scheduled within next 5 days and the trend in the number of in-house donations are also considered while taking decision. All the data for platelet inventory management are collected from the blood bank software.

2.1 Prediction of platelet demand

The platelet usage pattern was calculated using the following formulae. Future requirement is estimated based on the usage in the previous quarter, discard rate, average increase in usage and an additional 1% for managing disasters.

Estimated Blood requirement is the sum of usage in previous quarter, Discard rate, 1% for disaster and an average increase in usage [6].

Wastage rate describes the percentage of total units discarded during the study period which includes the units reactive for transfusion transmitted infections, lipemia, red cell contamination, low volume, expiry etc. Expiry rate depicts the percentage of units discarded after the shelf life i.e. 5 days. Day's Cover is the number of days of available stock that is held in inventory for a particular product.

Wastage rate is calculated as total number of units discarded divided by the total number of units collected. Expiry rate is calculated as total number of units expired divided by the total number of units collected [7]. Day's Cover is calculated as number of available units in stock divided by the average daily issue [8].

2.2 Policy on Preparation of Platelet components:

Whenever there is a blood donation camp we prepare platelet units for the next 5 days based on the previous week utilization. The next day onwards, a minimum number 12 to 16 units are prepared from in-house donations to meet the unanticipated demands as and when required. Most of the week's utilization was met from this collection.

2.3 Issue policy: At our center, we follow first in first out policy while issuing whole blood derived platelet concentrates to prevent unexpected outdates. However, this policy is not followed for neonates and pediatric patients where only group specific products are transfused to avoid hemolytic transfusion reactions.

3. Results

We studied the platelet inventory management prospectively from January to December 2014. During this period a total of 6241 units of {Blood group; A (24.5%), B (28.2%), AB (7.4%), and O (40%)} platelet concentrates were prepared and 5706 units were issued. The daily average issue was 16 units ranging from 2-60 units. The total number of units discarded during the study period was 318 (wastage rate:5.1%) and that due to expiry was 217(3.5%).

3.1 Estimation of Platelet requirement:

Yearly assessment of platelet inventory management: To calculate the estimated blood requirement, the usage of random donor platelets in the past year (2013) was taken from blood bank software and was found to be 5473 units. The wastage in the previous year was 5%. The average increase in usage was 508 units. The estimated platelet requirement was calculated to be 6309 for the year 2014 ($5473+273+55+508=6309$). The wastage and expiry rate for the year 2014 were 5.1% ($318/6241$) and 3.47% ($217/6241$). The pattern of expiry with collection and issue of platelets month wise during the study period was as shown in Figure 1. There was variation in the rate of expiry in each month of the year.

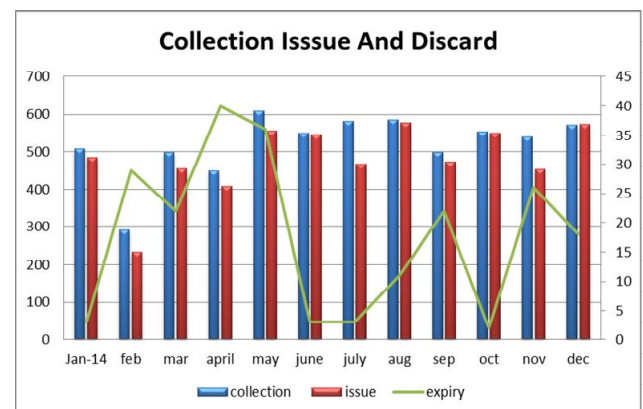


Figure 1: Pattern of collection, Issue and Discard rate month wise.

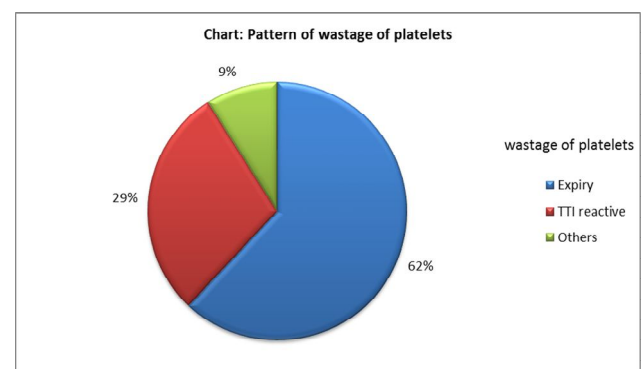


Figure 2: Pattern of wastage of platelet component

Expiry of platelet components contributed to 62% of the wastage followed by 29% due to TTI reactive and 9% due to other reasons like lipemia, red cell contamination (Figure 2).

The average day's cover of platelet units at our center was estimated using average monthly stock available and issued platelets. We observed that holding a stock of 45 units of platelets per day we had a cover for about 3 days for platelet issue. ($45/16 = 2.81 \sim 3$ days).

4. Discussion

Maintaining optimal inventory of platelet concentrates is a challenging task. It is due to various reasons, such as short shelf life of the product, unpredictability of usage and the disease outbreak affecting the demand. There are published data and formulations on inventory management of platelets, however none have been implemented in the transfusion centers. The simulation programs computed for optimal production decisions, requires a combination of special mathematical technique and computer simulation.

Gomez et al showed a decrease in outdate rate from 24.5% to 15.1% by the implementation of a real-time platelet inventory management system [3]. Still, they could observe significant variability in the month to month order and discard rates. However, such programs are difficult to be managed in resource poor countries. When we tried to estimate the requirement of platelets for the year 2014 based on WHO formula for blood utilization to see whether the needs of platelets were met, we observed an overestimation of the number of units to be collected. Actual usage was quite low when compared to estimated requirement. Hence, implementation of such formulae for platelet product estimation would alarmingly increase the number of outdates. Thus, through our calculations we suggest not to implement this formula to estimate the needs for platelet components, however, it is useful for packed red cells or whole blood which could have a constant demand, unlike platelets whose demand is very uncertain. 80% of blood collected at our center is from camps which are held on weekends. So our inventory of platelet components is based on the number of blood donation camps and holidays.

On comparison of collection, utilization and outdate rate per month during the study period, we could see a balance between collection and supply during the months of January, June, August, October and December where the wastage due to expiry was also less. The rate of expiry was high whenever there was increased difference between collection and utilization. On further thorough observation we found that the high expiry rate was because of anticipation of high demand due to increased utilization in the previous week. However, the demand for platelet products had decreased in the following days. This trend was seen in the months of February, April, May, September and November and led to increased wastage.

The day's cover as shown in Australian guidelines for blood inventory management is a very

useful indicator for predicting the future supply. Though it was a pilot study the index when applied to our platelet inventory showed us the actual pattern of supply of our platelet products. The average day's cover for the year 2014 was 3 days. This means on any day, our stock was sufficient enough to provide platelet units for 3 days. However, since this is an average calculated, we did come across shortages of supply during which apheresis products were prepared to support the patients.

Studies from Western Europe and the United States, of various blood banks reported that 15% to 20% of the produced platelet products are disposed of due to expiry. Another study concerning the efficiency of blood platelet production in 10 European countries mentioned an average outdating rate of 14% [2]. Saluja et al also reported a total wastage of 29.11% of which 20.5% were due to expiry, 1.1% due to TTI reactive and 5.27% due to other causes [7]. Morish et al reported a lesser rate of discard (6%) due to non-utilization and a much lesser percentage of wastage rate was reported in a quarterly wastage report, Transfusion Medicine ranging from 0.7% to 1.7% [9]. In contrast, the wastage due to outdate in our study was found to be only 3.2% and the total wastage was 5.1%. This accounts to the careful monitoring of usage and collection of platelet products on day to day basis and a good inventory management plan. The main cause of wastage of platelets was expiry (62.4%) followed by TTI reactive (29.2%) and other causes like presence of irregular antibody, lipemia or low volume (8.4%).

The code of ethics for blood donation and transfusion personnel states that as blood is a public resource access should not be restricted and wastage of blood and its components should be avoided at all times [10]. However, there are no proposed standards against the acceptable percentage wastage of blood and its components. According to Australian guidelines on blood bank inventory management, the average discard rate in a blood bank should not exceed the state or national level discard rates.

Understanding and regularly monitoring the inventory, setting up an optimum inventory level, follow of first in first out policy and to have an alternate management plan in times of shortage, usage of apheresis derived products are some of the strategies which would benefit in best inventory practices. So we would propose the use of inventory management of platelets be done on a day to day basis by taking into account the current stock status along with age and utilization on the previous three days.

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