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Utilization management in the blood transfusion service

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ABSTRACT

The scope of activity of the Blood Transfusion Service (BTS) makes it unique among the clinical laboratories. The combination of therapeutic and diagnostic roles necessitates a multi-faceted approach to utilization management in the BTS. We present our experience in utilization management in large academic medical center.

1. Introduction

Among the clinical laboratories, the Blood Transfusion Service (BTS) holds a unique niche in that it has three facets: activity devoted to collection and manufacturing (the Blood Donor Center and Processing Laboratory), a component devoted to resource banking, allocation and diagnostics (the Transfusion Service), and a clinical and therapeutic component (the Transfusion/Infusion and Apheresis unit). In addition, unlike other Pathology subspecialties, the primary activity of the BTS is therapeutic and not diagnostic. Delivery of health care is a costly endeavor. Assessment and reassessment of areas for improvement present opportunities for enhancing clinical care, coupled with cost savings. Because of its complexity, a large BTS requires a multi-pronged approach to utilization management.

We present elements of our experience at a large academic hospital, the Massachusetts General Hospital (MGH), in Boston, as an example of this multi-faceted approach. As part of utilization management, we considered the landscape of hemotherapy presented as risk versus cost of select blood products (see Fig. 1), allowing us to prioritize areas of focus.

2. Sources of cost in a blood transfusion service

The MGH is a large academic general hospital (approximately 900+ beds) with an annual Pathology operating budget of about $ 105 million. Within the Department, Anatomic/Surgical Pathology accounts for 21% of the budget while 50% is allocated to the Clinical Laboratories, other than the Blood Bank. The BTS itself accounts for almost a third (~29%) of the entire Pathology department budget.

Most clinical laboratories use 60–65% of their budget for labor and only 35–40% for consumables. In contrast, only 30% of the MGH BTS budget is used for labor while 70% is allocated for consumables and blood products. The most recent approximate annual costs of blood products at MGH are presented in Table 1.

Considering that the annual MGH BTS operating budget, excluding labor, is ~$30 million, it makes sense that cost containment strategies should consider blood product usage.

3. Data harvesting and analysis

In all areas of utilization management, it is important to acquire multiple pieces of information and then analyze the data. Reviewing Blood Bank data allows for understanding costs and identifying potential areas of improvement in the transfusion service [1].

At MGH, we have made investments in data acquisition and analysis, including dedicated staffing for the BTS information system, to facilitate utilization management. Data are harvested within the blood bank electronic database (HCLL™ and LifeTrak™) using Crystal Reports. This allows us to monitor and characterize blood usage for any individual patient, a particular time period or a category/type of blood/component or a combination thereof. A drawback of our current BTS database is the limited interface with the hospital/clinical data repository. The MGH BTS developed a homegrown software, called the Blood Utilization Report (BUR)[2] that can access information from within the general laboratory databases and generate reports about blood orders along with relevant clinical and laboratory data that clinicians may use in deciding to administer a blood product.

An effective blood utilization program should be targeted at the highest yield areas. Two potential ways of identifying what might be high yield areas is to ask the questions: "Who is ordering the blood?" and "What blood products are being ordered?" Table 2 shows the number to components transfused at MGH over a three-year period.

Abbreviations: BTS, Blood Transfusion Service; CMV, cytomegalovirus; FFP, fresh-frozen plasma; FNH, febrile non-hemolytic; IVIg, intravenous immunoglobulin; LR, leukoreduction/leukoreduced; PCC, prothrombin complex concentrate; PLT, platelets; POC, point-of-care; pRBC, packed red blood cell; RCT, randomized control trial; rVIIa, recombinant activated factor VII.

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Blood usage by clinical service is identified by the hospital location since most clinical services have associated hospital locations. This is more informative than tracking blood use by individual patients as patients may move from one clinical service to another. The intensive care units (surgical, medical, cardiac and pediatric), operating rooms (ORs) and Hematology–Oncology/Bone marrow transplant unit are some of the biggest users of blood products. Notably, cardiac surgery and the cardiac ICU are major users of red cell and plasma units while the bone marrow transplant service is a major user of platelet (PLT) concentrates. Blood transfusion guidelines targeted towards these units are a high-yield area for utilization management (see **Blood Management Program**, below).

In selecting which blood products to target, we select products used in large quantities and products with high adverse event profiles or a combination of both (see Fig. 1). For instance, we have specifically targeted IVIg and rVIIa as high-yield targets for blood utilization management (see Section 5 **Blood Management Program**, below). Both are used in relatively lower quantities than pRBCs, PLT or FFP. However, both are expensive and their adverse event profile is significantly higher than all three traditional blood components combined.

4. Managing the inventory

Balancing supply and demand is particularly challenging when a product has a short shelf life and the demand varies from day-to-day as is the case with PLT concentrates. Because blood products are perishable, utilization management must also include an analysis of the blood needs of the hospital and the available supply. Overstocking perishable products is wasteful and reduces availability for patients in other hospitals who depend on a common blood supply. On the other hand, it is probably worse to have an insufficient supply of blood products for life-saving therapy.

Although a full cost analysis of our Blood Donor Center and Processing Laboratory activities is beyond the scope of this manuscript, it bears mentioning that selection of what blood products to produce and what types of tests to perform is dependent on hospital utilization patterns.

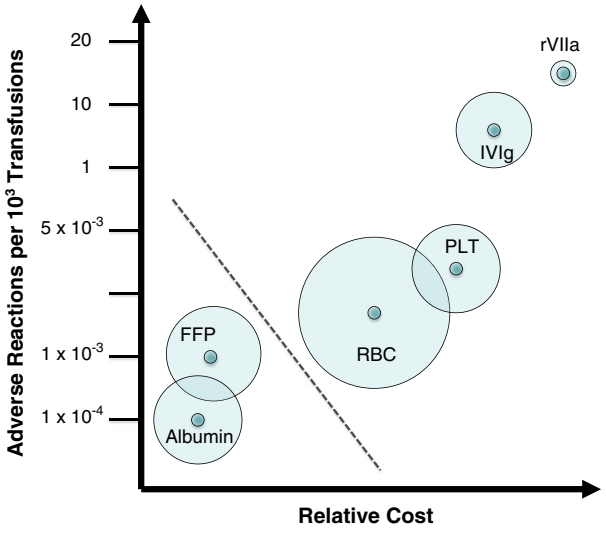

Fig. 1. Adverse Risk versus Cost of Select Blood Products. We categorize blood products by rendering a plot of relative severe adverse events (Y-axis) against the relative cost per therapeutic transfusion (X-axis). The relative volumes used at MGH are represented by the size of each bubble. Severe adverse risk was extrapolated from multiple sources and expressed as adverse events per 10^3 transfusions[35–39]. Adverse events for IVIg and off-label use of rVIIa in this figure were limited to thromboses. Only mortality attributed to RBC, whole blood-derived and apheresis platelets (PLT), FFP and albumin transfusions was considered. Relative costs and volumes transfused are specific to the MGH BTS.

Table 1
Costs of select blood products.

High volume products	Low volume products
- lower price per unit	- higher price per unit
- includes[a]: pRBC, FFP, PLT and albumin	- includes[a] derivatives: rVIIa, IVIg, factor concentrates (factor VIII and factor IX)
- cost: $5.567 million	- cost: $5.513 million

[a] pRBC - packed red blood cells, FFP - fresh frozen plasma, PLT - platelets, rVIIa - recombinant activated factor VII, IVIg - intravenous immune globulin.

Intrinsic costs for the production of blood components include marketing to attract donors, blood collection, processing, testing and storage.

One third of our annual pRBC inventory and half of our PLT and FFP units are produced by the MGH Donor Center and processing laboratory activities. All other blood products and derivatives are purchased from manufacturers or blood centers (such as the American Red Cross).

For blood transfusion services that do not make their own blood components, all blood units are purchased from a vendor. In this case there is limited opportunity to request non-leukoreduced units, as only leukoreduced products are offered for sale by our vendor. Leukoreduction (LR) is useful in reducing the risk of some adverse events associated with blood transfusion, including febrile non-hemolytic (FNH) transfusion reactions [3], HLA alloimmunization[4], and transfusion-transmitted CMV infections [5]. However, there is no evidence of benefit of LR applied to every patient. For example, a randomized control trial (RCT), performed at MGH, showed that patients without FNH reactions and whose medical issues did not necessitate prevention of HLA alloimmunization or CMV infection, did not benefit from LR in terms of mortality, length of stay and cost of care [6]. In our hands, the additional cost of pre-storage leukoreduction (the filter) is about $50/unit. In the most recent three years (2010–12), we produced ~36,000 red cell units or about 12,000/year. By rough calculation, this is an annual savings of $600,000.

Coupled with a donor program, come costs associated with infectious disease testing. In order to decrease such costs, pooling strategies have been shown to have some cost benefit in both HIV and HCV testing [7,8]. Another alternative is to determine the cost of infectious agent testing in-house versus sending the specimens to a reference laboratory. Until 2009, the MGH BTS performed HIV, HCV, HBV and HTLV-1/2 testing on all in-house manufactured units. Following a cost analysis, it became clear that in-house infectious agent assays would cost more than sending out blood segments to a reference laboratory in the region.

Germane to inventory management, is the ongoing question of whether fresher blood is better than older blood. Because red blood cells can be stored for up to 42 days following collection, inventory management would become far more complex should the expiration date of red blood cells be substantially shortened [9]. To date, the data are equivocal regarding the superiority of short-duration storage versus longer-duration storage of blood [10]. A number of randomized controlled trials (RCTs) are attempting to address this issue, including the ABLE [11], RECESS and RECAP trials [12]. The MGH is a participant in the latter two trials and is leading another RCT in children with malaria

Table 2
The numbers of transfused components at MGH from 2010 to 2012.

Component[a]	2010	2011	2012
pRBC (units)	37,167	36,468	34,602
FFP (units)	13,093	11,452	10,544
PLT (doses)	8202	7153	7844
Albumin (bottles)	23,949	23,359	24,557
IVIg (grams)	52,085	45,261	44,973
rVIIa (milligrams)	42	19	35

[a] pRBC - packed red blood cells, FFP - fresh frozen plasma, PLT - platelet, IVIg - intravenous immunoglobulin, rVIIa - recombinant activated factor VII. Albumin is calculated as bottles where 1 bottle is 50 mL of a 25% albumin solution or 250 mL of a 5% solution. Note that these are not corrected for the number of patients or procedures.