Moving toward error-free transfusion

Point-of-care blood management systems reduce transfusion errors, increase efficiency and maintain end-to-end traceability of blood

The operating principles of hospital transfusion are to ensure the "the five rights of transfusion administration", which are:

- right product
- right time
- right condition
- right dose
- right patient

Despite advances in technology and process controls, hospitals are still not performing as well as they could in ensuring the five rights. The need for improvement is seen in the still-significant numbers[1,2] of "wrong patient" and "wrong product" errors, as well as "near miss" events. Such errors result in preventable deaths.

To see more than incremental improvements a new approach to transfusion safety and the mechanics of the entire hospital blood supply chain is needed. Point-of-care blood management technology can significantly reduce transfusion errors. At the same time, it can improve efficiency and reduce costs for already lean and short-staffed transfusion laboratory operations.

Since the Food and Drug Administration (FDA) and other equivalent local or international authorities regulate blood and blood products used for transfusion, improved blood supply chain management and visibility can also help transfusing facilities adhere to the quality standards for patient safety, traceability, temperature and control of blood products.

Problems with the current hospital blood supply chain

Patient safety

In the transfusion process, patient safety is the paramount goal. Recent FDA and British Haemovigilance data shows that this goal is still not being met.

Despite technological advances supporting patient identification, patient identity errors (wrong patient and wrong product) still occur. The problem stems not from technology, but from insufficient or inconsistent identification processes in clinical workflows, particularly under time pressure[3,4].

Hemolytic reactions (ABO and non-ABO incompatibilities) account for 16 percent of transfusion-related fatalities in the U.S.[5]. In the U.K., half of all reports relate to transfusion process errors that result in death or major morbidity[6]. From 1996 to 2012, the Serious Hazards of Transfusion (SHOT) Haemovigilance system recorded at least 3,300 incidents of incorrect blood component transfusion[7]. The actual number of incidents is likely to be significantly larger, given that SHOT data reflects a "passive" Haemovigilance process.

"Near miss" incidents, where the error is caught before the start of transfusion, but could have led to a wrongful transfusion or adverse reaction, also remain relatively common. One major Canadian medical center reported 135 instances of blood pickup for the incorrect patient in a five-year period, with 10 percent of these actually reaching the patient before the error was detected[8].

A point-of-care blood management system can significantly reduce wrong patient, wrong product and near-miss errors.

Efficiency

The blood supply chain is complex, entailing preparing and labeling units, and issuance. This effort is performed with the knowledge that the many issued units will need to be returned to stock. In one U.K. orthopedic hospital, unused blood orders were as high as 70 percent[9]. In another study, the supply chain from transfusion laboratory to operating room refrigerator averaged nearly an hour, while even "urgent" calls from blood took 24 minutes[10]. Transport of these units back to the transfusion laboratory is done manually and is time consuming. Re-released units are walked back to the point of use. All of these steps are potential points of handling failure and delay.

Published experience demonstrates that when clinicians are confident that the blood will be available when needed, unused blood orders drop significantly[11,12]. Additionally, the use of an updated, institution specific Maximum Surgical Blood Order Schedules (MSBOS) and point-of-care blood management systems increase transfusion service efficiency by significantly decreasing the crossmatch-to-transfusion ratios[13].

A point-of-care blood management system can also significantly reduce handling errors and delays. For example, at one U.S. Level 1 trauma center, delivery time and the number of trips from the transfusion laboratory to emergency department (ED) were both reduced by 76 percent[14], while at another trauma center; point-of-care blood management technology reduced idle transfusion service time while improving turnaround time for blood components[15].

Cost

Wastage of red blood cells and platelets due to outdating is typically 10 percent[16], leading to significant costs. While hospitals track this tangible cost, they generally do not account for the expense of using nurses as blood delivery messengers, time expended preparing units that are returned unused, having to discard mishandled and outdated units or redrawing patient specimens due to labeling errors.

Furthermore, many hospitals have a large number of preoperative type and screen and type and crossmatch orders predicated by the MSBOS and "just-in-case" blood ordering practices. These processes drive up costs when the blood is not utilized. Point-of-care blood management systems provide the tools to increase efficiency.

The solution: A point-of-care blood management system (PBMS)

Point-of-care blood management systems (such as BloodTrack® software solutions, Haemonetics Corporation), consist of software-controlled storage devices such as the BloodTrack® HaemoBank® blood storage device, standard refrigerators, platelet incubators and freezers, which are linked by an interface to a laboratory information management system (LIMS).

This technology tracks, manages and dispenses blood products independently from the transfusion laboratory, in close proximity to operating suites, emergency rooms, infusion centers and other clinical areas. Only authorized personnel can gain access to the blood inventory. Blood dispensed from the point-of-care blood management system is either electronically crossmatched (EXM) for EXM-eligible patients; crossmatched by the transfusion laboratory and pre-labeled; or released as uncrossmatched, universally compatible units for emergencies.

Once the unit has been released for transfusion, the BloodTrack software verifies that the right blood was dispensed for the right patient. Information about the unit and transaction is immediately available in the transfusion laboratory via a central control and monitoring module of the software called BloodTrack Manager®. The BloodTrack software records traceability and unit history information and provides real-time alerts (such as low inventory or emergency release activation) enabling the transfusion laboratory to respond proactively.

Results

Blood is a precious, frequently scarce resource at hospitals, yet blood is often over-ordered "just-in-case" because of a lack of confidence that the blood will be ready when the caregiver is ready to transfuse. While clinicians may be hesitant to change established workflow, studies have shown that a point-of-care blood management system that makes blood products available just-in-time, results in improved traceability, temperature control and control of blood products. These point-of-care blood management systems have increased safety, compliance and efficiency, while reducing cost.

Safety improvements

The Irish Blood Transfusion Service (IBTS) deployed BloodTrack point-of-care blood management systems across 48 hospitals beginning in 2014. Results included a reduction in time to deliver urgently needed blood products and prevention of transfusing incorrectly stored or outdated units[17].

At Oxford, an "end-to-end" electronic management system incorporating point-of-care blood management reduced ABO-incompatible transfusions from 13 over a period of four years to none over a period of five years. Near-miss events were reduced from one in 27,523 to one in 67,935, a reduction of 59 percent. There was a commensurate reduction in blood administration-related tasks by 50 percent[18]. The use of BloodTrack Tx® software as a bedside transfusion administration for a final check prior to transfusion reduced mislabeled unit errors from 0.04 percent to zero[19].

Speed

Speed matters in life-threatening clinical situations. Delays in provision of blood products can jeopardize clinical outcomes. U.K. National Patient Safety Agency data indicate that delays led to 11 deaths and 83 incidents of harm over a four-year period[20]. Point-of-care blood management systems allow for rapid response by eliminating the need for blood runners in the implementation of massive transfusion protocols. American College of Surgery guidelines call for the immediate availability of universally compatible red blood cells and thawed plasma. A U.S. Level 1 trauma center found that BloodTrack software reduced delivery time and number of trips from the transfusion laboratory to ED by 76 percent[21].

Implementation of the BloodTrack point-of-care blood management system at a large tertiary academic hospital resulted in an 81 percent reduction in delivery time from transfusion laboratory to OR. In urgent cases, blood could be available in as little as 90 seconds[22].

Efficiency improvements

Implementation of BloodTrack® software at a variety of hospitals has demonstrated significant improvements in speed and efficiency.

Efficiency improvements at four different hospitals

BloodTrack OnDemand® in OR	Before	After	Reduction	Impact
Blood Availability (JRI)	24 min	1 min	-96%	Increased Safety & Efficiency
Transfusion Laboratory Staff Time (JRI)	59 min	17 min	-71%	Decreased Labor Costs
Unused Blood Orders/ Requests (JRI)	42%	20%	-52%	Increased Caregiver Confidence
Units Issued but Not Used (JRI)	60%	38%	-52%	Reduction in Unused Units
Units Issued but Not Used (TOH)	70%	25%	-64%	Reduction in Unused Units
Blood Issued from Transfusion Laboratory (JRI)	407 units	197 units	-52%	Reduction in # of RBCs Issued+
Clinical Staff Time (JRI)	58 min	17 min	-70%	Increased Clinical Room Productivity
Total Workload (ATC)	2704 min	1841 min	-32%	Overall Labor Savings+
Emergency Blood Delivery Time (O)	18 min	45 sec	-96%	Delivery Time Reduction

+ Measured over a 30-day period
JRI: John Radcliffe Infirmary[23]
TOH: Tertiary Orthopedic Hospital[24]
ATC: Academic Trauma Center[25]
O: Oxford[26]

When Johns Hopkins Medical Center implemented their point-of-care blood management system in conjunction with an updated institution-specific MSBOS, they improved the crossmatch-to-transfusion ratio by 27 percent and significantly reduced transfusion laboratory workload[27].

Crossmatching improvements at Johns Hopkins[28,29]

BloodTrack software – in conjunction with new MSBOS	Before	After	Reduction	Impact
Crossmatched Unit Requests	151	91	-40%	Reduced Transfusion Laboratory Workload
Crossmatched Units	407	197	-52%	Reduced Transfusion Laboratory Workload
Units Crossmatched Per Patient	3.5	1.6	-54%	Reduced Transfusion Laboratory Workload & Cost Savings
Crossmatch to Transfuse (C/T) Ratio (all hospitalized patients)	2.1 : 1	1.5 : 1	-27%	Reduced Transfusion Laboratory Workload
Type and Screen (T/S) + Type and Cross (T/C) Procedures	40%	25%	-38%	Reduced Transfusion Laboratory Workload
Perioperative Blood Orders (all surgical patients)	62%	51%	-18%	Effective Blood Management

Blood availability/time to issue also improved to 62 seconds for electronically crossmatched and 42 seconds for emergency O-negative release[30].

A recent study at five hospitals in England, Wales and the United States for 1 to 10 years reported a 76 percent time savings in issuing blood from a point-of-care blood management device (BloodTrack® HaemoBank®) compared to obtaining it from the transfusion laboratory. The study also reported improvements in issue:transfusion ratio, reductions in staff time and costs[31].

Faster time to transfuse through use of BloodTrack software controlled storage devices instead of central transfusion laboratory[32]

Site	Before	After	Reduction	Impact
Oxford	8.43 min	2.02 min	-76%	Reduced Patient Wait Time
Johns Hopkins	6.54 min	1.57 min	-76%	Reduced Patient Wait Time

Patients at smaller satellite hospitals without transfusion laboratories of their own are often forced to travel to larger locations to receive blood. A point-of-care blood management system, such as the BloodTrack HaemoBank device, can provide patients with blood at their home facility. One hospital estimated the cost to establish a satellite transfusion laboratory as approximately $400,000[33].

Additionally, deploying BloodTrack software-controlled storage devices (BloodTrack HaemoBank) close to the transfusion site in the adult outpatient clinic at Johns Hopkins showed significant improvements in patient and clinical staff satisfaction by reducing turnaround time and overhead[34].

In another instance, using a BloodTrack-controlled storage device enabled a U.S. Level 1 trauma center to more effectively provide blood products for incoming trauma patients to support ratio-based transfusion protocols, improve staff efficiencies and proactively respond to emergencies[35].

Further, by providing ED staff with ready access to emergency units when needed, rather than necessitating blood coolers for emergencies, the BloodTrack software freed up an estimated 6-10 hours of tech time per month. Plus, alerts automatically notify the transfusion laboratory when emergency units are removed, allowing for quick response, without unnecessarily tying up group O RBC units[36].

Cost savings

In its first year of usage of BloodTrack software in 2014, IBTS estimated savings of $1.1 million (US equivalent) on blood products and approximately $3 million in full-time personnel equivalents. RBC outdating was reduced from 10 percent to 0.8 percent, with associated costs reduced from $3.9 million to $1 million. Platelet outdating was reduced from 10 percent to 4.8 percent. Rerouting of 3,558 units for transfusion saved $1.2 million[37].

At Johns Hopkins, implementation of the point-of-care blood management system resulted in an annualized cost savings of $6.08 per surgical patient and $6.20 per hospitalized patient, for a total of $436,000[38].

BloodTrack® software enabled multiple hospitals in Oxford, U.K. to network with their blood supplier and automatically replenish inventory through usage-driven forecasting algorithms. Transfusion data was visible to all participants, giving a clear view of usage and inventory and supporting more informed planning[39].

Conclusion

The consequences and costs of imperfect control of the entire blood transfusion supply chain, from transfusion laboratory to bedside, are often underestimated. In the absence of better technology, delays, wastage and errors are accepted as the status quo. But the proven results of implementing point-of-care blood management systems in a variety of hospitals shows that improvements in safety, efficiency and cost are fully achievable.

A point-of-care blood management system can help ensure the five rights of transfusion administration for all patients.

About the Author

Dr. Mark Popovsky was Clinical Associate Professor of Pathology at Harvard Medical School and Beth Israel Deaconess Medical Center for more than 20 years. He has served on 7 editorial boards, authored more than 375 peer-reviewed publications, published 2 reference books on transfusion medicine, and served on many national and international committees. He served as Chief Medical Officer of Haemonetics for 15 years and is currently serving as Chief Safety Officer.

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