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Technology Enables Issuing Blood at the POINT OF CARE

Automated blood analysis techniques enable blood bank IT systems to identify all compatible units in inventory for patients with a confirmed blood group with no red cell antibodies, so blood units for transfusion can be released without the need for further testing. Such "electronic issue" saves time, but transporting the blood units to the site of care may still be subject to delays. Issuing these units where they will be used — for example, operating rooms, labor and delivery areas and emergency departments — can make electronic issue even more efficient.

The concept of point-of-care technology for issuing red cell blood units — sometimes likened to a vending machine for blood — was first implemented in the 1990s by hospitals in Hong Kong and Australia. In 2005, a fully automated system for electronic blood issue at the point of care was developed in the United Kingdom and Canada.[1] It was acquired by Haemonetics, Boston, in 2009 and is known today as BloodTrack transfusion management software.

Although computerized blood issue systems using a "vending style" refrigerator may be known by different names — operating theatre blood transaction system (Hong Kong), electronic blood release system (Australia) and electronic remote blood issue (ERBI) system (United States and U.K.), they share several characteristics, such as software and hardware to ensure the appropriate unit goes to the correct patient; unit storage at or near operating rooms and other points of care; and electronic issue and tracking of products.

While a survey of six studies on such systems published in 2015 was inconclusive, the authors noted that specific studies showed positive outcomes and called for further, more rigorous studies.[2] A multicenter international study in *Transfusion* published last year demonstrated that an electronic system got RBC units to patients more quickly and created workflow efficiencies that saved time and reduced costs.[3]


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Why Remote Issue?

The ERBI system aims to replace a manual one to improve the safety and efficiency of issuing blood to patients who need it quickly.

In the traditional blood issue method, clinicians estimate how many units of blood they might need for a surgery and the hospital blood bank issues units that are transported to blood refrigerators near the patient or in coolers that are manually transported close to the patient, such as to operating rooms. "Even though the current process works pretty well, units could potentially end up going to the wrong patient at the wrong time due to errors and breakdowns in the process,"said Mark Popovsky, MD, chief medical safety officer for Haemonetics Corporation, adding that the ideal scenario is to consistently ensure that the right blood is always transfused to the right patient at the right time.

Popovsky offered one potential scenario, based on his experience as a transfusion medicine specialist. During surgery, an unneeded unit of blood gets left in the cooler. The cooler is not retrieved from the operating room. When the next patient arrives a half hour later, in the urgency of the moment, the anesthesiologist reaches for the wrong cooler, takes a unit of blood and transfuses it. Although rare, such an error could cause a hemolytic transfusion reaction with potentially serious consequences for the patient.

Rapid care for patients presents another impetus for enhancing current blood issue methods. Michael Murphy, MD, FRCP, FRCPath, FFPath, a consultant with the Oxford University Hospitals, and its blood bank manager, Julie Staves, saw the need for a system that released blood at the site of care. With one blood bank located at its largest hospital, John Radcliffe, Oxford wanted to make blood available quickly for patients who were already eligible for electronic issue at other hospital sites.

"At Oxford we have many hospitals on different sites, and it was unrealistic to think we were going to have a blood bank on each of those sites," explained Murphy. "The sites are not very far away from John Radcliffe. But in certain times of day, particularly the early afternoons, the traffic between the blood bank and the other sites can be horrendous. It can take 40 minutes to go two miles. An efficient way of providing blood really required the development of a process where the clinical staff can, if they need blood, self-serve at the remote fridge for all the patients with a known blood group and negative antibody screen."

Murphy and Staves piloted ERBI in 2005. They selected a cardiac operating room at John Radcliffe. "Cardiac surgery was in the same hospital as the blood bank, so the pilot was designed to make sure the process worked and was safe," said Murphy. The experiment was successful: the system reduced the time it took to get blood to patients and improved transfusion efficiency. Now, Oxford has six remote smart refrigerators in its four acute care hospitals.

This same ERBI system is now also used by hundreds of hospitals in the U.K., U.S. and Canada. The results of a recent study published in *Transfusion* assessed whether the system reduced blood bank work, improved controls in the supply chain and worked in different size hospitals in countries with different health care systems.

The study included two large academic medical centers: Oxford and Johns Hopkins in Baltimore. The latter instituted ERBI in 2009 with one remote refrigerator and by 2017, had expanded it to four: three in operating suites and one in the outpatient cancer center for same-day transfusions. Three smaller hospitals were also part of the study, one of which had been using ERBI for less than a year.

"What we showed was that in each of the situations, there was a benefit — better control of the supply chain, improved efficiency and cost savings," said Popovsky. It shows that even though there's a learning curve, you get the benefit right out of the gate."

Point-of-Care Technology

The ERBI system used by the hospitals in the study uses BloodTrack software integrated into a smart refrigerator that stores and dispenses blood units. Refrigerators come in two sizes: one holds up to 80 units of blood and the other holds up to 20. In Oxford, ERBI runs in parallel with an electronic bedside process for blood sample collection and the administration of blood, also using BloodTrack.

When a patient needs blood, a staff member scans the patient's wristband — which has a barcode and visible information — using a BloodTrack hand held device that prints a pickup slip. A trained and authorized staff member undertakes the following actions:

1. Collects the pickup slip, goes to the HaemoBank refrigerator, scans their staff ID card, selects the action "taking out" and then scans the barcode on the slip. The smart fridge software communicates with the blood bank computer system to determine the patient's blood group and eligibility for remote issue and selects an appropriate unit for the patient. The

tray containing the unit lights up, indicating the unit can be removed.
2. Scans the unit number; the smart refrigerator produces a compatibility label.
3. Confirms the label has printed and then puts the label on the unit.
4. Scans the unit number and compatibility label separately to verify the compatibility label is on the correct unit.
5. Takes the unit to the patient.

When the unit is released, the software automatically conveys this to the laboratory information system, updating the inventory, and enters it in the patient's records.

The ERBI system can be located anywhere in the hospital, including ORs, ERs, ICUs and outpatient clinics. In some cases, it is used in the blood bank itself.

According to Staves, each hospital needs to work out its stocking process. Oxford stocks a standard amount based on historical use and adjusts it as needed based on surgical schedules. "We store about 3 days' stock for O positive and A positive, and 5 days' stock for the other groups. If a patient is having a big surgery that might potentially need a lot of blood available in group, say, AB negative, we might increase the stock level for that group. So we're flexible, but we have a standard level."

For ERs and trauma centers, remote refrigerators can be programmed to release only type O blood. Steve Frank, MD, director of the Johns Hopkins Health System Blood Management Program, explained how it works. "The refrigerator will ask if your patient is male or female, and if they are less than 50 years old. If they are a female under 50, it will issue O negative; if it's anyone else, O positive. And if you don't know, you get O negative. It's a good way to allocate the most valuable resource we have."

ERBI works well for most scheduled surgeries. But in the small minority of cases where large quantities of blood may be needed — such as liver transplant or thoracic aortic aneurysm repair — coolers may still be preferred, according to Frank. "ERBI is not adequate for a true massive transfusion protocol because you can't get red cells, plasma and platelets in the OR quickly in large quantities. It's good for temporizing until you get your cooler. In other words, you can get red cells right away while they're packing the cooler for a massive transfusion protocol.."

Benefits: Efficiency and Safety

There are several potential benefits to bringing blood units close to the point of care.

Faster delivery: The study in *Transfusion* showed that delivering

The computerized control of the blood release process minimizes the opportunity for human error and mismatched blood.

blood to patients was significant — approximately 4 times faster — in two of the three hospitals where the remote refrigerators were close to the clinical area. For example, at Johns Hopkins, the remote blood bank was 50 feet — or 1 one minute and 15 seconds — from the operating room, while the walk to the blood bank was about 15 minutes, plus time waiting for the units, according to Frank.

Improved safety: The computerized control of the blood release process from the blood bank through transfusion minimizes the opportunity for human error and mismatched blood. "HaemoBanks will only issue units that are safe for your patient. You can't take out the wrong unit," said Frank. "We don't have a wrong unit we've known about for the last 7 years. We use 40,000 red cells a year, so 7 years would be a quarter million red blood cells." Similarly, Oxford, which issues 20,000 units a year, has not experienced a blood unit mismatch since implementing its system 15 years ago.

Lower usage: The speed in delivery gives clinicians peace of mind that blood is readily available, so they use less. The recent study demonstrated the ratio of blood units issued to those transfused improved significantly (range of 1.02-1.09, compared to traditional process of 1.48-1.58).[3] Fewer blood units used reduces costs.

Saved time/money: A remote refrigerator reduces time spent by staff waiting for blood to be released and transporting units. "You have to obviously stock the fridge wherever it is, but with ERBI you can do it routinely without having to send multiple transport systems — taxis or couriers," said Staves. Saving transport time results in cost savings, she added.

Less Waste

In addition to cost savings related to time and transport, ERBI can help control blood waste. "After surgery, units would sometimes just be lost or go out of range more than 10 degrees, which is the maximum allowed. And if after 30 minutes the unit is not used, the blood units are no longer usable," said Popovsky. "You have just thrown out this precious blood product, which is getting in shorter and shorter supply."

At Johns Hopkins, one of the major operating room suites was so far from the blood bank that anesthesia staff and surgery attendings wanted coolers of blood in the ORs. As a result, 82% of the blood was being returned to the blood bank. "That's a very inefficient system because the blood that's returned unused is yet a day older, and not available for other patients while it's sitting in the OR," Frank said. "Our HaemoBanks hold up to 80 units of red cells. They stock them every day. If there are 10 A positive units, you are sharing those with other patients that are A positive. That way, if there is a 5% chance your patient will need it, it will be available for the other patients that have a 5% change of needing it."

Good management of the stock in the remote refrigerators is critical to avoiding waste, said Staves. She cautioned against leaving blood in remote refrigerators until it expires. "If you develop a process to manage the units carefully, and staff are compliant, it should help reduce wastage." Oxford returns units to the laboratory with 5 days' shelf life left, and it is then issued to patients who are likely to require it.

Training and Resources

Training staff on the remote blood issue process is straightforward.

Murphy recommends educating staff on the purpose of ERBI, as well as the procedure itself. For the latter, his hospital developed a training video and a competency test to make sure staff were competent to perform the procedure. The short video can be found on YouTube.[3]

Johns Hopkins found a web-based learning module works well for gaining competency.

When considering ERBI, hospitals should weigh the value of the system and resources required. "First, it's important for hospitals to understand the value of electronic issue linked to remote release of blood units, which is getting blood quickly, safely and efficiently to patients when they need it," Murphy said. "Secondly, they need to have the right IT systems. Third, financial considerations include an upfront cost, but we think that it saves money in staff time and in the use of blood."

The study published in *Transfusion* has generated interest in ERBI. "We think the software and the refrigerators that are part of it are unique," said Popovsky. "Although the technology is not new, many people are now becoming aware of it." ■

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