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needed. The operating room (OR) uses an electronic ordering system to notify the blood bank in advance of how much and what types of blood will be needed for scheduled surgeries. Orders for blood also come in from the OR for emergency surgeries, from the emergency room, and from other departments as well.

A plastic loop called a Bloodloc, resembling a giant decoder ring, is affixed to each unit of blood before it's put into a pneumatic tube system to be whisked off to a patient. DHMC started using this simple safety system right after the Medical Center moved from Hanover to Lebanon in 1991. At the old site, pretransfusion samples were collected by blood-bank technicians. But at the Lebanon location, pretransfusion samples are collected by phlebotomists instead. "The blood-bank techs know what happens if something goes wrong," says AuBuchon. "We had more confidence that they were going to be labeling everything correctly."

But the change that worried him most was that blood would no longer be delivered by humans to the operating suites and other departments, but would be traveling through the Medical Center via pneumatic tube. Each bag of blood would be labeled with the name and identifying information about the recipient. Then, says AuBuchon, they "put the unit of blood into a tube and watch it go 'schhhhp' into the wall."

Luckily, the Bloodloc system came on the market in the nick of time. A unit of blood can't be transfused until it's unlocked with the right code—a random, unique, three-letter code that's been imprinted on a label attached to each patient's hospital wristband as well as transcribed on the pretransfusion blood sample. A blood-bank staffer issues the blood components for a patient, sets the Bloodloc with the patient's code, and attaches it to the bag, then sends it on its way through the pneumatic tube. When the unit gets to the patient, the transfusionist dials in the code on the patient's wristband to open the lock.

"There's only 40 to 50 hospitals using this technique," says AuBuchon. "Many began using it only after there was a fatality." DHMC has never had a fatality from mistransfused blood, but the system has prevented a few near misses.

**I**f getting the wrong blood is the number-one transfusion-related cause of death, the number-two cause is bacterial contamination. Almost one in 4,000 transfusions results in a severe reaction due to bacterial contamination, and as many as one in 17,000 can lead to death.

DHMC was the first medical center in the United States to culture platelets for bacteria. Platelets

are more likely to grow bacteria because they're stored at room temperature—an ideal growing condition for bacteria like salmonella and staphylococcus. Some types of bacteria can grow in refrigerated blood, too.

Bacteria can get into platelets in a couple of ways: from the donor's blood if the person has a low-level, chronic infection; from the donor's blood if it is taken during one of the brief periods in a day when there are bacteria in one's bloodstream (after brushing one's teeth or defecating, for example); or from the donor's skin if the needle pushes through a subcutaneous location where bacteria weren't killed by disinfection of the skin.

The trick is to identify infected units so they won't be transfused, but usually there aren't enough bacteria initially to be measurable. About one in a thousand units of platelets contain bacteria, according to AuBuchon. Culturing is a way to find those units.

The culturing process begins the morning of the second day after collection, and the results are available in 12 hours—so if there are no bacteria present the platelets are ready to transfuse by day three. Under current FDA regulations, platelets must be used within five days, even though they can live for seven days. AuBuchon hopes that the FDA will one day allow blood banks that use bacterial testing to extend the storage of platelets to seven days.

Another safety measure that AuBuchon has instituted is hiring a transfusion safety officer to focus on safety issues outside the walls of the blood bank. DHMC and most other hospitals already have compliance officers, as well as multidisciplinary transfusion committees made up of doctors and nurses. Blood banks in other countries have transfusion safety officers, but DHMC is the first place in the U.S. to establish such a position. "We have come to recognize that although we can certainly make errors in the laboratory, there are significant problems that can occur outside the laboratory—for example, all the problems related to mistransfusion," AuBuchon explains. "To my knowledge, we are the first American hospital to have not only a compliance officer that looks internally at the laboratory but a transfusion safety officer that performs the same kinds of functions, but whose view is meant to be external—that is, to look at the clinical transfusion process."

Blood centers everywhere are concerned not just with safety but also with the challenge of keeping the blood flowing—of finding enough people willing to donate blood. AuBuchon hopes that the DHMC blood donor room will increasingly attract donors who don't mind giving blood but might not