RFID-enabled Locks Secure Bags of Blood

Ospedale Maggiore, a hospital in Bologna, Italy, has been using a system involving RFID-enabled seals to be sure patients are given only the blood intended for them.

By Rhea Wessel

Sept. 26, 2006—At hospitals around the world, workers continue to make mistakes matching blood groups, and some studies show human error rates for blood transfusions have not improved during the past two decades. Ospedale Maggiore, located in Bologna, Italy, has been using an RFID-based system to match patients and blood bags, ensuring that transfusion patients are given the blood intended for them. Tiomed, an Italian medical-device company, designed and installed the system, which has been in operation since May.

Daniele Luppi, a doctor at Ospedale Maggiore who worked on the project, says the hospital is moving away from its current system, using an ID bracelet with an iButton from Maxim Integrated Products. The iButton consists of a computer chip enclosed in a 16-millimeter stainless steel circular case. It can be read at a rate of 16 or 142 kilobits per second, but instead of transmitting that data via a radio signal, the iButton requires direct electrical contact with a handheld device by means of a cable.

The hospital is moving toward an RFID system for several reasons: It is more user-friendly, it has faster reading and writing capabilities, it has larger data-storage capacities, and it can perform some steps of the positive-identification process automatically. Luppi says the most important advantages for the hospital have been better compliance with procedures and higher acceptance from both blood-service operators and clinical unit operators.

Tiomed's system features MediLock, an RFID-based electronic seal attached to bags of blood. MediLock can be unlocked only when a multifunctional, wireless handheld device, the Palmed, communicates the correct identity of a patient receiving the blood.

The basic idea behind the system is to identify, in a unique way, every single item used in the transfusion process—from the test tube and request form to the patient, explains Sonia Rubertelli, Tiomed's head of operations. "It works by linking all these unique codes, and all the information gathered throughout the process, to the unique patient code, so that we are sure that all information is related to that patient and not another," she says.

After receiving a request form filled out by a doctor, a nurse goes to the patient's bedside with the form, a test tube with a bar-code label on it and the Palmed. About the size of a mobile phone, the Palmed includes an RFID interrogator that conforms to the ISO 15693 standard and operates at 13.56 MHz. It also comes with a bar-code reader, a fingerprint reader that may be utilized later for user authentication and the software needed to run the device. The RFID reader on the Palmed is supplied by U.S. company SkyeTek, while the bar-code reader is manufactured by Symbol Technologies.

The test tube is used to hold a blood sample that will be analyzed to confirm that a patient's blood group is the same as that of the blood being transfused.

At the bedside, a nurse first uses the Palmed to read his or her own ID badge, which has an RFID tag attached to it. She places a Tiomed wristband containing an embedded RFID tag on the patient's arm, using the Palmed to read the unique ID number on the wristband's RFID tag. Tiomed buys these RFID-tagged wristbands from Precision Dynamics Corp. The nurse also uses the Palmed to read the bar code on the test tube filled with the patient's blood. The system then links all three numbers.

Another RFID tag, placed inside an adhesive label, comes attached to the blood-request form. (In Italy, hospitals are required by law to use paper request forms at transfusion centers.) The tag on the form has a unique code provided by the factory, as well as memory capability. The operator encodes the linked data (patient ID, test tube number and operator ID) to the RFID label on the form, again using the Palmed.

The request form containing all the data is then taken, along with the test tube, to the transfusion center's Tiomed workstation. The station is outfitted with a PC running Tiomed's Basic Hemo and Emoguard software programs, which manage the process; a Palmed; a supply of MediLocks; a "tagger," a small RFID reader connected to the PC and used to recall the information saved on the tag on the request form; and two other small devices connected to the back of the PC, called Medilinks. Medilinks use Bluetooth technology to allow communication between the Palmed, the MediLock and the PC.

In the next step, the operator places the form's tag on the tagger and reads it. The information on the tag is then transferred to the database and updated immediately. After filling out the form by hand, testing the blood in the tube for blood type and selecting a corresponding bag of donor blood, the operator uses the Palmed to read the tag on the request form and the bar code on the bag of donor blood. The bar code is a standard ID code for blood bags, used worldwide, and the Palmed communicates with it via the Bluetooth connection to the PC.

"In this way, we have assigned the bag, with its unique identification code, to that specific patient and linked it to the request form and to all the information gathered until that moment," says Rubertelli.

The operator then puts the assigned blood bag into another clear plastic bag with a ziplock closure and applies a MediLock. The nurse uses the Palmed to read the bar code on the blood bag inside the outer bag, and the information on the request form. If all the information matches, this confirms that the operator has inserted the proper blood bag into the holding bag. The MediLock is then sealed (after receiving notification via Bluetooth) and can only be opened after a Palmed operator transmits the proper electronic combination via a Bluetooth connection. The electronic combination is made up of a series of numbers, including the request code, the bar code of the blood unit and the patient's ID.

The MediLock contains a temperature sensor allowing it to monitor the temperature of the air outside the blood bag and its carrier. Once the MediLock is sealed, it begins to keep a log of the external temperature and the time, since blood can spoil at certain temperatures.

Back at the bedside, the nurse scans a patient's wristband with the Palmed. Since they both contain Bluetooth modules, the Palmed and the MediLock communicate continuously. Therefore, once the wristband has been scanned, the MediLock compares the patient ID of the wristband with the patient ID that is part of the MediLock combination. The MediLock knows that only one particular patient ID can be used to open the seal, so it compares the patient ID number on the wristband with the one encoded in its combination. If the codes match, the lock opens. The unlocking procedure takes about two to three seconds. If the temperature at which the blood bag was stored is higher or lower than the parameters set, the lock will not open.

The transfusion can now begin. Once finished, the nurse uses the Palmed to record the time it was completed, along with any reactions the patient may have experienced. Some 25 reactions are codified, and the operator

simply enters a few digits into the Palmed. The information is then shared with the MediLock and returned to the blood bank. All information on the MediLock is updated into the database via the Medilink, and the Emoguard software keeps a record of each step of the transfusion process for every patient.

During the implementation, Luppi says, the hospital and Tiomed faced challenges training staff on the concepts of the system and how to use it.

"The biggest challenge is organizational. It's a change of mentality," Rubertelli explains. "We're asking the operator, who used to work manually, to use a device to do something that was done without one before."

Tiomed offered training to a small group of people, who then became responsible for instructing others. Presently, more than 60 people are trained to use the system. In 2007, the hospital will implement the blood-tracking system across all departments. The system will also be implemented at hospitals in four other cities: Ospedale S. Martino, in Belluno; Ospedale Civile dello Spirito Santo, in Pescara; Ospedale Civile, in Venice; and Ospedale S. Anna, in Ferrara.

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