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RFID and ISBT 128: Using Radio Waves and Bar Codes to Increase Patient Safety

By Tanya Brown
AABB Staff Writer

RFID — a technology that uses radio waves to communicate with a tag that can be attached to or incorporated into a product or person for the purpose of identification — and ISBT 128 — a data and bar-coding standard that contains information about blood, cellular therapy or tissue products — encode information using different mechanisms, but both types of symbology hold significant value and potential for AABB-accredited facilities and the greater community. With several options on ways to label and track blood and cellular therapy products for maximum process efficiency and quality, as well as an ongoing communitywide emphasis on patient safety, how do RFID and ISBT compare? And can the RFID world and the ISBT world find common ground?

Two Technologies Working Together

Bringing two worlds together to increase patient safety is what BloodCenter of Wisconsin set out to do a year ago when the facility initiated a study designed to gauge how radio frequency identification (RFID) could help enhance ISBT 128, the universal bar code symbology system adopted by the International Society of Blood Transfusion as an acceptable global standard for identification, labeling and information processing of human blood, tissue and organ products.

“What we found was that the use of RFID is far better positioned with ISBT 128,” said Lynne Briggs, BS, MA, director of the blood center’s information system applications. “Because the blood and transfusion medicine community has internationally accepted uniform labeling and data standards for blood and tissue, the community avoids large hurdles in creating a standard use of RFID in the blood supply chain from donation to the patient’s bedside. Other industries do not have this advantage. While we could have used the old Codabar standards, ISBT 128 offers so many specific improvements in terms of unique identification of products, as well as additional embedded information in the product codes, that its adoption worldwide opens up many opportunities — such as the use of RFID.”

In assessing whether RFID could augment the ISBT 128 bar-coding system, the first phase of the study concluded that RFID along with ISBT 128 creates a more efficient process that reduces time-consuming scans and increases overall safety.

Briggs said a second phase of the study will soon determine how well RFID will do from the donor to the bedside. “Our blood center/supply side study looks very good, and we’re building a prototype to confirm our assessment of quality and efficiency gains from collections to shipment to hospitals. At the same time, we’re beginning the same assessment in the hospital from the point of receipt of products to the patient.”

Using RFID on the blood bag with the ISBT label will require the addition of an RFID tag. Briggs said they are working with the ISBT’s RFID Working Party and EPCglobal on the tag specifications, but the data contained in the tag would coincide with the requirements defined in ISBT 128. RFID also would be able to hold other data such as time stamps to see when a product was removed from storage and for how long. According to Briggs, it is important when working on the tag specifications that the tags and frequencies used by transfusion medicine professionals are positioned to move forward in alignment with the technological applications in other health care and pharmaceutical fields.

Moving Away From Aging Symbologies

The ISBT 128 system replaces ABC Codabar, which was adopted by the blood community in the late 1970s. Although useful at that time, Codabar's limitations are now the cause of some errors.

"There are a variety of problems with Codabar," explained Pat Distler, MS, MT(ASCP)SBB, technical director at ICCBBA. "There is lack of ongoing support, so it is not really growing as the industry has grown. There are data security issues, traceability issues and there are limitations in the number of product codes or unique unit numbers that can be assigned. There also is a limited ability to encode data for autologous collections, and it has very weak process control capabilities when compared to ISBT 128."

Offering an example in which ISBT 128 could have served a vital role, Distler described how after the terrorist attacks of Sept. 11, she labeled about 1,500 units of blood during a single weekend. Twice she scanned a unit and found that the wrong unit number was displayed on her computer screen due to a mis-scan. "ISBT 128 avoids this. Each character, each number in that code, has three separate self-checking features," said Distler. "Likewise, there is a built-in check character for the entire message, so the entire unit number has to read correctly or an error message occurs. These features are in addition to the keyboard entry check character that most people are familiar with. This level of safety is really what we want."

Codabar limitations are what moved Gulf Coast Regional Blood Center in Houston to fully implement and go live with ISBT 128 in October. "Our big motivator was that we were running out of Codabar numbers to use," said Bart Block, director of the center's management information systems. "We wanted to move as quickly as possible to remove the risk of running out of numbers."

Because the Codabar donation identification number is only seven digits long, it allows a single facility to identify 9,999,999 blood components, but more than 700 facilities in the United States collect more than 14 million components a year, forcing some facilities to duplicate numbers. ISBT 128 eliminates that concern.

"ISBT 128 has a process for requesting and acquiring new codes and even site-specific codes," said Block. "As long as that remains in place, then ISBT 128 will be able to keep up with industry changes."

For years, Puget Sound Blood Center in Seattle performed automated blood component labeling using Code 39 — a bar-code symbology that can encode uppercase letters as well as digits and a handful of special characters — instead of Codabar. As part of a scheduled upgrade, ISBT 128 was fully implemented in November 2006. The blood center, which serves 70 hospitals across 14 counties, provided assistance to its customers to help them implement ISBT 128 by the deadline.

"The process is very involved, and it was important to work with our client facilities to prepare for ISBT 128 implementation," said Margaret Ohashi, MT(ASCP)SBB, senior quality systems specialist at Puget Sound Blood Center. "Errors are reduced when the computer does the decision making by printing the correct bar-coded label. Also, scanning the bar-coded label to electronically transfer the information helps to avoid errors of incorrect manual transcription."

Benefits of ISBT 128

According to Distler, more than 3,000 facilities have registered with ICCBBA — which creates and manages the codes and databases for ISBT 128. About 1,000 of those facilities registered within the past year. A five-digit code is assigned to each facility and is part of the coding that tells where the blood product was drawn. Because of this facility identifier — which includes the year of collection — unit numbers assigned to all products are unique globally for 100 years.

"ISBT 128 is able to encode a lot of information," said Distler. Once scanned, everything about a particular blood product will be known. "The unit number and the ABO can be scanned as a single bit of information; likewise, the expiration date and the product code. This will help reduce errors."

Distler noted that errors are uncommon in the processing of blood products because of tightly controlled conditions used during the process. "It's extremely rare for errors to occur during this phase. However, we need to bring scanning technology to the patient's bedside," she said, adding that less manual transcription and more scanning of bar codes or even the use of RFID will help facilities and patients benefit from the safety and efficiency of technology.

Medical Errors and the Use of RFID

According to the 2002 report “Death from Transfusion: Sources of Error,” by Kathleen Sazama, MD, JD, of MD Anderson Cancer Center, about 25 percent of ABO hemolysis errors occur within the blood bank, and an average of 46 percent occur at the time of transfusion. The report — which summarizes 20 years of data collected by the Food and Drug Administration — noted that more than half of the deaths were due to failure to properly identify the patient either at the time the sample is collected or at the time the blood is being transfused.

In an effort to move the health care industry to be more careful and take responsibility for its mistakes, the Centers for Medicare and Medicaid Services announced in August that it will no longer pay for the additional cost to treat certain preventable errors in hospitals, including blood transfusion errors. Beginning in October 2008, hospitals will have to absorb any costs associated with treating blood transfusion errors for any Medicare or Medicaid patients.

Those type of medical errors prompted Massachusetts General Hospital in Boston to begin a pilot program in 2005 to help decrease the number of costly mistakes. Between 1999 and 2003, Massachusetts General administered seven transfusions to the wrong patient. No deaths occurred, but the hospital began piloting the use of RFID to reduce those numbers.

The pilot program gave patients a wristband with an RFID tag that transmits radio waves to a microchip on a blood bag. If the information embedded in those signals do not match, then an error message comes up on a computer screen indicating an incorrect match.

“I do believe that this is the way to go,” said Walter “Sunny” Dzik, MD, co-director of the blood transfusion service at Massachusetts General. “Imagine what the rest of the world would be like without machine-readable identification. There would be no ATMs, no online shopping and no electronic air travel. Health care is behind.”

Although health care lags slightly behind companies such as FedEx and Procter & Gamble Co., which have incorporated RFID into their shipping and asset-tracking systems — RFID is a promising complement to ISBT 128 to increase efficiency, reduce multiple handling of blood bags and decrease errors at the bedside.

Another organization evaluating RFID’s potential to reduce errors is Mississippi Blood Services in Jackson, Miss., which funded a study in 2004 to test RFID as a replacement for its current bar-coding system. Working with RFID companies AARFID and Texas Instruments, the center was able to reduce several hours of scanning bags for inventory — which is generally a three-step process — into one hour.

“Currently we have to pick up each and every bag and scan the bar code while working in sub-freezing temperatures. During the RFID trial we were able to package 30 bags, and with one pass, we were able to get a reading on all 30 bags,” said Gulam Patel, manager of information systems at Mississippi Blood Services. “This is definitely a patient safety factor. The less we have to handle the products and expose them to different temperatures, the more we improve blood safety.”

Applications engineer Rafael Mena of Texas Instruments said RFID automates time and labor-intensive manual inventory processes at the blood bank. “Using RFID, multiple bags of blood can be read simultaneously through a portal, and safety procedures can be performed, such as checking for expiration dates. This automation increases the processing speed and delivery to hospitals, while ensuring the integrity of the blood supply,” he said.

Once the blood reaches the hospital, an RFID tag can be programmed with the blood’s origin, its designated purpose and, once dispensed, its recipient. “By automatically matching the right blood with the right patient, through a positive patient-matching RFID system, the technology can reduce or eliminate errors caused by misidentification,” said Mena.

The system has worked perfectly for Ospedale Maggiore in Bologna, Italy. In May 2006, the hospital fully implemented an RFID system to match the correct blood with the patient. Each blood bag contains an electronic seal that locks the bag. Only when the correct patient information is communicated to a wireless device will the bag unlock, allowing the patient to be transfused. The seal also contains a sensor that monitors the outside temperature. If the temperature at which the blood was stored is higher or lower than required, then the bag will not unlock.

Changes on the Horizon

Even with the advances and efficiencies of RFID, the technology continues to evolve. Standards are still being developed, and RFID

readers are not fully standardized. And like most technology, RFID will advance rapidly with newer versions and more high-end equipment that can do the job better and faster.

“Moving to RFID and ISBT 128 is an investment, but they will create great efficiencies in the way we process and handle blood,” said Briggs. “Eventually the investment will pay for itself.”

The Bar-None Answer to Labeling and Tracking Blood

Lessons Learned from Those Who Have Successfully Implemented ISBT 128 or Are Well on Their Way

By Laura Fusco

They adorn boxes of frozen pizza and bottles of shampoo, keep your airline luggage from getting lost, track nuclear waste and your holiday packages, and allow you to enter the latest movie or sporting event. Wikipedia even suggests that they can help scientists understand the mating habits of bees. What could possibly be so omnipotent? The answer is the bar code, a machine-readable representation of information.

The number and range of applications for bar codes has grown tremendously in the more than three decades since a bar code was first used to scan a commercial product — a pack of Wrigley’s Juicy Fruit gum sold at a supermarket in Troy, Ohio, on June 26, 1974. While the blood community’s use of bar codes, particularly Codabar, has served a valuable role over the years, the increasing need for more product codes has taxed this symbology’s capabilities.

Advances in transfusion medicine and transplantation therapies means a new type of bar code is necessary, with the consensus opinion of the blood community that ISBT 128 is the best option for blood products. Not only does ISBT 128 offer significantly more product codes in a structure that is expandable and able to accommodate new products, it also includes controls — unlike Codabar — that are likely to further reduce errors and improve safety for the recipients of blood, components and cellular therapy products. The movement away from Codabar was set into play many years ago, but as the technology reaches the end of its useful life, it has become imperative that the blood community adopt ISBT 128.

With the deadline for implementation of the 25th edition of *Standards for Blood Banks and Transfusion Services* rapidly approaching, there are multiple steps blood centers and hospital transfusion services must take to be ready to convert to ISBT 128 by May 1, 2008.

Starting the Ball Rolling

For most facilities, the path to this updated approach to blood labeling and tracking begins with a written implementation plan. Colleen Mason, MS, MT(ASCP)SBB, project director for the Blood Bank of San Bernardino and Riverside Counties in San Bernardino, Calif., used the AABB template implementation plan and modified it to best fit the needs of her organization. “I started with the plan, and I looked at what they suggested we use, and then I based ours off of that one,” said Mason. “It was a good framework.”

The Armed Services Blood Program initiated the transition to ISBT 128 using a Department of Defense implementation plan, which was further refined by the Army, Navy and Air Force Blood Programs. Maj. Toni Mattoch, MS, MT(ASCP), SH, SBB, explained that within the Air Force, the transition to ISBT 128 began when DoD funded the development and subsequent addition of ISBT functionality to the Defense Blood Standard System (DBSS), the military’s blood bank computer system. “The goal was that DBSS needed to be able to read ISBT *and* Codabar,” she said.

Hospitals, in contrast, often follow the lead of the supplying blood center, according to Verene Sandoz, MT(ASCP), lead technologist at Island Hospital in Anacortes, Wash. “We collaborated with Puget Sound Blood Center when they were converting to ISBT 128, and they sent us guidelines as far as what their products were going to be named and how the bar codes were going to be used,” she said. Sandoz commented that it also is helpful for blood centers to help hospitals with the conversion by supplying clear sample pictures of the new labels, pointing out how and where all the essential information is included. “That way we could start becoming familiar with the unit numbers and product codes on-site,” she said.

As far as transition teams are concerned, Mason said she has found that a 20-person group is necessary to get the job done at her facility. “We have people from collections, the component lab, the labeling lab, product management, quality assurance, one of our process specialists, someone from the reference lab, our hospital services liaison, training people, information systems, someone responsible for monitoring our labels, our donor counselor ... we were meeting once a month to touch base, and now we are meeting twice a month as we get closer,” she said.

Handling Training and Education

As blood centers and hospitals check off items on their ISBT 128 conversion “to-do lists,” one of the most important steps is engaging all stakeholders in training and education. “We coordinated our efforts with hospital nursing staff and administrators,” said Mattoch. Visiting each hospital department with a slide show about ISBT and the implementation process and examples of labels, she said she found that in-person training helped clear up many misunderstandings. “We emphasized to the hospital staff that the number is the entire thing, beginning with the ‘W,’” Mattoch explained. “That was a big issue — the nurses like to peel off the label and stick it in the chart and document that unit, but what we found people were doing, even after training, was instead of continuing the take the sticker off the back of the unit, they recorded the unit number in the chart by abbreviating it to the last six or seven digits. We had to re-emphasize to the nursing staff the need to document the entire number. That’s why the stickers are so handy.”

As a hospital employee, Sandoz said that training for nurses went fairly smoothly because no changes were made in their ordering process. “Filling the order was the bigger deal,” she said. “The most frequent comment we heard was the length of the unit number because it extended so long.” She explained that staff training at Island Hospital included modifications to the order of entry into inventory. “I think the biggest change to procedures was scanning and entering the product code first. Originally, we scanned the unit number first. Now we enter the product code first to differentiate not only the products, but also product aliquots and multiples of the same unit. These carry the original unit number to which a distinguishing letter suffix is added. Scanning the product code first tells the LIS that more than one unit with the same unit number may be added to inventory. The multiples are tracked separately when the unit number bears the letter suffix.”

Handling product code changes in particular, Sandoz explained, is when due diligence is most critical. “The key for us, and what I’d suggest to others, is that when you start to define all of the products you can’t take shortcuts. Some facilities would consider just doing one code for platelet products, for example, but they can be apheresis or irradiated, and they can be manipulated so they need separate product codes,” she said. “The supplying blood bank can provide you with all of that, since they manufacture them.” Sandoz noted that her transfusion service built many codes they do not currently use but have on hand in case they are needed in the future. “For example, for platelet leukoreduced apheresis irradiated products, we have scanned that bar code, entered that code and now we have that choice should the need arise,” she said.

Tackling Computer Compatibility and Equipment Needs

When addressing a computer system’s compatibility with ISBT 128, Mason of San Bernardino explained that oftentimes it is best to have those who have been through it already assist those in the midst of conversion. “We tried to find customers who worked with Puget Sound Blood Center and Gulf Coast Regional Blood Center [blood centers that have already implemented ISBT 128] who were willing to talk to our customers who shared the same computer systems,” she said. In some cases, ensuring that computer systems are compatible and that the right equipment is in place to handle the new symbology means considering every entity that handles or receives your products, as Mattoch — who worked at Keesler Air Force Base in Mississippi during its ISBT 128 conversion — can attest.

As the first customer of the Blood Center of New Orleans to implement ISBT, the blood center at Keesler Air Force Base had to ensure that its vendor could read its labels in order to continue conducting infectious disease testing for the facility. “We printed out sample labels and sent them because they had to make changes in order to handle our testing. If someone else does your testing, you need to talk to them early and make sure they’re set up properly, or if you’re exchanging products back and forth,” said Mattoch.

As for handling equipment challenges, for some the task is as minor as defining a scanner. For others, it is about anticipating challenges with printers and short-staffed hours of operation. At Keesler Air Force Base, conducting process flow analysis and examining how ISBT 128 was going to fit into operations enabled Mattoch to assess practicality. “You have to think about where the printers are going to go because they take up a lot of room and they have to be stacked properly, and then you have to think about printer maintenance and things like that,” she said. “I realized that we only have one tech on in the middle of the night, and I only had one ISBT label printer and realized that if we’re busy, there won’t be time to change the ribbon on the printer, so I requested four additional printers and had to make room for them. We couldn’t have implemented successfully if I only had one printer.”

Recognizing that a small staff has many limitations, Mattoch said she opted to purchase her facility’s number sets rather than printing them off in-house. “It’s all about expediency and what’s going to work well,” she said. “I didn’t have a lot of people , and to me, it’s important to make sure the labels are legible, and without a lot of staff, I elected to purchase the unit number sets, and that ended up working fairly well.” Mattoch also discussed the use of on-demand or stand-alone printing. “Think about it when you are converting …

are you going to do all on-demand or a combination, and what's your backup?" she said. "Some places don't have the computer system, but they need to be able to print labels, so they go stand-alone. Some donor centers have on-demand and stand-alone for labeling their blood products, and I would say if you're going to go all on-demand, you need to be able to have backup."

Validation 101 and Going Live

Although there are a multitude of steps a facility must take before going live, another major hurdle before implementation is validation. "We've done a recent upgrade to SafeTrace, so we have written test cases to accommodate ISBT. Basically we can use this to tell us what is working and what isn't," said Mason. "We've printed labels with it, so that's done, but our biggest issue is using Digi-Trax print server and being able to figure out how much validation we have to do."

According to Sandoz, making sure products are scanning correctly was one of Island Hospital's biggest complications during validation. Once those issues were resolved, the blood bank coordinated with its supplier, Puget Sound, to go live. "Puget Sound established the 'go live' date, and then we worked out ours so that we could go live at the same time, which we did successfully," she said.

The processes and procedures for Keesler Air Force Base were similar. "We had our validation plan, and we had our test cases identified, and we proceeded with that. We had given the nursing staff at our hospitals a target implementation date, and once we finished validation, we were about ready to go," said Mattoch, who noted that one of the biggest lessons learned was the need to develop a realistic timeline for implementation. "We had to add some extra time because we went live with ISBT just after the war started in 2003, and when we started the implementation process we padded our timeline because we weren't sure what other challenges were on the horizon."

At San Bernardino, coordination of the facility's future "go live date" has been managed by a customer task force that continuously sends out updates and reminders about the targeted start date. "We have a few customers that are ready and can accept the products. But the smaller hospitals usually have manual processes anyway, so they're just going to have to adapt to the new unit number and the appearance of the label," said Mason. "But for those in the middle, we have to keep communicating about the start date. We do that by sending out the minutes from each our meetings so everyone knows what we've discussed, and any time we have an updated product list or a new code for a product, we send that info out via e-mail or postal mail."

You're Live! Now What?

Once a facility reaches its start date and officially goes live, the issue of dual inventory may become more readily apparent. Many facilities plan for this ahead of time. For Mason, major complications with an inventory of both ISBT 128-labeled units and Codabar-labeled units are not expected. "Right now it's not that difficult for us with SafeTrace because it will handle both systems. The one issue that we'll run into is how we're going to label some of our frozen red cells in inventory. When we're 42 days into it, we'll still have red cells and platelets, and we'll need to figure out how to flip our switch back and forth. This is because SafeTrace only allows labeling one or the other at one time," she said. "We'll get together with our labeling staff and product management staff and pick a time to flip back and forth because it will take a lot of coordination."

The Armed Services Blood Program was well-positioned from the start and was not forced to go to an ISBT software provider to gain the capabilities it needed.

"Our computer system already accepted both Codabar and ISBT, so it was pretty seamless," said Mattoch. "As for our frozen blood inventory that was Codabar, it wasn't a problem because we were going to have to stay in the Codabar business anyway because we still get Codabar blood from civilian facilities," she said.

Lt. Col. Michael Lopatka, deputy director of the Armed Services Blood Program Office, said dual capabilities is an important feature to have in a computer system. "I understand the fear of people who say, 'If I convert and I get blood from a Codabar facility, how will I continue to get blood from them?' My understanding is that any new system needs to be able to handle Codabar, and when you convert up, it should be able to handle both, which should eliminate any fear you have," he said. "We were really lucky that way back when someone decided that DoD was going to do this, someone in the blood program had the foresight to realize that we needed to have a system that could do both, especially since we exchange blood and maintain a frozen blood program."

Inventory issues after implementation can extend to customers who have preferences about whether they purchase blood labeled with ISBT or Codabar. "With the hospitals, basically the ones that aren't ready are going to be wanting Codabar, and we'll need to say that we're operating on a first-come, first-serve basis. We'll need to get our Codabar units out because the sooner we have just one

inventory the better," explained Mason. "We've done this once before when we weren't 100 percent leukoreduced, and we'd have to say, 'Okay, we have so many leukoreduced [units] and we have so many nonleukoreduced [units], but this hospital only wants leukoreduced and this one doesn't care.' Our product management staff has been dealing with that already." According to Mason, her facility already has a dual inventory because they are importing from Puget Sound. "We had to find hospitals that were able to accept those units. We're lucky that we're not outdating," she said.

Financing It All

Mason also was able to shed light on the issue of paying for ISBT 128. "The one issue that we did run into was the Digi-Trax print server," she said. "It wasn't clear to us up-front that we had to purchase that; we thought we could build our own." She explained that although the costs were not budgeted, "our executive team understood that this was a necessity and was really good about it." Mason noted that another financial issue for San Bernardino was simply how to move money around. "We went from buying preprinted component labels to purchasing blank stock; it wasn't a financial burden, just a change," she commented.

Assessing the Transition Process, Value

Reflecting back on the experience, Sandoz noted that converting to ISBT 128 was not as challenging as some might fear. "It's not a difficult job; it's just tedious because there are so many details to think about," she said.

Mason, on the other hand, noted that "the process is a lot of work even though we have a good understanding of why it was a good idea to go to ISBT. The biggest benefit is gaining more flexibility out of labeling." Relying on the wisdom that comes with working for a blood center for more than 22 years, she said her advice to other blood establishments is to emphasize communication. "We can only stress how important it is to have good communication and to constantly update your staff and your customers, being available for their questions, working with them to get through this," she explained. "Have a good team that's willing to do the work and knows the importance of the change."

Because all three branches of the armed services were fully implemented by 2006, the Armed Services Blood Program has had time to fully assess the value of converting to ISBT 128. As Lopatka noted, going through the process and analyzing the end result has enabled him to see how the technology improves standardization and predictability. "None of us in the blood community, however, will be able to see the full effect until everyone is using ISBT 128," he said.

Will RFID Help the Blood Community?

Case Studies on How Other Industries Have Successfully Used Radio Technology

By Al Staropoli
AABB Contributing Writer

When Marconi established the first transatlantic radio service in 1901, little did he know that radio would some day be used to keep track of people. As Orwellian as it may sound, dozens of patients with Alzheimer's already have been implanted with devices slightly larger than a grain of rice under their skin. By using a scanner that can detect radio waves, health care providers can now keep better track of individuals who may wander off and obtain valuable information, including their names and health records.

The technology, called radio frequency identification (RFID), is not only used in people. Millions of farm animals have been tagged to avoid health hazards such as mad cow disease. In the United States, RFID is still being explored for use in blood centers, but other industries are using RFID to keep track of millions of products from drugs to airplane parts.

Companies in the health care, retail and pharmaceutical industries have implemented RFID to various degrees. Their challenges and successes might provide insight into what the blood community may face if the technology is someday implemented on a large scale.

Birth of RFID

RFID is not a new technology. Its practical use began during World War II after the invention of radar. Radar helped spot planes at night or at a distance but could not decipher whether the planes belonged to friend or foe. To overcome this, the British began installing radio

transmitters on their planes that would send friendly recognition signals.

Since then, the technology has boomed and is widely used in many sectors. In fact, chances are you've probably used RFID. If you've ever waved an employee ID card through a reader, used a keychain wand at the gas pump or zipped through a toll using electronic toll collection, you've used RFID.

At the most basic level, RFID consists of a tag and a reader, much like a scanner and a bar code, but this is where the similarities end. "Bar codes are a one-way street," said Brad Moore, vice president of sales and marketing at Swisslog, a company that provides warehouse and distribution solutions. "They are not interactive like RFID that can have information added to it as it moves along, such as where it is, where it's been or how long it's been in a certain environment. RFID allows us to track larger pieces of information on the products moving through the system."

A bar code, for example, cannot tell how long a product has been stored at a certain temperature. In the refrigerated or frozen food industry this can be an important quality factor. Unlike RFID, bar codes have to be in sight to be scanned. With RFID, one can wave a reader and instantaneously gather information on every product inside a case without opening it. This translates into tremendous time savings as tens of thousands of products roll along the supply chain.

RFID tags come in two types: passive or active. Passive tags simply "reflect" back a signal to a scanner, while active tags include a battery and emit a signal to wireless infrastructures that can include antenna in the walls and ceilings of a hospital. Passive tags can be as cheap as 25 cents each but usually have to be scanned at a close distance, while active tags can cost $20 or more and can be read farther away. Tags like these have helped hospitals save money and improve services.

Health Care RFID

In 2006, Wayne Memorial Hospital in North Carolina began using RFID to keep tabs of high-ticket items such as infusion pumps, diagnostic machines, blood warmers and wheelchairs. A two-month study showed that only 50 to 60 percent of the infusion pumps were used throughout the hospital. When it came time to replace the pumps, fewer were ordered, realizing significant savings. So far, the system has saved nearly $300,000.

At the hospital, RFID tags in devices can be set by the nurses to indicate whether an item is in use, needs cleaning or is ready to be used. With hundreds of devices on the hospital floor in constant flux, it can become tricky to quickly find a device such as a wheelchair for an ailing patient. Before installing RFID, it took about 20 minutes to find a wheelchair compared to less than five minutes now.

In Virginia, the Bon Secours Richmond Health System now uses RFID to track more than 10,000 pieces of equipment across all its centers of care. The system has realized significant savings due to a reduction in equipment and fees to third parties for equipment management services. According to Agility Healthcare Solutions, the company that provided the RFID system for Bon Secours, the system has saved the hospital an average of $1 million per year over the past three years.

In Texas, the Heart Hospital Baylor Plano — which focuses solely in heart and vascular health care — uses RFID to keep track of expensive equipment such as drug-coated stents and pacemakers that can cost thousands of dollars. The system uses special cabinets throughout the hospital that are outfitted with RFID to hold tagged items. This allows physicians or nurses to know if an item is in stock and, if so, where in the hospital it is located, saving crucial time during surgery. The system also eliminates the need to maintain an excess inventory and alerts staff to order a device when the stock is getting low. But the system does not come cheap — in all it cost nearly $400,000.

At the Birmingham Heartlands Hospital in the United Kingdom, RFID patient bracelets have been used to prevent surgery mix-ups by matching the right patient to the right doctor. The technology also can help track each patient though the pre-surgery process, making sure all routine checks are carried out. In patients, RFID has some advantages over bar-code bracelets. RFID tags can be read from a distance without disturbing the patient and can be used in wet areas that could blur a bar code. RFID tags also are more resistant than bar-code wristbands, which can wear out after a few days.

One company is developing prototype RFID tags smaller than a lentil that can be inserted inside surgical instruments. Some surgical procedures, such as knee replacements, depend on surgical kits that have dozens of tools. With a quick scan the surgeon can make sure that all parts of the kit are there before surgery, avoiding the loss of precious time spent searching for a missing tool. The tags also measure temperature to see if the tool has undergone high-temperature sterilization. Another company has developed tags for surgical sponges that emit signals to prevent them from accidentally being left inside the patient during surgery. RFID tags have even been

developed to match mothers with their newborns.

According to a report by IDTechEx, an RFID consulting company, close to 10 million RFID tags were sold in the U.S. for use in health care in 2006. Nonetheless, relatively few hospitals and health care companies have adopted RFID.

One of the major barriers for adoption of this technology is cost. Bar codes, because they are simply ink printed on paper, are significantly cheaper than the electronic RFID tags. Specialized RFID readers as well as software also are expensive.

Another significant barrier is the lack of set standards for the radio signal frequency used in RFID. With different manufacturers selling equipment that works at different frequencies, there is corporate hesitation about investing in the "wrong" infrastructure, keeping many hospitals in a "wait-and-see" mode.

The Pharma Case

In 1987, the Prescription Drug Marketing Act required pharmaceutical distributors to document a drug's pedigree — or chain of custody of the drug — as a measure to certify the drug's authenticity and prevent counterfeits. In 2004, an FDA report recommended the use of RFID to establish electronic pedigrees for all drugs by 2007. In addition to helping with drug authenticity, establishing a unique product number through RFID at the item level could help track down individual drugs during a recall.

Individual pill bottles of high-value drugs such as OxyContin and Viagra are now tagged. The RFID tags track these drugs through a complex supply chain that includes vendors, storage facilities, transporters, distributors, clinics, physician offices and retail pharmacies. New requirements are being placed on the supply chain by states that also are calling for pedigrees. California, for example, has called for each pharmaceutical package to have a unique identifier tied to a unique pedigree.

Bar codes can track cases of these drugs, but they are not really practical at the item level. "If we have to read every bottle, and we're talking about tens of millions of bottles, we would have to open a case and pull everything out to read it," said Stephen Perlowski, vice president of industry affairs at the National Association of Chain Drug Stores. RFID tags are more efficient because they can be read at a distance, and there is no need to open a case to read every product inside it. Tags also are being developed that can measure temperature, location and time to allow for the safe delivery of temperature-sensitive pharmaceutical products.

Despite these advances, only a handful of drugs have been individually tagged with RFID. A 2007 survey of 143 companies in the pharmaceutical community by Health Industry Insights, a market research and advisory services firm, showed that only 16 percent of firms are currently evaluating the use of RFID, and only 3 percent have achieved widespread adoption.

There are a host of barriers for adoption, including standards. "We don't have enough standards completed in order to execute a full-blown solution at this time," said Perlowski. "We're getting close, but the industry has not resolved whether we are going with an HF or UHF frequency. In fact, we can't even agree on how to create a standard for serialized numbers. In the supply chain we want to see the National Drug Code, which identifies the drug, but some manufacturers don't want to provide that."

Companies also are working on security issues. With tags getting to the item level, inappropriate security would mean that a person could walk by with a reader and "see" prescriptions others may be carrying in their purse or briefcase. Overall, companies responding to the Health Industry Insights survey cited cost as the major barrier for adoption, followed by lack of a standard frequency and privacy concerns.

RFID in Retail

One of the most successful models of RFID use is at the retail level. According to IDTechEx, last year nearly 200 million RFID tags were sold to tag pallets.

Wal-Mart, which buys billions of dollars in goods annually, announced in 2005 that it would require its top 100 suppliers to adopt RFID to track pallets and cases. Target and Best Buy also have started to require some of their suppliers to use RFID tags.

"Wal-Mart is requiring tags at the case level for their over-the-counter medications to track the product from the point where it's shipped to the sales floor. They are finding value in RFID and have just announced plans to continue their rollout to cover more stores," said Perlowski.

In the U.K., the large retailer Marks & Spencer, which sells clothes and other products through hundreds of its stores, began in 2003 attaching RFID tags to paper labels in millions of their products. The company's goal is to achieve 100 percent stock accuracy by ensuring that the right goods and sizes are in stores to meet demand.

However, Marks & Spencer and Wal-Mart are different from most retail stores. "There's no distributor in the Wal-Mart supply chain. Vendors ship products directly from their distribution center to Wal-Mart's distribution center," said Perlowski. This means that only two, rather than dozens of companies, need to be outfitted and trained to use RFID. Marks & Spencer is even a simpler case, as the company only sells its own brand.

Some product manufacturers that supply retailers have found that tagging at the individual level is still unrealistic. "A lot of companies find that tags cost between a quarter and a dollar. In the food industry if we added 50 cents to every item, the cost of food would rise tremendously," said Pamela Stegeman, vice president of supply chain and technology at the Grocery Manufacturers Association. But she notes that other industries can justify the cost of even more expensive tags.

"In the aerospace industry it's good to know where parts of a plane are at all times. They're quite expensive so if one goes missing that could be quite a loss for a company," she said. "In the near future Boeing will use RFID tags for plane parts that will allow us not only to track them but include inspection data and alert us when the parts need maintenance. Industries that surround the Department of Defense also are using RFID because the products are so costly and need to be readily available," she added.

Stegeman noted that companies that work with liquids, such as beverages, face additional challenges. "The radio waves get distorted through liquids, so the reader may not be able to read the tag due to interference from the liquids," said she. Although some preliminary solutions have been applied, she believes this is one of the factors to consider for use of RFID in blood products.

"Over the next few years I think we're going to see a lot of tests. We will likely see more industries that have high-cost products begin using RFID. The learnings of these industries and the ability to reduce the costs of tags and readers will help propel its use in other industries," she said.

RFID and Blood Products

Although no blood centers in the U.S. have fully implemented RFID, institutions currently exploring the possibility of future use include the BloodCenter of Wisconsin, Carter BloodCare in Texas and Mississippi Blood Services. The University of Wisconsin-Madison RFID Lab is working closely with the BloodCenter of Wisconsin, which leads the effort.

"There are three reasons why a blood center should consider using RFID: improved safety, quality and efficiency," said Alfonso Gutierrez, director of the university's RFID lab.

According to Gutierrez, using RFID can track processes so that they are more accurate and secure as the product is manipulated from donation to distribution. "Deviations from processes can create a fair amount of investigation and documentation. Using RFID could reduce errors, resulting in higher quality products and savings in labor," he said.

To comply with an FDA requirement, the project is now testing whether RFID has any harmful effects on blood products. As part of the assessments, Gutierrez also is currently working on predicting a return on investment for those interested in adopting the technology.

"It's difficult to assess costs and benefits in general, but one of our assessments showed that for a blood center that collects about 230,000 donations a year, the time to recover the initial investment for this technology would be around four years," he said.

Gutierrez expects to have a complete ROI model that would assess operations of both blood centers and hospitals of different sizes by February 2008.

One of the project's goals is to create an RFID system that can track blood transfusions from "vein to vein," ensuring that the right patient is matched with the right blood. Another goal is to improve the safety of the product. While the current ISBT label holds the most important pieces of data, such as blood type and expiration date, an RFID tag could hold more information — including, eventually, temperature.

Gutierrez believes that using temperature tags would be financially feasible as the costs of these sophisticated tags go down, but temperature control can currently be achieved by other means, such as tracking when products go in and out of controlled

environments.

Adoption of systems such as these still face some barriers. “One of the challenges will be the integration of RFID with already existing hospital or transfusion management systems. RFID is a layer that needs to be integrated with the rest of existing technology; it’s not a stand-alone system. If you don’t have a way to transform the data collected with RFID into usable and actionable information, all you have is a very expensive data collection system,” said Gutierrez. “We’re not attempting to replace bar codes. We want to augment the existing system to increase the overall safety by having two redundant systems working together.”

Gutierrez believes that real adoption will begin when final users begin to require it, just as retailers have from some of their suppliers. “Adoption will happen when hospitals demand that the technology be part of the processes of all their suppliers. But there’s a lot of education that needs to happen. I don’t think that everyone in the health care industry is aware of the potential of RFID, but we are getting good traction so far,” he said.

On the technology front, Gutierrez is also optimistic. “At this point we can read the contents of a cooler with 25 standard-size blood bags in about five seconds,” he said. “This is a significant improvement over what we can do today with bar codes.”

Gutierrez expects the first pilots for use of RFID in blood centers to roll out by 2009, after the successful development of a prototype.