Chips with Everything

Is RFID ready for healthcare?

Colin Jervis, Director, Kinetic Consulting Ltd

Enthusiasts in healthcare fields suggest that one day a tiny RFID (or radio-frequency identification) tag implanted under your skin could transmit your NHS number and automatically record a comprehensive record of your care.' Members of staff, drugs and equipment could also be tagged, creating the potential to automate administration, reduce errors and improve security.

The current excitement about RFID has been fuelled by its popularity in the retail sector—where organisations like Tesco, Wal-Mart and Marks & Spencer are testing it for use in supply-chain management. With this technology, items can be tagged and, using radio transmissions, remotely identified by a reader–making tracking easy.

We have to ask, however, whether the technology is ready to be applied to creating the ultimate patient record ... or is it simply a technical solution looking for an operational problem?

RFID in a nutshell

RFID has two main components: a tag and a reader. Most tags have an antenna attached to a microchip containing a short identification number (see figure 1).

Tags can be active or passive. Active tags have a battery with a life of several years, a range of tens of metres and a larger data capacity than passive tags. Passive tags have no battery and use reader emissions to power a brief response, usually just an ID number. They have a short range—about 10 millimetres to 5 metres–and they can be small enough to implant under the skin.

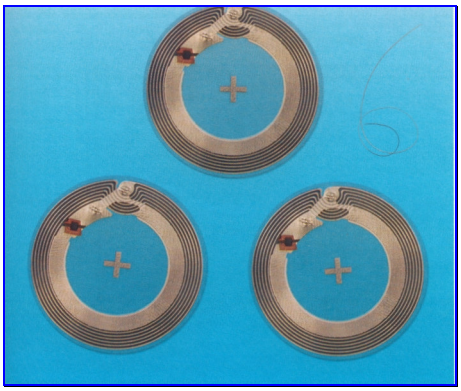


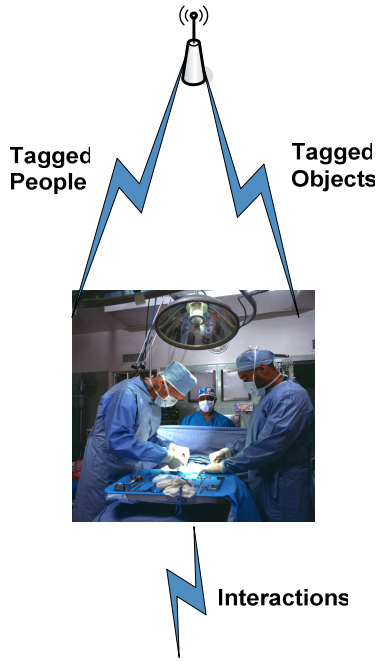
Figure 1 Passive RFID tags

An RFID tag differs from a barcode in that you can write to it and read it automatically without it being visible—it just has to be in radio range. You can also, in theory at least, read many tags simultaneously, at any orientation and in any environment.

Applications of RFID

RFID is not a new technology. It was used, for example, to identify friendly aircraft during World War II. Recent interest in the technology, however, is mainly due to the falling price of passive tags, which has made them attractive to high street retailers.

Tags may be applied to people and to objects, allowing readers on door frames, wards and treatment areas to detect and record interactions (see figure 2 for some of the potential applications of RFID in healthcare settings).



Identification and Verification	Tracking	Sensing	Interventions	Alerts and Triggers
Patient and Staff ID	Vulnerable Patients	Temperature	Automated Care	Blood Transfusions
Access and Security	Assets and Equipment	Pressure	Pathways	Drug Administration
Samples	Patient Flow	Failure or Fatigue	Procedures	Tubes Syringes
Pharmaceuticals	Supplies and Stock		Audit	
			Management	

Figure 2 RFID applications and potential

Suppliers already offer patient wristbands containing RFID tags (figure 3). These tags could interact with hospital information systems, allowing administrative tasks like admissions, transfers and discharges to be automated. The US FDA, meanwhile, has recently approved a tag called the VeriChip (www.verichip.com) for use in humans. These tiny tags could hold a full medical record and are being used to help make disorientated, elderly and high-risk patients more secure.

Tagged equipment can be easily located and managed. The Royal Sussex County Hospital in Brighton, for example, is piloting a system called Eureka in its equipment library—which is helping staff to track stocks of pumps, oximeters and heart and blood pressure monitors.

Figure 3 Suppliers already offer patient wristbands containing RFID tags

Though the tagging of objects and people is interesting, it is in the field of intervention-capturing that RFID has most potential.

Tag readers connected to security systems can help manage access: they can prevent equipment—and even vulnerable patients such as babies and children—from being removed without authority. The ELPAS system, for example, is being used to track patients in the Wirral Hospital NHS Trust emergency department.

In the US, the Massachusetts General Hospital is using RFID to prevent blood transfusion errors[2]. A warning alerts staff to possible mismatches and helps to prevent errors in busy areas such as operating theatres.

The pharmaceutical industry, meanwhile, is testing tags that will uniquely identify drugs. Such tags could also be used to alert staff to incorrect drug dosages or adverse reactions, reducing the potential for errors to be made.

Suppliers like MBBS are already incorporating RFID tags into instruments, and they could also be incorporated into prostheses, which would support the automated recording of procedures for audit, recalls and risk management. Eventually, cheaper passive RFID tags could allow all goods to be uniquely identified. Equipment, drugs, devices and staff could then be linked to the care record, allowing detailed care pathways to be created and managed.

Privacy concerns

RFID data can be secured by encryption and by careful design of transmission protocols. The limited range of passive RFID tags also deters snooping. Furthermore, some developing RFID standards include password protection for tag identification fields and allow a reader (at a checkout, for example) to erase all tag data.

Nevertheless, civil libertarians are concerned that patient tags could be read by snoopers and, together with data on tags on credit cards and other goods, could be used to identify patients and track them after discharge.

"There are obviously data protection and other privacy concerns at stake here", said Anne Crofts of solicitors Beachcroft Wansbroughs. "Anybody consenting to being 'tagged' should be fully and fairly informed about the nature of the data being collected, how it will be used, and by whom. There is also the human rights angle—a need to ensure that use of the tags is not an unwarranted restriction on the rights and freedom of individuals—a particularly difficult issue if the patients involved are not capable of consenting themselves, whether due to age or infirmity."

The combination of automation, integration, unique identification and increased accuracy offered by RFID—which has already drawn the retail sector—should also attract healthcare. Among potential benefits are reduced administration time, the automation of laboratory procedures and better management of supplies, stocks and equipment. There could also be a marked reduction in clinical and procedural errors and a more comprehensive bank of information available on treatment and resource use.

Case Study: tagging newborns

South Tyneside Healthcare Trust is using an RFID-based system developed by Concourse Systems to help make newborn babies more secure. At birth, mother and baby are given passive RFID tags with the same ID number. Ward security systems are integrated with RFID readers at the exits to the postnatal ward so that exits can be locked if a baby is being removed without authority.

"The system is overridden by a fire alarm and the doors can also be opened by entering a pin number or using a door key", said Mike Cox, Head of Biomedical Engineering. "The system is also used for managing ward assets—anything that might 'walk' can be tagged."

Mike had to fine-tune antennae on doors, because at first tags at certain orientations were able to pass through the field undetected.

Mike estimates that the system might cost £50,000 to replace. Passive, writable, glass RFID tags for the system cost £9 each, but are reusable. The door readers, meanwhile, cost about £2,000 each.

A proposal to use a similar system to make elderly patients safer was eventually turned down by the Trust, because it would have restricted personal freedom.

Benefits and costs

Though the potential benefits are great, care must be taken to estimate the full costs of RFID implementation. The price of passive tags depends on the frequency at which they operate and their functionality. Basic passive tags cost about 75p each when bought in small volumes. Writable tags operating at higher frequencies can cost £10 or more. Doorframe readers cost about £2,000 each and handheld readers, £170.

Some of the largest costs, however, are likely to be:

- middleware and systems integration;
- installation and cabling;
- implementation and training;
- extra storage and data management; and
- consultancy and project management.[4]

Other considerations

Existing methods of auto-identification, such as barcodes, are still sound. They are well established and have standards, and many healthcare organisations already have the equipment to read them, which is more than can be said for RFID.

Some early users have reported difficulties in tuning RFID and in finding the technical architecture to support it. Transmissions can be absorbed by humidity and by the wood on pallets and can be distorted by emissions from other equipment.

Ultra High Frequency (UHF) tags are now available and they have a range of up to two metres. Further, Ultra Wide Band (UWB) for RFID is now approved in the US and is likely to be approved in Europe. UWB can transfer vast amounts of data at low cost.

Passive RFID tags have a short range and this may make automatic reading in wide hospital corridors and wards impractical. Furthermore, comprehensive passive tagging of goods by suppliers is unlikely until tag failure rate and price have fallen even further. Even if the large-scale recording of interventions in the NHS were feasible, it could generate terabytes of data a day. The costs of storing and managing such data volumes would need weighing against potential benefits.

In summary, there appear to be many good reasons for early adopters of RFID to explore its potential applications within a healthcare setting, though it is clearly not yet time to bin the barcode.

Acknowledgements

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