

Technology Solutions to Patient Misidentification

Report of Review

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Document Control

Client

This document has been prepared for the Australian Commission on Safety and Quality in Health Care.

Document Purpose

The purpose of this document is to provide a summary of the position current in Australia at the time of this Review of Technology Solutions to Patient Misidentification.

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1. INTRODUCTION AND SUMMARY

1.1 Background to the Review

1.1.1 The Project

The Australian Commission on Safety and Quality in Health Care (the Commission) has, as one of its priority areas of work, a Patient Identification Program directed at the continuing problem of patient misidentification.

Throughout the healthcare sector, the failure to identify patients correctly and to correlate that information to an intended clinical intervention continues to result in wrong person, wrong site procedures, medication errors, transfusion errors and diagnostic testing errors.

This project investigates the current use and potential benefits of technological solutions to patient misidentification in the Australian healthcare setting and its application to safety and quality to the Commission.

1.1.2 Project Objective

1. To provide information to health departments and healthcare providers about the current status of work in this area.
2. To inform the Commission about work it could undertake to support the use of technology to reduce patient misidentification.

1.1.3 Project Scope

The project focussed on technologies which are specifically applicable to an inpatient hospital environment but which could be applied to an outpatient and community environment. The focus of the study was directed at technologies aimed at ensuring a consistent identification of an individual throughout the patient journey, as against absolute identification of specific persons. While a range of sophisticated, if relatively expensive technologies are becoming available for identifying individuals, the review concentrated on readily available and relatively cost effective technology.

1.2 Structure of the Document

This review comprises

- Section 1: general information about this review and a summary of key findings.
- Section 2: a strategic perspective that describes the framework for an analysis of how and where patient misidentification occurs in the patient journey.
- Section 3: a concise overview of the technologies currently being used or envisaged for patient identification.

- Section 4: a description of those critical points in the flow of information throughout the patient journey, the points of vulnerability for patient identity information, and the technologies that may provide a solution to the problem of patient misidentification. The section includes a series of scenarios which give examples, at each critical point, of potential uses of the technologies.
- Section 5: a selection of current specific initiatives in the application of technological solutions to patient misidentification.
- Section 6: an outline of the risks of, and inhibitors to, introducing technologies to address patient misidentification.
- Section 7: sources of relevant standards.
- Section 8: appendices that include findings on patient misidentification from NSW Health and a list of references.

1.3 Current Situation and Key Findings

1.3.1 The current situation across Australia

The current situation in Australia for the use of technology for solving the problem of patient misidentification is similar to the situation to be found in many other developed countries. 'Islands' of technology exist whereby particular institutions or jurisdictions have introduced various technologies at specific points in the patient journey and/or to solve specific problems. While the technologies tend to be similar in nature, utilising barcodes and/or radiofrequency identification (RFID) tag technologies associated with wristbands, it is not the case that a strategic, or system-wide, approach is yet being taken to patient identification. That said, progress is being made to introduce standards and policies.

The range of initiatives being introduced across the health arena, such as the Ensuring Correct Patient, Correct Site, Correct Procedure Protocol, highlights the need to address the problem of patient misidentification. A significant ongoing development is the commitment to specifications for a standard patient identification band by the Australian Health Ministers Conference, endorsed in July, 2008. From a technology point of view, this standard focuses on the wristband, including the dataset to appear on the band, colour of band, etc. It is important to note that this standard will include the requirement for space for a barcode on the wristband.

In terms of technology deployment, a broad pattern can be discerned:

- **Barcode technology** is being deployed where the purpose is to tie items and documentation to a particular patient, for example, the prescription through administration of medication, the ordering and reporting of tests and the provision of blood.
- **RFID Tags** are being deployed where the prime purpose is to track the patient themselves, for example neo-natal and geriatric environments.
- **Biometric technologies** (e.g. iris scanning) are being deployed where precise identification of an individual is required, for example in methadone distribution situations.

Many correspondents who were contacted during the study expressed the view that interest in deploying technology for patient identification has reached a critical point, wherein a significant number of projects will move from the planning stage to implementation.

1.3.2 Key findings from experience to date

Industry experience in the implementation of technological solutions for patient identification has highlighted a number of issues:

- Diligent execution of appropriate process/workflow remains the key aspect of patient identification. Technology is an enabler, not a sole solution.
- To be successful in the long term, implementation implies ubiquitous deployment of the technology throughout the patient journey.
- The importance of formally developed corporate implementation strategies, planning, and process scoping should not be underestimated.

2. FRAMEWORK FOR ANALYSIS

This section describes the contexts in which patient misidentification occurs, discusses the high risk points in the patient journey, and highlights the critical information flows of patient identification information during the patient journey.

2.1 Patient Identification Errors

Patient identification errors are associated with harm, or the potential for harm, when incorrect information is used to link a particular individual to an action or activity. Therefore the patient safety risk associated with patient identification can be considered as a mismatching between a given patient and their care. These errors can occur in all types of clinical activities, whether they are diagnostic (such as radiology or pathology testing), therapeutic (medication administration, surgery) or supportive (such as patient admission processes).

Patient identification errors can be characterised as being caused by:

- The identity of the patient not being clearly established, such as when one patient is mistaken for another, and / or
- The nature of the intended care (including procedures / treatments / medications) is not clearly established, which may result in the correct procedures / treatments / medication not being applied to the correct patient.

For these errors to be minimised:

- Every patient must be uniquely identified in an unambiguous manner.
- This identification must be maintained consistently throughout the period of care.
- Each procedure / treatment / medication must be uniquely identified in an unambiguous manner.
- This identification must be explicitly tied to all requests, medications, procedures, devices, etc applied to the patient.

At critical steps in the patient journey, there are points where these processes are vulnerable to patient misidentification.

For any misidentification event within the patient journey, the components are

- A cause of the misidentification.
- An effect of the misidentification.
- A level of severity of the effect in terms of patient safety.

- Points where technology can be applied in order to reduce the possibility of identification errors.

The following diagram summarises the components of a misidentification event and the place of technology.

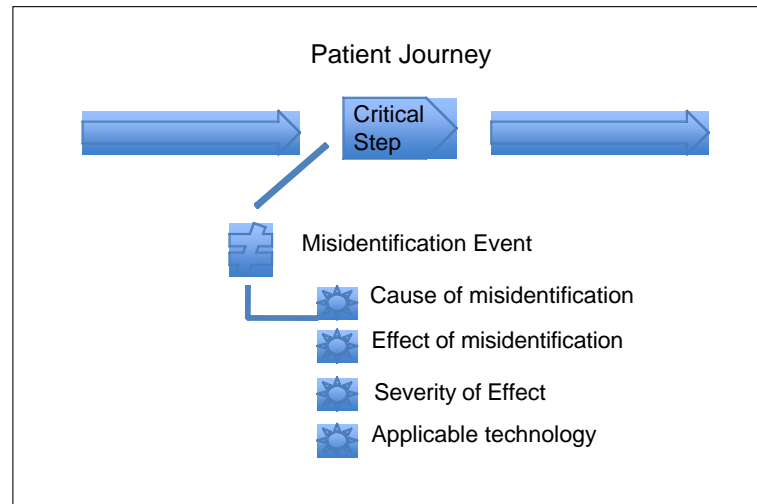


Figure 1 – Misidentification in the patient journey

2.2 The Patient Journey

When individuals enter a clinical care setting, they commence a series of steps along a continuum of patient care that is described as the 'patient journey'. The steps in the patient journey are usually sequential but can often occur in parallel (and can sometimes be repeated within the same journey). The journey begins with patient admission and usually concludes with discharge. In between these two episodes, the patient and the healthcare facility systems interact: care procedures are performed and information is produced and recorded.

At each new step in the patient journey, the individual (and the information about them) engages with:

- A new set of care providers. For example, the triage nurse passes care over to the registrar who then admits the patient. Admission is processed and recorded by clerical and nursing staff.
- A new system. For example, the patient is moved from emergency to the ward, at some point going via the x-ray department. Subsequently, the individual undergoes surgery and receives medication. These processes often have their own, specific, information systems.
- New information. With each new engagement, documentation relating to the care of the individual is received, requested, and/or generated. Based on this information or documentation, decisions about the individual's care are made and processes are initiated.

The steps within this journey describe the path of the patient through their encounter with the health system. The steps also highlight where there may be points of vulnerability to patient identification errors. The different stages of the patient journey point to intersections between patients, healthcare staff, and organizational and information systems where mismatching can occur.

Across all of these stages it is crucial that the identity of the patient is maintained, and that this identity is correctly matched to the intended care.

The following diagram illustrates the framework of the patient journey that is used in this review, together with the key points of intersection between patients, staff, and systems where patient identification errors can occur.

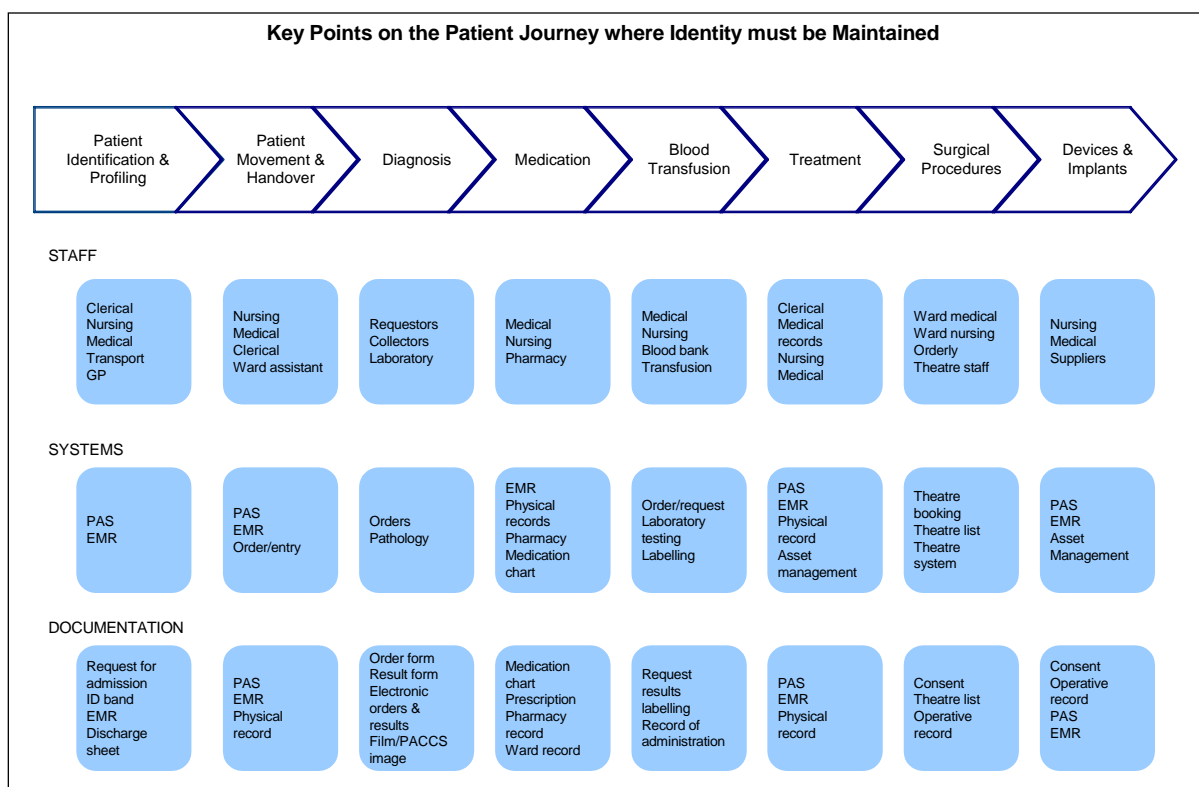


Figure 2 – Key points of identity in the patient journey

Technological solutions can be applied to address problems of patient misidentification at the critical steps in the patient journey, i.e. at each occurrence of the patient's engaging with a new process or system.

2.3 Flow of Patient Identification Information

Errors regarding the mismatching of patients and their care can be seen as the result of an error in the accuracy or transmission of patient identification information. These errors occur within the information flows implicit in the progress of the patient journey. Using this framework it is possible to identify points where the risk of patient identification errors may be particularly high. Particular points of concern are those where:

- A patient's identity is not correctly documented. This will typically occur upon initial registration where the patient is linked to an incorrect medical record number or other identifier.
- A patient is moved from one location to another or from one practitioner or treatment team to another, (e.g. from ward to operating theatre).
- A procedure / medication / test / treatment is not tied to the correct patient. This can occur at the point of requesting a procedure / medication / test / treatment, at the point of applying the procedure / medication / test / treatment, or at the point of returning the procedure / medication / test results / treatment.

All of these high-risk steps are characterised by the potential for the patient's identification to be separated from either the patients themselves or from other aspects (e.g. medication, diagnoses, etc) of their care. Throughout the patient journey, information flows from the patient, or the patient's immediate environment (e.g. a nurse), to a third party (e.g. a pharmacy or theatre). Information then flows back to the patient's environment from the third party.

To avoid the risk of misidentification, the identity of the patient must accompany any information flowing from and to the patient's environment.

The following diagram illustrates the flow of information between the patient's environment and the various environments where care is delivered or planned (the diagram shows only a selection of the information flows that could occur in a particular patient journey).

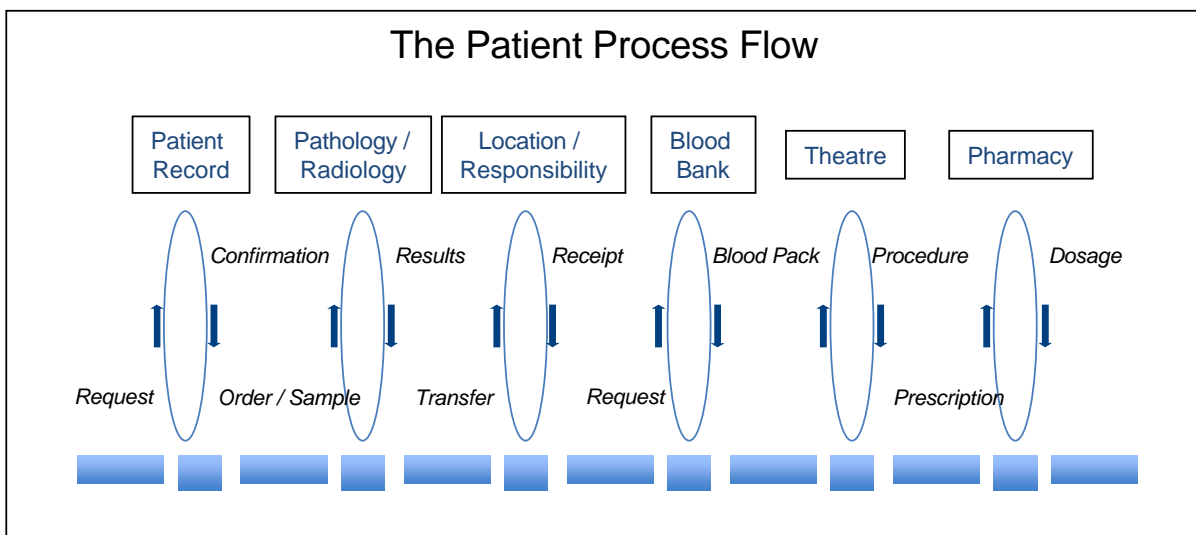


Figure 3 – The patient process flow

As the flow of information proceeds over the course of the patient journey, there are critical points of vulnerability for patient mismatching, along with the potential to use technology to prevent these errors. These are discussed further in Section 4.

The following section describes the most common technologies that are being employed in this area.

3. OVERVIEW OF CURRENT AND EMERGING TECHNOLOGIES

This section gives brief descriptions of current and emerging technological solutions to the problem of patient misidentification. Each description is accompanied by a listing of the benefits of each solution and of the risks and/or limitations associated with it.

3.1 Wristbands

The wearing of plastic identification bracelets (wristbands) is the accepted practice for patient identification in Australian healthcare settings. The information on the patient wristband varies but usually includes, at a minimum, full name, date of birth, and hospital number. Wristbands are sometimes colour-coded to indicate special conditions, such as allergy, pregnancy, diabetes, and so on.

In July, 2008, Australian Health Ministers agreed to adopt specifications for a standard white patient identification wristband and to standardise the information placed on it.

While convenient and widely used in health care, errors involving wristbands play a role in patient misidentification. In a 12-month study conducted for the UK National Patient Safety Agency in 2006, more than one in 10 reported cases of patients “being mismatched to their care” were related to wristbands. Such mismatches occurred in more than 2900 of the total 24,382 reports of patients receiving the wrong care from February 2006 to January 2007.¹

Benefits:

- Portable.
- Cheap.
- Legible to all parties, medical and nursing staff, patients, and relatives.
- Generally easy and quick to attach.
- Widely accepted.

Limitations / Risks:

- Can be difficult to fit to newborns, obese patients, patients with an allergy to plastic.
- Wrong wristband can be attached to patient.
- Missing or incorrect information can lead to misidentification.
- Not all patients are given a wristband, e.g. emergency room, some outpatients.

¹ Mayor, Susan. (2007) *Hospitals must standardise patients' wristbands to reduce risk of wrong care*. *BMJ*. March 13; 318(7185): 692.

- Colour coding is not standardised at present and varies from one setting to another, sometimes resulting in confusion for staff.
- Not universal: e.g. psychiatric patients often do not wear wristbands and emergency departments (which order many diagnostic services where identification is essential) do not usually give patients wristbands.
- Patient refusal. Whilst there is a high level of acceptability by hospital patients, for patients cared for in the community, wearing a wristband could adversely affect their privacy and dignity.
- Easy to remove or fall off.
- Illegible when not printed correctly or with printing that is difficult to read.
- Vulnerable to damage by contact with water or other liquids.
- Difficult to apply in some medical conditions or treatments.
- Not yet standardised.

The advent of new technologies, such as barcodes, radio tags, and biometry, for matching patients to their care will not, however, make the wristband redundant as a device for patient identification. Generally, these innovations will enhance its role by including these technologies in the band. These enhancements will make it increasingly important that hospitalised patients wear wristbands.

Compliance with procedures for producing and attaching wristbands and for verifying the accuracy of the information thereon is crucial to the correct identification of patients. All technology needs to operate within an environment of safety awareness and on its own cannot replace best practice in these processes.

3.2 Barcodes

Barcoding, using adjacent bars and spaces to present information², is the most familiar form of identification (ID) coding technology. Attached to a wristband, identifying information about the patient and their care may be contained in or accessed through the machine-readable barcode on the wristband. A biometric patient identifier, such as an iris scan, could also be coded into a unique number and worn as a barcoded wristband.

Barcodes are typically used with a database application, where the information encoded in the barcodes is used as an index to a record in the database that contains more detailed information about the item (in this case the patient ID) that is being scanned.³

² C A Ranger, S Bothwell (2004) *Making sure the right patient gets the right care*. Qual Saf Health Care;13:329.

³ Egan, Marie T. and Sandberg, Warren S.. (2007) *Auto Identification Technology and Its Impact on Patient Safety in the Operating Room of the Future*. Surg Innov; 14; 41-50

Barcode applications in health care typically have used one-dimensional (1-D) linear barcodes, similar to those used in the retail sector. Gaining wider user acceptance are two-dimensional (2-D) barcodes that contain more information than conventional 1-D barcodes. Conventional barcodes get wider as more data is encoded. 2-D barcodes make use of the vertical dimension to pack in more data. Using 2-D barcodes has become possible as auto scanning 'charge coupled device' (CCD) and laser scanners have replaced the original 'light pen' type of scanner.

At this time, most conventional CCD and laser scanners cannot read 2-D barcodes but this is likely to change with the introduction of relatively low cost combined 1-D/2-D scanners.

Benefits:

- Simple to use.
- Well known 1-D barcode technology; 2-D barcodes are reasonably well known.
- Inexpensive method of encoding text information.
- Easily read by inexpensive electronic readers.
- Data can be collected rapidly.
- Extreme accuracy: automatic input means that the potential for errors from entering data manually is eliminated.
- Quick and error-free means for inputting data into an application running on a computer.
- Easy to copy / print.
- New 2-D barcodes have the capacity to encode a lot more data than is possible with the more familiar 1-D barcodes.
- 2-D barcodes: Local data rich, (i.e. substantial amount of data can stored on the barcode itself) and remote data rich (i.e. barcode can link to stored information in another data source).

Limitations / Risks:

- Barcode reader requires line of sight.
- Illegible to staff, patients, and relatives; thus misidentification not readily recognised manually.⁴
- Limited data capacity, especially with 1-D barcodes.

⁴ Clement J. McDonald (2006) *Computerization Can Create Safety Hazards: A Bar-Coding Near Miss*. [Ann Intern Med](#);144:510-516

- 1-D barcodes: Local data poor (i.e. limited amount of data can be encoded in the barcode itself) / remote data rich.
- 2-D barcodes require a special reader and line of sight.
- Requires the reader machine to be located with patient: implications for space, portability, mobility, and convenience.
- Cost. While having a low unit cost, the number of readers required to give ready access over an entire establishment can be significant.
- Potential for physical difficulties in gaining a line of sight for the barcode reader in some departments. Examples include Intensive Care, where patients have numerous lines and monitors attached, and neonatal wards, where the size and the curvature of the infant wristband can be too small to allow the barcode to be read.

3.3 Radio Frequency Identification Tags

Radio frequency identification (RFID) uses radio frequency transfer of data between a reader and a tag. The tag can be attached to the wristband or inserted under the skin. The system consists of a transponder, or tag, that transmits a signal and an antenna and transceiver that read the signal and transmit it to a server. Radio frequency identification uses the radio frequency portion of the electromagnetic spectrum to transmit signals. The tag contains radio frequency circuitry and memory containing the data to be transmitted. Whether or not the tag has a power source determines the category of RFID in use - passive, semi-passive, or active.

Passive instruments are capable of short-range transmission only when activated by an external energy source, such as a radio transmitter. The information stored on a passive RFID appliance cannot be edited or changed. It may be accessed by exposing the device to a predetermined radiofrequency at a sufficiently close range. The device converts this external energy into a signal that can be received and translated by the transmitter. The information thus captured is specific to the person carrying the appliance or to the device to which it is attached (such as a surgical sponge).⁵

Active RFID devices use battery-powered tags that transmit radio signals over distances of about 10 metres. They provide time and location data in real-time.

Semi-active devices use battery-powered tags but must be activated by a passive reader. They operate over a longer distance than an active RFID.

In 2004, the United States Food and Drug Administration approved a (passive) RFID device that is implanted under the skin of the upper arm of patients and stores the patient's medical identifier. When a scanner is passed over the device, the identifier is displayed on the screen of an RFID reader. An authorized health professional can then use the identifier to access the patient's clinical information, which is stored in a separate, secure database.⁶

⁵ Levine M, Adida B, Mandl K, Kohane I, Halamka J (2007) *What are the benefits and risks of fitting patients with radiofrequency identification devices?* *PLoS Med* 4(11): e322. doi:10.1371/journal.pmed.0040322

⁶ *ibid*

Benefits:

- Can provide an ID unique to a particular person or object.
- Remote data rich: links the patient ID to other data sources, e.g. patient record, treatment, surgery, medication, test results.
- Enables tracking of patients across sites of care: the medical record hence is available in inpatient, surgical, outpatient, laboratory, pharmacy, and emergency department sites.
- Potential exists for a patient-controlled health record after discharge for patients in the community. The patient with an RFID can assemble a reconciled medication list, a complete problem list, and a list of diagnostic study results, and then apply personal privacy preferences. This patient-controlled record is then available to treating clinicians in the case of emergency, possibly via an implanted device.
- The RFID reader does not require a line of sight.
- Can be used for personnel tracking, so enabling the nearest staff member to attend a patient.
- Object tracking function adds the potential to develop an environment in which automatic patient identity (and by extension access to associated electronic patient data) and automatic inventory replenishment bring together data and material at the point of care, where the providers of patient care are most in need of them.⁷ The inventory items include treatment items such as medication and dressings but potentially also items (from an automated inventory-replenishment cabinet) for patient comfort or refreshment.
- Tags are reusable.

Limitations / Risks:

- RFID is orientation dependent, particularly the passive RFID systems.
- Requires magnetic induction between the reader and the tag to supply power and receive signals from the tag.
- Logistics: reusable tags need to be collected, cleaned, and reassigned to new patients. Tag assignment requires that the tags first be dissociated from the previous patient in the system database. Assignment to a new patient requires manual data entry at a personal computer and provides an opportunity for data-entry error, as the hospital record number is typed in along with the tag identification number.
- Comparatively higher cost than barcodes.
- Difficult to make copies or print from if required for transmission offsite.

⁷ op cit. Egan (2007), p. 46

- Local data poor.
- Added burden that the higher volume of data and database linkages for the enterprise's computing infrastructure to maintain and manage, especially with real-time active RFID systems.
- Does not provide absolute unique identification: at the present time, not all RFID tags have globally serially unique identifiers. An ISO standard is being developed to address this.⁸

Specific limitations of passive RFIDs:

- Short read range.
- Very limited data capacity.
- Location and time tracking data is only as good as the last read, due to their 'passive' mode.

Specific limitations of active RFIDs:

- Battery life is limited, reducing the life of the tag, although newer tags have up to 4 years life.
- Blocking of radiofrequency signal can occur.
- Tag cost and size.
- Some require infrastructure.

Specific limitations of semi-active RFIDs:

- Same cost and battery issues as active tags.
- No location data-portal application.

Specific limitations / risks of implanted devices:

- Public interest groups' concerns about the informed consent, privacy, and access issues raised by the storage of personal data in implanted RFID systems, in particular the tracking of individuals in the community.
- Implanted device can activate retail security and monitoring systems.⁹

⁸ ISO/CD 15963.1 (2008) *Information technology – Radiofrequency identification for item management – Unique identification for RF tags.*

⁹ op cit. Levine et al, p. 1710

3.4 Biometric Devices

Biometric devices use automated methods of identifying or authenticating a living person based on physiological or, less commonly, behavioural characteristics.

Common biometric approaches include the recognition of fingerprints or thumbprints, hand or palm geometry, the retina, the iris, or facial characteristics. Biometric security applications use devices to capture, and computers to process, these characteristics in order to confirm or determine the identity of an individual. Iris-based biometry is marketed as an acceptable, non-invasive method of identification; the literature reflects some use in research, rather than clinical, settings.¹⁰

Despite the volume of biometrics marketing information, a search of the peer-reviewed literature revealed no studies of its application in clinical or hospital settings, apart from ophthalmic uses of iris-based biometry and methadone outpatient programs.

Benefits:

- Quick.
- Accurate.
- Requires minimal training.
- Non-invasive.
- Simple technology involved, e.g. laptop and camera for iris recognition.

Limitations / Risks

- Expensive option.
- Applications generally not yet ready to be implemented on a large scale; applications currently in use are generally local stand-alone systems.
- Concerns over informed consent, privacy, secondary uses.
- Cumbersome to use in some settings, e.g. to set up and access the equipment for fingerprint capture and reading.
- Iris recognition is not as useful with children due to their inability to hold the head in position for the camera.
- Iris recognition can be affected by cataract surgery.

¹⁰ Corby, Patricia M. (2006) *Using Biometrics for Participant Identification in a Research Study: A Case Report*. *Journal of the American Medical Informatics Association* 13: p.233

3.5 Wireless Networks

Although not a specific application for patient identification, wireless networks (also Wireless Fidelity or WiFi) have the potential to provide a platform for RFID devices that can be used to identify and track patients.

With WiFi networks quickly becoming ubiquitous, the opportunity to use the infrastructure for location determination and identification presents itself. Every wireless access point (WAP) broadcasts a unique signal that can be used to differentiate it from other WAPs. Either WiFi-based active RFID tags or WiFi devices themselves can send out a wireless signal at regular intervals. The signal is picked up by a WAP and sent to a location engine that uses algorithms to determine the transmitter's location. Location resolution is accurate to the nearest WAP. Thus, a very dense WAP network could probably provide room-level resolution, involving the use of PDAs, laptops, or other screen-based equipment. This may be adequate for most identification and tracking purposes, with the added advantages of using a multipurpose infrastructure.¹¹

Benefits:

- Multipurpose platform: provides information management, access, and input across multiple functional areas.
- Operates in real time thereby ensuring up-to-date 'snapshots' of patients with locations or procedures.
- Accuracy associated with the unique signal technology.
- Accuracy associated with nursing staff using screen based information from doctors instead of handwritten notes.
- Accuracy associated with screen based information available at shift handover.
- Safe. The UK Health Protection Agency has said that sitting in a WiFi hotspot for a year results in receiving the same dose of radio waves as making a 20-minute mobile phone call.

Limitations / Risks

- Involves whole-of-enterprise support and change management.
- Involves substantial whole-of-enterprise funding.
- Radiation fears (although emissions are lower than mobile phones and there is no evidence base for fears).
- Ubiquitous nature raises some ethical and privacy issues.

¹¹ op cit. Egan (2007), p.43

3.6 Patient Smart Cards and Digital Images

The idea of a medical record on a patient-carried “smart card” is an older one and now is less frequently mentioned in the literature about patient identification. It is generally not a viable stand-alone solution to the problem of patient misidentification but can still form part of a complementary system when used in conjunction with other identifying methods, such as a digital image or swiping a barcoded card over a barcode reader.

Benefits:

- Cards can provide a genuine solution for outpatient care regimes as long as other identification verification is integrated into the hospital system.
- When a digital image is included on the card, it provides quick and easy identification. Digital cameras that can also read a barcode are relatively cheap technology, the images are easily produced onto the cards, and the image file can be retained and used in other systems.
- Emerging technologies with smart cards allow them to store demographic and clinical data that can be accessed and, if required, amended by the patient
- A patient-carried card system could complement the patient record in the community based system or hospital that the patient attends.¹²

Limitations / Risks

- The smart card is less reliable for medical record data storage because cards can become separated from patients and because many kinds of clinical results - radiology reports, referral notes, laboratory reports - are produced after the patient and the card have left the medical office or hospital.
- Any card-based solution requires some form of centralised and standardised medical data storage from which the patients or their carers could download any results and create new copies of their medical record to replace lost or damaged ones.

3.7 Packaged Software Systems

Previous sections have profiled specific hardware technologies. To operate, these technologies require software support. This may involve varying levels of complexity, from ‘drivers’ which enable various devices to communicate with computer systems to special purpose software packages designed to manage aspects of patient care specifically using patient identification technologies. Some examples of such systems include patient identification packages using barcodes with modules for medication administration, specimen collection verification, and transfusion verification; barcode patient point of care (BPOC) medication and specimen management systems; and computerised physician order entry (CPOE) which automates the medication ordering process.

¹² Hildebrand C, Pharow P, Blobel B. (2008) *The role of patients and their health cards in integrated eHealth environments*. *Stud Health Technol Inform* 136:629-34

3.8 Technology Comparison Table

This table summarises the main features of current and emerging technologies that are being applied to the problem of patient misidentification.

Technology	Characteristics	Advantages	Disadvantages	Potential Patient ID Use
1-D barcode	Alpha and alphanumeric data, 20-30 characters.	Inexpensive, ubiquitous.	Limited data capacity; reader requires line of sight. Not designed for long-term use in harsh environments.	Patient identification bands. Drugs tracking. Specimen tracking.
2-D barcode	100-2000 characters.	Can hold large amount of data.	Requires special reader and line of sight. Not designed for long-term use in harsh environments.	Patient identification bands. Patient identification bands. Drugs tracking. Specimen tracking
Wireless networks (WiFi)	Uses wireless technology for location; can locate personal computers, handhelds, and RFID tags.	Multitasking; global trend to ubiquitous deployment of networks.	Radio frequency can impact performance; security issues, including potential privacy issues.	Hospital information system data communicated to PDA's, laptops, and computers on wheels.
Passive RFID	32 – 16000 characters. Label is energised by a reader and transmits data to a reader.	Relatively small and inexpensive.	Short read range; very limited data capacity; does not provide unique identification; location and time data only as good as last read.	Staff and patient identification; medium and large sized items such as implantable prostheses, blood products.
Semi active RFID	Battery-powered tag; passive reader activates tag.	Longer Range (~ 12 metres).	Same cost and battery issues as active tags, but no location data.	Passive RFID features plus storage of other information, e.g. medical condition, treatment.
Active RFID	Battery powered tag that transmits radio signals.	Provide identification and location; long range ~10 metres); real time data.	Tags need batteries; battery life; blocking of RF; tag cost and size; some required infrastructure.	Semi-active RFID features plus location in time and space of people and items.
Biometrics	Major technologies include iris recognition, Fingerprint, hand geometry and facial recognition.	Can provide high degree of certainty as to identity of specific individual.	Can be intrusive; some technologies require physical contact (hygiene issues). High cost can be a factor.	Identification of specific individuals.
Digital image	Camera captures image to file and produces hard copy (on card if required)	Quick; easy visual identification	Easily separated from patient.	Patient ID, Smart card, hospital bed label/clipboard. Use in inpatient, outpatient, and community.

4. CRITICAL POINTS ALONG THE PATIENT JOURNEY

Most patients interact with multiple departments or services over the course of a hospital stay; the concept of the ‘patient journey’ is used to reflect the interaction with multiple departments or care teams over a period of time.

Patient journeys are characterised by transition of care from one care team to another. These transitions could include, for example, a transition from an Emergency Department or operating Theatre to a ward, a blood sample to pathology, or a patient to radiology. If identification is not accurate, each of these points of transition carries a risk that an error could occur.

The following section looks at steps in the patient journey describing where current or emerging technologies can provide solutions to problems of patient misidentification. For each of these steps, information is provided about the patient identification risks within the step, the technologies that apply, any specific considerations that might need to be noted, one or more example scenarios of potential applications, and design issues that need to be taken into account.

4.1 Patient Identification and Profiling



Patient registration, which includes patient identification and profiling, marks the beginning of the patient journey. This process includes ensuring that the patient’s ‘absolute’ identity is discovered and documented, confirming that ‘the patient is who he says he is’. While establishing ‘absolute’ identity is not the focus of this review, it nevertheless needs to be acknowledged as a critical first step to ‘get right’ in the flow of patient identification information.

The general practice is often the starting point for the patient journey and the processes conducted at this point are generally comparable to hospital admission procedures. As such, studies of general practice registration errors can provide useful examples of the type of patient misidentification errors that can occur at this initial encounter of the patient with the system.

The Threats to Australian Patient Safety (TAPS) Study, conducted in 2003, was surveyed a representative sample of Australian general practitioners. Among other issues, it collected reports of system administration errors, including patient identification and registration. The study reported that errors at the point of patient registration chiefly related to patient medical records or to practice filing systems.¹³

Examples of the types of patient identification errors involving record and filing system that were reported in the TAPS study included:

- Failing to record patient contact details.

¹³ Makeham, M., Bridges-Webb, C., Kidd, M. *Lessons from the TAPS study; Errors relating to medical records.* *Aust Fam Physician* 37, (4), April 2008 243-4

- Having outdated patient contact details in the practice records.
- Having multiple records for the same person.
- Filing results or correspondence into the file of a different patient with a similar name.
- Recording details of a consultation in the wrong patient's file, especially in the electronic medical record of the previous patient.

An error at the patient identification and profiling point in the patient journey sets up a flawed foundation upon which to accumulate all the subsequent data regarding the patient and their care.

4.1.1 Identification

The patient entering the healthcare process must be provided with a unique identifier that stays with the patient throughout the journey – and potentially over multiple journeys if there are subsequent events or visits - and is readily distinguished by care teams. This is mandatory for an effective patient identification environment.

Before any comprehensive patient identification system can be put in place, it ideally must be possible to identify a patient unambiguously by means of some (ideally machine readable) identification tag or label. This label identifies the patient with a minimum necessary set of personal information. This information could comprise simply name and age information, but could contain a subset of patient record information including allergy and other alerts.

Technological solutions for patient identification at the admission point typically focus on 'attaching' some form of 'tag' or label to a patient: this is usually a wristband. The band might comprise:

- A simple band with hand written identification information.
- A band with machine printed identification information, usually including a barcode.
- A band with printed identification information and including a RFID tag.

While patient identification processes typically take place at the point of admission, they can, however, occur at other points in the patient journey or with particular types of patient, where the 'tagging' approach is not possible.

Some settings, therefore, require particular consideration. For example:

- In emergency departments where, in many environments, the patient is not always admitted prior to treatment being provided.
- In the outpatient and community environment where care is provided over multiple visits (refer also 'Treatment' below).
- In the mental health environment, where provision of tags may be inappropriate.

Scenario

On admission to the hospital, an iris scan provides a unique ID of the patient that is then coded as a unique number on a 2-D barcode worn as a wristband. A digital photograph is taken and kept on the patient record system for later use in confirming identity along the patient journey. On subsequent admissions, the existing patient record is retrieved from the patient record system and the details used to confirm identification.

4.1.2 Profiling

A patient's profile includes any information that can be used to confirm the identity of a patient. It can include any medical records that may be available. A portion of this profile information may be included in the identification tag. Patient identification information is also commonly held in an information system. The identification tag should provide sufficient information to provide a link to a more comprehensive patient record held in a patient administration system. This patient record could include a digitised photograph or other details that could be used to confirm the identity of the patient at key points in the patient journey.

Scenario

The level of sophistication of the technology employed depends partly on the profiling environment. For example, at a GP surgery, where patients tend to be mobile and compliant, simple technology such as a patient smart card incorporating a digital image of the patient would mitigate errors; at a higher level of sophistication, iris scan technology can provide a unique and reliable ID without the risk of lost or misused ID cards.

System design issues for Patient Identification and Profiling centre on:

- How much information is included in the tag (vs the patient record).
- Constraints on the reading of the tag (eg barcodes require line of sight).
- The mechanism by which the patient record system provides information to healthcare staff subsequent to patient identification information being passed to it (e.g. PDA, trolley mounted PC, barcode printer).

4.2 Patient Movement and Handover



Patient movement may involve an explicit handover from one care team to another (formal or clinical handover), or may involve the patient moving without the knowledge of the care team (or a requirement for a formal handover).

A high risk of potential misidentification as a result of a patient movement from one physical location, e.g. a bed, to another and/or one treatment team to another suggests that processes and technology need to focus on these steps in the patient journey.

4.2.1 Informal patient movement

Situations where it is necessary to track the physical movements of patients as they move about a facility (or are moved by a third party) imply the use of technologies that can track patient movement automatically. Examples include the tracking of neonatal or dementia patients. In these cases, technologies that do not require line-of-sight to the tag and manual intervention are appropriate; for example, RFID tags.

Scenario

Each patient whose care requires tracking is given an active radio frequency/infrared (RFID) tag. The hospital wireless system tracks the patient during their stay, if necessary automatically documenting timestamps. Automatic documentation with 'indoor positioning systems' can also help in managing patient flow and in increasing transparency with faster availability, for example monitoring the length of waiting rooms queues, and better accuracy of data, for example, length of waiting or physical patient transfer times.

4.2.2 Clinical handover

Clinical handover is recognised as a critical point for patient misidentification. The Commission established the National Clinical Handover Initiative in 2007 to identify, develop, and improve clinical handover communication across all health care settings nationally and is, in part, Australia's contribution to the World Health Organization (WHO) Patient Safety Alliance High Fives initiative.

Solutions will be based on the best available evidence and will be designed to accelerate systemic improvements and potentially lead to reduced risk of harm to patients in high-risk clinical handover scenarios. Stage 1 of the project will develop existing clinical handover solutions into transferable standardised solutions.

The full range of patient identification technologies, from simple hand written wristbands through barcodes, RFID tags to biometric solutions can be appropriate for reducing the risk of mismatching at the point of clinical handover, depending on the environment. The key point is that care teams must specifically identify the patient by reading the patient's identification and matching that identification against the patient and their intended care.

In the case of a formal handover, it must be noted that adherence to correct procedures by the care teams is as important, if not more so, than the technologies involved. In some situations, responsibility for a patient is passed from one care team to another without formal protocols being practiced: this makes correct patient identification even more critical.

Scenario

The four-hourly observations are conducted by the nursing staff who move around the ward with a mobile trolley device which collects the patients' blood pressure, temperature, pulse and respiration rate and uploads the data to the clinical information system, over the wireless network. Other special observations are collected and recorded based on the patient's care plan that has been selected from the clinical information system.

The clinical information system is linked to the nurse rostering system. At handover, staff access the system using their handheld devices or scanning their staff ID badge. Staff can only access patient information if they are rostered to work on the ward/area where the patient is located, or they are assigned to the clinical unit under which the patient has been admitted.

System design issues for Patient Movement and Handover need to focus on the integration of technology solutions with effective workflow and process management.

4.3 Diagnosis



The diagnostic process involves the provision of a sample, image, or request for a service to a pathology/radiology laboratory and the subsequent receipt of test result(s). Minimising mismatch errors involves ensuring that the identity of the patient is tied both to the request/sample and to the results.

The general technological solution to patient misidentification in diagnostic procedures - pathology and radiology - involves creating a label or 'tag', which is attached to the physical sample or image request and to the subsequent results. This tag includes either the patient's identification code explicitly, or a 'sample/image identifier' that is linked to the patient identifier in an associated information system.

4.3.1 Pathology

Patient misidentification in pathology occurs in several stages: in requesting the sample, in taking the sample, in carrying out the investigation, and in reporting the results.

- Errors in the process of requesting pathology investigations include, for example, ordering a test for a patient and accidentally putting the details of another patient on the form.
- Errors in the process of taking the sample include placing the wrong label or tag on the specimen.
- Errors in the process of carrying out the investigation include mixing up the request and the type of investigation required.
- Errors in reporting the results include mismatching the report and the patient sample.

In 2007 the College of American Pathologists (CAP) published a report that reviewed 3.4 million blood specimens collected at 147 institutions, concluding that the median specimen error rate of U.S. laboratories was 1.31 per 1000 labels.¹⁴

A primary source of system failure in hospital pathology tests is the need for manual entry of sometimes up to 14 digits for each test, e.g. five numbers for operator and nine numbers for patient account identification. Incorrect patient numbers get attached to results preventing the results from being transmitted to the patient's medical record. In the worst cases, they can lead to results being transferred to the wrong patient's chart and inappropriate medical treatment,¹⁵ for example, treating a patient's urinary tract infection based on another patient's investigation results that had been incorrectly filed.

While re-engineering specimen collection processes, such as batch processing, improves accuracy and turnaround times, some U.S. hospitals are planning the introduction of technologies such as 'bedside barcoding' or 'barcoding at-point-of-care' (BPOC) to reduce error rates further.¹⁶

Scenario 1

In a hospital bedside to laboratory request, routine use of a barcode-based electronic positive patient and specimen identification system reduces identification errors in patient and laboratory specimen identification in a clinical laboratory. The system includes barcode identifiers and handheld personal digital assistants supporting real-time order verification.

When patients are discharged from the hospital into community health care, the communication from the hospital or clinical laboratory to the community practitioner includes the barcoded patient identification. The identification information is replicated as part of the general practice patient intake process. Upon discharge, requests for tests are accompanied by a barcoded label and matched to the patient file upon receipt back at the community practice.

Scenario 2

In hospital bedside to laboratory communication, requests for blood specimens are sent wirelessly to the phlebotomists' handheld devices; they view and download the patient information for patients on the specific floor to which the phlebotomist is assigned. Throughout the shift, when an order comes in from the hospital information system, they see it almost instantly because of live streaming. The handheld beeps and a light indicate the type of draw (stat order or routine draw).

At the bedside, in addition to verbal checks, the phlebotomist scans the wristband for the medical record barcode, and the system checks to confirm that no added test has come in since the download. (This eliminates the common situation of phlebotomists returning to the laboratory only to find that another test has been ordered and they have to return and 'stick' the patient again.)

Barcode labels are produced at the patient's bedside, printed at the moment that the barcode is scanned, thereby eliminating mislabelling errors.

¹⁴ Paxton, Anne. (2008) *Punching a hole in specimen ID errors*. CAP today. June 2008.

¹⁵ Nichols, JH et al. (2004) *Reducing medical errors through barcoding at the point of care*. Clin Leadersh Manag Rev Nov-Dec;18(6):328-34

¹⁶ http://healthcare.nicewareintl.com/cgi-bin/site.pl?3208&dwContent_contentID=87

4.3.2 Radiology

Radiology represents a procedural area of high risk for patient misidentification.

NSW Health found that in the July 1 to December 31, 2007 reporting period there were 42 SAC1* incidents classified as wrong patient/site/procedure. Of these, 29 occurred in the area of radiology or nuclear medicine; patient identification was a consistent theme in 20 of these incidents.¹⁷

The South Australian Department of Health found similarly for the 2005/2006 period in which it “received multiple reports of potentially serious incidents where radiological investigations and/or procedures were performed on the wrong patient, the wrong investigation or procedure was performed or the investigation or procedure was performed on the wrong site of the patient.”

Errors in the South Australian report included ten wrong patient/wrong site adverse events involving radiological procedures. Contributory factors included same surnames, wrong details/sticky labels on request forms, wrong site identification and inadequate checking procedures.

Image labelling is a common source of errors in radiology, including instances of incorrect patient-identifying numbers. Research into process improvement forms a significant part of the scientific literature in the area. Patient demographics and date labels have been identified as the most common sources of error.¹⁸

Applying technology in this area includes the use of barcode labels for manually linking images to patient data and the use of RFIDs for patient identification and physical tracking. More recent developments involve electronic requests for diagnostic radiology being transferred via integrated systems that capture and link images with patient data. A request for a procedure is transferred electronically and the results posted electronically to the patient's record.

Increasingly, biometrics are being introduced into wireless systems to reduce further the risks of patient misidentification.¹⁹

* Severity Assessment Code 1: (extremely serious); also called ‘Sentinel Events’.

¹⁷ NSW Health. (2007) Incident Management in the NSW Public Health System. July – Dec, p.30

¹⁸ Aakre KT, Johnson CD (2006) *Plain-radiographic image labeling: a process to improve clinical outcomes*. J Am Coll Radiol. Dec;3(12):899-900.

¹⁹ Guo, B. et al. (2007) *Experiences with a prototype tracking and verification system implemented within an imaging center*. Acad Radiol. Mar;14(3):270-8.

Scenario

Wireless tracking and facial biometric technologies automatically monitor and identify staff and patients to address problems of misidentification of patients (along with protecting medical data privacy and monitoring patient waiting times). A master location tracking and verification system (LTVS) using wireless technology runs hospital information systems, radiology information systems, picture archive and communication systems, and a voice recognition system; a wireless real-time location system and a facial biometric system integrated with the radiology information system. Patient real-time location information and identity verification can be obtained from LTVS so that patient misidentification can be prevented during the course of radiological examinations. Additionally, warning messages are immediately sent to alert staff when a patient's waiting time is over a predefined limit and unauthorized access to a security area can be audited.

System design issues for **Diagnosis** are strongly influenced by the capabilities of existing diagnostic management information systems, both radiology and pathology. Issues centre on:

- Integration with existing information systems.
- Implementing information flows in electronic rather than hard copy format e.g. provision of radiology results on-line.
- Ensuring effective tagging of physical samples.

4.4 Medication



The medication process involves generating a prescription and the receipt and administration of the relevant medication. As with the diagnostic process, the patient identification must explicitly or implicitly accompany the prescription, dispensing, and administration of the medication.

Medication error in hospitals is the most frequently discussed area in the literature of patient safety. Medication error occurs when prescriptions are misread, when medicine is given to the wrong patient, doses are 'doubled up' (usually after a change of shift or carers) or doses are missed.

In an audit of 10 years' prescribing in a New Zealand hospital, inpatient medication charts were audited annually from 1998 to 2007. Inadequate patient identification comprised 8% of the medication charts that failed to document adequately against the predetermined standards set for the audit.²⁰

²⁰ <http://www.ajan.com.au/Vol23/Vol23.3-5.pdf>

Barcode-enabled point-of-care (BPOC) systems help to ensure that the right medications reach the right patient at the right time by allowing barcodes on a patient's ID wristband to be checked against the barcodes on medication packaging.

BPOC systems, however, are only effective if medications are widely available in unit-dose packaging. At present, only about a third of all medications in the U.S. are available in this form. Hospitals wanting to take advantage of BPOC technology need to do some drug repackaging themselves (or have it done by a third party).

RFID technology, when systems are configured to include medication, might provide earlier and less labour-intensive improvements in the rate of medication errors due to patient misidentification. The matching of the patient's unique ID to their medication orders and dosage history would reduce errors in both misidentification and 'double up'.

A simple use of technology could involve the production of barcodes for the prescription and medication pack where the barcode can be tied back to the patient identification at the point of administration. A more sophisticated scenario could include the use of electronic prescriptions and robotic systems for the 'picking' and assembling of medication packs. It must be noted that standards for the barcoding of medication pack by suppliers are well advanced.

By linking a medication pack (or individual dose) to a particular patient through capturing the barcode identifiers of both, cross-referencing would enable medication audits and tracking. In the event of a recall or similar emergency, cross-matched data could be produced to identify vulnerable patients.

Scenario

Each patient is supplied with a smart card containing a Radio Frequency Identification (RFID) chip storing a unique identification code. In the presence of nursing staff, the patient places the smart card on a pill-dispenser unit containing an RFID reader. The RFID chip is read and the code sent to a Base-station via a wireless Bluetooth link. A database containing both patient details and treatment information is queried at the Base-station using the RFID as the search key. The patient's treatment data (i.e., drug names, quantities, time, etc.) are retrieved and sent back to the pill-dispenser unit via Bluetooth. Appropriate quantities of the required medications are automatically dispensed, and administered to the patient, unless the patient has already taken his/her daily dose. Safe, confidential communication and operation is ensured.²¹

System design issues for Medication include:

- Integration with existing information systems (pharmacology).
- Integration of existing barcode standards into the solution.

²¹ Testa M, Pollard. (2007) *Safe pill-dispensing*. *J.Stud Health Technol Inform.*;127:139-46

4.5 Blood Transfusion



The management of blood supply for purposes of transfusions can be seen as a similar issue to those of medication and diagnosis.

A U.S. study conducted by researchers at Georgetown University Hospital, Washington, found that, as a result of human error, an estimated 1 in 12,000 blood transfusions is given to the wrong patient. “The cause of nearly all of these errors is failure of hospital personnel to identify positively intended transfusion recipients, their blood samples for cross-matching, or their correct blood components.”

After the introduction of a point-of-care barcode transfusion safety system, the result was 100 % accuracy of matching patients, their blood samples, and components for transfusions. For verifying information before starting blood transfusions, nurses preferred barcode "double checks" to conventional visual "double checks" by a second nurse.²²

A UK study found that, “The weakest link in the transfusion process seemed to occur when blood was taken from a hospital blood bank refrigerator, with the incorrect type being taken and then transfused into a patient without further checking. The number of errors was small in relation to the total numbers of transfusions carried out, with the UK Transfusion Service preparing around 3.5 million items of blood components each year. But giving patients the wrong type of blood was by far the largest hazard.”²³

As with the diagnostic process, the patient identification must explicitly or implicitly accompany the ordering, retrieval and transfusion of the blood. An additional aspect in the management of blood occurs when the patient has provided their own blood for subsequent transfusion to themselves, in which case patient identification information must be attached to the blood pack.

Typical identification technologies in blood transfusion processes include barcoding and RFID tagging.

Scenario

Barcode scenario: a point-of-care barcode transfusion safety system links the patients' barcoded wristbands with barcoded labels on blood sample tubes, blood component bags, and nurses' identification badges.

RFID scenario: Blood is stored in the local refrigerator with an electronic lock. The nurse scans patient 2-D barcode and wireless link to refrigerator identifies if the patient's blood sample is stored there. The refrigerator automatically opens only if patient's blood is stored there. The nurse retrieves the blood bag and scans the 2-D barcode on the blood bag to confirm a match.

²² Sandler, SG, Langeberg, A, & Dohnalek, L. (2005) *Barcode technology improves positive patient identification and transfusion safety*. *Dev Biol* (Basel); 120:19-24

²³ Mayor, Susan (1999) *Review calls for improved patient identification systems for blood*. *BMJ*. 318: p. 392

System design issues for **Blood Transfusion** include:

- Integration with existing information systems.
- Ensuring effective tagging of physical samples.

4.6 Treatment



Treatment (non surgical procedures and on-going care) occurs in a number of environments, specifically:

- Inpatient.
- Outpatient.
- Community.

In all cases the patient identification issue centres on ensuring the correct treatment is provided to the correct patient.

4.6.1 Inpatient treatment

Identifying the patient in an inpatient environment has been discussed above (Patient Identification and Profiling, and Patient Movement and Handover). Adequate technology is also required to provide information concerning the patient's treatment regime to the care team. This could range from attaching a barcode containing the patient's identification code to the hard copy patient record to an integrated electronic medical record system wherein the patient's 'tag' contains the EMR identification code.

Scenario

The Royal Women's Hospital (Melbourne) Quality and Safety Unit has developed the following scenario to illustrate how technology could be integrated into hospital care:

"The patient's scanned record is integrated with the clinical information system where all information is collected. The clinical information system includes radiology images on-line, order entry for laboratory and medical imaging requests, along with a medications management system that includes prescribing, reviewing and recording of administration on-line. There are tools to aid decision-support within the system and access to expert systems and the latest evidence-based medicine.

“As the clinicians move about the ward with their handheld devices, the device reads the patient’s identification bracelet which includes an RFID tag. (An RFID tag is a ‘radio frequency identification’ tag that is encoded with the patients UR number and basic demographic details). Recognising the patient UR number, data from the clinical information system (that is the electronic patient record) is downloaded to the handheld device through the wireless network. The clinician can view and acknowledge the latest laboratory results, add notes to the patient record all through the handheld device and wireless network.²⁴

4.6.2 Emergency, outpatient, and community treatment

These environments bring particular challenges to patient identification, as the patient will typically not be wearing a wristband or other form of ‘attached’ identification. In this case, it may be possible to implement more ‘public friendly’ technology such as Magnetic Stripe Cards or Smartcards (readily held in a wallet or purse and easily scanned by the care team), or more sophisticated technologies such as iris scanning. Barcoding of patient records and documentation (e.g. referral letters) assists in tying the patient to the correct treatment.

Patients who come to emergency departments or who regularly visit hospitals for oncology treatment and renal dialysis are particularly vulnerable to misidentification. Emergency patients do not usually have wristbands unless they are formally admitted; the relationship between frequent-visit outpatients and staff can result in a loosening of formal identification procedures.

Patients in all these contexts may be misidentified when staff mispronounce their names, refer to them by their first or last names only, are complacent and fail to check armbands, or encounter language or communication barriers.

Outpatient misidentification can also occur at the dispensing point in the hospital pharmacy when labels can become confused.

Scenario

Patient identification and profiling scenario: A patient ‘smart card’ is issued to new patients at the beginning of their treatment program. Each card, which is the size and shape of a credit card, features a digital image of the patient and contains a computer chip that is capable of storing data. The card also consolidates each patient’s medical history, which can be accessed anywhere in the hospital — from its outpatient clinics to the emergency department.

Hospital pharmacy to outpatient scenario: Adhesive labels containing a barcode representation of the U.S. Food and Drug Admin National Drug Code (NDC) identification for the hospital’s formulary medications are printed for each stock bottle or drug package used in dispensing. When an outpatient prescription is presented to the pharmacist, a label containing a barcode representation of the NDC identification for the prescribed medication is generated on-line and attached to the back of the prescription form. After the pharmacist fills the prescription item, an automated check is performed with a scanning wand by comparing the barcode on the prescription with the previously generated barcode on the stock bottle or drug packaging. A match indicates that the correct medication has been dispensed.

²⁴ Royal Women’s Hospital (Melbourne). (2005) *A Women’s Hospital of the future*. Clinical Practice Review Issue, 5 June.

System design issues for Treatment include:

- Employing a 'tagging' technology that is acceptable to the patient
- Linking the patient identification to the (often hard copy) patient records

4.7 Surgical Procedures



One of the most prolific sources of publication in the area of patient misidentification is the literature on reporting and preventing errors in achieving correct patient, correct site, correct side safety in surgery.

Surgical procedures usually involve the handover of the patient from ward staff to theatre staff. So, two aspects of patient identification apply: (a) ensuring correct identification of the patient and (b) ensuring the correct procedure is performed.

The preceding discussion of Patient Movement and Handover describes the importance ensuring correct identification of the patient and the role that technological solutions can play. Access to digital images of the patient in the electronic patient record is an example of a technology that is used to confirm the patient's identification (correct patient) in the first instance.

Ensuring the correct procedure (correct site, correct side) involves ensuring that details of the required surgical procedure are included in the patient record that is referred to by theatre staff.

A major challenge for operating room staff on the day of surgery is to ensure that all the relevant data have coalesced into a coherent and complete record that furnishes all the information necessary to provide this one patient with safe, efficacious care. Given the scope and diversity of input sources and methods, many surgical patients' charts are incomplete or missing information that is still being collected at the threshold of the operating room.²⁵

Technologies employed can include barcode readers or RFID readers connected by an associated screen-based communication with a central patient identification system to confirm the patient / procedure match. Here, the 'tag' is read by the system and the patient's record (specifically, the required procedure) is retrieved and displayed to the team on the computer screen.

²⁵ op cit Egan (2007), p.50

Scenario

On admission, patients are issued with an RFID embedded in the ID bracelet, with similarly coded RFIDs embedded inside the patient chart and medical equipment. The RFID is used to track the patient in the multi-step ambulatory preoperative process, such as needle localization and excisional biopsy of breast lesions. The process is distributed across the ambulatory surgery, pathology, and radiology departments of the hospital.

Data continue to accrue as the patient progresses toward the actual act of surgery and then beyond, into the postoperative period. Along the care path the patient may encounter the outpatient laboratory for blood testing, radiology for imaging, or a number of other points of care.

System design issues for **Surgical Procedures** include (in addition to the patient handover issues):

- Provision of clearly visible patient/procedure match information.
- Integration with existing theatre management systems.

4.8 Devices and Implants



Tracking of devices and implants means that a particular item can be linked to the particular patient who has received or used it. Technology in this area is often introduced by the item's suppliers in the form of barcodes or RFID tags. Additional information system support will normally be required to tie these items to specific patients via their patient record.

4.8.1 Devices

Apart from patient-related data, a key input for the surgical process is the flow of material (supplies, instrumentation, and equipment). In the increased complexity of today's operating theatre, it is quite possible to have 17 or 18 trays of instrumentation for a total joint replacement, an everyday procedure.

Devices such as surgical instruments, sponges, and drapes can be tracked to ascertain information such as sterility status, location, and sterilisation procedure requirements. When integration into other systems is enabled, this information can be linked to particular patients, theatres, and staff.

Supply companies are starting to embed RFID chips in surgical sponges, allowing doctors to check a patient after surgery. The chips alert the doctor if a sponge is left inside the patient.

Scenario

Automatic inventory management cabinets utilise supply-chain software and a touch-screen user interface. They are capable of real-time inventory reports, automated replenishment orders and internet-based connectivity with medical supply distributors. Cabinet users sign on to the cabinet and select a patient. After selecting the item to be removed from the cabinet, the door opens, and the user pushes a button on the shelf next to the item. This button is associated with a specific item and must be pressed once for each unit of the item removed.

The process is reversed for the purpose of returning unused items to the shelf or for adding inventory. The anaesthesia team works with a drug and supply cart using the same technology, with controlled access medication and supply drawers.

4.8.2 Implants

Implants such as joint replacements, plates, rods, and screws used in fractures, spinal injury products, and cardiac devices can be tracked using barcodes or RFIDs to link them with the particular patient who has received it. As these products typically arrive at the facility warehouse or theatre store with a barcode or RFID identifier, this information can be matched to a patient record.

Scenario

The interactive medical implant device includes a radio frequency identification tag mounted to an implant, the tag being covered with a liquid impermeable seal. Identification of the RFID tag allows the physician to identify the specific identified implant with an instrument model or patient database and allows the physician access to desired pertinent information regarding the medical implant device. This linked information can then be checked to ensure that the correct implant has been placed into the correct person.

System design issues with **Devices and Implants** include:

- Integration with existing information systems (e.g. electronic medical record).
- Integration of existing barcode / RFID standards into the solution.

5. SPECIFIC INITIATIVES CURRENTLY BEING UNDERTAKEN

Both Australian and overseas initiatives are described in this section.

5.1 Australian Initiatives

5.1.1 Australian Commission for Safety and Quality in Healthcare

The Australian Commission for Safety and Quality in Healthcare (the Commission) has developed specifications for a standard national patient identification band.

These specifications have been endorsed by Health Ministers for use in public and private health services in Australia. The specifications describe the standard features patient identification bands should have. They cover the following features:

- Colour.
- Size.
- Usability.
- Method for recording patient identifiers.
- Presentation of information.
- Use of new technology.

The core patient identifiers should be limited to:

- Name.
- Date of birth.
- Medical record, or other identification number.

An allowance should be made for the incorporation of new technologies such as bar codes on the identification bands, while still fulfilling other requirements.

5.1.2 NSW Health – Patient Identification Project

NSW Health is extending its 'correct site' initiative from operating rooms to pathology, radiology, and pharmacy environments. This work has highlighted the need for effective patient identification. This initiative has resulted in a draft Patient Identification Policy for NSW that includes the national specifications developed by the Commission, described above.

To inform the patient identification project NSW Health carried out a modified Failure Mode Effect Analysis on processes in the area of patient induction, medication, theatre and pediatrics in order to identify activities and points of transfer where patient identification is critical. The findings illustrate some of the patient identification risks that exist and include suggestions about how technology can ameliorate these risks. A summary of the findings from the project appears as Appendix 8.1.

NSW Health Strategic Information Management is carrying out a technology review (for wristband and barcode technology) in support of the initiative.

As a next step, it is envisaged that the project will work closely with the Department's process re-engineering initiatives including the Clinical Services Redesign project and Nursing and Midwifery Essentials of Care project to ensure patient identification aspects are included in these initiatives.

Some service areas are using barcodes as a means of patient identification. Currently, the pathology area is most advanced in the introduction of barcodes.

5.1.3 Eastern Health: Box Hill Hospital Victoria - Barcode Trial

During 2006 Eastern Health carried out a trial of barcode technology at Box Hill Hospital. The pilot was held on the ACE (Acute Care of the Elderly) unit. The pilot included order placement, electronic patient identification via a barcoded patient wristband, specimen collection and labeling using mobile devices in a wireless environment. The scope of the project included: Order placement and authorisation, order review and cessation, collection list and generation of specimen labels, electronic patient identification crosscheck, order tracking and status, order transfer and specimen receipt in laboratory.

The system uses a PDA with an integrated barcode reader and a mobile bedside printer for producing sample labels. The PDA receives patient demographic information from the patient management information system (PMI) and order information from the laboratory information system (LIS). The system uses this information to provide electronic collection lists of patients including tests, tube types and special instructions. The information from the PMI/LIS is transferred to the PDA in real-time over the wireless network. At the time of phlebotomy the user scans the patient's barcoded wristband and prints a sample label from a mobile printer. Phlebotomists cannot print labels in the absence of electronically verified patient identification. The software also includes a verbal identification check, which requires the user to actively select that they have performed this check, thus covering the less common, but possible error of the patient not having the correct patient wristband attached.

Labels generated on the wireless printer specify the tests required but also which tubes and how many are required. Each tube has unique secondary barcode, which is scanned back into the system to ensure that the label matches the current accessed patient and that each tube has been labeled. On receipt in the laboratory the order is transmitted directly into the LIS by scanning the barcode on the specimens. No data entry, application of barcodes or crosschecking with a paper request form is required.

Queensland Health is planning to repeat the Box Hill Hospital Barcode Trial in Queensland hospitals.

5.1.4 Queensland Gold Coast Hospital Emergency Department

A barcoded wristband will be given to all Queensland hospital patients to reduce identification mix-ups. It is being trialed at the Gold Coast Hospital.

The standardised ID bracelet will carry a patient's name, age and medical record number, and will replace a system that allows the use of 58 bands with a range of colours and meanings.

It is being tested at the Gold Coast Hospital and will be rolled out across the state. The project is one of a series of safety measures being introduced to reduce error over patient identification. It is currently being introduced into the emergency department, which historically has not assigned wristbands to non-admitted patients.

The other safety measures are largely systems and protocol based re-engineering of work processes.

The project also includes Royal Brisbane Hospital.

5.1.5 Royal Brisbane Hospital

The Royal Brisbane Hospital is undertaking a similar project in conjunction with the Gold Coast Hospital.

Renal patients who come regularly to the hospital for dialysis and chemotherapy patients have been issued, on an 'opt-in' basis, with laser self-laminating wristbands and 'Pathology Care' cards that contain identifying data along with a digital image of the patient.

The camera being used produces the card with the image; the barcode reader includes prompts and produces the labels for the wristband and specimen tubes etc.

The digital image assists with establishing 'absolute' identity and the barcodes on the wristbands maintain the match between correct specimens or medication with the correct patient.

5.1.6 St Vincent's (Sydney) and Melbourne Hospitals - Iris Scanning

As part of their implementation of the Argus Solutions MethaDose methadone administration system, these hospitals have implemented the Argus iris scanning system.

Under state laws, methadone patients are tied to a specific, state-licensed dispensing point and must return there regularly for their doses. Historically, pharmacists have been developed their own methods for tracking how much is given to whom and when. These methods have ranged from spreadsheets to handwritten logbooks - manual methods that are inherently open to error. The MethaDose program makes it possible to track and audit all of a patient's interactions with the program.

Details of each dose, or other patient contact, are recorded in the database automatically, and an attached label printer can be used to identify drugs as required. When patients arrive for their doses, they look into the iris scanner to confirm their identity. The linked information automatically alerts the administering nurse if the patient has been given a dose within the past prescribed number of hours and is returning too soon. Patient who cannot remember when they were supposed to come in can have an iris scan and MethaDose returns the allowable dose for the day. If the patient's last dose was just two days ago and it was a three-day dose, the system simply won't dispense the drug until tomorrow.

As iris scanning is non-invasive and anonymous (unlike identity cards), the patients are currently reported to be happy with the system.

5.1.7 RFID Tags in Neonatal Unit - King Edward Memorial Hospital, WA

The security of babies in the Neonatal Unit is being monitored via an RFID system, known as HALO. Each baby is fitted with a foot band containing an RFID tag. The tag must be cut in order to remove it. Once cut, the RFID tag is deactivated and the band cannot be re-attached. The tag is interrogated every 20 seconds by an RFID reader. If the tag does not respond, or if it is tracked in area beyond its designated 'border', an alarm is raised. Mothers are fitted with a matching RFID; if a baby is placed with a mother with a non-matching device, an alert is activated.

5.1.8 Medicare Australia Smart Cards

The Medicare smartcard was launched in July 2004 by the Minister for Health and Ageing, as an optional replacement for the standard Medicare card in Tasmania.

The card has the same appearance as the standard Medicare card, except that it contains a computer chip. The chip holds the same information as the standard Medicare card and customers are able to include a personal digital photograph if they choose to do so.

The card was issued on an opt-in basis. Uptake has been limited: the card was originally intended to be provided for 40,000 people; 13,000 invitations were issued; by 2006 only 2500 cards had been issued.

5.2 Overseas Examples

Below is a selection of case studies of technology implementations from overseas jurisdictions that provide a concise cross section of recent initiatives.

5.2.1 New Zealand Ministry of Health - New Zealand Medication Safety Project

The New Zealand Medication Safety Project is an initiative of the New Zealand Ministry of Health to reduce medication errors by introducing bedside verification of medications using a standardized (GS1) barcode point of care system in all public hospital. The Project has a budget of NZ\$10.2 million.

Internet Reference:

www.gs1.org/about/media_centre/news/medication_safety_project_launched_in_new_zealand.html

5.2.2 RFID Tags for Theatre Patients at Birmingham Heartlands Hospital (UK)

An RFID tagging system has been implemented at the day-case unit. Patients have a digital photograph, taken when they are admitted to the unit, which is added to their Electronic Patient Record. They are given a wristband, which includes an RFID tag containing their identification details. Clinicians in the unit have hand-held computers containing details of the day's operating list. These are connected to the hospital computer system (via WiFi). Whenever a patient's record is accessed, the patient's photograph is displayed to assist in confirming identification.

When the patient is taken to theatre, the RFID tag in their wristband is detected by a sensor in the door, which triggers the relevant patient record to be displayed on the theatre computer screen. If a biopsy is taken during surgery, the system can generate a pre-printed label with the patient's unique identifier encoded.

Internet Reference: www.rfidjournal.com/article/articleview/3222/

5.2.3 Blood Transfusion Management at Oxford Radcliffe Hospitals (UK)

The haematology department is implementing an electronic clinical blood transfusion management system involving barcode patient identification. Hand held computers are used to prompt clinical staff through each step of the transfusion process, including blood sample collection, removal of blood units from blood fridges and blood administration, and to check that the right patient receives the right blood.

Each patient's name, date of birth, gender and unique id are included in a 2-D barcode on their wristband. The hand-held computer is attached to a bedside portable printer to generate a label containing these details to be affixed to the blood sample. The laboratory scans the barcode on the sample to enter the patient's details into the laboratory information system. After laboratory testing, labels are printed and attached to the blood units for the patient. Blood collection from the blood fridges is electronically controlled. The staff collecting blood are required to bring a 'pick-up slip' with the patient's barcoded identification generated from their wristband.

Before administering blood, a member of staff, using a hand held computer, is prompted to make a series of checks and scans on the barcodes on the wristband and the blood. If the blood is not the correct match, the computer indicates 'Do not transfuse' and sounds an alert.

Internet Reference: www.e-health-insider.com/news/item.cfm?ID=1043

5.2.4 Medication Management at Eisenhower Medical Center (California USA)

Eisenhower Medical Centre implemented the Bridge Medical Medipoint System (since acquired by Cerner Inc). A 1-D barcode is generated in admission by the admission staff and is worn on a wristband at all times by the patient. A handheld scanner, linked to the pharmacy computer system, is used to read the barcode. Nurses scan medication to be administered as well as the patient's ID as well as their own ID.

New orders are electronically or manually transcribed and signed by a physician. A copy of the prescription is scanned to the hospital system where the image is stored. The pharmacist enters the physician order into the system. The pharmacy system will automatically check for any adverse allergy potential and flag them to the pharmacist. The order is confirmed and sent to the Bridge System. Note that the barcoded Bridge System can only work in conjunction with the pharmacy system and is not a system in isolation.

Internet Reference: www.hoise.com/vmw/02/articles/vmw/LV-VM-06-02-18.html

5.2.5 Patient Tracking at Oakwood Hospital & Medical Center, (Michigan, USA)

Oakwood Hospital & Medical Center (OHMC), in Dearborn, Michigan, has implemented a WiFi based real-time location system (RTLS) from AeroScout to track patients throughout the 632-bed facility. The hospital is employing AeroScout's T2 active WiFi tags, which transmit 2.4 GHz signals carrying the tags' unique ID numbers to the medical center's Cisco WiFi network. A tag is affixed to a patient's chart holder, which accompanies that person and can be tracked on any of the hospital's 10 floors and two patient-care towers. AeroScout Exciters, placed at doorways, trigger the tags to immediately transmit their position as patients enter and leave specific departments, such as ultrasound, radiation oncology or CT scanning. Each patient's location is updated on the map when they enter or leave the department. The location data transmitted by the tags is interpreted by AeroScout's MobileView software to display the patient's current location on a map on monitors at nurses' stations, or on any Web-enabled device. The implementation follows the completion of a successful pilot program in which 64 patients were tracked through 14 departments over two floors.

Internet Reference: www.hoise.com/vmw/08/articles/vmw/LV-VM-09-08-38.html

5.2.6 Patient Tracking at KangNam St Mary's Hospital South Korea

A similar approach to that at Oakwood Hospital has been taken at KangNam St Mary's hospital. The hospital has employed the AeroScout Visibility System to provide a patient tracking system using wireless infrastructure and active RFID tags. Patients are given an RFID tag when they are admitted. The tags include a call-button messaging facility and motion sensor. The tags use WiFi standard to communicate directly with existing wireless access points. The access points act as RFID readers, receiving tag signals and accurately determining location in real time. The tags are also given to staff so that associations between staff and patients can be maintained.

Internet reference: www.aeroscout.com/content/healthcare

5.2.7 U.S. Veterans Health Administration

The Veterans Health Administration is the largest government-operated health-care system in the United States. It operates the most broadly implemented and currently functioning health Information Technology (IT) system in the world. As such, the VHA provides possibly the best example of the application of large-scale integrated technology based on the electronic patient record, including the management of patient identification data along the patient journey

The clinical computer system, known as Veterans Health Information Systems and Technology Architecture (VistA), covers more than 1,200 sites of care, including acute care hospitals, ambulatory facilities, skilled nursing facilities, and pharmacies. The system contains a single health record of 8.5 million veterans in 22 regions across the entire United States. Authorised clinicians have access to any veteran's record, regardless of which region they reside in.

VistA Imaging provides a multimedia, on-line patient record that integrates traditional medical chart information with medical images, including X-rays, pathology slides, video views, scanned documents, cardiology exam results, wound photos, dental images, endoscopies etc into the patient record.

Barcode Medication Administration (BCMA) addresses inpatient medication errors by electronically validating and documenting medications for inpatients. Every tablet and infusion is individually barcoded.

Patient identification wristbands and nursing staff identification cards are barcoded with unique identifying numbers. Medications are packaged in plastic containers with barcoded content identifiers and placed on the medication carts by the pharmacy service. To administer a medication, the nurse scans the patient's wristband, the packaged medication, and the employee identification card. The data is sent to an electronic medication administration record. Advantages include positive verification of patient identification and prescribed medication at the point of care, an immediate alerting capability to prevent the wrong medication from being administered, precise medication administration documentation noting on time, early and late dosing, and automated missing dose requisition.

6. INTRODUCING TECHNOLOGY: RISKS AND INHIBITORS

Risks and inhibiting factors to the introduction of patient identification technologies fall under three broad categories:

- Organisation and process issues.
- Technology interactions.
- Cost.

6.1 Organisation and Process Issues

6.1.1 Organisational culture

Patient identification technologies operate optimally within a healthcare workplace that has established formal and widely promulgated principles and policies in relation to patient safety, including reliable patient identification. The establishment of a 'safety culture' within a healthcare facility can only be implemented as a corporate endeavour. Without institutional support and commitment, isolated initiatives to improve patient safety, while commendable, usually do not extend beyond the participating business units nor survive the departure of the individuals who instigated them.

The establishment of a "safety culture" can be embedded if patient safety measures (including accurate identification) are included in an organisation's performance measures, the responsibilities and accountability for promoting patient safety are clear, and these become part of a standard corporate reporting and performance monitoring process.

6.1.2 Process improvement

The introduction of patient identification technologies will not, of themselves, solve the problem of patient misidentification. The solution lies in defining and consistently executing appropriate processes and workflows, supported by relevant technology. Also, as with the introduction of any information technology solution in a clinical environment, the introduction of patient identification technology can have a significant impact on existing processes and workflows.

Any projects involving the implementation of new technology need to include business process review to ensure that the use of the new technology can be effectively integrated into clinical and administrative business processes. Once new processes are defined a change management and training plan can be developed and implemented. This should incorporate a comprehensive communication and stakeholder engagement plan.

6.1.3 Staff resistance

The introduction of patient identification technologies can be met with resistance by clinical staff. For example, the use of the technology can be seen as time consuming in busy or fast-paced environments such as emergency departments. If the technology is introduced in conjunction with inappropriate processes or workflows, then manual work-arounds can proliferate, significantly reducing the value of the technology. In some cases, staff resistance can stem from a lack of experience with or knowledge of information technology.

As mentioned above, it is critical that staff are engaged in the implementation of patient identification technologies and that effective communication, training and support strategies are put in place if these initiatives are to succeed.

6.1.4 Risk amelioration

Specific steps can be taken in order to address these organisation and process issues.

- Establish and promote a 'safety culture' within the organisation.
- Link patient safety measures to corporate reporting and performance indicators.
- Develop and implement full, organisationally supported process improvement.
- Implement an enterprise-wide, organisationally supported change management program.
- Identify the areas of high patient risk – define the real problem.
- Review and / or audit manual processes and carry out an appropriated risk assessment methodology / root cause analysis.
- Thoroughly prototype / 'shakedown' the new processes.
- Run manual processes parallel to automated system for an adequate period.
- Involve staff in the specification of requirements, procurement, and implementation process.
- Put a comprehensive communication plan into place to ensure that people are aware of the change, the impact it will have on them, and the benefits it will deliver.
- Ensure staff are adequately trained.
- Implement a comprehensive training regime.
- Establish an organisation-wide implementation program supported by the executive.
- Ensure that there are adequate support mechanisms in place to provide timely assistance to staff.

6.2 Technology Interactions

Patient identification technologies do not 'stand alone' in a clinical environment. Interaction with other technologies in the environment may pose a risk or act as an inhibitor to implementation.

6.2.1 Interference with medical equipment

An historical inhibitor to the implementation of some forms of patient identification technology (particularly RFID Tags) has been the possibility of electromagnetic radiation interfering with clinical electronics. However, modern devices employ low emission technology, lower than that emitted by a mobile phone and there is currently no evidence basis for this concern.

6.2.2 Interaction with existing systems

A free-standing patient identification system is of limited value compared to its contribution to patient safety when interfaced with other systems such as electronic medical record systems, pathology/radiology management systems, pharmacology systems, blood management systems and so on.

A technological inhibitor can, therefore, be the difficulty of interfacing with these systems and the potential need to upgrade these systems to support the additional features and workload introduced by automated patient identification.

6.2.3 Requirement for ubiquity

Ideally, the patient should be able to be identified at all stages throughout the patient journey. This implies the availability of a large number of scanners / readers distributed throughout the institution and possibly the distribution of PDAs or other readers to staff. This has significant cost implications. If staff cannot readily access patient identification technology when and where it is needed, however, it will impact on uptake and acceptance of the new technology.

6.2.4 Risk amelioration

These risks are best addressed by a strategic approach to planning for the introduction of patient identification technology and the use of appropriate application and technology architectures.

- Consider patient identification technology in the broader clinical information technology context.
- Define interface requirements with clinical and administrative systems prior to procurement of a solution.
- Plan for patient identification technology as part of the broader strategy for patient identification to ensure an integrated solution that considers clinical systems as well as manual identification processes.
- Ensure any products being considered have been tested to measure whether the electromagnetic radiation has any impact on any type of medical technology

- Work with vendors to determine the implementation approach to minimise the risk of interference with medical technology.

6.3 Cost

The risks and inhibitors identified above suggest that a strategic, institution-wide implementation of patient identification technology can incur significant cost. Even the relatively 'low-tech' alternative of barcoding can become expensive due to the need for ubiquity of readers. The costs will vary greatly with the size of the institution, its existing technology and communications architecture, and the nature, source, level of sophistication, and quantity of the technology being considered. Identifying even an indicative level of required funding for an unspecified institution is a fraught exercise.

Given the pressures on capital budgets that are faced by all jurisdictions, funding for this technology is competing with other substantial projects to implement clinical and corporate systems. Ideally, a patient identification solution should be applied across the complete patient journey. However, it can be implemented in a phased manner assuming initial implementations are carried out in the context of a long-term strategy.

6.4 Example of problems with introducing technology

A useful example of the issues that arise during the introduction of patient identification technology is documented in the paper "Barcode Medication Administration: Lessons Learned from an Intensive Care Unit Implementation" from the U.S. Veterans Health Administration.²⁶

An electronic barcode medication administration system (BCMA) was successfully implemented in the acute care and long-term care sections of a 118-bed Veterans Administration hospital beginning in February 2000. The barcode software implementation proved problematic in the 10-bed intensive care unit due to a number of reasons, largely related to the complex care required for these patients. Staff ceased using the barcode system 10 months into implementation and staff confidence remained low after re-implementation. A multidisciplinary team was convened to resolve the issues, focusing on the safe documentation of medication administered to open-heart surgery patients.

The findings identified human factor issues and cultural and management issues that had affected the success of the implementation.

Human factor issues and the hospital's responses to them included:

- Dual medication systems. A hybrid environment of paper and electronic medication administration documentation increased errors. Paper Medication Administration Records (MARs) were eliminated in favour of a paperless environment.
- Pharmacy–nursing staff communication is key to BCMA success. Collaborative phone communication processes were established between nursing, pharmacy, and, later, anaesthesia staff.

²⁶ Internet Reference: www.ahrq.gov/downloads/pub/advances/vol3/Wideman.pdf

- Personnel training; new programs were established, including ‘super users’ and ‘job-shadowing’ and regular re-training.

Cultural and management issues and the hospital's responses to them included:

- “A medication error policy with punishment potential may have been one of the most significant barriers to the success of the initial BCMA implementation.” A de-identified, fair, and just reporting system for errors and near misses was introduced.
- The development of a working environment in which communication flows freely is essential to an institutional safety culture. The team established Patient Safety Rounds - informal, confidential, and voluntary BCMA rounds.

The authors note in conclusion, “It is also necessary for organizational leadership to promote and endorse a culture of support during the system implementation and troubleshooting period.”

7. RELEVANT STANDARDS

7.1 Barcoding and RFID

The Australian Commission for Safety and Quality in Healthcare is encouraging the implementation of standards for wristbands. The Australian health sector is now at the point where future developments in wristband technology could include a barcode and possibly a radio frequency identification (RFID) tag. The Commission's wristband specifications require use of a wristband that has the capacity to include a barcode, RFID tag or other form of technology.

The most widely used standard for barcoding and RFID is owned and managed by the GS1 System, a not-for-profit member organisation. GS1 manages the definition of standards and allocation of barcodes for the vast majority of patient identification initiatives worldwide. GS1 has a presence in Australia and is active in the Australian health sector.

The GS1 Healthcare User Group is providing a revised standard for healthcare products in 2008.

7.1.1 Barcode standards

Australian/global standards

GS1 is the organisation undertaking the design and implementation of global standards and solutions to improve the efficiency and visibility in supply chains. GS1 Australia supplies barcodes to all Australian industries that are involved in the supply chain.

GS1 Healthcare develops global standards for automatic identification in health care. GS1 Healthcare consists of participants from all stakeholders of the Healthcare supply chain: manufacturers, wholesalers & distributors, as well as hospitals and pharmacy retailers. GS1 Healthcare also maintains contacts with regulatory agencies and trade organizations worldwide.

International standards

There are a large number of International Standards Organisation (ISO) standards relating to barcodes. All of these are published on the ISO website (Search on 'barcode'):

http://www.iso.org/iso/iso_catalogue/catalogue_tc/catalogue_tc_browse.htm?commid=45020

Most of these standards relate to the technical aspects of barcode products, particularly symbology standards.

7.1.2 RFID standards

Australian/global standards

GS1, via, EPCglobal, is developing industry-driven standards for the Electronic Product Code™ (EPC) to support the use of RFID.

The EPCglobal Network is a suite of tools utilising RFID technology for automatic identification of items moving through the supply chain. It uses the internet as a mechanism to easily locate and exchange information.

International standards

The ISO has issued standards relating to technical requirements for RFIDs. Each of these parts deals with a different aspect of RFID. The first part (Part 1) is the defining document that explains how the standard works and the rest are divided by frequency.

- *ISO/IEC 18000-1 Part 1 – Generic Parameters for the Air Interface for Globally Accepted Frequencies*
- *ISO/IEC 18000-2 Part 2 – Parameters for Air Interface Communications below 135 kHz*
- *ISO/IEC 18000-3 Part 3 – Parameters for Air Interface Communications at 13.56 MHz*
- *ISO/IEC 18000-4 Part 4 – Parameters for Air Interface Communications at 2.45 GHz*
- *ISO/IEC 18000-6 Part 6 – Parameters for Air Interface Communications at 860 to 960 MHz*
- *ISO/IEC 18000-7 Part 7 – Parameters for Air Interface Communications at 433 MHz*

Other RFID standards of interest are:

- *ISO/IEC 15961:2004 Information technology -- Radio frequency identification (RFID) for item management -- Data protocol: application interface.* The data protocol used to exchange information in a radio-frequency identification (RFID) system for item management is specified in ISO/IEC 15961:2004 and in ISO/IEC 15962:2004. Both are required for a complete understanding of the data protocol in its entirety;
- *ISO/IEC 19762-3:2005 Information technology -- Automatic identification and data capture (AIDC) techniques -- Harmonized vocabulary -- Part 3: Radio frequency identification (RFID).* ISO/IEC 19762-3:2005 provides terms and definitions unique to radio frequency identification (RFID) in the field of automatic identification and data capture techniques. This glossary of terms enables the communication between non-specialist users and specialists in RFID through a common understanding of basic and advanced concepts.

7.2 Barcoding of Blood and Blood Products

7.2.1 Australian standards

The Jurisdictional Blood Committee is the linchpin between Australian governments and the National Blood Authority. It is responsible for all jurisdictional issues relating to the national blood supply, including planning, production, supply, and budgeting. It provides national policy leadership on these matters and has endorsed the following National Policy on barcoding for blood and blood products:

- ISBT 128 for all fresh blood products
- GSI 128 (formally EAN 128) for all plasma, recombinant and diagnostic products
- Full implementation of these barcode standards was to occur by 1 July 2008.

See below for a brief explanation of ISBT 128.

7.2.2 International standards

The International Society of Blood Transfusion (ISBT) set up a working group on automation and data processing to establish a replacement for the currently used ABC Codabar, which has reached its limit of usefulness in a world of increasing information complexity. The working group designed a new blood bank barcode system based on symbology known as code 128. Code 128 was chosen because it codes more data into a smaller space, easily handles alphanumeric data, provides for internal scanning error checks, and supports concatenation (reading more than one barcode symbol with a single scan).²⁷

7.3 Biometrics standards

7.3.1 Australian standards

Standards Australia (SAI), an independent non-government organisation, represents Australia on the two major international standardizing bodies, ISO and the IEC. Standards Australia has established a dedicated committee (IT-032) to address standardisation in the field of Biometric and Identification technologies and applications. This committee's work includes Harmonized Biometric Vocabulary, Biometric Testing and Reporting, Cross-Jurisdictional and Societal Aspects, driver licences and passports. There is no specific work being done on standards for the application of biometrics in the healthcare sector.

7.3.2 International standards

The two major international standards bodies most relevant to biometrics are the International Electrotechnical Commission (IEC) and the ISO.

After identifying an overlap in their areas of interest, the IEC and ISO agreed to form the Joint Technical Committee 1 (JTC1), to operate on their behalf and focus exclusively on the development of information technology standards, in the fields of electricity, electronics, business and security processes, engineering standards, food preparation, and most fields of technology.

Standards Australia represents Australian interests at ISO.

²⁷<http://chapters.redcross.org/midatlanticblood/Hospital%20Services/archives/ISBT128%20Labeling%20Standard%20-%20QA.doc>

8. APPENDICES

8.1 Example Risk Areas from NSW Health

The table below summarises specific examples of risk areas in the patient journey identified from the NSW Health Failure Modes and Effects Analysis described in Section 5.1.

Procedure	Risk Activity	Patient ID Info Flow	Risk	Ramification for Patient ID
Imaging	Documentation of person and imaging required.	Diagnosis - Order / Sample	Patient misidentified on order document.	Patient ID automatically part of order.
	Patient transferred to imaging site	Movement – Transfer / Receive	Patient misidentified during handover to imaging staff.	Patient ID obvious to Ward Nurse & Imaging Staff
	Image Labeled	Diagnosis - Order / Sample	Image mislabeled with incorrect Patient ID	Patient ID automatically part of Result (Image Label)
Inpatient Procedure	Documentation of person and treatment / procedure required.	Treatment - Request	Patient misidentified on request document.	Patient ID automatically part of request
	Patient transferred to procedure room.	Movement - Transfer / Receive	Patient misidentified during handover to technician.	Patient ID obvious to Ward Nurse & Procedure Technician.
Medication Prescribing and Administration	Medication name and dose documented on patient's medication chart.	Medication - Prescription	Patient misidentified on medication chart (?)	
	Medication Prescribed from Chart	Medication - Prescription	Patient misidentified on medication chart.	
	Medication order read and medication prepared.	Medication - Dosage	Patient misidentified on prescription.	
	Patient Identity and Allergies verified.	Movement – Transfer / Receive	Patient misidentified during handover to nurse.	Patient ID obvious to Nurse.
Sample Collection and Testing Procedure	Documentation of person and test ordered.	Pathology / Radiology - Order / Sample	Patient misidentified on order document.	Patient ID automatically part of order.
	Sample collected and labeled.	Location / Responsibility – Transfer / Receive	Patient misidentified during handover to collection officer.	Patient ID obvious to Collection Officer.
	Sample matched to request.	Location / Responsibility – Transfer / Receive	Patient misidentified during handover to laboratory technician officer.	Patient ID obvious to Laboratory Technician. Request / Result explicitly linked.
	Results Labeled	Pathology / Radiology - Order / Sample	Result mislabeled with incorrect Patient ID	Patient ID automatically part of Result.

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OTHER READING

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