

REDUCING HARM IN BLOOD TRANSFUSION

Investigating the Human Factors behind
'Wrong Blood in Tube' (WBIT)
events in the Emergency Department





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GLOSSARY OF TERMS

ABO incompatibility	The reaction of the immune system that occurs if two different and not compatible blood types are mixed together. ABO incompatibility errors are a subset of IBCT errors (see IBCT below).
ACSQHC	Australian Commission on Safety and Quality in Health Care. The commission was established by the Australian, State and Territory Governments to develop a national strategic framework and associated work program that will guide efforts in improving safety and quality across the health care system in Australia.
AMA	Australian Medical Association. The independent organisation that represents the registered medical practitioners (doctors) and medical students of Australia.
ARCBS	Australian Red Cross Blood Service. The Blood Service is a division of Australian Red Cross responsible for the national supply of blood products and related essential services, including transfusion medicine advice, to meet the needs of patients.
Assessment Bay	Cubicle within the emergency department where patient consultations and treatments occur. This was the most frequent setting for blood sample collection observed in this project.
BCSH	British Committee for Standards in Haematology. A sub-committee of the British Society for Haematology responsible for providing haematologists with up to date advice on the diagnosis and treatment of haematological disease by the production of evidence based guidelines.
Blood sample collection	Blood samples are typically collected by one of two physical methods. The most common is by routine venepuncture. Where patients need to receive intravenous therapy (such as fluid, blood transfusion or intravenous medications) a cannula is inserted.
Blood Matters	A collaboration between the Victorian state government and the ARCBS for improving the quality and safety of hospital transfusion care to patients. The Blood Matters program includes support of the Transfusion Nurse program.
Bradma label	Pre-printed sticker which includes patient unique record number, name and date of birth. Bradma labels are used on request forms, blood tubes and other forms of documentation for ID purposes.
Cannula	A small tube that can be introduced into a vein using a needle, and remains there to allow movement of fluids into and out of the patient's blood system.
Cannulate	To insert a cannula into a vein.
Cross-match	Complex testing that is performed prior to a blood transfusion, to determine if a donor's blood is compatible with the blood of an intended recipient (see also Group and Hold and Group and Save).
DEPM	Department of Epidemiology and Preventive Medicine, Monash University, Melbourne, Australia.
Department of Health	One of eleven state government departments in Victoria.
ED	Emergency Department. Medical treatment facility specialising in acute care of patients who present without prior appointment, either by their own means or by ambulance.
Error	In healthcare, when a planned series of actions fails to achieve its desired outcome and when this failure cannot be attributed to the intervention of chance occurrence.
FMEA	Failure Modes and Effects Analysis. A systematic, proactive methodology for evaluating a process to identify where and how it might fail, and to assess the relative impact of different failures in order to identify the parts of the process that are most in need of change.
Group & Hold (Group & Save)	Pre-transfusion testing to determine the ABO and Rh(D) group of the transfusion recipient and detect any red cell antibodies. If no antibodies are detected, a cross-match prior to transfusion can be completed swiftly. Group and Hold samples are completed if there is a likelihood of the patient needing a transfusion and are valid for 72 hours.
Haematology	Branch of medicine that studies the blood and blood diseases.

Haemovigilance	Set of surveillance procedures from the collection of blood (and its components) to the follow-up of transfusion recipients in order to collect and assess information on unexpected or undesirable effects and prevent their occurrence or recurrence.
HF	Human Factors. The study of interrelationships between people, technology and the environments in which they live and work. The overall goal is to optimise the relationship between humans and systems with which they interact, to reduce error and failure and so improve safety.
HREC	Human Research Ethics Committee. Committee established by an organisation to review research proposals to ensure that the research is conducted according to ethical research principles as codified in the NHMRC National Statement on Ethical Conduct in Research Involving Humans.
HRO	High Reliability Organisation. Organisations that, despite high risk and high demand work, maintain very low accident rates.
IBCT	Incorrect Blood Component Transfused. Errors that occur when a patient is transfused with a blood component that does not meet the appropriate requirements or which was intended for another patient. This includes ABO incompatible components, components that do not meet other specific requirements of the patient, and ABO compatible components transfused to the wrong patient.
Incident reporting	A reporting system for healthcare professionals to notify errors or near misses, used as a tool to improve safety and enhance organisational learning.
Intervention	In healthcare, an alteration to practice or protocol with the intent of reducing the risk of harm to patients.
Junior doctor	Doctor who is completing his/her in-hospital training.
Miscollection	Error where there is mismatched information on the specimen and request form or historical results for the patient are inconsistent with results from the current specimen (see also WBIT).
Mislabelling	Error where a specimen label does not meet the local institutional criteria for acceptance. Criteria include: patient's family and given name, unique record number, date of birth, date of collection, collector initials or signature. Information on the specimen label must match that on the accompanying request form.
NBA	National Blood Authority. An Australian Government statutory agency, established under the National Blood Authority Act 2003 to improve and enhance the management of the Australian blood and plasma product sector at a national level.
NUM	Nurse Unit Manager.
Pathology	The branch of medicine concerned with the study of the nature of disease and its causes.
Pathology Collector	A person who collects and prepares specimens that will be examined in a pathology laboratory.
Patient safety	The discipline in healthcare concerned with the reporting, analysis, and prevention of error that can lead to patient harm.
Phlebotomy	The act of drawing or removing blood from the circulatory system through a cut (incision) or puncture in order to obtain a sample for analysis and diagnosis.
RCA	Root Cause Analysis. Systematic, reactive methodology used to identify the gaps in hospital systems and the processes of health care that may have contributed to the occurrence of an event.
Request / order form	The form used to request/order blood tests and products.
Resilience	Human Factors concept to describe how individuals, teams and organisations monitor, adapt to and act on failures in high-risk situations.

Glossary of Terms (Cont)

RPN	Risk Priority Number. A measure used when assessing risk (as part of an FMEA) to help identify critical failure modes associated with a design or process.
SHOT	Serious Hazards of Transfusion. The UK haemovigilance incident reporting system.
Senior doctor	A fully trained consultant doctor.
Specimen/Sample	Portion or quantity of material for use in testing, examination or study, (in this case blood.)
STIR	Serious Transfusion Incident Reporting. The haemovigilance incident reporting system coordinated by Blood Matters for Victoria, Tasmania, the ACT and Northern Territory.
TN	Transfusion Nurse. A nurse employed to work in hospitals with medical, nursing and laboratory staff to promote safe and appropriate use of blood and blood products.
Transfusion	The process of transferring whole blood or blood components from one person (donor) to another (recipient).
Triangulation	Means of comparing the results of different theories, methods, data sources, investigators or analytical methods in order to explore a single problem or phenomenon.
UR Number (or MRN)	Unique Record Number (or Medical Record Number). A unique number allocated to an individual patient to distinguish them from all other patients. Patients are allocated a UR Number on admission and it forms a crucial part of patient identification through use on records, labels and the patient wristband.
Venepuncture	The introduction of a needle into a vein (for example in the elbow) to allow the withdrawal of blood into a tube or syringe.
VHIMS	Victorian Health Incident Management System. A state-wide project to implement systematic clinical incident reporting, consumer feedback and occupational health and safety data analysis.
VMIA	Victorian Managed Insurance Authority. A Victorian Government statutory authority, established under the Victorian Managed Insurance Authority Act 1996 to provide risk and insurance services to protect Victoria's assets and minimise losses from adverse events.
WBIT	Wrong Blood in Tube. An error that occurs where identification information (label and request form) belong to one patient but the blood in the tube belongs to another patient.
WHO	World Health Organisation. The directing and coordinating authority for health within the United Nations system. It is responsible for providing leadership on global health matters, shaping the health research agenda, setting norms and standards, articulating evidence-based policy options, providing technical support to countries and monitoring and assessing health trends.
Workarounds	The strategies or work patterns that bypass procedural codes in an effort to improve efficiency or productivity, but are often associated with an increased risk of error.
Zero Tolerance	The practice of rejecting and discarding blood samples if any of the required labelling elements (e.g. signature, date, date of birth, etc) are missing. This compares with protocols that allow specimens to be accepted if certain compulsory elements are completed, but allow staff to complete and re-submit blood samples with missing label elements.

1 Executive Summary

The transfusion of blood and blood components is a common procedure in modern medicine. In the last 20 years, adverse outcomes following blood transfusion have been under increasing scrutiny. Transfusion process safety has traditionally received less attention than blood component safety and quality. It is now becoming apparent that the potential for serious problems exists at each step in the process of transfusion. Approximately 70% of these errors occur at the bedside (Stainsby, Russell et al. 2005).

'Wrong Blood in Tube' (WBIT) errors are those that occur where patient identification information (label and request form) belong to one patient but the blood in the tube belongs to another patient (Dzik, Corwin et al. 2003). WBIT errors most commonly occur at blood sample collection and are estimated to affect approximately 1 in 2000 samples (Gonzalez-Porras, Graciani et al. 2008). Mislabelling tubes occurs more often, affecting, on average, 1 in 40 samples (Murphy and Kay 2004).

The most severe result of WBIT is a patient receiving a transfusion of the wrong type of blood (incompatible blood component transfused - IBCT) which can result in death. Therefore, in spite of their low frequency, WBITs can have catastrophic consequences. 'Silent WBITs', which occur when a patient is transfused, by chance, with blood of a matching type to their own in spite of a WBIT error at sample collection, remain hidden in the system. Rates of silent WBITs are unknown.

WBITs compromise safety not only as a precursor to IBCT, but as the origin of inappropriate and/or delayed therapy due to incorrectly matched results. These errors are often overlooked but still represent significant risk to patients.

The science of 'human factors' (HF) is an integral underpinning to the research carried out in this project. According to the International Ergonomics Society, ergonomics or (the more commonly known) human factors can be defined as:

'...a scientific discipline concerned with the understanding of interactions among humans and other elements of a system, and the profession that applies theory, principles, data and methods to design in order to optimise human well-being and overall system performance' (International Ergonomics Association 2000).

Put simply, HF deals with factors influencing human performance, such as physical environments, individual characteristics, and management systems. It can contribute to describing known WBIT errors and discovering unidentified ones, as well as expanding our understanding of their underlying causal factors.

HF is necessary in the investigation of errors surrounding mislabelling and miscollection of blood samples since, in spite of attempts to reduce WBITs, the rate of occurrence remains relatively stable in this human-run process (Gonzalez-Porras, Graciani et al. 2008). Interventions to reduce WBITs may reflect assumed and not real practice and HF seeks to uncover

and design for the latter. New technology is often seen as a panacea for tackling risk, but patient safety within the current system must be addressed. It is important to understand the range of human factors contributing to errors in blood collection, rather than defer tackling these issues in anticipation of new systems.

Healthcare is a highly complex, adaptive system where relationships are critical, non-linear, and can lead to unpredictable dynamics and fluctuations. HF research employs qualitative methods which are well-suited to dealing with environments such as this.

This document outlines a descriptive study of factors impacting the ability to follow best practice in specimen labelling and patient identification, both of which are major causes of WBIT events. The application of a HF approach is in response to a failure of current attempts to reduce *WBIT which do not take account of the complexity of what is a human-dependent process* and treat solutions in isolation at an individual and not at a systems level. Identifying opportunities for and applying HF research can provide more answers and allow for the creation of *better designed* interventions.

Five key qualitative methods were utilised in this study:

- literature review,
- direct observations,
- interviews,
- survey, and
- proactive risk exercise (Failure Modes Effects Analysis - FMEA).

Further information was obtained from incident data. The findings from all sources are triangulated to provide recommendations for the development of best practice guidelines. A summary of the findings (p.12) as well as 40 recommendations for reducing WBIT errors (pp. 52-53 are included).

SUMMARY OF FINDINGS

Literature review:

- WBITs are currently underestimated (e.g. silent WBITs, under-reporting), with many errors unidentified or poorly understood
- healthcare systems exhibit resilience but rely on downstream error identification rather than prevention
- interventions have not been based on understanding causes of error and have focused on individual not systems levels
- barriers to change and cultural factors must be understood and taken into account, especially in healthcare

Observations:

- problems previously identified still occur without clear understanding of why they occur and/or continue despite intervention
- human factors play a significant role in causing WBITs
- nursing and medical groups approach blood collection differently
- culture must be considered in the development and implementation of solutions

Interviews:

- behaviours that deviate from the protocol have become accepted practice
- vigilance levels in blood sample collection was generally low

- required equipment and documentation was not at hand prior to the beginning of blood sample collection
- positive patient identification was routinely not performed
- relationships between laboratory and clinical staff require improvement

Failure Mode and Effects Analysis (FMEA):

- the separation of labels from notes was seen as a large contributor to error
- perception of risk varied based on the reason for blood sample collection (e.g. cross-match)
- labelling tubes was a key risk area, especially when not completed at the bedside

Survey:

- insufficient time is provided for education regarding blood specimen collection
- senior medical and management leadership is needed
- there can be a lack of understanding of each other's roles between clinical and laboratory staff
- error feedback is not always received by the relevant staff, or dealt with in a consistent manner

2 Introduction

2.1 Transfusion safety

Errors in blood transfusion are serious forms of medical error. They have, however, been largely neglected since the focus of adverse outcomes to blood transfusion remains on the safety of the blood product itself (Sazama 1990). There is a need to address the substantial risk that human process errors have on patient safety during blood transfusion (Dzik 2003). This project is a response to the desire, by the local transfusion community, to learn more about the risks involved in the complex multi-step process of transfusion and what factors predispose error.

Transfusion safety involves a series of complex events from appropriate specimen collection, compatibility testing, and product issue from the blood bank, to blood administration at the patient's bedside. Transfusion of blood to the wrong patient (mistransfusion) is one of the most important serious hazards of transfusion. The risk of mistransfusion is approximately 100 times greater than the risk of human immunodeficiency virus or hepatitis C virus transmission through blood transfusion (Dzik 2005).

Mistransfusion error is a leading cause of serious morbidity or mortality from blood transfusion. WBITs may begin the event chain leading to mistransfusion and are the result of procedural errors that are generally preventable.

The Serious Transfusion Incident Reporting (STIR) system is a haemovigilance program incorporating the states of Victoria, Tasmania and the Northern Territory. STIR identified transfusion-related procedural errors as a major issue, accounting for 38% of all incident reports (Department of Health 2008). The National Blood Authority (NBA) reported that in over 600 voluntarily-reported transfusion related incidents over the past 3-5 years, approximately 65% involved procedural errors (National Blood Authority 2008).

The four danger points in the transfusion process have been identified as:

1. the medical decision to transfuse
 - 'many doctors are ill informed, outdated or simply incorrect' (Dzik 2003).
2. the collection of patient samples
 - 'this accounts for between 10-15% of errors' (Linden, Wagner et al. 2000).
3. the laboratory where samples are analysed
 - 'manual techniques for blood grouping are inherently unsafe' (Stainsby, Russell et al. 2005).
4. the bedside administration of blood components
 - 'done by humans in a manner little changed in 50 years' (Dzik 2003).

Our research focus is on the collection of patient samples, where mislabelling and miscollection errors have the potential to start a chain of events which can lead to serious patient harm.

Linden (2000) reported that misidentification and mislabelling represent up to 15% of errors (danger point 2). However, these types of errors are often identified prior to an adverse event and consequently they often go unreported (Henneman, Avrunin et al. 2007). Considering this, they are likely to represent a much greater proportion of total errors than is currently reported.

Failure to report these errors is due, at least in part, to medical professionals not comprehending the significance of these errors when they are identified prior to (and thus not resulting in) an adverse event (Henneman, Cobleigh et al. 2008). In addition, some clinicians may feel that if errors are not identified by them, other procedural barriers would prevent an event further along in the process.

Unfortunately, adverse events usually occur as a result of a confluence of several errors – the 'failure of fail-safes or lack of fail-safes' (Bates, Cohen et al. 2001). Regardless of the reasons, it is clear that the numbers currently attributed to blood collection errors are just the 'tip of the iceberg'. The aim should be to prevent their occurrence, rather than continue to rely on the resilience of the system to identify and correct errors that put patients at risk of harm.

2.1.1 Patient identification

Safe transfusion of blood and blood components relies on accurate identification of the patient at a number of points in the extended process, including at the collection of pre-transfusion blood samples. The Australian Commission on Safety and Quality in Health Care (ACSOHC) has made patient identification a priority area of work, which mirrors the central focus other quality and safety organisations have given it across the globe. Inadequate patient identification is recognised as a root cause for serious transfusion errors (Murphy and Kay 2004). Bedside practice has improved, although in 2005, 6% of patients receiving a transfusion had no identification wristband in place and for 9% of those who did, the details were incomplete (Taylor, Murphy et al. 2008).

The mundane and routine procedures of patient and specimen identification are exactly the types of procedures that humans perform poorly. Issues concerning the perception of such tasks and the subsequent vigilance of those performing them are relevant for investigation. High task vigilance is needed to ensure correct identification of blood and patient, with all staff aware of the importance of correctly identifying the sample and patient and the potential risks of not doing so. Yet, most errors are multi-factorial and although they manifest themselves in mistakes made by the caregiver, are usually a result of a system failure that begins long before patient interaction at bedside.

2.1.2 'Wrong Blood in Tube' (WBITs)

WBITs are estimated to occur at a rate of approximately 1 in 2000 samples (Murphy, Stearn et al. 2004); (Gonzalez-Porras, Graciani et al. 2008). Practices resulting in WBIT reported from the literature (Krombach, Kampe et al. 2002) include:

- labelling of sample tubes away from the bedside
- failure to check patient identity
- similar names (exacerbated by incorrect identity checks)
- use of pre-printed labels
- confusion of patient notes and/or request forms
- inaccurate verbal instructions/no request form

It is well known that blood transfusion is a complex multi-step process involving personnel from diverse backgrounds with different levels of knowledge. Stainsby (2005) noted that "... staff undertaking phlebotomy must receive training and competency assessment", yet this is an area where practice may be less than ideal. Staff are often assumed to have had

adequate training although taught at different levels, by different teachers and with varied methodologies and without ongoing performance assessment. They undertake phlebotomy with limited supervision, and are often resistant to changing their technique. These factors, combined with the various practices listed above, make it easy to understand how errors can occur.

The nature of these errors makes HF a critical research avenue. There are a number of HF issues linked with WBITs (Dzik 2003), such as:

- poor communication between staff
- complexity of care and urgency of tasks
- confusing product labelling or packaging
- incomplete or inadequate education
- insufficient staffing or patient monitoring, and
- lack of automation or technologies that are mismatched to work processes.

Blood sample collection process

The ideal process, in a simplified form, in order to prevent WBIT error is:

- 1 Ensure request form is completed with all patient identifiers required i.e. full name, UR Number, and/or DOB.
- 2 Assemble all equipment required to collect the specimen, including sufficient patient labels (if these are used) to label specimens.
- 3 Identify patient using positive ID process: ask the patient to state full name and DOB and check these details and UR Number against ID band, patient documents and/or any products.
- 4 Collect specimens and place into appropriate containers using appropriate technique.
- 5 After checking UR labels, match the patient identifiers on request form and wrist band, label each specimen and initial that each label was checked for correct patient details. Sign and note date and time on request form.
- 6 Place all specimens in biohazard bag and seal, placing request form in outside pocket.
- 7 Dispatch to pathology laboratory.

3 Methods

Errors and adverse events in transfusion medicine are a significant concern, and many problems are unappreciated and likely to be underreported (Henneman, Avrunin et al. 2007). This is because investigating such errors in the process of transfusion is plagued by many of the same obstacles that affect other healthcare processes. Chart review and clinician self-reporting often provide data that underestimate the true scope of errors in transfusion medicine. Regardless of the method used, all traditional approaches to error detection rely on a pre-existing knowledge and recognition about potential types of errors. It is likely that a subset of medical errors remains undetected simply because these have not been previously identified as errors and consequently have not been monitored (Henneman, Avrunin et al. 2007).

Qualitative Research

Qualitative methods are well-suited to dealing with risk and safety within the transfusion domain since healthcare is a highly complex, adaptive system where relationships are critical, generally non-linear, and lead to unpredictable dynamics and fluctuations.

This study adopted a *multi-method qualitative approach*, based on five key methods, which were triangulated to explore the identified HF issues. Triangulation means comparing the results of different theories, methods, data sources, investigators or analytical methods to explore a single problem or phenomenon (Burns and Grove 2001) and is one of the advantages of a mixed method approach (Sandelowski 2000). The purpose of triangulation is to achieve greater confidence in the findings and to validate conclusions (Bryman 2004).

To best understand why errors occur when health professionals are taking blood samples, it was important to use different data collection methods so that the underlying causes could be identified and analysed from these varied perspectives. The following methodologies were assessed to be the most appropriate to match the aims of this project:

1. **Literature Review**
2. Direct **Observations** in different settings
3. **Interviews** with key stakeholders in the blood collection process
4. **Survey** of Transfusion Nurses, and
5. **Failure Modes and Effects Analysis (FMEA)** multi-disciplinary risk process
6. Analysis of **Incident Data**

As identified in the literature review (Section 3.1), there are many studies that have attempted to quantify and explain the WBIT phenomenon, with varying degrees of success. From this work we were able to build up a picture of the issues to address in our research. We chose to adopt a 'grounded theory' approach. Simply put, this means that we allowed theory about factors that predispose errors in blood collection to develop from the data, rather than the other way around.

Grounded theory has a long history as a qualitative research methodology and emphasises the "iterative nature of discovery" (Glaser and Strauss 1967; Strauss and Corbin 1998). It is well suited to research designed to identify major categories of behaviour patterns (such as compliance with blood collection protocols) rather than being led by preconceived concepts. This study was initiated with one broad research question, "Why do errors occur when taking blood, particularly in the hectic setting of an Emergency Department?"

Hospital study sites

The research was carried out at three metropolitan hospitals in Melbourne, Australia. These were selected pragmatically and opportunistically because of existing, good relationships between lead researchers of the current research project and haematology, clinical, quality and pathology professionals at these hospitals. Each of the hospital study sites brought different characteristics which directly and indirectly influenced the culture and process of blood collection in their institution. This allowed the research team to increase the investigation of WBIT to a greater number of 'scenarios'.

Differences in the three hospital study sites include:

- sample acceptance criteria (e.g. zero tolerance* vs. minimum criteria acceptance)
- patient populations (e.g. children vs. adult)
- trauma level services (e.g. state major trauma vs. tertiary referral centre)
- phlebotomy support services (e.g. pathology collectors vs. no pathology collectors)
- technology (e.g. paper request forms vs. electronic 'e-ordering')
- labelling requirements for cross match samples (e.g. handwritten vs. pre-printed)

* *zero tolerance* refers to the practice of rejecting and discarding blood samples if any of the required labelling elements (e.g. signature, date, date of birth, etc) are missing. This compares with protocols that allow specimens to be accepted if certain compulsory elements are completed, but allow staff to complete and re-submit blood samples with other missing, non-compulsory label elements.

Emergency Department (ED)

Transfusion safety is an example of a general domain that demands proper functioning of many interconnecting factors and processes rather than a single human completing a task. Analysis of incident data from the three metropolitan hospitals revealed that the Emergency Department (ED) was an area of patient care where significant numbers of mislabelling events occur. Consequently the ED was chosen as the focus of the observations, interviews and FMEA.

The ED has been described as a “natural laboratory for the study of error” (Croskerry, Shapiro et al. 2004). It provides a rich ground for the investigation of how an apparently simple task like blood taking can become more error-prone due to the context in which the testing is being carried out.

Preliminary discussion with ‘clinical champions’ identified the following reasons for the high rate of WBITs in the ED:

- high number of patients (pressure on timely turnover)
- urgency of individual cases
- ability of patients to communicate (impaired consciousness, language barriers)
- low staff-to-patient ratios
- time pressures (increased cognitive demands)
- high workload (competing tasks)
- high stress (emotional demands of work)
- interruptions (burden on memory and attention)
- rotating staff (implications on education and team culture)
- fatigue (physical and mental pressures)

Kaplan (2006) acknowledged that the complexity involved in carrying out the process of transfusion in a fast-paced environment like the ED, with multiple, interdependent components, numerous interruptions, and very ill patients, results in the potential for many errors.

A US Joint Commission Sentinel Event Alert issued in August 1999 and entitled ‘Blood Transfusion Errors: Preventing Future Occurrences’ claimed that “the processes involved in blood transfusion exhibit virtually all of the factors recognised to increase the risk of an adverse outcome”.

The following list is adapted from this document and highlights these factors:

- variability (patients could have 1 of 30 different blood group systems)
- complexity (including the technical aspects of cross matching and monitoring patients)
- inconsistency (no standardisation of procedures across hospitals)
- ‘tight coupling’ (failure in one step, leaves little chance to stop the sequence of the process)
- human intervention (is relied on but the process requires a high level of accuracy)
- tight time constraints (extra pressure on humans performing tasks, requiring high attention)

Different areas in the ED

Within the ED, different areas are designated for patients of different presentation or acuity. Each of these areas may be physically different and present different contextual challenges for blood sample collection.

Variations exist between hospitals in the use of different patient treatment areas, depending on the patient population treated, as well as methodological, administrative and historical factors. Although each site did not contain all area types, important areas within the EDs included:

• Triage

The point where patients present to the department either self-referred or via emergency services. Patient’s are assessed and prioritised according to the urgency of medical need.

• Central Workstation/Staff Station/Flight Deck

The centrally located area of the ED where computer terminals, writing desks, ward clerks and telephones are typically located. It usually provides an uninterrupted view of at least some assessment bays.

• Fast-Track

An area for the assessment and treatment of patients with less serious illnesses and injuries. Made up of either cubicles, treatment chairs, or a combination, these areas are typically smaller, have less within-bay equipment, and may be further removed physically from the central workstation.

• Assessment Bay

The cubicles within the ED where patient consultations and treatments occur. Separated by either solid walls or curtains, each cubicle contains a trolley and other equipment, although blood sample collection equipment may be shared between a number of assessment bays.

• Trauma/Resuscitation Bay

The area used for the resuscitation and treatment of critically ill or injured patients, each patient occupying one bay (although Hospital Two can accommodate up to two patients). Each bay is usually well-equipped and relatively spacious; although the nature of the patients treated here means that multiple staff members may be attending each patient.

• Treatment/Procedure Room

A room (with a door) used for treatments or procedures particularly where privacy is required or interruptions undesirable (e.g. lumbar puncture, tube thoracostomy, plastering, suturing).

• Short Stay Unit

A number of bays where patients are admitted and either await an inpatient bed or complete a treatment course for conditions requiring limited duration of treatment or observation.

Whilst different sites utilise alternate terminologies, below is a generalised summary of treatment areas available for use in each of the study sites.

	Trauma	Resuscitation/ High acuity	General	Short Stay Unit	Fast-Track	Other	TOTAL
Hospital One	4	4	17	12	8	3	48
Hospital Two	2	2	27	12	2	3	46
Hospital Three	0	5	19	9	0	8	41

Table 1: Emergency Department composition at each study site (information provided by NUM at each site)

3.1 Literature Review

The aim of the literature review was to review and analyse current gaps in work surrounding WBIT. An extensive search was undertaken to identify relevant literature up to and including December 2009. PubMed and MEDLINE databases were searched using the terms: transfusion, blood sample, blood collection, mislabelling, miscollection, interventions, reporting, safety, error, incidents and combinations of these terms. Searches were restricted to articles regarding humans and written in English. These searches produced a total of 118 articles (Figure 1).

The titles were initially screened by the principal author for relevance to this literature review, and abstracts of ambiguously

titled papers were reviewed (where available). The reference sections of the identified articles were reviewed to identify further relevant papers. This search was supplemented by a web-based search through Google and Google Scholar using the terms: transfusion safety, human error, human factors and new technology. Identified sites were further restricted using filters to those from Australia, United Kingdom, Europe, Canada and the United States of America. Manual searches of relevant journals and grey literature, including reports, were also undertaken. A total of 108 articles are included in the Literature Review, which is provided as an accompanying document. It outlines national and international initiatives and includes a focus on education and technology.

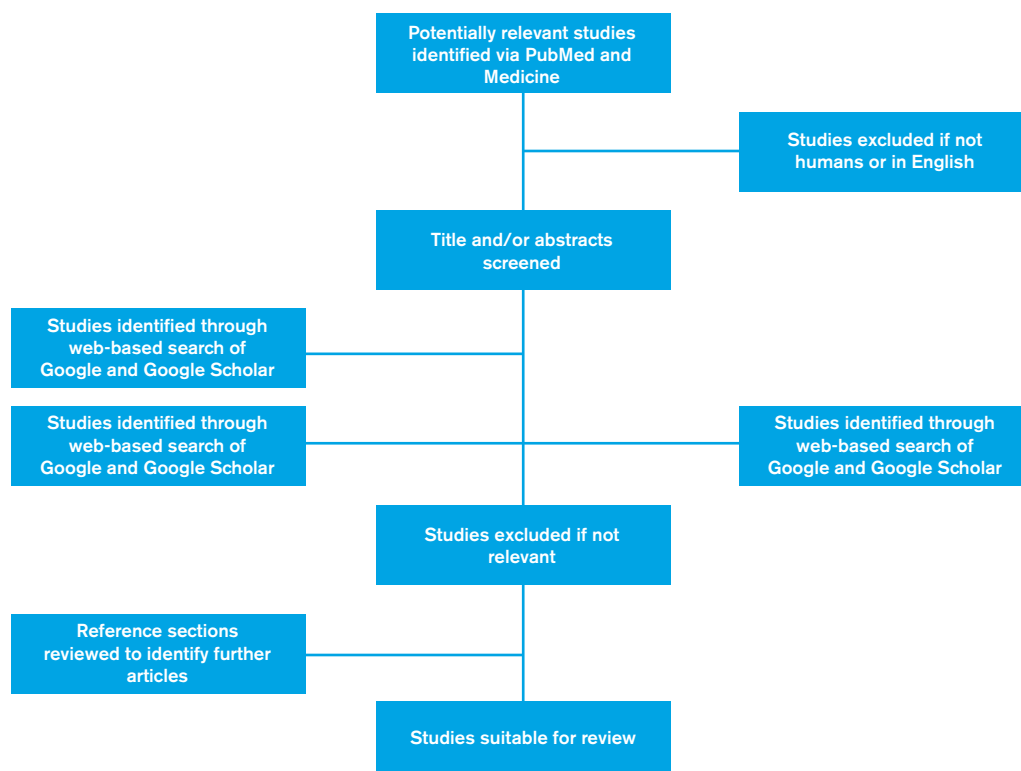


Figure 1: Flow chart of search and selection process for identification of studies included in Literature Review

3.2 Observations

The aim was to observe and so study the human factors around process errors which increase the risk of WBIT. Specifically, we sought to discover some of the barriers that staff face in the proper execution of blood collection and patient identification processes.

Approval for this study was obtained from Human Research and Ethics Committees (HRECs) at all sites for observations. Written consent from participants (patients or staff) was not required. No identifying information was recorded on any staff or patient included in these observations.

Information leaflets about the study were provided to patients. Hospital staff were informed about the study through introductory meetings within the departments, in-service sessions and emails sent via unit managers. No staff or patients were obliged to participate in observations. No audio or visual recordings were made of any observation sessions.

Participants were informed at the beginning of each observation that the researcher was conducting observations and that these observations were not evaluating their clinical or communication skills but trying to describe the contributing factors behind mislabelling and miscollection events.

Participants were advised that notes would be made of their words and actions, unless they specifically requested otherwise. At each observation session, specific acknowledgement was made by the researcher of the expert nature of staff in working within their roles and setting, that observations were being made by a non-clinically trained researcher, and that criticism of work practice has no place in this study.

During a six month period, a single researcher (with a background in psychology, human computer interaction and qualitative research methods) observed the activities relating to blood collection unfolding within three hospitals.

The majority of observations were undertaken in the EDs of the hospitals, with remaining observation sessions carried out in an Oncology Day Unit and during general ward visits with Pathology Collectors. Some additional observations were made at Central Pathology Reception and in laboratories.

The *first* phase involved preliminary observations in the Oncology Day Unit, Central Pathology Reception and Laboratory and with mobile Pathology Specimen Collectors on ward visits within two of the hospital sites;

- two different pathology collectors were followed on three morning rounds (a total of 13 blood collections were observed).
- three morning observation sessions were spent in a Haematology and Oncology Day Unit (a total of 7 blood collections were observed).
- a day was spent with blood bank scientists observing testing procedures and protocols, and
- three days were spent observing a quality manager responsible for the Central Pathology Laboratory for one of the hospital sites.

Through this phase, the researcher gained familiarity with the processes and sub-processes that occur as part of blood sample collection and analysis, prior to the official period of observations in the ED setting. Insights from these preliminary observations can be found in Appendix 1. In addition, information from this phase was used to develop a structured audit tool (see Appendix 2) for use during the formal ED observations which are reported in full.

The *second* phase involved observations in the EDs of the three hospitals (Table 2). Observation sessions lasted between five and 65 minutes and occurred during weekday morning and afternoon shifts. Each session took place from patient entry in the treatment area, to delivery of the sample to the chute or ward clerk. Observations were recorded on the audit tool, as were notes of contemporaneous discussions. Discussions of observations were conducted as soon as practical after the observation event and served as an informal verification of the researcher’s interpretations.

Different approaches were taken to identify when blood sample collection was occurring or imminent, in order to maximise the number of blood collections observed in any one session and to ensure a variety of situations and staff were observed.

Six strategies were adopted with effectiveness varying based on site, time and day:

	Assessment bays	Treatment rooms	Trauma/Resuscitation bays	'Fast-Track' bays	Total
Hospital One	15		5		20
Hospital Two	10	5			15
Hospital Three	17		2	2	21

Table 2: Location of observations at the three sites

1. nurse was shadowed (i.e. followed around for the duration of shift to observe pattern of work, in and around blood collection)
2. junior doctor was shadowed (as above)
3. imminent blood sample collection identified through collection of blood trolleys from the main work station
4. imminent blood sample collection identified through the nurse in charge following admission of new patients to the department
5. imminent blood sample collection identified through triage nurse following arrival of new patients to the department
6. imminent blood sample collection identified through arrival of patients to trauma and resuscitation bays

Finally, the observational data collection was supplemented with a documentary analysis to help enrich understanding of the WBIT issue and strategies to alleviate their occurrence. These included protocols, memos, incident logs and other organisational and safety-based documents from the emergency departments. Some of the difficulties surrounding observational research are discussed below in the context of how we sought to manage and capitalise on this method, which was crucial to a comprehensive HF analysis of WBIT.

Difficulties in observational research

In general, observational studies of actual work in practice and/or patient care have been shown to be a good measure of active errors and more powerful than self or peer reporting systems. But there are drawbacks. Subjectivity of the researcher, non-systematic gathering of data, reliance on subjective measurement, and possible observer effects, all have the potential to distort results unless appropriate care is taken in the planning and execution of the study.

The impact that the act of observing people can have on the way people behave and on their expressed opinions about their behaviour and work, is commonly referred to as the 'Hawthorne Effect' (Wickstrom and Bendix 2000). The Hawthorne Effect cannot be totally avoided, but can be minimised by the use of appropriately trained non-clinical researchers to perform the observations. It has been reported that healthcare professionals are more likely to feel uncomfortable if being scrutinised by 'peers' rather than neutral outsiders (Carayon and Alvarado 2007).

Ethical issues for participants in research studies that involve observation of clinicians in their daily work practice, and interactions with other staff and patients, include *anonymity, confidentiality and consent*.

The nature of qualitative work where an individual's responses – often their exact words – are reproduced, can make assurances about anonymity and confidentiality difficult. In uncontrolled settings, such as clinical practice, consent can become an issue where new staff enters the field of observation after an observation has commenced. Pausing observations to obtain consent from new individuals would affect the flow of the processes under observation in an unacceptable way. This issue can be minimised by the provision of information about projects to all staff prior to commencement and clarification of consent post hoc where necessary.

There is an imperative if 'natural' interactions are to be maintained, to limit the influence of the researcher on the normal flow of events. Interruptions to processes and interactions must be kept to a minimum during the observation.

However, in order that information is obtained in a thorough and timely manner, questions or discussions should take place as soon as practical following the observation event (e.g. in between patients, on breaks etc) and use only passive questioning techniques. Researchers must also limit their spatial impact whilst maintaining the ability to accurately observe relevant aspects of the task.

3.3 Interviews

The aim of this part of the study was to investigate the attitudes and perceptions of key stakeholders involved in blood sample collection. The interviews took place at only one of the study sites.

A preliminary set of interview questions were developed from the observation study and literature review. Pilot interviews were performed separately with a transfusion nurse, trauma nurse and junior doctor, to refine the questions, terminology and flow of the interview.

It was identified through this process that the interviews would be most informative if conducted by someone with relevant clinical experience. This experience enabled the interviewer to speak as a peer rather than an outsider.

In the observation study it was advantageous to have a non-clinical observer in order to avoid staff feeling like their clinical competence was being audited. In contrast, interviews relied on a level of rapport and understanding of the situation that was best established by a clinically trained interviewer.

The ideal length of time for an interview was identified to be an hour, but it was recognised it would be difficult to secure all

interviewees for this length of time. Accordingly, a collapsible interview protocol was developed. This consisted of an ideal protocol (Appendix 3) and an abbreviated version where some questions could be omitted if necessary. This ensured that questions identified as most important to the research were included in all interviews.

The questions focused; on the knowledge of blood sample collection, use of guidelines, physical environment, labelling issues, safety culture, adverse events, interruptions and interactions with pathology staff.

Opening statements for different sections of the interview were prepared. They were designed to lead into each new set of questions and to promote the feeling of a guided conversation rather than a question–answer session with researcher and subject.

All questions were open-ended and new questions were allowed to arise as a result of the discussion. Some new questions were subsequently incorporated into the protocol. Similarly, tapes were reviewed after each interview in order to appraise the questions and amend the protocol where necessary (as per (Bryman 2004).

Department	Position	Site	Time in current role	Relevant experience
Nursing	Trauma Nurse	Hospital One	>20 years	Long tenure trauma nurse
Nursing	Trauma/ED Nurse	Hospital One	3 years	Highly experienced with post graduate qualifications in Emergency Care
Nursing	ED Nurse	Hospital One	11 years	Long tenure Emergency nurse
Nursing	ED Nurse	Hospital One	9 years	Long tenure Emergency nurse, trained overseas
Nursing	Transfusion Nurse	Hospital One	5 years	Previously haematology nurse
Nursing	Transfusion Nurse	Hospital Three	3 years	Nursing for 13 years in areas including intensive care, surgery and general
Nursing	Transfusion Nurse	Hospital Two	1 year	12 years in neonatal intensive care nursing
Medical	ED HMO	Hospital One	Second year	Currently caring for patients with mid to low acuity
Medical	ED Intern	Hospital One	First year	Currently working in Emergency, not involved in trauma
Medical	ED Intern	Hospital One	6 weeks	Currently working in Emergency, not involved in trauma
Medical	ED Registrar	Hospital One	Second year	Currently running resuscitation bays with Trauma Registrar
Medical	Haematology Registrar	Hospital One	1 year	2 years in Blood Bank, now in final (4th) year of Haematology training

Department	Position	Site	Time in current role	Relevant experience
Pathology	Senior Scientist – Blood Bank	Hospital One	16 years	Working at Hospital One for 23 years, grade three scientist
Pathology	Pathology Collector	Hospital One	2 years	Previously collector for private pathology
Pathology	Pathology Collector	Hospital One	3 years	One of several dedicated collections staff
Pathology	Pathology Reception	Hospital One	3 years	Duty supervisor in specimen reception
Clerical	Ward Clerk – ED Reception	Hospital One	5 years	Experienced, long-tenure administrative staff

Table 3: Description of interviewees

Detailed, semi-structured interviews were scheduled with seventeen staff (Table 3). Interviewees were chosen opportunistically through links forged during the observation study and preliminary meetings. A set of criteria was developed to ensure that a variety of levels of experience and roles were represented by the interviewees.

Interviews took between 30-70 minutes and were all conducted by the same experienced, registered nurse. Interviews were recorded and later transcribed verbatim.

The interviews were coded according to thematic analysis, an approach for dealing with data by identifying passages of text and applying categories (or 'codes' or 'labels'). The codes identify portions of the text that represent some thematic idea (Aronson 1994) allowing the emerging themes from the data to be organised in a meaningful way. The qualitative software package N Vivo (QSR International 2008) was used in this process.

The coding structure was developed iteratively between two members of the research team, who were both involved in interview development and pilot interviews. The interview transcripts were segmented and annotated to identify key themes in an open coding process.

This preliminary list of categories was then refined and relationships between categories (i.e. links to sub-categories) established (Patton 2002). Final coding was done by one researcher (the interviewer), but a subset of interviews was double coded to check for consistency.

Ten thematic categories, each with constituent factors, were identified from the interview transcripts, as represented in Table 4.

Thematic Category	Key Facets (Where Appropriate)
Blood collection (1)	Blood collection from assessment bays (1.1) Blood collection during resuscitation (1.2) Re-bleeding (1.3) Blood delivery to pathology (1.4)
Equipment (2)	Blood tube familiarity (2.1) Labelling of blood samples (2.2) Availability of labels (2.3) Stocking of blood trolleys (2.4) Gloves (2.5)
Request forms (3)	Verbal requests (3.1) Access to doctors for signatures (3.2) Blood samples awaiting request forms (3.3)
Patient identification (4)	Registration process (4.1) Positive patient process (4.2) Wristband verification (4.3) Purpose of signatures (4.4)

Thematic Category	Key Facets (Where Appropriate)
Interruption (5)	Common interruptions (5.1) Consequences of interruption (5.2) Managing interruptions (5.3)
Education (6)	Awareness (6.1) Transfusion Nurses (6.2) Familiarity with pathology services (6.3) Incident feedback (6.4) Supervision (6.5)
Guidelines (7)	Understanding (7.1) Adherence (7.2) Deviations (7.3)
Risk perception (8)	Vigilance (8.1) Knowledge of risks (8.2) Training (8.3)
Safety culture (9)	Zero tolerance policy (9.1) Incident reporting (9.2) Blame culture (9.3) Management support (9.4)
Team culture (10)	Resilient practice (10.1) Interaction with other ED staff (10.2) Interaction with lab staff (10.3)

Table 4: Text Coding Themes and Constituent Facets

3.4 Survey

The aim of this mode of research was to explore the nature, range and effectiveness of interventions used to combat WBIT through an online survey of Australian Transfusion Nurses (TN). Anecdotal evidence suggests that different hospitals have used a variety of strategies to attempt to reduce their WBIT rates. Unfortunately, little information exists about either the types of interventions or their effectiveness, particularly in the middle to longer term, and collective audits or reviews have not been published.

Transfusion Nurses are employed within a particular health service or hospital to work with medical, nursing and laboratory staff to promote safe and appropriate use of blood and blood products. TNs are required to have a minimum three years post-registration experience within an acute care setting and current clinical knowledge in nursing with basic haematology skills and knowledge (Department of Health 2010).

The Transfusion Nurse (TN) role was first introduced in Victoria in 2003 as part of the Victorian Department of Human Service's Better Safer Transfusion (BeST) Program (currently known as 'Blood Matters'). Blood Matters is a Victorian state government program for improving the quality and safety of hospital transfusion care to patients. The TN role is a large part of this initiative.

The manner in which TNs approach their role varies according to hospital needs and individual interests and strengths, but reduction of WBIT rates is a common theme as is education and training around clinical competencies relating

to transfusion practice. Thus TNs can be considered to be an excellent repository of knowledge about WBIT-based interventions. In addition, TNs as a group are highly motivated and participate regularly in online surveys, which feedback valuable information to Blood Matters. Established links with the Blood Matters Program through the Monash University Department of Epidemiology and Preventive Medicine Transfusion Research Unit enabled access to the TN network.

The survey was developed following brainstorming of relevant questions by the research team. Questions were refined and piloted with one TN to ensure clarity, comprehension and relevance. The format of check box and narrative options was selected to allow TN's to elaborate on aspects specific to their context, or for additional comments. The survey also included a number of questions that allowed for longer discussion of issues. A copy of the 23 question survey can be found in Appendix 4.

The survey was constructed and administered through the web-based survey program SurveyMonkey (www.SurveyMonkey.com). Thirty-four transfusion nurses from the 'Blood Matters' network (encompassing VIC, TAS, ACT and NT) were invited to complete the survey and three reminder notices were sent to potential participants. A total of 21 responses were received representing 62% of those invited to participate. Quantitative responses were analysed using descriptive statistical methods. Narrative responses were imported into N Vivo, and subjected to thematic coding (as described in Section 3.5 above).

3.5 Failure Modes and Effects Analysis

The aim of this part of the study was to apply a proactive risk tool, adapted from other high risk industries for use in healthcare to identify and rank risk in the context of WBIT.

Although many different methods have been used to conduct systems analysis in other high-risk industries, few methods have been widely used in health care. Systems analysis methodologies include fault tree analysis and probabilistic risk assessment, however, these methods are better suited to technical rather than socio-technical systems like healthcare.

One method which has already been translated to healthcare and is better suited to the complexity of clinical care settings is 'Failure Modes and Effects Analysis' (FMEA). FMEA is a systematic, prospective tool designed to allow for identification of where and how processes might fail in order to reveal parts of the process most in need of change (Senders 2004). It helps those managing risk to take proactive steps to eliminate or reduce failures, starting with those of highest-priority.

The Victorian Managed Insurance Authority (VMIA) has recently begun a series of training courses in FMEA in order to provide a complement to the existing quality improvement tools such as Root Cause Analysis (RCA). RCAs have been shown to be beneficial but they are, by nature, reactive tools performed after the event. An FMEA is, by contrast, a proactive tool that should be used before any type of event has occurred or to model potential failures in a suspected or proven high risk process. Another difference between the two systems is that RCA focuses on an individual event whereas FMEA generally focuses on a complete process (Apkon, Leonard et al. 2004). Since FMEA is applied prior to an event, the view of how

processes may fail suffers from less bias. However, it is still a subjective exercise.

FMEA begins with the development of process maps through observations and interviews. Key stakeholders are engaged to help identify the 'failure modes' (things that could go wrong at each sub-process step) and their 'effects' (or outcomes – in this case patient safety is of particular importance). Further observation of work in practice may supplement this process. Failures are then prioritised according to how serious their consequences are, how frequently they occur and how easily they can be detected. These 'severity', 'likelihood' and 'detectability' scores (which have annotated rating scales) are used to calculate 'Risk Priority Numbers' (RPNs) ($S \times L \times D$). Risk reduction interventions are then able to be planned to address the potential failures. In practice, RPNs are grouped according to the timescale in which action is required i.e. the failure modes that can be addressed immediately, those that will be addressed at a later date or those that are determined to require no action. This grouping process usually occurs through the identification of threshold RPNs (e.g. RPN above which action is deemed to be urgently required). The evaluation of interventions and re-assessment of RPNs in light of the interventions completes the FMEA process, although ongoing monitoring is desirable.

One key drawback of the FMEA process is that it is very time-consuming and may suffer from lack of engagement (Senders 2004). As such, it was hoped that the FMEA undertaken as part of this project would be able to be easily adapted by others (e.g. hospital transfusion committees or quality units) and facilitate reduction in potential for WBITs at many sites.

Blood Sample Collection FMEA

Two recent FMEA's have been carried out in Victoria, centring on blood transfusion. The first was at Peter MacCallum Cancer Institute and focused on blood collection in an Outpatient Pathology Unit. The second took place at Sandringham Hospital, a community hospital within Alfred Health, and sought to model failure modes when nurses took blood samples in the resuscitation bay of the ED. In contrast, the FMEA reported here considered blood samples taken from stable patients in the assessment

bays, incorporating relatively new electronic blood ordering systems.

Both of these other studies were undertaken after the commencement of this project and results have yet to be published. Contact was made with investigators of both studies prior to this FMEA process and their shared experience contributed to this study.

In this project, the observational data from the three ED sites was used to form the basis of the process map (i.e. to produce an 'as is' rather than 'should be' process map). The observations and interviews were also important in helping to illustrate risk concerns and stimulate group discussion when creating and assigning scores to potential failure modes. However, the multidisciplinary team which included an ED nurse, a transfusion nurse, an ED Registrar and a Quality Manager (in addition to the two research staff) was specific to one of the study sites.

The Quality Manager who was part of the process was experienced in the facilitation of FMEA, having undergone the

extensive VMIA training program. The primary researcher was also experienced in FMEA methodology. VMIA FMEA training tools were made available by members of the project team. Two meetings of the multi-disciplinary team took place; the first to verify the process map and the second to verify potential failure modes and allocate scores. Modified ranking scales for probability (Pierce and O'Quinn 2006) were used. These modified scales can be found in Appendix 6.

Implementing risk reduction interventions to address potential failures was beyond the scope of this project but it is hoped that the process will continue within the relevant hospital.

Steps for an FMEA (Adapted from DeRosier, Stalhandske et al. 2002).

1. Define the topic - a case study may be a useful way to begin.
2. Map the process involved – it is important to directly observe the process rather than rely on protocols or assumed practice (*What happens?*).
3. Gather a multidisciplinary team to verify the process map and brainstorm the so-called 'failure modes' for each of the sub-processes (*What could go wrong and why?*).
4. List the potential 'effects' of each failure mode (*What would happen if it did go wrong?*).
5. Assign Severity, Likelihood and Detectability scores, using annotated rating scales to each and calculate 'Risk Priority Numbers' [RPNs = S x L x D] (*What are the biggest risks?*).
6. Meet with the multidisciplinary team to verify the assigned scores.
7. Decide upon the threshold RPNs and timeframes for action (*Which risks need most attention and when?*).
8. Identify interventions to reduce RPNs of separate failure modes (*How can we reduce risk?*).
9. Implement interventions.
10. Re-assess failure modes in light of interventions.

3.6 Incident data

In addition to the aspects of the project described above, data regarding mislabelling and miscollection events was collected and analysed. With the assistance of Risk/Quality Managers at the project sites, relevant incident reports for the five year period 2004-2009 were requested. This included a review of the main electronic incident reporting repository for Victorian hospitals, 'RiskMan' (RiskMan International 2010), and other quality reporting systems where they existed.

In addition, permission was obtained for review of the Blood Matters 'Serious Transfusion Incident Reporting (STIR)' data. STIR is a haemovigilance framework which was modelled on the United Kingdom Serious Hazards of Transfusion (SHOT) system. It was established in 2006 and captures information on serious hospital transfusion incidents, including near misses. All reports to STIR are reviewed by an expert group to validate clinical features, determine severity and attribute causality (Department of Health 2008). WBITs are an incident category reported to STIR.

The aim of this exercise was to evaluate current methods and systems of data collection surrounding WBIT and to provide recommendations about how to improve these to facilitate learning and improvement, thus preventing WBIT-related errors.

3.7 Recommendations

This report uses the six identified qualitative methods to reveal how HF impact upon the ability to follow best practice in specimen labelling and patient identification. The ultimate aim is to be able to promote best practice and suggest recommendations for further work which may help to alleviate the major causes of WBIT events and, thus, reduce harm in blood transfusion.

Section 4.2 presents the observations and interviews which form the bulk of the data collected for this report, under a set of six key HF themes (i.e. Environment, Staff, Equipment, Patient, Procedure and Culture). Each theme has a number of

corresponding issues which are the subject of potential best practice recommendations for those in clinical settings and particularly in the ED.

In order to give structure to these recommendations, we have borrowed from theory based on Haddon's countermeasures model (Haddon 1973). Developed to understand the processes by which injury occurs and can be prevented, this is a useful tool for those attempting to rank the impact of different countermeasures as applied to specific risks, in this case, within the process of blood collection in the ED (Runyan 2003). Haddon organised 10 countermeasure strategies to address injury control. These ranged from preventing the creation of the hazard through providing a physical barrier to those at risk to providing good quality care to counter damage done by the hazard (Haddon 1973).

Haddon's work formed the basis of a subsequent model called the 'Hierarchy of Controls' which was developed within the Occupational Health and Safety (OHS) domain (Workcover Authority of TAS 2008) and has found its way into the Victorian Department of Health's Root Cause Analysis (RCA) investigations. For RCA recommendations to be credible, the hierarchy of controls must be used to evaluate these and rate the likelihood of their effectiveness (Department of Health 2010).

Echoing the original countermeasures concept, the hierarchy of controls moves from elimination and/or substitution of the hazard, to the use of engineering or administrative controls and, finally, to accepting the risk and providing personal protective equipment to protect employees from contact. In many cases a range of countermeasures must be used to control hazards or risks and these measures are arranged in order of implementation preference and effectiveness. That is, the most effective or strongest measures are at the top (preventing the occurrence of the hazard or protecting against it) and the least effective or weakest measures (accept the hazard and deal with the consequences) at the bottom. Considerations

for choosing between different control measures should also include whether there are possible inadequacies of particular control measures in specific contexts. Woodward et al. have most recently linked Haddon's conceptualisation directly to error-reduction strategies in healthcare, stating that 'error-reduction strategies can be ranked by their effectiveness in decreasing the probability of error and harm, forming a safety spectrum' (Woodward, Mytton et al. 2010). These authors suggest that there are strong, intermediate and weak strategies (see below) and that these rankings can be used to guide priorities for action.

1. *Strong strategies*: These are strategies that build forcing functions into tools and procedures, making it difficult for an error or adverse event to occur in the first place. Forcing functions can be both in engineered safety devices and human procedures. A healthcare example is colour-coded pressure gauges (green for oxygen, blue for nitrous oxide) in theatres.
2. *Intermediate strategies*: These strategies include standardising less error-prone work processes and removing incentives in the work environment that encourage short-cutting and 'workarounds.' An example of an intermediate strategy in healthcare is the requirement for the use of techniques, such as the SBAR (Situation, Background, Assessment and Recommendation) tool, to prompt appropriate communication and 'read-back' in handover.

3. *Weak strategies*: The weakest strategies focus on education aimed at changing individual behaviour. This is primarily because there is little known about the process and factors involved in changing physician practice especially in response to guidelines and other widespread education attempts. An example of a weak strategy might be an in-service training on a complicated device or, after an adverse event, retraining a sole individual.

The best practice recommendations we provide in this report will all be rated according to the levels identified by Woodward et al. and suggestions for further work provided. The conclusion presents those considered to be most significant to help people who are tackling WBIT at a clinical level. In a case investigation of WBIT, Astion (Astion 2006) notes that 'the strong interventions are more expensive and difficult to implement, but are likely to be the only truly robust solutions to the pervasive problem of mislabelling.' The researchers attempt to address the conflicting pressures of strong intervention and cost-effectiveness by providing suggestions for further research.

4 Results and Discussion

4.1 Literature Review

The Literature Review is provided as a separate, stand-alone document. It encompasses a comprehensive scan of academic and 'grey' literature relating to WBIT and is something that has not been undertaken previously in the Australian context.

The review describes current best practice guidelines in the area of WBIT and outlines national and international strategies to deal with blood collection errors. There is a focus on interventions, their effectiveness and appropriateness within the Australian healthcare system.

4.2 Observations and Interviews

The series of observations of 56 blood sample collection events and interviews with 17 staff are reported together. In addition to qualitative aspects of the observations and interviews, the use of a structured observation tool (Appendix 2) allowed the collection of quantitative measures related to best practice in blood sample collection. The results are represented in Figure 2.

The only aspect in which there was 100% compliance with protocol was in signing the tubes prior to dispatch. Whilst it is positive that clinicians were uniformly undertaking this step, qualitative data presented in Section 4.2.5.3 indicates staff have little understanding of what their signature represents and so the value of the signatures is questionable.

Gloves were worn in 86% of blood collections observed. Some of the instances where they were not used represented situations where available gloves impeded the task. This issue is discussed further in Appendix 9, since it is not specifically relevant to WBIT events. Dedicated blood collection trolleys were only utilised in three quarters (74%) of blood sample collections. In the remaining instances, trolleys were already in use and alternative strategies were employed (Section 4.2.3.1).

Wristbands were in place in 69% of observed blood sample collections. In some instances wristbands were provided by the ward clerk but not attached to patients or used in ID checks.

The correct patient medical notes were at the bedside at the time of blood sample collection in 68% of cases and accompanied by appropriate labels in 62% of cases. This result is reflected in the qualitative results which point to the normalised practice of taking tubes to the workstation to look for notes and labels. In 60% of cases the request form was not present before blood samples were taken. Nurses were either acting on verbal orders, or pre-empting doctors' wishes in an attempt to expedite patient care (see also Section 4.2.5.1).

The correct procedure for carrying out positive patient identification, including verifying against the wristband, was only observed 38% of the time. More detailed quantitative data on this issue was not collected, but a range of behaviours were observed including no attempt at patient ID and 'confirmatory' rather than positive ID (see Section 4.2.5.3).

Cause and Effect Diagrams, also known as 'fishbone' or 'Ishikawa' diagrams (Ishikawa 1982), are used to allow possible causes of a particular problem to be depicted. The factors identified from the qualitative aspects of the observations and interviews (including those just discussed) are represented on a cause and effect diagram (Figure 3).

These factors are also used as headings (Sections 4.2.1-4.2.6) to report and discuss the results of the observations and interviews.

All names used within the observation vignettes are fictitious. It is important to remind the reader also that although the observations come from all three sites, the interviews are from a single site.

Each section provides a detailed discussion of the theory and evidence surrounding the key issue at hand and provides recommendations for strategies and initiatives relevant to the blood sample collection process.

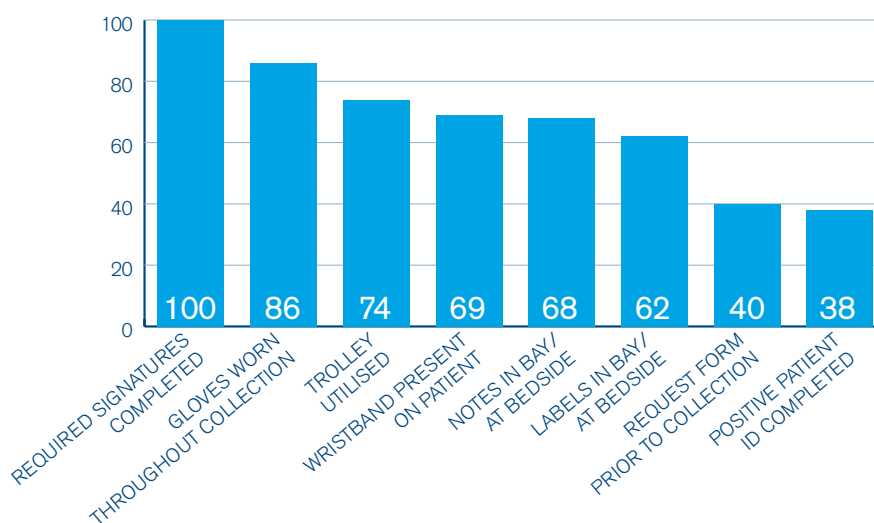


Figure 2: Components of best practice witnessed during observations (n=42)

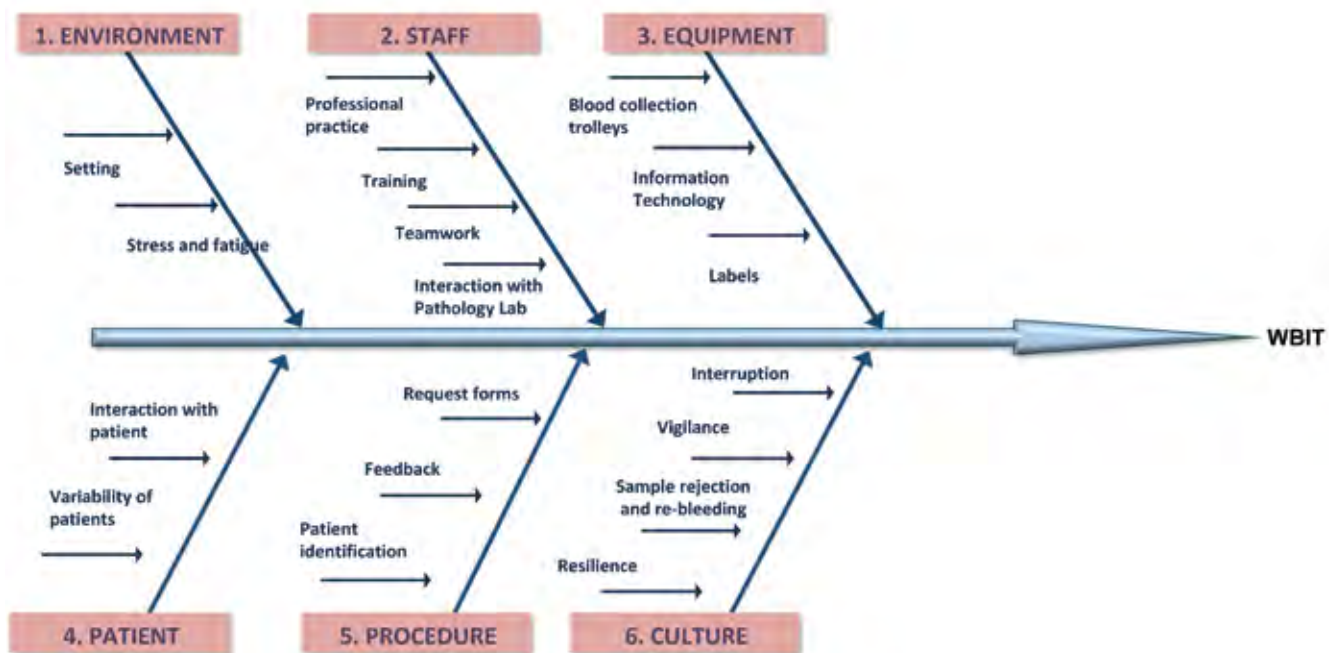


Figure 3: Cause and Effect or 'Fishbone' Diagram (Ishikawa, 1982).

4.2.1 ENVIRONMENT

4.2.1.1 Setting

Within the ED, and indeed within each hospital, there is generally a single protocol for the taking of blood samples. In practice however, different situations result in considerable variation in the process. For example, in trauma/resuscitation bays where the sickest patients are found, junior doctors typically take blood samples and hand them to a senior nurse for labelling and despatch. By contrast, in general assessment bays nurses are most often responsible for blood sample collection and a single individual usually completes the entire process.

In the development of protocols, it is necessary to strike a balance between generalisability and specificity. A 'one size fits all' approach may result in the protocol being dismissed by groups where situations do not permit realistic conformation with the rules. Dismissal of a protocol may result in unintended or

unacceptable risks through non-standard behaviours. On the other hand, it is undesirable for each area in a hospital to be using a separate protocol for a common task. Following the development of a standard protocol, assessment against practice should be undertaken to identify areas where a separate protocol is required.

Once it is established that significant differences exist and separate protocols are required, this should be reflected in training and policy. This is especially important in orientation of new staff so that they understand differing expectations on their contributions and responsibilities in the different work environments.

Vignettes from the Observations and illustrative quotes from the interviews are used within each section of the fishbone of human factors to demonstrate our arguments.

Observation

Trauma nurse, Jane, set up the equipment on the bloods trolley before Lisa, the junior doctor, arrived. Lisa took the samples from the patient and handed them to Sue, the trauma nurse leader. Sue had pre-signed six stickers which

she attached to the tubes. Sue signed and dated the pre-filled request form, bagged the tubes and despatched them immediately to pathology.

Interview

"In trauma the person who takes the bloods would give them to the person in charge of the trauma unlabelled." (Nurse)

"The Trauma Nurse Leader makes sure that all the paperwork matches and gets it all together in the bag." (Nurse)

4.2.1.2 Stress and Fatigue

The ED is an environment where patient volume is high and requires that individual patients are processed quickly and efficiently. This can cause stress for staff, particularly when patients are very sick and the timeliness of appropriate treatment has the potential to impact on patient outcomes. In addition, the high physical and cognitive workload involved in long shifts can compound the stress with fatigue effects. Overnight and weekend shifts, with limited 'back-up', were reported in the interviews to be associated with more errors. Sometimes blood tubes were sent completely unlabelled. The unevenness of patient volume on these shifts can also place great demands on a 'skeleton' staff. Lack of staff redundancy results in an inability to relieve pressure when patient volume is high.

Psychologists refer to a 'Stress-Performance Curve' when describing the nature of acute stress on performance (Nixon 1976). In situations of low or no stress, when things are running smoothly, complacency can result in error (Reason 1998) as staff work on 'auto pilot'.

This complacency may result from overconfidence (and lack of precision), unchallenging work (and lack of motivation) or limited supervisory oversight (and lack of performance review).

Increased stress can improve performance up to a point. Identifying the point at which stress worsens the performance, in either direction, may be very difficult. Even when recognised, acute stress is often poorly managed in healthcare, particularly in EDs.

This is due to the normalisation of noisy and chaotic environments. Insufficient time and processes for debrief and feedback and poor work-life balance may eventually lead to chronic stress.

People under stress tend to fixate on particular things (also called 'fixation error') and lose awareness of the bigger picture, known as losing 'situation awareness'. A broad view is necessary to remain aware of all risks. Stressed staff communicate less effectively and may operate automatically which may not necessarily match to the specific situation.

Fatigue is well documented in the healthcare setting and may be due to poor shift rotations and long working hours. Fatigue affects performance by impairing; concentration, judgement, decision-making, memory function and physical coordination. It results in increased error rates and lower efficiency. All of these are threats to patient safety (e.g. Rogers, Hwang et al. 2004).

Despite these effects being well known, hospital culture often requires people to work even when identifiably fatigued. More to the point, with increasing patient throughput and demand on the health system, the luxury of being able to stop work when fatigued is generally not a viable one.

The aviation industry has established fatigue management systems that demand that staff not come to work beyond a certain threshold of tiredness (according to prescribed criteria). Healthcare may not allow for such flexibility but education on the effects of tiredness and stress should be compulsory.

Comments during Observations

"It depends on how busy you are really. There have been a couple of instances where I have actually stood at the chute and turned to walk away, realising that I have a blood tube in my hand and have sent my pen to the lab." (*Doctor*)

"I had a doozy yesterday. We had a bloke in, very agitated, a druggie and we couldn't get bloods after many attempts. His veins were shot and we ended up having to do a femoral stab and have help from security to hold him down. It was a big mess and very stressful and, after all that, I sent them up to pathology with no labels. So, we had to go through it all again..." (*Doctor*)

"Night time. That's when I'll put the wrong blood in tube. When I am too busy or tired to check. Or when a big trauma comes in, that's when mistakes get made, in my experience." (*Doctor*)

"Yesterday I took bloods and sent them all down unlabelled so obviously had to do them all again. It was a nightmare and I felt really terrible. It was one of those days, though, with all demanding cases. I had no time to let my brain rest." (*Nurse*)

Interview

"I think it's just pure overload of things happening around you. Because I think in a situation where a patient comes in, it's nice and calm, all your other patients are under control, you know what you're doing, you're just going through the motions and maybe on night duty things happen more with fatigue. But I know especially working in the trauma centre where there's lots of things happening all at once. It definitely would make more sense that that was when errors would happen.

But then in another way too, often when it's really busy your brain's just in that mode so you're very efficient, you can just work that efficiently. So there's that aspect as well because, you know the old, when it's really quiet and you're kinda like in slow-mo and then you're like, 'oh my God I can't be bothered doing those bloods' so you take the blood and you're chatting to someone at the time and then there might be sort of, you know, an area for error there as well." (*Nurse*)

Recommendations and areas for further research

Setting:

1. Protocols must consider real differences in setting and situation and where necessary allow for alternative processes. Further research is required to develop protocols that allow for necessary variations. A system to increase awareness of the protocols, such as mandatory laminated charts on each blood trolley is required. Further research could investigate the presentation of that information to ensure that the most salient aspects are highlighted.

Stress and fatigue:

2. Compulsory education should be introduced to ensure staff are aware of the impacts of stress and fatigue on performance. Blood sample collection is a good example of where error can occur, with potentially harmful impacts, when stress and fatigue are involved. However, this is a weak intervention.
3. Further research into potential barriers, such as objective tests of individual fatigue and stress levels at the start of shifts, could be implemented as a stronger strategy to reduce the risk of mislabelling or miscollecting blood samples.

4.2.2 STAFF

4.2.2.1 Professional practice

Discrepancies in practice exist, not just between the different physical settings within the ED, but also between staff undertaking blood sample collection. Differences in professional group, education and experience are both relevant factors.

The majority of samples are collected by nurses and junior doctors, however senior medical staff will occasionally take samples. Differences in practice between professional groups are due, at least in part, to the location of their main work function (e.g. ED, trauma, ward).

By and large, nurses are responsible for a limited number of patients and the majority of their time is spent in close proximity to these patients, either at or close to the bedside. Doctors, on the other hand, may be involved with the care of more patients and generally operate from a central location, such as the main work station. Here they have access to computer-based results, telephones and desk space to write up notes etc.

Observations of practice reflected these differences, as nurses were more likely to label tubes and complete forms at the bedside or at workstations near the cubicle, whereas doctors routinely took unlabelled tubes to central workstations for labelling.

Routine behaviours deviating from protocol are often called short cuts or 'workarounds'. Workarounds can be defined as strategies or work patterns that bypass procedural codes in an effort to improve efficiency or productivity, but often with increased risk of error (Spear and Schmidhofer 2005).

Reason (Reason 1990), in his seminal work on human error, reported that the more often a particular routine achieves a

successful outcome, the more likely people are to develop an unwarranted belief that success is assured. However, in reality the opposite is true where random risks are involved the probability of risk materialising actually increases over time.

The usual reaction to violations of protocol is to attempt to eliminate them and reprimand those concerned but sometimes violations can have positive effects and are tolerated.

(Amalberti, 2006) commented that violations are interesting as "...they occur frequently, increase system performance and individual satisfaction, are mostly limited to practices with limited safety consequences, and therefore are tolerated or even encouraged by the hierarchy."

Diane Vaughan, who participated in the investigation of the 1986 Challenger disaster, coined the term 'normalisation of deviance' to describe a slow degradation of standards over time.

As this progression occurs slowly, there may be no negative consequences. In other words, if deviation from fundamental standards occurs without negative consequences, the degradation becomes the new standard (Vaughan 1999).

Normalisation of deviance and ingrained workarounds appear to have occurred with the practice of taking unlabelled tubes from the bedside to find labels and request forms. This practice increases the risk of referral to the wrong patient history and consequently using incorrect labels. This is very common in assessment bay areas, however it is perceived as 'normal' and is never challenged despite being clearly outside blood sample collection protocol at all studied institutions.

Observations

After taking blood samples John, a resident, picked up the unlabelled tubes and took them to the main work station. Jenny was at the desk, and while John completed the labelling and request form they discussed an interesting case. John took the tubes and form to the chute where they were dispatched without further checks.

Helen, an intern, took the patient's blood, without performing patient identification checks, and takes the tubes to the main work station where she has left the patient notes. After locating the labels, she signed and affixed them to the tubes. Leaving the tubes on the bench, Helen walked to the

computer terminal and created an e-order, picked it up from the main printer on the flight deck and put it straight into a bag with the tubes. No visual check against the labels was made.

Intern Tony, took some blood samples in the resuscitation bay. When finished, and holding the tubes in his hands, he walked to the bench to get a request form. He then walked out to reception to get a drink of water and stopped to speak to a colleague on the way. Tony then walked back and settled at the main workstation to label and sign the tubes and write the request form.

Interviews

"I'd probably take the blood with me to the desk with their notes and then I'd check that the notes, the labels correct, that it's the right patient, and then I'd send it up." (Doctor)

"I think it's important to label them straight after taking them so they don't go missing. I guess if you're ten steps up to the flight deck, I don't know how critical a difference that might make. But yeah, I think ideally the bedside would be optimal. Yep! *"Do you always label sample at the bedside?"* "Well...each cubicle has a desk out the front with a computer and the notes are supposed to be there, but if the notes are sometimes at the flight deck, like the main desk, then I'd have to take the bloods then label them there." (Nurse)

"Do you always label the bloods at the patient's bedside?" "...most of the time. There are some times where...if I forgot the stickers I actually bring them onto the table bench top where the stickers are located to put the stickers on the blood tube." (Intern)

"How important do you feel it is to label samples at the bedside?" "Oh I think it's fairly important because there's always some story you hear about the wrong labelling, you know, putting the wrong sticker on the tube and then that's considered an adverse event." *"So you always label at the bedside?"* "Not always, no." (Intern)

4.2.2.2 Training

Both nurses and doctors receive theoretical training in blood sample collection as part of their core education. Once in the physical reality of the hospital, practical training occurs in an apprenticeship fashion, i.e. 'on the job', both watching others and performing for oneself. Nurses have the advantage of being able to practice more often. Junior medical staff are more limited in opportunities to practise these skills, due to the broad range of skills to be learned during limited rotations in each department. Blood sample collection is not always considered a high priority.

Formal education through departmental or hospital orientation is limited. Transfusion nurses report that only 15 minutes or less is spent on this topic as part of a general one-off introduction to all new doctors in the hospital.

From anecdotal and observational evidence, practical training for blood sample collection focuses on venepuncture technique and is more likely to reflect the favoured practice of the teacher rather than agreed procedure as defined in protocols. Although there are standard procedures at each institution, actual practice is developed on an individual basis and deviations from the protocols are tolerated. Junior doctors appear to lack knowledge about the potential for error, a situation reinforced by a culture that openly accepts doctors not following protocols.

Whilst more experienced doctors were clearly competent in the act of venepuncture, blood sample collection protocol surrounding this such as patient ID and appropriate labelling practice, were often missed.

Poor education of junior doctors in blood sample collection corresponds with recent evidence from the Australian Medical Association (AMA) which reported on a national survey of junior doctors (Australian Medical Association 2009). The report exposed insufficient medical training resources and infrastructure in public hospitals. Nine hundred junior doctors from across Australia were asked about the quality of their medical training and the support they were receiving to become independent practitioners.

A clear need for better leadership was identified but it was acknowledged that clinical service and administrative workloads mean that senior doctors are finding it hard to find quality time for teaching and passing on their skills to junior colleagues. Sufficient resources must be provided to support senior doctors to train the increasing numbers of new doctors in our public hospitals over the next few years, and to support the junior doctors, who are juggling the demands of training and delivering health care to patients (Kilroy 2006). Blood collection appears to be a task which sits low on a priority list but it represents an area where error can lead to serious consequences.

Observations

Resident doctor Suzy tried to take a blood sample from Mr. Plummer's hand. Mr. Plummer squirmed and yelped with pain. Suzy abandoned this site and decided to try at the elbow instead. Mr. Plummer said "What's the trouble?", looking slightly concerned, and Suzy said, "Oh no, it's just me. I haven't done this that many times really and it takes some warming up. But I've got it now!" "Is it my fault?" asked Mr. Plummer, "No, no, it's me. You've got great veins. The first one was just a blip. This taking blood lark is harder than you might think, but I got it this time, don't you worry."

Conversation with a nurse: "We are all taught different ways and with me it is all about trying to limit haemolysis of samples. Everyone does it differently so every time I have a haemolysed sample I think what did I do that time that I could do differently or better. I watch others too. Like this new technique that I saw my mate do the other day and thought 'Wow, that's clever and effective and so I want to try it out.' The junior doctors training don't get to practice on the job like that, like we do though and sometimes they struggle a bit."

Observations

Conversation with ward support: "The interns rarely take bloods. They give it a try if the nurses are busy after hours and things. I know who I'd want, that's for sure! Definitely a nurse! They know what they are doing. The interns are not practiced. They're nervous and not trained in it"

Intern George was being supervised by a Consultant, Frank. Frank talked George through the different types of tubes while he was setting up. George went to take the samples from the elbow crease, "No," said Frank, "you should try the hand first since the elbow's no good for drips" "Oh, okay, I've never done a hand before" said George and as he started Frank told him he needed to change the angle of the needle and continued with other useful tips. Some blood dripped on the gauze and on the patient's blanket by the time the process is completed. Later Frank commented, "He needed walking through and made a bit of a mess of it. It depends on the patient though. If they are cranky, if they have to prick more than once, then often I will take over. This guy seemed okay though and sometimes they are

reassured by having another senior doctor in the room too."

Conversation with nurse: "...the big problem is medical students, grads and junior staff and their lack of knowledge. The first big problem is the wrong tubes are used for the wrong tests. It's so confusing and people can make mistakes and then it comes back from pathology. The second big problem is cross matches and incorrect documentation. These groups are just not properly trained up. Like bloods is such a low skill task that they don't need it, which is wrong. They learn from us [nurses] before they learn it off anyone else. You've got to expect to help hold their hands quite a lot and it worries me sometimes."

Conversation with junior doctor: "I don't know which is which anymore, they're always changing." Shouts to nurse at main workstation bench. "Is FBE in the purple one and the pink one is for a group?" "It's confusing because the colours are different in different hospitals and it's hard to keep track. I only really know FBE off the top of my head."

Interviews

"When I talk to graduate nurses or new doctors they're quite keen to get the knowledge and that sort of thing. But when you talk to nurses that have been around for a number of years, they feel that I'm there to tell them how to do a job and they don't like that." (*Transfusion Nurse*)

[Re: education sessions] "It's hard to get into the medical staff. I mean we've only just gotten into the intern orientation

and that was a big thing because there was no education with regards to blood transfusion in intern orientation." (*Transfusion Nurse*)

"There should be no reason that we should not use the guidelines... although nobody sits and looks at it and goes through it and ticks that they have been doing this." (*Haematology Registrar*)

Cannulation Competency

Blood samples from the ED are typically collected by one of two methods. The most common is by routine venepuncture, where a needle is introduced into a vein (commonly in the elbow) and blood is drawn into a tube or syringe. Where patients need to receive intravenous therapy (such as fluid, blood transfusion or intravenous medications) a cannula will be inserted.

A cannula is a small tube that can be introduced into a vein, using a needle, and this remains there to allow movement of fluids into and out of the patient's blood system. Once a cannula is in place, multiple therapies may be given or samples obtained without the need for further venepuncture. In the ED it is relatively common

for blood samples to be taken from the cannula, and cannulation is often initiated to obtain a blood sample. Keeping invasive procedures to a minimum is considered desirable so, where intravenous therapy is likely, cannulation is initiated.

Cannulation is a more complex procedure than standard venepuncture, and usually requires the completion of training and competency assessment before staff are permitted to perform this procedure. Not all nurses are competent to cannulate which means 'task sharing' is necessary to complete blood sample collection in some patients. This may result in interruption or lapses in positive patient identification processes.

For example, Nurse Jones is tasked with obtaining a blood sample from Patient Smith who already has a cannula in place. Nurse Jones prepares and gathers the appropriate equipment and performs the patient identification.

In her attempt to take the blood sample, however, Nurse Jones discovers that the cannula is blocked and re-cannulation is necessary. As she does not have this competency, she must locate a suitably trained member of staff, Nurse Brown, to perform the re-cannulation. Nurse Brown, as is common in this situation, has interrupted her own duties to assist and, without performing her own patient identification of Patient Smith, performs the cannulation and leaves Nurse Jones to label and sign the samples. Even in situations where Nurse Brown takes over the sample collection process totally from Nurse Jones, it is common that Nurse Brown will assume the correct completion of prior steps, including patient identification and accuracy of labels, etc.

The fact that not all staff have the same competencies and 'task sharing' must be engaged requires a level of trust. In this case,

some nursing staff must rely on their colleagues to help them to complete tasks and those assisting often rely on the safe completion of the task they initiated.

There is growing evidence in safety critical industries, including healthcare, pointing to the importance of trust in improving group cohesion, job satisfaction and organisational effectiveness. There are, however, disadvantages in relying on others to uphold standards of practice necessary to ensure safety (Gilson 2003). Recent work in the offshore mining industry shows that a high level of trust in workmates buffers against incident involvement and increases compliance with safety measures (Tharaldsen, Mearns et al. 2009).

Unfortunately, in spite of shared tasks in the emergency department reflecting good trust relationships, the process of blood collection is not a task that is designed to be shared. To ensure the highest standards of safety, the process of patient identification, labelling and other verification and checking should all be performed by a single, competent and responsible member of staff.

Observation

The patient had an existing cannula, and when Lois was flushing it with saline, she realised it had become blocked. Advising the patient she was just going to get some help, Lois left the room. She returned with the team leader,

Annabel, who replaced the cannula and took the blood samples at the same time, leaving the tubes on the trolley for Sally to label and sign.

Interview

"Yeah, sometimes you get issues with cannulas being blocked up and you need to get help with that, but the person who takes the blood is the one to label the tubes.

Always. You can't just hand tubes back to another nurse with no labels on. That wouldn't happen. Ever." (Nurse)

4.2.2.3 Teamwork

Different settings in the ED place different emphasis on teamwork and shared responsibility of tasks involved in blood taking. In the assessment bays, work is usually carried out by solitary individuals and if assistance is needed it must be deliberately sought.

By contrast, when trauma patients arrive, a coordinated team, each with designated roles, cares for the patient. If there are difficulties in tasks such as blood sample collection assistance is readily available.

Moreover, these blood sample collection tasks were commonly shared between trauma team members with different staff taking on different sub-tasks (e.g. cannulation, labelling and despatch).

Teams rather than individuals perform most human work. This is particularly true in healthcare where time is critical and human resources are often spread thin.

An obvious advantage of teamwork in healthcare is the mutual aid that team members can provide each other. One member can help another when busy or when a mistake or bad decision is made, or about to be made. Work can be divided between different team members to make the best use of individual expertise and to increase efficient and safe working.

Although teams can help detect and recover from errors, they can also create errors. Psychologists refer to the phenomena of 'groupthink' which is where decision-making is compromised to prioritise good relations between team members.

Appropriate decisions often require people to be prepared to speak out against the consensus, especially in emergencies and with unusual cases. Group cohesiveness can cause errors which compromise safety and it is important to train teams adequately to recognise such risks.

Observation

Steve had set up the equipment on the bloods trolley before Libby arrived with the patient. Libby took the trolley to the bedside, performed the cannulation and took the blood samples. She required some assistance from Steve but finished and handed the tubes to Seema who was at the

trolley. Seema took the tubes to the trauma nurse leader, Jackie's, desk. Jackie had pre-signed the request form and labels, which she put onto the tubes, and put them into the blood bag. Jackie gives them to Josh asking him to take them to the ward clerk, Andy, for immediate despatch to pathology.

Interview

"If it is a bad trauma and there is a lot going on, it's not usually the nurse taking the bloods, it may be the doctor. It is sometimes practised where the person taking the bloods hands them to the person in charge of the trauma, which is

normally the most senior nurse in charge of the situation. Generally speaking, if a trauma wasn't too bad, the labels are applied immediately." (Nurse)

4.2.2.4 Interaction with the Pathology Laboratory

When blood samples leave the ED or ward, they are sent to the pathology laboratory where the relevant tests are carried out. Tension sometimes exists between clinicians and laboratory staff due to different perceptions of priority and risk. Interactions between laboratory and ED staff are particularly prone to frustration due to both the high volume and urgency of work. Face-to-face interactions are rare and positive relationships may not develop where encounters are based only on phone conversations. The main communication channel between these departments is usually through the respective department/ward clerks who are both non-clinical and low on respective departmental hierarchies. Direct communication between laboratory scientists and clinicians is only common outside normal business hours.

Blood samples are rejected by the pathology laboratory if labelling criteria is not met. Depending on the policy of the hospital, the criteria may require only certain fields to be complete or all fields. The latter is described as a 'zero tolerance' policy and poorly labelled samples are discarded. In hospitals where zero tolerance does not apply, samples with incomplete labels may be redeemed by completion of label fields by the appropriate staff.

When a sample is rejected, a message is sent to the ward or department from which it originated. Typically this would result in a second blood sample being obtained from the patient, known as a 're-bleed'. Messages to re-bleed are commonly not communicated directly to the clinical staff involved, but to the ward clerk.

Observation

Justine approached the supervising nurse, Carla, at the flight deck, and showed her a patient's record and asked "Where's the test results? It's not back and it should take 15mins, it was ordered three hours ago." Carla phoned the lab and discovered that the test was not run. When she relayed this to Justine she said "The girl I spoke to had just come on so it's not her fault". Justine rolled her eyes and said "Typical".

When Trevor finished a re-bleed, the researcher asked the reasons for the re-bleed. "I don't know", he said, "The ward clerk just came up to me and said they needed another tube. She won't know why and I don't know who took the bloods in the first place to ask either, so I have no idea what happened".

"Does that happen a lot?" "Yes, and it can be annoying, especially if the patient wants to know why. Then you have to just make something up to make them not worry."

Conversation with nurse: "Sometimes things go to the wrong place, they get lost in the chute to pathology. But often after a good hunt for results, people manage to find them. But in the meantime the doctor might have asked for another set of bloods. When they come and tell me to take more bloods I always wait, like about half an hour to be safe, because often the lab ring and say 'we've found them'. It happens a lot and makes you wonder why they can't keep track down there."

Interviews

"What do you think the relationship is between the lab and the clinical area?" "I don't think it's good. Generally the feedback that I get from the clinical area is that they don't like the lab, they think that the lab makes mistakes that they don't acknowledge. I assume that it happens everywhere, I don't know for sure though. The lab relationship is poor." (Transfusion Nurse)

"...the lab does not sound like a warm place to call. When they answer the phone they don't sound friendly... I certainly hear that from the clinical staff. But I wouldn't want to be in the lab listening to some of the clinical staff." (Transfusion Nurse)

"They'll ring up and ask for the person who took, say Mr Smith's bloods...so you'll go and chat to them on the phone. I mean sometimes they say...'can you take another blood test on Mr Smith because his bloods were clotted' and you think, 'well, how the hell? That's crap, they couldn't have been clotted.' I took them and sent them you know. You think bloody hell!

And we have a bit of a joke and say 'well they've probably dropped them, you know, down there [in the lab]'. ...But you just have to go and take more blood anyway cause obviously they're not going to ring and say, 'listen sorry, I've just dropped that blood all over the floor, you have to do another tube'" (Nurse)

"They aren't very impressed that we reject samples. They say 'I know I definitely took it from that patient and you need to accept it' and you know, there's so many excuses that come up. We hear it all the time, it's just fairly poor. Sometimes the collectors, the nurses, will do the same thing over and over again." (Pathology Receptionist)

"Per day I'd probably say up to five cases [of problems with tubes from the ED]. It could be an unlabelled specimen or a complete mismatch where they've got the wrong stickers in the patient's file and they're not paying attention to what they're doing." (Pathology Receptionist)

Specific reasons for sample rejection are reported electronically, however these reasons are often vague, for example 'not suitable'. Clinicians thus face the awkward task of approaching the patient for a re-bleed, often with no explanation as to why it is necessary.

In general, clinical staff do not feel any connection with or understanding of laboratory processes nor any real engagement with laboratory staff. There is resentment that samples are rejected when minor errors are made. This also reflects a general perception that risk of miscollection is low. On the other hand, laboratory staff know that they are not popular with clinical staff, especially when samples are rejected. They express frustration that clinical staff fail to complete fairly simple labelling requirements. They also express anxiety about having to defend their adherence to non-acceptance protocols, particularly on night duty when confronted by senior clinicians in emergency situations.

Lack of understanding of roles, pressures and agendas between groups or work units can reinforce professional or organisational

boundaries. This serves to increase distance between groups and reduces trust, and can lead to an underestimation of the complexity of others' work and workload. Distance between groups also heightens the apportioning of blame when errors occur (Reason 1997).

The current limitation on direct and open communication between the pathology laboratory and the ED, particularly the inability to give and receive feedback - in both directions - has resulted in animosity. This was common across all three sites. Understanding each other's role is an important part of good teamwork and one that does not happen frequently in health services (Bond, Cartilidge et al. 1985).

Lack of opportunities for open communication can result in an "us and them" mentality. This appears to be the case with clinical staff in the ED and pathology laboratory staff who do not indicate a belief that they are on the same team. Although both share an interest in minimising patient harm, they have disparate perceptions and priorities.

Recommendations and areas for further research

Professional practice:

Strategies must be in place to ensure labelling and patient ID is always possible at the bedside to combat a culture in the ED that allows normalisation of the deviant practice of labelling blood samples away from the bedside.

4. Attaching the labels to the patient (strong) – e.g. a barcode scanner for the wristband with a handheld printer.
5. Attaching the labels to the bed (intermediate) – e.g. having a place attached to the bed where spare labels were available and ensuring that there was a pen which could write on tubes and that the tubes have a matt surface).
6. Attaching the labels to the cubicle (weak) – e.g. having a physical tray to store records for individual patients which are not easily confused between cubicles.

Training:

7. Junior doctors need more formal education, feedback and support, alongside opportunities to gain more experience. Ideally this should be given in scenario-based training rather than isolated skills-based training which is used at present. This will ensure that it covers the distractions and practical issues surrounding phlebotomy. This is a weak intervention.
8. Senior leadership support is required to help raise the profile of risks associated with phlebotomy. Further work needs to be done to determine innovative ways to increase awareness and application of proper procedure in blood taking and how to support a program where "champions" for each department are nominated and can drive improvements.

9. Mandatory cannulation competency for all clinical staff is required. Alternatively, protocols must address task-sharing, especially for patient ID.

Teamwork:

10. Teams must be established with appropriate supervision of inexperienced team members. The issue of adequate senior staff supervision is particularly marked in the assessment bay area and in medical groups, since competing priorities limit this supervision for junior staff, especially for junior doctors. Further work may include exploring mentoring programs that allocate new interns to certain key members of senior staff who are responsible for particular areas of practice, i.e. there is one who deals with blood collection and is a team resource.

Interaction with the Pathology Laboratory:

11. Formal protocols should be developed to feedback problems with samples to ensure that clear understanding of why samples are rejected reaches the relevant clinical staff. Further work may include the development of a checklist form which ward clerks must fill out to deliver to clinical staff. This is an intermediate level strategy.
12. Orientation visits of clinical staff to the pathology laboratory and vice versa to improve understanding of the other group's role and requirements. Further work would include how best to design and evaluate these, when and how often to carry them out and how to ensure the majority of staff is included. This is also an intermediate level strategy.

4.2.3 EQUIPMENT

4.2.3.1 Blood Collection Trolleys

In most hospital settings, equipment used for blood sample collection is housed in a dedicated trolley. These trolleys have drawers and shelves for storage and a stainless steel top used as a workbench during the sampling procedure. In the ED, blood collection trolleys are usually shared by all. When trolleys are not available, equipment may be carried to the bedside in kidney dishes in the hands or pockets of staff. In these circumstances, equipment is often arranged on the patient bed with the subsequent potential for contamination.

As all specialised equipment is located in the drawers of the trolley, staff are obliged to access a trolley when equipment is needed, even if the trolley is already in use. Consequently, the staff member using the trolley is often interrupted and their access to the trolley impaired.

Staff assume that trolleys are appropriately stocked with the necessary equipment and rarely check before commencing blood sample collection. As a result, sample collection may be interrupted and tubes potentially left unattended and unlabelled if staff need to retrieve appropriate equipment where they have run out.

Of even greater concern is the situation that occurs when the ED is over capacity and patients are housed on gurneys in the corridors. In these circumstances, patient assessment and treatment may commence before the patient is allocated to a cubicle. Obtaining blood samples under these conditions is difficult as space to place equipment or documentation is lacking and important aspects of patient verification and checking may be missed.

Observation

Joanne finished taking some blood samples and entered the utility room where she placed the labelled tubes on the bench, along with the request form from her pocket, and put the kidney dish on a pile of dirty dishes by the sink. "That always happens" she remarked "you get a whole stack of dirty ones here and then none on the trolleys and when trolleys are not free, you end up walking around with tubes and stuff in your hands and using your pockets."

Mr Kourpa's daughter was standing very close to Jamie while he took Mr Kourpa's blood sample. When Jamie turned she was between him and the trolley. Jamie asked "Can you please sit down. I haven't got a lot of room to play with here and I need to be able to get access to the trolley all the time, thanks."

Interviews

"Not having enough trolleys is one thing but what about when the patients don't even make it to a cubicle? That is when there is real trouble because there is no dedicated nurse, well a 'floater' nurse may help and the triage nurse is still supposed to keep an eye on them but if you have patients in the corridors... The corridor thing is a complete disaster

in terms of taking bloods 'cause there is no place to put anything and it's just musical chairs with new people coming in and then cubicles becoming empty and do the notes get swapped over appropriately and all that jazz. We need to acknowledge that bloods get taken in the corridor because, like I said, the corridor thing can be a real disaster." (*Doctor*)

4.2.3.2 Information Technology

One of the three sites has recently adopted an electronic ordering system for blood tests. Doctors log into the system with a unique ID and choose the blood tests required. The request is printed, collected from the printer and handed to the nurse to take the necessary blood samples.

Through the observations and interviews it was apparent that there were procedural issues with the new e-ordering system that had not been identified or addressed prior to its implementation. Most of the problems related to the printing of the order. This ED houses several computer terminals that doctors can use for e-ordering. However, all terminals connect to a single printer at the main work station. If two doctors are ordering blood samples at the same time, there is a risk that the wrong order could be collected from the printer.

Some of the clinical staff questioned why an electronic ordering system still involved paper forms. They could not identify any benefit for them in terms of efficiency, or to the patient in terms

of safety. The e-ordering system was an initiative spearheaded by the pathology laboratory to improve their record keeping and efficiency. The decision to move to this system and its implementation did not involve widespread engagement and consultation with ED clinicians who now have to use the system. The clinical staff feel resentment towards a new system that was not designed to benefit all those using it and that they were not engaged in the development process.

Designing to fit the way humans move, think and work is incredibly important in healthcare systems. These include not just the providers and workers but patients and their families and friends (Buckle, Clarkson et al. 2003). IT solutions are often promoted as a means of improving reliability and safety in healthcare work processes.

However, the results of introducing new technology into complex systems are mixed. There are often unintended consequences of any type of automation of previously manual processes (Ash, Berg

et al. 2004) and a concomitant de-skilling or reduced vigilance in human operators (Bainbridge 1983). IT alters technical work and hence the paths to failure and approaches to recovery will be new and can challenge healthcare professionals interacting with these technologies (Perry, Wears et al. 2005).

There must be sufficient understanding of actual practice in healthcare in order to understand how IT can support clinical practice (Nemeth, Nunnally et al. 2005). Appropriate education and change management processes are also vital to prepare clinical staff for new IT systems.

Observation

Phuong stood at the terminal and demonstrated how to order a blood test. At the fourth screens he realised that the computer is still logged in from the previous person who has used the computer so he has to start again from the beginning. Phuong said, "I do this all the time, I never learn.

Feedback and review of problems at implementation and beyond must be rigorous in order to measure adverse impacts. A medical informatics expert, (Coeira, 2004) reports that, "Since health systems are socio-technical systems, where outcomes emerge from the interaction of people and technologies, we cannot design organisational or technical systems independently of each other."

And sometimes someone then comes to get me and I leave and have to remember to come back, which is a pain and sometimes I forget until the nurse comes to find me and asks me 'where is the order, doctor?'"

Interviews

"There's only one printer on the flight deck so, yes, it's possible that more than one person is simultaneously making an order for bloods, which could cause a mix-up. Also, I guess if you don't collect the e-order in a timely manner there is a backlog of e-orders on the printer and so you've got to remember who the patient is, which is harder in the ED 'cause there is less familiarity and so greater risk. But the flip side is that we know this and are more vigilant in our checking processes, mostly." (*Doctor*)

"E-orders are a complete nightmare! We don't even have any green pads in the assessment bay area any more so you have to e-order. It's a pain in the neck. When the order doesn't come back though it's mostly a case of chasing the doctor, not about going to the printer. And they don't do a batch of e-orders, they usually do it one at a time per patient, so they go see a patient and then go and order bloods, pick up the printout, and then go onto the next patient." (*Nurse*)

4.2.3.3 Labels

Blood sample collection tubes must be labeled with patient details prior to despatch to the pathology laboratory. Details are either handwritten directly onto the tube or affixed using a pre-printed label. Pre-printed labels (commonly known as Bradma labels) are routinely used in hospitals to attach to various forms and other paperwork. Sheets of labels are printed when a patient arrives at the ED and are typically kept with the patient medical record.

In some hospitals, the use of Bradma labels on blood samples is prohibited in an effort to reduce WBIT errors. The theory behind this policy is that handwriting the label should increase the collector's attention to detail and encourage verification of identity with other sources, i.e. the patient wristband and notes. Transcription errors may occur, resulting in sample rejection by the pathology laboratory, but details of the wrong patient are thought to occur less frequently (Khoury, Burnett et al. 1996).

Due to workload pressures, printed labels are often preferred so that work flow and patient turnaround is maintained (Cummins, Sharp et al. 2000). Although deemed quick and convenient, the use of pre-printed labels may be less safe. Labels may be taken from the wrong patient record or labels stored with the wrong set of patient notes.

If checking procedures are not completed, samples may be accepted at the pathology laboratory and could lead to a WBIT. The likelihood of these errors increases where the patient notes and the printed labels are easily separated from each other (e.g. labels slotted loosely in the patient notes). In situations where patient records are piled up, such as at the central workstation, slipping labels from the files can easily result in the wrong label being used.

Current British Committee for Standards in Haematology (BCSH) guidelines recommend that handwritten labels are always used since this practice is more likely to result in appropriate patient identification. If printed labels are used, they must have the patient's surname, given name(s) in full, and hospital record number or date of birth, the date and time of collection and the signature or initials of the collector should appear on the sample tube indicating that identity has been confirmed. The use of a printed label on the request form – provided it matches the detail on the patient's identification band and the blood sample tube – is accepted by the BCSH (BCSH 2007).

In Australia, and in all three institutions in this research project, Bradma patient labels are usually printed out on admission to the ED and placed in sheets or strips into the patient notes. In two of the institutions blood sample tubes require hand-written labels if the sample is to be used for cross matching. For other types of blood tests, pre-printed labels are accepted.

Acceptance criteria for samples in the pathology laboratories of all three institutions are very strict. The laboratory will reject blood samples that are inadequately labelled i.e. do not show full patient details, the location of the patient or the name of the doctor requesting the test, or are inconsistent with details on the request form. Samples that are completely unlabelled or have been previously labelled with another patient's details are automatically discarded. One of the hospitals uses a zero tolerance approach where, unless the sample met 'precious sample' criteria where exceptions could be made in extreme circumstances, even minor labelling discrepancies or omissions, result in sample rejection. The other two institutions have re-labelling policies that allow staff the opportunity to correct minor errors on a sample tube label. In these circumstances, both institutions require the collector to sign a specimen amendment form, to confirm appropriate patient identification has been conducted.

Labelling of samples away from the bedside was a common problem identified in both the observations and the interviews.

In some instances this had become ingrained and normalised, due to the nature of work being separate from the bedside (i.e. in the case of junior doctors) and in others it was the result of work volume and/or lack of preparation prior to sample collection.

Pre-labelling of sample tubes (i.e. writing or affixing labels on tubes prior to filling collecting samples) has been identified as a major cause of patient identification errors that can lead to fatal transfusion reactions in other studies. However, this practice was not observed during our study. Only one conversation with an intern mentioned this practice. This individual had reached an understanding about its safety implications only through trial and error rather than any structured training or orientation.

'Well, I used to label them first because I had a few instances where I forgot to put labels on altogether, and then obviously had to re-bleed, but if you label them first and you can't get any damn bloods, then that's a problem too. You can shoot yourself in the foot both ways.'

Observations

Doctor Peter came into the bay while Sam was taking blood samples and took the patient notes. *"Aren't they supposed to stay with the patient?"* Sam replied, "Peter obviously wants to talk to the consultant or make a phone call about something and he needs the notes at the flight deck." *"Is that a problem?"* "No," she said, "I will just have to go and get the labels when I need them." *"What will you do with the tubes?"* "Oh, I will either leave them here or carry them with me to the flight deck."

Conversation with nurse: "If they come from an ambulance bay and straight in, not through triage, then the triage and clerks don't know they are here but you call them and let them know and they come in. They generate the labels and the [admission] form. Sometimes you are waiting for labels when the tubes are already done. But that happens rarely, I'd say."

Interviews

"The biggest problem that I see is that the labels are independent of the hospital chart. And not sure why this is, I guess it's for subsequent scanning and handling issues which are easier without the labels there. But avoiding floating stickers, separate from records and being placed back in the wrong records, or assumed to belong to the record that they are lying beside, is paramount to reduce the risks involved in these WBIT type errors." (Doctor)

"Sometimes you think because you have the record there, you have the labels too but there may not be any left or they have been removed from the record and someone is using them somewhere else. If that happens and you have already taken the blood then you have to hold the tubes in your hand and walk out to the clerks, out where the triage nurse sits, and get them to run off a sheet of labels. I wouldn't even know how to print off labels." (Nurse)

Interviews

"I have found the wrong labels in the wrong notes. And mostly just by fluke really. Because you mostly assume that the right labels are in the right notes and don't always check, especially when things are really crazy busy. And you assume that the right notes are by the bedside too." (Nurse)

"Sometimes we're taking blood before we have labels for a

patient, particularly in trauma... We haven't necessarily always got them on the system so we haven't always got the patient details to put straight on the blood tubes." (Nurse)

"If I turn around and the doctor has taken the notes... I would maybe go up to the flight deck to get the stickers and put them on at the flight deck." (Nurse)

Recommendations and areas for further research

Trolleys:

These strategies are all intermediate to strong and will help to stop people from having to leave the bedside to collect equipment necessary for blood collection.

13. The number of dedicated blood collection trolleys should be increased.
14. More frequent re-stocking of blood collection trolleys should occur.
15. There should be a non-trolley based store of blood collection equipment so that trolleys in use do not need to be accessed.
16. A tray/storage container should be attached to the ED bed so that there is a place to gather and store equipment if bloods need to be taken in the corridor.

Information Technology:

17. Engagement of clinical staff in any IT system changes is essential in order to provide sustainable and safe implementation (intermediate).
18. Changes to work practices caused by the introduction of technology should be trialled in a simulation setting prior to and monitored after implementation, as theoretical and real practice do not always match (strong).

19. Dedicated printers available for each cubicle to avoid potential confusion of e-order forms when printing from one central printer (strong).
20. Hand held scanners and label printers for patient ID and specimen labelling (strong).

Labels:

21. Sheets of labels should not be able to be separated from records in the ED, although this may not be feasible in other scenarios, such as on the ward. This is an intermediate level intervention.
22. Further work to trial the provision of printed stickers with e-order forms so that the stickers and the order forms can be brought together to the bedside. This is a strong strategy.
23. Enforcement of protocols for keeping patient records by the bedside is a weak to intermediate strategy depending on management commitment.
24. However, we have suggested stronger strategies which involve forcing functions (such as, scanners and printers at the bedside for all labels) in order to stop the situation where unlabelled tubes are taken from the bedside when records and labels cannot be located.

4.2.4 PATIENT

4.2.4.1 Interaction with patients

The interaction with the patient that occurs as part of blood sample collection is an important part of the process. It is important that patients understand what is happening and why, and have the opportunity to ask questions. Patients may also need reassurance and should be made as comfortable as possible during the procedure. However, questioning from or conversation with patients during blood collection is a distraction. Distractions are different from interruptions (see Section 4.2.6.1) and draw one's attention to a different object or in different directions at the same time. A distraction can redirect a clinician's attention away from an important task and therefore threaten safety, even in very experienced staff.

With increasing access to information through media and the internet, many patients are aware of healthcare issues including potential errors and are more likely to question what is happening than in previous times. In our observations, patients or their relatives asked many questions and had a variety of concerns about why blood samples are taken, how long results will take, which tests are which and why.

Particularly in paediatric cases, the patient's families were involved in the interactions and were extremely important to assist in minimising distress in the children. However, as ED cubicles are often not large, crowding and interruption to the flow of work practice can become a problem.

The quality of the interaction with the patient is an important determinant of the patient's feeling of reassurance and benefits greatly from clinician experience, particularly in tackling 'tricky' questions.

Ideally, the information sharing and questions should take place prior to the actual venepuncture so that the doctor or nurse is able to concentrate on the task at hand. This could be compared, loosely, to the pause before surgery known as the 'time out', which is intended to make everyone slow down for a few moments and double check what they are about to do (DeFontes and Surbida 2004).

In this situation, protocols for blood collection should include a pre-procedure conversation and a request from the clinician that the patient refrains from engaging them in conversation during the procedure. Clinicians should be encouraged to defer answering questions until the task is complete.

Observations

As Sharyn was taking the blood sample, Mrs Wills asked "Why are you taking bloods? To check for swine flu? I've got no swine flu." "No," Sharyn replied, "we are checking your blood for enzymes to make sure your heart is okay." Mrs Wills said "I had a blood test done a month ago by the GP, can you use that?" Sharyn replied "We need to do it again now to check for all those enzymes in blood to make sure nothing is wrong with your heart." After taking the sample and when Sharyn was flushing the cannula Mrs Wills asked "You're not injecting something into me now, are you?" "No," said Sharyn, "just a little water to flush it to make sure it's clear. But, I guess it depends on how nice you are to me." Mrs Wills smiled.

Mr Sims commented as Jarred was taking the blood sample "My bone marrow is B but I'm O. My body is O. If I need any transfusions make sure they get it right please." Jarred replied, "mostly when we take blood samples we don't check your type." Mr Sims continued "When you do the blood test, you'll get anti B in the blood too." Jarred was reassuring "If we ever do need to do a transfusion we would do the proper tests and the blood bank would sort it all safely, don't worry." Mr Sims answered "I know things go wrong, I just want to make sure it's not with me!"

Interview

"Patients increasingly want to be informed. Most doctors of our generation are very keen for patients to be informed, we encourage this mentality." (*Haematology Registrar*)

4.2.4.2 Variability of patients

The ED caters to a broad range of patients with varying characteristics and needs. A number of individual factors can impact on the task of blood collection. Some of these are relevant to communication with patients, for example, Non-English speaking or those who are non-responsive etc. Other factors that impact on the ability of clinicians to complete the phlebotomy process include violent or drug affected patients, patients whose peripheral vasculature is shut down due to shock and elderly patients who may have veins that are difficult to access. Paediatric patients also present specific difficulties, as do patients who are fearful or especially anxious.

In general, protocols are designed for the 'ideal' or 'average' patient and do not always include advice regarding when to escalate problems and where and how to access support for different circumstances. For instance, more senior medical staff can provide assistance when difficulties arise with venous access, but security or psychiatric staff may be required for violent or mentally unwell patients. The issue of violence in the ED is of increasing concern with an average of five violent incidents per week being reported in one Queensland hospital (Crilly, Chaboyer et al. 2004). ED professionals must be able to assess the type of patient and know where and when to seek appropriate support or to apply alternate protocols.

Observations

A tourniquet was placed and Mrs Green was asked to pump her right arm. Steve attempted to get blood from a vein at the elbow. When this attempt was unsuccessful, he tried from a vein in the hand of the same arm before swapping the tourniquet to the other arm and trying both elbow and hand, before moving back to the original arm. Rachel had been past a few times and observed the trouble. She stopped and asked, "Are you alright?" "No, can you come and feel please?" Rachel approached Mrs Green "Yes, there's one [a vein] but it's quite small though." Rachel makes an attempt to take blood in the original arm while Chris excused himself to find a more senior nurse. Coming back with Emily he says "Yeah, this is big trouble, we just can't find a vein". The attempt to access Mrs Green's veins continues. After more than half an hour and numerous attempts, Consultant Mark is summoned who finally finds a suitable vein with the aid of an ultrasound machine.

Jim, an intoxicated patient, raised his head when Laura walked in announcing that she is going to take a blood test "Is that okay, sir?" She pulled up his sleeve and, as she is about to apply the tourniquet, Jim sprang to life, sitting upright, and put the tourniquet on himself, pumping his fist and tapping for veins. As Laura is preparing the equipment, Jim starts kicking the trolley "Please don't do that" she asked. Laura pulled the trolley closer, but Jim reached out and pushed it away saying "Get out of my way." Laura smiled and left the bay. She returned with Ray who took over the sample collection. Jim kept fidgeting and shaking. Ray said "You have to keep still please - Ah, we had it there mate, and then you moved. You have to keep really still." Jim then said "Don't do it in my hand, get it out!" Eventually senior doctor, John, came and said "Let's see if we can get blood from somewhere other than your hand, shall we? If you stay still we can sort this out."

Recommendations and areas for further research

Interaction with patient:

Patients should not be discouraged from asking questions to clarify any concerns that they have with the blood collection procedure. However, these should be dealt with prior to the commencement of the actual taking of blood.

25. Protocols should include a 'step back' process before beginning blood sample collection in order to address patient concerns. This should include advising patients of the importance of limiting distractions. This is an intermediate level strategy.

Variability of patients:

Those designing protocols must acknowledge the complexity of "real life" situations. Standard operating procedures are not always carried out in practice within clinical environments. When a situation is not standard then people need suggestions to stop and think about what they need to do and how and where to escalate/get support.

26. The inclusion in protocols of 'what if' provisions to address different clinical situations and patient types will provide an intermediate level strategy. Further work is required to develop and trial the different 'what if' provisions in different settings and beyond the ED.

4.2.5 PROCEDURE

4.2.5.1 Request forms

The standard protocol for venepuncture, including that used at the three research sites, assumes that a request form is completed prior to blood sample collection. Different blood tests require the blood sample to be handled in different ways and consequently a variety of sample tubes are used depending on the test. The test request form allows the collector to select the appropriate tubes for the tests required. The form is also used in patient identification to ensure the blood collected and tests are conducted for the right patient.

In our observations, two types of situations were noted where blood collection occurred prior to completion of request forms. The first was where the nurse assessed that blood tests were necessary and pre-empted the doctor's request. Sometimes this was because consultation with a doctor was delayed and where nurses were attempting to streamline the patient's visit. On occasion this resulted in samples being discarded if the tests were ultimately considered unnecessary by the doctor.

The second situation involved the issuing of verbal orders by the doctor during initial assessment. Request forms would be completed later or 'chased up' by the nurse, but some understanding of the tests required was communicated to the nurse so appropriate samples were obtained.

In both situations, labelled blood tubes sat waiting in patient bays for completed request forms. In most but not all cases, samples were able to be stored relatively safely. However, delays of more than half an hour were observed. Nurses expressed frustration at the delay when, by taking samples prior to receiving the request form, they were actively seeking to accelerate patient care.

Verbal orders are routinely used in healthcare, despite concerns that they are a threat to patient safety (West, Levine et al. 1994). Recommendations from the Joint Commission in the USA point to the need to develop strategies to standardise how verbal orders are communicated (Joint Commission Resources 2003). The reason for the concern is that there are a variety of factors, both from a human information processing perspective and from a physical environment perspective (such as fatigue, workload, sound-alike medications, background noise, accents and body language) which can contribute to errors (Wakefield and Wakefield 2009).

Also relevant is the reason for needing verbal orders for blood in the first place. In health care a prime challenge to a culture of safety is 'production pressure', the overt or covert pressure to put 'production' (i.e. throughput and efficiency) ahead of 'protection' (i.e. safety) despite organisational commitment being voiced to the contrary (Dekker 2006). This has been shown to be a widespread problem in the ED where the pressure to work quickly, efficiently, and with minimal delays – especially in the face of government targets – can produce a signal to frontline staff that production is inherently valued over safety (Reason 1997).

So-called high-reliability organisations (HROs), which are defined as those that maintain very low accident rates in spite of high production demands in high risk work, have established mechanisms to ensure that these pressures do not overcome real safety concerns (Roberts 1990). Primarily, this includes engendering a system whereby even the most junior person feels empowered and obligated to halt production for a safety threat. Developing such mechanisms will be important for healthcare and the transfusion safety context.

Observations

Comment from nurse: "I'm going to take bloods from Mr Richards. The doctor hasn't done the script yet, but Mr Richards is 97 and generally unwell and he is going to definitely need bloods so I will take them and go and find the doctor afterwards to write up a script."

Conversation with nurse: "It happens all the time. It's all about targets, it's all about politics. They click on patients and then don't come and see them [the patients]. Like Cat 2 patients who should be seen in 10 minutes and Cat 3 in 30 minutes. And they have a mixture of patients they have to prioritise and

some patients wait ages so it is good to get their bloods going."

Conversation with nurse: "There are lots of patients I would just go ahead and immediately take bloods. Ones that have chest pains, abdo pain, headache, febrile patients, patients who might need surgery, the elderly – they all get bloods invariably. If they have pre-existing complaints like kidney disease or lung disease, patient in pain, patients who have had falls so that we will need to check their electrolytes. So, there are lots of circumstances that would require me to act quickly rather than waiting for the doctor."

Observations

James took blood from a patient without a request form and then left the samples bagged up on the desk by the patient bay, behind the computer terminal. He said "I shouldn't really do that, hope no one notices and the doctor comes soon. She's not replying to my pages though!" Kate walked past a moment later and asked "Do you want me to send those bloods up for you?" "No, needs a slip from the doctor first, but thanks", said James with a slightly guilty look.

As Julie took the blood samples she commented, "I don't have a request form, but this is quite urgent so I might just write it up myself. I'm not meant to but I'll get someone to co-sign it." Half an hour later, Julie confirmed, "the doctor signed the form and sent the bloods off for my patient."

Nurse comment: "I hope the request form will be there now but if not, I will just take one of everything to be safe and get them to order afterwards. That's what I usually do."

Interviews

"The nurses sometimes take blood and fill all the tubes and then wait until the doctors do a request. Or, I take the blood and I take what I want and then I go and do the request. And then occasionally I'll do the request first and then take the blood." (Intern)

"The practice should be to wait for doctors to see patients before taking blood but this doesn't happen in most cases. I'm fine, but with more junior nurses they are always clear about the names of tests and which tubes and volumes and things? Do they always know what is being asked of them from the doctor if there isn't a consistent approach to this? With the request in your hand, at least you have something to check back to." (Nurse)

"It's mainly an issue for junior staff who feel uncomfortable taking bloods before the request form and wait until the

doctor sees the patient and they have a request form. But it's not realistic to wait, you need to get things moving. If the patient already has a drip and the bloods are taken, then the doctor can focus on other tasks. Also, if you do it straight away and then sort getting the request form signed off, then before the doctor sees the patient you could have a whole bunch of blood results already." (Nurse)

"There are lots of cases where I would take bloods without a request form. You don't want to delay the whole process for the patient. You want to get that started. Most who come into the ED need bloods to be taken. Only a very small percentage wouldn't. Say 95% or maybe more will need bloods to be taken as part of their investigation or workup and the sooner you get those to the lab, the sooner you have results and that is important." (Nurse)

4.2.5.2 Feedback

As mentioned in Section 4.2.2.4, the provision of feedback in the event of error is less than ideal. When labelling irregularities occur or samples are subsequently found to be misidentified, the incident is reported in the hospital-wide reporting system, RiskMan. Transfusion nurses at all three study sites regularly review 'RiskMan' data as well as pathology department system data for errors in blood samples. Typically, incidents are followed up by the TN with the individuals involved, usually via email in the first instance, with copies sent to their nurse unit manager (NUM).

In the ED the majority of blood samples are signed, even if not necessarily collected, by nurses. Where incidents surrounding blood collection involve junior doctors, medical supervisors are not involved. This is unfortunate as the feedback appears not to be taken seriously and there may be a missed learning opportunity. There is a perception that errors in labelling are trivial and motivation for change in behavior is unlikely unless potential adverse consequences are understood. Involvement of their direct supervisors in the feedback of error to nurses ensures some motivation to reduce the negative reports.

Hierarchy and gender may have an impact on the ability to give or receive appropriate feedback. None of the transfusion nurses directly reported such an issue in the interviews, but there was discussion about a perceived reluctance from doctors, at all levels of seniority, to accept that they had made mistakes.

Learning about good and bad practice is very important in safety-critical environments. This is especially so in a situation like blood collection in the ED where the likelihood of errors impacting on

patients may be seen to be fairly low (the lab is viewed as a 'safety net'). The consequences of errors are often underestimated due to lack of opportunities for feedback and deviant practice has become normalised (see Section 4.2.3.3 above).

Referring back to HRO theory, one of the characteristics of an HRO, even in the face of considerable risk, is that they put a great store on problems being investigated at their occurrence and feedback being comprehensive, proactive and delivered directly to individuals, teams and supervisors involved in the problem (Roberts 1990). In contrast, error-prone organisations are characterised by people doing what is necessary to 'get the job done' with little or no additional attention drawn to the problem, allowing it to perpetuate (Reason 1997).

The 'Theory of Reasoned Action' is also relevant here (Fishbein and Ajzen 1975). This theory argues that people's likelihood to perform a particular behaviour is underpinned by how they feel about that behaviour ('attitudes') and how they think others will judge their behaviour ('subjective norms'). Relating this theory back to evidence surrounding blood collection, it appears that staff attitudes reflect a perception of minimal, if any, adverse consequences of errors. The relevant subjective norms suggest that senior staff in the ED do not appear to know or care about irregularities in practice. In some instances a lack of attention to protocols is even condoned (e.g. in labelling and identification). Thus, behaviour is reinforced that does not match best practice and the regular performance of this behaviour can, unfortunately, become ingrained.

Observation

Mark, a junior doctor, approached the pathology chute. Commenting to the researcher on the large sample bag Mark carried, Chandra, the ward support said "I think he's got tubes and blood cultures together and he's about to put them through the chute. You can't put the glass vials through the chute, that's lack of knowledge right there." "Are you going to do something?" the researcher asked.

"Yeah, I'll cut him off at the knees". Chandra walked over to Mark and spoke to him, taking the bag away with her. When she returned she commented "All good". The researcher asked "What did you say to him?" Chandra replied "Oh, I said I'll take that to pathology for you." "So how will he learn then?" "Oh, someone should explain to him it's very dangerous."

Interviews

"It is not only the junior medical staff, you'd be surprised. It is often the senior medical staff and in fact some consultants that often find it difficult to accept that they have made a mistake." (*Haematology Registrar*)

"There is a problem with feedback getting to the right place. Usually when there are incidents, which are reviewed by the transfusion nurse in respective hospitals, the nurse unit manager is contacted. But nurses, traditionally, don't challenge doctors and often the messages, if doctors are involved, are not fed back." (*Transfusion Nurse*)

"Documentation and sample labelling errors are thought to be of little consequence; minor errors that are easily fixed. In general people do not like to be made aware of their errors. The systems used for collecting the information are imperfect and it takes a lot of work to translate the raw data into a format that has meaning for the various groups. It can be difficult to gain access to the heads of department to provide the feedback. No one seems to have an answer to the problem only a lot of questions." (*Transfusion Nurse*)

4.2.5.3 Patient identification

When a patient arrives in the ED their personal details are obtained and either matched to an existing patient record or a new patient record created. The patient identification wristband and sheets of Bradma labels are prepared and the wristband placed on the patient. These steps are typically undertaken by the reception clerk and/or triage nurse in varying arrangements, depending on the specific hospital protocol.

This first step in admission to ED carries some risk of misidentification. The initial identification by clerk or triage nurse may be incorrect either due to inadvertent or deliberate error. Inadvertent error can occur through spelling mistakes or selecting the wrong patient from a computer list. Particular care is necessary with names from different cultures.

Deliberate error can occur where patients use a false identity or intentionally giving wrong ID information. This is known to occur where patients are afraid of repercussions following their presentation (e.g. with police) or wanting to utilise the Medicare or private health insurance status of another person (e.g. non Medicare-registered or uninsured patients). Both of these errors can be difficult to discover and subsequently rectify (i.e. restore the correct identification and records to each individual). The use of false ID can result in WBIT or specimen rejection, particularly where historical results for the patient do not match current results.

The initial determination of identity is extremely important. All subsequent identification checks are related back to the information recorded on patient notes and wristband. By the time the patient enters the ED their identity is assumed to be that which is displayed on their wristband, highlighting the importance of the first identification step.

Positive patient identification is the process by which a patient's identity is confirmed. Best practice positive patient ID requires the clinician to ask the patient (if conscious and rational) to state

their family name, given name(s), and date of birth and by checking against the patient wristband. To perform this correctly, the full details must be stated by the patient and not the clinician and patients should not be read the details from wristbands or notes.

In our observations, we recorded many instances of inappropriate identification processes. Patients were commonly asked to confirm rather than state their details and wristbands were checked rarely. Nurses were more likely to follow correct ID protocols than medical staff.

After completing blood sample collection and attaching labels to the tubes, collectors are required to sign and date the labels and forms, indicating that they have performed formal identification of the patient and confirming that they are certain that the blood in the tube was taken from the patient identified. During this study it became apparent that although signatures were recorded, they were not necessarily related to ID checks or visual checking of tubes and request form. Staff were signing because they knew samples would be rejected by the pathology laboratory in absence of a signature, but without any understanding of the real purpose of the signature or its significance.

Some processes and rules may not appear to have value (e.g. positive patient identification) especially if staff do not consider it likely there will be negative effects for the patient or consequences for themselves. When there is perceived benefit from an action (e.g. time saving, reduction in interruptions) people will be driven to that action. The greater the benefits and the lower the consequences, the more common it is for people to 'migrate' towards working in ways that they know to be wrong or that break the rules. Over time these ways become normalised and are integrated into culture (Vaughan 1999) (Section 4.2.2.1).

In many cases, it seems a lack of understanding of the importance of patient ID, an acceptance of 'not bothering' and

an assumption that this is done thoroughly and accurately at admission, leads to positive patient ID not being attempted before subsequent procedures such as blood sample collection. It was often observed that clinicians read out and ask for confirmation of the patient's details. There is a danger that 'confirmation bias' (seeing what you are most familiar with instead of what is actually there or seeing what you want or expect to see) reduces the ability to detect mistakes or discrepancies in two close, but not identical, pieces of information, such as a patient name or UR number (Green 1999).

In other cases an abbreviated identification process may occur, such as asking only the patient's name. This may be considered better than nothing, but the more identity attributes used, the more elements are provided for a correct identification and for detection of record mix-ups when identifiers do not match (Lichtner, Galliers et al. 2010).

Adding a second pair of eyes to view the same label or wristband (i.e. a 'double check') can improve the accuracy of comparing identifiers. Double checks work best when the person who is checking is allowed to form an independent judgment without cues from the person doing the initial work. For example, one nurse asking "I need you to check a group and

hold for Mr Macdonald" would not be considered to result in an independent judgement of the patient's name. The use of double checks is controversial as the process takes extra time, which some ED staff may not feel is justified for the relatively small number of problems that are initially missed. Others believe that double checks may lead to more mistakes because staff learn to rely upon others to catch problems. Either party may not attend appropriately to the task, simply trusting that the checks done by their colleague were accurate (Campbell and Facchinetti 2000).

It is important that patients are educated and engaged in understanding the importance of repeated, correctly conducted identity checks. Some patients express frustration and annoyance at being repeatedly asked to state their details and view it as a failing of staff not to know who they are, rather than a positive expression of appropriate process and important for their safety. This becomes even more of an issue in settings where patients are seen over long periods of time (e.g. outpatient oncology units) where familiarity can lead to break downs in proper patient ID processes and patients can resent being asked to confirm their ID. Patient education in this area would assist in not only reducing their frustration, but empowering patients to insist on appropriate checks

Observations

Wendy walked into a cubicle and said "Hello Greg, I'm Wendy and I am going to take some of your blood." Then looking at the request form she said "Oh sorry, Scott. Greg is your middle name, oops! I just looked at it quickly." Scott said "Yes, I'm Scott, glad you figured it out!"

Conversation with nurse: "I don't always do the ID thing because if they have a wristband on, I assume we know who they are. I look for that and if I don't see it then I will make sure I ask those questions we are told about."

Interviews

"Wrong labels in histories? I wouldn't think that would be common. The thing I would think that is more common is perhaps that the information that is given [at patient registration] is incorrect or the information dictated and then transposed onto the computer is incorrect." (*Ward Clerk*)

"I say 'Are you so-and-so?'" "And is that according to protocol?" "No, that's just according to me." (*Intern*)

"There's sort of an assumption that the patient is known 'cause they have been signed in on admission and usually the doctor has done the history and had that initial chat." (*Nurse*)

"When the patient's come in the ward clerk takes all their personal details and then the clerk gives the ID labels and wristbands to the triage nurse who puts them on and checks the name and DOB then. So, by the time they get to us, I guess I just take for granted that those checks have been done and don't always repeat them actually." (*Nurse*)

"When I sign the tube, is that me verifying that the bloods belong to the patient that I have taken blood from, or is it me taking responsibility for that sample and that I took it? I don't really know. Why we are signing is an issue which needs addressing, I think." (*Doctor*)

"I guess we are signing for patient verification but we are not actually using this step as a confirmation of identity and to carry out the proper patient ID process." (*Nurse*)

"To tell you the truth, I don't know why we have to put our signatures on tubes!" (*Nurse*)

"I identify the patient by asking 'Are you so and so?' ...I ask the patient name but I don't actually check the patient Bradma label and ensure that this in fact is the patient... I am relying on the patient totally." (*Haematology Registrar*)

"Do you always check the arm band?" "Not always. It's generally if I've got any concerns that they're not competent to tell me their own name or something like that." (*Intern*)

"I sort of go in and introduce myself and get straight into the history without actually asking the patient their name. Most of the time I sort of check once I've finished seeing them that their paperwork matches up with the person that I've put my name down to see." (*Intern*)

Recommendations and areas for further research

Request forms:

27. In the ED, protocols should allow for standing orders or for nurses to submit blood orders for patients fitting certain criteria. This is an intermediate strategy and further work is needed to specify the patient conditions and associated blood tests to be included.

Feedback:

28. Comprehensive feedback is necessary to ensure staff learn from errors and understand risks. Supervising staff should also be involved in the feedback process for both medical and nursing staff. This is again intermediate level.

29. Further work surrounding best methods of delivering and presenting information on errors, in order to facilitate individual and unit learning, would help to enable the development of stronger strategies to support error feedback.

Patient Identification:

30. Further work is needed to determine the level of knowledge of the correct methods of patient identification in the different staff groups, as some staff are already aware of the protocol but do or cannot follow it, for a number of reasons. This is an intermediate strategy.

31. Increase education for staff with reduced knowledge about risks and consequences of failing to carry out positive patient ID. Include clarification that the purpose of signatures on blood samples and forms is to directly verify identity and is a vital part of the ID process. This education should be incorporated into current scenario based training as environmental and patient factors influence adherence to protocols. Education is a weak level intervention for changing current behaviour.

32. A stronger strategy may be to involve patients in their own safety and to provide information direct to them regarding the need for repeated positive identification (i.e. encouraging them to demand proper process for their own safety). A poster campaign in waiting rooms might include punchy messages such as "Would you let your bank access your account without proper ID?" which sought to make patients uncomfortable if their identity was not checked as part of blood collection and labelling processes.

4.2.6 CULTURE

An important human factors concept that influences perceptions, attitudes and behaviour regarding risk and safety is the 'culture' of the organisation. More specifically, the 'safety culture', and how it is perceived by different levels within the organisation is very important. For instance, how do the Executive and Board of Management reveal their opinions about safety and the value of patient safety practices? Is this different from a direct line manager in touch with realities of day-to-day work and the staff pressure?

An interpretation of safety culture is 'the way we do things around here'. A positive safety culture can help promote interventions that may slow work but prevent serious errors i.e. protection

is prioritised over production (Reason 1997). The converse, a negative safety culture, is one where production is valued over protection and some approaches to patient safety may be difficult to promulgate in such a setting.

'Blame culture' describes settings where people blame each other to avoid accepting responsibility for error and are typified by distrust and fear. Since the beginning of the patient safety movement in the late 1990s, blame cultures have been commonly reported in health care. Discussions on how to limit impacts and move towards improvements on a systems and not individual level ('naming, blaming and shaming') continues (Wise 2001).

4.2.6.1 Interruption

Interruptions and multitasking are unavoidable in the hospital environment. An interruption refers to a pause, break or temporary halt in the continuity of a task or process, while multi-tasking refers to the act of undertaking more than one task at one time. Blood sample collection is not exempt from interruptions. Our observations suggest that it is a task that people feel relatively comfortable interrupting e.g. "Ah, I thought you were here, just taking bloods then?"

Doctors were routinely seen to interrupt nurses with questions, giving information about patients or assigning them new tasks during blood sample collection. Other nursing staff interrupt for a variety of reasons including need to access the blood collection trolley. Most blood collection is undertaken in ED cubicles without closing curtains. Closed curtains are a signal of the need for privacy and reduce, but do not eliminate, interruptions. The level of experience of the collector appears to be a factor in the way interruptions are managed. In the interviews, frustration was expressed by experienced staff about interruption, workload and expectation to multi-task.

Interruptions increase cognitive workload. When people are regularly interrupted they need to constantly reprioritise tasks in order to meet the changing demands of their work environment (Hakimzada, Green et al. 2008). In the ED there are many tasks that need to be performed in a timely, consistent and often non-linear fashion. The ED clinician's brain is bombarded with

visual and verbal stimuli, time and resources are limited and consequences of error are high. Many tasks require complex psychomotor skills and must be completed with a sense of urgency. As well as concentrating on the task at hand there are many interruptions and distractions. These factors have the potential to overload staff and impair decisions and performance.

Interruptions and multitasking are rife in the ED and a recent study reported that they are a major cause of clinical inefficiency and error in Australian hospitals (Westbrook, Woods et al. 2010). Specifically, 11 per cent of all doctors' tasks in the ED were interrupted and, of those, 18.5% failed to return to and complete interrupted tasks. Liu and colleagues in their study of interruptions in pre-transfusion checks (Liu, Grundgeiger et al. 2009) showed that clinicians who engaged with the interruption were more likely to fail to complete the original task whereas those who rejected or deferred the interruption generally completed the initial task appropriately.

Learning to deal with interruptions is important for ED staff, as is learning to minimise interruption to others. Processes such as blood sample collection should be completed without interruption and staff should be encouraged both to use physical barriers to interruption, such as cubicle curtains, and to reject or defer interruptions when they occur.

Observations

As Maria labelled the blood sample tubes Lei entered the cubicle and puts her hand in Maria's pocket saying "Hi, you've got the keys, right?" and then looked down and said "Sorry, you're signing tubes", Maria answered "No worries".

David was setting up to take blood samples when Lotta came to ask whether she can have help "for a tic". David went with her. He returned, finished setting up and started to take the sample. Lotta came back and asked another question and David said "Umm, I'm kinda busy now, I will come in a minute." Lotta walked out and David commented, "That happens all the time when you are taking bloods. It's like 'it's only taking bloods'".

Whilst Consultant Ryan was taking a blood sample, with the needle in Ms Zhang's arm, the phone in his back pocket rang. He pulled it out with his spare hand and answered it. "Hi, hi, Andy, thanks for getting back to me." He covered phone and called to a nurse, gesturing to the now-full syringe of blood he has laid on the trolley, "Just fill up the tubes as the request says. Thanks". Ryan turned to the patient with a smile and said "I'll be back to see you again" and left the cubicle as he continued talking on the phone.

Interviews

"Do you think you manage interruptions better as time progresses?" "Yeah because you learn, I think you learn to prioritise." (*Ward Clerk*)

"How do you deal with interruptions? *Do you get better as time progresses?*" "I think sometimes I get worse. I think I probably become less tolerant. It is quite an interesting question because you would think that most of us would get better at this. We do in some ways, but in some ways

we get a bit frustrated and annoyed at the fact that we are expected to do so many things and make so many decisions." (*Haematology Registrar*)

"I've been here for a few years, I also know a lot of the staff, so you feel confident to say 'Come back later'. Cause I guess if you were new... you don't want to upset or disappoint anyone so you probably would try to multi-task, maybe more things than you can handle sometimes." (*Nurse*)

4.2.6.2 Vigilance

'Vigilance' is the process of paying close and continuous attention as distinct from being 'alert' which is a heightened watchfulness to all activities. Vigilance therefore involves a decision process to prioritise attention on a particular activity rather than a more generic process of being attentive to all stimuli. When we encounter situations which we consider risky or dangerous our attention and vigilance purposefully heighten. The reverse is also true when we perceive low risk (March and Shapira 1992).

A general finding from the observations was that in the ED phlebotomy is considered a menial task, requiring low vigilance and carrying low risk. Blood sample collection and the accompanying identification processes are commonly interrupted which seems to indicate a perception that they do not require undivided attention.

Interestingly, staff acknowledge an association between the reason for the blood sample collection and the degree of vigilance which relates to the potential consequence of an error. Many staff made reference to their own greater care and

attention to samples used for determining the patient's blood group (variously referred to as 'group and holds', 'group and saves' or 'cross matches'). Results from these tests will be used to identify appropriate units of blood should it be necessary to transfuse the patient at a later date. Cross matches appear to be treated with greater vigilance (i.e. routine positive patient ID and visual checks on sample and wristband) than other blood tests.

Hollnagel (2008) states that "...safety can be brought about either by eliminating hazards, by preventing initiating events, and/or by protecting against outcomes". When vigilance is high, individuals employ more defences (i.e. double checking with other staff) to ensure safe practice. Our observations indicate that more defenses are present to prevent error when cross matches are taken as compared to other blood samples. It is positive that special care is taken with these samples but, on the other hand, it is unfortunate that all samples are not carried out adopting best practice. It appears necessary to engender a culture of general alertness to safety in the blood collection process rather than simple vigilance for certain tests over others.

Observations

After taking the blood and labelling and signing the tubes, John addressed Miss Larsson "Now, because I am taking a pink one – to check what your blood type is in case we need to give you a top up – I'm going to ask who you are. Don't worry, I know who you are, but I want to know who you are! So, what is your name?" Miss Larsson answered with her first and last name. "What is your date of birth: day, month and year?" Again Miss Larsson answered in full.

Later John said "I rarely check their labels unless I'm doing a group and hold. I know who they are since I have already spoken to them at that point"

Conversation with nurse "All cross matches are handwritten here. We are very particular. There can't be any spelling errors and it's signed by two nurses so you have another witness for the cross match."

Interviews

"I think that part of it is education. The lack of understanding the consequences of major ABO incompatible transfusion. I think that we are fortunate enough that we rarely see such an event... if you have not seen it and you don't understand, you think, 'what are the chances of that?!'" (*Haematology Registrar*)

"It really depends on your definition of WBIT. That needs to be qualified to distinguish between good and bad WBITs. You know those with greater or lesser consequences. Because an error with an FBE is very different from one with a group and save. I know that I pay more attention to the process when I am doing the latter, for sure." (*Doctor*)

"Most places handwrite for a cross match since that's where the big risk is." (*Nurse*)

"We mostly do the group and cross match in trauma and resus bays. In the assessment area this is done with less frequency and so maybe people are less vigilant." (*Doctor*)

"I think the biggest thing is that people think they know about it already. They don't need to know any more." (*Transfusion Nurse*)

"...I don't think that they realise what the risks are until you put them blankly. You know, blood transfusion is a process they do every day and it's a fairly simple process but they don't realise that there's a lot of associated risks with it" (*Transfusion Nurse*)

4.2.6.3 Sample rejection and re-bleeding

When samples are received at the pathology laboratory, they are screened and accepted or rejected as unsuitable for testing. If a sample is rejected, the originating department is notified and requested to provide a new sample. Repeat samples require re-bleeding of the patients, either through repeat venepuncture, or if in place, through the cannula.

It is important that samples are rejected by the laboratory when mistakes are made in order to avoid WBITs. The culture of the ED should encourage clinical staff to view sample rejection as a necessity and a positive intervention to prevent WBITs rather than an inconvenience.

A common reason for sample rejection is that there is a problem with the labeling on the tube (e.g. no signatures) or a mismatch between the labels on the tubes and the request form. Other causes for rejection occur when the tests cannot be carried out due to haemolysis (disintegration of red blood cells), clotting or under-filling of tubes. It is reported that rejection of samples collected in the ED is the result of many factors including the specific patient, phlebotomy practice and specimen transport factors (Lippi, Blanckaert et al. 2008).

Despite many reasons contributing to the need to recollect blood, feedback to clinicians was commonly reported as 'unsuitable specimen'. Samples that had the potential to become WBITs are included in this group. Without understanding the specific reason for sample rejection, clinicians do not have the opportunity to correct errors in practice.

In our observations the reason given to the patient for re-bleeding most often was 'laboratory error', implying or stating that the laboratory lost, spilt or forgot the sample. This is likely as there is a stigma attached to admitting a mistake and patients are unhappy, and even distressed or rude when approached for repeat blood samples.

Use of the 'laboratory error' explanation creates a 'common enemy' and lowers the social awkwardness attached to the need to re-bleed by attributing the fault to an anonymous third party. The collection of blood samples is not a pleasant experience for the patients, particularly for those who have phobias of needles or the sight of blood. ED staff are aware of the added discomfort to the patients. This is especially true when an extra venepuncture is required or the patients in question are infants or children.

Clinical or laboratory staff alone should not take the blame for re-bleeds. Rather, system factors which limit education or prevent learning from error need to be addressed. A move away from individual responsibility and an 'us and them' culture surrounding who is at fault is necessary.

Our psychological tendencies support the attribution of error to individuals (Norman, 1981) and organisational processes reinforce the tendency to regard frontline staff as both the primary cause of mishaps and the main target for remedial efforts.

Examples of two such major organisational processes are:

1. The '*principle of least effort*'. It is usually easy to identify the proximal errors and to consider these to be the 'cause' of a mishap. That being the case, investigation of the adverse event proceeds no further. Identifying the human as the acceptable cause is therefore an automatic 'stop rule' and prevents learning about why an adverse event really happened (Rasmussen 1990); and,
2. The '*principle of administrative convenience*'. By restricting the search to the actions of those directly in contact with the patient, it is possible to limit the blame accordingly and thus minimise any institutional responsibility (Firth-Cozens 2000).

The issue of sample rejection needs to be addressed at a wider systems and HF level, particularly since it is currently a cause of division and results in a blame culture between clinical and laboratory staff.

Observations

Theresa came into the ward and said "Sorry, I've got to take some more blood. We need more blood. It may have clotted since it took a very long time to come out, didn't it?" Mr Newby's son said to Mr Newby "At least she tells you straight out so you know what's happening!" Mr Newby replied, "She's made one mistake though, she better not make another one!" Theresa looked slightly intimidated but went ahead with the repeat sample.

Mrs Tang said "I came in first thing this morning... and they needed to take blood, and boy have they! Look at all my bruises, I'm like a pin cushion, I'm gonna need a transfusion

after today!" Lucy replied "Yes, you have had two samples that have clotted... so that the lab can't use them." Mrs Tang's daughter interrupted, "Clotted? What? Is there something wrong with Mum?" "No," Lucy replied, "this is very normal. But it needs to be repeated is all. The lab is telling us that the samples we've taken are not viable, so we need to take another one." "Why are they not viable?" asked Mrs Tang's daughter, "Oh there are lots of reasons but the lab doesn't usually tell us much about it. We'll just take another one now and make sure we make them happy."

Observations

Michèle went to Mr Kovalevsky and said to his daughter "We need to take another small tube of blood." Mr Kovalevsky is elderly and doesn't speak English. His daughter turns to him and they speak in Ukrainian. The daughter turned back to Michèle and asked "Why do you need to take more blood? The last nurse took four tubes.

Why do we need more?" Michèle said "Well, sometimes blood gets collected and you need to get more. Or there isn't enough in the tube." "So, the other nurse made a mistake?" "No, not really. It could have just waited too long in the lab. It doesn't happen very often, nothing to worry about. Let me just take another sample so we can help your father, OK?"

Interviews

"I don't think any one of us, especially when we are faced with a patient who is unwell and critically unwell, enjoys being told that they made a mistake." (*Haematology Registrar*)

"I don't know why but nine times out of ten it's a patient that was really difficult to bleed so it's a big hassle." (*Nurse*)

"The most common reason is for clotted and the second, I'd say, is under-filled." (*Nurse*)

4.2.6.4 Resilience

Resilience is an HF concept that seeks to understand and describe how individuals, teams and organisations monitor, adapt to and act on failures in high-risk situations (Hollnagel, David et al. 2006). Importantly, following this approach moves the focus away from 'what went wrong?' to 'why does it go right?' Understanding resilience also changes the style of error management from reactive to proactive (Jeffcott, Ibrahim et al. 2009). It centres on how and what we can learn from successes and error avoidance rather than the reactive search for single solutions (Alberti 2001).

It is possible to learn more about how to support best practice by describing how people learn and adapt in safety-critical scenarios (Cook, Render et al. 2000). A resilience approach acknowledges the reality of problems in the system and focuses, not on their negative effects but, on how people successfully navigate these problems to achieve successful outcomes.

In the context of WBITs both system and individual resilience are at play. On a system level, WBITs may be identified in the laboratory before potentially catastrophic outcomes, by cross checks against historical results.

For example, the results of a blood sample taken today for cross matching prior to blood transfusion are cross referenced against results for that patient from earlier tests. If discrepancies between the results exist, investigations are undertaken to ensure errors are identified. These strategies are effective, but run the risk of engendering complacency in staff who rely on errors to be 'caught' downstream.

On an individual level, we observed resilient practice in some clinical staff. Nurses were more likely to display such behaviour than junior doctors. This may be attributed both to more effective feedback to nurses when errors occur, resulting in proactive behaviours to prevent repeat errors, and greater experience through repeated practice. Doctors, as described above, receive little feedback and are often not required to remedy previous errors and both situations are unfavourable to the development of resilient behaviour.

Observations

Jamal walked past with sheets of labels. "What are you doing?" "Oh just doing a sweep to catch stray labels and put them back in their rightful homes." "What about the histories, how do you find them?" "Well, a lot of the label sheets can get left in the bays and the histories all over the place. At the desks, at the flight deck, in people's hands. The newbies, the junior doctors, who only spend 3-4 months here, don't give a rat's and don't put the histories back in the right place!" "Where is the right place?" "Well, in the patient bay or on the desk by the patient, the correct patient in that bay."

Alima stood at the chute and checked the details of the request form and tubes again before sending them, "...it

makes me feel better to know that I have got it right... Oops, the doctor has forgotten to write in the clinical notes section, to explain the reason for taking blood. The lab won't accept it, if not. The doctor should have done it and I probably shouldn't, but I don't want to delay any longer and better to be safe than sorry for the patient's sake and I know what is wrong with the patient." She filled in the missing field on the request form before checking details one more time and finally sending the samples.

Interviews

"I wait to see that the bloods go after I put them in the chute and if I am waiting more than... a few minutes which happened a few weeks ago – the tube wasn't working very well – then I just ask the ward clerk to call someone to send the blood straight to pathology. Or I would put it in the tray on the flight deck but I would make sure I told the ward clerk it was there rather than just leaving it there." (*Nurse*)

"So after you print the form and have your blood taken, then you put it in one of the chutes and you just press the buttons and the chutes will always magically go up to pathology." (*Intern*)

Recommendations and areas for further research

Interruption:

33. Physical barriers such as the curtain should be employed to indicate the need for concentration. This is at an intermediate or strong level of intervention but only if education accompanies their use and to respect them being closed.
34. Education about strategies to manage interruptions should be compulsory in the ED. Specifically, staff should be encouraged and empowered to reject or defer interruptions during procedures including blood sample collection. This is a weak level strategy but may be a necessary start and would be made stronger with senior staff leadership.

Vigilance:

35. Education regarding the importance of all tests, not just those that could lead to ABO incompatible transfusion, in order to engender a culture of general 'alertness' rather than specific 'vigilance' in blood sample collection. This is a weak level strategy.

Sample rejection and re-bleeding:

36. Improve feedback from the laboratory to give the accurate cause/s of sample rejection. This may include the design of a specific checklist to enable a standard set of information to be gathered and is an intermediate strategy.

37. Improved education regarding factors that impact on the ability to deliver appropriately prepared blood samples to the laboratory, including selection of correct tube, appropriate volume, and appropriate specimen handling. This is a weak intervention.
38. Further work looking at the design of laminated sheets that sit on blood trolleys may provide a strong intervention which could produce a more relevant order and clearer presentation of information e.g. the most common blood tests at the top (FBE, LFT, U&E etc.) and in bold font and then the rest listed alphabetically.
39. Raise patient awareness of the complexity and complications involved in blood collection to 'decriminalise' re-bleeding. This may be through a poster campaign in patient waiting rooms and also around the ED itself.

Combining such a resilience approach with an examination of error-producing conditions will increase understanding of WBITs and lead to solutions which build system strength and remove failures.

Resilience:

40. A multi-disciplinary sharing of common experiences, errors, tips to improve technique and strategies to avoid error should be introduced. This may be promoted as part of existing structures such as handover, where there is a rotation of weekly topics, which would include blood taking. This is an intermediate to strong intervention.

4.3 Survey

4.3.1 Relationships and Education

Results from the online Transfusion Nurse (TN) Survey complemented some of the themes highlighted in the observational and interview results reported above. In particular, they identified problems with education and feedback, especially in medical staff. The collection of data, feedback and education relating to WBIT errors is a facet of transfusion nurse practice common to most transfusion nurses. Seventy percent of TNs reported spending less than 10% of their time on WBIT and related issues while the remaining TNs spend between 10-20% of their time. This corresponds with a desire from 50% of TNs to spend less than 10% of their time on WBIT. Thirty percent of respondents would prefer to allocate 10-20% of their time to WBIT and 20% would prefer to allocate 20-50% of their time to WBIT-related activities (Figure 4).

Transfusion Nurses interact with a range of stakeholders throughout the hospital including; clinicians of all types, laboratory staff, quality departments and hospital administration.

Respondents were asked to rate their satisfaction with the relationships they have with key stakeholder groups on a 5-point scale; extremely satisfied, very satisfied, satisfied, somewhat satisfied, unsatisfied (Figure 5).

TNs report highest satisfaction with their relationship with Blood Bank Scientists (95.2% extremely or very satisfied). The majority were 'very satisfied' or 'satisfied' with pathology scientists (76.2%), junior (85.8%) and senior nursing staff (76.2%), clinical educators (66.7%), quality department (71.5%) and pathology collectors (60%). By contrast, TNs reported their satisfaction as 'somewhat satisfied' or 'unsatisfied' regarding relationships with junior (50%) and senior (61.9%) medical staff.

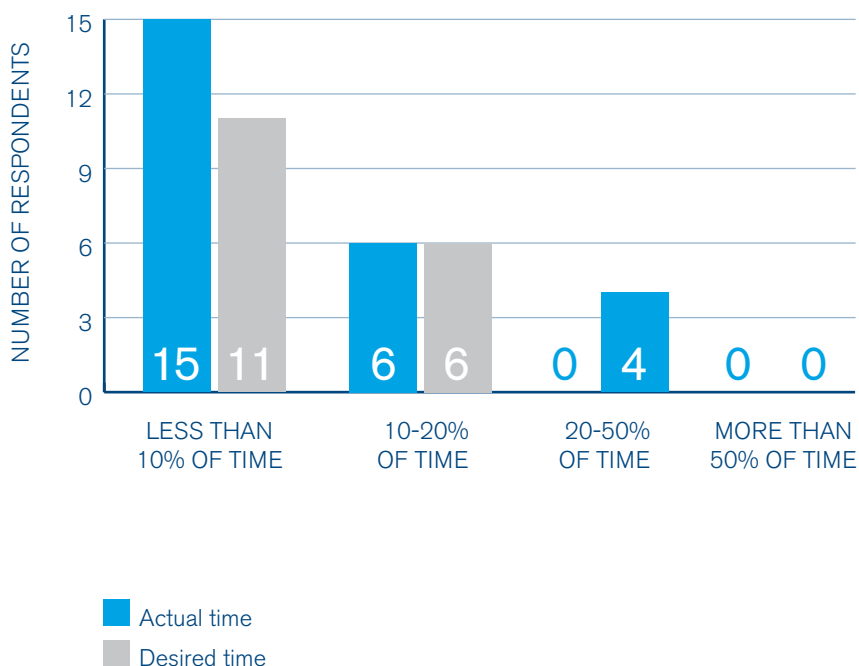


Figure 4: Actual versus desired time allocated to WBIT-related activities

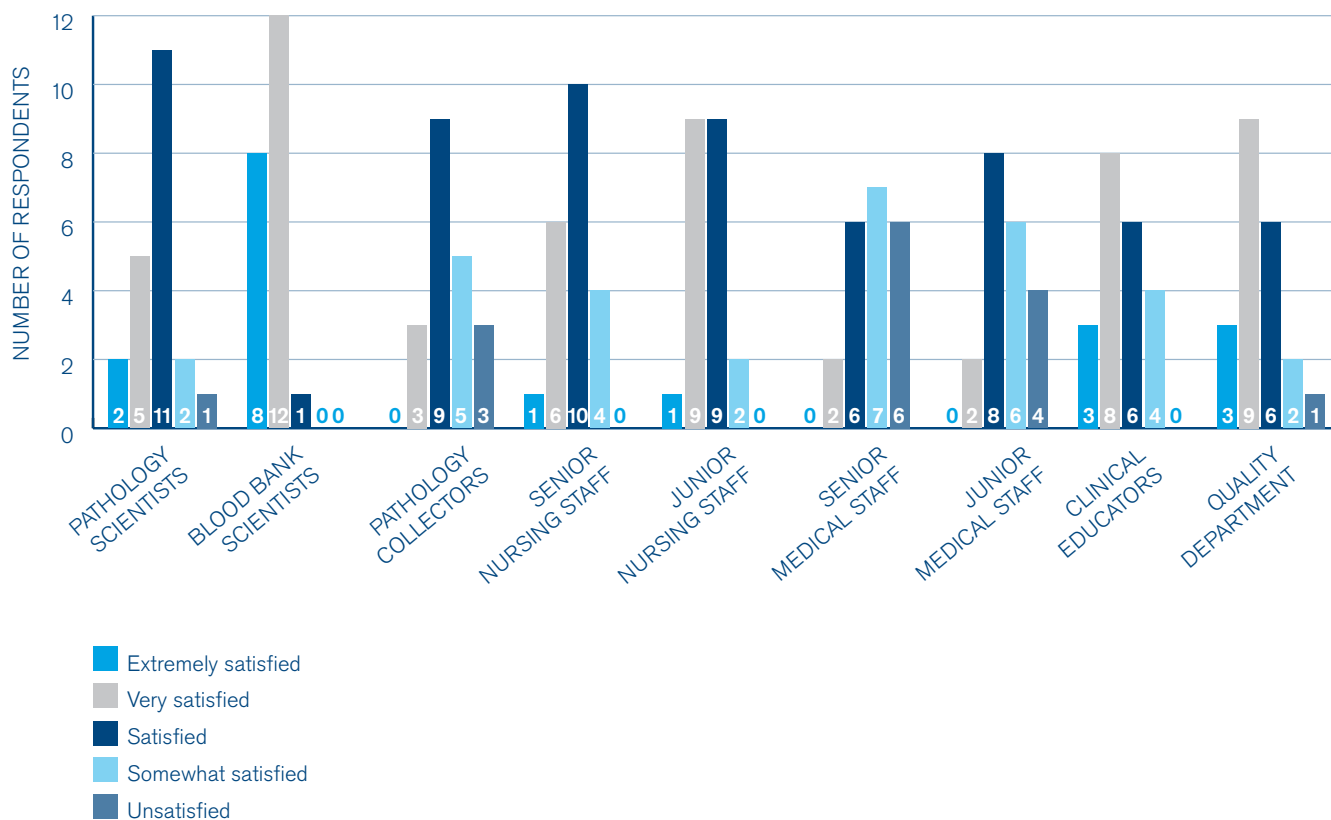


Figure 5: Transfusion nurse satisfaction regarding relationships with key stakeholders

Education forms an important part of the TN role in most hospitals, but is provided in different ways to different stakeholder groups. For most stakeholder groups, education is delivered informally when providing feedback following errors. The exceptions being for junior nursing staff who TNs report being able to educate via formal in-service education (81%) and junior medical staff through formal orientation (47.6%). The TNs report that they reach the majority of junior and senior nurses with education each year and spend an average of 2 or more hours with each of these groups. Medical staff were not as comprehensively accessed with TNs estimating they spent less than half an hour with the majority of junior and senior medics. This is particularly marked with the senior medical group, with less than half TNs (42.9%) reporting spending zero minutes educating this group in the last calendar year.

The lack of education time with medical staff seems to be reflected in TN perceptions of each group’s knowledge of patient ID and blood sample collection protocols. Respondents were asked to rate their confidence in the stakeholder group’s knowledge on a 5-point scale (extremely confident, very confident, confident, somewhat confident, not confident). TNs were, on average, ‘very confident’ that pathology collectors and clinical educators had sound knowledge and ‘confident’ that senior nursing staff had sound knowledge. Their average confidence in junior nursing staff fell between ‘confident’ and ‘somewhat confident’, but for junior and senior medical staff they were on average only ‘somewhat confident’. Thirty five percent of respondents reported being ‘not confident’ in the knowledge of both junior and senior medical staff.

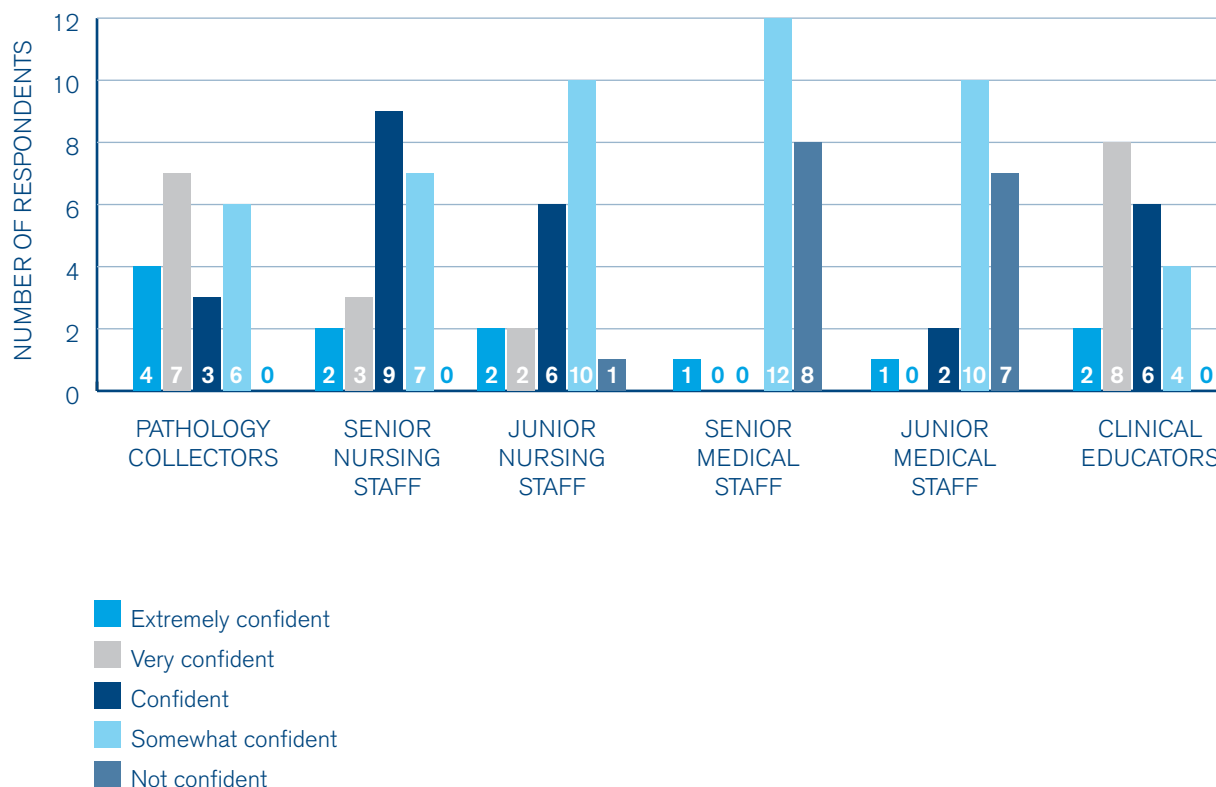


Figure 6: Transfusion nurse confidence in the knowledge possessed by key stakeholder groups

Comments accompanying responses to these questions mention difficulties with access and priorities of medical staff, particularly in comparison to nursing staff;

“There is a lack of opportunity to speak to senior clinicians and limited time slots with interns.”

“Competing priorities and busy workloads of clinical staff.”

“A challenge is being given the time to perform education sessions for the medical staff. Nursing education is performed regularly and results of audits are disseminated.”

4.3.2 Relationships and Interventions

The literature review revealed little published information regarding interventions to reduce WBIT rates in Australian hospitals. The TN survey was therefore taken as an opportunity to discover the nature and range of interventions surrounding WBITs, plus the perception of TNs regarding the effectiveness and impact of these interventions. Respondents were asked to record key interventions which have been implemented in their hospital since 2005. They were also asked what the key facilitators and barriers were and if there had been any measurable fall in WBIT rates or behavioural impact following the intervention/s. The lists below present this data (pp. 47-48).

It should be noted that this list of interventions may be considered representative of efforts to reduce WBIT, particularly in Victoria, but may not be exhaustive. It should also be noted that facilitators and barriers reported are those perceived by the respondents to be important.

Some TNs reported a reduction in the number of errors following specific interventions; although proportions of errors attributed to different clinical groups remained similar i.e. doctors were over-represented.

The zero tolerance intervention, whereby the pathology laboratory rejects samples with any labelling discrepancy or omission, was seen as very successful in reducing the number of ABO incompatible transfusions. This intervention was also said to have improved relationships between *the laboratory and clinical staff*, for example: “*[the laboratory]... no longer get any flack from the clinician, and are more likely to get an apology.*”

Generally, however, medical attitudes were said to have changed very little after education attempts although there was a reported increase in awareness of the significance of errors. The involvement of senior nursing staff to support nurse interventions seemed to be a strong determinant of success in educational interventions. It appears that clear leadership by senior medical staff is needed to change (especially junior doctors) behaviour and the perceptions that blood sample collection is a low risk task and that errors will be caught further downstream.

Noticeably, none of the respondents believed they were able to show long term reduction in WBIT rates, as supported by quantitative data. A summary of the interventions reported by TNs and the facilitators and identified barriers to these are presented in the following pages.

Summary of Interventions aimed at reducing WBIT rates

Education:

- Introduction of mandatory education packages, either paper or web-based (e.g. BloodSafe e-Learning module)
- In-service education sessions for nursing
- Specifically designed education package and orientation for junior medical staff

Feedback:

- One-to-one counselling for staff involved with each WBIT
- Improvements in feedback to unit managers when errors are made by staff
- Signed personal acknowledgement from staff involved in WBITs that they have read the policy and understand their responsibilities for ID and labelling
- Visual audits by transfusion nurses with on-the-spot education and feedback
- Root cause analyses performed on all WBIT incidents

Equipment and Process Based:

- Electronic request forms which automatically print corresponding labels
- Hand-written labelling of blood tubes
- Individual 'cubby holes' for storage of medical records (to prevent confusion)
- Re-design of request forms to make it easier for staff to complete

Increasing Awareness:

- Posters advertising monthly WBIT data (separating nursing and medical data)
- Raising awareness of reasons behind the need for zero tolerance policy

Other:

- Working party to develop and implement strategies to reduce distractions on wards
- Clinical practice guidelines reinforcing correct identification procedures

Factors that facilitate the success of WBIT interventions

Staff:

- Executive level support (gained by regularly presenting to and engaging the medical executive)
- Senior staff commitment (across administration, quality, nursing, medical and laboratory departments)
- Real-life examples within education help to illustrate risks involved in poor practice
- Continuous education to keep up awareness and reduce complacency

Education:

- Making education modules:
 - compulsory (e.g. included in health service policies and procedures)
 - require annual updates
 - require review in order to give feedback to the ward/clinical area
- Starting transfusion safety education for doctors early (e.g. at orientation)

Feedback:

- Involvement of supervisors in feedback to reinforce the importance of WBIT
- Direct, one-to-one error feedback, stressing learning/support and not blame
- In-situ audits enabling real-time interaction and feedback about concerns

Factors that create barriers to WBIT interventions

Staff:

- Senior staff do not engage with or support interventions
- Frequent rotation of staff (particularly medical)
- Agency and locum staff do not participate in education programs
- Lack of management review and follow-up of incidents

Education:

- Lack of time (and dedicated space) for education
- Transfusion safety knowledge not included in student education prior to joining workforce
- Restricted access to computer terminals for e-Learning modules and resistance by older staff to learn in this way

Resistance to Change:

- Tolerance of non-standard practice
- Development of “workarounds” in busy units to save time
- Ingrained practice (e.g. “this is the way I've always done it”)
- Lack of awareness and engagement in the problem/s
- Lack of motivation and willingness to participate in education
- Urgency of the sample or precious sample (e.g. lumbar puncture) often accepted

Abrogation of Responsibility:

- Lack of personal responsibility in contribution to WBIT errors
- Perception that the transfusion nurse and laboratory are responsible for transfusion safety

4.4 Failure Modes Effects Analysis

Process maps were developed to identify the steps involved in blood sample collection based on direct observations within the ED. Marked, uniform differences were observed in practice between doctors and nurses, so separate maps were created to reflect these differences. These maps were verified by the FMEA team. Copies are found in Appendices 5 and 6. A general set of steps, common to both maps, was identified and it was this process that was used for the FMEA.

The analysis identified 11 sub-process steps, 17 potential failure modes, and 43 causes associated with the potential failures. The completed FMEA worksheet is reproduced in Appendix 7.

Risk priority numbers (RPNs) were attributed to the 17 failure modes and ranged from 48 to 432 (out of a possible 1000). Six failure modes were associated with RPNs over 250 (Table 5). This level was identified as the threshold for immediate remedial action.

Failure Mode	Risk Priority Number (RPN)
Tubes are confused with another patient's	432
Positive patient identification is not carried out appropriately	405
Inability to check identity with the patient or a lack of identifiers (i.e. wristband)	378
Incorrect labels are attached or tubes not labelled	324
Blood is taken from the wrong patient	270
Labels become lost or detached from the notes	256

Table 5: Failure Modes associated with the highest risk

The FMEA team formulated recommendations to address the highest ranked failure modes, as follows:

- sheets of labels should never be separated from the patient medical record
- tubes should never be taken away from the bedside
- patient identification must always be carried out

There were a number of difficulties experienced in conducting the FMEA process. Due to heavy workload commitments, clinical members of the team were frequently unavailable, even at agreed meeting times. As the team was selected to include representatives of different stakeholder groups, in busy environments such as the ED it may be desirable to include multiple representatives of clinical groups to increase the likelihood that each group can be represented at all steps of the FMEA process.

4.5 Incident data

A subsidiary piece of work was performed, in parallel with the aspects of the project described above, involving the collection and analysis of data regarding mislabelling and miscollection events. With the assistance of Risk/Quality Managers at each site, relevant (WBIT) incident reports for the five-year period 2004-2009 were requested.

Another difficulty encountered was that although a single process was involved, consequences were felt to vary for different types of test (e.g. cross match versus all other blood tests). In order to complete the analysis a single combined score was determined, but this was felt by the team to be suboptimal.

When scoring the likelihood of a failure mode, the team found that some failures had multiple potential causes with disparate likelihoods. Again, a single score was determined, but it is recommended that future analyses treat each cause separately. This will also assist when devising appropriate interventions.

This FMEA can be used by other groups as a template against which to measure their practice. It identifies the areas of greatest risk, and makes recommendations for changes in practice to help reduce these risks.

Obtaining this data involved a review of the main electronic incident reporting repository for Victorian hospitals, 'RiskMan' (RiskMan International 2010), as well as accessing other pathology quality reporting systems where they existed. Table 6 summarises the data obtained.

Site	System used to capture data	No. of records	Data captured	Narrative data included	Time period captured
Hospital One	RiskMan (hospital-wide)	980	<ul style="list-style-type: none"> • Unlabelled • Mislabelled • WBIT 	Yes	Nov 2004 - Mar 2009
	Transfusion nurse collated WBIT data	81	<ul style="list-style-type: none"> • WBIT 	Yes	Feb 2007 - Sept 2009
Hospital Two	Pathology department database	83	<ul style="list-style-type: none"> • Unlabelled • Mislabelled • WBIT 	No	Jan - Dec 2008
	'Specimen collection and labelling quality audit'	216	<ul style="list-style-type: none"> • Unlabelled • Mislabelled • WBIT 	No	Jan - Dec 2007
Hospital Three	RiskMan (hospital-wide)	127	<ul style="list-style-type: none"> • Unlabelled • Mislabelled • WBIT 	Yes	Aug 2006 - Apr 2009
	Pathology department 'unsuitable specimen' database	80	<ul style="list-style-type: none"> • Unlabelled • Mislabelled • WBIT 	No	Apr 2009

Table 6: Incident data available for analysis

Substantial difficulty was encountered in obtaining the above information, which ultimately represents a far less comprehensive dataset than the project team intended to collate. Efforts were hampered by systemic issues that must be addressed in order to bring real meaning to healthcare error reporting data, and to enable assessment of improvements in transfusion and patient safety.

The dataset and taxonomy for each site were vastly different; despite implementation of the same, or very similar, electronic risk reporting systems. There were also enormous discrepancies in incident reporting criteria (what should be reported) between different departments within a hospital site. Data was inconsistent, incomplete and inaccurate (e.g. urine, stool and sputum samples often coded as WBIT events) so that it was not possible to identify patterns or trends. There was considerable variation in categorisation of events both internally and between different hospitals.

In the course of data collection, it became apparent that RiskMan (and other system) platforms were poorly understood within the hospitals and thus misuse or under-utilisation of the functionality lead to unreliable reporting. This was prevalent within the Risk/Quality teams relating to analysis of data, and was endemic in the nursing and medical staff at input of the data. Use of independent, non-linked information technology systems resulted in data duplication and loss of detail when compiling information from multiple sources, with entries for one incident commonly being reported more than once.

In addition to hospital reporting systems, permission was obtained from the STIR Expert Group to gain access to the Blood Matters 'Serious Transfusion Incident Reporting' (STIR) data. STIR is a state-wide, centralised system for voluntary reporting of serious adverse events relating to the transfusion of blood or blood components. It was established in 2006 and captures information on serious hospital transfusion incidents including near misses. All reports to STIR are reviewed by an expert panel

to validate clinical features, determine severity and attribute causality (Department of Health 2008). WBIT events are one of ten incident categories reported to STIR.

STIR data reports 154 serious adverse events from 2006-2007, of which 25 were identified as WBIT incidents. The remaining 129 events involved (from most to least common) were: acute transfusion reactions, near misses, incorrect blood components transfused (IBCT), transfusion-related acute lung injuries, bacterial contamination and delayed transfusion reactions.

The common theme identified in error-based serious adverse events relating to transfusion, was failure to positively identify the patient, due to either a conscious or unconscious failure on the part of the clinician to follow hospital policies and procedures.

It is evident that hospitals are attempting to gather and track information regarding blood sample collection and transfusion incidents, however the absence of a consistent approach results in unreliable and unusable data. It is impossible to make a comparative analysis within individual hospitals and between hospital sites, and thus opportunities for information-sharing and education leading to improvements in practice is lost. Investment in a compulsory, comprehensive system to capture, report and manage adverse event incidents should be a priority.

The Victorian Health Incident Management System (VHIMS) project aims to improve quality through incident management via a new e-Learning package, and a "... systematic approach for reporting clinical incident, consumer feedback and occupational health and safety data" (VHIMS 2010). This new portal is being implemented across Victoria in 2009/2010 and will integrate with STIR. This should result in common definitions being applied across the state, but widespread education is obviously necessary to ensure consistent reporting within these categories. It should also be noted that while STIR captures data on WBIT events, errors potentially leading to WBITs (e.g. labelling errors) are not collected, or defined, by STIR.

5 Conclusion

Wrong Blood in Tube (WBIT) incidents represent a failure in the blood sample collection process that has the potential for catastrophic consequences. They occur due to lapses in proper blood sample collection procedure such as lack of identification or mislabelling. Rates of WBIT events are refractory to interventions, particularly in the longer term.

This multi-method study was aimed at understanding the factors leading to these lapses in procedure as well as the barriers to the success of intervention strategies.

Understanding and applying HF in healthcare can provide opportunities for improving patient safety by elucidating the factors which both create risk and safety. The use of HF approaches in this project has allowed for an in-depth appreciation of the issues surrounding the WBIT problem under the key headings of: Environment; Staff; Equipment; Patient; Procedure; and, Culture.

A total of 40 specific recommendations are set out in the results section, with associated levels of strength of their effectiveness. The intention is that they will provide input for those responsible for reducing errors related to mislabelling and miscollection of blood samples. Real-life examples have been used for illustration and provide vignettes that may be used in clinical education initiatives.

Studies such as this, and the recommendations it provides, are particularly important because they are based directly on real life practice. Safety and quality practice in healthcare often suffer due to a separation between those making decisions about risk and those confronting those risks on a daily basis (Dekker 2006). The potential result is that data is gathered and incidents investigated based on assumptions about risk that are obsolete or of limited relevance to the real nature of practice and risk.

The implementation of our recommendations should be considered in the broader context of the organisational culture of Australian healthcare. The need to engage those responsible for carrying out 'safe' work, as part of a specific process and within a particular setting, is paramount. The 'human factors' (HF) impacting on people's attitudes and behaviours to their work,

colleagues, management and patients should be incorporated if recommendations for practice re-design are to be feasible (Plsek and Wilson 2001).

The results of this study illustrate the complexity of the issues underlying WBIT errors. Myriad factors were seen to prevent the routine performance of best practice, especially in the hectic setting of the ED. Blood sample collection is often considered a low risk or menial task. Underestimation of the potential consequences of error is common as is reliance on the resilience of the system.

Patient identification is a critical safety step that we observed, (in most ED blood collections) as either not being attempted or being completed unsuccessfully according to institutional procedures. This is an area that is not just specific to transfusion medicine and our recommendations may be of benefit in other fields such as radiology and surgical procedures which also suffer high consequences of failure to perform positive patient ID.

This study emphasises how HF research can bridge the gap between a theoretical understanding of risks and the reality of potential risk in a given situation and demonstrates how we can arm those responsible for quality and safety with better information.

Future research should explore 'same but different' contexts (e.g. EDs within regional or rural hospitals) and 'different but the same' contexts (e.g. other setting within the hospital), to test both the reality of the world represented in this report and the generalisability of the recommendations to improve safety in blood sample collection.

WBIT is a transfusion safety concern that has low probability but high consequence, making it perfectly suited to HF investigation. A summary of all recommendations created from this research work are listed on pages 52-53 as a quick resource for those seeking to identify the key messages to take home from this extensive project report.

Summary of Recommendations and Areas for further research

ENVIRONMENT

Setting:

1. Protocols must consider real differences in setting and situation and where necessary allow for alternative processes (intermediate)

Stress and Fatigue:

2. Compulsory education should be introduced to ensure staff are aware of the impacts of stress and fatigue on performance (weak)
3. Development of objective tests of individual fatigue levels at start of shift (strong)

STAFF

Professional practice:

4. Attaching labels to patient e.g. ID scanner and handheld printer (strong)
5. Attaching labels to bed e.g. spare labels and pen for tubes (intermediate)
6. Attaching labels to cubicle e.g. designated tray for patient notes (weak)

Training:

7. Scenario-based training rather than isolated skills-based training (weak)
8. Senior leadership to help raise profile of phlebotomy risks (weak)
9. Mandatory cannulation competency for all clinical staff (intermediate)

Teamwork:

10. Teams must be established with appropriate supervision of inexperienced members (weak)

Interaction with Pathology Lab:

11. Formal protocols should be developed to feedback problems with samples (intermediate)
12. Orientation visits of clinical staff to the pathology laboratory (intermediate)

EQUIPMENT

Blood collection trolleys (all are intermediate to strong):

13. Number of dedicated blood collection trolleys should be increased
14. More frequent re-stocking of blood collection trolleys should occur
15. Non-trolley based store of blood collection equipment so that trolleys in use do not need to be accessed
16. A tray/storage container should be attached to the ED bed so that there is a place to gather and store equipment if bloods need to be taken in the corridor

Information technology:

17. Engagement of clinical staff in any IT system changes (intermediate)
18. Changes to work practices caused by the introduction of technology should be trialled in a simulation setting (strong)
19. Dedicated printers available for each cubicle to avoid confusion of e-order forms (strong)
20. Hand held scanners and label printers for patient ID and specimen labelling (strong)

Labels:

21. Sheets of labels should not be able to be separated from records in the ED (intermediate)
22. Trial and provision of printed stickers with e-order forms (strong)
23. Enforcement of protocols for keeping patient records by the bedside (weak)
24. Forcing functions to keep equipment by bed and keep tubes in bay (strong)

PATIENT

Interaction with patient:

25. Inclusion of a 'step back' process to address patient concerns (intermediate)

Variability of patients:

26. 'What if' provisions in protocols to address different clinical situations (intermediate)

PROCEDURE

Request forms:

27. Standing orders or for nurses to submit for patients fitting certain criteria (intermediate)

Feedback:

28. Supervising staff should be involved in the feedback process (intermediate)
29. Investigation of best methods of delivering and presenting information on errors (strong)

Patient identification:

30. Further work is needed to determine the level of knowledge of correct patient ID in the different staff groups (intermediate)
31. Increase education for staff about risks of failing to carry out positive patient ID and clarify that purpose of signatures on blood samples (weak)
32. Poster campaign to engage patients in their safety and need for repeated ID checks (strong)

CULTURE

Interruption:

33. Physical barriers such as the curtain be employed to indicate the need for concentration (intermediate)
34. Education about strategies to manage interruptions should be compulsory in the ED (weak)

Vigilance:

35. Education regarding importance of all tests, not just those that could lead to WBIT (weak)

Sample rejection and re-bleeding:

36. Design checklist to enable standard set of information surrounding sample rejection (intermediate)
37. Education on factors that hinder ability to deliver appropriate blood samples to lab (weak)
38. Re-design of laminated trolley sheets to highlight common risks and tubes (intermediate)
39. Poster campaign to raise patient awareness and 'decriminalise' re-bleeding (strong)

Resilience:

40. Use of handovers to promote sharing of lessons surrounding blood collection (intermediate)

6 References

- Alberti, K. G. M. M. (2001). "Medical errors: a common problem." *BMJ* **322**(7285): 501-502.
- Apkon, M., J. Leonard, et al. (2004). "Design of a safer approach to intravenous drug infusions: failure mode effects analysis." *Quality and Safety in Health Care* **13**(4): 265-271.
- Aronson, J. (1994). "A pragmatic view of thematic analysis." *Qualitative Report* **2**(1).
- Ash, J. S., M. Berg, et al. (2004). "Some unintended consequences of information technology in health care: the nature of patient care information system-related errors." *J Am Med Inform Assoc* **11**(2): 104-12.
- Astion, M. (2006) "Case & Commentary: Right Patient, Wrong Sample." **Volume**, DOI:
- Australian Medical Association. (2009). "AMA Junior Doctor Training, Education and Supervision Survey." Retrieved 1 July 2010, from <http://www.ama.com.au/node/5202>.
- Bainbridge, L. (1983). "Ironies of automation." *Automatica* **19**(6): 775-779.
- Bates, D. W., M. Cohen, et al. (2001). "Reducing the frequency of errors in medicine using information technology." *J Am Med Inform Assoc* **8**(4): 299-308.
- BCSH. (2007). "British Committee for Standards in Haematology (BCSH) Guidelines web site." Retrieved 25 June 2010, from <http://www.bcsghguidelines.com>.
- Bond, J., A. M. Cartilidge, et al. (1985). A study of interprofessional collaboration in primary health care organisations. Health Care Research Unit Report No. 27. *Health Care Research Unit*. Newcastle, University of Newcastle upon Tyne.
- Bryman, A. (2004). *Social research methods*. Oxford, Oxford University Press.
- Buckle, P., P. J. Clarkson, et al. (2003). *Design for patient safety: a system-wide design-led approach to tackling patient safety in the NHS*. London, UK., Department of Health Publications.
- Burns, N. and S. K. Grove (2001). *The practice of nursing research : conduct, critique & utilization*. Philadelphia, Saunders.
- Campbell, G. and N. Facchinetti (2000). "Using process control charts to monitor dispensing and checknig errors." *American Journal of Health-System Pharmacy* **55**: 946-952.
- Carayon, P. and C. J. Alvarado (2007). "Workload and patient safety among critical care nurses." *Crit Care Nurs Clin North Am* **19**(2): 121-9.
- Cook, R. I., M. Render, et al. (2000). "Gaps in the continuity of care and progress on patient safety." *BMJ* **320**(7237): 791-4.
- Crilly, J., W. Chaboyer, et al. (2004). "Violence towards emergency department nurses by patients." *Accident and Emergency Nursing* **12**(2): 67-73.
- Croskerry, P., M. Shapiro, et al. (2004). "Profiles in Patient Safety: Medication Errors in the Emergency Department." *Academic Emergency Medicine* **11**(3): 289.
- Cummins, D., S. Sharp, et al. (2000). "The BCSH guideline on addressograph labels: experience at a cardiothoracic unit and findings of a telephone survey." *Transfus Med* **10**(2): 117-20.
- DeFontes, J. and S. Surbida (2004). "Preoperative safety briefing project." *Permanente Journal* **8**(2): 21-7.
- Dekker, S. (2006). *The field guide to understanding human error*. Aldershot, Ashgate Publishing.
- Department of Health, V. (2008). "Serious Transfusion Incident Report. Blood Matters - Better, Safer Transfusion Program 2006-2007."
- Department of Health, V. (2010). "Root Cause Analysis and Risk Reduction Action Plan Summaries." Retrieved 13 July 2010, from <http://www.health.vic.gov.au/clinrisk/sentinel/rca.htm#prep>.
- Department of Health, V. (2010). "Transfusion Trainers/Nurses." 2010, from <http://www.health.vic.gov.au/best/tools/nurses.htm>.
- DeRosier, J., E. Stalhandske, et al. (2002). "Using health care Failure Mode and Effect Analysis: the VA National Center for Patient Safety's prospective risk analysis system." *Jt Comm J Qual Improv* **28**(5): 248-67, 209.
- Dzik, W. H. (2003). "Emily Cooley Lecture 2002: transfusion safety in the hospital." *Transfusion* **43**: 1190-1199.
- Dzik, W. H. (2005). "Technology for enhanced transfusion safety." *Hematology Am Soc Hematol Educ Program*: 476-82.
- Dzik, W. H., H. Corwin, et al. (2003). "Patient safety and blood transfusion: new solutions." *Transfusion Medicine Reviews* **17**(3): 169-180.
- Firth-Cozens, J. (2000). "New stressors, new remedies." *Occup Med (Lond)* **50**(3): 199-201.
- Fishbein, M. and I. Ajzen (1975). *Belief, attitude, intention and behavior: an introduction to theory and resaerch*. Reading, MA, Addison-Wesley.
- Gilson, L. (2003). "Trust and the development of health care as a social institution." *Soc Sci Med* **56**(7): 1453-68.
- Glaser, B. G. and A. L. Strauss (1967). *The discovery of grounded theory : strategies for qualitative research*. New York, Aldine.
- Gonzalez-Porras, J. R., I. F. Graciani, et al. (2008). "Tubes for pretransfusion testing should be collected by blood bank staff and hand labelled until the implementation of new technology for improved sample labelling. Results of a prospective study." *Vox Sanguinis* **95**(1): 52-56.
- Gosbee, J. (2002). "Human factors engineering and patient safety." *Qual Saf Health Care* **11**(4): 352-4.

- Green, R. (1999). "The psychology of human error." European Journal of Anaesthesiology **16**(3): 148-155.
- Haddon, W. (1973). "Energy damage and the ten countermeasures strategies." Trauma **13**: 321-331.
- Hakimzada, A. F., R. A. Green, et al. (2008). "The nature and occurrence of registration errors in the emergency department." Int J Med Inform **77**(3): 169-75.
- Henneman, E., G. Avrunin, et al. (2007). "Increasing patient safety and efficiency in transfusion therapy using formal process definitions." Transfusion Medicine Reviews **21**(1): 49-57.
- Henneman, E. A., R. Cobleigh, et al. (2008). "Designing Property Specifications to Improve the Safety of the Blood Transfusion Process." Transfusion Medicine Reviews **22**(4): 291-299.
- Hollnagel, E., D. David, et al. (2006). Resilience Engineering: Concepts and Precepts. Ashgate, Aldershot UK.
- International Ergonomics Association. (2000). "The discipline of ergonomics." Retrieved 29 June 2010, from <http://www.iea.cc>.
- Jeffcott, S. A., J. E. Ibrahim, et al. (2009). "Resilience in healthcare and clinical handover." Qual Saf Health Care **18**(4): 256-60.
- Joint Commission Resources (2003). "Verbal orders: strategies for proper use." Joint Commission Perspectives on Patient Safety **3**(7): 5-6.
- Khoury, M., L. Burnett, et al. (1996). "Error rates in Australian chemical pathology laboratories." Medical Journal of Australia **165**: 128-130.
- Kilroy, D. (2006). "Clinical supervision in the emergency department: a critical incident study." Emergency Medicine **23**: 105-108.
- Krombach, J., S. Kampe, et al. (2002). "Human error: the persisting risk of blood transfusion: a report of five cases." Anesth Analg **94**(1): 154-6, table of contents.
- Lichtner, V., J. R. Galliers, et al. (2010). "A pragmatics' view of patient identification." Qual Saf Health Care.
- Linden, J. V., K. Wagner, et al. (2000). "Transfusion errors in New York State: an analysis of 10 years' experience." Transfusion **40**(10): 1207-1213.
- Lippi, G., N. Blanckaert, et al. (2008). "Haemolysis: an overview of the leading cause of unsuitable specimens in clinical laboratories." Clin Chem Lab Med **46**(6): 764-72.
- Liu, D., T. Grundgeiger, et al. (2009). "Interruptions and blood transfusion checks: lessons from the simulated operating room." Anesthesia and Analgesia **108**: 219-222.
- March, J. G. and Z. Shapira (1992). "Variable Risk Preferences and the Focus of Attention." Psychological Review **99**(1): 172-183.
- Meshkati, N. (1991). "Integration of workstation, job, and team structure design in complex human-machine systems: A framework." International Journal of Industrial Ergonomics **7**(2): 111-122.
- Murphy, M. F. and J. D. S. Kay (2004). "Patient identification: problems and potential solutions." Vox Sanguinis **87**(s2): 197-202.
- Murphy, M. F., B. E. Stearn, et al. (2004). "Current performance of patient sample collection in the UK." Transfusion Medicine **14**(2): 113-121.
- National Blood Authority (2008). Initial Australian Haemovigilance Report 2009. Canberra: 50.
- Nemeth, C., M. Nunnally, et al. (2005). "Getting to the point: developing IT for the sharp end of healthcare." Journal of Biomedical Informatics **38**(1): 18-25.
- Nemeth, C., M. O'Connor, et al. (2004). "Crafting information technology solutions, not experiments, for the emergency department." Acad Emerg Med **11**(11): 1114-7.
- Nixon, P. G. F. (1976). "The human function curve." Practitioner **217**: 756-769; 935-944.
- Patton, M. (2002). Qualitative Research & Evaluation Methods. Thousand Oaks, CA, Sage.
- Perry, S. J., R. L. Wears, et al. (2005). "The role of automation in complex system failures." Journal of Patient Safety **1**(1): 56-61.
- Pierce, R. and T. O'Quinn (2006). Walking the Tightrope with a Safety Net. Society for Health Systems - Leading Healthcare Improvement: 7.
- Plsek, P. E. and T. Wilson (2001). "Complexity, leadership, and management in healthcare organisations." BMJ **323**(7315): 746-9.
- QSR International (2008). NVIVO 8 Fundamentals. Melbourne, QSR International Pty Ltd.
- Rasmussen, J. (1990). "Human Error and the Problem of Causality in Analysis of Accidents.1990;" Philosophical Transactions of the Royal Society of London Series B - Biological Sciences **327**(1241): 449-462.
- Reason, J. (1990). "The contribution of latent human failures to the breakdown of complex systems." Philos Trans R Soc Lond B Biol Sci **327**(1241): 475-84.
- Reason, J. (1997). Managing the Risks of Organisational Accidents. Ashgate, Aldershot UK.
- Reason, J. (1998). "Achieving a safe culture: theory and practice." Work and Stress **12**(3): 293-306.
- RiskMan International. (2010). "RiskMan International." from <http://www.riskman.net.au/>.
- Roberts, K. H. (1990). "Some Characteristics of One Type of High Reliability Organisation." Organisation Science **1**(2): 160-176.
- Rogers, A. E., W. T. Hwang, et al. (2004). "The working hours of hospital staff nurses and patient safety." Health Affairs **23**(4): 202-212.

- Runyan, C. (2003). "Introduction: Back to the Future - Revisiting Haddon's Conceptualisation of Injury Epidemiology and Prevention." *Epidemiologic Reviews* **25**: 60-64.
- Sandelowski, M. (2000). "Combining qualitative and quantitative sampling, data collection and analysis techniques in mixed methods studies." *Research in Nursing & Health* **23**: 246-255.
- Sazama, K. (1990). "Reports of 355 transfusion-associated deaths: 1976 through 1985." *Transfusion* **30**: 583-590.
- Senders, J. W. (2004). "FMEA and RCA: the mantras of modern risk management." *Quality and Safety in Health Care* **13**(4): 249-250.
- Sexton, J. B., E. J. Thomas, et al. (2000). "Error, stress, and teamwork in medicine and aviation: cross sectional surveys. (Statistical Data Included)." *British Medical Journal* **320**(7237): 745-749.
- Spear, S. J. and M. Schmidhofer (2005). "Ambiguity and workarounds as contributors to medical error." *Ann Intern Med* **142**(8): 627-30.
- Stainsby, D., J. Russell, et al. (2005). "Reducing adverse events in blood transfusion." *British Journal of Haematology* **131**: 8-12.
- Strauss, A. L. and J. Corbin (1998). *Basics of qualitative research : techniques and procedures for developing grounded theory*. Thousand Oaks, Sage Publications.
- Taylor, C. J., M. F. Murphy, et al. (2008). "Changes in practice and organisation surrounding blood transfusion in NHS trusts in England 1995-2005." *Qual Saf Health Care* **17**(4): 239-43.
- Tharaldsen, J. E., K. J. Mearns, et al. (2009). "Perspectives on safety: The impact of group membership, work factors and trust on safety performance in UK and Norwegian drilling company employees." *Safety Science* **48**(8): 1062-1072.
- Vaughan, D. (1999). "The Dark Side of organisations: Mistakes, misconduct and disaster." *Annual Review of Sociology* **25**: 271-305.
- VHIMS. (2010). "Victorian Health Incident Management System Project." Retrieved 29 June 2010, from <http://www.health.vic.gov.au/clinrisk/vhims/index.htm>.
- Wakefield, D. S. and B. J. Wakefield (2009). "Are verbal orders a threat to patient safety?" *Qual Saf Health Care* **18**(3): 165-8.
- West, D. W., S. Levine, et al. (1994). "Pediatric medication order error rates related to the mode of order transmission." *Arch Pediatr Adolesc Med* **148**(12): 1322-6.
- Westbrook, J. I., A. Woods, et al. (2010). "Association of interruptions with an increased risk and severity of medication administration errors." *Arch Intern Med* **170**(8): 683-90.
- Wickstrom, G. and T. Bendix (2000). "The "Hawthorne effect"-- what did the original Hawthorne studies actually show?" *Scand J Work Environ Health* **26**(4): 363-7.
- Wise, J. (2001). "UK government and doctors agree to end "blame culture"." *British Medical Journal* **323**(7303): 9.
- Woodward, H., O. Mytton, et al. (2010). "What have we learned about interventions to reduce medical errors?" *Annual Review of Public Health* **31**: 479-497.
- Workcover Authority of TAS (2008) "Hazard Management: Play it Safe." **Volume**, 1-12 DOI:
- World Health Organisation (2010). WHO guidelines on drawing blood: best practices in phlebotomy. Geneva, World Health Organisation: 108.
- World Health Organisation Collaborating Centre for Patient Safety Solutions (2007). "Patient identification." *Patient Safety Solutions* **1**(2): 1-4.

7 Appendices

Appendix 1: Observational Audit Tool

OBS NO.						
Setting Name:			Date: / /			
Location:	Trauma Bay	Resuscitation Bay	Assessment Bay	Fast Track	Short Stay	
Observation:	<i>START TIME</i>	<i>END TIME</i>				
Blood Collection:						
Role/Title:						
Patient condition:						
Other Staff:						
Family members:						
Type of test:	Group & Hold /	FBE / U&Es / LFT/	Cultures/ Other:			
Sterile procedures:	Gloves	Hand washing	Both			
Staff comments:						
Patient comments:						
Details:						
Request form:	Easy to find?	Y / N	Legible?	Y / N		
Medical record:	Easy to find?	Y / N	Enough/right labels?	Y / N		
Patient ID process:	Before bloods?	Y / N	Simply repeat?	Y / N	2 forms?	Which?
Wristband:	Present?	Y / N	Verified against?	Y / N		
Labels:	Present?	Y / N	Tubes left no label?	Y / N		
Trolley:	In bay?	Y / N	Tubes on bed/side?	Y / N		
Checking:	Signatures?	Y / N	Against Form?	Y / N		
Equipment:	Available?					
Staff:	Interruptions?					
	Multi-tasking?					
Culture:	Support?					
Environment:	Noisy?	Y / N	Busy?	Y / N		
General comments:						

Appendix 2: Interview Protocol

INTRODUCTION

[I am working on a project looking at Wrong Blood in Tube, alongside Dr Shelly Jeffcott who has now finished an observational study at three metropolitan EDs in Melbourne hospitals. To support these observations we are doing a series of 1:1 interviews to find out more about some of the real-life issues and ways of identifying potential errors in miscollection and mislabelling of blood.]

The general aim of this interview is to help us understand more about blood collection practices in the ED and in particular problems which may lead to Wrong Blood in Tubes (or WBITs).

This interview is for research purpose only. Please, be assured that we will keep your answer confidential and that all information in the interview will be de-identified.]

What is the nature of your role within the ED team?

How many years' experience do you have in this role/in other healthcare roles?

What is your relationship with senior and junior medical staff?

What is your relationship with nursing staff?

Use of Guidelines

[I would like to find out about your knowledge and use of protocols.]

Are you familiar with existing protocols regarding blood grouping and cross matching in your department?

If so, do you know the location?

If not, why not?

How do you comply with protocols in emergency situations (i.e. do you use verbal requests for cross matching and transfusion, do you follow verbal requests)?

If so, what happens after?

If you were ever to see other colleagues not following protocol- i.e. walking with unlabelled tubes or having left tubes unlabelled by a patient's bedside- what would you do, if any?

Positive Patient Identifications

[The research evidence suggests that the failure to correctly identify patients can result in wrong procedure, medication error, transfusion error or diagnostic error. Although this doesn't happen very often, most of these errors are mostly preventable. With that in mind:]

Can you describe the steps in patient identification starting from admission to patient bay?

Is it different in different circumstances?

If so, what is done differently?

How do you verify patient identity?

Do you always do this?

Under what circumstances do you not carry out positive patient

ID procedure?

Is it done differently if the patient is unconscious or doesn't speak English?

In terms of blood grouping and cross matching:

Do you still verify patient identity despite caring for the patient for the last 8 -12 hours?

If not, why not?

Blood Collection Process

[Error in the collection and labelling of patient samples used for pre-transfusion testing are known to be an important source of transfusion-related patient morbidity and mortality. Miscollected samples represent greater risk because blood in tube is different from that of patient whose name is on the label. I would like to ask you now about blood collection and labelling. Let's start with request forms:]

Do you always have request forms before proceeding with blood collection?

If not, what do you do?

Are there any competing tasks or time constraints that prevent you from organising a request form?

Does it happen often? Do you have a measure of how often?

What factors do you feel effect this (i.e. time of day and the medical staff interactions, when you are working in certain parts of the ED etc)?

If you are ready to send blood to pathology and you still don't have a request form, do you chase the RMOs for request?

What do you do with the tubes in the meantime?

Is obtaining a request form usually quite straight forward?

What makes it trickier to get the form signed off?

Physical/behavioural environment

Can you please recall step by step what you do if a blood test is urgently needed and you cannot cannulate?

Would you feel that other team members may judge you for not being able to cannulate?

What do you think their views may be?

How might the views of other team members affect your management of a patient?

[Sometimes it is difficult to perform venepuncture if the patient is dehydrated or elderly. I would like to ask a similar set of questions but regarding venepuncture.]

Can you please recall step by step what you do if a blood test is urgently needed and you cannot take bloods?

How easy or difficult is it to take blood?

What skills are required to perform that task?

What do you struggle with most?

Would you feel that other team members may judge you for not being able to complete the task?

What do you think their views may be?

How might the views of other team members affect you managing a patient?

Blood Labelling

Do you know the tube colour coding for each pathology test?

If you don't know, what do you do?

Do you always label the sample at the bedside?

If not, what prevents you in doing so?

How important do you feel it is to label sample at the bedside?

Is sample labelling different for cross match, group and hold? How is it different?

Do you always have the labels by the bedside? What happens if you do not have enough labels or there aren't enough labels?

Can you think of a time when labels got mixed up in patient history or at the records?

[It is widely documented that many "near-miss" events occur, but adverse consequences are often prevented by stringent criteria for sample acceptance. I would like to find out how it is done in your hospital.]

Does pathology in your hospital have a zero tolerance policy?

What is the relationship between the lab and clinical areas like?

How do you feel about having to re-bleed patients? Do you always get full explanation from the lab?

What are the most common reasons?

Sending samples to Pathology

[Different hospitals have different protocols as to whom and how the blood samples are getting to pathology for processing].

How is it done in ED?

Is it different during trauma?

How do you decide what is urgent?

Do you always wait to see if the chute has cleared?

If you don't have enough time, how do you make sure that the sample went to the blood bank?

What happens if the chute is broken?

Do you know the ward support staff by name?

Are you confident that the ward support staff are efficient in making sure samples are delivered to the blood bank on time?

If you suspect that samples are not being delivered in a timely manner, what do you do?

Safety culture

[Safety culture is the term often used to describe the way in which safety is managed in the work place. There is a lot to discuss about safety culture and patient safety in healthcare.... I would like your views on that subject.]

What happens when people make mistakes?

What happens when things go wrong?

What circumstances cause things to go wrong?

How does the adverse event reporting system work in your department?

Do you report all mistakes or only important ones with adverse outcomes?

Is RiskMan in your hospital simple to access, use and user friendly?

What is feedback like? And specifically, in relation to any problems with samples you have taken or been involved in taking?

What are the time delays between reporting and feedback?

Interruptions

[The hospital domain is a highly interruptive workplace and it is widely documented that interruptions negatively affect performance. With that in mind:]

How often do you think you get distracted during a blood collection?

What sort of distractions and from whom?

How do you deal with interruptions and do they have an impact on remembering other tasks, checking patient ID, for instance?

How do you manage interruptions? Do you use physical barriers like the curtain, for instance?

Have you gotten better at dealing with interruptions?

Adverse events

SCENARIO: "In 2003 two patients in the oncology ward required elective transfusions; one was group O and one group A. Blood for both was collected after midnight from the blood bank and checked on the ward away from the bedside. The two units of blood were then inadvertently transfused to the wrong patients. The patient who was group O suffered a severe acute haemolytic reaction after the first 50ml of blood and required ICU admission. The patient later recovered"

Has this ever happened to you?

Could this ever happen to you? If not, why not?

Do you think this is a common problem?

Do you know how adverse incidents are tracked in your department?

Are you aware of any education to staff regarding error reporting?

Appendix 3: Transfusion Nurse Survey

This survey is part of a project looking at the factors that contribute to error surrounding blood specimen collection and can lead to 'Wrong Blood in Tube' (WBIT) events in hospitals. It accompanies an observational and interview study based in some high-risk settings (e.g. ED) in three Melbourne hospitals.

As part of our objective we would like to gather more information about your experience in the Transfusion Nurse role and specifically about what sorts of interventions and strategies that have or are being implemented to tackle WBITs.

NB: While we are aware that your role is broader than a focus on blood specimen collection and the tasks and responsibilities that relate to this, this will be the focus of our questioning.

1.

Please specify what period of time you have worked as a Transfusion Nurse:

In a Full Time role: _____

In a Part Time role: _____

2.

What is the approximate percentage of your time that you focus on WBIT?

< 10%

10-20%

20-50%

> 50%

3.

What percentage of your time would you like to devote to WBIT?

< 10%

10-20%

20-50%

> 50%

4.

How satisfied are you with your working relationships with the following stakeholders?

	unsatisfied	somewhat satisfied	satisfied	very satisfied	extremely satisfied
Pathology Scientists	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Blood Bank Scientists	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Pathology Collectors	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Senior Nursing Staff	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Junior Nursing Staff	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Senior Medical Staff	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Junior Medical Staff	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Clinical Educators	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Quality Department	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Comments: _____

5.

How is education commonly delivered to staff about WBIT and related risks?

	formal during orientation	formal during in-service education	informal impromptu chats	informal when feeding back from error	ground rounds	newsletters	none
Pathology Scientists	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Blood Bank Scientists	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Pathology Collectors	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Senior Nursing Staff	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Junior Nursing Staff	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Senior Medical Staff	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Junior Medical Staff	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Clinical Educators	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Quality Department	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Comments: _____

6.

Where is the following information kept?

	intranet	resource folder on the ward	resource folder in the lab	pathology collection trolley
Blood collection protocol	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Pathology handbook	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Hospital policies/guidelines	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Please specify and add any others: _____

7.

In relation to question 6, how confident are you that the following groups have sound knowledge of this information?

	not confident	somewhat confident	confident	very confident	extremely confident
Pathology Collectors	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Senior Nursing Staff	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Junior Nursing Staff	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Senior Medical Staff	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Junior Medical Staff	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Clinical Educators	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Comments: _____

8.

What tools are used to assess knowledge of protocols relating to WBIT?

- Orientation quizzes
- Competency assessment packages
- Online learning packages
- Audit

Please specify and add any others: _____

9.

What percentage of each of the following groups do you reach per year with education surrounding WBIT?

	0% -10%	10-20%	20-50%	50-80%	80-100%
Pathology Scientists	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Blood Bank Scientists	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Pathology Collectors	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Senior Nursing Staff	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Junior Nursing Staff	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Senior Medical Staff	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Junior Medical Staff	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Clinical Educators	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Quality Department	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Comments: _____

10.

Please specify how much time, on average, you spend a year with each group?

	0-15mins	15-30 mins	30-60 mins	1-2 hours	> 2 hours
Pathology Scientists	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Blood Bank Scientists	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Pathology Collectors	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Senior Nursing Staff	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Junior Nursing Staff	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Senior Medical Staff	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Junior Medical Staff	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Clinical Educators	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Quality Department	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Comments: _____

11.

What are the key challenges in educating staff about WBIT risks and positive patient identification?

12.

What are the key challenges in error reporting and feedback surrounding labelling and collection error?

13.

What are the key challenges in managing interactions between Lab and Clinical areas?

14.

What are the key interventions, if any, to tackle WBIT that your hospital has implemented since 2005?

15.

In relation to question 14, what precisely was your role and level of involvement in development and implementation?

16.

In relation to question 14, what have been the key success factors?

17.

In relation to question 14, what have been the key barriers?

18.

What impact, if any, do you think there has been in behaviour and/or WBIT rates?

19.

If there has been a reduction in WBITs what evidence has there been of this and how has this/will this be sustained?

20.

Briefly outline how often clinical areas are audited (random or announced) for adherence to policies/guideline regarding WBITs?

- Every month
- Every 6 months
- Every year
- Every 2 years

Comments:

21.

Do such audits usually achieve their objectives?

- All of the time
- Most of the time
- Some of the time
- None of the time

Comments:

22.

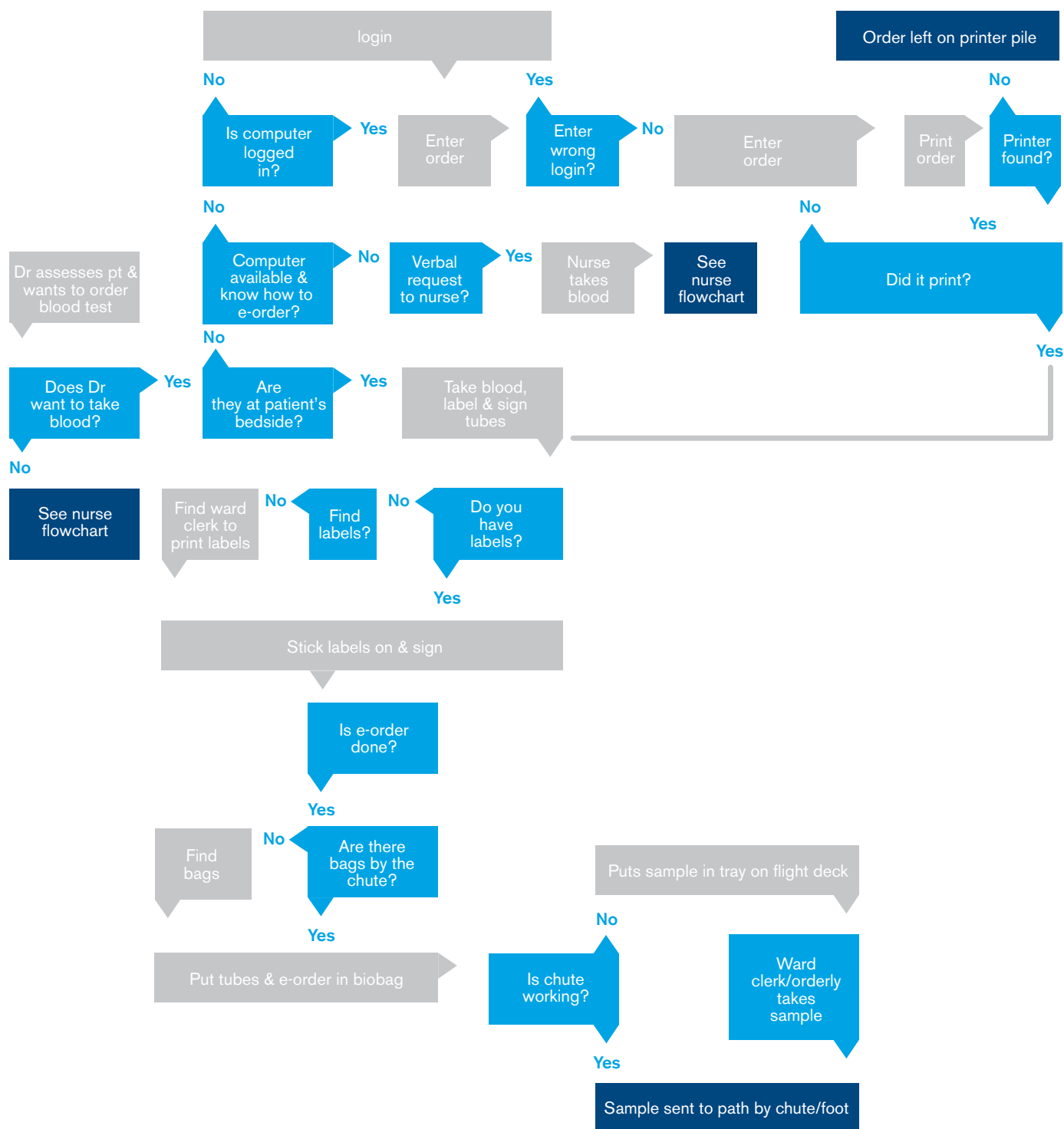
If not, what actions are generally taken?

23.

How effective are those actions?

Thank you so much for your time and participation. The information you have given will be of great help to the project and we will happily provide you with a final report, if requested. The project lead, Dr. Shelly Jeffcott, can be contacted on email or direct phone line on: shelly.jeffcott@med.monash.edu.au or (03) 9903 0248 in order to lodge such a request.

Appendix 4: Process Map – Doctor



Disclaimer

"This diagram is a direct observational representation of a blood collection map process from an ED. In order to preserve the integrity of the observation, the diagram has not been edited or otherwise re-worked. This diagram should not be relied upon as a definitive or proposed process for blood collection at your organisation."

Appendix 5: Process Map – Nurse



Disclaimer
"This diagram is a direct observational representation of a blood collection map process from an ED. In order to preserve the integrity of the observation, the diagram has not been edited or otherwise re-worked. This diagram should not be relied upon as a definitive or proposed process for blood collection at your organisation."

Appendix 6: Ranking Scales

Severity	Description	Ranking
Hazardous	Category I An error occurred that may contribute to or result in the patient's death	10
	Category H An error occurred that required intervention necessary to sustain life	9
Very high	Category G An error occurred that may have contributed to or resulted in permanent patient harm	8
	Category F An error occurred that may have contributed to or resulted in temporary harm to the patient and required initial or prolonged hospitalisation	7
High	Category E An error occurred that may have contributed to or resulted in temporary harm to the patient and required intervention	6
	Category D An error occurred that reached the patient and monitoring to confirm that it resulted in no harm to the patient and/or required intervention to preclude harm	5
Moderate	Category C An error occurred that reached the patient but did not cause patient harm	4 3
	Category B An error occurred but the error did not reach the patient (An 'error of omission' does reach the patient)	2
Low	Category A Circumstances or events that have the capacity to cause error	1

Likelihood of occurrence	Ranking
More than once per day	10
Once every 3-4 weeks	9
Once per week	8
Once per month	7
Once every 3 months	6
Once every 6 months	5
Once per year	4
Once every 1-3 years	3
Once every 3-6 years	2
Once every 6+ years	1

Probability	Detection	Ranking
Detection not possible at any point in system	0 of 10	10
Remote		9
Low	1 of 10	8
Low likelihood that error will be detected before error reaches patient	2 of 10	7
Moderate	4 of 10	6
Moderate likelihood of detection before error reaches patient	5 of 10	5
		4
High	7 of 10	3
Error likely to be detected before error reaches patient		2
Very high	9 of 10	1

Appendix 7: Failure Modes and Effects Analysis worksheet

Process		Failure Modes		Effects		Consequence	Causes	Likelihood	Current Controls	Detectability	RPN
1	Patient labels printed and put into patient notes	Not enough or no labels generated	Blood tubes, unlabelled and could be confused while labels found	8	Printer was broken or distracted by another task	8	8	Regular checks on printer function and prioritisation of admission tasks	3	192	
2	Patient labels printed and put into patient notes	Labels placed into wrong patient notes	Incorrect results attributed to patient	8	Didn't check patient notes before filing or had two similar named patients	8	6	Receptionist does visual check to ensure correct patient notes	4	192	
3	Patient labels printed and put into patient notes	Labels lost	Incorrect results attributed to patient	8	Labels fall out of notes on way to assessment bay or end up on main workstation	8	8	New red folders have plastic slip to place labels into	4	256	
4	Doctor decision to take blood and e-order completed	E-order not completed or wrong test ordered	Blood test not done or wrong test done	6	Computer logged in for another doctor and distracted before re-log in and complete. Workload causes confusion re patient and right tests	6	8	Doctors are relied on to know how to prioritise workload and how to deal with IT systems	4	192	
5	Doctor decision to take blood and e-order completed	Simultaneous e-order for another patient and wrong order given to nurse	Incorrect results attributed to patient or rejection of sample	8	Only one printer at the main work station that is linked to several computers	8	6	Doctor does a visual check to ensure correct patient e-order on collection from printer	3	144	
6	Nurse decision to take blood prior to doctor e-order	Labelled tubes left waiting that could be confused with others	Incorrect results attributed to patient or rejection of sample	8	Nurse has pre-empted medical order or has not communicated need for e-order or doctor has forgotten to e-order or pick up e-order from printer	8	9	Current policy is that the e-order must be part of the documentation to verify identity against before blood collection	3	216	
7	Equipment assembled at bedside, including labels and e-order	Incorrect labels collected	Incorrect results attributed to patient or rejection of sample	8	Cluttered work space where more than one record sit and patient labels become detached from records	8	6	Visual checks and double checks when performing signatures	3	144	
8	Patient identity checked	Positive patient identification not carried out appropriately	Identifiers placed on sample do not match patient and wrong patient bleed	9	Non adherence to guideline, assumption that admission process and/or assessment by doctor has confirmed identity	9	9	Positive patient identification policy	5	405	
9	Patient identity checked	Inability to check identity or lack of identifiers (no wristband or waiting on e-order)	Identifiers placed on sample do not match patient and wrong patient bleed	9	Non adherence to guideline and patient factors that make identity process difficult	9	7	Policy and guideline	6	378	
10	Patient identity checked	Patient incorrectly identified at time of admission ie as another patient.	Results attributed to incorrect patient	4	Clerical error or patient mis-identification.	4	6	Policy and guideline	6	144	
11	Blood taken from patient	From wrong patient	Incorrect results attributed to patient (VIBIT) or specimen rejected and re-bleed required.	9	Non adherence to guideline, workload (multiple patients to attend to) or incorrect patient documents taken to bedside	9	5	Policy and guideline	6	270	
12	Labels attached to tube at work station	Tubes confused with other patients or incorrect labels attached or tubes not labelled	Incorrect results attributed to patient or rejection of sample or wrong patient bleed	9	Unlabelled tubes taken from bedside and cluttered work space which multiple staff use causes confusion	9	8	Person who collected blood should visually check against other available documentation	6	432	
13	Labels attached to tube at bedside	Incorrect labels attached or tubes not labelled	Incorrect results attributed to patient or rejection of sample or wrong patient bleed	9	Not checked, work area labels in history, inadequate checking/identity verification with patient	9	6	Proper process to take all equipment to bedside but checked processes, including during signatures, should be adhered to	6	324	
14	Blood tube and e-order put into bag	Tubes put into bag with wrong e-order	Specimen rejected	8	Workload, distraction, unsuitable work area, lack of checking	8	9	Policy and guideline	3	216	
15	Blood tube and e-order put into bag	Tubes left at bedside or still awaiting e-order	Sample no longer viable and blood test not done	4	Workload, distraction, unsuitable work area	4	6	Policy and guideline	2	48	
16	Blood tube and e-order into chute	Chute not working and alternative not sought	Blood test not done	4	Workload, distraction, poor maintenance checks or equipment and/or problem with timely reporting	4	4	Policy and guideline	4	64	
17	Blood tube and e-order to container for clerk to take to pathology	Clerk delayed or unable to deliver or mislays bloods or delivers to wrong place	Blood test not done	4	Workload, distraction and lack of checking that new bloods are needing delivery	4	4	Verbal confirmation that sample placed in tray as back-up	4	64	

Appendix 8: Additional observation - Gloves

World Health Organisation phlebotomy best-practice guidelines (World Health Organisation 2010) suggest that when taking blood, clinicians should wear well-fitting, non-sterile gloves. Wearing gloves not only protects the clinician from exposure to blood borne pathogens from the patient, but reduces the patient's risk of cross contamination from other patients.

Prior to actual venepuncture, the clinician must palpate the area of the arm or hand, usually with index and middle finger, to select a vein and also to allow them to distinguish such structures as arteries, tendons etc. A high degree of

tactile feedback from the patient's skin is necessary when searching for veins, especially in elderly and haemodynamically compromised patients. During observations, clinicians were seen not to wear or to remove gloves in such situations. Different types of gloves are available, with varying degrees of sensitivity. For example, surgical gloves typically allow better precision and sensitivity than regular examination gloves. In the provision of gloves, hospitals must ensure considerations of functionality are weighed above cost. If necessary, higher grade gloves should be available for use by staff for situations where regular gloves are inadequate.

Observation

Jack had gloves on and he turned to complain about them.
"I can't feel his veins properly with them on. They're too thick. These are new gloves and there is no sensitivity... you actually have to take them off or at least pull off two fingers to feel properly, especially in a tricky case like this."

Recommendation

Provision of gloves that allow clinicians sufficient sensitivity to feel patient veins.
If necessary, higher grade gloves should be made available for difficult cases.

Notes

