Bedside Transfusion Practice Audit
An audit in eight New Zealand Hospitals

Final Report

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EXECUTIVE SUMMARY

BACKGROUND

The most basic principle of patient care during transfusion is to ensure patient safety. The administration of blood to the wrong patient or the failure to identify a developing transfusion reaction early enough may lead to major morbidity or death.

AIM

The aim of this audit was to determine the level of adherence to the Australian and New Zealand Society for Blood Transfusion (ANZSBT) guidelines with the administration of resuspended red cells at patients' bedsides at North Shore, Auckland, Middlemore, Waikato, Palmerston North, Wellington, Christchurch and Dunedin public hospitals.

METHOD

Episodes from a spread of specialities were collected prospectively by the Transfusion Nurse Specialist (TNS) at each site, both as the transfusion took place by direct observation and later from the patient's clinical records after the transfusion had been completed. Patients in operating theatre or undergoing a rapid massive transfusion were not included in the audit. A list of bare essential safety checks was compiled and each episode compared to this list.

RESULTS

Patient identity checks were generally performed well when assessed against the ANZSBT guidelines. Notable exceptions included failing to ask patients to state their identity (45% compliance overall), and neonates (33%) and day cases (57%) not wearing identification wristbands. Clerical checks were conducted well but the presence of an additional form with handwritten unit numbers and blood groups used in some sites appeared to distract from checking the unit against the compatibility label and introduced the risk of transcription errors. The two-person bedside check of a unit against the patient and prescription was performed variably, with one hospital failing this step in almost a quarter of transfusions audited. Checking patient vital signs revealed confusion over the role of pulse oximetry versus observed respiratory rate. The patient was observed for the first 15 minutes of the transfusion in only 86% of cases. Only 60% of adverse reactions were reported to blood bank. Post-transfusion documentation was well performed except for failure of staff to counter-sign the prescription in one site and a lack of records of transfusion times at several hospitals. Transfusion duration was over 4 hours in up to 10% of transfusions. Only 67% of transfusions met the requirements of the bare essential safety checks, with up to five omissions per transfusion.

COMMENT

Some of the key areas for improvement identified by this audit include:

- identifying in hospital policy how neonates and outpatients will be identified for transfusion, and in particular, whether and how wristband labels will be applied.
- removing transcription of blood unit numbers and blood groups onto forms accompanying blood from blood bank
- training that the two-person checks must occur at the bedside.
- clarifying in hospital policy the role of pulse oximetry vs respiratory rate in monitoring transfusion.
- reinforcing that the patient must be closely observed for the first 15 minutes of each unit transfused.
- educating that all adverse reactions need to be reported to Blood Bank.
- improving documentation, in particular, the signing of the prescription to show the blood has been transfused as well as when, needs improving.
- ensuring red cells should be transfused in less than four hours other than in exceptional circumstances due to the risk of bacterial contamination.
- considering providing day-case transfusion recipients with a contact card for obtaining advice in case of a delayed transfusion reaction.
- encouraging DHBs to work together to establish nationally consistent processes and documentation. NZBS will be happy to support this development.

INTRODUCTION

The most basic principle of patient care during transfusion is to ensure patient safety. Enormous efforts are made to ensure the product is safe, but the bedside process is, in many ways, the most vulnerable point in the transfusion. The administration of blood to the wrong patient or the failure to identify a developing transfusion reaction early enough may lead to major morbidity or death. The Serious Hazards of Transfusion (SHOT)[1] and The New Zealand Blood Service (NZBS) Haemovigilance programme[2] receive reports of adverse transfusion reactions and incidents such as incorrect blood component transfused and 'near miss' events. Annual reports from both schemes highlight that errors in bedside checking are a major contributor to the number of reported incidents.

The published 'Guidelines for the Administration of Blood and Blood Components and the Management of Transfused Patients' by The British Committee for Standards in Haematology (BCSH)[3], and 'The Guidelines for the Administration of Blood Components' by the Australian and New Zealand Society of Blood Transfusion (ANZSBT)[4] have offered recommendations for minimising the risk. These recommendations are the basis of present hospital policy for the transfusion of blood and blood products.

Murphy[5] considers that 'if hospitals have poor processes for transfusion care, the likelihood of successfully recognising and preventing adverse reactions must be diminished'. Therefore, bedside procedural practice and the recognition of adverse transfusion reactions can be related.

A recent extensive audit of blood transfusion practice throughout the United Kingdom by The National Comparative Audit of Blood Transfusion[6] found that patients continue to be put at risk of suffering avoidable complications of transfusion through misidentification and lack of proper observation.

AIM

The key aim of the audit has been to determine the level of adherence to the ANZSBT guidelines on the administration of resuspended red cell transfusions at the patient's bedside.

The audit sites were the main public hospitals in the Auckland, Waitemata, Counties Manukau, Waikato, Mid Central, Capital and Coast, Canterbury and Otago District Health Boards.

The procedure for the administration of blood in each audited DHB's blood transfusion policy was checked for the adherence to the ANZSBT component administration guidelines.

METHOD

Episodes were collected prospectively by the Transfusion Nurse Specialists (TNS) at each site. Data collection occurred in two phases. Initially data was recorded as the transfusion commenced by direct observation. Further data was gathered retrospectively from the patient's clinical records after the transfusion had been completed.

The following data or evidence was collected:

- Demographic data: National Health Index (NHI) number, age, gender and ward of the recipient.
- Inpatient/outpatient/day case status and clinical specialty for the admission.
- Patient safety issues, namely bed position in the clinical area (open ward, single room or intensive care), level of consciousness and presence of an identification wristband.
- Whether a consent form had been signed.
- Procedural checks of the unit of red cells, compatibility form and the prescription.

- What patient vital signs were monitored: baseline observations, and observations recorded during and at the completion of the transfusion.
- Whether a record of the transfusion could be found in the patient's clinical notes and if the compatibility label was included.
- Any adverse reaction to the transfusion, if this had occurred.

The completed audit aimed to have a minimum of 50 episodes and a maximum of 100 episodes collected at each site.

The target spread of collected episodes throughout the clinical specialties was:

General Surgery	15%	Haematology	15%
Cardiac Surgery	15%	Medical	15%
Orthopaedic	15%	Paediatrics	5%
Obstetric and Gynaecology	15%	Oncology	5%

Ethics approval was obtained from the multi-region ethics committee. The data was entered via a secure website into a PostgreSQL database. Analysis was performed using a Microsoft Access database with restricted access, located on the NZBS internal network. Only the Transfusion Nurse Specialists (TNS) and the Transfusion Medicine Specialists (TMS) directly overseeing the audit had access to identifying data.

Criteria

- Patients in operating theatre or undergoing a rapid massive transfusion were not included in the audit.
- Audits were conducted during normal working hours and, where possible, outside of these times.
- Clinical areas were notified before the audit commenced that bedside transfusion practice would be observed.
- The TNS obtained verbal consent from the patient or their guardian before commencing the bedside audit episode.
- Each audit episode proceeded without comment to the staff from the auditor, except when patient safety was compromised. The specific patient safety issues for which the auditor would intervene were, if patient identity had not been established, if it appeared that the wrong unit was about to be transfused, or if there had been an unobserved transfusion reaction.

Definitions

- Episode: The audited transfusion of one unit of resuspended red cells. Where a patient had multiple units transfused, only one was audited.
- Issue form: The form other than the compatibility label accompanying the unit, frequently initially filled in by the ward to request the unit. Known by various names in different sites.
- Compatibility label: Also known as the swing label, this is the official documentation linking the unit to the patient. It is tagged to the unit and swings from it during the transfusion.
- Transfusion record: The documentation of the transfusion, including the issue form and compatibility label.

Analysis and Reporting

The audit data was analysed by the Transfusion Medicine Specialist overseeing the audit using Microsoft® Access and Excel. No identifying data regarding patients or individual staff has been included in the audit report. This report was presented in draft to the Hospital Transfusion Committees of the participating District Health Boards for comment. The final report was issued to the audited institutions and to the other thirteen district health boards via New Zealand Blood Service's national Demand Management contacts.

RESULTS

Demographics

427 transfusions were audited, including thirteen episodes where the unit was tracked to the bedside but the transfusion was aborted before the patient received the blood. These thirteen aborted transfusions will be discussed separately as the transfusions were stopped at different points.
The average age of the recipient was 59 years (range 0-105) and 53% were women.

Counties Manukau contributed 33 transfusions instead of the planned 50 as the Clinical Nurse Specialist auditing in the DHB changed jobs during the audit.

The spread of specialties for the collected transfusions is shown below (table1). A breakdown of specialties by DHB is shown in Appendix 1.

Table1. *Spread of specialties of collected episodes*

Specialty	Target	%	Actual	%	Variance (Actual - Target)
Obs & Gynae	65	16%	49	12%	-16
Paediatrics	19	5%	28	7%	9
Haematology	65	16%	66	16%	1
General Surgery	65	16%	74	18%	9
Orthopaedics	65	16%	53	13%	-12
Cardiac Surgery	37	9%	27	7%	-10
Oncology	19	5%	35	8%	16
Medical	65	16%	82	20%	17
Total	400		414		14

The majority of patients were in open wards (51%), with 38% in single rooms or alone, and the remaining 11% in intensive care or high care areas. 91% were conscious, 4% confused and 5% unconscious.

Patient identity check at the bedside

'The patient shall be positively identified by asking the patient to state their surname, first name and date of birth (whenever possible) and make sure that the surname and first name are the same as on the patient's identity bracelet. Special care should be taken for those patients who cannot state their name for whatever reason. .... All patients having a blood transfusion shall have an identification band attached, that includes the patient's surname, first name, gender, date of birth and patient identification number. Exceptions to this rule (emergency retrieval/neonate/day stay outpatients) shall ensure a method of positively identifying the patient.' (ANZSBT Guidelines for the administration of blood components 2004)

Identity checking varied widely between DHBs (table 2). Of the 55% of episodes where staff failed to adequately identify patients, reasons included:

- staff did not ask the patient for his/her identity (53%)
- staff stated the patient's identity and asked the patient to confirm it (18%)
- staff asked for secondary identifiers (e.g. date of birth) (14%)
- the patient was unable (e.g. unconscious, intubated) (14%)
- the patient was sleeping (1%)

Table 2. *Checks of patient identity by DHB*

DHB	ID stated	Wristband on	Wristband checked	Wristband readable	All identifiers readable	n
Auckland	78%	82%	90%	90%	90%	51
Canterbury	40%	94%	94%	94%	90%	62
Capital & Coast	22%	84%	80%	84%	84%	51
Counties Manukau	39%	100%	94%	100%	100%	33
MidCentral	54%	92%	86%	96%	94%	50
Otago	46%	80%	82%	82%	14%	50
Waikato	29%	82%	84%	86%	84%	56
Waitemata	51%	100%	98%	100%	100%	61
Overall	45%	89%	89%	91%	82%	414

Reasons given that the patient was not wearing a wristband were that:

- the unit where the transfusion took place, typically an outpatient unit, had a policy not requiring the wearing of wristbands (62% of reasons) (as opposed to DHB policy).
- the wristband was on the incubator/heat table or in the room (16%)
- the wristband was put on immediately prior to transfusion (11%)
- the wristband was attached to clothing not the patient (5%)
- the patient had removed the wristband (3%)
- the wristband was not worn while in theatre (3%)
- the DHB policy had a policy not requiring wristbands in this area (3% of reasons).

In 70% of episodes where the wristband was not checked, the wristband was not being worn by the patient. No reasons were given for the remaining 30%.

The main reason that all identifiers on the wristband were not readable was because one DHB (Otago) did not have the gender on the smaller version of its wristbands. Other reasons included truncated details and smudging of the print after getting wet.

Certain patients are not able to identify themselves, in particular, neonates, the unconscious and the confused. Despite being not able to identify themselves, a low proportion of neonates had a wristband on at the time of transfusion (table 3). Of the six neonates without a wristband on, three had labels on the incubator, one had equipment and lines labelled, one had the label attached to clothing and one had the label attached to the heat table.

Table 3. W*ristband worn by patient by risk group*

Reason	Risk	Wristband on	n
Confused	High	100%	17
Neonate	High	33%	9
Unconscious	High	100%	15
Conscious	Standard	90%	373

Some patients are transfused without being admitted to hospital. As might be expected, a lower proportion of these patients had a wristband on at the time of transfusion. The proportion of patients having neither wristband nor stating ID differed significantly by admission status (table 4) (Chi-squared test: p=0.002).

Table 4. *Checks of wristband by patient group*

Admission status	Wristband on	ID stated	Neither wristband on nor ID stated	n
Day case	57%	75%	12%	67
Inpatient	96%	37%	2%	330
Outpatient on ward	82%	65%	6%	17

Pre-transfusion clerical check

'*The bedside check is a vital step in preventing transfusion error, and staff shall be vigilant in checking procedure to ensure that the right blood is given to the right patient. Two members of staff shall be responsible for carrying out the identity check of the patient and the blood component at the patient's bedside.'* (ANZSBT Guidelines for the administration of blood components 2004)

The clerical checks cover the prescription, consent and identification of the unit to the patient. Blood is classed as a medicine by Medsafe and as such it needs to be prescribed and the prescription checked before being administered. Signed consent by the recipient is a key element of consent for administration of all blood components and fractionated blood products and this therefore needs checking prior to transfusion. Because each unit is matched to patients individually, the identity of the intended recipient needs to be checked against the actual recipient. Lastly, a document accompanying the blood, varying between DHBs from a computer printout to a handwritten form, showing the patient's details and the list of components issued (here known as the issue form) is checked as part of the DHB's blood policy. Checks of these are shown in table 5.

Table 5. *Checks of prescription, consent and patient identity on issue form and compatibility label by DHB*

	Patient details checked on					
DHB	Issue form	Compatibility label	Prescription	Component prescribed	Consent signed	n
Auckland	100%	98%	100%	100%	94%	51
Canterbury	100%	100%	84%	100%	100%	62
Capital & Coast	100%	100%	90%	100%	86%	51
Counties Manukau	-	100%	91%	100%	100%	33
MidCentral	100%	92%	94%	100%	100%	50
Otago	100%	100%	98%	100%	84%	50
Waikato	100%	100%	98%	100%	80%	56
Waitemata	-	100%	74%	98%	95%	61
Overall	100%	99%	91%	100%	92%	414

No reasons were recorded for not checking the patient's identity on the compatibility label (5 cases) or prescription (39 cases) or for checking if the component was prescribed (2 cases).

Consent was not found to be signed in 32 cases, with five consents given verbally, four signed after the event, three were on the incorrect form, and three were assumed because the recipient was chronically transfused. A further three were believed to have consented but the form was not sighted. Two were because consent is not usually checked in that ICU. In two the consent was two years old or expired, and in two cases, the consent had been checked with a unit given to the patient earlier that day.

The unit of blood does not have patient details affixed to it. Instead the compatibility label is attached to the unit. The unit shows the unit number, blood group, component name and expiry date. The compatibility label includes the unit number, patient's blood group, and patient's details and is checked by the computer against the unit at the point of issue. The issue form usually includes the patient's details, component name and unit number but this varies between DHBs. Checks of these are shown in table 6.

Table 6. *Checks of unit of blood by DHB*

DHB	Expiry date	Group on unit	Group on compatibility label	Group on issue form	Unit no on unit	Unit no on compatibility label	Unit no on issue form	n
Auckland	100%	100%	100%	100%	100%	98%	98%	51
Canterbury	94%	97%	95%	98%	87%	87%	100%	62
Capital & Coast	100%	100%	100%	-	100%	100%	-	51
Counties Manukau	97%	100%	100%	-	100%	97%	-	33
MidCentral	88%	98%	88%	98%	98%	92%	94%	50
Otago	94%	98%	98%	-	94%	98%	100%	50
Waikato	91%	95%	93%	-	98%	100%	100%	56
Waitemata	97%	100%	98%	-	95%	97%	-	61
Overall	95%	98%	96%	99%	96%	96%	97%	414

No reasons were recorded for not checking the expiry of the unit, the group or unit number on the issue form, unit and compatibility label.

A second person is required to perform the pre-transfusion clerical check at the bedside to confirm the right blood is going to the right recipient (table 7).

Because red cells should be administered as soon as possible after leaving controlled storage, patent IV access is required. If this is not checked, blood is unnecessarily exposed to room temperature delays.

Some patients have additional special requirements e.g. irradiated blood. If such requirements exist, these need to be checked as part of the pre-transfusion clerical check.

Table 7. *Two-person check, checks of IV access and special requirements by DHB*

DHB	Two person check	IV access patent	n	Special requirements checked	No with special requirements
Auckland	78%	96%	51	100%	9
Canterbury	98%	98%	62	100%	1
Capital & Coast	94%	100%	51	100%	6
Counties Manukau	100%	97%	33	100%	1
MidCentral	84%	98%	50	67%	6
Otago	100%	100%	50	100%	7
Waikato	98%	100%	56	100%	7
Waitemata	92%	93%	61	100%	3
Overall	93%	98%	414	95%	40

The two person check was performed away from the bedside in nine cases (2% of transfusions). In a further two cases, two people were present but the second person did not check. No reasons were recorded for the eighteen remaining cases where a two-person check was not performed.

No reasons were recorded for not checking the compatibility label against the patient identification. All cases were inpatients and conscious. No reasons were recorded why IV access was not patent at the time blood was called for transfusion. No reasons were recorded for not checking the special requirements (irradiation in both cases).

Monitoring of Transfusion

'A policy for the care and monitoring of patients receiving transfusion of blood and blood components shall be in place.' (ANZSBT Guidelines for the administration of blood components 2004)

'Vital signs (temperature, pulse, respirations and blood pressure) shall be measured and recorded before the start of each unit of blood or blood component and at the end of each transfusion episode.' (ANZSBT Guidelines for the administration of blood components 2004) (table 8).

Table 8. *Baseline observations performed by DHB*

DHB	Temp	Pulse	Respiratory rate	BP	n
Auckland	98%	98%	71%	96%	51
Canterbury	100%	95%	65%	97%	62
Capital & Coast	100%	100%	57%	100%	51
Counties Manukau	100%	100%	55%	100%	33
MidCentral	100%	100%	40%	96%	50
Otago	96%	96%	76%	96%	50
Waikato	98%	100%	68%	100%	56
Waitemata	93%	100%	95%	100%	61
Overall	98%	99%	67%	98%	414

At least one baseline pre-transfusion observation was performed in 99% of patients but all (temperature, pulse, respirations and blood pressure) were performed in only 65% (table 8). Blood pressure was not checked in eight patients and the reason given in two was that the patient was in too much pain, and that blood pressure is not routinely checked in paediatrics. No reason was recorded for not measuring temperature and pulse. Respiratory rate was not measured in a third of cases (137 patients) although in 31 of these, oxygen saturation was monitored. In a further two, constant monitoring was in place for the patient's underlying condition but it was not recorded. In one case the patient would not stop talking long enough for a respiratory rate to be measured.

'The patient shall be closely observed for the first 15 minutes after the start of each unit of blood or blood component to detect adverse reactions.' (ANZSBT Guidelines for the administration of blood components 2004) (table 9).

Table 9. *Initial observations performed by DHB*

DHB	Temp	Pulse	Respiratory rate	BP	Patient observed	n
Auckland	92%	92%	67%	90%	84%	51
Canterbury	98%	97%	66%	94%	84%	62
Capital & Coast	94%	94%	51%	88%	82%	51
Counties Manukau	100%	100%	15%	100%	58%	33
MidCentral	100%	100%	34%	90%	92%	50
Otago	100%	100%	84%	92%	84%	50
Waikato	86%	96%	52%	95%	98%	56
Waitemata	89%	98%	93%	98%	95%	61
Overall	94%	97%	61%	93%	86%	414

At least one initial observation within 30 minutes of the transfusion commencing was performed in 99% of patients but all were performed in only 55% (table 9). No reason was recorded for not checking temperature and pulse. Blood pressure was not checked due to pain in four patients, and thrombocytopenia in two patients. Respiratory rate was not recorded in 163 cases. Oxygen

saturation was monitored instead in 26 cases, two patients were being ventilated. A further case was having observations checked every 15 minutes but the respiratory rate was not documented, and in four cases from Waikato DHB, a respiratory rate is not required in the blood policy if the patient is stable.

Table 10. *Final observations performed by DHB*

DHB	Temp	Pulse	Respiratory rate	BP	n
Auckland	86%	88%	69%	86%	51
Canterbury	97%	94%	65%	89%	62
Capital & Coast	75%	80%	29%	78%	51
Counties Manukau	85%	100%	15%	97%	33
MidCentral	92%	90%	32%	84%	50
Otago	94%	94%	74%	80%	50
Waikato	75%	86%	50%	88%	56
Waitemata	87%	97%	92%	97%	61
Overall	86%	91%	56%	87%	414

At least one final observation was performed in 94% of patients but all were performed in only 48% (table 10). Four patients were on continuous monitoring but the recordings were not documented. In one case the transfusion was stopped midway and in one the transfusion record could not be found. The final blood pressure was not taken due to pain in the arm in two cases and severe thrombocytopenia in one. Oxygen saturation was measured in 18 instead of respiratory rates. In six cases, respiratory rate was not measured as per Waikato DHB protocol.

Adverse Reactions

'NZBS is obliged to monitor the occurrence of adverse reactions at all stages of the vein-to-vein transfusion process.' (NZBS Haemovigilance Annual report 2007)

Failure to report adverse reactions may put the patient at risk of complications of the transfusion concerned or future transfusions. For some reactions, reporting the adverse reaction may be needed to protect other patients (e.g. TRALI) or to highlight system failings. Two fifths of reactions were not reported (six of fifteen reactions) (table 11).

Table 11. *Adverse reactions by DHB*

DHB	No of episodes	No of reactions	Reactions as percent of episodes	No of reactions notified to blood bank	Percent of reactions notified to blood bank
Auckland	51	4	8%	3	75%
Canterbury	62	2	3%	2	100%
Capital & Coast	51	0	0%	-	-
Counties Manukau	33	1	3%	1	100%
MidCentral	50	2	4%	2	100%
Otago	50	1	2%	0	0%
Waikato	56	3	5%	1	33%
Waitemata	61	2	3%	0	0%
Overall	414	15	4%	9	60%

Of the six reactions that were not notified to Blood Bank, four were classed as minor reactions, but one was a transfusion associated cardiac overload, and one was a temperature spike of 1.9℃ 15 minutes after the transfusion commenced, with no further action or observations taken until the next unit was commenced.

Records of Transfusion

'A permanent record of the transfusion of blood and blood components and the administration of blood components shall be kept in the patient's case file.' (ANZSBT Guidelines for the administration of blood components 2004)

Table 12. *Checks of documentation that transfusion has occurred by DHB*

DHB	Prescription signed on completion	Transfusion record signed	Compatibility label in notes	Start time recorded	End time recorded	n
Auckland	41%	100%	96%	96%	76%	51
Canterbury	100%	95%	100%	95%	94%	62
Capital & Coast	98%	94%	100%	94%	59%	51
Counties Manukau	94%	73%	97%	76%	24%	33
MidCentral	100%	98%	100%	100%	72%	50
Otago	100%	100%	92%	100%	18%	50
Waikato	100%	95%	91%	95%	70%	56
Waitemata	93%	77%	98%	93%	80%	61
Overall	91%	92%	97%	94%	65%	414

No reasons were apparent not signing the prescription or the transfusion record to confirm that transfusion had taken place. In some cases the episode failed to meet this criterion because only one of the two people checking signed instead of both. No reasons were noted for not recording start and end times.

NZBS recommends the maximum time blood be transfused over is 4 hours. 2% of transfusions with a recorded start and end time exceeded this limit (table 13).

Table 13. *Transfusion duration by DHB*

DHB	Duration	Duration > 4 hours (%)	Duration > 4 hours (no.)	No of episodes with recorded start and end times
Auckland	2.3 (0.5 - 4.4)	2%	1	45
Canterbury	2.6 (0.3 - 4.0)	2%	1	61
Capital & Coast	2.6 (1.6 - 3.4)	0%	0	24
Counties Manukau	2.7 (1.4 - 3.9)	0%	0	30
MidCentral	2.8 (0.2 - 6.7)	2%	1	47
Otago	3.1 (1.8 - 3.9)	0%	0	9
Waikato	2.6 (0.2 - 4.7)	10%	4	41
Waitemata	2.4 (0.2 - 3.8)	0%	0	55
Overall	2.6 (0.2 - 6.7)	2%	7	312

Bare Essential Checklist

'In an ideal world each defensive layer would be intact. ... The presence of holes in any one "slice" does not normally cause a bad outcome. Usually, this can happen only when the holes in many layers momentarily line up to permit a trajectory of accident opportunity - bringing hazards into damaging contact with victims.'[7]

To identify the extent of overlapping omissions in safety checks, a list of bare essential safety checks was compiled. This list is not all the checks required by the ANZSBT administration guidelines and the authors are cognisant that the checks not included in this list are in the ANZSBT guidelines for a reason, but not necessarily the immediate safety of the patient being transfused. Some of the checks were excluded because other measures are frequently used

(e.g. oxygen saturation measurements instead of respiratory rate). Other steps, like the issue form and consent form checks, although useful, do not make the transfusion safer.
Transfusions were counted (table 14) as meeting the bare essential safety checks if:

- patient stated his/her identity and/or the wristband was checked
- prescription was checked
- patient identity, unit number and blood group on the compatibility label were checked
- unit number, blood group and expiry on the unit were checked
- any special requirements were checked
- a two person check took place at the bedside
- initial observations (temp, pulse, BP) were checked and/or the patient was closely observed for the first 15 minutes of the transfusion

Over a third of transfusions failed to meet all these bare essential safety checks. A detailed breakdown showing each parameter per DHB is shown in appendix 2.

Differences between DHBs were statistically significant (table 14) (Chi-squared test: $p<0.001$).

Table 14. *Bare essential safety checklist compliance by DHB*

DHB	Proportion of transfusions meeting all bare essential safety checks	Total no of episodes
Auckland	73%	51
Canterbury	56%	62
Capital & Coast	65%	51
Counties Manukau	79%	33
MidCentral	56%	50
Otago	86%	50
Waikato	68%	56
Waitemata	59%	61
Overall	67%	414

Differences between specialties were not statistically significant ($p=0.19$) (table 15).

Table 15. *Bare essential safety checklist compliance by specialty*

Specialty	Proportion of transfusions meeting bare essential safety checks	Total no of episodes
Cardiac Surgery	70%	27
General Surgery	73%	74
Haematology	74%	66
Medical	65%	82
Obs & Gynae	53%	49
Oncology	71%	35
Orthopaedics	66%	53
Paediatrics	54%	28
Overall	67%	414

There was no difference between risk groups (under 5 years old, unconscious or confused vs other patients) ($p=0.87$).

Differences between patients with different admission status were also not statistically significant ($p=0.10$) (table 16).

Table 16. *Bare essential safety checklist compliance by admission status*

Admission status	Proportion of transfusions meeting bare essential safety checks	Total no of episodes
Day case	78%	67
Inpatient	64%	330
Outpatient on ward	71%	17
Overall	67%	414

Where transfusions failed to meet the bare essential safety checks, the average number of omissions per transfusion was 1.4 and the maximum number of omissions was five (table 17).

Table 17. *Average number of omissions in bare essential safety checks per patient by DHB in transfusions where omissions occurred*

DHB	Average number of omissions (min - max)	n
Auckland	1.2 (1 - 3)	14
Canterbury	1.4 (1 - 4)	27
Capital & Coast	1.1 (1 - 2)	18
Counties Manukau	1.0 (1 - 1)	7
MidCentral	1.8 (1 - 5)	22
Otago	1.6 (1 - 3)	7
Waikato	1.6 (1 - 5)	18
Waitemata	1.3 (1 - 2)	25
Overall	1.4 (1 - 5)	138

Interventions

The observing Transfusion Nurse Specialist had to intervene on four occasions. Twice an attempt was made to put blood into a domestic fridge (not approved for storing blood), once the transfusion was set to run in at half the prescribed rate, and once an attempt was made to run antibiotics through the same line as the blood transfusion.

No incorrect blood component transfusions or ABO incompatible transfusions were identified during the audit.

Aborted transfusions

Three DHBs reported thirteen aborted transfusions. These are shown in table 18.

Table 18. *Aborted transfusion and the reasons given by DHB*

No of episodes	DHB	Reason transfusion was aborted
1	Canterbury	IV cannula was leaking
1	Waikato	Incorrect first names on compatibility label
1	Waikato	Wrong component type issued and patient's name incorrect.
1	Waikato	Patient pyrexial and transfusion delayed after discussion with medical staff
2	Waikato	Failure to obtain IV access despite having requested unit from blood bank
2	Waitemata	Patients had critical bleeding
2	Waitemata	Patient had not signed consent
3	Waitemata	Staff requiring competence assessment

Blood Policies

All DHBs had blood policies in place and these generally complied well with ANZSBT guidelines. A detailed list is shown in appendix 4. Areas not addressed by more than one policy are shown below:

- identification of outpatients and daycases
- the identifiers required on a wristband label (should include first name, surname, date of birth, NHI and gender and be readable)
- the requirement for final observations after the transfusion has been completed

AUDIT LIMITATIONS

It is accepted that an audit provides only a snap shot of activity over a determined period.

There were eight Transfusion Nurse Specialists collecting data. This permitted a national audit to be performed, but an inherent problem with multiple collectors is variation in data collected. Efforts were made to reduce this by using a standard national data collection form and regular telephone and face to face meetings to clarify problems raised during the audit period.

Despite these efforts, significant differences were noted between Transfusion Nurse Specialists in recording why criteria were not met (mean: 43%, range: 3-71% of failed criteria had reasons).

The audit data was collected by direct observation as well as retrospective examination of the clinical notes. Notes do not necessarily reflect what occurred, only what was documented.

Transfusions in operating theatres or emergencies, including massive transfusions, were not included in this audit.

Direct observation of transfusion practice, although time consuming, has been shown to be an effective way to identify deviations from written blood administration policies[8]. However, it is recognised that the fact of being observed may alter performance behaviour. It is thought that initially the direct observation method may have an effect on compliance because the staff member may exhibit their best behaviour while being watched[9]. Behaviour has also been described as diligent or overly nervous when being observed but over time the observer was forgotten[11]. The auditors were conscious that this audit should not only reflect staff who regularly transfuse, so repeated auditing of the same clinical staff was avoided.

This audit did not assess clinical outcome other than adverse effects noted at the time of transfusion. While desirable, this would have added considerably to the complexity of the audit, and was beyond the resources available. Similarly, it was not possible to assess the morbidity or mortality prevented by transfusions assessed as inappropriate.

DISCUSSION

This audit is the first multi-centre multi-specialty audit to look at transfusion practice in New Zealand. The DHBs audited transfused 71% of all red cells administered across New Zealand (NZBS data for '07/'08 financial year). As such this audit provides a useful measure to compare practice and a baseline from which to measure change.

The results of the audit show that for most individual measures, compliances levels are in excess of 80% across the eight DHBs audited. A summary of compliance of all parameters across all the eights DHBs as a whole is shown in appendix 3.

Three notable exceptions are the asking of patients to state their identity (overall 45%, range 22-78%), recording respiratory rate 15 minutes after commencing the transfusion (overall 61%, range 15-93%), and recording the time at the end of transfusion (overall 65%, range:18-94%).

Identity checks are well described as a problematic part of the transfusion process[5,6,8,9,10,11] and this audit was no exception. 89% of patients' wristbands were checked, which compares reasonably well with other audits (e.g. 73%[5], 91%[11] and 94%[6]). However a verbal check, where the patient states his/her name, was performed poorly at 45% overall. This seems to be a difficult area in practice, as suggested by one report showing good results (80%[11]) another showing worse results (18%[12]), and yet another showing the combination of verbal and wristband checks in only 43-68%[13]. Although it may seem superfluous, the verbal check is to verify the wristband details[4]. It is important to ensure the patient states his name and is not prompted for a yes/no answer. An anecdotal example of the weakness of asking for confirmation is an incident where the patient was asked if he was Mr Bloggs, to which he replied "Wright". This was interpreted as "right" and the transfusion commenced. Similarly, it is common for a person not understanding or hearing the question to answer yes. In our multilingual society this is particularly prone to occur.

A reluctance to perform the standard identity check on a patient well known to the staff is the inevitable consequence of such a policy. This attitude fails to recognise that the unit of blood in their hands could be intended for a different patient and that the check is as much about the unit as it is about the recipient[10].

Paediatric and unconscious or confused patients are unable to assist in the identity checks and it is precisely these patients for whom the check is most important. This can be seen in the UK Haemovigilance data[14] where reports for children under one year of age show a significantly higher proportion of ABO-incompatible blood transfusions (i.e. erroneous transfusion) than in patients over one. It was gratifying that all unconscious and confused patients had wristbands on but of concern that two thirds of neonates did not. While there are some significant practical issues to keeping a wristband on a neonate, labelling the incubator or clothing is possibly less ideal, given that neonates are moved between incubators and their clothing gets regularly changed. Where a wristband cannot be worn by a neonate, labelling intravenous central lines has been suggested as an alternative, with the proviso that the wristband is placed on an arm or leg as soon as the neonate can wear it again[10].

The second group to have poor compliance with wearing wristbands was the group of patients attending day wards or hospital wards as day cases. Although these patients should be able to identify themselves, there is a risk that staff get to know the regular patients and fail to follow identification protocols[15]. However, when several regularly transfused patients are being transfused, the chance of a mix-up is significant. It is therefore essential that an adequate identity check is completed. If hospital policy is not to apply wristbands for outpatient transfusions, the policy must clearly define how such patients will be identified and the procedure adopted should not be less than established guidelines.

The pre-transfusion clerical check of the prescription, consent, and the details on the unit and compatibility label was generally well done, with overall measures all above 90%.

The issue form accompanying the labelled unit was one area of variation across DHBs. Although the unit of blood and its compatibility label contain all the necessary information to check the unit against the patient and the prescription, many hospitals also use this additional form. Compliance with checking this additional form was generally better than that of the unit and associated compatibility label.

Although in widespread use, the value of this additional form, which is frequently transcribed manually by blood bank staff from the computer generated and linked compatibility label, needs consideration. A risk exists that transcription errors can occur in this form as it is a handwritten

document with little or no checks in place. A further risk exists as it appears it is sometimes used in preference to the compatibility label produced by the dedicated blood banking computer system which checks the unit against the patient's serology. Although this form typically records the provision of blood in response to a request, any transcribed information makes its contribution to the safety of transfusion dubious. By increasing the amount of documentation involved in transfusion and detracting from the critical documentation checks, it possibly decreases safety.

In contrast to the clerical checks, the two-person check of the unit prior to transfusion was not performed as well, with one DHB failing this step in almost a quarter of units audited. This compares with 96% in an American audit[11]. The purpose of the second check is to ensure the right unit is given to the right patient and that the first checker has not made a mistake. This extra precaution, whilst not fool-proof, does reduce errors[16]. However, the check has to occur next to the patient so that the patient can be correctly identified. In this audit, the commonest reason for failing this step was because the checking was done away from the patient, e.g. in a drug room. This misses the point of the check as all that can be checked in the drug room is that the blood bank computer system linked the right label to the unit, something the computer system does robustly. At least one ABO incompatible transfusion has already occurred in New Zealand in recent years due to failure to check at the bedside[15].

If the additional form referred to above was modified to include a written checklist, it is possible that staff would be more aware of expectations of the two-person check and accountability would be less ambiguous. Such written checklists are well described as improving performance[16,17].

Alternative solutions such as bar code scanning exist and have been successfully implemented in other countries. These solutions, although effective, require significant capital outlay, raising the cost of red cells by 7-8% in one estimate[18]. This has largely excluded them from implementation in New Zealand in the past, although this does not preclude their use at some point in the future.

All baseline, initial and final observations were performed in only 65%, 55% and 48% of transfusions respectively with at least one observation (e.g. temperature) performed in 99%, 99%, 95% of transfusions. This is similar to an international study showing 97-98% for baseline vital signs, and 91-93% for checks within 15 minutes of commencing the transfusion[13].

Respiratory rate stands out as the observation most often omitted, albeit replaced by oxygen saturation measurements in a number of cases. Part of this is the ease of using a saturation monitor compared to observing respiratory rate, but another part may be that the BCSH guidelines[3] do not require respiratory rate in their observation around transfusion. Although oxygen saturation probes are better at detecting desaturation[20], respiratory rate may be more sensitive at detecting an adverse reaction before desaturation has occurred or where peripheral oxygenation is poor. There does not appear to be any literature directly answering this question, however, the Modified Early Warning Score (MEWS)[21], a well described and proven tool for assessing medical patients at risk of catastrophic deterioration, uses respiratory rate as one of its five parameters. As the lungs are affected in the commonest severe transfusion reactions, e.g. transfusion related acute lung injury (TRALI) and transfusion-associated cardiac overload (TACO), as well as the less severe allergic reactions, monitoring respiration needs to be emphasised in teaching and training of staff.

The patient was not closely observed for the first 15 minutes of the transfusion in 14%, or one in seven, transfusions. This compares poorly, with another audit showing only 6% non-compliance[11]. This issue is of concern as severe reactions such as acute ABO haemolysis and anaphylaxis, typically occur within the first 15 minutes of the transfusion. A recent SHOT report[22] has gone further saying that observations should be "done at baseline, throughout the transfusion of blood components and regularly during the subsequent 24-hour period in order

that serious transfusion reactions are identified immediately and not missed. Patients having day case transfusions should be advised to contact the clinical team if late reactions occur, and they should be given a 'contact card' with access to 24-hour clinical advice."

Nine adverse reactions (2.2% of episodes) were reported to blood banks. However fifteen reactions were detected on auditing (3.6% of episodes). This compares with 0.3% reported in 2007 at the eight DHBs participating in this audit[2], a highly significant difference ($p<0.0001$). Observations are performed to identify transfusion reactions. If a reaction occurs, it is often not possible to know which type of reaction it is without further investigation. Highlighting this, there have been cases of ABO incompatible transfusion reported to NZBS where a temperature spike was the only clinical sign initially. It is a concern that these figures suggest only one in ten adverse reactions is actually reported to blood banks.
A transfusion should not last longer than 4 hours, due to concerns regarding bacterial proliferation in the red cells as the unit warms up. It was reassuring that 98% of units were transfused in under 4 hours but of concern that 10% of transfusions at one DHB were outside that time limit.

Documentation of the transfusion in the patient's notes was generally well performed but signing the prescription was poorly performed (41%) in one DHB and the transfusion's end time was poorly recorded in two DHBs (18 and 24%). Documentation is critical to being able to interpret any adverse reactions that may occur post-transfusion, either acutely or as part of a look-back, as in the Hepatitis C cases of the early 1990's.

Looking more broadly at the transfusion process, a number of steps overlap in the errors that they aim to prevent. This layered approach to safety reduces the risk of error, particularly in a manual system such as transfusion. Ideally all layers would be intact at all times, but reality is that there will be gaps in different layers from time to time. When multiple gaps occur in the same transfusion, an error is much more likely to occur. This approach, termed the Swiss-cheese model[7], where each layer is represented by a slice of Swiss cheese with holes in, is illustrated below (figure 1).

When a bare essential checklist was applied to the transfusions in this audit, one in three failed the checklist, with up to five errors per transfusion. No significant variation was seen across specialities or admission status but a statistically significant variation between DHBs in proportion of transfusions failing to meet this bare essential checklist was noted.

This suggests that the variation stems from the organisation's culture and could be remedied with a review of DHB policy and procedure together with a wide education programme.

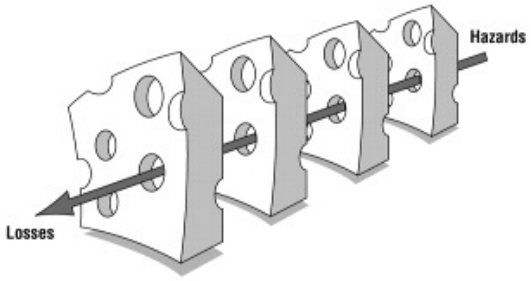

Figure 1: *The Swiss cheese model, showing how gaps in multiple layers may align to permit a system failure*[7]

Maintaining a heightened level of awareness for the possibility of error is a difficult state to work in and creates a fear of error in staff. A different approach, coming from analysis of high reliability organisations, e.g. air traffic control rooms and nuclear power plants, reveals that they expect humans to fail and train staff to reorganise and recover from the error[7]. Apart from creating an understanding of where the system fails, this prevents errors from propagating when staff try to handle an unfamiliar situation.

Whilst it is essential to reduce errors in administration, unnecessary transfusion exposes patients to risk with no gain. The safest transfusion is one that is not needed and does not take place. Ongoing efforts are needed to reduce inappropriate transfusion.

Although this audit has shown generally good compliance with ANZSBT requirements the areas for improvement are significant, with patients exposed to the risks of incorrect or poorly monitored transfusions. Tackling these areas needs a systematic approach to address hospital policy deficiencies; to educate staff on the requirements for a safe transfusion and to create an understanding of what to do when things do go wrong.

RECOMMENDATIONS

1. Correct patient identification is a key component to any transfusion. To ensure this:
    - Hospital policy must state how neonates and outpatients will be identified for transfusion, and in particular, address whether and how wristband labels or other reliable identification will be applied.
    - Standard wristband labels should be used which include all five identifiers (first name, surname, date of birth, NHI number and gender)
2. Manual transcription of blood unit numbers and blood groups introduces the potential for erroneous transfusion. Any forms used to request blood should not have the unit number or group written on the form. The compatibility label (also know as the compatibility label) together with the unit are sufficient to identify the unit to the patient.
3. The two-person checks must occur at the bedside. Consideration should be given to reinforcing this via ongoing education. Developing a bedside checklist, preferably incorporated into existing paperwork, would be ideal.
4. Hospital policy needs to be clear regarding the role of respiratory rate measurements vs. oxygen saturation devices in monitoring transfusion. Clarity from the Australian and New Zealand Society for Blood Transfusion on pulse oximetry's role in transfusion monitoring should also be sought.
5. Current guidelines recommend checking respiration as part of monitoring for transfusion reactions. As the lungs are affected in the commonest severe transfusion reactions, transfusion related acute lung injury (TRALI) and transfusion-associated cardiac overload (TACO), as well as the less severe allergic reactions, this needs to be emphasised in teaching and training of staff.
6. The first few minutes of a transfusion is when the most severe reactions will present. It is therefore critical that the patient is closely observed for the first 15 minutes of each unit transfused.
7. Adverse reactions, however minor, may be clinically significant both for the current transfusion as well as future transfusion. Accordingly all adverse reactions need to be reported to blood bank
8. Consideration should be given to providing day-case transfusion recipients with a contact card for obtaining advice in case of a delayed transfusion reaction.
9. Documentation of transfusion is needed to provide the information necessary to be able to interpret response to transfusion, any adverse reactions and to be able to perform look-backs in the future. This needs to be emphasised in teaching and training of staff. In particular, recording the end time of transfusion appears to be most in need of improvement.
10. Red cells are subject to bacterial contamination. Transfusion duration should therefore be less than four hours, other than in exceptional circumstances.
11. DHBs are encouraged to work together to establish nationally consistent processes and documentation. NZBS will be happy to support this development.

ACKNOWLEDGEMENTS

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APPENDICES

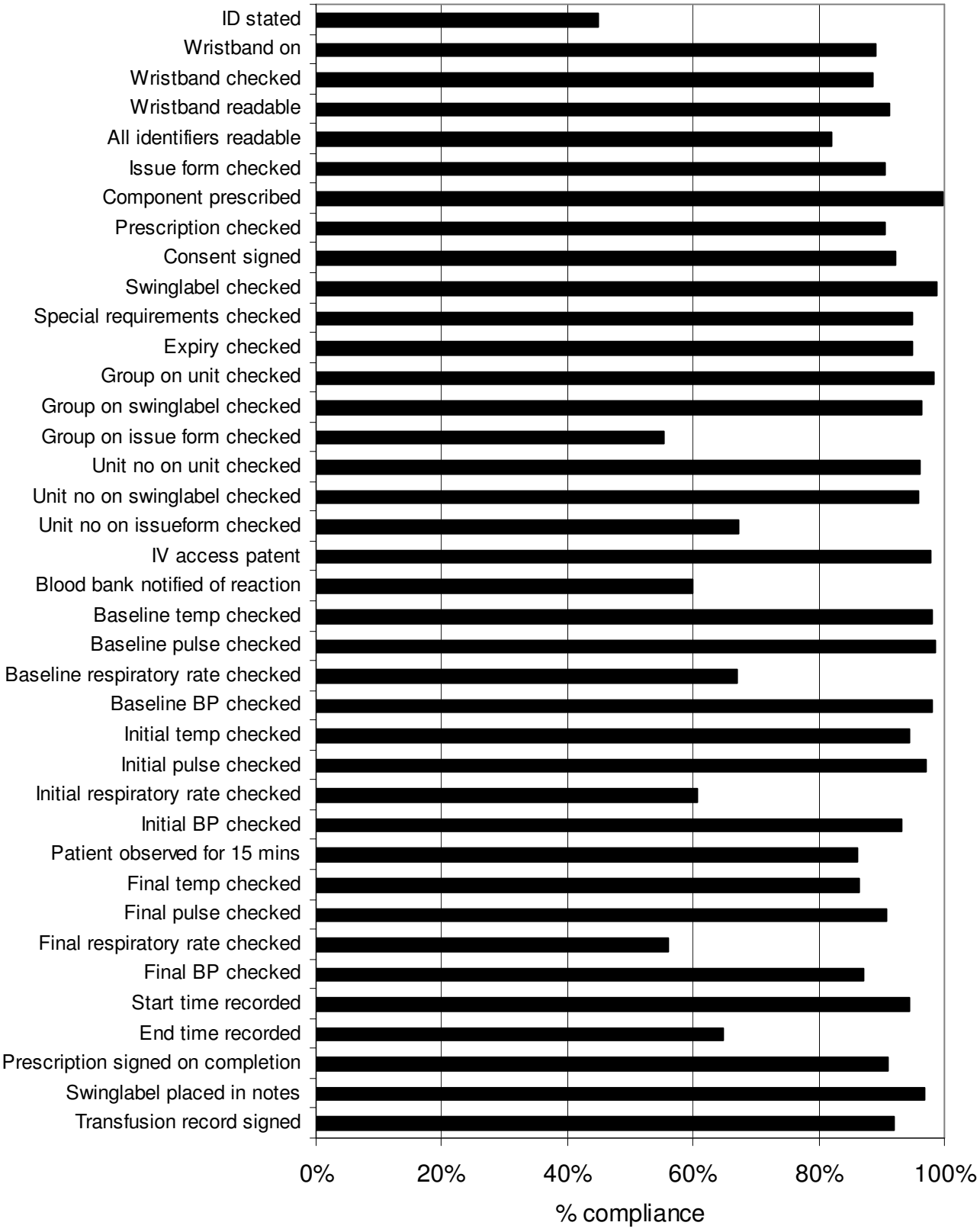
Appendix 1. *Spread of specialties by DHB*

Specialty	Auckland	Canterbury	Capital & Coast	Counties Manukau	Mid Central	Otago	Waikato	Waitemata
Cardiac Surgery	5	7	6			2	7	
General Surgery	9	8	7	11	9	7	8	15
Haematology	7	7	8	11	7	9	8	9
Medical	6	14	8	8	9	11	11	15
Obs & Gynae	5	8	6	3	8	5	7	7
Oncology	7	5	4		5	5	3	6
Orthopaedics	3	8	8		9	8	8	9
Paediatrics	9	5	4		3	3	4	
Total	51	62	51	33	50	50	56	61

Appendix 2. *Bare essential safety checks not completed by DHB (see table 14 for overall compliance with check list)*

DHB	Auckland	Canterbury	Capital & Coast	Counties Manukau	Mid Central	Otago	Waikato	Waitemata
ID stated and/or wristband checked	0%	0%	16%	6%	6%	2%	11%	2%
Compatibility label checked	2%	0%	0%	0%	8%	0%	0%	0%
Script checked	0%	16%	10%	9%	6%	2%	2%	26%
Expiry checked	0%	6%	0%	3%	12%	6%	9%	3%
Unit no on compatibility label checked	2%	13%	0%	3%	8%	2%	0%	3%
Unit no on unit checked	0%	13%	0%	0%	2%	6%	2%	5%
Group on unit checked	0%	3%	0%	0%	2%	2%	5%	0%
Group on compatibility label checked	0%	5%	0%	0%	12%	2%	7%	2%
Special requirements checked	0%	0%	0%	0%	4%	0%	0%	0%
Two person check	22%	2%	6%	0%	16%	0%	2%	8%
Initial obs done and/or patient closely observed for 15 mins	8%	5%	8%	0%	4%	0%	14%	3%

Appendix 3. *Overall compliance to ANZSBT guidelines by requirement*



Appendix 4. *Comparison of DHB blood policies with audit measures*

Criterion used in audit	Canterbury	Waitemata	Auckland	Otago	MidCentral	Counties Manukau	Capital & Coast	Waikato
Patient asked to state identity	✓	✓	✓	✓	✓	✓	✓	✓
Wristband must be worn by patient	✓	✓[1]	✓[2]	✓	✓	✓	✓[2]	✓
Wristband must be checked by person administering blood	✓	✓	✓[2]	✓	✓	✓	✓	✓
Wristband must be readable	×	×	✓	✓	✓	✓	✓	×
Wristband must have 5 identifiers (first name, surname, date of birth, NHI, gender)	×	×	✓[2]	×[3]	×[3]	✓	×[3]	✓
Patient identity must be checked on issue form	✓	N/A	✓	✓	✓	N/A	✓	✓
Patient identity must be checked on compatibility label	✓	✓	✓	✓	✓	✓	✓	✓
Patient identity must be checked on script	✓	✓	✓	✓	✓	✓	✓	✓
Consent must be signed prior to transfusion	✓	✓	✓	✓	✓	✓	✓	✓
IV access should be patent before requesting blood	✓	✓	✓	✓	✓	✓	✓	×
Expiry date of unit must be checked	✓	✓	✓	✓	✓	✓	✓	✓
Group on unit must be checked	✓	✓	✓	✓	✓	✓	✓	✓
Group on compatibility label must be checked	✓	✓	✓	✓	✓	✓	✓	×
Group on issue form must be checked	✓	N/A	✓	N/A	✓	N/A	N/A	NA
Unit no on unit must be checked	✓	✓	✓	✓	✓	✓	✓	✓
Unit no on compatibility label must be checked	✓	✓	✓	✓	✓	✓	✓	✓
Unit no on issue form must be checked	✓	N/A	✓	✓	✓	×	N/A	✓
Component must be prescribed	✓	✓	✓	✓	✓	✓	✓	✓
Special requirements must be checked	✓	✓	✓	✓	✓	✓	✓	×
Prescription must be signed by person administering blood	✓	✓	✓	✓	✓	×[4]	✓	✓
Compatibility label must be placed in notes	✓	✓	✓	✓	✓	✓	✓	✓
Transfusion record must be signed	✓	✓	✓	✓	✓	✓	✓	✓
Two person check must be performed at bedside	✓	✓	✓	✓	✓	✓	✓	×
Start time must be recorded	✓	✓	✓	✓	✓	✓	✓	✓
End time must be recorded	×	✓	✓	✓	✓	✓	✓	✓
Patient must be closely observed for first 15 minutes	✓[5]	✓	✓	✓	✓	✓	✓	✓
Baseline obs must be performed pre-transfusion and include temp, pulse, BP, respiratory rate	✓	✓	✓	✓	✓	✓	✓	✓
Initial obs must be performed 15 mins after commencement and include temp, pulse, BP, respiratory rate	✓	✓	✓	✓	✓	✓	✓	✓
Final obs must be performed post-transfusion and include temp, pulse, BP, respiratory rate	[6]	[7]	✓	[7]	✓	✓	✓	✓
Blood bank must be notified of adverse reactions	✓	✓	✓	✓	✓	✓	✓	✓

Notes:

1. wristband requirement described in general hospital policy, not blood policy
2. wristband required for inpatients only
3. gender not a requirement on wristband label
4. two people checking blood sign compatibility label instead of prescription
5. policy states “closely observe” rather than stay for first 15 minutes of transfusion
6. requirement for final observations not clearly stated. Hourly obs are taken during transfusion
7. requirement for final observations not clearly stated. 30 min obs are taken during transfusion