A Clinical Audit Of Overnight Transfusion In Eight New Zealand Hospitals

Final Report

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August 2011

EXECUTIVE SUMMARY

Non-essential overnight transfusion interrupts the recipient's sleep and also that of neighbouring patients. Transfusing overnight can also expose the patient to avoidable risk factors such as inadequate observation and monitoring, related to the reduced lighting and lower staffing levels.

This audit reviewed red cell units administered between the hours of 8 pm and 8 am at eight large public hospitals in New Zealand over four weeks, excluding high acuity areas (emergency departments, intensive care units, high dependency units, operating theatres, birthing units and delivery suites).

9% (535) of all red cell units transfused at the audited hospitals were transfused overnight in non high acuity areas. Of the units transfused overnight:

- 66% were for symptomatic anaemia or active bleeding/haemolysis.
- 16% were for asymptomatic anaemia.
- 42% were assessed as not essential for overnight transfusion.
- 49% of post-transfusion haemoglobin levels were greater than 100 g/L, indicating a high degree of liberal transfusion.

Overnight transfusions most frequently commenced before 11 pm, suggesting the drive to transfuse overnight is not a clinical factor, which might be expected to occur more evenly during the night. Only 16% of patients were discharged the following day.

The median time interval between taking either the pre-transfusion haemoglobin sample or the pre-transfusion group and screen sample and commencing the transfusion were 9 hours and 9.2 hours respectively. Based on these findings, overnight transfusions cannot be explained by the time taken to get the haemoglobin result. This adds further support to a view of a system unable to respond promptly and during the day to anaemia requiring transfusion.

Transfusion practice appeared to be worse at night than during the day. This is suggested by twice the rate of transfusions lasting more than four hours and half the rate of adverse reaction reporting when compared with a previous audit of bedside transfusion practice of the same hospitals, as well as by the fall-off in observations documented over the duration of the transfusion.

This audit has shown a significant reduction in the amount of overnight transfusion when compared to the previous audit undertaken in 2004. Nevertheless a significant proportion of these transfusions appear to have taken place at night because of a systematic failure to commence the transfusion during the day, combined with a liberal transfusion strategy. The poorer compliance to recommended best practice observed during overnight transfusions adds support for further action to reduce this risk to patient safety.

It is recommended that DHBs:

- re-emphasise policy to restrict overnight transfusion to clinically urgent cases only
- encourage nurses to challenge directives to transfuse stable patients overnight
- improve systems to maximise the opportunity to transfuse during the day
- reinforce a restrictive transfusion strategy to reduce all inappropriate transfusions

INTRODUCTION

It is well recognised that non-essential overnight transfusion interrupts the recipient's sleep and that of neighbouring patients. Transfusing overnight can also expose the patient to avoidable risk factors such as inadequate observation and monitoring, related to the reduced lighting and lower staffing levels.

Both the Australian and New Zealand Society for Blood Transfusion (ANZSBT)[1] (paragraph H2) and the British Committee for Standards in Haematology (BCSH)[2] (section 14.0) as well as the United Kingdom's Serious Hazards of Transfusion programme[3] recommend that transfusions out of core hours should be avoided unless clinically essential. Many DHBs in New Zealand have adopted a positive approach by placing a statement in their local policy manuals that transfusions are not recommended overnight in stable patients.

The risk of an adverse transfusion reaction may occur at any time, so should this happen overnight it may be less likely to be recognised, treated or reported. The New Zealand Haemovigilance programme[4] found that 16% of the adverse reactions reported in 2008 were from non emergency transfusions occurring between 10 pm and 8 am during 2008.

AIM

The primary aim of this audit was to ascertain the percentage of red cell units being administered between the hours of 8 pm and 8 am and to compare this to NZBS's 2004 multisite audit of overnight transfusion[5].

The secondary aims were to determine the reason why overnight transfusions are given in order to offer guidance to avoid the inappropriate administration of blood out of hours and improve patient safety.

The audit sites were the main public hospitals in Waitemata, Auckland, Counties Manukau, Waikato, MidCentral, Capital and Coast, Canterbury and Southern District Health Boards (DHB).

METHOD

The audit was undertaken over a four week period divided into two blocks of two weeks. The local Transfusion Nurse Specialist audited the transfusions at each audit site. The total number of red cell transfusions during the audit period for each hospital was provided by NZBS's data analyst. The local DHB policy for overnight transfusions was identified as were the blood bank opening hours and accessibility to units of blood by remote refrigerator.

Audit Data

The following data was collected for each audited red cell transfusion:

- Patient : NHI, ward, clinical speciality,
- Transfusion: date, day, start and finish time, sequence (e.g. 2nd of 3 units)
- Pathology: pre and post transfusion haemoglobin level with time and date.
- Blood Bank Issues: availability of blood for that patient, details of any delay with issue and pre transfusion cross match.
- Documentation:
    - clinical indication for transfusion e.g. rationale written in notes, haemoglobin level, symptoms and co morbidities.
    - monitoring and observations – evidence in bedside charts of baseline, 15 minute from commencement and upon completion of the red cell unit observations.
    - adverse reaction occurrence and if reported to blood bank
    - discharge date from hospital.

The data was collated in a secure database with restricted access.

Criteria

- Each unit of red cells issued during the hours of 8 pm and 8 am was audited.
- Issues to Emergency Departments, Intensive Care Units/High Dependency Units, Operating Theatres and Birthing Units/Delivery Suites were excluded as these areas maintain a higher nurse to patient ratio overnight.
- Clinical reason: National Health and Medical Research Council (NHMRC) guidelines[6] suggest that the decision to transfuse red cells should consider factors such as the patient's cardio-pulmonary reserve, volume of blood loss, oxygen consumption and atherosclerotic disease as well as haemoglobin level as follows:

Hb < 70 g/L	Transfusion of red cells is usually indicated. A lower threshold may be acceptable in patients without symptoms and/or where specific therapy is available, e.g. Vitamin B12 administration in patients with pernicious anaemia to correct the anaemia.
70-100 g/L	Transfusion of red cells is likely to be appropriate during surgery associated with major blood loss or if there are signs or symptoms of impaired oxygen transport.
< 80 g/L	Transfusion of red cells may be appropriate to control anaemia-related symptoms in a patient on a chronic transfusion regime or during marrow suppressive therapy.
> 100 g/L	Transfusion of red cells is not likely to be appropriate unless there are specific indications.

- Monitoring and observation guidelines[1] recommend that at a minimum the patient's vital signs are measured and recorded before the start, 15 minutes after the start and at the end of each transfusion episode.

Rationale

The rationale for the transfusion was classified according to the four groups identified in the National Health Service (NHS) audit of overnight transfusion[7]. An addition was made to Group 4 for patients with a low haemoglobin but with no symptoms. The groupings were intended to reflect the acuity of need for transfusion. These were:

Group 1: Acute clinical need	Patient with active bleeding / haemolysis at time of transfusion Patient with low haemoglobin and symptoms
Group 2: Less acute clinical need	Patient transfused to raise haemoglobin prior to surgery/procedure
Group 3: Pragmatic need	Patient transfused for discharge same / next day Oncology / haematology patient with limited line time
Group 4: Other	Patient with low haemoglobin but no symptoms Patient transfused for reasons not in above categories

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 is presented in draft to the Hospital Transfusion Committees of the participating District Health Boards for comment. The final report will be issued to the audited institutions and to the other twelve district health boards via New Zealand Blood Service's national Demand Management contacts.

RESULTS

Transfusion Nurse Specialists each audited transfusions within the main public hospital of their DHB. Each nurse contributed a total of 28 audit nights each in two blocks of 14 days separated by 0-7 weeks. The audit commenced on 8th March 2010. The end date varied for each DHB with the final site concluding on 24th May 2010.

359 patients with a mean age of 64 years (range: 0-99) were audited. A total of 535 units were transfused overnight with an average 1.5 units per recipient. Of all units transfused, the proportion overnight ranged from 4% to 12% per DHB (table 1). MidCentral and Southern do not operate 24 hour blood banks which may have influenced the lower percentage in these DHBs.

DHB	Units transfused overnight	Total units issued during audit period	Proportion transfused overnight
Auckland	100	1575	6%
Canterbury	76	795	10%
Capital & Coast	62	651	10%
Counties Manukau	96	923	10%
MidCentral	19	462	4%
Southern	20	317	6%
Waikato	86	780	11%
Waitemata	76	646	12%
Total	535	6149	9%

Table 1. *Units transfused overnight compared with overall issues of red blood cell units.*

Although there was a slight preponderance towards more overnight transfusions during the middle of the week. 17% and 18% of all the overnight transfusions were on Wednesdays and Thursdays respectively compared with 13% on average for each of the other days (chi-square test, p=0.06).

A broad spread of clinical specialties was apparent in the audited transfusions (appendix 1). General medicine (23%), general surgery (21%), orthopaedics (14%) and haematology (10%) were the four most represented groups. This does not represent all overnight transfusions as some departments, such as Emergency Departments and theatres, were excluded from the audit (see Method).

The commonest rationale for transfusion in this audit was symptomatic anaemia (43%), followed by active bleeding/haemolysis (23%). Of concern is that asymptomatic anaemia was the third most likely reason for transfusion overnight (16%) (table 3).

	Acute clinical need		Less acute	Pragmatic need		Other	
	Active bleeding / haemolysis	Anaemia & symptoms	Prior to surgery	For discharge within a day	Onc / Haem & limited IV access time	Anaemia without symptoms	Other
Auckland	15%	31%	21%	9%	6%	18%	0%
Canterbury	25%	43%	16%	4%	1%	8%	3%
Capital & Coast	35%	37%	2%	5%	0%	21%	0%
Counties Manukau	19%	58%	18%	1%	4%	0%	0%
MidCentral	5%	74%	11%	0%	0%	11%	0%
Southern	40%	40%	0%	0%	0%	20%	0%
Waikato	29%	53%	2%	5%	0%	9%	1%
Waitemata	22%	26%	4%	1%	0%	43%	3%
Overall	**23%**	**43%**	**11%**	**4%**	**2%**	**16%**	**1%**
Appropriate	87%	67%	47%	33%	45%	10%	20%
Mean pretransfusion haemoglobin (g/L)	78	72	80	81	77	82	92

Table 3. *Rationale for transfusion per DHB*

Patients grouped as having symptomatic anaemia had a mean pre-transfusion haemoglobin of 72g/L whilst those with asymptomatic anaemia had a mean of 82g/L. This was statistically significant (t-test, $p<0.0001$).

The Transfusion Nurse Specialists assessed the appropriateness of each unit transfused based on the clinical indication for transfusion. This was subjective to each nurse specialist and not standardised between DHBs. Overall 58% of the 535 episodes were considered appropriate with a wide range (30-79 %) between DHBs (tables 3 and 4).

DHB	Percentage appropriate	No of units assessed
Auckland	30%	100
Canterbury	63%	76
Capital & Coast	50%	62
Counties Manukau	79%	96
MidCentral	58%	19
Southern	65%	20
Waikato	79%	86
Waitemata	46%	76
Overall	58%	535

Table 4. *Subjective assessment of transfusion appropriateness*

The majority of patients (68%) were still in hospital 48 hours or more after the transfusion, with only 16% of patients discharged within 24 hours of the transfusion (table 5). Twelve patients died within the first 48 hours after the transfusion.

DHB	Discharged			Transferred			Died			Still an inpatient > 48 hours	No of units
	< 24 hours	24-48 hours	> 48 hours	< 24 hours	24-48 hours	> 48 hours	< 24 hours	24-48 hours	> 48 hours		
Auckland	4%	20%	28%	0%	2%	8%	0%	1%	2%	35%	100
Canterbury	8%	5%	43%	1%	4%	8%	0%	3%	4%	24%	76
Capital & Coast	11%	11%	63%	5%	3%	6%	0%	0%	0%	0%	62
Counties Manukau	40%	11%	34%	0%	1%	1%	0%	1%	8%	3%	96
MidCentral	16%	21%	42%	11%	0%	0%	0%	0%	0%	11%	19
Southern	15%	0%	40%	0%	0%	5%	5%	0%	0%	35%	20
Waikato	24%	8%	51%	0%	0%	0%	0%	1%	0%	15%	86
Waitemata	5%	8%	5%	0%	0%	0%	8%	0%	4%	70%	76
Overall	16%	11%	37%	1%	1%	4%	1%	1%	3%	24%	535

Table 5. *Patient disposition following transfusion*

The median time from taking the pre-transfusion haemoglobin sample to the start of the transfusion was 9 hours (figure 1) for the 528 transfusions where both times were known. 88% of pre-transfusion haemoglobin levels were taken between 8am and 9pm (figure 2). The average number of units transfused before repeating the haemoglobin level was 2.3 (figure 3).

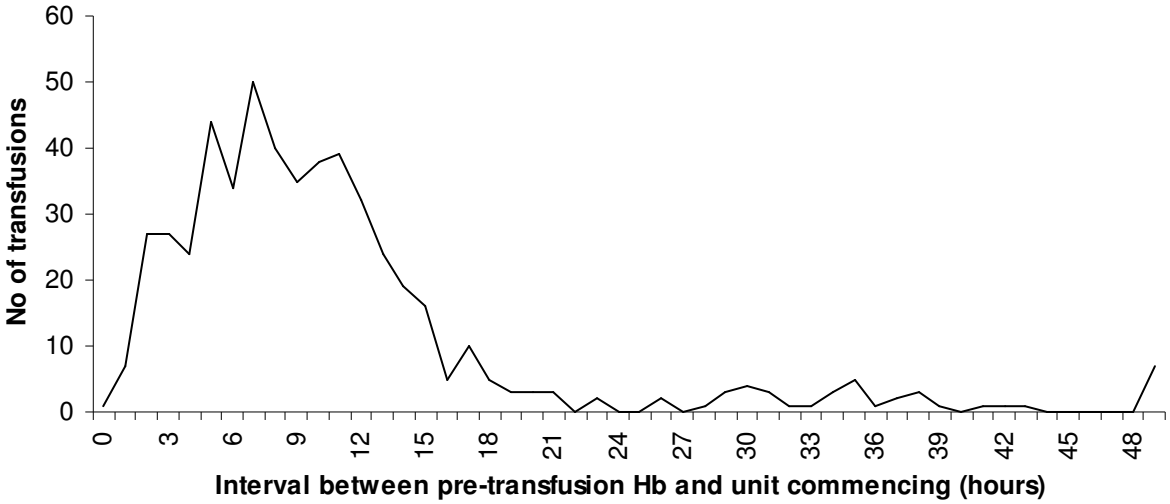

Figure 1. *Interval between pre-transfusion haemoglobin level and start of transfusion.*

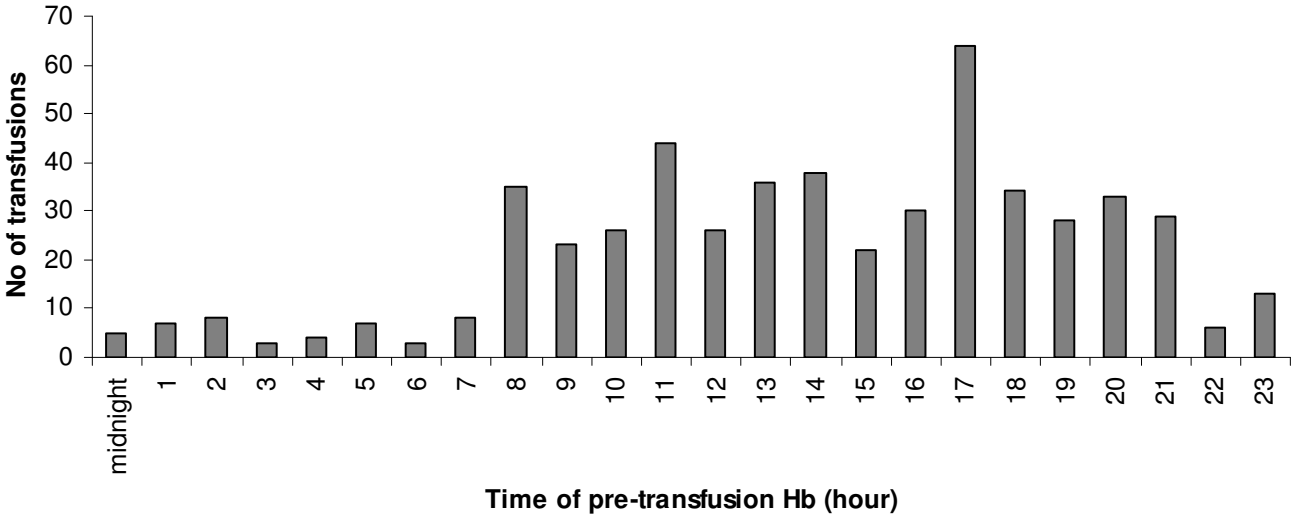

Figure 2. *Timing of pre-transfusion haemoglobin level*

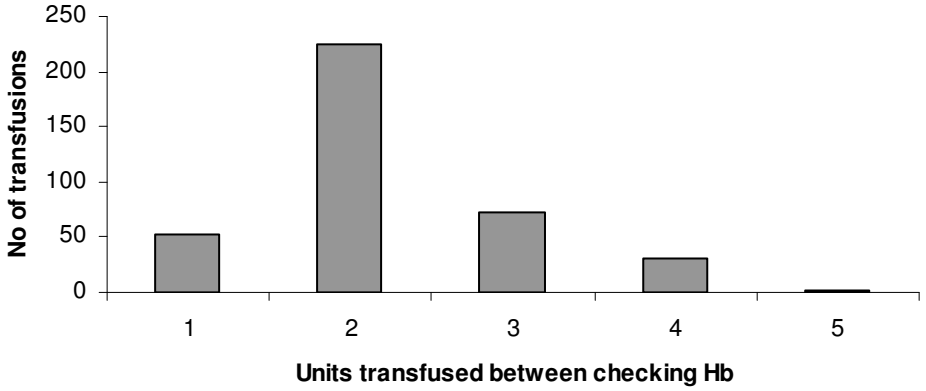

Figure 3. *Number of units transfused before the haemoglobin level is checked.*

The response to transfusion, where the haemoglobin was checked less than 18 hours post-transfusion (80% of units), showed a mean haemoglobin rise from 77g/L to 101g/L (figure 4).

The highest post-transfusion haemoglobin level was 145 g/L. 49% of post-transfusion haemoglobin levels were greater than 100 g/L. Breakdown by specialty and DHB (appendices 2 and 3) shows relatively restrictive transfusion by haematology, despite the patients mostly having bone marrow failure disorders, compared with the more liberal transfusion of many other specialties.

The average interval between the pre-transfusion haemoglobin and post-transfusion haemoglobin level was 33.9 hours.

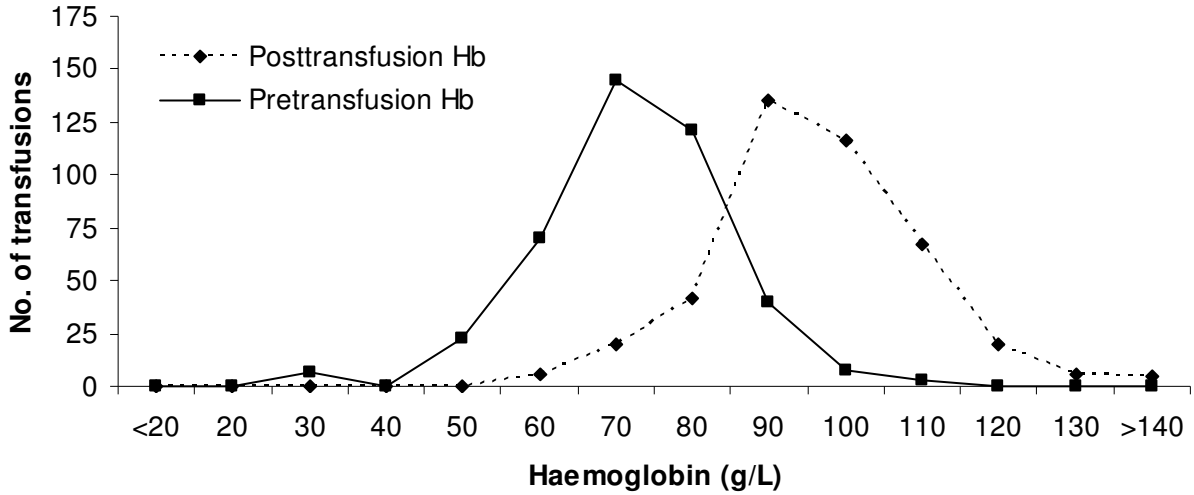

Figure 4. *Pre and post transfusion haemoglobin levels*

Analysis of overnight transfusion activity was undertaken by tracking the transfusion start times. Increased activity was evident between 9 pm and 10 pm and again around 1am. To a lesser extent, a number of transfusions were commenced between 4 am and 5 am. The start times of transfusion appear to relate to shift changes. The graphs of this for each DHB are shown in appendix 4.

Delays in the various steps leading to provision of blood can result in transfusion occurring later than planned. Possible reasons include recollection of the pre-transfusion sample, identification of red cell antibodies and sourcing blood from other blood banks. In the ward, the patient may be called away to another procedure becoming unavailable for the transfusion. Table 6 indicates that 1% of all units could have been delayed due to the sample delays and 2% due to blood bank delays.

DHB	sample delays	blood bank delays	number delayed
Auckland	0%	5%	5
Canterbury	0%	5%	4
Capital & Coast	0%	0%	0
Counties Manukau	0%	2%	2
MidCentral	0%	0%	0
Southern	5%	5%	2
Waikato	3%	0%	3
Waitemata	3%	0%	2
Overall	1%	2%	18

Table 6. *Sources of transfusion delays by DHB*

Prior to transfusion a current group and screen must be available in blood bank. The median interval between the group and screen samples and transfusion was 9.2 hours with some samples being taken up to 19 days prior to transfusion (Figure 5).

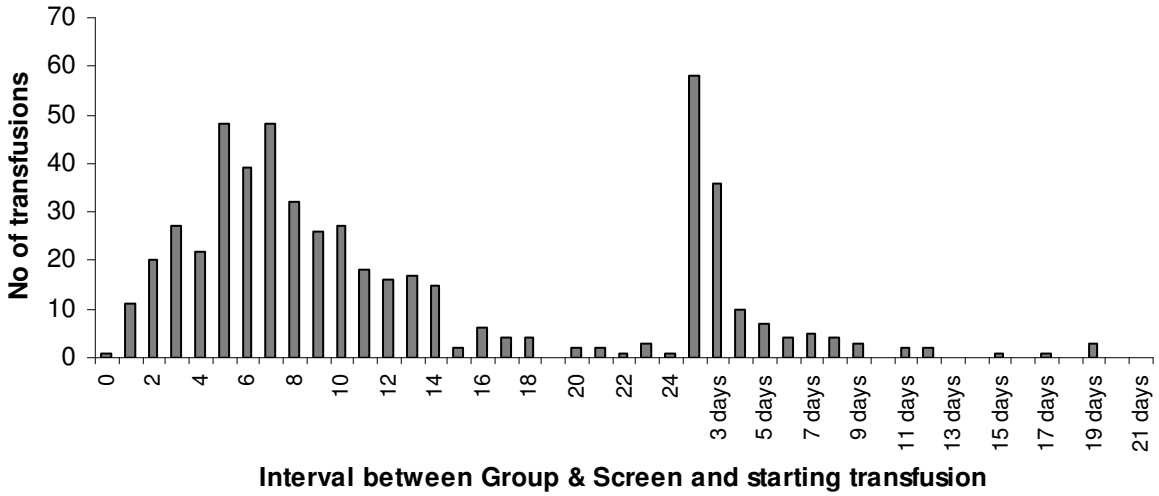

Figure 5. *Interval between Group and Screen and transfusion commencement*

The sequence number following a haemoglobin check was determined for each unit transfused overnight (e.g. second unit following Hb check). A minority (33%) of units transfused overnight were the first unit after a haemoglobin check. 50% of units transfused overnight were the second unit transfused after a haemoglobin check (figure 6).

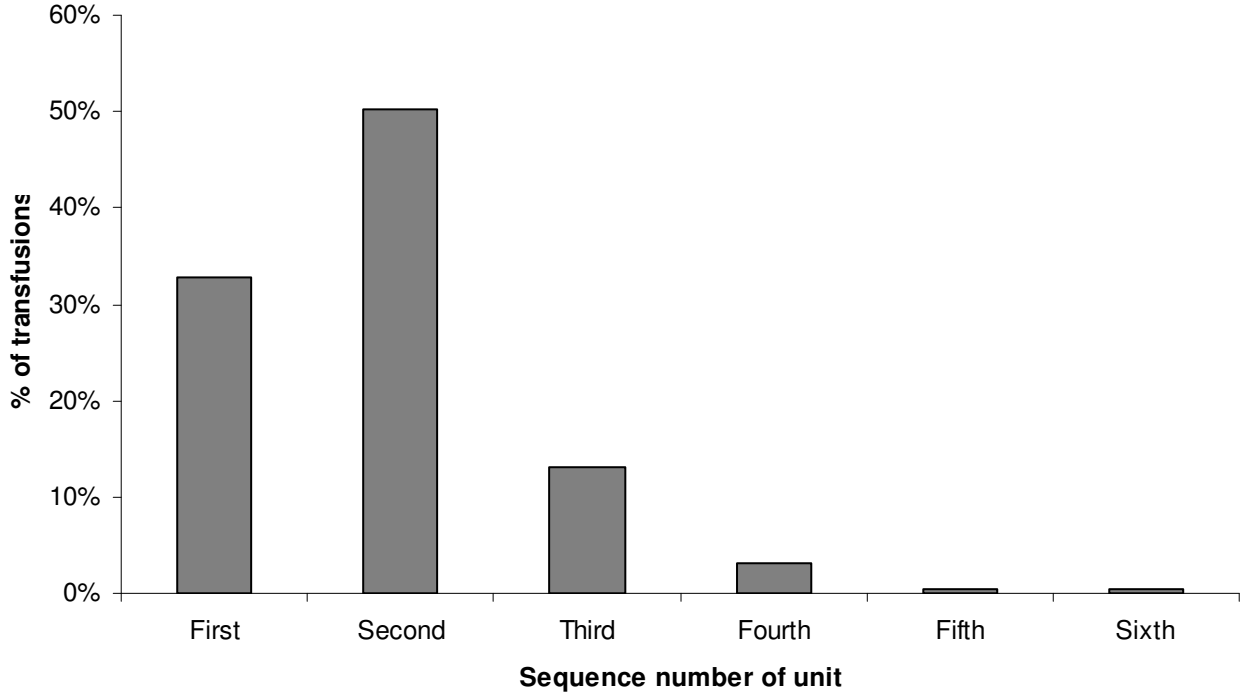

Figure 6: *Proportion of units vs the sequence number of the unit following a haemoglobin check*

For those units that were the first unit transfused after a haemoglobin check, 54% were commenced before 11pm (figure 7).

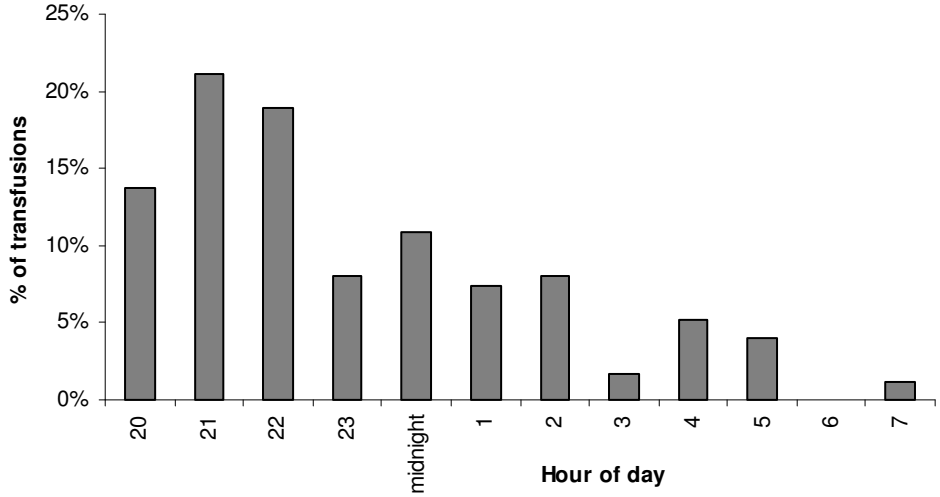

Figure 7: *Time of commencement where the unit was the first unit following a haemoglobin check*

It is recommended that red cell transfusions are completed within 4 hours from the time of leaving refrigerated storage[1]. Where times were provided, the average transfusion duration from commencement was 2.7 hours. The maximum duration was 5 hours with 4% exceeding this limit.

The time from when the unit was issued by Blood Bank until the transfusion was also recorded (table 7). However, for at least three sites, blood was issued to a blood fridge and later removed for transfusion, making the upper limits of this data unhelpful. An example of this is a unit issued at North Shore Hospital at 11pm to a blood fridge, with the transfusion commencing at 6am, finishing at 8:20am. This gives a duration of 9.3 hours from issue, but the majority of that was still in controlled storage.

DHB	From issue from Blood Bank		From transfusion commencement		Number of units audited
	Average transfusion duration	Number and percent of units transfused over 4 hours	Average transfusion duration	Number and percent of units transfused over 4 hours	
Auckland	3.0 (1.1 - 5.3)	16% (15)	2.7 (0.5 - 5.0)	10% (9)	93
Canterbury	3.1 (1.1 - 5.2)	9 % (7)	2.8 (0.8 - 4.3)	3 % (2)	74
Capital & Coast	3.1 (1.2 - 4.4)	2 % (1)	2.8 (1.1 - 4.2)	2 % (1)	47
Counties Manukau	2.6 (0.4 - 7.4)	3 % (3)	2.3 (0.4 - 3.9)	0 % (0)	90
MidCentral	3.4 (2.4 - 4.3)	21% (4)	3.1 (2.1 - 4.0)	5 % (1)	19
Southern	2.8 (0.5 - 5.2)	33% (6)	2.5 (0.3 - 4.0)	6 % (1)	18
Waikato	3.4 (1.9 - 4.7)	15% (12)	3.1 (1.5 - 4.4)	6 % (5)	81
Waitemata	3.3 (0.3 - 9.3)	15% (11)	2.8 (0.1 - 4.0)	3 % (2)	74
Overall	3.1 (0.3 - 9.3)	12 % (59)	2.7 (0.1 - 5.0)	4 % (21)	496

Table 7. *Transfusion duration and transfusions extending over the 4 hour limit.*

Overall 96% of the transfusions audited had baseline observations (temperature, pulse, respiratory rate and blood pressure) recorded. This decreased to 86% at the 15 minute interval and 81% on completion of the transfusion. No documentation of recordings was found for 2% of baseline observations and 13% of post-transfusion observations. In up to 6% of instances, only a partial set of observations had been documented (table 8).

The documentation of the recommended observations in relation to the time during the night is shown in Figure 8. Baseline observations appear to be close to 100% complete in their documentation, whereas the observations required at the 15 minute interval range between 80-100% compliance. End of transfusion observations often fell below 80% compliance with the least compliant time being around 6 am (69%).

DHB	Pre-transfusion			At 15 mins			Post-transfusion		
	no	partial	yes	no	partial	yes	no	partial	yes
Auckland	1%	0%	99%	1%	0%	99%	1%	0%	99%
Canterbury	1%	1%	97%	4%	3%	93%	24%	1%	75%
Capital & Coast	0%	6%	94%	16%	35%	48%	27%	35%	37%
Counties Manukau	0%	0%	100%	0%	0%	100%	0%	0%	100%
MidCentral	0%	16%	84%	11%	11%	79%	47%	16%	37%
Southern	0%	0%	100%	40%	0%	60%	40%	10%	50%
Waikato	7%	5%	88%	8%	5%	87%	10%	3%	86%
Waitemata	3%	3%	95%	13%	3%	84%	12%	0%	88%
Overall	2%	3%	96%	8%	6%	86%	13%	6%	81%

Table 8. *Documentation of patient observations*

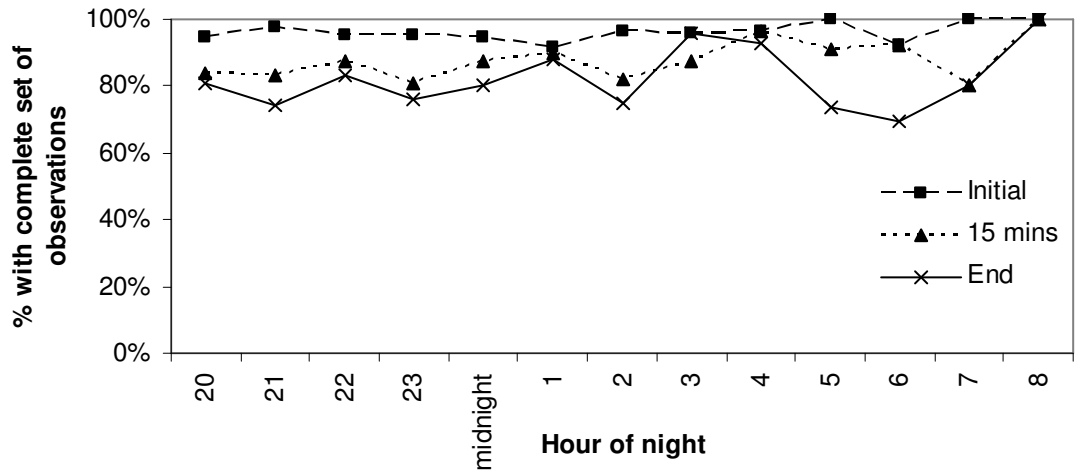

Figure 8. *Completed observations of patient documented throughout the night*

During the review of the patient case notes the auditors noted that only 31% of the adverse reactions documented in the patient notes had been reported to Blood Bank (table 9).

DHB	No of adverse reactions	Reactions as a percentage of units transfused	Proportion of reactions notified to Blood Bank
Auckland	6	6%	17%
Canterbury	0	0%	No reactions
Capital & Coast	2	3%	50%
Counties Manukau	0	0%	No reactions
MidCentral	1	5%	0%
Southern	1	5%	100%
Waikato	1	1%	100%
Waitemata	2	3%	0%
Overall	13	2%	31%

Table 9. *Adverse reactions in units transfused overnight*

AUDIT LIMITATIONS

This audit provides only a snap shot of activity over the period March to May 2010. The audit data was collected by a retrospective examination of the clinical notes. Notes do not necessarily reflect what occurred, only what was documented.

There were eight Transfusion Nurse Specialists collecting data which permitted a multi-centre audit to be performed. An inherent problem with multiple collectors is variation in data collected. Efforts were made to reduce this by using a standard data collection form and regular telephone and face to face meetings to clarify problems raised. Despite these efforts, significant differences were noted between Transfusion Nurse Specialists, most notably in assessment of appropriateness of transfusion.

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

This audit did not assess clinical outcome other than adverse effects noted at the time of transfusion. Whilst 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 caused by transfusions assessed as inappropriate.

DISCUSSION

Recommended best practice guidelines suggest that overnight transfusion in stable patients should be avoided unless clinically essential[1,2]. This audit investigated the frequency of overnight transfusions at eight hospitals and whether it was appropriate to continue the transfusion episode into the night. It is the second audit of its nature to be undertaken in New Zealand. The first, a smaller audit[5] (n=317 units) was undertaken by NZBS in 2004.

During the audit period in 2004, 22% of units issued were transfused overnight in non-high acuity areas. This finding is similar to a large English study[8] that found 28.5% of red cell units were transfused out of core working hours and another[9] that reported 25% in their audit. Subsequent to the 2004 audit it was recommended[5] that education should be provided to discourage transfusions overnight and local hospital policy should actively discourage the practice. In this audit we found only 9% of units were transfused overnight. This improvement suggests some of the measures implemented subsequent to the 2004 audit have been successful in lowering the overnight transfusion rate.

Eight hospitals were audited in the 2010 audit. All had policy statements in place which encourage routine transfusions to be completed by 10 pm. Two hospital sites do not have twenty-four hour blood banks, but operate an on-call service after midnight. This system may also discourage overnight transfusion.

There are many reasons why a patient may be transfused overnight outside high acuity areas. Some of these may be genuine timing issues, including other commitments such as radiography or fully utilised intravenous lines. In other cases the problem may be more organisational, such as the clinical ward round occurring late so that the decision to transfuse and prescribe is not completed until late in the day. Delays may also be caused by sample and blood bank issues, such as sample labelling problems or difficult red cell antibodies.

This audit identified that the main reason for overnight transfusion was for patients with symptomatic anaemia (43%), followed by active bleeding/haemolysis (23%). On the face of it this appears appropriate, however the transfusion nurse specialists auditing the cases considered that 13% of the actively bleeding/haemolysing patients and 33% of the patients with symptomatic anaemia could have been transfused earlier. In some cases the patients had already had previous units and the overnight one could have waited until the morning. In other cases the indication at the time of prescription may have been active bleeding but the patient may not have been bleeding at the time of the overnight transfusion.

Of concern is that 16% of transfusions were for asymptomatic anaemia. These would not usually be considered appropriate at any time, least of all overnight. It is noteworthy that there was a clear correlation between haemoglobin levels and presence or absence of symptoms, verifying the clinical assessment of asymptomatic anaemia and correlating with the NHMRC Guidelines[6].

The proportion of patients with an acute clinical need for transfusion (66%) is similar to that found in the NHS audit[7] (58%). Interestingly while this audit found 11% of transfusions were pre-op, the NHS found less than 2%.

Overall 58% of transfusions were considered appropriate although it is acknowledged that this is a subjective assessment. This compares with other audits, showing 33% of patients' transfusion could not be delayed[9] and 20% appropriate transfusions[10]. In the 2004 NZBS audit[5], only 15% of transfusions were considered appropriate. In conjunction with the reduction in the proportion of units transfused overnight, this suggests that there has been a considerable improvement in hospitals' approach to overnight transfusion. However, many of the units transfused were the second or third that the patient had received subsequent to checking the haemoglobin. This raises the question of the urgency of the transfusion in non-bleeding patients.

The transfusion nurse auditors assessed each unit transfused using the information documented in the notes. Although the ANZSBT guidelines[1] recommend that the reason for transfusion of red cells should be documented in patients' clinical notes, this was often poorly performed, making the attribution to appropriateness more difficult to assess.

The NHS audit[7] found the specialist areas of general medicine and general surgery were where the patients were most transfused. This too was our finding, together with orthopaedics, and similar to another English audit[9].

We were interested to note that 16% of patients were discharged from hospital within 24 hours of their transfusion, similar to an English audit's[10] finding of 10%. It is worth noting that the majority (68%) of patients in this audit were still in hospital more than 48 hours afterward, dispelling this often quoted rationale for overnight transfusion.

The audit identified that overnight transfusions most frequently commenced before 11pm, consistent with other audits[7,8]. This suggests the drive to transfuse overnight is not a clinical factor, which might be expected to occur more evenly during the night. The impression given is a rush to finish the day's work.

The median interval between taking the pre-transfusion haemoglobin sample and starting the transfusion was 9 hours. Similarly, the mean interval between the group and screen sample and commencing the transfusion was 9.2 hours. This adds further support to a view of a system unable to respond promptly to anaemia requiring transfusion.

It was gratifying to see that post-transfusion haemoglobin checks were performed frequently, typically the day after the previous haemoglobin level, and on average after only 2.3 units of red cells. However, 49% of post-transfusion haemoglobin levels were greater than 100 g/L, indicating a high degree of liberal transfusion. More than a decade after the landmark TRICC study[11] showing that restrictive transfusion, with a trigger of 70g/L and an endpoint of 70-90g/L was as safe as a liberal transfusion strategy, this is a disappointing result, even after allowing for the exceptions to the study.

Documentation of the patient's observations decreased over the time of the transfusion and is of concern for patient safety. Not all participating hospitals mandate the need for end of transfusion recordings, even though this is an ANZSBT recommendation[1], which does affect the interpretation of the post-transfusion observations. Nevertheless, overall this audit compared well with one English audit[9] that found 40% of patients did not receive all the recommended observations, and another UK national audit[12] that found only 72% of baseline observations were documented.

Transfusions lasted 2.7 hours on average but 4% exceeded the four hour limit intended to protect patients from bacterial complications. This is double the frequency noted in a previous New Zealand audit[13] and suggests decreased attention to the transfusion.

Staffing levels are reduced at night, especially in the lower acuity areas that this audit focussed on. The lower staff numbers, poor lighting and a desire not to wake the transfused or other patients may be the reason why patient observations are not recorded[9]. Staffing levels may be especially significant at busy times of the night, for example 6 am, the nadir of post-transfusion observations. Although we did not note the location of the patient in the ward during the transfusion, it is worth observing that patients in single rooms or those isolated from the nurse's station may be observed even less.

A study on monitoring of patients post transfusion[14] noticed a continuing failure to monitor vital signs appropriately at night despite interventional education. This suggests that this is a system issue and a good reason to actively avoid transfusing at night.

Thirteen adverse reactions (2% of 535) were found when the case notes were examined by the auditors with only 31% being reported to Blood Bank. This is half the rate noted in a previous New Zealand audit, conducted during the working day[13]. This is of concern as it suggests that adverse reactions may not be properly assessed or treated due to the reduced staffing levels and reduced skill set of medical staff on site overnight.

This audit has shown a significant reduction in the amount of overnight transfusion when compared to the 2004 audit. Nevertheless a significant proportion of these transfusions appear to have taken place at night because of a systematic failure to get the blood transfused during the day, combined with a liberal transfusion strategy. The poorer transfusion practice at night, as evidenced by more transfusions running over four hours and lower adverse reaction reporting, adds support for further action to reduce this risk to patient safety.

RECOMMENDATIONS

It is recommended that DHBs:

- re-emphasise policy to restrict overnight transfusion to clinically urgent cases only
- encourage nurses to challenge directives to transfuse stable patients overnight
- improve systems to maximise the opportunity to transfuse during the day
- reinforce a restrictive transfusion strategy to reduce all inappropriate transfusions

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APPENDIX

Appendix 1. *Attributed clinical specialty for DHB in percentage of units audited.*

Specialty	Auckland	Canterbury	Capital & Coast	Counties Manukau	MidCentral	Southern	Waikato	Waitemata	Overall
General Medicine	22%	22%	18%	11%	11%	35%	26%	42%	23%
General Surgery	15%	22%	18%	24%	5%	20%	28%	26%	21%
Orthopaedics	25%	12%	21%	4%	0%	10%	9%	16%	14%
Haematology	12%	7%	10%	18%	16%	10%	9%	4%	10%
Gynaecology	5%	1%	2%	20%	0%	0%	10%	9%	8%
Oncology	4%	8%	19%	0%	26%	0%	0%	0%	5%
Gastroenterology	0%	12%	0%	11%	5%	0%	0%	0%	4%
Renal Medicine	2%	5%	2%	8%	11%	0%	5%	0%	4%
Cardiology	1%	1%	2%	2%	5%	5%	7%	0%	2%
Urology	1%	4%	5%	0%	0%	0%	0%	0%	1%
Elderly AT and R	4%	0%	0%	0%	0%	0%	0%	3%	1%
Vascular	1%	0%	2%	0%	0%	20%	0%	0%	1%
Transplant	5%	0%	0%	0%	0%	0%	0%	0%	1%
ENT	3%	1%	0%	0%	0%	0%	0%	0%	1%
Paed Medicine	0%	0%	0%	0%	11%	0%	2%	0%	1%
Cardiothoracic	0%	3%	0%	0%	0%	0%	1%	0%	1%
Palliative Care	0%	0%	0%	1%	0%	0%	2%	0%	1%
Obstetrics	0%	0%	3%	0%	0%	0%	0%	0%	0%
Paed Haem/Onc	0%	1%	0%	0%	5%	0%	0%	0%	0%
Psychogeriatric	0%	0%	0%	0%	5%	0%	0%	0%	0%
Total	100	76	62	96	19	20	86	76	535

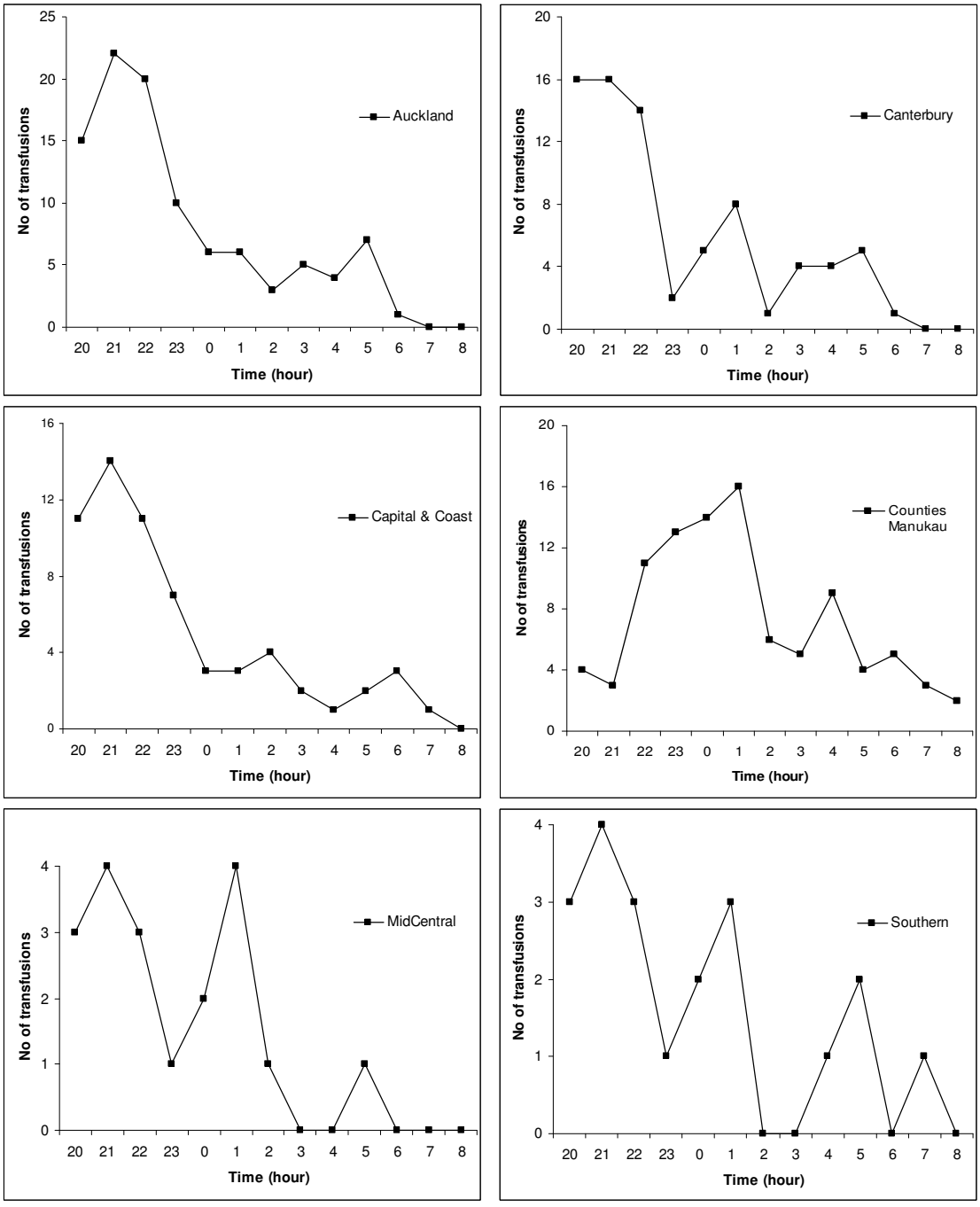
Appendix 2. *Average and range of post-transfusion haemoglobins by specialty where post-transfusion Hb checked within 18 hours of transfusion completing*

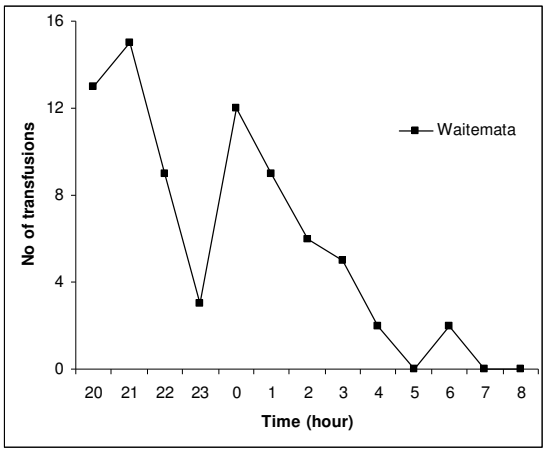
Specialty	Average post-transfusion Hb (g/L)	Range	Proportion >100 g/L	n
Cardiology	109	(97 - 119)	83%	12
Cardiothoracic	87	(81 - 93)	0%	3
Elderly AT and R	99	(84 - 116)	50%	6
ENT	89	(66 - 112)	25%	4
Gastroenterology	101	(77 - 127)	58%	19
General Medicine	106	(75 - 145)	58%	109
General Surgery	104	(64 - 143)	53%	105
Gynaecology	95	(77 - 120)	27%	37
Haematology	93	(62 - 128)	24%	51
Obstetrics	75	(74 - 76)	0%	2
Oncology	103	(74 - 117)	74%	19
Orthopaedics	103	(80 - 125)	58%	66
Paed Haem/Onc	80	(77 - 83)	0%	2
Paed Medicine	95	(92 - 97)	0%	4
Palliative Care	101	(95 - 106)	50%	2
Psychogeriatric	122	(122 - 122)	100%	1
Renal Medicine	97	(84 - 121)	19%	16
Transplant	100	(92 - 107)	80%	5
Urology	91	(62 - 118)	14%	7
Vascular	105	(93 - 112)	80%	5
Overall	101	(62 - 145)	49%	475

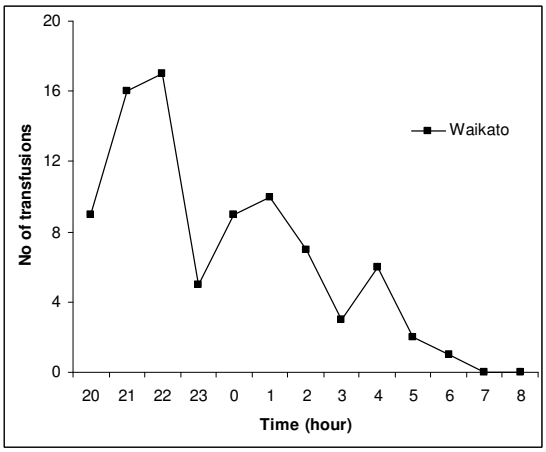
Appendix 3. *Average and range of post-transfusion haemoglobins by DHB where post-transfusion Hb checked within 18 hours of transfusion completing*

DHB	Average post-transfusion Hb (g/L)	Range	Proportion >100 g/L	n
Auckland	102	(66 - 130)	53%	93
Canterbury	100	(70 - 138)	47%	70
Capital & Coast	100	(62 - 123)	53%	45
Counties Manukau	101	(62 - 143)	45%	84
MidCentral	101	(77 - 122)	42%	19
Southern	95	(64 - 119)	39%	18
Waikato	99	(75 - 119)	46%	78
Waitemata	107	(80 - 145)	54%	68
Overall	101	(62 - 145)	49%	475

Appendix 4: *Time distribution of overnight transfusions for each DHB*




16
12
8
4
0
No of transfusions
Waitemata
20 21 22 23 0 1 2 3 4 5 6 7 8
Time (hour)


20
16
12
8
4
0
No of transfusions
Waikato
20 21 22 23 0 1 2 3 4 5 6 7 8
Time (hour)