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Cascade Filtration for Familial Hypercholesterolemia

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Introduction:
Results of LDL-aphereses in a patient with homozygous familial hypercholesterolemia (FH) Afrikaner-1 LDLr gene mutation are presented.

Case Report:
A 13 year old South African girl, weight, 61 kg, BMI, 23 and BP, normal had prominent tendon xanthomas but no corneal arcus or significant cardiac abnormalities. Prior to any treatment, aged 8 years, total cholesterol (Tc) was18.4 mmol / L, LDL cholesterol (LDLc), 16.1 mmol / L, HDL cholesterol (HDLc), 1.09 mmol / L and triglycerides, 1.3 mmol / L. She did not have secondary hypercholesterolemia. Because of inadequate response to diet control, exercise, statins and ezetimibe, LDL apheresis was started in early 2010.

Results of 10 LDL apheresis procedures, using a COM.TEC cell separator (Fresenius Kabi AG, Bad Homburg, Germany) and the Evaflux 5A fractionator column (Kuraray Corp., Osaka, Japan), are summarised. Average plasma volume processed was 2473 ml (1.1 x PV) and average procedure time, 103 minutes.

	Tc (mmol / L)	LDLc (mmol / L)	HDLc (mmol / L)	Apo B lipoprotein (mmol / L)	IgG, IgM, Fibrinogen (g / L)
Mean C_{max}	9.1	7.7	1.04	1.64	-
Mean C_{min}	4.9	3.9	0.81	0.92	7.2, 0.6, 1.4
Mean C_{mean}	7.8	6.4	-	-	-

C_{max} : pre-procedure level

C_{min} : post-procedure level

C_{mean} : interval mean (Kroon et al[1])

Discussion:
The FH Afrikaner-1 mutation significantly reduces LDLr activity.[2] LDL aphereses may be required in addition to conventional treatment.

Average C_{mean} for Tc exceeds, but that for LDLc meets, the limits recommended by Thompson et al.[3] Average acute reductions in Tc and LDLc (47.3% & 50.5% respectively) meet criteria recommended by the American Society For Apheresis [4] but not Thompson et al.[3] The clinical relevance of these is uncertain.

LDL-aphereses caused minor citrate effects, eye irritation, borderline, but asymptomatic, IgM and fibrinogen levels and iron deficiency.

References:

1. Kroon AA, et al. Atherosclerosis 2000; 152: 519 – 526
2. Kotze MJ, et al. Ann Hum Genet. 1991;55:115-121.
3. Thompson GR, et al. Atherosclerosis 2010; 208: 317-321.
4. Szczepiorkowski ZM, et al. J Clin Apher 2007; 22: 106 - 75

Effect of Electromechanical Pump versus Conventional Gravity Flow for Platelet Transfusions in Haematology Patients

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Background:
The electromechanical pump offers a well controlled infusion rate, accurate volume measurement and an alarm system for monitoring infusions while the gravity flow method has the advantage of less mechanical damaging effect on transfused platelets. Although both methods are well recognised and considered as a standard treatment, there is little data available regarding a randomised comparative trial between the two methods.

The aim of this study is to evaluate whether the infusion method influences the quantity of platelets transfused and to determine the most efficient procedure for the administration of platelets either via electromechanical pump or through the gravity method.

Patients and Methods:
At a single institution in the Haematology ward, we assessed 182 episodes of platelet transfusions between 2007 and 2010 and were randomised between the two transfusion methods; gravity versus Gemini PC-1, Graseby 300 and Baxter colleague electromechanical pumps. The main outcome was measured by platelet count prior to transfusion and platelet count increment after 60 min of completion of transfusion as well as 24 hours post platelet transfusion recovery.

Patients with factors that may influence platelet recovery were excluded. These include: presence of infection, disseminated intravascular coagulopathy (DIC), platelet and HLA antibodies as well as the occurrence of transfusion reactions.

Results and Conclusions:
Using a simple comparison of the change in platelet count from before the transfusion to one hour after transfusion there was a trend but not statistically significant yet showing that the Baxter Colleague method might be associated with the highest platelet increment among this cohort of patients. On the other hand, the other electronic pump methods appear to be similar to the gravity set. Further studies to confirm these findings are warranted.

Disclaimers: The authors state that there is no conflict of interest in relation to this research.

Audit Of Plasma Exchange In TTP-HUS In Christchurch, New Zealand

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New Zealand Blood Service

Introduction:
TTP & some HUS are overlapping disorders ('TTP-HUS'), in which plasma exchange (PEX) is indicated but optimal parameters are uncertain.

Aims:
To evaluate compliance with guidelines[1,2] and the effect of diagnosis & PEX parameters on outcome.

Methods:
Chart review of TTP-HUS patients with >1 PEX between 2000 - 2009.

Results:

Patients: 19

Diagnosis: 'TTP', 9/19; 'HUS', 7/19; uncertain, 3/19

PEX number: range, 2 - 17; <5, 6/19; 5 - 10, 9/19; > 10, 4/19

PEX frequency: range, daily - once every 3.7 days; daily, 9/19; once in 1 - 2 days, 8/19; less than once in 2 days, 2/19

PEX volume: range, 28.8 - 64.8 mL / kg body weight; ≤40 mL / kg, 7/19; >40 - 50 mL / kg, 7/19; >50 mL / kg, 5/19

Replacement fluid: FFP, 5/19; cryosupernatant, 6/19; FFP & cryosupernatant, 8/19

Complete remission (normal platelets, LDH & neurological status & rising Hb):

- in 9/19 overall (partial / no remission, 10/19)
- in 5/9 with 'TTP'; 4/7 with 'HUS'; 0/3 with uncertain diagnoses
- in 3/4 with >10 PEX; 5/9 with 5 - 10 PEX; 1/6 with <5 PEX
- in 2/8 with daily PEX; 5/8 with PEX every 1 - 2 days; 2/2 with PEX less frequently than once every 2 days
- in 5/7 at ≤40 mL / kg; 3/7 at > 40 but ≤50 mL / kg; 1/5 at >50 mL / kg
- in 2/5 using exclusively FFP; 4/6 using exclusively cryosupernatant; 3/8 using FFP & cryosupernatant.

In 7/19 PEX complied with guidelines[1,2] regarding frequency, volume & replacement fluid.

Conclusions:
Outcomes were generally poor but better with HUS, greater PEX number, lower PEX volume & cryosupernatant alone as replacement fluid. PEX frequency appeared not to influence outcome.

References:

1. Szczepiorkowski, et al. J Clin Apher 2007; 22: 106 – 75
2. British Committee for Standards in Haematology. British Journal of Haematology, 2003; 120: 556-573

Positive DAT Reactions With Negative Eluates In Transfused Patients

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Background:
239 reactions to RBC transfusions, reported to NZBS Haemovigilance and investigated serologically between 2008 and 2009, had a positive direct antiglobulin test (DAT) – 218, pre- & post-transfusion; 13, pre-transfusion only; 8, post- transfusion only. In 85%, 31% & 25% of these respectively, and in 77% overall, eluates tested negative.

Aim:
To determine if positive DAT with negative eluates are explainable by antibody loss, pre-elution, during washing.

Methods:
D-positive RBC were sensitized - 15 with commercial anti-D (to give a range of DAT strengths), 5 with anti-D from antenatal samples. Two RBC samples each that were single or double dose *Fya*- or *Jka*-positive were sensitised with commercial anti-Fya or -Jka. Commercial antibodies were from Lorne Laboratories, Reading, UK. Post-sensitization DAT was checked using monospecific anti-IgG. Elution, following 4 washes, using Gamma EluKit II (Gamma Biologicals, Houston, TX, USA), was performed on sensitized RBC. Wash supernatants and eluates were antibody-screened using reagent RBC (Ortho Clinical Diagnostics, Raritan, NJ). In other experiments elutions and screening were done after sensitizing 2 RBC samples each with one of 3 combinations of 2 antibodies (anti-D & -Jka, anti-D & -Fya or anti-Jka & -Fya) and with 5 patient-derived DAT-positive RBC.

Results:
Check DAT was positive in all sensitized RBC. This stayed positive after each pre-elution wash. Supernatants were negative, but eluates positive, on antibody screening. Similar results were obtained with RBC sensitized with 2 antibodies and with the patient samples.

Conclusions:
Washing did not remove antibody from sensitized RBC regardless of antigen, dose, whether sensitised with one / two antibodies, DAT strength or derivation. Negative screens on eluates from patients with positive DAT are likely due to hypergammaglobulinemia, drug-induced antibodies or, less likely, anti-A/B from ABO-incompatible plasma-containing components.

Fetal and Neonatal Alloimmune Thrombocytopenia Management (FNAIT): Case Report on Four Siblings.

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Fetal and neonatal alloimmune thrombocytopenia (FNAIT) occurs when fetal platelets expressing paternally inherited antigens are destroyed by maternal alloantibodies. It commonly affects the first pregnancy with an estimated recurrence of >80% in subsequent pregnancies. In the absence of randomised controlled trials, management of unexpected cases and antenatal care for at-risk pregnancies pose great challenges for clinicians. We describe, to our knowledge, the first reported case in New Zealand of FNAIT affecting four siblings and the differing strategies employed to manage the cases. Thrombocytopenic twins were delivered in the first pregnancy and they were each transfused with a unit of random donor platelets. Investigations confirmed a positive HPA-1a paternal phenotype and a negative HPA-1a maternal phenotype with anti-HPA-1a alloantibodies detected in maternal plasma. The third sibling born in the second pregnancy, suffered severe thrombocytopenia and was treated with intravenous immunoglobulin (IVIg) only. The last sibling born in the third pregnancy was also severely thrombocytopenic and was treated with random donor platelets coupled with IVIg. No antenatal therapy was instituted during the second and third pregnancies. Conclusion: This report supports the need for a standardised protocol, based on current knowledge, to manage both unexpected FNAIT cases and antenatal therapy for at-risk pregnancies.

Oxygen of Transport Through Blood Bags During Platelet Production

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Australian Red Cross Blood Service

Introduction:
Modern platelet storage containers are made of plastics which are gas permeable. Oxygen transmission is dependant on the plastics, the surface area of the bag and standard conditions of temperature and pressure. Platelet oxygen demands are dependant on the number and concentration of platelets and platelet metabolic state. The theoretical oxygen transmission values were compared to values calculated from the actual storage conditions and processing times.

Method:
The production process for pooled and apheresis platelets was outlined in a flow chart and then followed. The time taken and uncovered surface area of the bags at each stage were recorded. Using the oxygen permeability of each bag type, the maximum theoretical values and calculated maximum possible values, based on the uncovered surface area, were calculated. Platelet oxygen demands were calculated from reference values (321µM/hr/10^{12} platelets[1]) and collated blood component data from 2009.

Results:
Maximum oxygen transport through the plastics during donation, processing and transport was 91% and 92% of the oxygen requirements of the platelets for pooled and single apheresis platelets respectively. At storage 60-70% of the bag surface area was available for oxygen transmission. During transportation available surface area and oxygen transport was effectively zero.

Conclusion:
The oxygen transport through the plastics did not meet the oxygen demands of the platelets at all stages of production. The surface area available for gas transport was found to vary significantly at different stages of the production process. It is not known what functional effect this has on the platelets as routine quality control tests do not measure platelet viability but research by manufacturers and Blood Services confirms the functional viability of platelet components. The study has identified critical points in the process where improvements will be implemented.

1. Dumont LJ, VandenBroeke T. Seven-day storage of apheresis platelets: report of an in vitro study. Transfusion (2003) 43:143-150.

Prospective Audit of Cryoprecipitate Use at Prince of Wales Hospital: Monitoring demand and the impact of the Massive Transfusion Protocol

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Aim:

(i) To determine the indications used for justification of cryoprecipitate transfusions

(ii) To assess cryoprecipitate usage related to activation of the hospital's massive transfusion protocol (MTP).

Methods:
Consecutive orders for cryoprecipitate were audited during the period 15 February until 4 April 2010. On receipt of each cryoprecipitate order the laboratory staff completed a survey questionnaire. Data was tabulated and compared against a previous audit.

Results:
During the audit period a total of 16 doses of cryoprecipitate were provided to 12 patients. Cardiac ICU, NICU and general ICU together accounted for 7/16 issues, operating theatres 5/16 doses, with the remaining 4 doses given for patients with DIC.

Half of the doses went to actively bleeding patients, with massive bleeding noted for 5 orders; 3 patients recorded as having massive bleeding not on the MTP.

Fibrinogen <1.0g/L was recorded in 6/16 orders and the MTP activated on two occasions. In this cohort no concurrent rVIIa use was recorded by the laboratory staff.

Conclusion:
Transfusion of cryoprecipitate commonly occurs without either determining a fibrinogen level or when the fibrinogen is >1g/L.

Audit against NHMRC guidelines found less inappropriate use than a previous audit though inclusion of a single patient with afibrinogenemia does contribute to this finding. The majority of cryoprecipitate use is associated with fibrinogen levels above the NHMRC guideline of 1.0g/l and not part of a MTP.

The current use of cryoprecipitate in clinical practice appears more closely aligned with the recent draft Critical Bleeding/Massive Transfusion Module of the NBA Patient Blood Management Guidelines than with the existing NHMRC guidelines.

The standard for appropriateness of cryoprecipitate transfusion is currently under review and the Blood Service will continue to investigate the optimal use of products in an environment of increasing demand.

"No conflict of interest to disclose"

Improving Transfusion Safety: The Checklist

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Background:
Between April and May 2008 Waitemata District Health Board (WDHB) participated in a multi-region Transfusion Practice Audit. The aim of which was to determine the level of adherence to the Australia New Zealand Society for Blood Transfusion (ANZSBT) guidelines with the administration of red blood cells at patients bedsides. The key findings of this audit indicated that WDHB was failing to meet all of the bare essential safety checks 41% of the time. These results highlighted a clear and present danger to the safety of patients requiring transfusion.

Method:
A change management project was commenced utilising the principles of Lean and Sigma, tools which are being used on an increasing basis within healthcare organisation's to improve productivity and reduce wastage. A transfusion checklist incorporating the required transfusion documentation was developed. The introduction of a checklist has been found to significantly reduce errors in clinical and non clinical settings. The principles of Lean and process of Sigma were utilised to define, measure, analyse, improve and control the process of implementation of the transfusion checklist.

Results:
The transfusion checklist was introduced alongside a programme of education. A re-audit was commenced 18 months following the introduction of the transfusion checklist. The re-audit showed an overall improvement of 42% (59% to 82%, p0.0001) when checking the bare essential safety checks. Improvements were also seen across all areas of bedside transfusion practice, including, preparation, monitoring and documentation.

Conclusion:
Patient safety at WDHB has been significantly improved following the introduction of a transfusion checklist. Lean and Sigma methodologies were used successfully as a change management tool, providing a framework, to develop and implement a transfusion checklist.

Review of Intravenous Immunoglobulin (IVIG) Dosing Within a Haematology Unit: Comparing 3 Strategies to Reduce Usage

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Aim:
To determine the potential effects on intravenous immunoglobulin (IVIG) usage from three dose reduction strategies.

Methods:
Patients receiving IVIG in January and February 2010 were identified and data extracted: Current approved dose from the Blood Service STARS Database; patient's weight from ARIA electronic medical record, IgG and paraprotein levels from AUSLAB pathology system.

Current IVIG dose was revised if;

1. patient's weight had reduced,
2. measured IgG level was > 9 g/L not due to paraprotein,
3. the dose would be lower based on lean bodyweight.

With revised doses calculated the potential reductions in IVIG usage were compared.

Results:
In 2 months 55 patients received 97 IVIG infusions, 49 patients for immune replacement therapy (92.8% of treatments) and 6 patients for immunomodulation (ITP 4, Factor VIII inhibitor 1 and CIDP 1) : Total IVIG usage 3 418.5g.

(1) Body Weight: Patient weight reduced in 8 cases, revised doses 3-10g lower (average 4.625g), decreased total IVIG usage 148g.

(2) IgG Levels: In 12 patients on immune replacement with Ig $\geq$ 9g/L not due to paraprotein lower doses by 3 - 6 g/ month, reduced IVIG usage 72g to 144g.

(3) Lean bodyweight: For 23 patients with Body Mass Index (BMI) >25 lean bodyweight dosing was up to 36g/ treatment (av 12.57g) less and reduced IVIG usage 289g.

Of 3 dose reduction strategies "IVIG lean bodyweight dosing" had greatest impact. BMI > 25 did not appear to correlate with higher IgG levels, 7 patients with BMI <25 had IgG > 9 g/L.

Conclusion:
Correlating available electronic data highlighted potential IVIG dose reductions. The most effective of the approaches was dose modification based on lean body weight. Lean body weight dosing provided reduction in IVIG usage equivalent to 8% of current use (1 734 g IVI). Dose reductions were also possible at BMI <25 for IgG levels > 9.

"No conflict of interest to disclose"

Blood Matters - Hospital Based Audit Program of Transfusion Practice

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Background:
The Blood Matters program is an initiative of the Department of Health, Victoria and the Australian Red Cross Blood Service that aims to improve outcomes for patients requiring blood product transfusion, by enhancing the safety and appropriateness of blood and blood product use. Clinical practice guidelines for the appropriate use of blood are currently under review.

Aims:
To describe audit methodology used in assessing appropriate transfusion practice and highlighting the data gained from 8 audits over a period of 4 years.

Methods:
In excess of 25 hospitals conducted retrospective medical record audits. Participating hospitals were asked to complete 30 consecutive transfusion episodes related to a specific component using a one page data collection form or consider a questionnaire related to institution policy and procedure over a period of months. Audits have now been repeated providing longitudinal data.

Results:
Audits undertaken include red cell use in orthopaedic surgery, platelet, FFP and cryoprecipitate use and appropriateness, as well as adherence and documentation of hospital transfusion policy and procedures. Many results show a high variability of adherence to current usage guidelines or local policy. Reports are provided to individual institutions annotating a summary of their results together with de-identified results from other hospitals. The audit data collection forms and assessment algorithms are available to hospitals to utilise for ongoing audit.

Conclusion:
Findings of these audits can detect inappropriate transfusion practice and/or that the current guidelines in this area of transfusion need review. Our findings demonstrate that there are possible intervention opportunities to enhance safe and equitable practice. These data assist in individual institutional benchmarking and provide a focus for practise improvement as well as objective measures for monitoring change. Assessing current patterns of use, emerging trends can be assessed that can inform guideline review and may help direct future research effort.

Tn Activation in Acute Myeloid Leukaemia

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Polyagglutination refers to the agglutination of red cells by most samples of normal human sera but not by the patient's own serum. This is most commonly due to the action of bacterial enzymes, revealing antigenic structures on the red cell membrane which are normally hidden. A less common cause of polyagglutination is a somatic mutation causing the production of red cells which lack an enzyme required for the formation of normal red cell antigens. This results in the exposure of the Tn antigen. We report the case of a 64-year-old man with acute myeloid leukaemia who had a peripheral blood blast count of 199 × 10^9/L and symptoms of the hyperviscosity syndrome at presentation. A discrepancy was found on initial ABO typing. Testing with a lectin panel revealed that the patient's red cells were Tn activated. Recognition of polyagglutination allows resolution of ABO typing discrepancies and the provision of appropriate blood products to these patients.

Aligning Supply with Demand

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Australian Red Cross Blood Service

Introduction:
Ensuring sufficient red cell inventory holdings by blood group is challenging for Blood Services. At the Blood Service the Supply Chain Team has initiated a project to assist employees with their decision making to ensure that the mix of red cell component blood groups was appropriate and improved the likelihood of meeting patient demand and reducing losses across the fresh product Supply Chain.

Method:
Issues to hospitals and pathology laboratories were used in standard safety stock calculations to derive the minimum stock holdings necessary, per distribution point to ensure 95% of deliveries in full and on time. Using 6 standard deviations from this minimum point to arrive at a maximum stock holding, an inventory sufficiency band was determined for each blood group at each distribution depot. The variation in stock levels by blood groups was analysed for two 2-month periods; immediately after project initiation (March/April) and the following 2-months (May/June).

Results:
The standard deviation in stock levels of Group O and A Rh Pos/Neg reduced from the first analysis period to the second. These changes were significant ($p<0.005$). For example the SD for stock levels of O Positive red cells reduced from 1.22 to 0.62. The improvement was also observed in a reduction in the variation of stockholding (by days cover) between blood groups.

Conclusion:
The ARCBS has implemented strategies to improve red cell stock holding by blood group. These include the use of a preferred inventory holding chart and closer liaison between the demand and supply chains. A donor relationship management tool and a funded project aligning supply with demand will increase the capacity for managing stock levels by blood group.

The Role of Registries in Evidence-Based Medicine

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Evidence based medicine aims to apply consistent principles of properly evaluated scientific evidence to decision making in clinical settings. Various hierarchies for the evaluation of evidence have been proposed which rate the randomized controlled trial (RCT), within the highest levels of evidence.

However, not all questions can be answered by the use of RCTs. Situations where populations are small or highly variable, or where ethics do not allow for randomisation, demand alternative approaches to obtain reliable evidence.

A clinical registry is a register of patients in a particular clinical setting, recording treatment and outcomes of all patients within the population involved and collecting information on variables that facilitate risk adjustment.

Our department has extensive experience with a number of clinical registries, including several related to transfusion medicine. Notable amongst these are the Haemostasis Registry, the TTP Registry, the NAIT Registry, the Australasian Society for Cardiothoracic Surgery Database and the Victorian State Trauma Registry. New registries in development include the Massive Transfusion Registry and the Venous Thromboembolism Cohort Study.

The Haemostasis Registry which collected data on the off-license use of rFVIIa is a good example of a clinical registry that has grown in importance due to the absence of RCT evidence and recent unsuccessful attempt to conduct a large scale multicentre trial to answer questions on patient safety and efficacy. The Haemostasis Registry is the largest dataset of rFVIIa cases to date and has translated into several key publications including an investigation on the safety[1] and dosing[2] of rFVIIa in cardiac surgery.

Although registries cannot, and do not attempt to, take the place of RCTs, they play an important part in the provision of high quality data, where RCTs are not feasible, to monitor the impact of interventions across the whole patient population, and to provide important baseline information that can generate hypotheses or enable the planning of future randomized studies.

[1] Mitra B *et al.* Anaesth Intensive Care 2010

[2] Willis C *et al.* Vox Sanguinis 2010

Deriving the Residual Risk of Viral Infection to Fresh Component Transfusion Recipients in New Zealand

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Background:
The long-term complication of viral infection is widely acknowledged and has been a major problem in the past. Despite no reported transmissions of HIV or HCV in New Zealand since testing was introduced in 1986 and 1992 respectively, these two viruses remain of particular concern to recipients.

NZBS currently uses serological and nucleic acid tests for Hepatitis B (HBV), Hepatitis C (HCV), and Human Immunodeficiency Virus (HIV). Human T-cell Lymphotropic Virus (HTLV) 1&2 is tested for serologically only.

Aim:
To calculate the residual risk per donation of HCV, HBV, HIV and HTLV 1&2 infection from fresh component transfusion.

Method:
Eight years' donation data was extracted from NZBS's data warehouse for HIV and HCV and three years for HBV and HTLV 1&2. Annual donor epidemiology reports were utilised for numbers of infections. The Incidence Window Period and Dax models were used to derive the residual risk for repeat and first time blood donors respectively. Window periods used in the calculations were: HBV, 38 days; HCV, 7.4 days; HIV, 9 days; HTLV, 51 days. HTLV1&2 risk was calculated using only the Dax model as New Zealand donors are only tested on their initial donation. Test performance and wrong blood in tube errors were not considered.

Results:
1,307,764 donations from repeat donors and 105,726 from first time donors were analysed. The residual risk estimates were HBV:3.4, HCV:0.4, HIV:0.2, HTLV:0.4 per million donations.

Conclusion:
The residual risks derived confirm the risk of these viral infections from transfusion is small and comparable with other published results. The models assume window period donations represent the dominant source of risk. This is likely for HIV and HCV but is not likely for Hepatitis B where occult infection is, in our clinical experience, the more likely cause and not reflected in these calculations.

The Effect of a “Zero Tolerance” Policy and Educational Intervention on Sample Collection Errors in Blood Transfusion Practice.

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Introduction:
Our laboratory complies with NPAAC (National Pathology Accreditation Advisory Council) guidelines for the rejection of non-conforming pre-transfusion samples. However we allow limited corrections if a disclaimer is signed by the collector. Following a rise in the incidence of errors, our Transfusion Committee initiated a "zero tolerance" policy of mandatory recollection of all non-compliant samples, together with educational intervention. The effect of these changes on compliance and the incidence of major errors were analysed.

Method:
Compliance of pre-transfusion samples and request forms with NPACC guidelines were audited for 8 weeks prospectively (Cycle 1) and for 2 weeks retrospectively (pre-audit phase). After feedback of results to key stakeholders, a “zero tolerance” policy was agreed to and implemented, together with educational intervention including, but not limited to memoranda, counselling and in-house training directed towards medical and nursing staff. Educational interventions were repeated after a cluster of "wrong blood in tube" (WBIT) incidents This period was audited retrospectively in Cycle 2 (4 weeks), followed by the final re-audit, Cycle 3 (4 weeks), completed 12 months post-implementation. Events audited were defined as follows: (1) Non-compliance errors: collector's declaration unsigned, addressograph label used on tube (2) Mislabelling errors: patient identification details on sample or request form incorrect, incomplete or missing, including WBIT errors (3) Disclaimers: corrections allowed after disclaimer signed. Error source (location) was recorded.

Results:
5,962 samples were analysed. The incidence of corrections using a disclaimer was reduced from 2.5% (n=561) in the pre-audit phase to 0% in Cycle 2 (n=1,384) and Cycle 3 (n=1,422). Non-compliance errors were reduced from 5.0% (n=561) pre-audit to 2.0% (n=1,422) in Cycle 3. However, the incidence of mislabelling errors increased from 0.36% (n=561) pre-audit to 0.50% in Cycle 1 (n=2,565) and 0.49% Cycle 3 in (n=1,422), with a further increase to 0.94% (n=1,384) in cycle 2 (including two WBIT errors).

Conclusion:
Our data suggests that a "zero tolerance" policy together with educational intervention can reduce the incidence of non-compliance. However the incidence of mislabelling errors was not reduced. Possible reasons for this and future directions are discussed.

Challenging the Customer Service Paradigm – An Overview of the Australian Red Cross Blood Service's new 'Customer Engagement Strategy'

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Australian Red Cross Blood Service

Aim:
The Australian Red Cross Blood Service has identified the strategic objectives of: (i) improving customer service, (ii) providing value for stakeholders, and (iii) increasing organisational capability, and is committed to proactively engaging customers and other key stakeholders.

Method:
In 2007, the Blood Service initiated the Re-engineering our Supply and Service (RoSS) Program, to coordinate projects focussed on enhancing customer service provided by the 'Inventory and Distribution' (I&D) function to transfusion laboratories.

One of the four main work-areas of the RoSS Program is to review and improve customer engagement activities. This activity is managed by the Customer Engagement Team (CET), with national, cross-functional representation from Transfusion Medicine Services, I&D, Communications, Supply Chain and Operations.

To inform the process of customer engagement and development of new strategies in this area, the CET reviewed feedback provided to the Blood Service through a number of channels, including targeted interviews, the annual customer satisfaction survey, general customer feedback and focus group meetings.

Results:
Initiatives and improvements undertaken by CET include:

- Customer engagement strategy: development of a plan for more comprehensive engagement with customers.
- Customer service charter: outlining key commitments to customers.
- Product and service offer: detailing products and services available to customers.
- Customer service pack: a range of reports and performance measures relating to service delivery.
- Improved annual customer satisfaction survey for 2010
- National inventory template (version 2): a twice-daily inventory statement detailing available stock and product restrictions.

Other initiatives in development include a national customer feedback system and additional customer service training for staff.

Summary:
The Blood Service, through RoSS, is committed to meeting the needs of customers and in particular improving our customer service. The CET supports the strategies and activities in place to achieve this by 2012.

No conflict of interest to disclose

Four Years On. Trials and Tribulations Post the Introduction of Hand-labelling to a Tertiary Hospital.

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New Zealand Blood Service

During April and May 2006 the practice of hand-labelling pre-transfusion specimens was introduced to Dunedin Hospital to improve and enhance patient safety. The introduction included a six-week education and change management campaign “Think Pink, Think Hand-Labelling” for clinical staff, which incorporated correct patient identification practices and label at the bedside themes.

By 2007 the practice had embedded well into the hospital, the local error rate started to decline, the topic of “think pink” was firmly established and no documented wrong blood in tube (WBITs) occurred during that year. During 2008 however four WBITs were detected despite the practice change.

In response to the rising WBIT rate Shewhart’s model of “Plan-Do-Check-Act” (PDCA Cycle) was employed, with the hope of moving from “problem faced” to “problem solved”.

The application of the PDCA cycle highlighted that to achieve and affect a positive change, in practice, on-going and variable approaches to the problem are beneficial. The PDCA cycle also reinforces the need for frequent review of practice; no “magic wand” exists, humans by their very nature make mistakes. An important lesson learned however was that many of the measures introduced were very simple in concept or design.

Subsequent to the application of the PDCA Cycle the hospital has been WBIT-free for an 18 month period. The multiple strategies employed using PDCA appear to have contributed to this result. Although the problem of WBIT may not be permanently classified as “problem solved”, we hope to minimize occurrence on a day-to-day basis.

Profiling Clinical Plasma Usage to Inform Supply and Contingency Planning: Final Results from Puppy, the Prospective Utilisation of Platelets and Plasma Study

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Background:
Few national or international data exist regarding urgency of need or clinical use of plasma transfusions.

Aim:
To determine clinical utilisation and urgency of Fresh Frozen Plasma (FFP) requirements, to inform supply & contingency planning.

Methods:
Random sample survey adapted from the Bloodhound red cell utilisation study. FFP units (n=1885) were tagged with a case report form (CRF) at production and distributed to Victorian transfusion laboratories, with CRFs completed by the laboratory scientist at time of issue for transfusion.

Results:
Of 1808 (95.9%) CRFs returned; 1587 units (87.8%) were issued for transfusion, 48 (2.7%) expired, 170 (9.4%) other (discarded [breakage or thawed not used]) & 3 (0.2%) recalled. Major clinical requirements for FFP were cardiothoracic surgery (n=249,15.7%); gastroenterology (285, 17.7%); solid organ transplant, including plasma exchange for renal transplant (187, 11.7%); haematology/oncology (234, 14.6%) and trauma (104, 6.5%). In 889 cases (49.2%) FFP was used to support interventional procedures; of these, 168 (18.9%) were elective & 404 (45.4%) non-elective; for 317 (35.7%) urgency was unknown to laboratory. Clinical urgency of transfusion was acute (required <1h) in 563 (35.5%); urgent (1-24h) in 851 (53.6%); semi-urgent (24h-1 week) in 83 (5.2%) and non-urgent (>1 week) in 14 (0.9%). In 76 (4.8%) urgency was not known.

Conclusions:
The final Puppy results demonstrate that 89% of FFP transfusions are required acutely (<1h) or urgently (within 24h), with most use to support complex medical and surgical interventions. Many would be deferable only temporarily during a major blood shortage. FFP use for many of these indications may be anticipated to increase in the future. Linking an understanding of plasma utilisation with demographic, epidemiological and clinical trends allows further refinement of supply planning to help ensure clinical availability, including contingency planning for possible blood shortages during emergencies.

No conflict of interest to disclose

Prenatal Rhesus D Detection and Gender Determination Using Cell Free Fetal DNA in Maternal Circulation.

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The presence of cell free fetal DNA (CFF DNA) in the maternal circulation was first reported by Dennis Lo and colleagues in 1997. It has since become an important target for prenatal genetic diagnostics, avoiding invasive amniocentesis or chorionic villus sampling and the associated risk of miscarriage. Detection of a paternally inherited Rhesus D (RhD) gene was among the first reported uses and is now routinely implemented in the UK and Europe. Its prime benefit is identification of pregnancies at risk of Haemolytic Disease of the Fetus and Newborn (HDFN). Gender determination using Y chromosome PCR targets is useful both to confirm the presence of fetal DNA and determine inheritance risk in sex-linked genetic disorders.

Twelve millilitres of EDTA blood was collected from 29 RhD negative pregnant women ranging from 10-19 weeks gestation, with a median of 12 weeks. DNA was extracted from 2mL plasma using the Qiagen QIAamp Circulating Nucleic Acid (CNA) kit. Six Taqman PCR assays were performed for exons 4, 5, and 7 of the RhD gene, the SRY gene for gender determination, and the RASSF1A and B-actin genes to confirm the presence of fetal DNA.

The baby's gender was available in 29 of 29 cases (15 male, 14 female) and blood group in 26 of 29 cases (14 RhD positive, 12 RhD negative). RhD and gender genotypes were performed blinded to phenotype and were 100% concordant. Fetal DNA was detectable in all samples by RASSF1A PCR. The QIAamp CNA kit showed a greater than 5 fold recovery of fetal DNA than a modified QIAamp blood DNA mini kit protocol, even accounting for a 2.5x higher starting volume.

Prenatal RhD status and gender determination was 100% accurate using our method. The technique is relatively expensive and labour intensive but will be a useful tool for identifying high-risk pregnancies.

Seroprevalence of West Nile Virus in NZ blood donors

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West Nile Virus (WNV) is a mosquito-borne flavivirus that is transmitted primarily among birds; humans serve as incidental hosts. Other modes of transmission include blood transfusion, organ transplantation, transplacental transfer and breast-feeding. Most WNV infections are asymptomatic or produce an undifferentiated febrile illness.

There have been no cases of WNV disease in New Zealand (NZ). During 2002 WNV emerged as a significant transfusion transmitted infection in the United States (US) and Canada and national blood donor screening using nucleic acid tests (NAT) was initiated in 2003 to ensure transfusion safety. In 2003 the New Zealand Blood Service (NZBS) introduced a travel based risk reduction strategy whereby donations from donors who returned from North America within 6 weeks preceding donation should be used for fractionation purposes only.

We conducted a study of anti-WNV immunoglobulin (Ig)G seroprevalence among blood donors at the Wellington Blood Donor Centre. A total of 1208 donors participated in the study. Approximately half of the donors had travelled to a WNV endemic country within the past year. 25 samples were WNV IgG positive and sent to an Arbovirus Reference Laboratory for confirmatory testing. Four were confirmed to be positive for WNV only, 7 were confirmed to be positive for WNV and Dengue, 8 were positive for Dengue, 1 was positive for a flavivirus not otherwise specified and 4 were negative for WNV, Dengue or flavivirus. All 24 samples were negative for WNV IgM. The result for one sample is awaited.

Overall 0.9% of blood donors have been exposed to WNV in the past, with no evidence of recent infection. There appears to be a low risk of WNV entry through travelers from WNV endemic areas who donate blood in NZ. No additional procedures are necessary to reduce the risk of transfusion transmitted WNV in NZ.

True Auto-Antibody, a Mimic, a Blocking Antibody or an MDS Related Genetic Mutation: What Caused the Switch from an Rh(D) Positive to a Weak D Phenotype?

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New Zealand Blood Service

Abstract:
An 83 year old man with a seven year history of anaemia, requiring intermittent transfusion support, developed anti-C, anti-S, anti-Fya, anti-Jka and anti-Lua allo-antibodies. In addition, an autoantibody developed over time, refining into a clear anti-D pattern.

Three months after developing the auto-anti-D, he tested Rh(D) negative. Eight positive Rh(D) groupings (R2r) had been previously obtained over five years. Genotyping, using PCR of exons 4 and 7, detected the presence of one RHD gene. PCR also detected an E and a c gene, consistent with the patient's original phenotype.

Five months later the Rh(D) grouping remained negative with persistent anti-D but none of the previously identified allo-antibodies. Repeat Rh(D) investigations detected a weak D and a strongly reacting anti-D eluate with a titre of 4. This low titre excluded a blocking antibody as the cause of the change in Rh(D) phenotype. Anti-LW mimicking anti-D was excluded by DTT treating cells. Bone marrow aspirate and trephine were consistent with Myelodysplastic Syndrome (MDS) - Refractory Cytopenias with Multilineage Dysplasia.

Discussion:
This patient with MDS developed an auto-anti-D and subsequently altered his expression of the Rh(D) antigen from positive to weak. Genotyping demonstrated the Rh(D) gene. Genetic mutation/s related to his MDS may have included deletion, missense or newsense mutations causing changes in the transmembrane region of the RhD protein or the RHD/RHCE promoter region. Because determining the causative mutation would not have altered management, gene sequencing of the Rh(D) was not pursued.

Conclusion:
Both autoimmune disorders and red cell phenotype changes have previously been reported in the setting of MDS. This case is unique in the combination of an auto-anti-D and alteration in Rh(D) antigen expression.

Variant Reactions with Monoclonal Anti-N in Genotypically N-negative Gp.Mur (Mi.III) Positive Chinese & East Asian Donors

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The antigens of the MNS system are carried on sialic acid rich glycoproteins, glycophorin A, glycophorin B or named genetic hybrid glycophorins. Hybrid glycophorins initially named the “Miltenberger” series represent a complex subset in the MNS system. One of these, Gp.Mur, is a *GYP[B-A-B]* hybrid with a normally silent *GYPB* pseudo-exon expressed as exon III, a result of repair of a defective splice site by genetic exchange. Gp.Mur is significant in East Asia with the highest prevalence in indigenous Taiwanese tribes (frequency 21%-88%). The 'variant N' reactions of Gp.Mur have been known since the 1970s, typically Gp.Mur+ cells reacted with *Vicia graminea* lectin (VGL), were weakly positive with rabbit anti-N and negative with human anti-N. For several donors genotyped as MM but with Gp.Mur, the serological typing result with monoclonal anti-N was reported as MN. Reactions with monoclonal anti-N were 3+ and VGL 3+ to 4+. Examples of human anti-N were negative but following trypsin treatment weak agglutination (1+) of Gp.Mur pos RBC was observed. These donors were of East Asian ethnic origin (Philippines, China). The genotype was consistent with the Gp.Mur antigen profile (Mut+, Mur+, Mi.III MAb+, Hil+). In conclusion, altered N reactivity in donors with Gp.Mur (Mi.III) resulted in incorrect typing as MN. As VGL does not bind to MM cells, it is reasonable to infer that this typing is a result of a reaction with Gp.Mur. Increased surface expression of Gp.Mur, as well as the increased size of the extracellular structure of the hybrid glycophorin, may contribute to these reactions. This unusual presentation of an N-like antigen in Gp.Mur can be a source of error in MN serotyping. A full investigation or genotyping should be considered when these cells are to be used as a reference source in investigations. MNS typing with monoclonal anti-N typing reagents should include consideration of potential error when serotyping individuals from East Asian ethnic groups in which there is a high frequency of hybrid glycophorins such as Gp.Mur.

Red Cell Use In The Elderly Patients: A Review Of South Australian Public Hospitals

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Background and Objectives:
As a consequence of an ageing population and advanced medical care, the demand for red cells is expected to grow against a decreasing red cell donor pool. The objective of the study was to evaluate patient characteristics and blood use in elderly patients in South Australian public hospitals.

Methods:
A linked electronic database was developed for SA public hospitals using clinical, epidemiological and red cell transfusion data. Electronic data files provided information on clinical variables such as diagnosis related groups (DRGs), surgical and medical procedures (ICD-10-AM codes) including speciality related groups (SRGs) and major diagnostic categories (MDCs); as well as demographic variables such as age and gender; and red cell transfusion data.

Results:
Across a period of three financial years (2007-2009), 81,887 units of red cells were transfused in the elderly patients (≥65years), representing 57% of the total red cell used in public hospitals. Eighty four percent of the red cells were transfused into inpatient/overnight stay patient and 16 % of red cells were transfused into patients categorised as same day admissions. Overall, most of the red cells were transfused to patients with haemato-oncological diseases (28%), diseases of the digestive system (16%), diseases of the circulatory system (14%) and musculoskeletal disorders (11%). Diagnoses for anaemias, myeloproliferative diseases, lymphomas and neoplasm (digestive & respiratory) accounted for 89% of the red cells transfused in same day admissions.

Conclusion:
Blood use in the elderly population is mostly associated with medical diseases and disorders, confirming a trend towards the increasing use of red cells in medical diagnoses. This data signify the need for improvement initiatives in transfusion practices in haemato-oncology.

Comparison of 0.8% vs 3.0% Screening Cells for the Antibody Detection and Identification

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Background:
Antibody detection and identification in routine hospital transfusion laboratories requires methods that are both rapid and sensitive. With the introduction of automated column agglutination technology which facilitates high throughput, rapid processing, is sensitive, and this operator independent platform also improves consistency and reproducibility of results. The performance of both 0.8% and 3% red cell suspensions was compared in our study.

Method:
Samples tested utilised the AutoVue Innova® instrument, BioVue® Anti-IgG / C3d, polyspecific cards, Ortho BLISS® (LISS additive), 0.8% & 3.0% Abtect Cell III® screening cells and 0.8% & 3.0% Phenocell B extended panels (CSL Biotherapies – Immunohaematology®). Testing of patient plasma for antibody screen was performed within a 24 hour from time of collection, and antibody identification was performed within 5 days of collection. Some historical frozen plasma samples with known antibodies were also evaluated.

Results:
A total of 534 samples were tested in the period of evaluation. 513 samples were found to be negative in both 0.8% & 3.0% Abtect Cell III Screening cells. 23 samples were found to be antibody screen positive against 0.8% & 3.0% Abtect Cell III Screening cells and subsequently the antibody(ies) were identified utilising the 0.8% & 3% Phenocell Panel B. The strength of reactions (score) was in general stronger (higher score) with 0.8% cells. The specificity of the antibodies that showed a significant increase in reaction score were E, Jk^a & Fy^a.

The antibodies indentified from the 23 positive screens were of the following specificities:

Table: 1

Jka	E	Abun	D	D E	D C	E	E Fya	E c	c	Bg
2	1	1	1	1	8	3	2	2	1	1

Conclusions:
The evaluation of the 0.8% vs 3.0% CSL Abtect III screening cells and 0.8% vs 3.0% CSL Phenocell panel B on the AutoVue Innova® platform in our laboratory has shown increased sensitivity when using the 0.8% cell suspensions. This increase in the sensitivity of identification of many significant anti-red cell antibody specificities is relevant to our tertiary teaching hospital clinical setting.

Developing the Role of the Specialist Nurse to Advance Transfusion Practice Improvement: The Blood Matters Approach

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Blood Matters commenced in 2002 as an initiative of the Department of Health (formerly Human Services) and the Australian Red Cross Blood Service. It aims to improve the safety and appropriateness of use of blood components.

A central program element was the introduction of the specialist transfusion nurse (TN) role, with introduction of the concept, executive endorsement, training and peer support. After an initial pilot, the collaboration trained 13 TNs and recently, a transfusion trainer role was introduced to support rural and regional centres. In 2010 there is now an established specialist nurse in transfusion in 45 health services across Victoria.

An important part of developing the TN role has been the Graduate Certificate in Transfusion Practice. Established for local delivery in 2002, content was developed by local clinicians with support from the postgraduate nursing education unit at Peter MacCallum Cancer Centre. The curriculum & content has since been updated periodically, to include feedback from student evaluations and to review scope & content, with addition of new material as appropriate. It is now a fully-accredited qualification run entirely on-line through Melbourne University Consulting Custom Programs. During 2009-10 the course was substantially redeveloped with involvement of an expanded network of transfusion and other clinical experts nationally to author/review course content and materials. To date 76 students have successfully completed the course, with the majority of students from Victoria and additional national/international participants.

The TN role was formally evaluated in 2006. The review demonstrated “that delivering improved transfusion practice requires a coordinated, collaborative, inclusive approach, supported by senior hospital management and clinicians, facilitated by the right persons and informed by the collection and sharing of locally relevant performance data.’” Ongoing evaluation will monitor the impact of the role, and ensure relevance in transfusion improvement and patient blood management activities.

Information about the program, course and specialist nursing role, is available at http://www.health.vic.gov.au/bloodmatters

Identification of Rhesus DEL Genotype in Blood Donor: It's Implication in Transfusion Medicine

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Rhesus blood group system has great importance in transfusion medicine. It is encoded by two genes, *RHD* and *RHCE* which are located on chromosome 1.

Rhesus D phenotype is classified as negative or positive. In Asia Pacific region, the incidence of Rhesus negative was low. Study by Rapiaah et al(2006) showed 0.44% of Malay blood donor were Rh-negative. The molecular changes of *RHD* alleles in phenotypically negative individual could result in partial D, weak D, DEL or true D negative. Those with weak D or DEL are considered individual of rhesus positive. For a definitive rhesus classification, our aim was to identify Rhesus DEL genotype in our blood donors who were serologically phenotype as rhesus negative

Material and Method:
Total of 37 Malay blood donors who were identified as rhesus negative by serology were recruited. Two mls of blood were collected in EDTA bottle. DNA was extracted using commercial kit according to the manufacturer's protocol (GENE√ALL^{TM}). Then it was followed by PCR-SSP for both RHD genes and RHCE genes.

Results:
Of 37 rhesus negative donors, 24(64.9%) had total RHD gene deletion while 13 (35.1%) carried a minimal of one to eight exons of RHD gene. Most donors (23/24) who had total RHD gene deletion were also Rh ccee, but twelve donors (92.3%) that carried some RHD exons (defined as Rhesus DEL) were noted to have either Rh Ccee or CCee phenotypes.

Discussion:
Rhesus DEL genotype was highly prevalent among Malay blood donors. It is important to identify the subtype of Rhesus DEL in an area where rhesus negative donor was low. For the purpose of transfusion management, patients with rhesus DEL subtype will be able to receive blood from a rhesus positive donor.

Improving Transfusion Practice: Medical Intern Baseline Transfusion Knowledge

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Background:
In 2008-09 Western Health, surveyed their medical interns during orientation to determine baseline transfusion knowledge and how they rated this knowledge. Data demonstrated deficiencies in knowledge despite a majority attending undergraduate transfusion teaching with a correlation between a fair or poor rating of knowledge to incorrect answers to questions.

Purpose:
To ascertain if these findings were replicated across other Victorian metropolitan and regional health services; it also aimed to:

1. enable health services to target areas of transfusion medical education essential for all interns to safely practice, and

2. inform medical training programs whether the timing of transfusion education impacts on interns to safely and effectively manage the transfusion process.

Method:
The questionnaire was completed during orientation programs at participating health services. It included questions regarding venue and locality of medical training, availability of transfusion teaching and attendance. To rate current knowledge of the transfusion process, four basic transfusion questions were included. Contact with the interns during orientation programs was important to reduce access to resources that could provide correct answers to the survey. To ensure consistency of data entry and interpretation, individual health service results were entered in a purpose designed excel spreadsheet. Analysis was conducted by Western Health.

Results:
301 surveys were completed (67.8%) from 431 interns and 13 second year hospital medical officers that commenced at participating health services in 2010. During their medical training, 90% stated specific transfusion teaching was offered, mainly in year six, and 97% of respondents attended with 55% at a university and 42% at a health service. Initial results were replicated across other health services where knowledge was rated between fair or poor with incorrect answers.

Conclusion:
This survey demonstrated that despite an improved attendance at specific transfusion teaching in 2010, there remains a need for medical interns to acquire basic transfusion knowledge prior to commencement of work, so they can effectively and safely manage the transfusion process.

Sensitivity of ABO Test Methods – Insights gained from the use of Kodecytes in Australasian and New Zealand QAP Surveys

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Little concrete data exists on the intra- or inter-platform sensitivity of ABO grouping methods due partly to the fact that modern grouping approaches now largely rely on a combination of automation and the use of powerful monoclonal antibodies. Also, many proponents argue that such methods do not require a high level of sensitivity as the inability to detect subgroups has no undesirable clinical consequences. So why do we employ sophisticated automation and powerful monoclonal antibodies if so many would argue that it is not necessary ? What level of sensitivity is appropriate for ABO testing ? Is there any difference between different methodologies ?

In an attempt to produce data to help answer some of these questions kodecytes have been included in two Australasian and one New Zealand QAP survey over the past six years. Kodecytes (cells transformed with KODE™ technology) bearing A antigens were utilized to provide cells with a lower expression of the A antigen than would be commonly encountered and these were provided to laboratories who participated in QAP programs in Australasia and New Zealand. In 2004 the Royal College of Pathologists of Australasia Immunohaematology QAP sent samples to 717 laboratories and this survey was repeated in 2008 with 792 laboratories receiving samples. The New Zealand Blood Service employed similar cells in a 2007 NIQAP survey that was sent to 210 laboratories.

The reported results show remarkable variations in average reaction strength of Anti-A methods and reagents. This variation was not observed with Anti-B testing. Analysis of the data reported for Column Agglutination Technology grouping showed that some brands of cards have high analytical sensitivity while other brands appear to be significantly less sensitive than most other methods. In addition to this, grouping card types show wide variations in sensitivity and subsequent extra testing demonstrated significant batch to batch variation in some column systems. Testing showed this low sensitivity is due to low levels of monoclonal antibodies in some column system cards. The correlation between reported reactions and the resulting ABO group interpretation was examined for accuracy. This demonstrated a very high failure rate in many cases demonstrating the variability in analytical sensitivity of the available testing platforms and reagents.

Post Transfusion Information Cards

Thrift L

New Zealand Blood Service

Introduction:
Patients receiving transfusions in day units are discharged soon after completing the transfusion. They are typically not given guidance on management of any symptoms or reporting of transfusion reactions occurring after discharge.

MidCentral District Health Board (MDHB) supported post-transfusion information being given to the patients and the content of a credit card sized notice was agreed by MDHB and NZBS.

The Transitory Care Unit (TCU) was identified for a trial as most patients received their transfusions as day cases. Nursing staff were asked to issue the cards to all patients receiving transfusions.

Method:
One year later, card use was audited by sampling patients at the TCU over a two week period. 20 patients were approached with 100% participation. Transfusion reaction numbers were obtained from NZBS.

Results:
40% had not received the card. Of those that had, 80% kept it in their wallet, 20% lost it. 100% thought the card was a good idea. Some commented that they receive so many cards that it could get lost amongst others and that the print was small.

In 2009 the TCU transfused 1404 units of red cells and IntragamP with just one transfusion reaction reported. 4888 units of red cells and IntragamP were transfused in the rest of MDHB with 25 transfusion reactions. The difference in reaction reporting between TCU and the rest of MDHB is significant ($p=0.04$). No reports of reactions were made as a result of the card.

Conclusion:
Although the card has not resulted in any reports of reactions, the patients value its use with no appreciable workload for those receiving the calls. MidCentral District Health Board has opted to maintain the use of the card for patients receiving transfusions in the Transitory Care Unit.

Introduction of a Platelet Transfusion Worksheet to Encourage Compliance with Platelet Increment Testing Following Transfusion of HLA-Matched Platelets.

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Platelet support is essential for the prevention of spontaneous haemorrhage in severely thrombocytopenic patients. Failure to achieve satisfactory increments to transfusion of single donor ABO-matched platelets may be attributable to immune or non-immune mechanisms. In a patient with HLA-mediated immune platelet refractoriness the provision of HLA matched platelets may be of benefit.

The HLA matchmaker is a computer based algorithm used to determine structurally based HLA compatibility and to identify acceptable HLA mismatches for highly sensitized patients. The identification of suitable donors is greatly assisted if accurate increment levels are obtained following transfusion of any HLA-matched platelets. The **ARCBS Special Platelet Support Management Worksheet** was instituted in October 2009 at The Townsville Hospital (TTH) to mandate the practice of documenting platelet increments and to improve communication between the Red Cross and medical/laboratory staff at TTH.

The information supplied in this document cannot be obtained from any single source. The nursing staff has access to the platelet bag identification, the time the platelets are infused and the platelet increment which they then document on the worksheet. In the past a combination of discussions between red cross staff and laboratory staff accessing AUSLAB and medical staff accessing clinical notes would be collected over the telephone to collate the same information.

From October 2009 until June 2010, 5 patients at our centre were identified with HLA mediated platelet refractoriness. During this period a total of 168 platelet transfusions were given to these patients. Compliance with platelet incrementing was 79%. Prior to the implementation of the transfusion worksheet from January 2007 until September 2009, 4 patients with immune based platelet refractoriness were identified. A total of 230 platelet transfusions were given with only 18.7 % of these transfusions being followed by an increment.

Conclusions:
Objectively the **ARCBS Special Platelet Support Management Worksheet** has increased the checking of platelet increments. This information is essential for identification of appropriate donors. Additionally we have attempted to assess qualitatively the impact this document has had on staff efficiency and communication.

Molecular Characterization of the D - - Phenotype found in Two members of a New Zealand Family

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The molecular basis of the rare Rh D - - phenotype is heterogeneous, as several different backgrounds have been described. Anti-Hr_o (Rh17) was detected in the serum of a patient, DH, at routine pre-transfusion testing prior to plastic surgery. Immunisation was thought to have occurred through rbc transfusion for severe burns in childhood. DH's Rh phenotype is D - -, her red cells express D but no C, c, E or e antigens. Red cells of her sister (RH) have the same phenotype. Their parents are not known to be consanguineous. Red cells of their mother express D, C and e antigens and have an apparent R_1R_1 phenotype, while those of their father (and brother) express D, c, and e antigens and have the R_o phenotype.

Unlike in this family, most individuals with this rare phenotype are the offspring of consanguineous parents, hence it was decided to characterise their *RH* genes. Sequencing of RNA from the whole blood of all family members produced numerous spliceoforms making it impossible to determine the molecular background of this rare haplotype. To circumvent this problem, CD34+ cells were isolated from the whole blood of DH and RH and cultured in media containing IL-3, stem cell factor and EPO in order to obtain an erythroid cell lineage. mRNA was prepared from the cultured erythroblasts. *RHD* and *RHCE* cDNA was amplified by PCR and directly sequenced. Both sisters were found to have a normal *RHD* gene. However, sequencing of the *RHCE* gene of both showed that exons 6 – 9 were *RHD* derived. Completion of *RHCE* sequencing will show whether the rare Rh phenotype in these sisters is due to homozygous inheritance of an identical D - - haplotype from each parent or to heterozygousity for a dissimilar allelle giving rise to an identical D - - phenotype.

Documentation of Information Given for Transfusion: Implementation and beyond

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Introduction:
Informed consent for transfusion should ideally be obtained and documented prior to the transfusion being given. As part of the consent process a patient should be given a clear explanation of the potential risks, benefits and available alternatives to the transfusion. This requires a conversation between the prescribing medical officer and the patient. As a result the patient is made aware of:

- Reasons blood components may be required
- Risk versus benefits associated with receiving transfusion
- Potential side effects of transfusion, and
- Likely clinical outcome if the patient should refuse transfusion.

Aim:
To assess if the 'Documentation of Information given for Transfusion' section of the Blood Product Request Form (BPRF), had been completed by medical staff, indicating that "informed consent" has been obtained for patients receiving a transfusion.

Method:
'Documentation of Information given for Transfusion' was implemented at Peter Mac in August 2009. This process requires the medical officer to provide their signature on the BPRF, which confirms the patient has verbally been informed about transfusions. A retrospective audit during the first 12 weeks of implementation to determine compliance of medical staff completing the 'Documentation of Information given for Transfusion' section of this form. A further audit was conducted 7 months post implementation.

Results:
During the first 12 weeks of implementation, 1326 BPRFs were reviewed, 83% (1,103) had 'Documentation of Information given for Transfusion' completed, while 17% (223) were blank. Seven months post implementation, 1020 BPRFs were reviewed, 76% (773) had 'Documentation of Information given for Transfusion' completed, while 24% (247) were blank.

Conclusion:
The introduction of 'Documentation of Information given for Transfusion' for patients receiving transfusions, demonstrates that clinicians were documenting patients verbal consent and their discussion of the risks, benefits and alternatives to blood transfusions 80% of the time. The next phase involves determining patients knowledge and understanding of the information provided about transfusion.

No conflict of interest to disclose

Cryopreservation and Recovery of Red Cells for Therapeutic Use

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New Zealand Blood Service

Introduction:
In 2009 a year long study was carried out on two methods which were used for the cryopreservation of erythrocytes. The first method was the conventional Liquid Nitrogen at -196°C (LN2) storage (Low Glycerol Method), red cells are stored in a liquid nitrogen tank (liquid phase). The second method (which is being adapted world wide now) is the -80°C method, red cells are stored in an upright -80°C freezer (High Glycerol Method).

Method:
Six (6) units were stored and recovered for each method (LGM & HGM).

These study of the two methods concentrated on the following points:

- Final product result outcome
- Sterility
- Cost
- Processing Time
- Safety
- Unit Shelf Life

Results:
The result outcome for the final product of units done using HGM was far better than the results for units done using LGM. Both methods had matched processing time, however when it came down to cost, LGM had more expensive consumables than the HGM (this did not include equipment cost and other factors such as equipment maintenance). Both methods tested negative for bacterial growth after 5 days of incubation.

When comparing shelf life, units stored in LGM can only be stored can only be stored for 10 years, HGM on the other hand can have units stored in it for up to 37 years. However once the units have been thawed, they have a 24 hour expiry.

HGM has less hazardous risks than LGM thus it is safer.

Conclusion:
Overall HGM is proven as a better method for long term storage of red cell for therapeutic use.

Those points were compiled into a poster and into a project book.

Validation of Storage bags for Platelet Neonatal Apheresis - Leukocyte Depleted

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Objectives:
Evaluation of Terumo® Transfer bags, Fresenius Compoflex® quadruple bags and MacoPharma® quadruple bags for storing neonatal platelet apheresis(PLT APH).

Methods:
Eighteen plateletpheresis were selected to be split into PLT APH. They were stored in 3 different types of bags. The neonatal platelet apheresis were stored up to 7 days at 20-24°C with gentle agitation. Each PLT APH was tested for pH, platelet count, and lactate from day 0 to day 7.

Results:

1. pH vs Storage time in 3 type bags

The pH of PLT APH decreases during the storage in both the Terumo® transfer bags and Fresenius Compoflex quadruple bags. There results are statistically significant($P<0.05$) and shows a negative correlation between the pH and storage time($P<0.05$).

On the other hand, there was only a slight decrease in pH for the PLT APH stored in MacoPharma® quadruple bags over the 7 days. But this is not statistically significant (Kruskal-Wallis test $P=0.153$, $P>0.05$). The values of pH had no differences over the 7 days period. ($P>0.05$).

2. Platelets vs Storage time

The platelet count did not changed over time in all three types of bags. ($p>0.05$).

3. Lactate vs Storage Time

Lactate accumulated during storage in all 3 types of bags.

The lactate accumulated in the MacoPharma® quadruple bags is only one third of that in the Fresenius Compoflex® quadruple bags on the day 7.

Conclusion:
MacoPharma® quadruple bags were superior for storing neonatal platelet up to 5 days, than the Terumo bags and Fresenius Compoflex® quadruple bags

A Comparative Study of Semi-Automated Blood Processors

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Australian Red Cross Blood Service

Background:
The Blood Service processes blood from whole blood and apheresis collections to supply end users. It is considered essential to maintain up to date knowledge of available blood processing systems to assist with the development of future strategies and to make ongoing improvements in processing efficiency, whilst continuing to produce quality components for transfusion. Increased automation is one means to improve efficiency within the manufacturing process. Additionally, automation has the capacity to reduce component variation, thus delivering improved component quality. Two new semi-automated blood processing systems include the CompoMat G5 and MacoPressSmart. These devices offer improved features which may increase efficiency.

Aim:
This study aimed to evaluate two semi-automated blood processing systems for the separation of whole blood into red cell, plasma, buffy coat and platelet components.

Method:
Whole blood was collected from standard donations (n=28). After centrifugation, plasma and red cells were simultaneously extracted in a top and bottom bag system, with the residual buffy coat left in the original bag. Platelet concentrates were prepared by pooling four buffy coats with SSP+ (MacoPharma), followed by centrifugation and separation, via the top system (n=7). Two semi-automated blood processors (expressors) were evaluated: CompoMat G5 (Fresenius-Kabi), and MacoPressSmart (MacoPharma). Quality and functionality of blood components were assessed using *in vitro* assays.

Results:
Blood components produced on the CompoMat G5 and MacoPressSmart met standard blood banking parameters for total volume and cell counts. However, the total time of the whole blood separation was significantly reduced with the new expressors, therefore having the potential to improve efficiency. Red cell concentrates were tested on days 1, 7, 14, 21, 28, 35 and 42 of storage for haemoglobin, haematocrit, pH, glucose, lactate, blood gases, percentage haemolysis, ATP and 2,3-DPG. The results indicated that there was no significant difference in the components produced by the new processors in comparison to red cell concentrates produced by the current blood banking methods. Platelet concentrates were assayed on days 1, 5 and 7 of storage for platelet count, mean platelet volume, blood gases, glucose, lactate, pH, lactate dehydrogenase, hypotonic shock response, collagen and ADP-induced aggregation, cytokine production, viability, mitochondrial membrane polarisation and apoptosis. The results showed that platelets produced with the new processors were not significantly different to results observed in standard bank blood platelets on day 5.

Conclusion:
The CompoMat G5 and MacoPressSmart systems both improve manufacturing efficiency whilst maintaining the quality and functionality of blood components.

Can recipients of minor ABO mismatch bone marrow transplant acquire A or B antigens through transferase activity of recipient origin – further evidence?

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The A and B antigens of the ABO blood group system are expressed on glycoproteins and glycolipids and result from the interaction of 3 separate genetic loci - the *ABO* locus found on chromosome 9 and the *H* and *Se* loci on chromosome 19. The genes do not directly code for the antigen but rather for the production of specific glycosyltransferases that add sugar residues to a basic precursor substance in order to form the antigenic structures. These glycosyltransferases reside in the Golgi apparatus of cells in bone marrow, lung and gastric/gut mucosa, and sequentially add carbohydrate units to growing oligosaccharide chains on proteins and lipids. ABO antigens are widely distributed in human organs and the level of expression varies, with different reaction patterns detected for each tissue.

Wichmann et al (1996) reported a weak group A antigen detected on the red cells of a patient 3.5 years after a minor ABO mismatched bone marrow transplant. The donor was group O. The authors concluded that recipient transferase activity was possibly responsible for converting the H substance on O cells into A.

Over the past few years, we have had opportunity to study 3 patients who were genetically group A and who had received haemopoeitic stem cell transplant from a group O donor. The patients involved were between 2 and 10 years post transplant. Routine blood grouping in each of these patients returned weak reactions with anti-A and subsequent investigation showed that anti-A could be absorbed and eluted from the red cells. There was no routine evidence of persistent chimerism, graft failure or relapse in any patient. In each instance the finding was incidental with blood group performed for reasons not related to follow up of haematological disease.

The result observed with these 3 patients once more raises the question of whether recipient derived A transferase is responsible for the expression of the weak A antigen in these patients.

Overnight Transfusion. An audit in eight New Zealand Hospitals

Wright A [1], Charlewood R [2]

[1] New Zealand Blood Service and Canterbury District Health Board, [2] New Zealand Blood Service

Aim:

- To ascertain the rationale and the percentage of red cell units being administered between 20.00 and 08.00 hours at eight District Health Boards.

- To determine the need to offer guidelines to avoid the inappropriate administration of blood out of hours and recommendations to improve blood transfusion safety.

Method:
An audit was undertaken at the main hospital site of eight District Health Boards of all red cell units transfused between the hours of 20.00 and 08.00 hours over two instalments of a two week period. Issues to Emergency Departments, Intensive Care Units/High Dependency Units, Operating Theatres and Birthing Units/Delivery Suites were excluded as these units do not have the same fluctuations in staffing ratios and are expected to function at high intensity 24 hours a day. Data collected included the availability of blood out of hours, delays in issue or pre transfusion cross match. Clinical notes were searched for rationale for transfusion and correlated to pre determined categories (NHMRC 2001).

Results:
533 units were identified, 9% of all red cells issued during the audit periods. The proportion varied from 1-15% ($p<0.0001$). Where the first unit following a haemoglobin estimation was transfused after hours, the average interval between the pretransfusion haemoglobin level being taken and the first unit commencing was 8 hours 10 mins. Only 92 (17%) were discharged or transferred within 24 hours of the transfusion. The two blood banks that were not staffed at night had the lowest proportion of units transfused overnight. Although a subjective assessment by the auditing Transfusion Nurse Specialist, 42% of overnight transfusions were inappropriate.

Conclusion:
Although this audit has shown a decrease in overnight transfusion from 22% in a previous audit to 9% now, further room for improvement is evident.

Identifying Service Delivery Issues - The Australian Red Cross Blood Service Customer Satisfaction Survey 2009

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[1] Australian Red Cross Blood Service Adelaide, [2] Australian Red Cross Blood Service Melbourne

Background:
The Australian Red Cross Blood Service has conducted annual customer satisfaction surveys since 2005 to measure customer satisfaction.

The Blood Service, through the Re-engineering our Supply and Service (RoSS) program, utilises the survey results to drive and track service improvement initiatives.

Recent surveys have utilised an abbreviated version of the SERVQUAL[1] method to identify service 'gaps' (difference between perceived service and importance of that service).

Method:
An online survey was distributed to 315 laboratories nationally in August 2009. Responses were graded using a 10 point Likert scale. Mean scores were calculated for each response.

Data were analysed to show the average score for service received compared to the importance. This 'gap' was plotted on an action matrix with four quadrants. Gaps in quadrant 1 were targeted as service improvement areas.

Results :
Analysis of 120 (38%) returned surveys showed:

- **Overall satisfaction with the Blood Service**: 8.4/10.
- **Areas of greatest importance**: Safety of our blood products 9.6/10; Overall quality of our blood products 9.6/10; Ability of the Blood Service to meet your requirements 9.4/10.
- **Areas of greatest satisfaction**: Safety of our blood products 9.3/10; Overall quality of our blood products 9.0/10; The Blood Service's delivery drivers 8.8/10.
- **Areas of least satisfaction**: Your involvement in Blood Service decision making when it impacts on you 7.7/10; Satisfaction with time from placing an emergency order to its delivery 7.9/10; Suitability of the time of day routine orders are delivered 8.1/10

Conclusion:
The satisfaction survey is one of a set of tools being utilised by the RoSS program to measure and improve service delivery.

[1]SERVQUAL: A multiple-item scale for measuring consumer perceptions of service quality, Journal of Retailing, Spring 1988, pp. 12-40; A. Parasuraman, Valerie A. Zeithaml, and Leonard L. Berry