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Staffing Collection Services - are production and service compatible?

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In February 2002 the Australian Red Cross Blood Service (ARCBS) Donor Services Leadership Team undertook a research project aimed at developing a National model for effectively staffing collection services. Donor Services Managers constantly struggle to meet collection target demands whilst providing a sensitive, comfortable, relaxed experience for the voluntary donor, and address staff needs. Following an internal and external review of staffing model theory and practice, blood collection process analysis and monitoring was conducted in each Business Unit, establishing base line measures for benchmarking. Using a best practice framework, model components and variables were agreed and a model drafted for testing and re-definition. The project was conducted at a time when ARCBS was embarking on a significant change agenda, still adjusting from a state based and rather parochial culture to a National organisation with consistent, congruent operational approaches. Posing a number of challenges for the project, this environment provided considerable learnings about the impacts of culture on organisational change and the 'readiness' of an organisation to embrace it. This paper will present the project background, rationale and outcomes in the context of an organisation in transition and the eternal blood service dilemma of balancing production demands and the service expectations of the voluntary blood donor. Project recommendations which aim to address these contextual dilemmas will be discussed and focus of future work on organisational culture and its relation to productivity, standardisation of HR policies, model refinements and the value of benchmarking.

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Implementation of National Blood Management System in the Processing, Inventory and Distribution Department in ARCBS-SA

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Background: Adelaide was chosen as the pilot state for the introduction of a National Blood Management System for ARCBS. To enable a successful implementation to occur each department in ARCBS-SA was instructed to identify the gaps between their current system and the new system. Method: The initial undertaking was to determine the physical requirements for implementation in situ in Processing, Inventory and Distribution (PID). A gap analysis was then performed. Introduction of the new system required substantial revision to work flow, processes and procedures. Necessary changes to these parameters were then identified. Results: The laboratory required redesign to accommodate new equipment and altered workflow. This included provision for PCs, linked scales and Zebra printers, plus a paper free processing environment. Work flow analysis revealed that additional staff resources would be required to meet the changing work environment. Training was necessary not only in the new system but also in the altered processes necessary for successful implementation to occur. Conclusion: Implementation successfully occurred on the 26th May 2003. Within the limited space available in PID, changes to the processing environment were made which facilitated the new system. Significant benefits were found in improved process control for component quality.

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Today's Performance will be Bettered by Tomorrow's

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One of the key corporate objectives of the National Blood Service is to develop a sustainable and loyal donor base. Currently up to 7000 donors every week are removed from our database due to their reluctance to return to donate. In the late 2000, thirteen Donor Groups were established nation –wide to investigate what they liked and what they disliked about the donation process. The message was loud and clear – waiting times, queuing to queue, irritation at the number of personal identification checks and delays prior to being deferred. A major project was set up to re-engineer the donation process to satisfy these donor needs. We began by checking with all 113 Blood Collection Teams exactly what local practices were being followed. Back came 113 varying responses. A multidisciplinary group representing teams nation-wide was quickly put together and Process Redesign Consultants then worked with the group to radically remodel the Donation process with the aim of drastically reducing waiting times. A Cross-Functional Group supported the group providing clinical and operational expertise. Within 18 months an Implementation Plan was ready and a new team of 50 training officers was ready to launch the first National Training Programme for 2500 staff. Thousands of staff and donors have been involved in the consultation process. We are on target to complete our Implementation Plan by year-end 2003 but, already vast changes have been made and the donors are already enjoying a 30-minute Donation Experience in many parts of the country.

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GMP in Practice – a positive perspective

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Most stem cell laboratories exercise a high degree of control over laboratory processes, however the quality system required for compliance with Good Manufacturing Practice (GMP) is more stringent. Our laboratory has recently implemented GMP and has experienced the increased documentation and expenditure that this entails. The positive impact on patient safety is desirable, but the added labour and increased costs are considerable. We report recent laboratory incidents that demonstrate the value of regulatory oversight. During the thawing of a bag of cryopreserved stem cells at the patient bedside the bag became swollen with gas and a cracking sound was heard. The bag was not infused as a safe stem cell dose could be achieved without it. We could not detect lesions or breaches to bag integrity, nor was it possible to expel gas from the bag by applying pressure. In more than fifteen years of transplantation we had not had a similar experience. A week later we had similar observation. Both bags were subsequently forwarded to the manufacturer. Prior to the implementation of GMP, the investigation of this problem would have been time consuming requiring retrieval of much information from files. GMP involves documentation to be complete (and accessible) at all levels of the manufacturing system. Because of GMP-we were able to launch an investigation and make an assessment of patients at risk within an hour of the incidents. In a short time we were able to

- retrieve data on all components used in the processing of the two products including batch numbers, manufacturing details, storage, expiry and compliance with specifications

- identify components in common and whether they were nonconforming
- identify patients infused with such components who were at possible risk
- verify that all equipment was within specification at the time of processing
- verify staff training and competency
- ascertain how many products using suspect items had been administered to patients.without adverse incidents
- review the storage history for the stem cell products.
- review patient haemopoietic recovery data

We could make an assessment of the level of risk, and of any impact on haemopoietic recovery. While our investigations did not yield a solution to the problem at hand, the speed with which we could retrieve data because of our quality management system ensured that risks to the patients treated in our unit were minimised.

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Temperature Monitoring – a step towards control of stem cell product in transit

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Process control is exercised at all levels of manufacture, issue and transportation of stem cell to ensure the quality of stem cell products. To ensure efficacy and safety of products, transportation from the collection facility to the transplantation centre should be performed in such a manner as to limit deterioration and prevent damage. Packaging, handling and transportation procedures must be validated to ensure product safety and to ensure that temperatures do not go outside the accepted range for the duration of shipping. The Australian Bone Marrow Donor Registry specifies that temperature of the product should be in the range $4^{o}C$ – $10^{o}C$ for the duration of transport. Temperature during transport is maintained by cold packs which are replaced as required. Temperature is validated by reading and recording of package temperature at frequent intervals during shipping. The courier - who must be trained and competent - is responsible for all aspects of product safety in transit. We use temperature data loggers to monitor temperature of stem cell products during shipping for process validation and with the aim of continuous process improvement. Data loggers – sometimes more than one per package – were packed with the product at the commencement of transport and data was collected until the package was received by the transplantation centre. The courier also recorded product temperature during shipping at intervals specified by laboratory protocol. To date we have collected data from the transport of seven products, two from international donors and five from interstate donors. Journey time varied from 47 hours to 2 hours and 40 minutes. A median of 35% (range 6.3-100%) of temperature readings logged were outside the specified range. The median volume and total nucleated cell count of products transported were 280ml (range 173-1890ml) and 298.6 $x10^{8}$ (range 204.7-529.2$x10^{8}$). Median product viability on arrival was 84% (range 74-98%). The results demonstrate that procedures must be modified to ensure that product temperature remains within the acceptable range for the duration of shipping. Critical factors include product temperature at the start of the journey, ambient temperature in transit and the disposition of cooler bags and temperature probe. Results also indicate that product inspection can result in out-of-range temperature readings. Results indicate that temperature logging is an effective method of transport validation that can be used to assist in the development of improved transport procedures that are less demanding for the courier.

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Post or Pre-storage? When to Process Filtered Washed Red Cells

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Introduction: The preferred transfusion components for the treatment of Thallassaemia by clinicians are filtered or filtered washed red cells. These components, particularly filtered washed cells, carry a reduced risk of transfusion reaction due to their depleted number of white cell antigens and plasma proteins. Additional processing performed to create these components may be done at varying stages of the red cell's shelf life. In order to determine if the timing of the process has any impact on the quality of the component comparisons will be drawn on a number of parameters. Method: Validations were performed by both ARCBS-SA and ARCBS-Vic to determine the duration of expiry for filtered washed red cells. ARCBS-SA performed a validation on fresh red cells, processed at 20-24°C. ARCBS-Vic performed a validation on cells that were filtered on day one, but washed at 4°C at varying stages of the cell's shelf life. Both methods employ the use of a preservative solution in the final component. Results: Quality parameters compared included haemoglobin, % haemolysis, pH, potassium, volume and total protein content. Resulting components meet all current quality parameters as required by ARCBS and the Council of Europe (8th Ed). Conclusion: Filtered washed red blood cells are desirable for use in the clinical setting, particularly for the treatment of conditions requiring multiple ongoing transfusions. Preparation of these components may occur either pre or post-storage. Filtered washed red cells could therefore be produced either on the day blood is collected from donors, or as required using cells already in storage.

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Evaluation of a High Speed Separation Process on the Baxter Optipress II

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Aim: To evaluate primary separation of whole blood into buffy coat poor AS-RBC, plasma and a buffy coat using the Optipress II, when the machine operates at the highest possible press plate force of 50kg. Method: Machine parameters were changed for the force setting and a new protocol (1-2) programmed on three Optipress II machines. Forty whole blood units (Baxter Optipac FGR7339B) were processed using Protocol 1-2 and results compared to the routine QC results using existing Protocol 1-1 (n=1090 for RBCP and n=495 for plasma). The process duration was also recorded for comparison. The evaluation focused on the quality parameters detailed in the ARCBS Product Specifications and the process duration. Results: All quality parameters were acceptable for Protocol 1-2 and are detailed below:

Protocol	RBCP				Plasma		Average Process Duration (s)
	N	Vol (mL)	WBC (10^9/ unit)	% Haemolysis	WBC (10^9/ unit)	Platelets (10^9/L)	
1-1	1090	263 ± 18	0.7 ± 0.4*	0.26 ± 0.18	0.02 ± 0.03	2 ± 3	267
1-2	40	270 ± 16	0.7 ± 0.4	0.23 ± 0.14	0.03 ± 0.04	5 ± 3	186

* n=180

The most notable difference between the two protocols is the process duration. On average, Protocol 1-2 is 81 seconds faster than Protocol 1-1. Comparing this further, in an hour 20 units are able to be processed compared to 14 units using Protocol 1-1. When all twenty four machines are utilised, an extra 144 whole blood units can be processed on Protocol 1-2. Conclusion: Since all parameters met the ARCBS Product Specifications, Protocol 1-2 was implemented at ARCBS-VIC in December 2002. This new protocol has made a positive impact on the blood processing staff as the reduced processing duration creating a 30% improvement in throughput has eliminated the bottleneck created during the evening when additional blood arrives from mobile locations.

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Blood Components

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Blood components plays a vital and important roles in our blood transfusions area, here in our home lab. From the begining of morning duties every lab technicians must learn how to collect blood components, into blood bags. As to avoid clerical errors of collecting blood from donors, the role of a technician is to identify the type of blood from donors before bleeding and counselling of donors. Laboratory Technicians used single blood bags for group oRh pos and Rh negative donors, while double bags for those whose having group A, B, and AB blood type. There is a reasonable way why we do this procedure, we used it for plasma when we separate red blood cells when packing a unit as requested by Doctors at various ward for treating patients. In most severe cases when we run out of donors we asked the help from the Red Cross. Platelets, and plasma plays a important role during transfusions requesting by doctors. We kept plasma components for a year in the fridge at the optimum temperature for their safety. In all, blood components is very vital and importance and could also have a lot of issues, and problems arises all in trying of each's best to do his/her work honestly and confidently. Amongst all that I have said above, there are a whole other appropriate topics and also issues regarding the blood components.

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Introduction of a Leucodepleted Pooled Buffy Coat Platelet Concentrate; The Victorian experience - Revolution or Revelation.

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Background: As of Jan 1st 2003, with special funding provided by Victorian Department of Human Services, the Australian Red Cross Blood Service - Victoria was able to offer as part of the routine production process a Leucodepleted (filtered) Buffy Coat Platelet product. This ensured that 100% of all Buffy Coat derived Platelets (and 95% of all platelets overall) issued to all Victorian hospitals were leucodepleted. Implementation: The implementation involved the validation of all Optipress II blood component separation machines to allow processing of the Pooled Buffy Coat Platelet Concentrate with the Baxter OptiPure PC filter. A special bracket was attached to the side of each Optipress machine to accommodate the filter and a new protocol (2-2) to guarantee correct priming of the filter. Information leaflets and letters were distributed to all hospital end users indicating the change in product quality and the associated label change description. The positive impact of introducing leucodepleted platelets as a standard product was also discussed at the March 2003 meeting of the Victorian Blood Users Group. Conclusion: The successful implementation of a Leucodepleted Pooled Buffy Coat Platelet Concentrate, as part of the routine production process at the ARCBS-VIC is an example of how quickly and easily a blood centre can implement leucodepletion on a large scale whilst providing a quality product that meets and exceeds the end users requirements.

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Leucodepletion of Red Cell Concentrates: OptiPure RC an integral RBC filter system

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Background: Currently the majority of filtration of blood components occurs on demand at the patient's bedside. However it is now possible to pre-storage leucodeplete buffy coat poor red blood cells using a closed blood pack system. Method: Whole Blood (± 470 mL) is collected into an Optipac configured unit with an inline red cell filter (OptiPure RC: FGR8431B). The unit is spun at 4200 rpm for 10 mins and processed on the Optipress II machine using Protocol 1 to produce a buffy coat poor red cell concentrate, a buffy coat, and a plasma unit. The buffy coat poor red cell concentrate is then inverted and filtered. Results: All quality parameters were acceptable and are detailed below:

Leucodepleted Red Blood Cells						Filtration Time
N	Vol (mL)	WBC (10^6/ unit)	% Haemolysis	Hb (g/unit)	Haematocrit (L/L)	(mins)
24	243 ± 15	0.002 ± 0.002	0.095 ± 0.033	46 ± 5	0.628 ± 0.026	26 ± 4

Conclusion: The OptiPure RC filter system has been in routine use since June 2001 without a failure (> 10^6/ unit) detected during routine QC. Over 21,000 units have been processed over this period. Routine use of the OptiPure RC product continues to provide the hospital end user with the highest quality red cell concentrate.

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The Role of Anti-D and Anti-c Quantitation

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Antibody quantitation is a measurement of specific antibody concentration in a person's serum or plasma. At the ARCBS Blood Group Reference Laboratory (BGRL)-NSW we employ an autoanalyser to enhance red cell agglutination with polybrene in a low ionic strength environment. The red cell agglutinates are lysed and peak heights graphed via a colorimeter. To calculate antibody concentrations, peak heights are read against international standards and reported as IU/ml. During the period from June 2002 to June 2003, the BGRL-NSW quantitated, at various stages during pregnancy, 156 patients with anti-D and 37 patients with anti-c. 62 patients were found to have an anti-D concentration of potential clinical significance while 2 patients had an anti-c concentration of potential clinical significance. During the same period 254 plasma donations were quantitated. Of these, 119 had high antibody levels while 135 had low antibody levels. In HDN, potential clinical significance may occur when anti-D concentrations reach 4 IU/ml or greater and when anti-c concentrations reach 10 IU/ml or greater if the foetus is D or c antigen positive respectively. However, failure to detect a rise in quantitation when the level is clinically significant does not always indicate an unaffected baby. When results are below potential clinical significance we recommend re-screening every month. However, following invasive techniques and pregnancies with risk of foetal-maternal haemorrhage, samples are requested fortnightly prior to 24 weeks gestation and weekly after 24 weeks gestation unless the foetus is known to be antigen negative. To highlight the importance of frequently monitoring pregnancies with the risk of foetal-maternal haemorrhaging, the BGRL-NSW was presented with the case of a 24-year-old woman with HDN. During her second pregnancy her anti-D quantitation at 18 weeks gestation was 4.6 IU/ml. After 2 months without further quantitation, her anti-D concentration increased to 730 IU/ml. Since no invasive technique was performed in this period, the significant increase in antibody concentration is assumed to be due to a bleed during pregnancy. Quantitation is also performed to measure anti-D levels of plasma donations and to monitor rises in anti-D levels post boosting of selected donors. Donations with concentrations less than the CSL Rh D Antibody Plasma control are considered to have low antibody levels while donations with anti-D higher than the control are considered to have high antibody levels. All donations with anti-D are sent to CSL for processing into anti-D Rh Immunoglobulin (RhIG) to prevent HDN.

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Easier is Not Necessarily Better. Reduction in Compliance with a Simplified Blood Transfusion Observations Protocol

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Aim: To assess the compliance with transfusion observations pre and post introduction of a simplified observation protocol in a tertiary referral hospital. Method: The protocol for transfusion nursing observations was reviewed in September 2001 to focus on the most clinically appropriate observations. This resulted in fewer observations being required in the majority of patients. A retrospective audit of all transfusion observation forms for January 2000 and January 2003 was undertaken to review the success of the change in policy. A total of 584 forms was reviewed, looking at the recording of observations and compliance with the respective protocols. Results: Of all forms reviewed in 2000 (n=233), 93 (40%) recorded all observations, compared with 101 (31%) from 2003 (n=351; $p<0.025$). Observations were recorded during the most clinically significant period following the initiation of transfusion on 176 (75.5%) forms from 2000 and only 188 (58.9%) forms from 2003 ($p<0.001$). Documentation indicating that the patient had been informed of potential transfusion reactions was present in 23% of cases where it was required under the 2003 protocol. Few cases (7%) used a classification of transfusion reactions specified under the 2003 protocol and provided on the observation form. Conclusion: Although our strategy for improvement involved a reduction in the number of observations required to be recorded, overall compliance and compliance with the most clinically significant observations decreased following the intervention. Our results demonstrate the importance of evaluating the outcomes of quality improvement initiatives in blood transfusion setting.

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Evaluation of the DiaMed Product ID-Perfect ADD and Determination of its Suitability for Use with Automated Equipment (ID-Walkaway) in a Private Pathology Laboratory

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DiaMed Australia requested Sullivan and Nicolaides to evaluate a new proprietary product to determine its suitability for use in a busy private laboratory utilizing automation. The test protocol was evaluated manually and then transferred to the automated equipment used within the laboratory (ID-Walkaway) to perform all routine blood bank tests. ID-Perfect ADD was trialled over a 12 week period and approximately 320 samples were tested. A range of clinically significant antibodies were tested in the trial and test sensitivity and specificity were both calculated at 100%. Productivity improvements particularly in terms of test time for antibody screening were achieved with the ID-Walkaway.

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Pilot Study on the Use of Pneumatic Tube System for the Transportation of Blood

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Introduction: A new pneumatic tube Atlas System (Mecomb, Holland) with a carrier speed of 6 m/s was installed to transport blood products from 10 critical areas in our hospital to the blood transfusion laboratory. On account of their high speed, hemolysis may occur in blood units transported through pneumatic tube systems. A pilot study was carried out to compare the level of hemolysis in transported and un-transported blood units. Method÷ The background rate of hemolysis was determined in un-transported, non-expired, whole blood (WHB) and red blood cells (RBC) on Day 1, 7 and 14 after blood donation. To determine the rate of hemolysis after using the pneumatic tube system, four expired WHB and one RBC were each spilt into 2 bags. Bag A remained in the laboratory while Bag B was transported to and fro 3 times (a total distance of 1800m) before being returned to the laboratory and kept for a week. Hemolysis was calculated using the formula {Free Hgb(g/L)x(1-HCT) x100}/HGB(g/L). Results:

Table 1: Percent hemolysis of un-transported and transported RBC and WHB

DAY (after expiration)	% HEMOLYSIS (RBC), n = 1		% HEMOLYSIS (WHB), n = 4	
	Un-transported	Transported	Un-transported	Transported
1	0.21	0.35	0.28	0.60
3	0.30	0.50	0.29	0.67
5	0.36	0.62	0.32	0.70

Conclusion: The background level of hemolysis increases with storage with RBC showing a higher rate of hemolysis (0.15%) when compared to WHB (0.10%). Table 1 shows that hemolysis increased immediately after pneumatic tube transport and remained stable thereafter. However, this rate of hemolysis is still well below the limit of 0.8% reported for stored blood units without transportation. Because of the possible increased hemolysis after pneumatic tube transportation, it may be prudent to shorten the expiration date of the returned unused units.

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Comparative Antibody Sensitivities-DiaMed versus BioVue

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Background: Since 1997 the department has used the DiaMed system for antibody screening. Increasing workloads, particularly out of hours, and staff moratoriums necessitated a review of automation options in Transfusion Medicine. The Ortho BioVue/AutoVue system was chosen as the solution that best met the department's

current and projected needs. Aim: To determine if the sensitivity of the Biovue/AutoVue system was comparable to the DiaMed system currently in use for the detection of clinically important antibodies. Methods: A comparative in house study was performed on patient samples, a number of which contained previously identified antibodies (by Diamed). 141 patient samples, including 84 fresh samples and 57 samples that had been frozen at –30^{o} C for >12 months, were tested using CSL 2-cell antibody screening red cells and the BioVue and DiaMed LISS AHG cassettes. The 3% CSL antibody screening cells were pre-diluted to 0.8% in Ortho Red Cell Diluent for BioVue and DiaMed CellStab Diluent for DiaMed, prior to use. Results:

Positive Antibody Detection

Antibody	No. Tested	BioVue Positive	DiaMed Positive	Antibody	No. Tested	BioVue Positive	DiaMed Positive
D	4	4	4	S	4	4	4
E	5	5	4	Le^a	2	2	2
C	5	5	5	D+C	2	2	2
K	8	8	7	D+C+E	1	1	1
k	1	1	0	D+ Jk^a	2	2	2
C^w	2	2	1	E+c	3	3	3
Jk^a	4	4	2	E+c+ Jk^a	1	1	1
Fy^a	7	7	6	E+S	2	2	2
M	1	1	1	E+ Jk^a +K	1	1	1

There were 4 false positive reactions in BioVue and 1 in DiaMed when testing stored frozen samples. No false positive reactions were observed with any fresh samples. Discussion: Overall, 55 positive antibody samples were detected by BioVue. One anti-K, one anti-cellano(k), one anti-E, two anti-Jk^a, one anti-C^w and one anti-Fy^a were detected by BioVue but were not detected by DiaMed. These were all frozen stored samples. Three other stored samples that had antibodies previously detected by DiaMed (results not shown), were no longer detectable by either method in this study. This observation is likely to be due to a decrease in antibody activity during prolonged storage. The false positive results are likely to be due to sample deterioration. Conclusion: The Ortho BioVue antibody screening system detects clinically significant antibodies to a sensitivity equal to or better than the DiaMed system and is therefore an acceptable replacement. Although the testing of samples following prolonged frozen storage falls outside the manufacturer's recommending testing protocols, the results suggest that BioVue may be more sensitive than DiaMed. Further study is required to determine the detection rates of antibodies that may be less clinically significant, such as anti–P_1 and Lewis system antibodies.

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Discrepancies in Rhesus D Typing

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Since the introduction of automation to Blood Bank in 2001 we now find a number of laboratories using a mixture of tube/slide manual Blood Banking and Column Agglutination Technology (CAT). As one of these laboratories the Alfred has discovered discrepancies between tube Rh (D) typing and Rh (D) typing with CAT. Our study describes patients with a weakened expression of D who appear Rhesus negative when tested by traditional tube test but positive when tested by CAT. The two variables we have investigated relate to differences between clones used in reagents and their ability to agglutinate. Consistency is important with D typing and there is a loss of confidence when the ordering physician notes a discrepancy in their patients rhesus type from one transfusion service to the next. Currently it is recommended that only donor services need to test Rhesus negative patients for the presence of a weakened expression of D. However, it is vital for safe transfusion medicine, that careful consideration needs to be given to the Rhesus D status of antenatal women when administering prophylactic anti-D. It is wasteful of a limited resource to give Immunoglobulin to a Rhesus positive female. Similarly it is essential to determine the exact Rhesus status of all babies born to a Rhesus negative mother. We have compared two Rhesus D clones available in tube and Biovue columns It appears that D typing with Biovue using clone D7B8 is very sensitive at detecting weakened D. We have compared this clone with others in both tube and column technique to see how they perform. It is our aim to increase the awareness of scientists to the performance characteristics of their reagents used in routine testing.

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Mixed Field Red Cell Populations: tests to deter blood doping by elite athletes

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With the introduction of tests capable of detecting the abuse of recombinant erythropoietin as a means of increasing oxygen-carrying capacity, there is now anecdotal evidence that some athletes are resorting to homologous blood transfusion before competitive events to achieve performance advantage. The aim of this work was to develop tests capable of identifying mixed red cell populations that could arise only through transfusion. The tests depend on the likelihood of mismatches between donor and recipient with regard to minor blood group antigens. Aliquots of EDTA-blood from transfused patients were incubated with each of 12 polyclonal antibodies directed against common red cell antigens and derived from donor plasma. After washing, the treated cells were incubated with a fluorescein-labelled anti-immunoglobulin reagent and analysed by flow cytometry. Antigen positive and negative red cells were distinguished by the intensity of the fluorescent label. Twenty five patients were tested and evidence for the presence of mixed red cell populations was obtained for 22 of them. The 3 patients found to have homogeneous red cell populations did not in fact receive their scheduled transfusions. In conclusion, tests for the heterogeneity of minor blood group antigens can provide proof of blood transfusion with small risk of false positive results. Establishment of such tests and publicity about them may serve to deter abuse in competing athletes.

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Platelet Genotyping Makes Good Cents

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The PIRL has developed a platelet genotyping protocol with the potential to service a wide client base. The four aims of this project were to:
1) Improve clinical service by setting up a simple, efficient method for extended platelet genotyping.

2) Provide genotype compatible platelets to enhance treatment of recipients requiring platelet antigen specific transfusion with resultant cost management benefits to end-users.
3) Build a comprehensive panel of platelet donors for clinical requirements.

4) Determine frequencies for human platelet antigens (HPA)-1, 2, 3, 4, 5, 6 and GOV in Australia.

The Sequence Specific Primer Polymerase Chain Reaction method was modified to genotype donors and patients for HPA-1, 2, 3, 4, 5, 6 and GOV. We have successfully implemented this efficient and cost-effective method for the simultaneous genotyping of these antigens, with a rapid turnaround time. Platelet genotyping can be performed on EDTA whole blood, buffy coat or cultured amniocyte preparations. These samples can be stored and transported at room temperature, refrigerated or frozen. This service is utilised by both local and interstate clinicians, primarily for investigation of Feto-Maternal Alloimmune Thrombocytopenia (FMAIT). Genotyping of both parents, and if indicated, foetal amniocytes, enables clinicians to determine with confidence the necessity for interventions such as the treatment of the mother with intravenous immunoglobulin (IVIG) during pregnancy. IVIG, derived from plasma of blood donors, is used to treat a variety of disorders, and supply does not always meet the demand. In clinical situations where the uses of IVIG and antigen specific platelet transfusion are indicated (eg FMAIT, Post-Transfusion Purpura (PTP), genotype compatible platelets function more effectively and reduce the risk of transfusion reaction.

In the last 12 months PIRL has genotyped over 300 regular blood donors. The initial selection criteria for genotyping were blood group O Negative, CMV Negative donors. More recently group A donors have been included. These genotyped donors form the basis of a dedicated platelet panel and the antigen frequency of this panel is tabled. In conclusion, we were able to implement a simple effective method to simultaneously genotype for HPA-1, 2, 3, 4, 5, 6 and GOV. This led to the development of a platelet donor panel and calculation of platelet antigen frequencies. The provision of blood group compatible, HPA compatible platelets to appropriate recipients is instrumental in improving patient outcomes and allowing end-users to better manage the public health dollar.

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Gonorrhoea and Human Blood Groups; any connection?

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Human samples were collected in collaboration with Auckland Sexual Health. 174 tested positive for *Neisseria gonorrhoeae*, the causative agent of gonorrhoea. 212 tested negative, and 12 were of unknown gonorrhoea status. All blood samples were tested for ABO (by serology), secretor status (by genotyping) and Lewis status (by serology and genotyping). A significantly higher number (p value = 0.05) of weak secretor genotype was found in the gonorrhoea positive group, as compared to the gonorrhoea negative control group. The weak secretor genotype is the result of a mutation at nucleotide 385 in the secretor gene. This results in an unstable fucosyltransferase, and produces elongated chains of blood group sugars on the mucosal surfaces, including those of the reproductive tract. This may provide a mechanism for increased adherence for *Neisseria gonorrhoeae.* The results are suggestive of an association between gonorrhoea and the weak secretor genotype. However, data needs to be disaggregated for ethnicity, as the weak secretor genotype is common in some populations, and absent in others.

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Fully Automated Cord Blood Processing and Volume Reduction in a Closed System Using the SEPAX S-100 Biosafe Cell Centrifugation Instrument

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Volume reduction of cord blood units (CBUs) is a prerequisite to cost-effective cord blood banking as it minimizes the costs associated with storage tanks and space and the recurrent costs of liquid nitrogen. It also allows a decrease in the volume of cryoprotectant required and thus the potential for unnecessary toxicity at reinfusion. Current techniques for cord blood processing are manual or only semi-automated. The aim of this study was to evaluate a new fully automated cell centrifugation device that provides a closed system - the SEPAX S-100 (Sepax, Biosafe SA, Eysins, Switzerland) for cord blood processing. Human umbilical cord blood (HUCB) was collected *ex utero* from consenting mothers (n=11) into sterile blood collection bags (MACOPHARMA Tourcoing France). The CBUs were processed within 24 hours of collection on the SEPAX S-100 using the fixed volume protocol set to 30mL. Pre-processing, aliquots were taken for testing. The CBU bag was then connected to the disposable kit with a sterile docking system (TSCD, TERUMO Belgium Europe). The system returns the buffy coat, RBC and plasma to individual bags. Post-processing an aliquot was taken from the buffy coat bag for testing. WBC counts were performed on the Technicon H*3 (Technicon Tarrytown New York). 200 cell differentials were performed and the WBC counts were corrected for NRBC. $CD34^+$ counts were performed on the Coulter Epics Flow Cytometer (Coulter Miami Florida) using the Beckman Coulter Stem-Kit $CD34^+$ HPC enumeration kit. The mean ± SEM and range for pre- and post-processing volume and total nucleated cell (TNC) dose were 97.2 ± 11.4 (67.3-155.5) mL vs 29.9 ± 0.1 (28.8 – 30.1) mL and 11.6 ± 2.0 (4.02- 25.7) x 10^8 vs 9.3 ± 1.5 (3.9 – 20.6) x 10^8

respectively. TNC and mononuclear cell (MNC) recovery after processing was 81.3 ± 1.7 (71.3 – 88.9) % and 81.7 ± 2.3 (72.3 – 93.6)% respectively. Corresponding values for CD34+ recovery were 85.7 ± 2.5 (71.2 – 100%) and for RBC depletion were 44.5 ± 6.2 (21.2- 82.4) %. Time for processing was13.57 ± 0.41 (12.22-15.6) min. The SEPAX S-100 provides a computer controlled fully automated cytapheresis process within a closed sterile system. TNC, MN and CD34+ recovery were comparable to published data with manual or semi-automated techniques. We used the fixed volume protocol, which meant that the degree of RBC depletion varied according to the starting volume. The SEPAX S-100 system meets regulatory requirements and has the potential to automate and standardize cord blood processing.

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Lectin-Binding and Carbohydrate Expression on Red Blood Cells During Storage of Red Cell Concentrates

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Loss of terminal sialic acid residues, and subsequent exposure of galactose residues, on red blood cell (RBC) membranes targets the cell for removal from the blood circulation. Little is known about the profile of carbohydrate expression on RBCs during storage of RBC transfusion products. This study used a panel of glycoconjugate-specific lectins to investigate the expression of carbohydrates on RBCs during storage of RBC products. Leukocyte-filtered RBC units were prepared from normal blood donors (n = 20) according to standard procedures. RBC units were stored at 2-8°C and samples collected at time-points throughout 42-days storage. Carbohydrate expression on RBCs was determined by lectin binding and flow cytometry. Fluorescein-labelled lectins (Vector Labs) with primary specificity for α-2,3 sialic acid (MAL-I), α-2,6 sialic acid (SNA), galactose (ECA) and N-acetyl-glucosamine (WGA) were used. Optimal concentration for each lectin was determined prior to the study and used throughout. Heterogeneity of RBC lectin binding, particularly for SNA and WGA, was observed between RBC units. An inverse relationship between SNA- and WGA- binding was noted, which continued throughout storage. Consequently RBC units were categorised into three groups based on the level of SNA binding at Day 1 (Table). ECA-binding was similar across the three groups. At Day 42, significant changes in lectin binding were found, particularly for the Low and Medium groups. Changes in WGA, and a lesser extent ECA, were suggestive of loss of sialic acid. The significance of enhanced SNA-binding is unclear, but may indicate exposure of additional galactose residues, for which SNA is known to have secondary specificity. There was no correlation with ABO blood group.

	SNA-binding Group at Day 1	SNA	WGA	MAL-I	ECA
Day 1	Low (n = 6)	70	680	168	31
	Medium (n = 9)	296	425	272	27
	High (n = 5)	1921	232	241	23
Day 42	Low (n = 6)	322*	1726*	173	55
	Medium (n = 9)	754*	569*	228	45
	High (n = 5)	909	228	294	28

Results are medians of mean channel fluorescence (MCF). * $p<0.05$ compared to paired Day 1 level, by signed rank test
In conclusion, the results suggest that carbohydrate expression on RBCs varies significantly between individuals. Changes in lectin-binding profiles during storage of RBC units were suggestive of loss of sialic acid residues. The biological significance of these results is not clear, but may have implications on the survival of transfused RBCs.

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Enumeration of Red Cell Contamination in Clinical Fresh Frozen Plasma

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Enumeration of red cell contamination in Clinical Fresh Frozen Plasma (FFP) is a requirement of the Council of Europe guidelines. Currently no quantitative method is in use at ARCBS-SA. A flow cytometric method was adapted from Jilma-Stohlawetz (2001) to enumerate any residual red blood cells in fresh unfrozen plasma using TruCount™ tubes and Flow Cytometry. The method used TruCount™ tubes that contain a known number of brightly fluorescent beads. Fresh unfrozen plasma was pipetted into these tubes and mixed with PE-conjugated anti-glycophorin A monoclonal antibody for detection of the red cells. Acquisition was performed on a flow cytometer after an incubation period of 15 minutes. This was compared with an expected red cell count obtained from the Cell Dyn haematology analyser. Determinations of accuracy, precision and linearity were performed to confirm that this assay could detect red cells around the critical value of 6 x 10e9/L. The volume (µL) of Glycophorin A monoclonal antibody was also determined to obtain optimal sensitivity. The linearity study was performed using serial dilutions (in triplicate) of whole blood in PBS. The desired range for the study was to detect contaminating red cells below the critical value of 6 x 10e9/L. The data demonstrates that the assay was linear within this range with an R value comparable to that reported by Jilma-Stohlawetz of 0.98. Analysis of red cell contamination in units of fresh unfrozen plasma for FFP shows that no units had contaminating red cells above the Council of Europe guidelines. In conclusion, this method provides a simple, precise and easily reproducible test for red cells in Clinical FFP for routine Quality Control testing that will enable assessment of our compliance with the Council of Europe Guidelines.
Reference: Jilma-Stohlawetz P. (2001) et al. A new flow cytometric method for simultaneous measurement of residual platelets and RBC's in plasma: validation and application for QC. TRANSFUSION Volume 41, January 2001 p87-92.

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Comparison of von Willebrand: Ristocetin Cofactor and von Willebrand Antigen Assays for determination of von Willebrand Factor Activity in Cryoprecipitate.

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Introduction: Von Willebrand disease is the most common congenital bleeding disorder. It is estimated to occur at a frequency of one in 100 individuals, but is symptomatic in only about one in 10,000. The clinical bleeding in von Willebrand disease occurs because of defective platelet aggregation and platelet plug formation following vessel

injury. Cryoprecipitate contains the high molecular weight von Willebrand factor (vWF) multimers missing in von Willebrand disease and is the treatment of choice for severe haemorrhages and major surgical procedures. Methods: The von Willebrand Factor:Ristocetin Cofactor (vWF:RCo) assay is both a quantitative and qualitative assay, however it is an assay that suffers technical problems, including considerable assay variability. The assay measures the ability of a patient's plasma to agglutinate formalin-fixed platelets in the presence of ristocetin. The rate of ristocetin induced agglutination is related to the concentration of vWF:RCo and the percent normal activity can be obtained by comparing the slope of a sample with that of a standard line as determined by the aggregometer tracing. The von Willebrand Factor: Antigen (vWF:Ag) assay is a fully automated latex microparticle enhanced turbidimetric quantitative assay. When the Latex reagent, buffer and test sample are mixed, the microparticles agglutinate proportionally to the vWF:Ag present in the sample that provides a measure of the level of vWF:Ag. Objective: The Council of Europe: "Guide to the preparation, use and quality assurance of blood components" (8th edition) states that vWF must be assayed in cryoprecipitate with levels of >100 IU/pack, however the methodology is not specified. This trial compared levels of vWF activity in cryoprecipitate obtained via the vWF:RCo assay performed on a Packs 4 aggregometer and the vWF:Ag assay performed on a Sysmex CA1500 coagulation analyser. Results: Twenty three cryoprecipitate units were tested with only one failing to meet the Council of Europe specification. A t-Test (p= 0.777) was performed which indicated that there is no statistical difference between the results obtained from either method. In addition the CV for the vWF:Ag assay was 1.82% and 5.53% for the vWF:RCo assay. Conclusion: ARCBS-SA recommends that the vWF:Ag and the vWF:RCo assays, in addition to Factor VIII and Fibrinogen estimation be performed following any changes to cryoprecipitate manufacturing processes and that the vWF:Ag assay be used for routine quality control.

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Laboratory Trial of ID-Perfect ADD at Middlemore Hospital New Zealand

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Trial Objective: To evaluate the performance of DiaMed's new proprietary accelerating reagent ID-Perfect ADD in the routine blood banking laboratory at Middlemore Hospital, New Zealand. Methods: All test protocols were in accordance with the manufacturers recommendations. Sample selection was random from the routine samples presenting to the laboratory. The current method used within the laboratory (DiaMed LISS/Coombs) was run in parallel with the test protocol for all tests to act as a reference method. Results: Over 1000 samples were tested using the ID-Perfect ADD product with a variety of sample types and a range of different clinical conditions. A range of clinically significant antibodies were detected with no discrepancies between either method. Conclusions: The new DiaMed product ID-Perfect ADD appears to offer significant productivity improvements within the laboratory and provides equivalent performance to the LISS/Coombs method currently used within the laboratory.

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Blood Transfusion Appropriateness in the ACT

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Aim: To determine the rate of appropriateness of blood transfusion usage within the ACT and to identify the prescribers of blood transfusion in order to target practice improvement interventions.
Methods: A concurrent audit of the medical records on all consecutive transfusions in ACT public hospitals and one associated private hospital was conducted. Patients were interviewed, when available and appropriate, to review symptoms and adverse events of transfusion. Transfusion episodes were subsequently classified as appropriate, inappropriate or possibly appropriate, based on compliance with the NHMRC / ASBT guidelines. Results: Interim analysis on 544 transfusions demonstrated that 16.2% of transfusion episodes were likely to be inappropriate, 15.4% possibly appropriate and 68.4% likely to be appropriate. Rates of inappropriateness were significantly worse for fresh frozen plasma (27%), than for red blood cells (15.6%) and platelets (2%). The good compliance with guidelines for platelet concentrate transfusion is attributed to prospective monitoring of requests by blood transfusion staff and regulation of the supply of this resource. The requesting practitioner could be determined in 82.2% of cases. Of these, 58.8% were ordered by consultants, 37.4% by registrars and 3.8% by interns or residents. Rates of inappropriate transfusion did not significantly differ with the experience of the prescribers. Documentation of transfusion events was generally considered to be poor, as was the rate of reporting of transfusion reactions.
Conclusions: A significant rate of inappropriate transfusion has been demonstrated within the ACT. Practice change strategies should be targeted at senior clinicians who prescribe the majority of transfusions and influence the attitudes of junior staff.

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Transfusion Nurse Education Program: importance of education and efficacy and sustainability of role

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Transfusion Nurse (TN) role is evolving and nationally and internationally becoming a pivotal component in improving clinical transfusion practice, training and transfusion best practice awareness for health care professionals. However, minimal consideration has been given so far to the educational and training needs of those fulfilling the TN position. As part of the "Blood Matters Pilot Project", a three-year rapid cycle project funded by the Victorian State Government, the development and implementation of a postgraduate education program to support the installation of the TN role into the hospital sector has been trialled. The education program is a world first and to date has generated much interest. The development of the education program involved defining the TN role and scope of practice, using this as a basis for initial curriculum development. The education program was implemented to support 15 TNs employed as part of the expanded pilot project involved in a Blood Matters Breakthrough Collaborative. Evaluation of the course curriculum is broad, encompassing TN's, nursing/medical

mentors, professional organisations and individuals with an interest in transfusion practice. Curriculum design for the TN role presented a significant challenge given that the required content is drawn from several disciplinary areas and does not reside in existing nursing programs. The course aims to

- Assist students to develop skills and attitudes that will enable them to initiate and accommodate change within the speciality area of Transfusion Medicine.
- Inform participant's knowledge of international best practice, theory, policy and trends emerging around transfusion practice.
- Develop thinking skills, problem solving, critical / analytical inquiry in relation to transfusion practices, and determines the need for practice change.
- Develop a high level of communication and educational skills to complement the resource person aspect of their role.

For the TN role to be effective, sustainable and operate as a resource regarding transfusion practices, it is essential that the necessary professional and clinical knowledge and skills be attained to ensure TN's have the ability to function within the specialist role.

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Interventions and Documents Developed to Foster and Support a Quality Transfusion System

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The BloodSafe project in South Australia comprises two sub projects, one dealing with metropolitan hospital transfusion practice and the other dealing with country inventory management. Methods to assist in achieving the safest possible outcomes for transfusion and ensuring appropriate use were examined. This poster outlines and displays the interventions developed to facilitate best transfusion practice. Metropolitan BloodSafe Interventions: An audit of 664 red cell units transfused to surgical or orthopaedic patients across 5 major metropolitan teaching hospitals in South Australia, revealed problem areas and interventions were developed to facilitate best practice. Interventions were trialled on the surgical, anaesthetics and intensive care units of the 5 participating hospitals. The interventions included the following:

- Sticker for patient case notes to record indication and consent for red cell transfusion to be used by doctors.
- Consent information for doctors including a pocket card outlining the current risks of transfusion.
- Administration checklist for nurses to use when giving a transfusion.
- A pocket card for patients with questions to ask their doctor.
- Posters detailing correct specimen labelling, patient identification procedures and transfusion administration practices.
- Flow chart for investigation of pre-operative anaemia.
- A sticker for domestic hospital refrigerator indicating blood products should not be placed inside.
- A range of stickers with blood transfusion safety messages.

Country BloodSafe Interventions**:** A survey of documentation in country hospitals revealed records of transfusion, storage and fate of blood products and inventory management procedures ranged from good to virtually non-existent. A series of standardised documents were developed which form the basis of a quality framework for blood product history, allowing traceability of products. These include:

- Series of procedures covering receiving, storage, transport and return of stock
- Register of blood/blood products to record inventory and fate of units
- Log book for blood bank fridge maintenance
- Flow chart outlining correct inventory practice.
- Forms for tracking movement of blood products between hospitals

The interventions and documents presented here were developed by hospital transfusion nurses, haematologists and medial scientists forming the BloodSafe collaborative.

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Development of the Transfusion Quality Officer (TQO) Role for Optimising Safer Transfusion Practice

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Abstract: This paper describes an overview of the successful introduction of a Transfusion Quality Officer (TQO) at Peter MacCallum Cancer Centre. The role has addressed the systematic issues and procedural steps of the transfusion process and addressed major deficiencies in these areas. Multisystem failures and the occurrence of three serious transfusion related incidents prompted the introduction of the TQO role crossing the continuum of transfusion practice from the laboratory to the wards. The TQO's brief was to identify the procedural steps in the transfusion process, identify existing problems and develop solutions, implement and improve quality systems to minimise incident recurrence and clinical risk and provide educational packages to improve and sustain the standards in transfusion practice at Peter Mac. The key practice improvements involved:

- Improved patient identification processes at specimen collection and product administration
- Introduction of a checklist for nurses with transfusions of all products
- Updated policies on all blood products and procedures
- Reduction in the number of blood products transfused overnight.
- Introduction of coded comments for clinical staff with the transfusion issue form
- Improved laboratory specimen labelling acceptance criteria
- Introduction of universal leukodepletion throughout the hospital
- Improved product transportation and traceability of personnel handling individual products. Access to blood products in the absence of a scientist was restricted and issues surrounding the use of satellite fridges addressed.
- Upgrading the shute transport system for delivery of blood products to major users
- Implementation of a 24 hour Blood Bank service.
- Implementation of Patient Information Brochures for blood transfusion education and consent.
- .Improved education and communication to nursing and medical staff with ward in-service meetings and via transfusion competency packages.

- Implementation of the serious hazards of transfusion and concepts of clinical risk at Nursing and Medical staff orientation
- Monthly communications in the CEO's newsletter
- Work is ongoing in major areas including a transfusion education web site, auditing and reporting of adverse events along with KPI development

The Transfusion Quality Officer role has delivered significant long term sustainable improvements and system changes in the Transfusion Medicine process to Peter Mac. Ongoing development is being undertaken for further improvements.

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Hospital System Changes to Reduce the Out of Hours Administration of Blood Products

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This paper discusses the effectiveness of hospital system changes used to reduce the number of "non-urgent" blood transfusions administered at suboptimal times, especially overnight. The benefit versus the risk of overnight transfusion was unbalanced at Peter Mac for a number of reasons including the limited operational hours of the Pathology and Blood Bank (BB) Services, the closure of the BB overnight which reduced the provision of products internally, reduced support to staff in the event of transfusion reactions and required external providers of Pathology creating a confusing blood product requisition process. Reduced numbers of nursing staff rostered overnight impaired the delivery of routine observations of patients undergoing a transfusion. Importantly, patients' sleep integrity was disrupted due to transfusion accentuating the common problem of sleep deprivation while patient education and consent was not being adequately addressed. As a result of these problems, overnight blood product transfusions were limited to those decided by the treating clinician to be essential for the patient's immediate therapy, with examples including emergency treatment of bleeding or symptomatic anaemia, or severe thrombocytopenia in accordance with National Health and Medical Research Council (NHMRC) guidelines. Non-urgent transfusions were delayed until the morning of the next working day. System changes included:

- Routine bi-weekly group and hold specimen collections on haematology patients for improved availability and turnaround times for crossmatching in-hours
- Clinical Services Coordinators (CSC) reviewing the necessity of after hours transfusion with the treating medical and nursing staff, and being responsible for accessing the Blood Product Release fridge overnight
- Night duty nursing staff obtaining group and hold specimens in the early morning rather than commencing early morning transfusions. The method of introducing these changes included:
- An education campaign by the Transfusion Quality Officer of night nursing staff
- Posters in ward treatment rooms alerting to practice change
- Clinical Services Coordinators undertaking a gate-keeping and transfusion championing role overnight by questioning and discussing transfusion necessity
- Three monthly audits of overnight transfusions with feedback of results displayed for ward staff viewing
- Expansion of Pathology and Blood Bank services to 24 hours.
- Reporting of progress to, and review by the Hospital Transfusion Committee

Results of follow up over a 6 month period demonstrate a 50% reduction in red cell transfusions overnight. Platelet transfusion overnight remained stable and appropriate according to NHMRC guidelines while plasma based products (albumin & intragam) increased. Improvement in

systems and approach to blood product transfusion overnight by simple interventions can improve suboptimal timing of administration. Education and cultural change will be required for these interventions to be maintained.

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Is Volunteer Blood for Sale? The Issue of Blood for Non-Clinical Purposes

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Three years ago, the Australian Red Cross Blood Service-NSW (ARCBS-NSW) introduced fees on blood and blood products supplied for non-clinical purposes outside the organisation. These charges were introduced with the endorsement of the New South Wales Department of Health, based on cost-recovery and supported by specific guidelines. However, within a year of implementation, the news made headlines, indicting the Blood Service of generating revenue by 'selling' blood donated by unsuspecting volunteer donors to the private industry. This adverse publicity threatened to undermine the confidence of the community in the Blood Service. The consequence of this publicity was a possible decline in the number of donors resulting in an inadequate blood supply. This paper considers the process implemented by ARCBS-NSW to alleviate community concerns regarding their voluntary donations being 'put on sale', whilst ensuring its obligation to the medical and scientific community for the advancement of better healthcare. In addition, the article looks at the demand for blood and blood products for non-clinical use, the practice behind the supply and why the fees are probably here to stay.

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Improving Blood Transfusion Safety: Education Interventions from the BloodSafe Project

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BloodSafe is a state wide collaborative project sponsored by the South Australia Hospital Safety and Quality Council of the Department of Human Services and Australian Red Cross Blood Service-SA. The aim of the project is to improve blood transfusion safety and efficiency. This paper details the educational interventions undertaken by the BloodSafe group aimed at improving transfusion practice. Changes to individual institution policies and procedures were undertaken at each of the sites. However, the BloodSafe group identified the need for more unified policies and procedures and a common knowledge base to support best transfusion practice. Areas of concern identified by the group included compliance by staff with sample collection and labelling; correct

handling and checking of blood products; and staff knowledge levels. A 30-minute in service education session for nurses was developed for use at all five campuses. These sessions started with nurses anonymously answering six questions that attempted to delineate gaps in knowledge. This helped to make nurses more receptive to the information that followed. Answers to the questions were then provided including a discussion of rationales for specific hospital practices in relation to blood transfusion. The video comedy "The strange case of Penny Allison" (NHS) that highlights transfusion issues was shown to participants to reinforce practice. Additional educational interventions were developed for other hospital staff groups e.g new overseas doctors. Posters reinforcing correct collection and labelling procedure were placed in key locations throughout the hospital. A checklist was developed detailing the correct step by step process for administering blood. Stickers with simple slogans promoting awareness of blood safety were devised and attached to a number of items including chocolate bars, patient folders, and equipment. Cards with the current risks of blood transfusion and the process of informed consent were developed. These were distributed to medical staff, and were also placed in pre-operative assessment areas for reference when consenting patients undergoing planned procedures. As a result of these interventions compliance with sample collection and labelling and awareness of correct handling of blood products by nursing staff has measurably improved. Staff at each of the intervention sites has a greater awareness of blood transfusion safety issues. The implementation of a state wide education program has produced identifiable improvement. Sustaining such an improvement will be an ongoing process.

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Audit of Red Cell Utilisation Against National Guidelines in 5 Teaching Hospitals

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Objective: As part of the BloodSafe project, red cell utilisation was audited to establish a baseline before the introduction of interventions to improve practice. Methods: 5 major metropolitan teaching hospitals in Adelaide audited red cell use in either Adult Orthopaedic in-patients (4 hospitals) or Paediatric Surgical in-patients (1 hospital). This involved all red cell transfusions that the patient received during their admission including those given in intensive care, theatre and recovery. Audit of consecutive red cell transfusions was performed within 72 hours of discharge except for the paediatric setting where a retrospective component was also undertaken. Data collection included indication, consent, administration and documentation. Indications for use were compared to the National Health & Medical Research Council (NHMRC) and the Australasian Society of Blood Transfusion (ASBT) Clinical Practice Guidelines for the Appropriate Use of Red Blood Cells released in 2001. These guidelines apply to stable Adult patients. Transfusions to unstable or potentially unstable Adult patients and to all Paediatric patients were therefore not compared to these guidelines. Results: Overall 664 units of red cells were administered in 357 transfusion episodes to 191 patients [mean 3.5 units]. Table 1 compares the key outcomes across the 5 hospitals (Hosp).

Table 1- Red Cell Audit Results: Pre Interventions

Outcome	Hosp 1	Hosp 2	Hosp 3	Hosp 4	Hosp 5	Overall
NO. of units of red cells audited	138	98	111	200	117	**664**
% of episodes with Autologous blood available	4%	25%	0%	11%	6%	**9%**
% of planned admissions where the patient was anaemic pre-operatively	22%	27%	25%	61%	19%	**31%**
% of episodes with no stated indication for transfusion	32%	25%	32%	32%	11%	**26%**
% of episodes with no form of documented consent	95%	0%	79%	42%	71%	**59%**
% of episodes (in stable patients) outside NH&MRC/ASBT guidelines	10%	36%	9%	18%	N/A	**18%**
% of units transfused overnight to stable patients on general wards with Hb>70g/L	17%	5%	15%	26%	0%	**19%**
% of units given where 2 checking signatures were not present	8%	13%	32%	18%	36%	**21%**

Conclusion: Overall there is significant room for improvement in a number of important aspects of transfusion practice. Interventions to improve practice have been implemented. Red cell use will be re-audited from August to September of 2003.

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Utilization of Autologous Blood Units in Singapore

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Aim: A study was conducted to analyse the usage of blood collected through a targeted autologous blood donation programme Background: Many patients for elective surgery are not appropriate candidates for autologus blood donation on account of possible blood contamination or low blood utilization. We therefore instituted a restricted autologous blood donation programme targeted specifically at orthopedic, dental, cardio-thoracic and breast surgeons. Method: Record of patients with autologous donations were compared against homologous cross-

match requests for patients undergoing surgery. Usage of donated units was compared against the surgical procedures. Results: 13,135 (12,838 homologous and 297 autologous) operations were accompanied by a request for a cross match. Blood was eventually transfused to 1910 patients (1816 without autologous collections and 94 with collected autologous blood). The crossmatch/transfusion ratio for homologous and autologous units is therefore 7.1 and 3.2 respectively. Patients preparing for orthopedic surgery were the main contributors (72.4%) to the autologous pool. The C/T ratio for the various disciplines were 3.4 (215patients), 2. 2 (29 patients), 1.8 (7 patients), 0.2 (8 patients), for orthopedic, dental, cardiothoracic and breast surgery respectively. Autologous blood was most frequently requested for spinal surgery (32.6%). A smaller proportion was collected for joint replacement surgery. Of the 264 discarded autologous units, 8 units tested positive for transfusion–transmitted disease and 1 unit was discarded because of the presence of clots. 237 units were not requested by surgeon before the expiry date. Most of the autologous blood collected for laminectomy (19.1%) and / or discetomy remain untransfused. Conclusion: Targeted autologous collections are an efficient use of scarce resources. Many autologous units however remain un-utilized. Most specific targeting according to operation types will result in greater utilization efficiency.

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Transfusion Crossmatch Specimens – the labelling issue

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BloodSafe is a project sponsored by the SA Hospitals Safety and Quality Council of the Department of Human Services and the Australian Red Cross Blood Service–South Australia (ARCBS-SA). The primary aims of the project are to ensure the safe and effective use of blood products in hospitals and to maintain a culture of quality practice and continuous improvement at all times and in all steps of blood transfusion practice. The projects are centred on the four major Metro Hospitals where a Transfusion Nurse Specialist works closely with the Haemovigilance and Effective use project managers and hospital haematologists. All hospitals are currently recording the numbers of inadequately and incorrectly labelled specimens because of their potential for wrong blood/wrong patient incidents. At one site an audit in October 2002 showed that only a third of specimens were labelled in accordance with ANZSBT Pretransfusion Guidelines. The majority did not comply because sticky labels with the patient's details were used but not signed by the collector to indicate that the patient's identity had been verified. A circular addressing this was attached to hospital employee pay slips at the end of November. Compliance after this intervention alone improved to over 70% based on the results of the follow-up audit in December. Extensive in-service education and the introduction of a statutory declaration (for staff to verify that patient identity has been checked) has improved compliance further to 92% in January and 96% in February 2003. Education will need to be ongoing and sustained to maintain this improvement because of the high staff turnover rate.

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The Value of Back-Up Donors for Matched Unrelated Donor Searches in Stem Cell Transplantation

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The value of finding back-up donors when performing matched unrelated donor (MUD) searches is often underestimated by Transplant Centres when a suitably matched unrelated stem cell donor has already been found. Often, Transplant Centres rely on unrelated volunteer stem cell donors to be available, willing and medically fit for donation of either bone marrow or peripheral blood stem cells whenever their patient is ready for a transplant. Of a total of 86 work-ups initiated between 2001 and 2003 for NSW patients, there were 10 donor-related cancellations (of which 4 were from donors being deferred for medical reasons). It is recommended that at least one back-up donor is found when searching for a matched unrelated stem cell donor to accommodate the problems that may occur with donor availability and medical deferrals. Having a back-up donor can save time and anxious moments for the Transplant Centre, patient and their family.

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Can Red Cells Be Transfused Through PICC Lines Using the IMED Gemini PC-1 Volumetric Infusion Pump?

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Aim: This study undertook to assess whether red cell transfusions could be administered through Peripherally Inserted Central Catheters (PICC) by applying pressure via a peristaltic volumetric infusion pump IMED Gemini PC-1. Methods: Eleven red cell units were studied of which six were packed red cells, three leucocyte depleted and two were both leucocyte depleted and irradiated. The age of the units ranged from 4 days to 43 days (mean 17 days) from the date of collection. We collected five 10ml samples for each red cell unit. The first sample was from within the red cell unit prior to infusion (Bag Pre-infusion); second sample was post infusion through the pump and PICC line with a pump rate of 70ml/hour (70ml/hr); third sample was post infusion through the pump and PICC line with a pump rate of 110ml/hour (110ml/hr); fourth sample was post infusion through the pump and PICC line with a pump rate of 170ml/hour (170ml/hr); fifth sample was from within the red cell unit following the completion of the infusion (Bag Post-infusion). Each of the 10ml samples was analysed for parameters of haemolysis including red cell count (RCC), potassium (K), lactate dehydrogenase (LDH) and plasma haemoglobin (PLHB). Results: The results of the 11 red cell units showed minimal changes in each of the four parameters from pre-infusion to post-infusion samples. The difference in the pump rate showed no impact on RCC, K, LDH or PLHB measurements (Table 1). Irrespective of the infusion pump and PICC line the level of K and PLHB increased with the age of the red cell unit and with irradiation, in accordance with other studies. The level of LDH was lowest in leucocyte-depleted red cell units.

Two packed red cell units analysed 7 days after collection showed LDH levels of 275 U/L and 800 U/L suggesting that the level of LDH was not totally age-dependent.

Table 1. Analysis of parameters of haemolysis for 11 red cell units [**Mean** (Range)]

SAMPLES	RCC ($x10^{12}$/L)	K (mmol/L)	LDH (U/L)	PLHB (g/L)
Bag Pre-infusion	**6.9** (6.1-7.7)	**34.5** (10.2-69.1)	**464** (70-1776)	**5.1** (2.2-12.0)
70ml/hr	**6.9** (6.1-7.6)	**36.3** (10.5-73.4)	**487** (88-1774)	**6.4** (2.6-12.0)
110ml/hour	**6.6** (5.8-7.1)	**36.0** (10.7-73.3)	**506** (78-1847)	**5.9** (2.8-10.5)
170ml/hour	**6.5** (5.8-7.0)	**35.0** (10.7-73.3)	**502** (74-1798)	**5.6** (3.0-10.0)
Bag Post-infusion	**6.2** (5.6-6.8)	**35.9** (70.7-72.4)	**503** (62-1859)	**4.7** (1.8-8.0)

Conclusion: Red cell units infused through a PICC line using IMED Gemini PC-1 volumetric infusion pumps do not cause any increase in haemolytic parameters and is therefore considered appropriate practice.

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Incidence of Alloimmune Neonatal Neutropenia in an Unselected Population of Infants from Brisbane Metropolitan Area

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Background: Alloimmune neonatal neutropenia (ANN) is a rare condition resulting from the transplacental passage of antibodies directed at neonatal neutrophil surface antigens that are inherited from the father. In almost all cases the antibody is reactive with neutrophil specific antigens. Clinical neutropenia may result, and this potentially predisposes the neonate to a risk of bacterial infection. The incidence of this condition is poorly defined with estimates ranging from less than 0.01% to 0.1%. There are few prospective studies of the incidence of ANN. Method & Results: This study consisted of 251 unselected healthy pregnant females, at 36 weeks gestation or greater who attended the Royal Women's Hospital, Herston, Brisbane. The majority of the participants were caucasoid. Informed consent was obtained for the collection of cord blood for screening for neutropenia and antigranulocyte antibodies. Neutropenia (<6.0 x 10e9/L) was found in 103 (40.9%) cord blood samples. The granulocyte agglutination test (GAT) and granulocyte immunofluorescence test (GIFT) was performed on these samples to determine whether granulocyte reactive antibodies were present. Antibodies were detectable in only 2 infants who were twins. This gave an incidence of 2 ANNs in 103 neutropenic newborns (1.94%) or 2 ANNs in 252 of full term newborns (0.79%). Neither infant developed any infectious complications in the first 3 months of life. Conclusion: Neutropenia was found in a high proportion of "full term" cord blood samples (41%). Although neutrophil reactive antibodies was only detected in two cord samples, ANN should considered when unexplained neonatal neutropenia occurs.

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Prolonged Profound Immune Thrombocytopenia Following Exposure to ReoPro

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Patient's receiving ReoPro (abciximab) occasionally develop transient severe thrombocytopenia within a few hours of receiving the drug. Recently, antibodies directed at sequences in the drug structure have been demonstrated and suggested as a possible cause of the thrombocytopenia. For cases published so far, the thrombocytopenia has resolved within 10 days of ReoPro administration. We report a case associated with profound thrombocytopenia refractory to platelet transfusion and IVGG infusion for three weeks before spontaneous resolution. A 44yo lady was admitted to hospital with a 6yr history of ischaemic heart disease and coronary artery stenosis. She had received a stent 3yrs earlier at which time ReoPro was given uneventfully. Further stent insertions were required and ReoPro was administered but ceased after <3hrs when the platelet count dropped from 280x 10^9/L to 83x10^9/L Within 24hrs the platelet count was 25x10^9/L. Platelets were transfused but no increment obtained. At this time, moderately increased IgG was demonstrated on the patient's platelets and platelet reacting antibodies in her plasma. No glycoprotein specificity was identified, but ReoPro associated antibodies were demonstrated. The platelet count reached a nadir of 1x10^9/L on day 3. Over the first 8 days 18 units of apheresis platelets were transfused and a 3 day course of IVGG, none of which resulted in more than a transient (<24hrs) platelet increment. On day 9 antibodies directed at glycoproteins IIb/IIIa, Ib/IX and Ia/IIa, in addition to HLA, were detected. A further course of IVGG was given on days 10-12 but the patient maintained platelet counts <10x10^9/L without further intervention until day 21. The platelet count then increased spontaneously but slowly from 4x10^9/L to 47x10^9/L over the subsequent 5 days, at which time the patient was discharged. This case demonstrates an exceptional prolongation of ReoPro associated thrombocytopenia and the management difficulties aggravated by the development of multispecific platelet antibodies.

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Cryopreserved Allogeneic HLA Matched Platelets For Alloimmunised Patients Requiring Platelet Support

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HLA alloimmunised patients undergoing haemopoietic stem cell transplantation or high dose chemotherapy present a significant problem in regard to platelet support during treatment due to variable platelet requirements and the availability of HLA matched platelet donors. Cryopreserved matched platelets have the potential to improve platelet availability for these patients. In this study, we describe the cryopreservation and transfusion of HLA matched single donor apheresis platelets for three patients with broadly reacting HLA antibodies. Each of these patients had HLA types for whom few donors were available. HLA matched, single donor leucoreduced apheresis platelets were collected by the local ARCBS, specifically for individual patients. Cryopreservation was carried out if the platelets were not required before expiry. The platelets were volume reduced and cryopreserved in 5% DMSO at a final concentration of $\leq$1600 x 10^9/L (range 1100 to 1600 x 10^9/L), using a controlled rate freezer. Sterility testing was performed post processing and platelet aggregation studies carried out before and after

cryopreservation. Transfusion of cryopreserved platelets occurred only when fresh HLA matched platelets were unavailable. The frozen products were thawed at 37^0C with gentle agitation at the patient bedside and transfused immediately. The average platelet dose infused was 2.45 $\pm$ 0.21 (SEM) x 10^{11}. Eight cryopreserved platelet products were transfused to three patients (Table 1), two patients receiving two and one patient receiving four transfusions. Five of the transfusions achieved an increase in patient platelet count of $\geq$ 10 x 10^9/L (range: 3 - 35 x 10^9/L). For two of the failed transfusions (<10 x 10^9/L 1 hour post transfusion), the patient was febrile. Cryopreserved allogeneic platelets are a useful resource for HLA alloimmunised patients, whose platelet requirements are difficult to predict and for whom there are few HLA matched donors. The use of platelet cryopreservation reduces wastage and provides a valuable back up when fresh HLA matched platelets are unavailable.

Table 1.

Platelet Bag	Patient	Plt Dose (10^{11})	Plt count (10^9/L) pre transfusion	Plt count (10^9/L) 1hr post transfusion	Comment
1	1	3.28	29	59	
2	1	2.27	16	22	
3	2	3.34	9	44	
4	2	2.15	14	11	Febrile
5	2	2.19	6	18	
6	2	2.43	4	13	Febrile
7	3	1.79	11	24	
8	3	2.11	11	21	Bleeding

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Blood Transfusion

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Blood transfusion does cover a lot of areas. For example: The role of a lab technician in preparation of the blood unit for transfusion, Confidentiality in carrying out of safety procedures, the role of a lab technician in the blood donor sessions (blood bank technician here bleed the donors and doctors after hours). As well as doctor-technician relationship regarding blood transfusion not forgetting other duties such as the monitoring of refrigerator of blood units and so on. The role of a lab technician at the Blood Bank is to perform the required tests and provide information on the results that have been obtained from crossmatching or screening and other tests. They should perform at high standard with responsibility to complete records accurately and maintain them. At the Blood donor session, here in Samoa, the lab technician bleed the donors during working hours and doctors after hours, only in times of emergency then we lab technician are called to bleed the donors. It is the responsibility of a lab technician then to make sure that donors are suitable to donate. Making sure they are healthy, low risk and are appropriately screened. Also to council and care for them during and after the donation. Must make sure the blood bags and tubes are correctly labelled and accurate records are maintained. The role of a trained lab technician in the Blood Bank at all sessions whether donor sessions, counselling or at bench for crossmatching and other tests, is very important. We have the responsibility to make sure that we are confident at all times. When we deal with blood donors in counselling, we tend to have some or great ideas of personal information about them especially

also when we find out that he/she is RPR or HbsAg positive by screening. So all these information are confidential. In our cases here in Samoa, a senior lab technician of staff may give the results to the concerned person or else, we tell the doctors, and they will tell him or her of the result.

The doctor to a lab technician relationship is another thing. Sometimes friction arises between doctors and lab staff especially when doctors does not allow sufficient time for the technician to prepare the blood unit for safely transfusion. On the other hand, we lab tech do not always know or recognise the problems faced by medical staff when they have an emergency and needed blood units or whatever other tests urgently. Doctors also may not really understand the procedure of safely blood transfusion and why it is important. In all, blood transfusion is very vital and importance and could also have a lot of issues, and problems arises all in trying of each's best (doctor and a lab technician) to do his/her work surely and confidently. Amongst all that I have said above, there are a whole other appropriate topics and also issues regarding the blood transfusion.

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Factors Influencing the Incidence of Citrate Toxicity in Platelet Donors.

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The aim of this study was to review accuracy and frequency of citrate event reporting by plateletpheresis donors and to determine whether predonation hydration status is a contributing factor. In addition, the association of other parameters with citrate toxicity was examined; including age, gender, body mass index, and dose of collection. A questionnaire was administered to plateletpheresis donors to record the occurrence of toxicity associated symptoms and the key parameters indicated above. Hydration status was estimated based on volume and type of fluid consumed within a prescribed interval prior to donation. Severity of reaction was graded according to the number of symptoms experienced by the donor. Results demonstrate that females tended to experience symptoms of citrate toxicity more often than males where a single dose of platelets were collected although the difference was not significant ($p=0.067$). No significant difference was observed where a double platelet dose was collected. Neither hydration status or body mass index was associated with the incidence of or number of citrate toxicity symptoms recorded in females donating a single dose of platelets. Double collections in females resulted in a higher incidence of symptoms than single collections, however again no relationship was found between body mass index or hydration status. Similar results were observed for male donors. This study shows that symptoms of citrate toxicity are relatively common in male and female platelet donors. Improved hydration prior to donation does not appear to reduce the incidence of these symptoms. There appears to be no relationship between body mass index or gender and citrate toxicity. Studies such as this may assist in detecting the factors which impact on citrate toxicity such that appropriate interventions may be designed to improve the donation experience for platelet donors.

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Platelet-Associated CD40L

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Post transfusion immunosuppression remains a challenge for the management of transfusion recipients. The mediator of immunosuppression remains obscure, however biological mediators present in blood components such as cytokines and other cofactors have been identified as possible agents. This study sought to determine whether one of the immunosuppressive agents present in platelet products was CD40L as this potent immunomodulatory molecule has been shown to be expressed and released by platelets. Basal activation status was assessed by determining the percentage of CD62P (a marker of platelet activation) positive platelets for both apheresis and buffy coat platelets on days one and five of storage. The basal expression of CD40L was also examined. Buffy coat platelets contain a higher proportion of CD62P positive platelets than apheresis platelets on both days one and five and activation status was shown to significantly increase over the storage period. Basal expression of CD40L on both apheresis and buffy coat platelets was low on platelets at day one. Because basal CD40L expression does not increase over the storage period despite activation status changing it is unlikely that the level of CD40L surface expression is an activation marker. The potential for platelets to increase expression of CD40L was examined using known agonists including ADP, TRAP and thrombin. TRAP and thrombin were shown to cause marked platelet activation illustrated by the high proportions of platelets expressing CD62P, however CD40L expression, whilst elevated, did not correlate with CD62P expression. It appears that even at maximal stimulation the level of expression of CD40L remains low in comparison to CD62P. Marked increases in the concentration of soluble CD40L (sCD40L) were found in the later stages of the storage period suggesting release of the soluble form. The apparent consistent expression of the membrane form may be a consequence of rapid cleavage of the new membrane expressed CD40L as activation status increases while the soluble form tends to feature as part of the storage lesion. The effect of sCD40L on cell proliferation was analysed. Using platelet-derived plasma with known concentrations of sCD40L, a relationship between high concentrations of sCD40L and inhibition of cell division was shown. This suggests that sCD40L present in platelet products may be a mediator of post transfusion immunosuppression, however, other biological mediators have not yet been discounted.

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The Rational Use Of Blood In Two Slovenian Hospitals

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Objectives: There are many activities in transfusion medicine for rational use of blood and blood components. With the same aim hospitals in many countries constituted Transfusion Committees to help the blood transfusion service in developing transfusion practice guidelines, monitoring blood-ordering practice, collecting and evaluating data for hemovigilance and other activities to provide a safe, potent and correct blood component at the right time for the patient in need of blood. Design:In our country a Transfusion Committee was first established in 1994 at the hospital in Nova Gorica, in the capital of Slovenia, Ljubljana, in1998, in Maribor and Celje in 1999. Its main aim was to promote a high standard of transfusion practice and rational use of

blood and blood components. Materials and methods: The use of blood and blood components in the last five years (from 1998 to 2002) at the transfusion departments of two regional hospitals, Maribor and Celje, is presented. Results: The use of whole blood and blood components is presented in next table.

Year	Whole blood(ml)		Red cells(ml)		Platelets (units)		FFP(ml)	
	Maribor	Celje	Maribor	Celje	Maribor	Celje	Maribor	Celje
1998	159240	229880	3815186	2684418	2539	3165	1899109	737651
1999	26690	95272	3808028	2577519	3099	2447	1843651	727042
2000	11720	49640	3801331	2591390	3061	2133	1553229	717450
2001	6160	22360	3729653	2577519	2711	1499	1679158	622735
2002	400	1200	3665595	2425524	3485	1352	1824194	640215

1998: 2002 99.8 % 99.5% 4.0 % 9.6% 37.2% 57.3% 4.1% 13.2%

In last five years, the use of blood and blood components decreased at both hospitals. In Maribor we note an increase from 37.2% in the use of platelets due to the introduction of heart surgery and liver surgery. Despite the introduction of heart surgery and liver surgery, the use of other blood components was lower. Conclusion: The analysis of the results is presented the more rational use of blood and blood components at our two hospitals in the connection with the constitution of Blood Transfusion Committee.

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Strawberry Thick shake "Apheresis in Hyperlipidaemia" an Easter Special

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A 46-year-old female presented to the Emergency Department with diabetic ketoacidosis and pancreatitis. Symptoms included dull epigastric pain radiating through to the back, nausea and vomiting. Nocturia had been present for the preceding 12 months. Polyuria and polydypsia had been present for the 3 weeks immediately prior to presentation. Physical examination revealed tachycardia and tachypnoea, pallor, dehydration, abdominal distension, epigastric and left upper quadrant tenderness and reduced bowel sounds. Laboratory investigations: haemoglobin 104g/L, mild neutrophilia, normal platelet count. The plasma was grossly lipaemic, resembling a strawberry thick shake. Biochemistry revealed a Creatinine of 130μmol/l, Amylase 167U/L, glucose 31.6mmol/l, Potassium 3.2mmol/L, Cholesterol 40mmol/l and triglycerides 120mmol/l. Abdominal CT showed an oedematous pancreas consistent with pancreatitis. The initial management included fluid resuscitation, potassium replacement and insulin. The patient was subsequently plasma exchanged. Outcome: Following 2 x 3 litre exchanges the patient's abdominal pain settled rapidly and her clinical condition stabilized. The exchange was performed

utilizing the Haemonetics MCS+ with minor technical alterations to override the optic sensors. The patient was discharged well.