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Abstract Book

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Red blood cells from donors with diabetes are not differentially impacted by manufacturing stresses

Abstract Summary :

Background: With recent expansions in donor eligibility criteria and the rising diabetes prevalence in Canada, individuals with diabetes are increasingly contributing to the blood supply. However, little is known about the quality and manufacturing effects on red blood cells (RBCs) from this growing donor group. This study aimed to identify differences in RBCs from donors with type 1 diabetes (T1D) or type 2 diabetes (T2D) after routine processing to generate red cell concentrates (RCCs).

Methods: Whole blood (WB) donations were collected from voluntary T1D (n=12), T2D (n=11) and non-diabetic age/sex-matched controls (n=23) at the netCAD Blood4Research centre. Donations were processed via red cell filtration to generate RCCs. A 2.7 mL tube of EDTA WB was collected at donation, and following processing, 70 mL of RCCs were aliquoted into satellite bags. WB-EDTA tubes and RCC satellite bags were characterized on Day 2 post-collection. Measurements included HbA1c in WB, and hematological indices, p50, and ektacytometry metrics in WB and RCCs. Data were analyzed using a two-way ANOVA with Bonferroni correction.

Results: Donors with T1D and T2D had higher HbA1c levels than their matched controls ($p < 0.001$), with no difference between T1D and T2D groups. All groups showed increased RBC count, hemoglobin, and hematocrit after processing ($p < 0.0001$). Donors with T2D had decreased mean corpuscular hemoglobin concentration compared to controls, both pre- and post-processing ($p < 0.05$), with a similar trend in p50 (pre: $p < 0.01$; post: $p < 0.05$). Additionally, red cell distribution width and Ohyper (tolerance to hypertonic environments) increased post-processing across all groups ($p < 0.05$).

Conclusions: Routine blood processing did not exacerbate stress on RBCs from donors with diabetes compared to controls. However, donors with T2D exhibited modest alterations in MCHC and oxygen affinity (p50) compared with age/sex-matched controls, which persisted following processing. These T2D-specific differences suggest underlying influences of T2D on RBC physiology that are independent of glycemic control. These findings emphasize the importance of donor health on blood product quality, particularly as diabetes becomes more prevalent in the donor population.

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Investigating the Thaw-Time and Post Thaw Storage of Solvent Detergent (S/D) treated Plasma

Abstract Summary :

Introduction:

Solvent Detergent (S/D) Plasma is a pooled human plasma formulation that is pathogen inactivated through (S/D) treatment. S/D plasma has been in use around the world for over thirty years. In 2011, S/D plasma became available for use in select patients within Canada. In 2023, restrictions were lifted, S/D plasma became available for routine use in all adult and pediatric patients. Recently, some sites have reported formation of precipitate in thawed, refrigerated S/D Plasma. To the best of our knowledge, this has not been reported in any other country.

This study aimed to determine the nature of the precipitate observed in some bags of thawed S/D plasma during refrigerated storage and explore the potential for solubilization of the precipitate. We also evaluated a shortened thawing time for S/D Plasma to compare with that of Frozen Plasma (FP).

Methods:

The study consisted of three parts: 1. Thaw time analysis and Plasma Storage, 2. Assessment of Particulate matter and 3. Quality Assessment during storage and after re-warming S/D plasma.

The Study included 10 bags of S/D plasma and 5 bags of FP, which were thawed under usual conditions using either the Barkey Dry Bath or the Helmer Water Bath. The plasma was thawed and monitored for precipitate formation over the course of five days refrigerated storage. The quality of the plasma was assessed throughout the 5-day storage period and before and after re-warming of the precipitate. Measurements were made of PT, INR, PTT, fibrinogen, FVIII, VWF activity and antigen and free PS Ag. The refrigerator temperature was continuously recorded.

Results:

100% of the S/D plasma bags achieved complete thaw in 26 minutes and 100% of the Frozen plasma bags achieved complete thaw in 22 minutes. Particulate matter was observed in 8/10 of the S/D plasma after 48hr refrigerated storage. The precipitate contained several bands of protein as shown on gel electrophoresis. After re-warming and solubilization of the precipitate, the plasma

demonstrated acceptable levels of the coagulation assays measured to achieve hemostasis.

Conclusion:

S/D plasma can achieve complete thaw within 20-26 minutes. A precipitate can develop during refrigerated storage, but after solubilization, the plasma contains adequate levels of clotting factors and can be used for transfusion.

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Scoping review of social, ethical, and legal considerations of genomic sequencing

Abstract Summary :

Introduction/Objective: Genotyping blood antigens enables blood collection agencies (BCAs) to improve matching between donors and recipients. Advancements may allow BCAs to sequence longer segments and more donors than they currently genotype with anticipated clinical benefits. Although scholarship on genomics and blood donation is limited, research on genomics in health and research has been conducted. This study aimed to review the social science, ethics, and legal literatures on genomic sequencing in health and research to identify key considerations for BCAs.

Design and methods: A scoping review of the social science, ethics, and legal literatures was conducted. For the social science review, abstracts with the keywords (genom* OR genetic) AND (sequenc*) AND (blood OR hematolog* or hemo*) AND (attitude* OR perception* OR concern*) were identified. For the ethics and legal reviews, abstracts with the keywords (genom* OR genetic) AND (sequenc*) AND (blood OR hematolog* or hemo*) AND (bioethic* OR ethic*) were included. Articles published in English from 2008-2024 with additional criteria specific to each body of scholarship were included. All articles underwent title and abstract review followed by full text review of articles to determine which articles met inclusion criteria. Articles were analyzed following a thematic analytic approach.

Results: In total, 55 social science, 42 legal, and 29 ethics articles were included. Four themes were identified across all three literatures: informed consent; incidental findings; ownership of data; and privacy. Informed consent, including the use of consent forms, was highlighted as an important tool in informing patients and research participants about genomic sequencing, along with the effectiveness and adequacy of consent forms from their perspectives. Legislative requirements to disclose incidental findings, whether they should be disclosed, and who should be disclosing was another notable theme. Literatures suggest limited value in existing ownership models for genetic information, and highlight the importance of transparent communication regarding data management and usage. Lastly, regarding privacy, literatures identified gaps in existing legislative frameworks regarding use, management and storage of genetic data; debate over who should have access to genetic data; and the importance of maintaining patient and research participant privacy.

Conclusions: Results suggest that the context for the collection and use of genetic data matters

(i.e., whether genetic data is collected and used for research, public health, or clinical care). Further research on informed consent, return of incidental findings, ownership of data, and privacy of donors would be helpful to inform BCAs as they explore expanding genomic sequencing.

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Physician Management of Ig in Canada: A Qualitative Study

Abstract Summary :

Introduction:

The use of plasma-derived medicines like Immunoglobulin (Ig) has expanded in recent years. Globally, countries are undertaking efforts to increase plasma sufficiency. There is very little literature on the experiences of physicians who prescribe Ig; such research could offer insight into how to address the efficient use of this therapy. Our study aims to understand how physicians prescribing Ig in Canada manage Ig amid public discussions about cost, sufficiency and potential shortages.

Design and Methods:

In this qualitative study, we conducted semi-structured interviews with physicians who prescribe Ig in Canada. We used a purposive sampling strategy to recruit physicians through organizations representing relevant specialties. Our thematic analysis generated themes and subthemes on different aspects of clinician experiences with using Ig as a treatment. This study was approved by the Research Ethics Board at Canadian Blood Services and the University of Toronto.

Results:

We conducted 12 interviews with physicians who prescribe Ig in Canada. They were from Ontario, BC and Alberta, and practiced in haematology (n=4), immunology (n=4), neurology (n=3) and rheumatology (n=1). They treated oncological conditions or bleeding disoders, immunodeficiencies, neuropathies, autoimmune conditions with Immunoglobulin.

Our findings are broken down into four thematic categories. In Theme 1, The Science of Ig, participants indicated confidence that Ig works for their patients but expressed uncertainty about the exact mechanisms of how Ig works, optimal dosing and frequency, under-researched indications that may require Ig and side-effects. Some felt clinical practice guidelines have not kept up with published literature in the field. In Theme 2, Education About Ig, participants said their patients have limited information about their illness or Ig. Further, given the lack of

training about Ig (and conditions that require this therapy), family physicians can misdiagnose patients, which can lead to delays in treatment. In Theme 3, The Cost of Ig, participants believed Ig is a scarce and expensive resource and were careful about prescribing. Several were concerned that other physicians are not as conscientious about cost as they are. In Theme 4, Access to Ig, participants said they can access Ig, but sometimes have to advocate for their patients. They were aware of the potential for a shortage in Ig, and many had been part of initiatives to address sufficiency of Ig in Canada's blood system.

Conclusion:

Our exploratory study of the perspectives and experiences of physicians who prescribe Ig therapy in Canada provides a nuanced understanding of the challenges in the science, education, resource allocation and access to Ig. Our study can offer insight into how to address these issues.

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A qualitative study of donors’ views on uses of genomic sequencing in a blood donation context

Abstract Summary :

Introduction/objective: Blood collection agencies (BCAs) are exploring the use of genomic sequencing of blood donations to better match donors and recipients. To date, limited research has been conducted on donors' understanding of genetics and genomic sequencing, and their views on different uses of genetic information in a blood donation context. The objective of this study was to explore blood donors' understanding of genomic sequencing and their views on use of genetic information in a blood donation context.

Design and methods: A qualitative study was conducted with 40 whole blood donors in Canada. Interviews were conducted from Mar-May 2024. Inclusion criteria included having donated within the last 12 months and being comfortable with communicating in English. Semi-structured interviews explored: 1) understanding of genes, genetic testing and genomic sequencing; 2) views on four scenarios describing current and potential future uses of donor genetic information; and 3) their willingness to donate if BCAs expanded the uses of donor genetic information. Interviews were audio-recorded, transcribed, and thematic analysis completed.

Results: Most participants expressed that they have limited knowledge of genetics, genetic testing, or genomic sequencing and were aware of genetic testing in relation to tests for disease predisposition and ancestry. Overall, participants viewed the uses of genetic information presented in the 4 scenarios favourably. Views were informed by their understanding of the role of BCAs, understanding of what they are agreeing to when they donate, familiarity with the purpose of the use of genetic information, and viewing genetic information as beneficial. Reasons for support were informed by their trust in the BCA. Participants expressed several considerations including, having sufficient information about testing and/or uses, whether donors can "opt out" of genetic testing, privacy interests, third-party use of genetic information, and potential future uses. Most participants would not be deterred from donating blood where genetic testing is done for purposes described in the scenarios.

Conclusions: Results suggest that Canadian whole blood donors are generally supportive of current and potential future uses of their genetic information presented in the scenarios and would not be deterred from donating if these future uses were implemented. Participants identified certain

considerations they felt were key to donor support. Further research is needed on how best to inform donors about genetic testing and uses in a way that is understandable and meaningful to them.

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Sera from Patients with Immune Platelet-Transfusion Refractoriness Primarily Drive FcγRIII-Dependent Platelet Destruction In Vitro and Clearance In Vivo in a Humanized Mouse Model

Abstract Summary :

Introduction / Objectives

Immune platelet-transfusion refractoriness (iPTR) remains a significant clinical challenge in transfusion medicine. Anti-HLA antibodies that trigger macrophage-mediated destruction of platelets are well-known contributors; however, the specific roles of distinct Fc gamma receptor (FcγR) subtypes in this process-and the therapeutic potential of FcγR blockade-are less clearly defined.

Design and Methods

Sera from iPTR patients were used to sensitize HLA-matched vs. HLA-mismatched platelets from healthy donors. Macrophage-mediated platelet destruction was assessed *in vitro*, with selective blocking of FcγRI, FcγRIIA, or FcγRIII to determine which receptors were key in mediating platelet-destruction. For *in vivo* validation, we employed a humanized mouse model that expresses all human FcγR isoforms. Mouse platelets from human HLA-A2 transgenic donor mice were fluorescently labeled with CMFDA, pre-sensitized using human iPTR sera containing anti-HLA-A2 antibodies, and injected into FcγR-humanized mice. The clearance of these fluorescent platelets was monitored over time in the presence versus absence of an FcγRIII-blocking therapeutic (17C02-albumin).

Results

Sera from 16/17 iPTR patients clearly mediated destruction of HLA-mismatched platelets but not HLA-matched platelets in vitro. FcγRIIIA was the primary mediator, with FcγRI also contributing; FcγRIIA had no significant role in this setting. *In vivo*, sera from four iPTR patients with anti-HLA-A2 antibodies triggered rapid platelet clearance in Fc receptor-humanized mice. Notably, selective blockade of FcγRIIIA with 17C02-albumin successfully mitigated clearance for all four iPTR sera tested.

Conclusion

These findings demonstrate that sera from iPTR patients can drive FcγR-dependent platelet destruction *in vitro* and clearance *in vivo* primarily involving FcγRIIIA. Moreover, therapeutic blockade of this receptor effectively rescues sensitized platelets from immune-mediated clearance, underscoring the potential of FcγRIIIA-blockade in managing immune platelet-transfusion refractoriness.

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Differential Roles for the Coagulation Factor X Gla-Domain During Activation

Abstract Summary :

Introduction: Factor (F) X is a crucial blood coagulation protein that is activated by proteolysis to FXa. FXa generation is initiated by the tissue factor (TF)/FVIIa or FVIIIa/FIXa tenase complex, both requiring anionic phospholipid (aPL) and calcium. Additionally, FX can also be activated by Russel's Viper Venom FX activator (RVV-X). While the γ-carboxyglutamic acid-rich (Gla)-domain of FX is essential for binding to aPL-containing membranes for optimal presentation to the respective physiological tenase complex for activation, the role of the Gla-domain in protein-protein interactions is poorly understood. In this study, we investigated the role of the Gla-domain in human FX activation in the absence of aPL to ascertain its effects on tenase catalytic efficiency.

Methods: Human FX was treated with chymotrypsin in a time-dependent manner, which has been reported only for bovine FX to excise the Gla-domain. Cleavage patterns were analyzed by Coomassie blue-stained polyacrylamide electrophoresis, the resulting protein bands were further analyzed by Edman degradation and mass spectrometry to determine the precise proteolytic cleavage sites. FX activation efficiency was assessed using a two-step kinetic chromogenic assay that followed FXa generation. Three purified tenases in the presence of calcium were compared: RVV-X, soluble recombinant TF (sTF)-FVIIa, and FVIIIa/FIXa. A range of FX and chymotrypsin-treated FX (FXchy) concentrations were used as substrate. Initial reaction velocities (Vs) were fitted to Michaelis-Menten kinetics to derive Km and Vmax.

Results: In contrast to conclusions drawn in the literature for bovine FX, human FX exhibited an additional cleavage site by chymotrypsin. While the expected removal of the Gla-domain was observed (Tyr44), N-terminal sequencing unexpectedly revealed that chymotrypsin excised approximately half of the activation domain at Tyr163 in ~20% of FX molecules. In the absence of aPL, each of three tenases activated full-length human FX faster than FXchy, demonstrating that the FX Gla-domain is important for more than aPL-binding and involves protein-protein interactions for all tenases. Interestingly the efficiency of FXa generation was differentially affected, with greatest effect in the order, RVV-X>sTF/VIIa>VIIIa/IXa.

Conclusion: These data show that in addition to the known role in aPL-binding, the FX Gla-domain plays a vital role in tenase protein-protein interactions and the substrate FX presents itself differentially to each tenase. These data may have implications for designing clotting pathway branch-targeted anticoagulants, especially applicable for surgical procedures involving patients on prophylactic treatment for hemophilia.

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7

Impact of Cannabis Use on Platelet Quality: Implications for Blood Donors

Abstract Summary :

Background: Platelet transfusions are essential in the management of thrombocytopenia, bleeding disorders, and hematologic malignancies. Ensuring the optimal quality of donor platelets is crucial for transfusion efficacy and patient safety. Cannabis use is increasing globally, yet its impact on platelet function in blood donors remains largely unexplored. This study evaluates the effects of *in vitro* exposure to cannabis extracts on platelet activation, procoagulant phenotype, mitochondrial function, and cytokine/chemokine secretion, with implications for transfusion medicine.

Methods: Human platelets were exposed to increasing concentrations of two cannabis extracts (CJE) with distinct cannabinoid compositions-Orchid [O] (10.4% THC, 14.7% CBD) and QCGold [G] (25.5% THC, 0.04% CBD). Membrane CD62P (P-selectin) expression, annexin V binding and mitochondrial membrane potential were assessed by flow cytometry. ATP level was assessed using the ATP lite Luminescence Assay and platelet aggregation evaluated with the aggregometer. Cytokine/chemokine quantification (CCL-3, PF4) was performed by Luminex.

Results: A dose-dependent increase in CD62P expression and annexin V binding was observed, indicating an increased platelet activation and a shift toward a procoagulant phenotype. Platelets exposed to higher CJE concentrations showed mitochondrial membrane depolarization and reduced ATP levels, suggesting metabolic stress, apoptotic process and potential functional exhaustion. Additionally, CJE exposure reduced platelet aggregation in response to ADP, collagen, and arachidonic acid probably related to the already increased activation, raising concerns about increased thrombotic potential. Proteomic analysis revealed modifications in platelet proteins linked to blood vessel integrity and tumor metastasis protection (ANGPT, MAN2A1, etc.), alongside upregulation of stress-response proteins (DDI2, RNF123, etc). Furthermore, cannabis exposure significantly increased CCL-3 and PF4 levels, which may have implications for platelet-mediated immune interactions.

Conclusions: These findings suggest that cannabis consumption may alter platelet quality in blood donors, potentially affecting post-transfusion platelet function and potentially involved

in acute transfusion reactions. The observed increase in platelet activation and metabolic stress could impact platelet storage properties, viability, and hemostatic efficacy in recipients. Given the growing prevalence of cannabis use, further research is needed to determine whether cannabis-exposed donors present a risk of reduced transfusion efficacy or increased thrombotic events in vulnerable patients. These results highlight the importance of considering donor cannabis use in transfusion safety policies and optimizing donor screening strategies in transfusion medicine.

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Comparative oxygen delivery potency of young and old red blood cells

Abstract Summary :

Background: Blood transfusion has a critical role in oxygen (O_2) delivery to tissues, yet current blood quality assessment criteria, such as hemolysis rates and ATP levels, do not directly evaluate this fundamental function. The age of red blood cells (RBCs) is a key determinant of their O_2 transport efficiency, as RBCs undergo progressive changes during circulation that alter their biophysical and biochemical properties. Older RBCs exhibit reduced deformability, increased membrane rigidity, altered hemoglobin-O_2 affinity, and greater susceptibility to oxidative stress. These age-related changes can impair O_2 unloading at the tissue level, potentially reducing the effectiveness of transfusions. Understanding how RBC age influences O_2 transport is crucial for optimizing transfusion strategies. This study compares a novel metric, O_2 Flux, to benchmark the O_2 delivery capacity of young (Y-RBCs) and old (O-RBCs) red blood cells.

Methods: To evaluate O_2 delivery properties, oxygen dissociation curves (ODCs) and oxygen association curves (OACs) were generated for Y-RBCs and O-RBCs. The p50 values, representing the partial pressure of oxygen at which hemoglobin is 50% saturated, were quantified as an indicator of hemoglobin-O_2 affinity. The O_2 flux reflects the ability of RBCs to deliver O_2 from the lungs to tissues, with hemoglobin concentration ([Hb]) determining the maximal potential delivery potency and the efficiency of O_2 transport and release. Comparisons were performed among Y-RBCs and O-RBCs to provide a comprehensive assessment of O_2 delivery potential across different RBC populations.

Results: Y-RBCs demonstrated superior O_2 delivery, characterized by significantly higher O_2 Flux values compared to O-RBCs (mean O_2 Flux: Y-RBCs, 40.6 ± 3.2; O-RBCs, 36.8 ± 2.8; $p < 0.01$). Tissue O_2 offloading was also significantly improved in Y-RBCs, with a greater area under the curve (AUC) for O_2 offloading (Y-RBCs, 150.4 ± 4.5; O-RBCs, 136.7 ± 5.1; $p < 0.001$). The p50 values for O-RBCs were significantly higher than Y-RBCs (O-RBCs, 26.2 ± 1.1 mmHg; Y-RBCs, 24.6 ± 0.8 mmHg; $p = 0.023$), indicating reduced O_2 affinity in O-RBCs.

Conclusions: O-RBCs exhibited reduced O_2 potency compared to Y-RBCs. Their O_2 content per gram of hemoglobin reflects the left shift in hemoglobin-O_2 affinity, attributed to 2,3-DPG depletion. O_2 Flux is a functional metric for evaluating RBC products by quantifying their O_2 delivery capacity.

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New cryopreservation model provides new insights into the sensitivity of hematopoietic stem cell and progenitors to cryostorage

Abstract Summary :

Introduction/Objective: Cryopreservation of biological samples is essential to support the successful deployment of most cell therapies. However, loss of function can be a limitation and, warming and cooling cycles during storage known as transient warming events (TWE) exacerbate such loss. The objectives of the present study were to establish a TWE model to characterize the sensitivity of hematopoietic stem cell and progenitor (HSPC) to TWE of increasing severity. Also, to compare the protective properties of different cryosolutions to TWE and, to investigate the contribution of ice recrystallization in loss of potency following TWE.

Design and Methods: A model for TWE was established with cryovials exposed to two warmup cycles at functionally relevant target temperatures of either -120°C, -80°C and -50°C. Processed cord blood vials were then exposed to TWE. The impacts on the viability and potency were measured post-thaw by cytometry and by the colony forming cell assay, respectively.

Results: The TWE model revealed that warm up of samples above the intracellular glass transition temperature of -50°C led to worst outcomes (>50% reduction in HSPC and potency, $p< 0.05$, n=4) while mild TWE at -120°C were far less disruptive. Viability analyses further revealed that a fraction of CD34+ HSPC (~20%) initiated apoptosis post-thaw but reverted over time to live status if not exposed to TWE or if the TWE was limited to -120°C, whereas those exposed to TWEs warmer than -80°C progressed to necrosis. In contrast, mature CD45+ cells showed greater necrotic rates without meaningful viability recovery over time. Next, we compared the cryoprotective properties of three commercial cryosolutions [DMSO-based solution and two DMSO-free solutions, CryoProtectPureSTEM (CPP) and CryoScarLess (CSL)]. All solutions provided effective protection under normal cryogenic conditions but different outcomes after TWE. CPP samples showed pronounced reductions in the recovery of HSPC ($p< 0.05$) and potency, while CSL provided the best overall protection ($p< 0.05$) followed by DMSO (n=4). Lastly, the role of ice recrystallization (ice growth) in TWE was investigated. An inverse relationship between cell potency post-thaw and ice-crystal size among the different cryosolutions was noted ($R^2=0.778$). Moreover, supplementation of DMSO with the ice

recrystallisation inhibitor 2FA largely protected samples from loss of potency due to TWE -50°C.

Conclusions: This study provides key functional and operational insights into TWE on stem cell grafts and reveals that inhibition of ice-recrystallization can limit TWE-mediated loss of function. The versatile TWE model will enable future investigations on different cell therapy products.

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Temporal trending of seasonal Influenza and HIV-1&2 serological false positive results in blood donor testing

Abstract Summary :

Introduction

In Canada, infectious disease testing for HIV is performed on all blood donations. Due to the low positive predictive value (PPV) of the blood donor population, false positive serology results can occur. Respiratory viruses have been implicated in cross-reactivity in serological methods, therefore we sought to determine if a temporal trend was observed in our non-confirmed HIV-positive serology results.

Design and Methods

Donor samples were screened for HIV by electrochemiluminescence immunoassay (HIV-ECLIA) to detect HIV-1 p24 antigen and antibodies to HIV-1&2 (Elecsys HIV-Duo, Roche Cobas e801). Results were confirmed by antibody differentiation (Bio-Rad, Geenius). ECLIA repeat reactives were stratified by age at time of donation, sex, date of donation, collection site, and HIV result. Influenza trending data was downloaded from the Public Health Agency of Canada's notifiable disease list and compared to the blood donor HIV repeat reactive rate.

Results

332 HIV-ECLIA repeat reactive samples were identified in 2023. Donors ranged in age from 17 to 82, 56% were male, 98% were negative by confirmatory testing, 0.5% were indeterminate, and 1.5% were positive. 90% of repeat reactive results had COI values just above the cutoff (range 1.0-5.0 COI where >=1.0 is considered positive), while only 10% had COI values >5. All confirmed HIV had ECLIA COIs between 400 and 900. Influenza case data had a similar temporal trend as observed false positive HIV-ECLIA samples with 61% of samples collected during typical influenza season.

Conclusions

Due to the low prevalence of HIV in the blood donor population, nearly all HIV-ECLIA reactives (98%) were not confirmed. A temporal trend of non-confirmed reactive HIV-ECLIA results, and

influenza case data suggest an association with influenza and cross-reactivity of the HIV-ECLIA. Blood operators should be aware of the increased false positive rate in the donor population and assess any variances to evaluate assay functionality.

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The ability of Cutibacterium acnes to establish chronic infections is heightened in the platelet storage environment

Abstract Summary :

Introduction and Objectives: *Cutibacterium acnes,* a member of the skin flora is the predominant contaminant of platelet concentrates (PCs). *C. acnes* contaminated PCs are often transfused due to slow growth of this bacterium during culture-based PC screening. The risk associated with these transfusion events have been historically dismissed due to mild adverse reactions associated with *C. acnes*. However, it does raise concerns about the potential long-term risks to patients, since this bacterium can harness a host of virulence genes to cause chronic infections resulting in significant morbidity. Furthermore, the PC storage environment has been demonstrated to enhance the expression of virulence genes in other PC bacterial contaminants like *Staphylococcus aureus*. Therefore, the **objective** of this study was to assess the impact of the PC storage environment on the virulence of *C. acnes* and evaluate the potential long-term risk to transfusion patients.

Methods: One *S. aureus* (CBS2016, control) and two *C. acnes* (BPNBT195 and BPNBT329, test) transfusion relevant isolates were used to inoculate PCs and brain heart infusion (BHI) broth, followed by incubation at 20-24°C under agitation for 5 days. PC and BHI samples were compared in the *Bombyx mori* (silkworm) virulence model by evaluating larval survival 72hrs post infection. Hemolymph melanization and superoxide dismutase activity were also assessed in infected larvae to evaluate the ability of *C. acnes* to elicit acute immune responses driven by cell wall components. Larvae inoculated with unspiked samples served as controls. Furthermore, differential expression of *C. acnes* genes involved in persistence (*roxP* and lipase) and tissue invasion (*mce* and *hyl*), together with the ability to adhere to HEK293T mammalian epithelial cells were assessed. All experiments were performed three independent times.

Results: Significantly higher mortality ($p < 0.05$) was observed of larvae injected with PC-derived *S. aureus* compared to BHI samples. In contrast, a significant reduction in mortality in conjunction with a significant reduction in the innate response was observed when PC-derived *C. acnes* was used to inoculate larvae compared BHI-derived counterparts ($p < 0.05$). Furthermore, all PC-derived samples displayed higher adherence to HEK293T cells, with the

expression of all four virulence genes tested heightened in PC-derived *C. acnes* isolate BPNBT195, while only two genes (*roxP* and *hyl*) were upregulated in BPNBT329.

Conclusion: Antigen shielding of *C. acnes* cell wall components by PC components likely contribute to lower virulence in the silkworm model and may explain the mild acute reactions attributed to *C. acnes* contaminated PCs. However, the PC environment primes *C. acnes,* in an isolate dependent manner, to be able to initiate infection through enhanced adherence and colonization. Therefore, the risk associated with *C. acnes* PC contamination shouldn't be dismissed especially in the context of chronic infections and warrants further investigation.

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Biofilm Formation by Acinetobacter baumannii Strains involved in Septic Transfusion Reactions is Stronger in Platelet Concentrates Prepared in 100% Plasma Compared to Platelet Additive Solution

Abstract Summary :

Introduction/Objective Incidence of septic transfusion reactions (STRs) caused by bacterially contaminated platelet concentrates (PCs) has declined following the implementation of mitigation strategies such as bacterial screening or pathogen reduction (PR). However, reports of STRs involving PCs contaminated with the Gram-negative pathogen *Acinetobacter baumannii*, despite screening with culture or rapid methods or treatment with PR technologies, is concerning. Bacterial biofilm formation in PCs has been suggested to contribute to the evasion of mitigation strategies. It is unknown if the content of plasma in PCs affects biofilm formation and therefore **this study aimed** to compare biofilm formation of *A. baumannii* when grown in media or PCs prepared in 100% plasma or a mix of plasma and platelet additive solution (PAS).

Design and Methods: Two STR-associated *A. baumannii* strains (ARCphen1 and ARCphen2), a strain isolated during PC screening (BACT20009-3) and *A. baumannii* ATCC19606 (control) were evaluated. Buffy coat and apheresis PCs were prepared in 100% plasma (BC-PL, Aph-PL) or PAS SSP+ (BC-PAS, Aph-PAS). For biofilm formation, glucose- supplemented tryptic soy broth (TSBg) or PCs were inoculated with ~10^7 CFU/mL of *A. baumannii* and incubated at 37°C for 48 hours with no agitation (TSBg), or 20-24°C for 5 days under agitation (PCs). Unspiked samples served as negative controls. Biofilm formation was evaluated using a semi-quantitative crystal violet assay and categorized based on the intensity of biofilm formation. Optical densities (OD_{492}) were compared to the cut-off value (ODc=average OD of negative control + 3×SD). Biofilm formation was categorized as: strong (4×ODc<OD), medium (2×ODc<OD≤4×ODc), weak (ODc<O ≤2×ODc), or negative (OD≤ODc). The assays were repeated at least three independent times.

Results: Table 1 summarizes the results of this study. All isolates were strong biofilm formers in TSBg compared to PCs. Importantly, the *A. baumannii* strains involved in STRs formed stronger biofilms in PCs prepared in 100% plasma than in PCs manufactured with PAS. Biofilm formation in Aph-PL was not assessed due to PC coagulation, which did not occur in Aph-PAS units. In contrast to the STR isolates, *A. baumannii* BACT20009-3, which was captured during PC screening, formed stronger biofilms in Aph-PAS compared to other PCs. Control *A. baumannii* ATCC19606 only formed weak biofilms in Aph-PAS.

Table 1. *A. baumannii* biofilm formation in PCs

Strains	TSBg		BC-PL		BC-PAS		Aph-PAS	
	OD_{492}	BF	OD_{492}	BF	OD_{492}	BF	OD_{492}	BF
ATCC19606	1.4071±0.0385	S	-0.0127±0.0064	N	-0.0349±0.0100	N	0.0403±0.0148	W
BACT2009-3	3.6272±0.122	S	0.0742±0.0082	W	0.1882±0.0124	W	0.3132±0.0105	M
ARCPhen1	1.1774±0.008	S	0.1955±0.0137	M	0.1541±0.0308	W	0.0904±0.0171	W
ARCPhen2	1.0402±0.1000	S	0.1923±0.0125	M	0.2284±0.0096	W	0.0922±0.023	W

BF: biofilm formation; S: strong; M: medium; W: weak; N: negative

Conclusions: STR relevant *A. baumannii* forms biofilms in PCs and the presence of plasma favors biofilm formation. Given the role of biofilms in the evasion of detection and potential impact on PR, further research on bacterial attachment to platelets and storage containers, and biofilm-related gene expression during PC storage, is warranted.

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How to create evidence to re-evaluate universal syphilis testing for blood donors?

Abstract Summary :

Introduction/Objective: Canadian blood donors are screened for syphilis using a serological test and confirmed positive tests result in donor deferral. *Treponema pallidum,* the bacterium that causes syphilis, is a risk group 2 human pathogen with an infection dose of < 100 cells. Despite the increase in community syphilis infections in the last decade, reported transfusion transmitted syphilis cases remain rare since WWII. Additionally, countries like Denmark and Iceland do not screen blood donors for syphilis, and Norway only tests first-time donors. We therefore **aim** to optimize in vitro cultures of *T. pallidum* and test bacterial survival during blood component storage. The study will provide evidence to either maintain or change universal syphilis testing at Canadian Blood Services.

Design and Methods: This study involves: 1) engaging subject matter experts, Legal and Employee Health Safety groups, 2) obtaining ethical approval, 3) preparing biosafety protocols and risk assessments, 4)) identifying dedicated lab space and specialized equipment, 5) obtaining *T. pallidum* stocks and rabbit Sf1Ep epithelial cells, 6) establishing and executing protocols for culturing *T. pallidum* and tracking bacterial survival during storage of RBC and platelet concentrates (PC), and 7) collecting and analyzing data.

Results: Ethical, Legal and Employee Health Safety endorsements for study development have been obtained. Additionally, protocols and biosafety documents have been developed. *T. pallidum* stocks and rabbit Sf1Ep epithelial cells have also been procured. Furthermore, specialized reagents have been obtained and dedicated equipment has been installed. Optimization of *T. pallidum* cultures in rabbit Sf1Ep epithelial cell culture is expected to be completed in the spring of 2025. Bacterial survival testing in PC and RBC will be evaluated once treponemal cultures have been established. Data obtained in the study will be analyzed in consultation with quality assurance and regulatory authorities to re-assess current donor testing for syphilis.

Conclusions: *T. pallidum* culture is not routinely performed by Canadian medical microbiology, provincial laboratories, or the National Microbiology Laboratory. Thus, the work proposed herein is exceptionally novel. To ensure success, involvement of key stakeholders is paramount for the development of this complex project. We are sharing our lessons learned and experience in the planning of this study. Upon optimization of *T. pallidum* cultures, we will provide evidence to re-

assess the safety risk of maintaining or changing syphilis testing of Canadian blood donors.

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Innovative Antifouling Bead-Based Platform for Identification of Novel Platelet Receptor Ligands

Abstract Summary :

Introduction: Platelets and plasma are vital blood products supplied by Canadian Blood Services. Platelets play crucial roles in hemostasis, aggregating at sites of vascular injury to form plugs that prevent blood loss. Key platelet receptors, GPIbα and αIIbβ3 integrin, mediate this process by interacting with ligands such as von Willebrand factor (VWF) and fibrinogen (Fg). However, platelet aggregation and occlusive thrombi still occur in mice lacking fibrinogen and VWF (but not β3 integrin). Mice lacking GPIbα also have severely impaired hemostasis and thrombus growth than $VWF^{-/-}$ mice, which demonstrates the existence of unidentified "X-ligands" of β3 integrin and GPIbα. As these X-ligands may either support hemostasis (useful for stopping bleeding) or compete with fibrinogen/VWF binding (useful for decreasing platelet activation and exhaustion during platelet storage), identifying and characterizing them is important for transfusion science.

Design and Methods: We utilized an innovative ligand-capture platform featuring ferromagnetic beads functionalized with organosilane self-assembled monolayers. These beads exhibit antifouling properties to suppress non-specific interactions and feature covalently immobilized, properly oriented receptors with high-affinity ligand binding conformations. . The functionalized beads were incubated with $Fg/VWF^{-/-}$ platelet-poor plasma under physiological conditions to enable native ligand-receptor interactions. Captured proteins were stringently washed, eluted, digested, and identified by high-resolution liquid chromatography-tandem mass spectrometry (LC-MS/MS), followed by label-free proteomic analysis.

Results: Preliminary proteomic analysis identified several candidate X-ligands that interact with αIIbβ3 and/or GPIbα, isolated using plasma from $Fg/VWF^{-/-}$ mice. Interestingly, complement components C3 and C4 emerged as potential novel ligands. These components, not traditionally associated with direct platelet receptor binding, suggest an alternative pathway for platelet activation independent of fibrinogen and VWF. Biophysical validation (BLI, ITC) and functional assays are underway to characterize binding specificity and assess the biological relevance of these interactions.

Conclusion: This antifouling, receptor-oriented bead technology provides a powerful platform for discovering previously unidentified platelet ligands. The identification of complement components as potential X-ligands highlights alternative mechanisms of receptor-mediated platelet function, independent of classical ligands like fibrinogen and VWF. These findings may lead to development of new strategies to optimize platelet storage conditions and enhance transfusion outcomes.

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RBC quality when a prototype DEHP-free collection set is used with Canadian Blood Services' whole blood-derived component production processes

Abstract Summary :

Introduction: For decades, di(2-ethylhexyl) phthalate (DEHP) has been the primary plasticizer in blood collection and storage bags. DEHP positively impacts RBC storage quality. However, toxicity concerns have prompted European legislation that will effectively prohibit DEHP in blood bags by 2030. This study compared prototype DEHP-free di(2-ethylhexyl) terephthalate (DEHT) sets containing phosphate-adenine-glucose-guanosine-saline-mannitol (PAGGSM) additive solution (AS) to current DEHP-saline-adenine-glucose-mannitol (SAGM) sets. The objective was to assess *in vitro* quality of leukoreduced-red cell concentrates (LR-RCC) produced at Canadian Blood Services (CBS).

Design and Methods: DEHT/PAGGSM and DEHP/SAGM LR-RCC were compared in two study arms. One arm used CBS' primary "warm" process; the other used a contingency "cold" process. Briefly, ~480 mL whole blood (WB) was collected into CPD in either 500 mL DEHP/SAGM (Macopharma REF#LQT710X) or 475 mL DEHT/PAGGSM (Macopharma REF#PRORQT4-B) sets. WB was kept at RT (18-24°C) overnight and LR-RCC were produced using semi-automated top/bottom processing. In the warm arm, LR-RCC were produced at RT within 24 hours of collection. In the cold arm, WB was stored cold (1-6°C) within 24 hours of collection and LR-RCC were produced at RT within 48 hours of collection. All RCC were stored refrigerated. Quality measures post-expiry (day 43) included QC parameters, and measures of RBC metabolism (ATP, glucose, lactate) and function (deformability). Statistical analysis (Minitab Statistical Software) used 2-sample t-tests or Mood's Median for normally and non-normally distributed datasets, respectively.

Results: All LR-RCC were within CAN/CSA-Z902:20 specification values for hemoglobin, hematocrit, and residual WBC. For hemolysis, all LR-RCC in the warm arm and all except three LR-RCC in the cold arm (one DEHP/SAGM and two DEHT/PAGGSM) were below the CSA specification of 0.8%. However, hemolysis (mean±SD) in DEHT/PAGGSM and DEHP/SAGM RCC was not significantly different in either warm (0.33±0.12 (n=29) *vs.* 0.29±0.10 (n=37); p=0.083) or cold (0.47±0.36 (n=30) *vs.* 0.34±0.19 (n=27); p=0.083) arms. Metabolic differences, including significantly lower glucose in DEHT/PAGGSM RCC at expiry in both arms ($p < 0.001$), were attributed to the AS change. In both arms, DEHT/PAGGSM RBC were less deformable (lower EI_{MAX}) than DEHP/SAGM ($p < 0.001$).

Conclusions: DEHT/PAGGSM LR-RCCs produced by CBS' primary process have acceptable *in vitro* quality; a critical finding that will inform CBS' preparations for a DEHP-free future.

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16

Evidence for Trogocytosis in RhIG-Mediated Immune Suppression: A Paradigm Shift in HDFN Prevention

Abstract Summary :

Abstract

Introduction/Objective

Despite five decades of clinical success, the mechanism by which Rh immunoglobulin (RhIG) prevents hemolytic disease of the fetus and newborn (HDFN) remains unclear. This knowledge gap has hindered the development of recombinant alternatives to RhIG and treatments for HDFN caused by other antibodies (e.g., anti-K). Early hypotheses for antibody-mediated immune suppression (AMIS) proposed rapid red blood cell (RBC) clearance via phagocytosis; however, this mechanism has been questioned, and antigen (Ag) loss from the erythrocyte surface has been proposed as an alternative. Our recent study in a mouse model suggests that antigen loss may be the primary driver of AMIS. Whether a therapeutic dose of RhIG administered to an RhD-negative mother induces RhD antigen loss via trogocytosis remains unknown. This study aims to determine whether anti-D induces *in vivo* RhD antigen loss on fetal RBCs following fetomaternal hemorrhage (FMH), and to evaluate whether maternal sera post-RhIG administration promotes trogocytosis versus phagocytosis of fetal RBCs.

Design and Methods

Maternal blood samples were collected from RhD-negative pregnant individuals who delivered RhD-positive neonates with FMH ≥3 mL, both before (Pre) and 18–24 hours after (Post) RhIG administration. Cord blood RhD-positive RBCs (CB-RhD^{+}-RBCs) were also collected. RBCs (10^{8} cells/mL) were analyzed for RhD antigen levels by incubating aliquots with serial dilutions of RhIG (starting at 2.5 µg/mL, 1 hour, room temperature). After washing, cells were labeled with Alexa Fluor 647 anti-human IgG and analyzed by flow cytometry to quantify RhD antigen levels. The proportion of fetal RBCs in maternal circulation was also measured pre- and post-RhIG using anti-HbF flow cytometry. Additionally, using flow cytometry and confocal microscopy, maternal sera pre- and post-RhIG were evaluated for their ability to induce trogocytosis versus phagocytosis of fetal RBCs.

Results

Following RhIG administration, fetal RBCs in maternal circulation exhibited lower RhD antigen levels than pre-treatment samples, suggesting that RhIG induces RhD antigen loss. The extent of RhD antigen loss varied between individuals, likely influenced by FMH volume, sampling time, or RhIG concentration in circulation. A reduction in the proportion of fetal RBCs in maternal circulation post-RhIG was also observed, confirming fetal RBC clearance. Significantly, sera from post-RhIG mothers promoted the transfer of fetal RBC membrane fragments to macrophages, consistent with trogocytosis. In contrast, phagocytosis of fetal RBCs was minimal.

Conclusions

These findings provide direct evidence that RhIG administration *in vivo* induces RhD antigen loss from fetal RBCs in maternal circulation. Furthermore, RhIG promotes fetal RBC clearance through trogocytosis rather than phagocytosis, supporting a model in which trogocytosis is a key mechanism underlying RBC clearance and potentially contributing to AMIS.

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Cryopreservation of red blood cells with isochoric freezing

Abstract Summary :

Introduction

Red blood cells (RBCs) are essential for transfusions but they degrade over time in storage. Maintaining their quality is crucial to minimize adverse transfusion reactions and optimize patient outcomes, driving ongoing research into effective preservation methods. Traditional freezing cryopreservation typically occurs in an isobaric (constant-pressure) environment, leading to ice formation and potential cell damage. In contrast, isochoric freezing, which cools solutions in a rigid isochoric (constant-volume) chamber, preserves biomaterials under pressure in a supercooled state, reducing ice-induced damage and improving cell survival. This study aims to identify optimal isochoric freezing conditions for RBCs, hypothesizing that lower pressure and higher supercooled temperatures will enhance RBC quality and reduce hemolysis.

Design and Methods

RBC samples were processed within seven days of storage at 1~6°C after collection from blood donors. Each sample was transferred into a plastic tube (8.5 ml) containing RBC suspension in Esol 5 solution, ensuring that the tube was completely filled with no air bubbles. The tube was then sealed with a screw cap. A total of 3 tubes were prepared, one for each of the three different donors. The experiment involved cryopreserving the RBCs under isochoric freezing or oil-sealing supercooling conditions at temperatures of -2.5°C/27MPa, -5°C/56MPa, -10°C/105MPa, and -15°C/156MPa. The cells were pressurized and cryopreserved for one day followed by rewarming. The quality of cryopreserved RBC samples was finally analyzed for hemolysis, RBC count, morphological alterations, and membrane integrity.

Results

After one day of isochoric freezing, cell count decreased (-1% to -43%), morphology index varied (+20% to -66%), and membrane rupture occurred. Hemolysis increased from 0.14±0.02% (pre-cryopreservation) to 0.49±0.13% (-2.5°C/27MPa), 0.57±0.12% (-5°C/56MPa), 3.42±0.41% (-10°C/105MPa), and 3.22±0.51% (-15°C/156MPa). Hemolysis at -2.5°C was higher with isochoric freezing (0.49±0.13%) than supercooling (0.25±0.02%), likely due to pressure-induced membrane damage.

Conclusions

Isochoric freezing at higher subfreezing temperatures (e.g., -2.5°C) and lower pressure better preserves RBC quality than freezing at lower temperatures (-5°C to -15°C). However, hemolysis remains above quality guidelines (>0.8%). Future research will explore protective additives to mitigate high-pressure effects, improving blood storage for safer transfusions, particularly in remote areas and emergencies.

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Changes in Intravenous or Subcutaneous Immunoglobulin Usage Before and After Efgartigimod Initiation in Patients With Myasthenia Gravis

Abstract Summary :

Introduction/Objective

While efgartigimod usage is expected to reduce immunoglobulin (IG) utilization, evidence in clinical practice is limited.

Design and Methods

In this retrospective cohort study, patients with gMG treated with efgartigimod for ≥1 year were identified from US medical/pharmacy claims data (April 2016-January 2024) and data from the My VYVGART Path patient support program (PSP). The number of IG courses during 1 year before and after efgartigimod initiation were evaluated. Patients with ≥6 annual IG courses were considered chronic IG users. Myasthenia Gravis Activities of Daily Living (MG-ADL) scores before and after efgartigimod initiation were obtained from the PSP where available. Descriptive statistics were used without adjustment for covariates.

Results

167 patients with ≥1 IG claim before efgartigimod initiation were included. Prior to efgartigimod, the majority of patients (62%) received IG chronically. During the 1 year after efgartigimod initiation, the average number of IG courses per patient decreased by 95% (pre: 9.2, post: 0.5). 89% (n=149/167) of patients fully discontinued IG usage. Mean (SD) best-follow up MG-ADL scores in patients with evaluable data (n=73/167 [44%]) were significantly reduced after starting efgartigimod (8.0 [4.1] to 2.8 [2.1], $P < 0.05$).

Conclusions

Based on US claims, IG utilization was substantially reduced among patients who continued efgartigimod for ≥1 year, with patients demonstrating a favorable MG-ADL response.

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Sustainability and cost-avoidance of reduced inappropriate red cell transfusion at community hospitals: A follow-up analysis on a Quality Improvement initiative.

Abstract Summary :

Introduction/Objectives: Red blood cell transfusions (RBC) are a vital component of medical treatment. Yet, RBCs are expensive resources often inappropriately used, incurring unnecessary costs to the healthcare system. There is paucity of information surrounding the economic implications and potential cost savings from implementing quality improvement programs (QIP) aimed at reducing inappropriate RBC utilization. We aim to share the sustainability of a previous (QIP) promoting appropriate RBC utilization, and review the cost avoidance gained from this initiative.

Design and Methods: An initial QIP (technologist-led screening) aimed at reducing inappropriate RBC transfusions was conducted. We will be reviewing the original QIP and updated sustainability data. This study applied an activity-based costing model to estimate cost avoidance in three acute care facilities. A secondary analysis was conducted on RBC utilization from May 2018 to September 2024. The unit cost of an RBC transfusion was derived from a previous study and corroborated with Canadian Blood Services, factoring in direct and overhead costs (~$1500/transfusion). Descriptive and forecasting statistics were used to estimate cost avoidance and analyze trends in RBC inappropriate utilization.

Results: Following intervention, adherence to Choosing Wisely Canada guidelines of pre-transfusion hemoglobin (Hb) of 80 g/L or less and single unit rose from 85% and 54% to 90% and 71%, respectively. Appropriate rates of RBC transfusion were sustained for over 2 years since the intervention was implemented. We observed a significant decrease in total RBC utilization between pre-intervention (2018-2021) and post-intervention periods (2022-2024). The total financial spending was $11,481,000 in the pre-intervention, dropping to $6,429,000, resulting in a $5,052,000 cost avoidance. This represents a 56% reduction in RBC utilization and 44% cost avoidance. Variation was noted between the three sites, indicating differential effectiveness of the QIP. Interestingly, local data on transfusion adverse reactions did not change with the QIP.

Conclusions: Previously, there have been few interventions yielding significant improvement in appropriate RBC usage. This study demonstrates a reduction in inappropriate RBC utilization aligning with national accreditation benchmarks, translating into substantial savings. Importantly, our intervention demonstrates that appropriate RBC usage and cost avoidance can be sustained, likely related to technologist-led screening.

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Unusual spike in PTP cases in Canada – Not so rare anymore?

Abstract Summary :

Introduction:
Post Transfusion Purpura (PTP) is a rare, immune-mediated complication that typically develops 5-10 days following transfusion of a cellular blood product. It occurs when an individual has formed alloantibodies, frequently against the HPA-1a platelet antigen, leading to significant thrombocytopenia and often severe bleeding. Despite this condition's recognized rarity (1 in 50,000 to 100,000 cases), three positive cases of PTP were identified within a one-year time frame, by the National Platelet Immunology Reference Lab (NPIRL). The objective of this study was to review the incidence of positive PTP cases in Canada over the last 10 years, highlight the typical clinical presentation, and describe the testing required to confirm the diagnosis.

Methods:
We performed a retrospective review of all cases submitted for PTP investigation to NPIRL from 2014 to 2024. Clinical characteristics, including presentation, history of sensitizing events, management, and outcomes, were collected on the three positive cases from 2024.

Results:
From 2014 to 2024, 7/95 patient samples that were investigated for possible PTP had newly detectable anti-HPA antibodies. Of the antibodies detected, 4 were anti-HPA-1a, 2 were anti-HPA-1b and 1 was an anti-HPA-5b. The laboratory investigation of PTP involves two complementary methods: PakLx for HPA antibody identification and HPA Beadchip (Werfen) for HPA genotyping. The three patients identified in 2024 all had anti-HPA-1a antibodies detected in both PakLx and the monoclonal antibody immobilization of platelet antigen (MAIPA) assay. Genotyping confirmed that the predicted phenotype the three patients was HPA-1b1b. In all three cases, the patients presented with significant thrombocytopenia 9-10 days post transfusion of a platelet or RBC unit. Two of the patients were post-cardiac surgery and one was post-craniectomy. One of the patients had ongoing symptoms (including wet purpura, bruising, and melena) and required washed RBCs and HPA-1b1b platelets. All three patients were treated with IVIG 1g/kg and recovered within 1-3 weeks.

Conclusion:
PTP is a challenging diagnosis to make due to its reported rarity and the delayed presentation post-transfusion. The most common cause of PTP are anti-HPA-1a antibodies. Management includes limiting further transfusion events as much as possible, early testing, and assessment for IVIg for management. If transfusion is required, HPA-1a negative platelets and washed RBCs are the standard of care until the diagnosis is ruled out. We have described 3 recent cases that were identified in Canada, which is the highest number recorded in a single calendar year in this country at NPIRL. Clinicians should keep transfusion reactions within their differential diagnosis for any new symptoms that

develop within 28 days of transfusion, including PTP.

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Impact of doctor’s care on eligibility in Canadian blood donors

Abstract Summary :

Introduction/Objective

The donor health questionnaire (DHQ) contains an open-ended question "*In the last 6 months have you consulted a doctor for a health problem, had surgery or medical treatment?*" that generates a significant amount of "yes" responses from blood donors.

The objective of this project was to evaluate donor responses to this doctor's care question and determine the type of information obtained from donors, and how often this question alone results in a donor deferral.

Design and Methods

DHQ data for allogenic blood donations (excluding source plasma donations at stand alone source plasma donation centres) from January 1, 2023 to December 31, 2023 were obtained from BI Warehouse and eProgesa. The responses were analyzed to identify how many donors answered "yes" to the doctor's care question. 1000 donors who answered "yes" and had a medical deferral were further examined to establish if the deferral was directly related to their response to the doctor's care question. Donor "yes" responses from January 1, 2023, to March 31, 2023, were also reviewed and categorized to determine the most common reasons for doctor consultations.

Results

Of the 905,329 DHQs completed in 2023, 117,852 (13%) donors answered "yes" to being under doctor's care. The most common reasons for "yes" responses were related to routine doctor's care such as annual physicals, prescription refills and follow-up of stable conditions (e.g. diabetes, hypertension) that are acceptable in the Donor Selection Criteria Manual (25%). 14,372 (1.6%) donors answered yes and had a medical deferral. Of the 1000 deferred donors sampled, 63% were deferred based on their response to the doctor's care question alone. Pending test results or ongoing investigations were the most common reason for donor deferral (68%).

Conclusions

Having an open ended question on the DHQ provides donor eligibility information that may not captured elsewhere on the DHQ. However, this question has a high "yes" response rate from donors and is associated with a low deferral rate. The results of this review can be utilized to enhance staff training, clarify DSCM criteria, and potentially modify the screening question to improve the donor screening process.

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Evaluation of the Seasonal Timing for Universal West Nile Virus Testing in Canadian Blood Donors: Is an Earlier Start Needed?

Abstract Summary :

Introduction

Canadian Blood Services conducts universal seasonal West Nile Virus (WNV) testing between June and November inclusive. This testing window aims to capture potential asymptomatic WNV-positive donations. However, increasing average temperature and the broadening of the active mosquito season prompted examination of testing ranges to ensure the current seasonal testing period is adequate based on historical WNV-positive donation data and national clinical case-based data to capture all WNV-positive donations.

Methods

WNV blood donor screening data were analyzed from 2015 to 2024. Positive WNV test results were extracted, including dates of donation, to evaluate timing of positive results relative to the current testing period. Additionally, clinical WNV case data from the Public Health Agency of Canada (PHAC) were reviewed where data was publicly available (2015 to 2023) to compare donation testing to national case detection trends (Vector-borne disease surveillance in Canada dashboard).

Results

During 2015 to 2023, universal donor screening identified asymptomatic WNV-positive donations between weeks 27-43, while national clinical WNV case data detected positive cases between weeks 22 and 48, with a peak in case numbers between weeks 33 and 37. One clinical case in 2015 was detected at week 22, while three clinical cases (2018, 2020, and 2022) were reported in weeks 48, 49, and 48 respectively. All national clinical cases and donor screen WNV-positive results were identified within the universal blood donor WNV-testing period (weeks 22/23-48/49). Blood donor screening WNV-positives tracked national WNV cases by geographic location, with the majority of cases seen in Ontario. Furthermore, the total number of WNV-positive donations matched the intensity of total case numbers detected in the general population.

Conclusion

The analysis of both universal WNV donor testing at Canadian Blood Services and national clinical WNV case data supports the effectiveness of the current seasonal testing window for WNV (weeks 22/23 to 48/49). WNV-positive donations consistently ranged between weeks 27 and 43, while national clinical cases were consistently detected between weeks 22 and 48. Moreover, WNV-positive donations tracked national clinical case data both in intensity and geographic distribution. The strong alignment between donor screening and national case data indicates that the current WNV universal screening timeframe used at Canadian Blood Services is appropriate, and effectively captures all positive cases.

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High-Sensitivity Detection of Low-Level Malaria Parasitemia for Blood Donor Screening

Abstract Summary :

Introduction

Malaria remains a significant global health challenge. A probable case of transfusion-transmitted-malaria (TTM) in Canada, reported in October 2023, was linked to a blood donor with an unrecognized asymptomatic semi-immune malaria infection and a parasitemia of 0.0004%, underscores the importance of detecting low-level parasitemia in blood donor screening. The Roche cobas® Malaria Assay offers a molecular diagnostic solution for detecting *Plasmodium* spp., including *P. falciparum*, *P. malariae*, *P. vivax*, and *P. ovale*. The malaria assay is intended for use in blood donor screening. This study investigates the assay's sensitivity and limit of detection (LOD) using known positive specimens from different *Plasmodium* species.

Design and Methods

Known positive clinical specimens for *P. falciparum*, *P. vivax*, and *P. ovale with travel history to Kenya, Djubouti, and Nigeria, respectively, were used in this analysis*. A series of dilutions were prepared (*P. falciparum* (1:6 to $1:1x10^{14}$) and *P. vivax* and *P. ovale* (1:100 to $1:1x10^{7}$)) to assess the assay's sensitivity at very low parasitemia levels. Samples were run in triplicate on the Roche cobas® Malaria assay, and the cycle threshold (Ct) and interpretation were recorded. Parasitemia was obtained from previous clinical testing and was used to estimate the percent parasitemia and the estimated parasitized red blood cells (RBCs) in each dilution.

Results

For all *Plasmodium* spp. tested, all dilutions were positive up to $1:1x10^{6}$ (Cts 36.57 to 39.11). For *P. falciparum*, and *P. ovale*, an inoculum of the $1:1x10^{6}$ dilution resulted in 3/3 replicates testing reactive, with an estimated parasitemia of $2x10^{-6}$% (~110 parasitized RBCs) and $3x10^{-7}$% (~17 parasitized RBCs), respectively. For *P. vivax*, a $1:1x10^{6}$ dilution resulted in 2/3 reactive replicates (Cts 38.46/37.78), with an estimated parasitemia of $2x10^{-7}$% (~11 parasitized RBCs) in the inoculum. All *Plasmodium* spp. tested non-reactive at the $1:1x10^{7}$ dilution.

Conclusion

Overall, the Roche cobas® Malaria assay demonstrates high analytical sensitivity for detection of very low parasitemia levels. Importantly, the observed detection of *Plasmodium* spp. is orders of magnitude more sensitive than *the estimated parasitemia observed in the asymptomatic donor involved in the* probable TTM case (donor: $4x10^{-4}$%, compared to $2x10^{-7}$% to $2x10^{-6}$% observed in this study). These findings highlight the assay's suitability for blood donor screening, where early detection of low-level malaria infections is critical to ensuring the safety of the blood supply. Further studies with additional clinical and donor samples are necessary to confirm these findings and assess the assay's performance in real-world screening settings.

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Oh Baby: A Review of Pregnancy Outcomes in Women with Bombay Phenotype

Abstract Summary :

The Bombay phenotype (Oh) is characterized by absent expression of H antigen, the red cell antigen that that defines group O and is the base of A and B antigens. Naturally occurring Anti-H is present in those with Oh and may cause hemolytic transfusion reactions. Anti H has been implicated in hemolytic disease of the fetus and newborn (HDFN). This study aimed to summarize the published literature on pregnancy outcomes of those with Oh.

A scoping literature review of Medline, EMBASE and SCOPUS was conducted in conjunction with an information specialist for all articles with search terms related to Oh and pregnancy outcomes between January 1946 – February 2024. Identified articles were uploaded to COVIDENCE with abstract screening by two independent reviewers. All conflicts were adjudicated by a third team member. Full text analysis of eligible articles by two reviewers followed. Exclusion criteria included technical reports, as well as absence of pregnancy outcome data, antibody information, non-human or phenotype prevalence studies. Data was extracted to Microsoft Excel™.

A total of 15 articles representing 21 infants from 16 pregnant people were reviewed. Reports were from 9 countries. Most were South-East Asian (11), two Italian and one of Chinese ancestry. Anti-H titers ranged from 8 to 4000 (median 512). Maternal Oh status was known either prior to or identified during the first trimester in 11 of the pregnancies. During pregnancy: 11 underwent maternal blood management planning, 6 underwent routine MCA-US and 5 had routine antibody titration. Three underwent autodonation, and one planned donation but delivered prior to collection. Most infants were term (15), one was preterm (35w GA) and 5 were not reported. No fetal losses were reported. Most did not have HDFN (15) and did not receive any form of therapy (15). Three were treated with phototherapy, and two with exchange transfusions. There was one neonatal death, four days post-delivery, following 3 exchange transfusions, though limited information regarding contributing factors and certainty of HDFN diagnosis was available.

People with Oh phenotype may present anywhere in the world and familiarity with serologic features, care plans and available blood supply is needed. There is no consensus for pregnancy monitoring requirements. Most infants of Oh pregnancies will have minimal hemolysis and no treatment requirement. Understanding the pregnancy implications of rare phenotypes may be increasingly important as migration evolves.

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25

A unique example of a Cromer system antibody

Abstract Summary :

Introduction: Samples from a non-transfused 42 year old Ethiopian female was submitted to the National Immunohematology Reference Laboratory (NIRL) for antibody identification. Cromer system (ISBT 021) antigens are adsorbed onto human red cells due to the presence of type II chains in the serum/plasma of secretors, thus making system antibodies quite rare. High prevalence antigens of the Cromer system are found in 100% of most populations and are described in literature as being resistant to enzyme treatment and weakened by DTT treatment. This review highlights a unique expression of a Cromer system antibody.

Design and Methods: Serologic evaluation included a standard ABO investigation, a partial RBC phenotype with licensed and unlicensed antisera, enzyme/DTT red cell treatment (Saline IAT and gel method), research use only recombinant, adsorption/elution studies, glycine soya, and testing with reagent red cells which lack the presence high prevalent antigens.

Results: A Cromer system antibody was identified that was resistant to DTT and weakened to enzyme treatment of reagent red cells. Antibody was neutralized using research use only recombinant, and patient was found to be CROM11 (GUTI) antigen negative. Further serologic and genomic testing is in progress.

Conclusion: The use of research use only recombinant has facilitated the identification of a Cromer system antibody with a unique expression pattern. This approach enables the detection of diverse antibody reaction patterns, contributing to a deeper understanding of their variability.

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Asymptomatic West Nile Virus Positivity Amongst Canadian Blood Donors Compared to Clinically Reported Cases

Abstract Summary :

INTRODUCTION: Canadian blood operators screen all donations for West Nile virus (WNV) in the summer and fall seasons using a nucleic acid test (NAT). In the winter and spring months donors with a travel history are screened for WNV using NAT. In contrast, patients with symptoms suggestive of WNV may be tested with a variety of serologic and NAT diagnostic algorithms. The purpose of this study was to compare the rates of asymptomatic WNV infection rate in blood donors to diagnostically reported clinical cases across Canada.

DESIGN AND METHODS: All blood donations in Canada (except Quebec) were tested by the Roche Cobas WNV-NAT assay during summer-fall season by a Canadian blood operator. Testing for recent travel outside Canada was performed in the winter-spring season. The estimated clinical rate in blood donors was determined from WNV NAT positive donations divided by total donations tested and multiplied by 100,000.

The estimated asymptomatic rate from reported clinical cases was based on reported clinical cases (outside of Quebec), which was calculated by multiplying the clinically reported case numbers) by 4 (there are four times as many asymptomatic cases compared to reported cases), dividing by the Canadian population (excluding Quebec) and multiplying by 100,000 to determine rate per 100,000 individuals.

RESULTS: Between 2019-2022, the total number of blood donor specimens tested by WNV NAT was 1,763,439. The rate of asymptomatic WNV in Blood Donors (per 100,000) per year was: 0.25 (2019), 3.04 (2020), 2.27 (2021), and 1.05 (2022). The estimated asymptomatic rate from reported clinical cases (per 100,000) per year was 0.43 (2019), 1.40 (2020), 0.42 (2021), 0.49 (2022).

CONCLUSIONS: While the overall trend of WNV NAT positives remains similar among blood donors and diagnostically identified cases in Canada (overall higher asymptomatic detection in blood donors correlates with higher numbers of clinical cases), the rate of asymptomatic infection is higher in blood donors than expected, based on extrapolated estimates from diagnosed, clinically compatible cases. For example, using an 80% asymptomatic infection rate for WNV, we would estimate a 3.32 per 100,000 blood donor positivity rate based on the reported clinical infections for 2018, rather than the observed 9.95 per 100,000 detected in blood donors. Likewise, in 2020, 2021, and 2022, the estimated asymptomatic rate was lower than the observed number of positive WNV NAT donors detected. The higher asymptomatic rate in the blood donor population suggests that clinically compatible WNV infections may be under-diagnosed.

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27

Is there value in sharing donor information with other blood agencies?

Abstract Summary :

Introduction / Objective

Canadian Blood Services (CBS) and Héma-Québec (HQ) share deferral/test code information, ostensively to increase safety related to transmissible disease (TD) deferrals.

We evaluated the efficacy of sharing information.

Design and Methods

All CBS donors are asked if their last donation attempt was at HQ. HQ has a similar process for donors whose previous donation was at CBS.

There are three ways that information is shared.

Process 1 - Remote check

Donated components from donors who disclose past donation at HQ are quarantined. HQ database is searched, and deferrals/test codes are assessed. Equivalent codes are applied to donor files if appropriate and quarantined components released or discarded.

Process 2 - Notification to HQ

HQ is notified when a deferral is added/removed, and a donor has donated at HQ

Process 3

HQ informs CBS about deferral/test codes added to donors who disclosed having donated at CBS. The information is assessed, and equivalent codes added to the CBS file if required.

Results

Process 1- Remote checks from May 1 to July 31, 2024.

Of 238,688 donations, 258 donors disclosed their last donation was at HQ.

30 deferrals/test codes were found at HQ.

- 3 were TD codes (2 false positives, 1 resolved HBV infection). The donor that was anti-HBc positive, had similar test results at CBS.
- 6 were medical deferrals (all eligible at CBS).
- 21 were CMV positive test codes (not tested at CBS).

Process 2 – Notifications to HQ from Jan 1 to Dec 31, 2023.

Of 922,981 donations, HQ was notified of 380 deferrals.

73 of these donors had TD deferral codes. 58 had negative or indeterminate confirmatory test results, were eligible for re-entry, and were most likely false positives. 15 were positive for anti-HBc only, signifying resolved HBV infection.

306 donors had medical deferrals, mainly related to donor safety.

Process 3 - Deferrals received from HQ in 2023 – 7 TD: all for false positive results. 1 medical deferral.

Conclusions

No shared information resulted in product discard or donor deferral that was not found on screening and testing on current donation at CBS.

Criteria change over time; for example, donors with stable cardiac disease are now eligible, but previously were deferred.

Very little information exchanged was related to recipient safety.

There were no confirmed positive TD deferrals shared from any of the processes.

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Utilization Performance Indicators: Improving Component Utilization Through Data Analysis and Visualizations.

Abstract Summary :

Introduction

Performance indicators are an effective tool for evaluating operational processes. They consist of objective measurements of system elements that identify performance outliers. By identifying outliers, transfusion medicine can focus attention on the areas requiring improvement; thus, optimizing resource allocation and improving transfusion practices.

Design and Methods

Using the Provincial Blood Coordinating Teams (PBCT) Component utilization data warehouse, monthly component discard rates, red blood cell out-of-group transfusion rates and red cell units transfused to avoid outdating were analyzed for the nine primary transfusion medicine labs in the Health Authority over a 30-month period. Percentiles (25th, 50th, 75th) for each of the three metrics were calculated and boxplots generated. The 75^{th} percentile was chosen as the performance indicator threshold, meaning values above this threshold were considered outliers.

A standardized utilization performance indictor report was developed using Power BI, automatically updating as underlying data changes. This report displays site specific determined indicator thresholds and the corresponding monthly value for the three performance indicators of each RBC blood group. Performance indictor thresholds and values for the discard rates of platelets and Plasma (all blood groups) is also provided along with transfusion tends for the past six months.

Results

A monthly component utilization performance indictor report provides insights into component utilization performance in relation to three key site-specific indictor thresholds. Using objectively established site-specific thresholds rather than benchmarking allows individual sites to identify outliers relative to their standard practices. The report enables transfusion medicine leadership to quickly and easily asset utilization practices, focuses attention to areas requiring further investigation and make informed decision-making regarding component use.

Conclusions

Using three key performance indicators, transfusion medicine sites across Nova Scotia, can assess their utilization practices in a timely manner, identifying areas for improvement. The standardized objectively derived performance indictor thresholds supports data-driven decision-making and enhances resource management and transfusion practices. By integrating these indicators, Transfusion Medicine labs can optimize blood component utilization and safeguard against deviations in practice.

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29

Exploring Physician-related Transfusion Errors reported to the Transfusion Error Surveillance System (TESS) from 2016-2023: A single centre study

Abstract Summary :

Introduction: Administering blood transfusions safely involves a multi-step process with an interdisciplinary team. Errors, defined as any deviation from established policies and standard operating procedures, can occur in any step of this process and may lead to adverse transfusion events. Using data reported to the Transfusion Error Surveillance System (TESS), we describe physician-related transfusion errors and their consequences in a tertiary care academic center.

Methods: This was a retrospective review of errors reported to TESS from 2016 to 2023, focusing on clinical service transfusion errors and errors where the primary individual involved was a physician. Clinical service errors were categorized as involving sample collection (SC), sample handling (SH), product request (PR), request for pickup (RP), or unit transfusion (UT). An error harm event occurs when there is an adverse event including transfusion reaction, delayed transfusion or under transfusion. Error rates were reported per 1000 of their respective denominators. Descriptive statistics were used to determine error rate trends, types and consequences of errors, and details of patient harm cases.

Results: Between January 2016 and December 2023, 29852 total errors were reported to TESS (16155 (54%) clinical service errors and 13697 (46%) transfusion service errors). 2448 (8%) of the events reached the patient, with 32 (0.1%) of these resulting in patient harm. SC had the highest error rate across all 8 years, ranging from 23 to 37 per 1000. While physician-related errors made up 9% (n=2670) of total errors, they accounted for 84% (27/32) of patient harm cases. Of the 27 patient harm cases, 25 (93%) were PR errors and 2 (7%) were UT errors. The consequences included 20 (74%) patients who had transfusion-associated circulatory overload (TACO), 3 (11%) who had febrile non-hemolytic transfusion reactions, 1 (4%) who had an allergic reaction, 1 (4%) who was hypotensive and 2 (7%) who had other adverse outcomes. Three patients died within 30 days of discovering the error. One death was deemed attributable to undertransfusion, while two were not deemed attributable.

Conclusion: Physician-related transfusion errors can have serious consequences; physician-related transfusion errors are responsible for 84% of cases that resulted in patient harm, despite making up only 9% of total errors. Analysis suggests that harmful transfusion events, such as TACO, could have been prevented (e.g. by ordering diuretics or decreasing the rate of transfusion to high-risk patients). This study highlights the potential harm and preventable nature of these errors and offers opportunities to improve patient care.

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Transfusion practices and management for multi-transfused patients with Anti-Jsb alloimmunization.

Abstract Summary :

Introduction

Js^b is a high incidence antigen within the Kell blood group system and is present in over 99% of the population. We report a case of anti-Js^b alloimmunization in a multiply transfused patient and discuss testing challenges and management considerations.

Case Report

A 53 year old, initially unidentified patient, presented to our trauma center as a passenger in a motor vehicle collision. On arrival, she received four units of emergency issued uncrossmatched red blood cell (RBC) units. The initial group and screen was O positive, with a positive antibody screen and an alloanti-E antibody was identified. On day 30, the patient's antibody screen and panel became pan-reactive, tested by MTS Gel and IAT, with a positive direct antiglobulin test and auto-control. To rule-out the presence of underlying alloantibodies, an alloadsorption was performed with phenotypically similar W.A.R.M. treated cells. The post adsorption plasma continued to be panreactive, suggesting a possible incomplete adsorption. Review of the patient's RBC genotyping revealed that she was negative for the Js^b antigen. Her samples were sent to the National Immunohematology Reference Lab and an anti-Js^b antibody was confirmed.

The blood bank testing results and need for rare blood for future transfusions with O+/E-/Js^b- RBC units were conveyed to the patient and clinical team. The patient was monitored for delayed hemolytic transfusion reaction, and recommendations were made to minimize iatrogenic anemia by reducing unnecessary blood draws, and using pediatric collection tubes. The patient's hemoglobin remained stable, no further RBC transfusions were required, and the patient and family were provided resources around the rare blood type and the rare blood donation program.

Conclusions

The differential diagnosis for pan-reactive antibody panels includes warm autoantibodies, multiple alloantibodies, or an antibody against a high frequency antigen. Antibodies against high incidence antigens are difficult to distinguish from warm autoantibodies. Adsorption studies can be utilized to

detect other coexisting alloantibodies. To enhance the effectiveness of the adsorption, most labs will treat the adsorbing cells. The use of W.A.R.M., which contains DTT, destroys antigens in the Kell blood group system, and therefore any antibodies with this specificity will not be adsorbed. Understanding the impact of DTT and enzymes on the various blood group systems is important when interpreting the serologic results of these tests.

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Analysis of Stem Cell Club Donor Recruitment Outcomes: Ten Years in Review

Abstract Summary :

Introduction: Stem Cell Club is a national donor recruitment organization founded in 2011 that works to extend patient access to unrelated donors. Here, we report our donor recruitment outcomes over the last ten years.

Design and Methods: Stem Cell Club (stemcellclub.ca, instagram.com/stemcellclubscanada), is a nonprofit organization with 20 chapters at Universities across Canada. We partner with Canadian Blood Services (CBS) and a wide array of community/student organizations to run stem cell drives. Stem Cell Club drives are standardized through use of checklists (Fingrut et al., Transfusion 2022) and Stem Cell Club training. Ahead of drives, we develop/share multimedia to engage needed demographics [Infographics, TikToks (https://www.youtube.com/@stemcellclub), donor/patient stories (instagram.com/whyweswab/)]. We train/coach chapter leaders to set/achieve goals. Drive leaders are connected through a stem cell donation community of practice. We analyzed Stem Cell Club donor recruitment outcomes at in-person recruitment events 1/2015-8/2019 (pre-pandemic) and 2/2023-3/2025 (post-pandemic). Data were obtained from Stem Cell Club post-event reports. We also conducted a thematic analysis of post-event reflections to determine factors that contributed to strong recruitment outcomes.

Results: Overall, since 1/2015, Stem Cell Club recruited >20,292 donors at 530 in-person drives (median:30 donors/drive, range:1-340). Half (51%) of recruited donors were male with over half (55%) non-White. Over one-quarter (147/530, 27%) of these drives recruited ≥50 donors, with 34 drives recruiting ≥100. By region, the majority of donors were recruited in Ontario (56%) or BC (29%), with a further 10% in the Prairies (AB/MB/SK) and 3% in Atlantic Canada (nearly all in NL). Analysis over time showed increasing numbers of donors were recruited each year in both the pre- and post-pandemic periods, with more donors recruited per year in the post-pandemic (mean:3501/year) versus pre-pandemic (mean:2,843/year) periods. Altogether, the donors recruited by Stem Cell Club during the study period made up 14% of all donors newly added to the CBS Stem Cell Registry. Qualitative analysis of perspectives from drive leaders revealed that dedicated guidance/coaching and goal setting were essential to improving drive outcomes over time.

Conclusions: Stem Cell Club is a model for recruitment of donors from needed demographics, relevant to recruitment organizations worldwide.

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32

Antenatal immunohematology: a review of two large provincial testing programs

Abstract Summary :

Background:

Identification and monitoring of red cell alloantibodies in pregnancy is essential to mitigate the risk of hemolytic disease of the fetus/newborn. Centralized provincial perinatal testing laboratories facilitate standardization of testing practices and provide insights into trends. The purpose of this study is to evaluate the prevalence and titre profile of antenatal red cell alloantibodies, timing of testing and rate of use of antenatal non-invasive fetal antigen genotyping (NIPT) in alloimmunized pregnancies.

Study design:

Test results (Jan 1 to Dec 31, 2024) from two provincial antenatal immunohematology testing programs that share common policies and procedures were extracted from the laboratory information system (eTraceline) to assess the following: number of patients tested, gestational age (GA) of initial sample, antibody specificities, number of pregnancies with critical antibody titres, samples sent for NIPT. Solid-phase Neo Iris (Werfen Inc) was the primary method and PEG was used as the secondary method for antibody identification. Titrations were performed using saline IAT with a critical antibody titre defined as ≥16 for all antibodies except anti-K. NIPT was performed by an external reference lab.

Results:

Of 126,115 antenatal patients tested, 1.9 % had a positive antibody screen during pregnancy. The most common clinically significant antibodies were anti-E (24.8 %), anti-D (17.3 %), anti-K (11.0%), anti-c (9.1 %), and anti-M (7.7 %). Excluding anti-K (n=71), of the clinically significant antibodies monitored by titration (n=793) 10.3 % reached a critical titre at least once during pregnancy, 89.7 % were noncritical throughout and 4.3 % transitioned from a non-critical to critical value. Of 42,303 patients with a documented expected delivery date, 29.9 % had the first antenatal sample collected prior to 8 weeks GA, 6 of whom were found to have a new clinically significant antibody on a subsequent sample. Of 56 samples sent for NIPT, 53.6 % were tested for D, 17.9 % for E, 3.6 % for C, 3.6 % for c and 25.0 % for K. 69.6 % of these predicted for positive fetal cognate antigen.

Conclusion:

Consistent with previous years, anti-E and anti-D are the most common clinically significant antibodies detected in this antenatal cohort. While antibodies are detected in1.9 % of pregnant patients, only a small proportion reach a critical value warranting more intensive fetal surveillance. About one third of patients have their first antibody screen performed prior to 8 weeks GA. The potential impact of this on antibody recognition requires further exploration.

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Empowering the Transfusion Medicine Community: The Impact of National Education

Abstract Summary :

Introduction:

Over the years, Transfusion Medicine education provided by a Canadian blood and biologic supplier has evolved into a multi-prong program. Originally developed to provide standardized blood center training and national curriculum to Transfusion Medicine Physician Trainees, the program has diversified to fill educational gaps across a broader audience including medical residents, blood suppliers, nurses, laboratory technologists, and other professionals. The objective of this post-hoc analysis is to review the following educational arms: Transfusion Medicine Physician Trainee Program (TMPTP), National Medical Resident Rotation, Learn.Transfusion Seminar Series, and Genomics Rounds.

Methods:

Each arm was reviewed from its inception. Data from individual program reports, event attendance, and surveys were used to summarize the reach and impact of each program arm.

Results:

TMPTP: tracking of the program first began in 1995, to date a total of 58 trainees have completed training. Training includes rotations in Medical Services, Testing, and the National Immunohematology Reference Laboratory, in addition to an annual retreat and weekly didactic teaching through Learn.Transfusion. Recent highlights of the program include the creation of the Elianna Saidenberg TM Traineeship award, and a 95% hiring rate for graduates into transfusion-related positions.

National Medical Resident Rotation: launched in 2021 to replace blood operator site-specific rotations. The national rotation focuses on Blood Centre content and is tailored to those at the resident-level. The virtual rotation provides teaching from experts across Canada in a consolidated curriculum. There have been 84 participants in the rotation since inception with 2024 hosting a record 35 attendees.

Learn.Transfusion Seminar Series: developed in 2007 to fulfill the seminar component of the TMPTP, the series is now open to anyone with an interest in Transfusion Medicine. Averaging 26 sessions per series, attendees are exposed to various scientific, technical and clinical aspects of transfusion medicine. Yearly attendance averages over 4500 attendees with various professional backgrounds. Primarily attended by those located in Canada there has been international reach including attendees from United Kingdom, Belgium, Singapore and Saudi Arabia.

Genomics Rounds: developed in 2024 to meet emerging educational needs in the field of genomics these rounds have hosted a total of two sessions to date. Each session welcomed over 200 live attendees with international representation of medical professionals at each event.

Conclusions:

The Medical Services Transfusion Medicine Training Program continues to reliability disseminate current blood and biologics knowledge and best practices to the national transfusion medicine community. Leveraging virtual platforms, geographical

limitations for national knowledge sharing are removed. Developing mechanisms to expand knowledge translation through recorded sessions and identifying emerging areas of interest continue to be a priority to the program.

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A comparison of manual and automated gel technology vs manual saline indirect antiglobulin test in prenatal antibody titration

Abstract Summary :

Abstract Summary:

Background: Prenatal alloantibody titration is crucial in the evaluation of patients who need clinical monitoring for fetal anemia due to hemolytic disease of the fetus and newborn (HDFN). Antibody levels, more commonly determined by the saline indirect antiglobulin test (SIAT) are assessed every 2-4 weeks and performed using the same technique to identify significant change in antibody levels as a guide for subsequent interventions.

The objective of this study is to compare antibody titrations by the standard method of manual tube SIAT with manual and automated gel technology and to establish a critical titer that corresponds to our current established SIAT levels.

Design and Methods: A total of 48 patients with known antibodies at various titrations were tested using both SIAT and gel technology. Manual and automated gel titration were also performed, and results were compared for validation. Our hospital is equipped with two analyzers; the same samples were assessed using both analyzers and results were evaluated for accuracy.

The titre is expressed as the reciprocal of the highest plasma dilution that shows 1+ reaction. R2R2 red cells were used as the indicator cells for anti-D, anti-c, anti-E. Single-dose expression of the appropriate antigen corresponding to the maternal antibody were used for anti-K, anti-C, anti-Jka and anti-Fya to reflect the antigen expression of the fetal red cells. The same indicator cells were used for both SIAT and gel.

Results: Titrations performed by gel were, on average, 2 tubes dilutions higher than SIAT particularly anti-D and anti-c (2.2). Anti-K showed a minimal 0.2 tube difference. Manual and automated gel showed 0.1 tube difference while the two gel technology analyzers showed 0.04 difference.

Conclusion: Titration using gel technology was comparable with SIAT testing for anti-K alloantibody titration. Gel titrations showed more variability for anti-D and anti-c antibody titration than SIAT and titres approximately 2 times higher for anti-D with gel technology and 2 to 3 times higher for anti-c. As automated gel technology has faster turnaround time, the variability will be further explore to enable standardization of testing with automated gel technology.

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The impact of pathogen reduced platelet implementation on manufacturing and process metrics

Abstract Summary :

Introduction/Objective:

Health Canada approved the use of Pathogen Inactivation Technology for manufacturing pooled platelets psoralen-treated (PPPT) in December 2021 and apheresis platelet psoralen-treated (APPT) in May of 2023 at a large blood and biologics supplier.Phased implementation began in January 2022 with PPPT and concluded in May of 2024 with production sites across the country distributing pathogen reduced platelets.

Aim: This study measures the impact of PPPT and APTT implementation on platelet demand discard rates and processing time.

Design and Methods:

A retrospective analysis was performed on data extracted from a large blood and biologics supplier's internal data information warehouse from January 2021 until January 2025. The analysis is limited to component information and does not include patient outcome or patient denominator data. Pathogen reduced (PR) platelets includes data for both PPPT and APPT components. Demand data reflects the number of platelet units issued to hospital sites. Processing time includes the time for pooling (buffy coat process of pooling, spinning and extracting) and pathogen reduction (sampling, docking, illumination and splitting) as they pertain to the different platelet types.

Results:

Platelet demand has increased annually during the study period. In 2021 there were 118,334 platelet units issued with an increase of 2.4% from 2021 to 2022 when there were 121,211 platelet units issued. There was an increase of 6.8 % from 2022 to 2023 when there were 129,409 platelet units issued and a further increase of 8.8% from 2023 to 2024 when there were 140,790 platelet units issued. Compared with pre-implementation, there was an increase of 32% in total pooled platelet discards at the blood supplier in the year following implementation (2021 compared to 2024). Processing time per pooled platelet unit increased ~60% from 7.98 (pooled platelet in plasma) to 12.78 (PPPT) minutes per unit.

Conclusion:

Following implementation of PR platelets there has been in increase in platelet demand and in pooled platelet discards. More time is required to produce a pooled unit of platelets following PR platelets implementation. Further study is required to understand the driving cause for increased demand and discard rates and how these rates will change over time as the process is further optimized.

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Impact of pathogen reduced platelet implementation on adverse transfusion reaction reporting

Abstract Summary :

Introduction/Objective:

Platelet transfusion carries increased risk of bacterial contamination amongst components due to storage conditions; with other adverse transfusion reactions (ATRs) often related to residual plasma. Pathogen inactivation technology for manufacturing pooled platelets psoralen-treated (PPPT) and apheresis platelet psoralen-treated (APPT) components began in December 2021 and May 2023 at large Canadian blood and biologic supplier respectively, with phased implementation beginning in January 2022 with PPPT and all production sites across the country distributing pathogen reduced platelets by May 2024. PPPT and APPT contain platelet additive solution (PAS) with small amounts of residual plasma which may also reduce ATRs. We hypothesized that ATRs reported to Transmitted Injuries Surveillance System (TTISS) would decrease with the introduction of PPPT and APPT.

Design and Methods:

A retrospective analysis was performed to assess the type, frequency, and severity of the ATRs related to all platelet components submitted by 159 hospitals in a single province to TTISS between 2018-2024; with an imputability of possible, probable, and definite. Denominator data was obtained for the number of platelet units reported as transfused by all hospital sites in a single province.

Results:

During the time period of 2018-2024, a total of 6342 reactions were reported to TTISS; of which 1469 were associated with platelet components. In 2020, 53,268 platelets were transfused with a total of 237 reactions (0.45%). In 2021 56,655 platelets were transfused with a total of 230 reactions (0.41%). In 2022 58,098 platelets were transfused with 240 total reactions (0.41%), in 2023 62,916 platelets were transfused with a total of 233 reactions (0.37%). In 2024 66,572 platelets were transfused with a total of 115 reactions reported (0.17%).

Following the introduction of pathogen-reduced platelets in a phased implementation beginning in 2022 there is a decrease in the number of Allergic Reactions (ARs) (minor and severe) and Febrile Non-Hemolytic Transfusion Reactions (FNHTR). FNHTR reactions decreased from 92 in 2022 to 85 in 2023 (7.61% decrease) and further to 57 in 2024 (a 32.94% decrease). In 2022, 317 allergic reactions were reported, decreasing to 296 in 2023 (a 6.63% decrease) and to 17 in 2024 (a 94.26% decrease). There was no difference between the proportion of reactions reported as severe between treated and untreated platelets.

Between 2018 and 2024, 17 bacterial infections were reported, 4 of which were confirmed to be product-related and 13 possibly related. Notably, there were no bacterial infections reported from pathogen-reduced platelets.

Conclusion:

Implementation of pathogen inactivated platelets were associated with decreased ATRs reported via TTISS, specifically FNHTRs, allergic reactions, and bacterial contamination.

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Education and knowledge translation initiatives supporting pathogen reduced platelet implementation by a Canadian blood and biologic supplier

Abstract Summary :

Introduction:

Platelet transfusion carries increased risk of bacterial contamination due to storage conditions. Health Canada approved the use of a Pathogen Inactivation Technology (PIT) for manufacturing pooled platelets psoralen treated (PPPT) in December 2021 and apheresis platelets psoralen treated (APPT) in May of 2023 at a large Canadian blood and biologics supplier. Phased implementation began in January 2022 with PPPT and concluded in May of 2024 with all production sites across the country distributing pathogen reduced platelets to over 570 hospitals.

Aim: Outline our approach to knowledge translation, including the specific educational resources designed to support implementation across Canada and their engagement metrics.

Design: A multidisciplinary group of individuals developed educational resources available on the blood supplier's educational website:

- *Clinical Guide to Transfusion*: Pathogen reduced platelets chapter
- One-page summary: Platelet component inventory, indications & ordering
- Frequently Asked Questions (FAQs): Information for health professionals on PPPT and APPT
- Slide decks and narrated presentations:
    - Clinical overview
    - Clinical highlights
    - Component overview
- Narrated and animated video depicting the manufacturing processes for PPPT and APPT
- Visual Inspection Tool (VIT) providing images of normal, variant and abnormal images of blood component.

Unrestricted educational resources were made available prior to implementation. The clinical highlights slide deck was presented at Town Hall sessions offered across the country. Information letters were sent out to all hospital customers and made available on the blood supplier's website to provide information in advance of implementation milestones.

Online engagement data was collected for the educational resources listed above from July 1, 2023 to December 31, 2024 and includes combined data for both the English and French pages. Specific visits and downloads of the slide decks is included in *Clinical Guide to Transfusion* chapter user-engagement data. Active users are those who engage with the page through scrolling and clicking.

Results:

The *Clinical Guide to Transfusion* chapter (combined English and French) had 9,026 page views, 5,665 total users, 5,620 active users and 336 downloads. Users were primarily from Canada, United States, France, Hong Kong and Algeria. The FAQs on PPPT

and APPT had 2,008 and 1531 page views respectively, 1,426 and 1,026 total users and 1, 405 and 1,015 active users Users were most commonly from Canada, United States and Hong Kong. The VIT had ~600-1000 visits and users which varied by page during the first 12 months following publication. Townhall attendance was between 20-50 per session and included medical laboratory technologists, physicians and nurses.

Conclusions: There was significant uptake of the educational resources provided. The most visited resource was the *Clinical Guide to Transfusion* chapter. Townhalls were well-attended.

Acknowledgements :

Pathogen reduced platelet implementation was a multidisciplinary initiative that spanned many departments. Development and dissemination of educational resources were the result of significant time, expertise and energy of many!

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Education and knowledge translation initiatives supporting solvent detergent plasma implementation by a national blood supplier

Abstract Summary :

Introduction:

In Canada (excluding Quebec) solvent detergent (SD) plasma became available for use in 2011 for select patients: (1) those requiring high volume or chronic plasma transfusions and with recurrent allergic reactions or an existing lung disorder with increased TRALI risk, (2) patients for whom group-compatible plasma was unavailable, and (3) patients with a historical life-threatening reaction to plasma.

On March 27, 2023, restrictions for ordering SD plasma from the national (excluding Quebec) blood suppler were removed, making SD plasma available for routine use in all patients. Hospitals were asked to transition 80% of plasma orders from frozen plasma to SD plasma by September 2023.

Aim:

This outlines our approach to knowledge translation, including the educational resources designed to support implementation of SD plasma, and their engagement metrics.

Design:

A multidisciplinary group developed educational resources available on the blood supplier's educational website for healthcare professionals.

- Summary article: SD treated plasma
- Frequently asked questions (FAQ): SD treated plasma
- One-page clinical summary: SD plasma
- Slide deck: SD plasma: Clinical overview
- Slide deck: SD plasma: Clinical overview - Short version
- Slide deck: SD plasma: Information for laboratory technologists
- Recorded presentations of all slide decks listed above narrated by transfusion medicine experts.

Educational resources were made available prior to implementation. Four initial stakeholder engagement sessions were held during the week of October 17, 2022. Additional sessions were coordinated to promote discussions among hospital key opinion leaders.

Online usage data was collected for selected educational resources from July 1, 2023, until December 31, 2024.

Results:

The Summary Article (English) had 3,338 page views by 2,456 users (2,406 active). The top countries by number of users were Canada (1,147), Saudi Arabia (598), U.S. (225), India (58), and U.K. (38). The French version had 211 page views by 163 users (156 active). The top countries were Canada (60), France (59), Belgium (8), Algeria (4), and Morocco (4).

The FAQ on SD treated plasma (English) had 2, 334 page views by 1,707 users (1,665 active). The top counties by number of users were Canada (252), U.S. (72), India (16), Australia (13), and Saudi Arabia (11). The French version had 231 page views by 189 users (188 active). The top countries were Canada (96), France (62). Algeria (10), Belgium (7), and Morocco (2).

Conclusions:

SD plasma implementation was a multidisciplinary initiative involving many departments. There was significant uptake of the educational resources provided.

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SD plasma implementation was a multidisciplinary initiative involving many departments at the blood supplier and the collaboration of hospitals and physicians. Abby Wolfe and Kaylee Brooks provided support gathering data and creating educational resources. The manufacturer also provided educational materials.

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Non-Invasive Prenatal Testing in Canada: Side-by-Side Evaluation of Two Platforms for Fetal RHD Screening

Abstract Summary :

Introduction: Non-Invasive Prenatal Testing for the detection of cell-free DNA (cfDNA) to determine fetal *RHD* genotype can guide targeted RhIg prophylaxis, avoiding unnecessary exposure to this blood-derived product in the 40% RhD-negative pregnancies carrying an RhD-negative fetus. This study evaluated two fetal *RHD* screening platforms to select the optimal assay for use in a Canadian reference laboratory setting.

Methods: Peripheral blood from 132 pregnant RhD-negative individuals (10 to 28 weeks gestational age) was collected into EDTA, centrifuged, and separated into plasma and buffy coat 1-6 days after venipuncture. Cell-free DNA was extracted from 2mL of plasma by an automated magnetic-bead based instrument (QIAsymphony) and tested in parallel using: (1) Health Canada licensed real-time PCR for *RHD* exon 4 (Devyser) and (2) mass spectrometry (MS) detection of *RHD* exons 4, 5, 7, and 10, chromosome Y, and reflex *RASSF1A* methylation (Agena). Buffy coat DNA from inconclusive samples was tested by Immucor RHD Molecular BeadChip Test. Assay detection limit was evaluated with 0.125-5ng spiked known *RHD* hemizygous samples and WHO standard 07/222. Fetal control performance was evaluated with spiked adult XX/XY DNA and placental DNA.

Results: Both assays detected < 0.5ng/ml spiked *RHD* DNA and were positive using 1:2 dilutions of the WHO standard in four replicates. Of the 132 samples tested by real-time PCR, 60 were tested by MS. Initial testing with MS resulted in false-negatives due to poor optimization of exon 10 thresholds. Once adjusted, 90% (54/60) samples were concordant. Two samples were flagged by real-time PCR for potential presence of maternal genomic DNA, and four samples for potential maternal *RHD* variant. Three of four samples were confirmed as *RHD* variants by BeadChip. MS reflex fetal sex determination incorrectly called samples spiked with adult genomic XX DNA and missed detection of a known XY sample. High amounts of spiked placental DNA (1ng) were required for detection of methylated *RASSF1A.*

Conclusion: While the MS assay has potential for higher sensitivity and precision due to

detection of multiple *RHD* exons and a fetal cfDNA confirmation test, it demonstrated need for further optimization and inconsistent performance of the reflex test in our laboratory. The real-time PCR assay is simple, robust, and well-optimized; its quantitative nature flagged the presence of increased maternal genomic DNA and potential maternal *RHD* variants. Consequently, the real-time PCR assay was selected for further clinical validation.

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Small volume platelet orders: Can aliquot validation improve platelet conservation?

Abstract Summary :

INTRODUCTION

Platelet utilization and the proportion manufactured with pathogen reduction technology (PRT) continue to increase in the United States. Similarly, Canadian Blood Services (CBS) started manufacturing PRT platelets in 2022 and there has been a yearly national increase in platelet issue. PRT component characteristics that increase the potential for waste include decreased platelet count increments, and nonimmune mediated mechanisms of platelet refractoriness. Further, platelet storage containers for PRT components are not validated for aliquoting. Therefore, small volume platelet orders are issued as full platelet units, wasting the residual volume. The Canadian National Advisory Committee (NAC) plan for managing shortages of labile blood components advises split platelet components for pediatric and adult patients, however amber phase communications for platelet components acknowledge that this may not be possible with PRT platelets. We aimed to audit our trends in platelet component issue since introduction of PRT; and platelet orders by volume to determine potential waste.

METHODS

Data for platelet units issued were obtained from CBS. Implementation of a unified provincial electronic medical record (EMR) was completed at all pediatric and high risk obstetrical acute care sites by May 2023. PRT platelets became available in our province in July 2023. Data were extracted for the most recent year on record in the EMR. Orders for platelet transfusion by volume were sorted by increments of 50ml since orders up to 150mL likely have residual volumes adequate for pediatric dosing. A range of potential units saved was estimated using the median platelet volumes ordered within each group, and the CBS published mean platelet volumes for pooled (184mL) and apheresis (277mL) units.

RESULTS

The number of platelet units issued in our province by CBS increased by 8.6% in 2024, compared with 7.6% in 2023. Between March 27, 2024 and March 26, 2025 a total of 15,793 platelet orders were recorded; at least 706 of these were for volumes ≤150mL. Based on binning the platelet volume orders by 50mL, this would require a maximum total platelet volume of 51,402mL. Data were not granular enough to determine if each unit issued was pooled or apheresis. Therefore, the total platelet volume administered to fill these orders was between 129,904mL to 195,562mL.

CONCLUSIONS

Platelet utilization has increased since the introduction of PRT. The use of whole platelet units to fill small volume pediatric orders may increase utilization for these cases by 250 to 380% depending on the use of pooled or apheresis units. Validation of PRT platelet containers for aliquoting by CBS has the potential to reduce platelet wastage and is required to facilitate the NAC plan for management of shortages.

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Transfusion Service Transformation

Abstract Summary :

Background: Our health authority's transfusion medicine (TM) service was historically managed by 5 governing operational teams with nine laboratory information systems (LIS), three antibody methods (gel, solid phase, PEG tube) and different clinical service expectations. Upon amalgamation, this variability posed risks for operational efficiencies in procurement, document management and maintenance of competency for technical staff. We have undergone a transformation effort to unify transfusion medicine practices to improve staffing portability, reduce inefficiencies and improve patient outcomes.

Methods: Since 2018, a diverse team, including TM physicians, managers, technologists, laboratory scientists, information technology, human factors and systems experts, were tasked with standardization of policies, test menus, reagents, methodologies, algorithms, and staff training in parallel to amalgamation of the 9 LIS's into one TM LIS and electronic medical record (EMR). Historical policies and processes were compared with the EMR vendor and published best practice recommendations to generate site classifications compatible with clinical services, testing volumes, and technical capacity comprised the single TM service.

Results: The 111 sites were divided into 5 categories: Dispense only sites (83), non-automated testing sites (14), automated testing sites (6); regional testing hubs (5) and immunohematology reference laboratories (3). Test menus and testing platforms were standardized for each category with the most limited menu including ABO/Rh(D), screens, direct antiglobulin tests, crossmatches and basic ABO discrepancy resolution and gradation of complexity through the other categories. 49 provincial documents were generated to facilitate this transformation – 12 specific to testing processes. The single gel testing platform, result sharing through common middleware and one LIS, facilitates centralized support by dedicated TM technologists. It has increased our ability to deal with inventory management, blood shortages, standardized reporting to external agencies and staffing constraints. To date, 70 shifts were covered by staff redistribution. 1.1 million legacy system patients were uploaded into our single patient registry which now contains data on 2.1 million patients, 276,000 of which have special requirements, phenotype and antibody histories. This streamlines patient care, improves turn around times and eliminates unnecessary repeat investigations. However, staff surveys document frustration with the rate and degree of change.

Conclusion: Through implementation of standardized practices, leveraging centralized resources and use of a shared LIS/EMR, this model has potential to enhance patient safety, reduce unnecessary testing and serve as a framework for other jurisdictions. Future optimizations will focus on stabilizing our system with a slower rate of change while improving our operational efficiencies and our workforce sustainability.

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42

Bridging the Gap: Navigating document management after the loss of an eDMS

Abstract Summary :

Introduction

Electronic document management systems (eDMSs) are a valuable tool to facilitate document administration to meet accreditation and regulatory requirements. In 2024, an unexpected decommissioning of the existing eDMS, forced the Transfusion Medicine (TM) Quality team to plan for an extended downtime without a conventional, commercial eDMS.

Design

The TM program's needs were broken into four interim system requirements: a mechanism to capture existing document records, a process to publish/revise new and existing documents, a way for staff to access existing documents, and a means for staff to acknowledge documents prior to publication (Read and Sign; R&S). Existing technology within the Microsoft 365 suite was assessed for ability to address these system requirements, while meeting accreditation and regulatory requirements.

Results

Due to a short, 15-day window between notification of potential eDMS system loss and access being revoked, a manual process was utilized to capture data from the existing eDMS. Document records and native copies for 1823 live TM documents were captured via screenshots and downloads respectively. Additionally, document records for 4632 archived documents were captured and 59 R&S records were downloaded. Obsolete and archived document versions were later recovered from back-up server copies.

Sharepoint Online and Teams were leveraged to create collaborative document records that include document approval. In the year following eDMS loss, 281 new/revised documents were published and 184 archived. A deviation to document management practice was required until organizational eDMS documents could be updated.

Staff were granted access to documents through existing downtime network folders; edit access was limited to ensure documents integrity. A hyperlinked table of contents was created to aid in staff navigation as the titles of auto-recovered files from the previous system often did not include a document number or the full document title.

Interim R&S processes were developed using Microsoft Forms and existing staff email groups. This document acknowledgment process was novel for 4 out of 5 zones and represented a significant change in practice for the remaining zone that already utilized R&Ss. In total, 58 R&Ss were sent in the first year.

Conclusions

Utilizing existing technology to meet document management requirements, allowed for a nimble response to the loss of the eDMS. While capturing native document copies was not an accreditation requirement, it allowed document revision to resume within 25 days. Ease of access to documents must be prioritized as real or perceived difficulties can lead to the use of uncontrolled documents.

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Impact on solvent detergent plasma implementation on adverse transfusion reaction reporting

Abstract Summary :

Introduction/ Objective:

In March 2023, a large national blood supplier announced the removal of restrictions on the use of pathogen-inactivated solvent detergent (S/D) plasma across Canadian hospitals, allowing it to be ordered for all patient groups. Following this change, Canadian hospitals were encouraged to adopt S/D plasma to a target of 80% of plasma orders by September 2023. S/D plasma is also derived from a large pool of donors, which may further decrease the risk of adverse transfusion reactions (ATRs) .We performed a retrospective study to assess the impact of transitioning to S/D plasma on the frequency of ATRs reported to the Transfusion Transmitted Injury Surveillance System (TTISS).

Design and Methods:

ATR data related to all plasma components and S/D plasma were extracted from the TTISS from 2018-2024. Retrospective analysis compared reaction characteristics/rates before and after March 2023. Denominator data was obtained from hospital entry to the provincial blood coordinating network to provide the number of units distributed across the province. Additional denominator data was obtain from the national blood supplier.

Results:

Between 2018 and 2024, a total of 181 transfusion reactions were reported, with 176 occurring in patients who received untreated plasma and only 5 in those who received S/D treated plasma. Notably, from 2022 onward, treated plasma began to be reported, and its associated reactions remained consistently low (2 cases in 2023 and 3 in 2024). In contrast, reactions with untreated plasma were significantly higher, particularly peaking in 2020 with 51 cases.

The data from 2018 to 2024 aligns with the implementation of S/D plasma in Canadian hospitals starting in March 2023. The steady decline in ATR rates observed, particularly the sharp decrease from 0.036% in 2023 to 0.016% in 2024, suggests a potential correlation with the widespread adoption of S/D plasma.

Year	Plasma Transfused	ATRs	ATR Rate (%)
2018	62,737	22	0.035%
2019	59,332	23	0.039%
2020	57,184	51	0.089%
2021	54,798	34	0.062%
2022	49,869	23	0.046%
2023	52,206	19	0.036%
2024	56,286	9	0.016%

Prior to the implementation of S/D plasma, minor allergic reactions were the most common (110 total). After the transition to S/D plasma, there was a marked reduction in minor allergic reactions, 4 only in 2024 compared to 29 in 2020, and febrile non-hemolytic reactions. Severe allergic/anaphylactic reactions and TACO (Transfusion Associated Circulatory Overload) also decreased.

There has been also a significant decrease in the severity of reported transfusion reactions with the use of S/D plasma compared to untreated plasma. Untreated plasma products had higher reports of severe (Grade 2) and life-threatening (Grade 3) reactions (13 and 7 cases, respectively), whereas S/D treated plasma showed only 1 severe case and no life-threatening reactions.

Conclusion:

The transition to S/D plasma in March 2023 was associated with a significant reduction in reported transfusion reactions. Data from 2018-2024 demonstrate a clear decline in both the incidence and severity of reactions, indicating an improvement in transfusion safety and patient outcomes.

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44

Emergency red blood cell utilization in Saskatchewan hold-blood sites: a 5-year audit

Abstract Summary :

Introduction: Understanding the volume and appropriateness of emergency group O red blood cell (RBC) transfusion is critical to ensure appropriate stewardship of this limited resource. Facilities designated as "Hold Blood" sites within our provincial health authority only stock group O RBC emergency use; no pre-transfusion testing is performed on-site. The purpose of this quality improvement audit was to evaluate the volume and appropriateness of emergency RBC units transfused at "Hold Blood" sites to ensure evidence-based rural RBC inventory optimization and local transfusion practices.

Design and Methods: Local Research Ethics Board approval was obtained. A retrospective manual paper-based audit of emergency RBC transfusions from 13 "Hold Blood" sites between January 1, 2018-December 31, 2022 was completed. Facility transfusion logs stating RBC disposition and copies of uncrossmatched RBC recipient patient charts were reviewed in a central hospital location. Collected data included: patient demographics, indication for transfusion, and available pre-transfusion hemoglobin. Group O RBC disposition data was obtained from Canadian Blood Services (CBS).

Results: A total 31 units (U) RBC were held as stock in "Hold Blood" site facilities. O negative RBC stock included: 1U at 2 sites; 2U at 9 sites; 3U at 1 site; 4U at 1 site (this site also stocked 4U O positive RBC). During our 5-year study period, there were 147 uncrossmatched RBC transfusion events including 205U (mean 1.4 units/event; range 1-9U). Over half (53%) of these RBC were given at 3 far-north sites. Charts were available for 133 (90%) transfusion events. Recipients included 71 (53%) males and 62 (47%) females. The mean age was 50.2 years, with males 49.8 years and females 50.7 years. The transfusion indication was recorded in 131 (89%) of cases, with 66 (50%) trauma, 46 (35%) gastrointestinal bleeding, and 19 (15%) obstetrical hemorrhage. Hemoglobin results were from on-site core-lab testing only. Pre-transfusion hemoglobin was documented in 87 (65%) of cases, with a mean of 75.1 g/L (range 21-147 g/L). CBS disposition data reported 581U O negative and 7U O positive RBC discarded due to outdate. Considering an estimated emergency stock of 1860U RBC at "Hold Blood" sites over 5-years, the transfusion rate was 11.0% and outdate rate was 31.6%; the remaining units were redistributed.

Conclusions: These data support the need to re-evaluate RBC stock in rural "Hold Blood" facilities to minimize overall RBC outdates and optimize O negative utilization. Consideration of the transfusion rate at each site, along with the surrounding population and transport times to larger facilities, is required to support modification of facility RBC stock.

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Comparison of Frozen Plasma and Solvent-Detergent Plasma Thaw Times: A Single-Centre Validation Study

Abstract Summary :

Introduction: As of March 27, 2023, solvent/detergent plasma (SDP; Octaplasma®) has become available from Canadian Blood Services (CBS) for use in patient care as a pathogen-reduced alternative to frozen plasma (FP). SDP is considered clinically equivalent to FP as a source of plasma proteins, and favored over FP with a more consistent coagulation factor composition and lower risk of infection and immune-mediated reactions. However, the Octaplasma® monograph recommends a longer thaw time of a minimum 30 minutes. We sought to complete a hospital-based validation comparing FP and SDP thaw times.

Design and Methods: A real-time audit of plasma ordered for patient care was completed between July-November 2023 within our largest hospital transfusion medicine lab. Plasma was selected based upon available inventory and included FP (Canadian Blood Services, Ottawa, ON) or SDP (Octaplasma®, Octapharma AB, Stockholm, Sweden). Units were stored in a -70°C Ultra-Low Freezer (Helmer Scientific, Noblesville, IN; NuAire, Plymouth, MN) and thawed according to standard lab protocol using the DH8 Plasma Thawer (Helmer Scientific, Noblesville, IN) with an 8-unit capacity and set point of 30-37°C. All units were placed in a protective thin plastic overwrap bag prior to thaw. A Traceable Digital Timers (VWR, Inc., Mississauga, ON) device was utilized. Units were considered thawed once a clear, yellow solution without precipitates was achieved.

Results: Thaw times of 55 events including 228 units FP and 59 events including 281 units SDP were compared. A mean of 4.1 FP units (range 1-8) and 4.7 SDP units (range 2-8) were thawed per event in a water bath (FP=mean 36.5°C, range 35.6-37.4°C; SDP=mean 36.6°C, range 36.0-37.2°C). The overall mean event thaw time of FP was 14:59 (range 12:00-18:03) and SDP was 18:31 (range 12:48-23:00). The mean FP thaw time of 1-4 units was 14:39 and 5-8 units was 15:53, compared to SDP thaw times of 18:42 and 18:06, respectively. All units passed visual inspection post-thaw and prior to issue or placement into the refrigerator.

Conclusion: This validation confirms that the mean SDP thaw time in a hospital environment is 3:50 longer than FP, but does not need to be 30 minutes. This difference is unlikely to be clinically significant in the emergency setting. Interestingly, the mean thaw time of 5-8 units SDP was shorter than 1-4 units. Utilizing our local methodology, no precipitates were observed upon inspection of thawed units prior to issue or placement in the refrigerator.

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46

Risk of high volume antenatal feto-maternal hemorrhage (FMH) in Rh negative pregnancies. What is the role of antenatal testing for FMH?

Abstract Summary :

Background: Rh Immune Globulin (RhIg) is given for prevention of D-alloimmunization in Rh-negative pregnancies as standard 3rd trimester prophylaxis and for antenatal sensitizing events. RhIg dosing depends on the fetal blood volume in maternal circulation; with one 300-microgram dose protecting against D-alloimmunization from 30 ml of fetal whole blood. Therefore, the volume of fetal blood in maternal circulation is determined by feto-maternal hemorrhage (FMH) testing.

Rationale and objectives: National and International Obstetrical Societies recommend performing FMH testing for all antenatal sensitizing events after 20 weeks gestation. However, evidence for the prevalence and etiology of FMH exceeding 30mL and requiring more than 300ug RhIg in the antenatal setting is limited, with wide variation in antenatal FMH testing across institutions and practitioners. This multi-center retrospective cohort study aims to determine the prevalence and etiology of antenatal fetal hemorrhage in Rh-negative pregnancies. This information may optimize FMH test utilization and inform practice regarding FMH assessment for antenatal sensitizing events.

Methods: Data was collected between January 1, 2018 and December 31, 2023. Study population was Rh-negative pregnancies with antenatal FMH testing or RhIg administration for sensitizing events. Cases were pregnancies with antenatal FMH exceeding 30 ml and/or higher than 300-ug antenatal RhIg dose for a sensitizing event. Aggregate data included number of Rh-negative pregnancies, antenatal FMH tests performed and proportion positive, RhIg doses given for antenatal sensitizing events and proportion greater than one 300-ug dose. Case-level data included gestational age at FMH event, FMH etiology, volume, and pregnancy outcomes including fetal demise, preterm delivery and maternal alloimmunization. Prevalence of antenatal high volume FMH was reported per number of Rh-negative pregnancies in study period.

Results: Aggregate data from four participating sites showed that 12.5% (3461/27,560) of Rh-negative pregnancies underwent antenatal FMH testing with 1% (86/3461) being positive. Nine pregnancies had antenatal FMH above 30 ml; with a prevalence of 0.03% (9/27,560). Three sites reported RhIg use for antenatal sensitizing events, which was required in 3% (581/20,360) of pregnancies. The proportion of pregnancies needing greater than one 300-ug RhIg dose antenatally was 0.03% (7/20,360). Case level data from three sites showed that intra-uterine fetal demise was most commonly associated with large volume FMH (6/9 cases). Four FMH cases occurred after 26 weeks gestation and one at 22 weeks GA. Red cell antibody screen was repeated in 45% (4/9) of cases, and showed no new antibodies.

Conclusion: Large volume antenatal FMH is a rare event observed mainly in the 3rd trimester with fetal demise being the most common association in our preliminary cohort. Data from additional participating sites will further clarify the causes and prevalence of antenatal high volume FMH.

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Turning the Tide: Transforming O RhD Negative RBC Management

Abstract Summary :

Introduction

Demand for O RhD negative (O neg) red blood cells (RBCs) in Canada has risen to over 12%, despite only 7% of Canadians being O neg. This discrepancy is multifactorial, driven by phenotype matching, neonatal use, and transfusions to non-O neg patients in emergency situations or to avoid outdating. However, the National Advisory Committee (NAC) recommendations indicate using O neg in non-O neg individuals solely to prevent expiry is likely unacceptable.

Our institutions redistribution program has been instrumental in mitigating outdate of RBCs, yet there remained instances where O neg RBCs were transfused to non-O neg patients to prevent expiry. In response, a policy was implemented in January 2023 prohibiting the use of O neg RBCs solely for the purpose of avoiding outdating, in alignment with current NAC guidelines.

Methods

To assess the impact of this policy change, data was collected following implementation (January 2023–October 2024), focusing on O neg RBC usage, ordering trends, and outdate rates.

Results

From January 2021 to October 2024, the proportion of O neg RBC orders from Canadian Blood Services (CBS) decreased from 16.5% to 12% of total RBC orders. O neg RBC usage in O neg recipients increased significantly, from 42.9% in 2021/2022 to 61.7% in 2024/2025.

Prior to policy implementation, the RBC outdate rate was 1.2% (2021/2022). After the policy was implemented, the outdate rate initially rose to 3.1% in 2023/2024, but it decreased to 2.2% in 2024/2025, suggesting stabilization as improvements in inventory management and alignment with guidelines took effect.

Conclusion

The implementation of NAC recommendations for appropriate O neg RBC usage at our institution resulted in a notable reduction in the proportion of O neg RBC orders and a marked increase in O neg usage among O neg recipients. Although there was a temporary rise in O neg RBC discard rates, they are now returning to near baseline levels, with further improvements expected as inventory management practices are refined.

Adhering to NAC guidelines not only conserves a precious donor resource but also ensures that O neg RBCs are allocated to patients who have no alternative, thereby optimizing red cell supply. In addition, policy compliance may reduce technologist workload and enhances overall inventory efficiency, ultimately supporting sustainable and equitable blood supply management across all regions.

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Platelet Intrauterine Fetal Transfusion

Abstract Summary :

Background:

Intrauterine platelet transfusion (IUPT) is infrequently required. The most common diagnoses for the need of IUPT is fetal/neonatal alloimmune thrombocytopenia (FNAIT). Other indications include twin anemia polycythemia sequence, parvovirus infection, and twin-twin transfusion syndrome among others. There is no standard platelet preparation process to optimize post IUPT platelet counts. Platelet number and volume need to be standardized for a maximal platelet increment following transfusion.

Objective: To determine factors that could improve post IUPT platelet counts.

Methods: We reviewed fetal platelet transfusions over a 3-year interval and compared pre and post platelet transfusion counts to determine whether current preparation methods resulted in a sustained platelet increment.

Platelets for IUPT are prepared by dividing an adult platelet dose. The adult dose bag is sterile connected to an empty satellite bag and approximately 100 mL is transferred. This aliquot is again sterile connected to another satellite bag and the product is concentrated in a temperature-controlled centrifuge for 7 mins at 3400 rpm. After centrifugation, the product rests for one hour after which, using a plasma extractor, plasma is extracted from the rested product so that the final, plasma reduced, concentrated platelet product has a volume of 20 - 25mL.

Results:

Over a 3-year interval, 19 IUPTs were performed. The average pre-platelet count across all indications was 86 X 10^9/L with pre-platelet counts starting as low as 7 x 10^9/L. The average post platelet count was 327 X 10^9/L.

Repeated platelet transfusions occurred in 2 of the 17 patients who received IUPT. Both patients were diagnosed with FNAIT: one patient received 5 platelet transfusions over a seven-week period and the other 3 platelet transfusions over a 3-week period. The average increment according to indication is listed in the Table.

Table: The average pre and post platelet counts across indications.

	Average		
Indication	Pre-Plt x 10^9/L (n)	Post-Plt x 10^9/L (n)	Volume transfused
FNAIT	54 (8)	280 (9)	24 mL(9)
Fetal Anemia	84 (5)	405 (3)	18 mL (5)
Twin anemia/polycythemia sequence	101 (2)	218 (1)	18 mL (2)
Twin-twin transfusion syndrome	71	241	10 mL (1)
Parvovirus infection	25	401	15 mL (1)
Unknown etiology	7	264	25 mL (1)

Conclusion: Post platelet increments varied. Future studies will determine other factors such as gestational age, patient weight and other maternal indices that may impact the platelet increment.

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Anti-KEL1 titration in pregnancy: a method comparison study

Abstract Summary :

Background:

Anti-KEL1 has been implicated in severe hemolytic disease of the fetus/newborn requiring antenatal transfusion. Serial antibody titration is currently not performed and the detection of anti-KEL1 triggers immediate referral to maternal fetal medicine (MFM) for anemia surveillance. There has been a resurgence of interest in anti-KEL1 titration to streamline patient care. The purpose of this study is to evaluate anti-KEL1 titres in pregnancy and compare results using SIAT versus gel-IAT titration and double dose versus single dose reagent red cells.

Study Design:

Frozen samples (n=48) from 33 pregnant patients with known anti-KEL1 antibodies were thawed and anti-KEL1 titration was performed by SIAT and gel-IAT (Ortho Gel Card) using commercially available single dose (Kk) reagent red cells (Immucor, Canada) and by SIAT IAT using in-house rare double dose KK (Cellano negative) red cells. A titre of 0 indicates that the antibody was not detected by the titration method but was historically detected by at least one other method.

Results:

The gestational age (GA) at time of testing ranged from 4^{+0} to 37^{+1} weeks. None of the patients had serial titrations. Using SIAT Kk reagent red cells anti-KEL1 titre values were: 0 (n=7), 1 (n=3), 2 (n=6), 4 (n=9), 8 (n=2), 16 (n=0), 32 (n=1), 64 (n=3), 128 (n=2),≥ 256 (n=0). For 12 patients with more than one sample in pregnancy, the highest value was chosen: samples collected at later GA were all within 1 tube difference of the initial titre. Of 48 samples, the gel-IAT titres using Kk cells ranged from 0 to 128 with 20 samples having the same titre, 24 samples gel > SIAT and 4 samples gel < SIAT. The mean tube difference for gel-IAT vs SIAT-IAT was +0.40. SIAT KK titres ranged from 0 to 512 with a mean tube difference of +1.33 compared to SIAT Kk titres.

Conclusion:

Of 33 pregnant patients with anti-KEL1 antibodies, 16 (48%) had titres < 4 using single-dose (Kk) reagent red cells in SIAT, a cut-off that has been adopted by some jurisdictions for the initiation of more intensive fetal monitoring by MFM. Titre values were on average one tube higher with double dose (KK) compared to single dose (Kk) red cells in SIAT. Contrary to the higher gel-IAT titre values typically reported for Rh antibodies, only half of the anti-KEL1 titres were higher in gel-IAT compared to SIAT.

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Creation of the Canadian Blood Group Genomic Reference Database: a Curated Tool to Support Precision Transfusion Medicine.

Abstract Summary :

Introduction: Accurate identification of blood groups is critical for matching donors to recipients to ensure the safety and clinical efficacy of blood transfusions. Currently, the International Society of Blood Transfusion (ISBT) recognizes 47 blood groups, encoded or regulated by 51 genes. Variations in those gene sequences impact the final blood type for everyone. Next Generation Sequencing (NGS) has emerged as a powerful tool to obtain a more comprehensive and precise blood phenotype than current licensed technologies. Accurate genotype interpretation and blood group phenotype prediction from NGS data requires a complete, normalized, precise, and curated database that includes reference genomic locations described using HGVS (Human Genome Variation Society) nomenclature and VCF (variant call format) nomenclature format. This critical tool is not available today: public ISBT blood group allele tables are lacking human genome assembly GRCh38 (hg38) coordinates and contain numerous inaccuracies. To support the development of novel NGS assays to enhance molecular red blood cell testing services in Canada, we created a comprehensive blood group genomic reference database.

Methods: The database design includes an allele table, a variant table, and a gene table. The allele table lists antigens in 47 blood groups and related information. The variant data table lists individual variants for blood group antigens, including hg38 genomic location. The gene table lists genes that correspond to all red cell blood groups. The database schema is intended to evolve with time, new knowledge, and use case situations. Extensive manual curation was conducted to collect and verify information listed in the variant table – for example, 42% of public ISBT records do not provide the required dbSNP ID (public archive of molecular variation for Homo sapiens). In multiple instances, the dbSNP ID listed by public databases incorrectly mapped to a paralogous gene. After verification of nucleotide changes and genomic coordinates, each allele was linked to an *in-silico* sequence covering all corresponding variants.

Results: The three database tables include 1965 ISBT-approved alleles (1298 defined by one single nucleotide variation (SNV) and 545 defined by multiple variants). Variant table consists of 1824 records; 1385 records are SNVs. Remaining records consist of 275 indels (34 insertions, 191 deletions, 35 duplications, and 15 deletion-insertion). A total of 108 structural variants (>50 bp) are listed in variant table after normalization.

Conclusions: We describe the creation of a blood group genomic database to support NGS transfusion medicine applications. It represents the most precise reference tool available in Canada for this purpose and incorporates rectifications to the current public ISBT Blood Group Allele tables. This database will inform probe design for future iterations of the blood group NGS enrichment panel, and it will be updated to include newly discovered antigens and clinically relevant variants published in the literature.

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Manual Method versus ECHO Lumena DAT-C3d Test Validation

Abstract Summary :

Background

The transfusion medicine laboratory at the Health Science Center (HSC) in St. John's performs approximately 180 DAT-C3d patient tests annually. Daily quality control testing also totals to approximately 1100 DAT-C3d tests annually. This results in the laboratory performing 6 times more QC than patient tests. A decision was made to undertake the validation of the new automated DAT-C3d assay available on the ECHO Lumena as it presents an opportunity to eliminate technique variability in the manual method, and a possible reduction in operating costs for this test.

Method

Between November 22, 2024, and December 17, 2024 , a total of 22 samples were tested concurrently by the manual tube method and on the ECHO Lumena. Four samples were also tested over 3 subsequent days on the ECHO Lumena to ensure reproducibility of the results. The ECHO Lumena utilizes a solid phase methodology for the automated DAT-C3d assay.

Results

Of the 22 samples tested, 20 (91%) samples consisting of 10 positives and 10 negatives had comparable results. It was noted that 5 weak-reacting results in the manual tube method were stronger on the ECHO Lumena, with a two-fold increase in grading of 2+ - 3+ results on the instrument. Two samples (9%), negative in manual tube method, resulted as equivocal (?) on the ECHO Lumena. The equivocal results on the instrument were deemed acceptable as the ECHO Lumena has been proven to be more sensitive, therefore detecting a weakly reacting DAT-C3d not detected by the manual tube method.

Reproducibility testing over the 3 days were consistent and showed no variability in strength of reactions.

DAT-C3d Results - Total of 22 Samples		**Reference Method: Manual Tube**	
		Positive	Negative
New Method: Automated ECHO Lumena	Positive	10	0
	Negative	0	10
	Equivocal	0	2

Conclusions

This validation indicates that the ECHO Lumena can be utilized to perform DAT-C3d testing. This will lead to staffing efficiencies and standardized results as variability due to technique in the manual method is eliminated. Automated testing on the ECHO Lumena will result in an overall cost reduction for DAT-C3d test as the QC for the manual method will only be performed when a tube DAT-C3d test is required, not daily as is currently being done.

Acknowledgements :

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Cost-effectiveness of reaching Ig self-sufficency targets using alternative treatments to reduce demand compared to increasing supply

Abstract Summary :

Ensuring a stable supply of immunoglobulin (Ig) products is a vital issue for patient care. Canada faces significant challenges in meeting demand for Ig, which has increased at an average annual rate of 8.5% between 2015 and 2019. This growing demand combined with reliance on U.S. plasma imports-accounting for 80% of Canada's supply-increases the risk of shortages. Since 2016, 13 instances of blood or plasma shortages occurred, some reaching a stage where supply is insufficient to continue with routine transfusion practices. This situation is exacerbated by current geopolitical uncertainties with the U.S.

Given the documented challenges in increasing domestic Ig supply, this work investigates the impact that strategies aimed at reducing Ig demand could have on self-sufficiency and healthcare costs. For conditions such as generalized myasthenia gravis (gMG) and chronic inflammatory demyelinating polyneuropathy (CIDP), representing 30% of total Canadian demand, alternative solutions , such as Efgartigimod, could substitute for Ig treatment.

Using data from plasma collectors in Canada, we project that Ig demand will reach 12.7 million grams by 2027-far exceeding the 2.7 million grams currently collected domestically. This shortfall could increase reliance on U.S. imports, for which prices are expected to rise from $60.60 USD/gram to $76.60 USD.

We show that the supply gap could be significantly reduced by a decrease in Ig usage for gMG and CIDP-projected at 1.2 and 2.5 million grams, respectively, by 2027. Leveraging such alternatives would lower operational risks and positively impact self-sufficiency targets: reducing Ig demand for these two conditions alone would increase self-sufficiency by 40% and reduce the projected deficit by 25%. Moreover, we estimate the marginal cost of increasing domestic Ig supply and show that treatment of gMG using Efgartigimod is cost-effective over a patient's lifetime, thus reducing the financial burden.

These results demonstrate that balancing efforts to increase domestic plasma supply while leveraging alternative treatments to reduce demand offers a sustainable and cost-effective solution to Canada's Ig deficit, in addition to lowering risks. Since it can be more advantageous to reduce Ig demand than raising supply, both strategies should be considered by policy-makers.

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Automation and Workload Assessment in the Transfusion Medicine Laboratory

Abstract Summary :

Background: Although transfusion medicine (TM) lags behind hematology and chemistry for implementation of automation, our workforce challenges are forcing TM to evaluate automated platforms as a mechanism to meet testing demands. However, data on the "right sizing" for automation has not been established.

Methods: Workload data for the 14 sites with automated analyzers were obtained from the laboratory information system (LIS) to capture the daily average volumes for tests considered appropriate for automation. The tests were considered to be ABORh(D) typing, antibody screen, crossmatch, antibody identification panels, polyspecific direct antiglobulin tests (DATs), IgG DATs, cord ABO/Rh(D) typing, weak D testing, eluate identification and red cell phenotypes as well as donor retesting. Complement DATs were excluded as appropriate gel cards and QC for automation were not available. The average daily automated tests (ADATs) currently being performed were calculated per site as well as per analyzer and compared to the potential ADATs to allow calculations for the site's percent automation. Sites were categorized as immunohematology reference laboratories (IRL); regional testing hubs (RTH) or metro automated testing sites (AT) to allow comparisons that could determine thresholds for re-evaluation of automation strategies.

Results: Overall, the average daily test volume considered suitable for automation ranged between 17.39 to 416.1 tests. The 5 RTHs ranged between 16.38 to 64.4 actual ADATs per analyzer but their potential ranged from 17.39 to 71.4 ADATs; only 2 sites have reached the 100% automation potential goal. The 6 ATs ranged between 19.81 to 66 actual ADATs per analyzer but their potential ranged from 19.81 to 68.8 ADATs; 3 sites have reached their 100% automation potential goal. The 3 IRLs, each currently have two analyzers and range between 54.65 to 208.05 ADATs per analyzer; 2 IRLs are at their 100% automation goal, the third is at 91%. Based on the comparators, we have established a threshold of 60 potential ADATs as the criterion to start evaluation potential addition of analyzers vs. replacing current automation with a higher capacity analyzer vs. redistribution of workload to alternate sites. We are also considering a lower threshold of 15, to initiate the evaluation of appropriateness of automated analyzer in comparison to manual gel workstations.

Conclusion: We require automation to maintain clinical service obligations, but we have not yet fully recognized our automation potential. Our data informed thresholds for site evaluations pertaining to automation strategies will allow transparency for our front-line staff, operational managers and leadership teams.

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54

Reducing Unnecessary Type & Screen Testing in Planned C-Sections: A Provincial QI Approach

Abstract Summary :

Caesarean section is a common obstetric procedure, with hemorrhage as a frequent complication. Traditionally, preoperative type and screen testing has been routine due to transfusion risks. However, evidence, including Choosing Wisely Canada's recommendations, suggests that limiting this practice to high-risk cases does not compromise patient safety. Based on the success of reducing type and screen testing locally there was a desire to expand this approach across additional sites.

Objective: Reduce the percentage of type and screen testing completed for planned c-sections in nine sites across the province to 20% by May 31, 2025.

To guide providers in determining when a type and screen test is necessary for planned caesarean sections, criteria were developed based on existing literature and expert consultation. Input from obstetrics, anesthesia, and transfusion medicine specialists across the province led to the identification of six risk factors that warranted type and screen testing for planned caesarean sections.

Nine high-volume sites across were selected to participate in the project. Implementation strategies included engaging site champions from obstetrics, anesthesia, and nursing, and conducting audit and feedback sessions to share baseline data and identify enablers and barriers to reducing unnecessary testing

Administrative and EMR data were extracted to generate run charts, allowing sites to track their progress over time. Comparator sites were included allowing sites to benchmark their progress against peer sites.

Challenges encountered included obtaining accurate transfusion data on the use of uncrossmatched blood to reassure clinicians about potential unintended consequences; identifying site champions and conducting audit and feedback sessions amidst competing priorities; and concerns about patient safety and the timely availability of crossmatched blood.

A total of 14 interactive sessions have been completed. In the 11 months since the first intervention, results indicate an absolute reduction of 16% (63% to 47%) in testing across the 9 sites involved. Variation in practice has also decreased from 63% to a 35% spread between the highest and lowest testing sites involved. The balancing measure of stat orders remains unchanged at 30%.

This project highlights the importance of a multidisciplinary approach in driving meaningful change and improving clinical practices. The integration of data plays a crucial role in supporting continuous improvement and helps to reassure clinicians that reducing type and screen testing does not compromise patient safety. For sustainable practice change, embedding criteria in an EMR offers a valuable mechanism for providing clinicians with a consistent, standardized reminder to guide decision-making.

Acknowledgements :

We would like to acknowledge the contributions of the Provincial Steering Committee, which included representation from

obstetrics, anesthesia, transfusion medicine, family medicine, the Perinatal Health Program, data and analytics, finance, and project management. Special thanks to the local site champions for their leadership in implementation and engagement throughout the project.

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The National HLA/HPA Selected Platelet Program: Utilization trends in Canada

Abstract Summary :

Introduction

The HLA/HPA Selected Platelet Program oversees the management of HLA/HPA selected platelets (HSP) for patients with alloimmune platelet refractoriness. This program coordinates the collection and delivery of platelets to hospital customers countrywide. The objective of this study was to review the temporal trends of patient and product demands for HSP over the past 4 years.

Methods

This was a retrospective cohort study examining the weekly and annual number of open patient cases and the number of HSP units ordered from 2021-01-01 to 2024-12-29. Inventory data was extracted from corporate data systems using pre-defined search criteria. Results were analyzed and reported in a descriptive manner.

Results

Over the examined period, a total of 16320 HSPs were issued to 781 patients (Table 1). There was a 40% increase in the number of patients enrolled in the program and a 28% increase in the number HSP units requested per week in 2024 compared to 2023. The fill rate in 2024 decreased from 98% to 95%. Over the 4 years, the total number of apheresis platelets (AP) shipped has reduced by 4.2% whereas the number of HSP shipped has increased by 17%.

Table 1: Patient Case and HSP Product Demands

	2021	2022	2023	2024
Patients enrolled (Annual change %)	178	171 (-4%)	173 (+2%)	259 (+40%)
Average active cases/week	37	46	41	54
HSP units requested (Annual change %)	3510	4285 (+20%)	3914 (-9%)	5013 (+25%)
Average HSP units requested/ week	68	81	75	96
Annual Calculated Order Fill Rate	99%	99%	98%	95%

Conclusion

The HLA/HPA Selected Platelet Program showed minor fluctuations in case load, product demand and order fill rates until 2024 at which point there was an unexpected increase in patients enrolled. The increased number of patient cases has also impacted the number of HSP units requested and has led to a larger number of unfilled HSP orders. This change could be due

to enhanced program awareness resulting from more frequent educational sessions that have been conducted with hospitals and transfusion medicine trainees. Alternatively, this could be due to a true increase in alloimmunized platelet transfusion refractory patients or an increase in recognized alloimmunized platelet transfusion refractory patients. This change in the number of cases has also been accompanied by a noted rise in patient complexity and a greater number of highly alloimmunized patents. Additional studies and ongoing monitoring are required to improve our understanding of the observed country-wide increase in demand for HSP products.

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Development and feasibility of a national prehospital transfusion registry: insights from the Blood on Board program at Ornge

Abstract Summary :

Introduction/Objective:

Out-of-hospital blood transfusion (OHBT) is an emerging practice for the management of hemorrhagic shock following trauma, but its outcomes remain unclear. The Canadian Prehospital and Transport Transfusion (CAN-PATT) network aims to standardize OHBT practices and link out-of-hospital care with in-hospital outcomes through a national registry. This pilot study assessed the feasibility of linking these records for patients who received OHBT via a provincial air ambulance service.

Design and Methods:

This retrospective cohort study included patients who received at least one unit of OHBT through an air ambulance Blood on Board program between September 2021 and July 2024 and were transported to one of two adult level 1 trauma centers. Prehospital data from the air ambulance database were linked to hospital data from the trauma registries. Hospital charts were manually reviewed for the missing variables. The primary outcome of the study was the percentage of prehospital and in-hospital records that could be successfully linked. Secondary outcomes included the percentage of variables collected by the registry vs chart review, injury patterns, and in-hospital mortality. Continuous variables were summarized as means/SDs or medians/IQRs, and categorical variables as counts and frequencies.

Results:

During the study period, 93 patients received an OHBT; 90 were transported to one of the trauma centres and 3 died in transport. Of those 90 patients, 83 (92%) were successfully linked (Site 1: 36/39; Site 2: 47/51) between the air ambulance database and hospital trauma registries. The remaining patients were unlinked due to unmatched identifiers like age and time of arrival. The air ambulance database provided 100% (97/97) of required out-of-hospital variables; the hospital registries collected 45% (13/29) (site 1) and 52% (15/29) (site 2) of required in-hospital variables. Among the 83 linked patients, median (IQR) age was 41.5 years (29–60), 73% male, 89% blunt trauma, and 22% in-hospital mortality.

Conclusions:

This study demonstrates the feasibility of linking prehospital and in-hospital records for OHBT recipients, achieving a 92% linkage rate. Challenges in linking records and in-hospital data collection highlight obstacles for an efficient registry. Future work should explore incorporating missing variables into hospital registries to support the establishment of a national OHBT registry to enhance prehospital trauma care.

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Analysis of the 2024 IQMH patterns of practice survey on provision of transfusion services and blood products to affiliated laboratories, subsidiary facilities, and other programs.

Abstract Summary :

Title

Analysis of the 2024 IQMH patterns of practice survey on provision of transfusion services and blood products to affiliated laboratories, subsidiary facilities, and other programs.

Introduction / Objective

The evolving healthcare landscape in Ontario and Canada is fostering partnerships to enhance patient care, improve delivery, and address laboratory staff shortages. 2024 IQMH Patterns of Practice survey examines the provision of transfusion services and blood components/products to affiliated laboratories, subsidiary facilities, and other programs. Effective management ensures compliance with standards, supports quality care, and mitigates transfusion risks.

Design and Methods

The survey was distributed to 183 participants, with a voluntary response rate of 87.4% (n=160) after excluding duplicate entries and non-hospital-based private/reference laboratories. Of the 160 responses, 84.4% represent Ontario laboratories, while the remaining 15.6% are from other provinces across Canada. The Transfusion Medicine scientific committee conducted a review that focused on four key aspects of providing transfusion services and blood components/products to affiliated laboratories, subsidiary facilities, and other programs.

Results

- The review of transfusion services revealed that approximately 32.9% of laboratories (51 out of 155) provided transfusion services to affiliated laboratories, subsidiary facilities, and other programs. Commonly offered services included:
    - ABO/Rh typing
    - antibody screening, identification, and phenotyping
    - differential direct antiglobulin testing and eluate
    - AHG XM
- In terms of blood components/products provision, over half (54.2%) of laboratories supplied these to affiliated laboratories, subsidiary facilities, and other programs. Key components/products included red blood cells, platelets, IVIG/SCIG, factor concentrates, and RhIG.
- The survey also assessed quality management practices, with 78% of laboratories reported having policies for error, accident, and adverse event reporting.
- Continuing education for blood administration and audits are a shared responsibility between TMED-AAU participants and the staff at the affiliated laboratory, subsidiary facility, other program. Variability in audit

preparation and policy clarity indicated areas for improvement. The need for standardized procedures for the disposition of unused blood products was also identified.

Conclusions

The findings of this Patterns of Practice survey highlight the diverse responsibilities of TMED-AAU participating sites and their crucial role in supporting affiliated laboratories, subsidiary facilities and other programs. Areas for improvement and standardization have been identified in this survey. Continued collaboration between supporting and receiving facilities is required to maintain standardized procedures, perform audits, and deliver training, to manage compliance with standards while mitigating transfusion risks.

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Exploration of Participant Responses to the 2024 IQMH Educational Survey and Discrepancies in Practice Across the Province.

Abstract Summary :

Introduction / Objective

As part of its annual education survey, the Institute for Quality Management in Healthcare (IQMH) administered three case studies focused on serologic weak D, prenatal care and blood product management. This study explores educational survey data on transfusion medicine practices across laboratories of varying proficiency levels.

Design and Methods

The survey was distributed to 150 participants, with a voluntary response rate of 80.0% (n=120). Of the 120 responses, 99.2% represent Ontario laboratories, while the remaining 0.8% are from other provinces across Canada. A review of the survey results was conducted by the Transfusion Medicine scientific committee, with a focused on the following four critical questions:

- **Q 1.2:** How do you report of a serologic weak D in your Laboratory Information System?
- **Q 1.4:** Would you administer RhIg to a patient with a weak serologic D?
- **Q 2.1:** Does your lab perform prospective screening of transfusion orders?
- **Q 2.4:** What is your institute's threshold for prophylactic platelet transfusion in patients with chemotherapy induced thrombocytopenia?

Results

Q 1.2	B indeterminate (35.8%)	B negative (21.7%)	B positive (30.8%)	Other (11.7%)
Q 1.4	Yes (57.5%)	No (29.2%)	Other (13.3%)	
Q 2.1	Yes (70.0%)	No (30.0%)		
Q 2.4	5 x 10^9/L (0.8%)	10 x 10^9/L (62.5%)	50 x 10^9/L (7.5%)	Other (29.2%)

Conclusions

While designing this educational survey, the expectation was that the majority of participants would be aligned in their transfusion medicine practices, based on current guidelines and recommendations. This educational survey identified that there is a considerable variability in transfusion practice across the province, with one-third to one-half of the participants managing the case in a different way, despite identical testing results. Additionally, there is substantial inconsistency in screening policies for inappropriate blood product orders. These findings highlight the need for continuing educational initiatives to support evidence-based decision-making.

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We extend our gratitude to the IQMH Transfusion Medicine scientific committee for their review and insightful contributions.

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Cord DAT strength correlates with the need for neonatal phototherapy

Abstract Summary :

Cord DAT strength correlates with the need for neonatal phototherapy

Introduction:
Hemolytic disease of the newborn (HDN) affects over 1% of newborns annually. HDN can be diagnosed when a positive direct antiglobulin test (DAT) accompanies features of hemolysis in a newborn's blood. Although DAT results are graded in strength from 1+ to 4+, cord DAT strengths are not routinely reported for newborns, as there is no consensus on their relationship to disease severity. This study aimed to examine the association between DAT strength and severity of disease presentation in HDN.

Methods:
Electronic charts for newborns with positive cord DAT results between January 2000 and December 2022 were reviewed. Premature infants and those admitted to the NICU for reasons other than phototherapy or red cell transfusion were excluded. Ninety-six newborns met the inclusion criteria. Data collected included gestational age, hemoglobin concentration, need and duration of phototherapy, and number of red cell transfusions. Relative risk (RR) and 95% confidence intervals (CI) were calculated for dichotomous independent variables [weakly positive DAT (1+ or 2+) vs. strongly positive DAT (3+ or 4+)] against dependent variables: anemia, red cell transfusion, and phototherapy.

Results:
Of the 96 newborns, 9 were anemic, 5 required red blood cell transfusions, and 58 received phototherapy. Compared to weakly positive DATs, a strongly positive DAT was associated with an increased risk of anemia (RR 1.89, 95% CI [0.51, 6.98]), red cell transfusion (RR 4.26, 95% CI [0.49, 36.7]), and phototherapy (RR 1.47, 95% CI [1.05, 2.06]).

Discussion:
A strongly positive cord DAT (3+ or 4+) indicates a newborn is at a higher risk of requiring

phototherapy for HDN. There also appears to be an increased risk of anemia and need for transfusion, though larger prospective studies may be needed to confirm these associations. Reporting DAT strengths may help identify newborns at greatest risk and improve postnatal care planning.

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Comparative evaluation of automated column agglutination technique versus manual conventional tube isohemagglutinin titration in ABO-incompatible renal transplant

Abstract Summary :

Introduction:

Anti-A/anti-B titration study is vital for assessing the ABO-incompatible renal transplant eligibility. While conventional tube testing (CTT) is frequently used, it is labor-intensive and prone to variability between observers. To address these challenges, the gel column agglutination technique (CAT) was validated at a renal transplant center with the goal of minimizing technical difficulties and enhancing operational efficiency.

Design and Methods:

This prospective validation study was conducted at the Transfusion Medicine Lab from April to December 2024. Residual blood samples from patients who had completed all necessary clinical assessments were utilized to evaluate anti-A1, anti-A2, and anti-B titrations using both CTT and CAT methods. The CTT titration was performed via saline dilution following the AABB Technical Manual, with IgM phase evaluated at immediate spin (IS) and 60-minute incubation, and IgG phase after 30-minute incubation at 37°C and an indirect antiglobulin test. For CAT, the Ortho Vision Max analyzer was employed in accordance with the manufacturer's protocols. The titre endpoint was defined as the highest dilution that produced 1+ agglutination. Data analysis, including the calculation of the intraclass correlation coefficient (ICC), was conducted using R software.

Results:

In the IgM phase, a total of 47 and 58 titrations from 27 and 30 patient samples were analyzed using CTT and CAT, respectively. The 60-minute incubation resulted in titres that were one-fold higher in 55% of cases compared to the IS CTT method. The CAT method demonstrated equivalent or one-fold higher IgM titres in 64% and 83% of cases for the IS and 60-minute incubation, respectively. Additionally, 55 titrations from 31 patient samples tested by CAT showed equivalent or one-fold higher IgG titres in 71% compared to those assessed by CTT. A strong correlation between CTT and CAT was demonstrated using Mixed Effects Regression Models, with coefficients of determination (R^2)

of 0.83 for IgM and 0.91 for IgG. The ICC between CTT and CAT demonstrated high reliability for both IgG (ICC=0.91; 95%CI=0.85-0.95) and IgM (ICC=0.82; 95%CI=0.71-0.89).

Conclusions:

The CAT method yields consistent titres that are either equivalent to or one-fold higher than those obtained by the CTT-based isohemagglutinin titres. Due to the slightly elevated titres associated with the CAT method, it is important to inform ordering physicians about the minor discrepancies between the two methods. Implementing automated CAT-based titration could be an effective way to reduce technologist workload and minimize variations.

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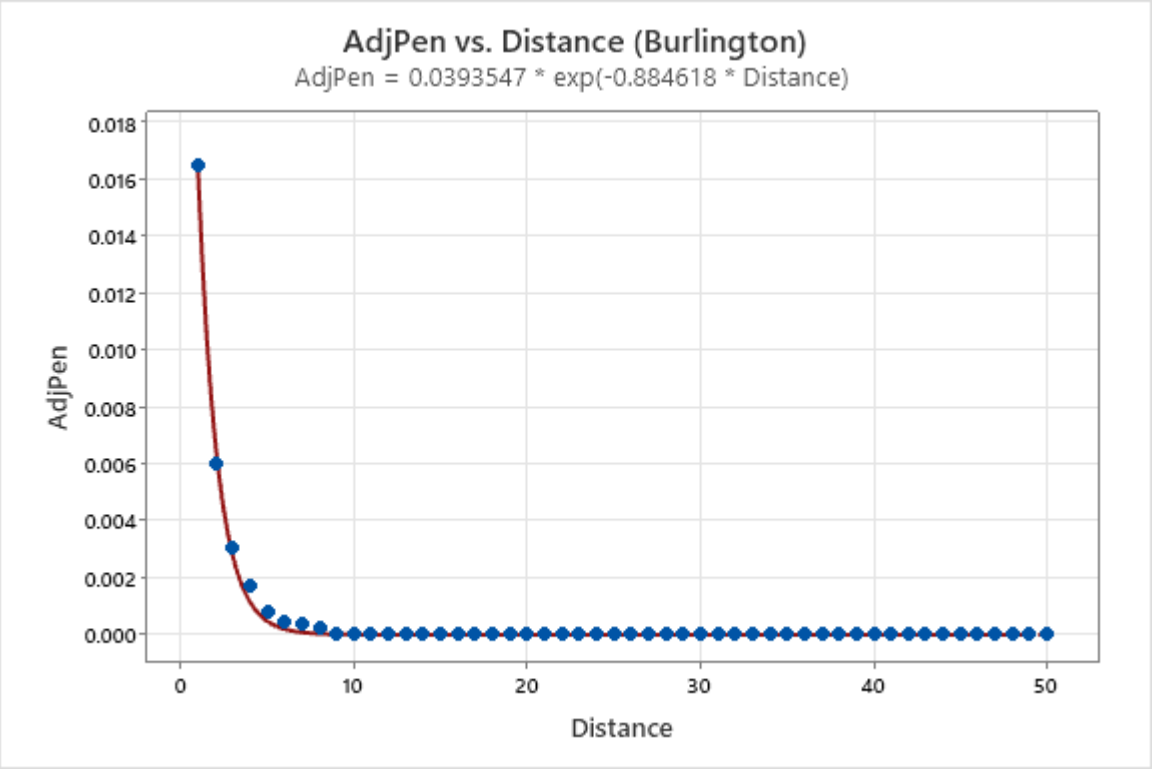
Designing Canada's Blood Supply Chain for the 2030's

Abstract Summary :

Background: Following the end of COVID-19 restrictions, a shift in blood donor behaviour occurred. Individuals are less likely to become donors and, if they donate, lapse more frequently. Changes in donor behaviour, combined with the conversion of whole blood collection centres to dedicated plasma donation centres (PDCs) and an increase in demand for packed red cells, has led to a prolonged period of lower inventory; national stocks of red cells, while still sufficient, are lower than have previously been experienced.

An analysis of donor behaviour indicates that individuals are highly sensitive to distance and are less likely to be a donor the farther away from a collection site the person lives. See below.



The rapid decay for donor participation vs. distance suggests that additional donor collection opportunities (fixed or mobile) must be established if the collection targets are to be expanded.

However, adding additional collection sites is only part of the solution. The placement of new collection centres into the CBS network will change its structure (or topology_. It makes sense to evaluate overall network optimization when considering changes to topology to accommodate increased collections. Accordingly, a network optimization model for the CBS supply network has been developed. The functions of this model are:

1. To identify the number and types of facilities to be operated (and over what time frame) by CBS.
2. Assign geographic regions of donors (FSAs) to collection sites.
3. Set annual targets for collection sites.
4. Develop a minimum cost assignment of transportation links between collection and production sites.
5. Determine an annual production plan for production sites.
6. Make a minimum cost assignment of products at distribution sites to demand sites to minimize transportation costs.

In this talk we discuss the develpment of the model, describe the interesting process of validating it, and provide preliminary results.

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Post-Pandemic Trends and Regional Variability in Red Blood Cell Issuance Across Canada

Abstract Summary :

Introduction:

Understanding regional variability in red blood cell (RBC) demand is key to optimizing blood supply management in Canada. While issuance, a proxy for demand in current data-sharing models, was stable across provinces pre-pandemic, post-pandemic patterns show significant increases, complicating forecasting and donor recruitment. This study analyzes shifting RBC demand to identify high-growth regions and inform targeted supply strategies.

Design and Methods:

We conducted a retrospective analysis using monthly red blood cell (RBC) distribution data from the national blood operator, covering the period from April 2014 to February 2024. The dataset included national RBC issue volumes to hospitals, stratified by province (excluding Quebec).

Results:

Post-pandemic data show a general rise in red blood cell (RBC) product demand and interprovincial variability. Nationally (excluding Quebec), RBC demand declined pre-pandemic, rose post-pandemic, and has declined again in the current fiscal year. O-negative issuance increased by 1.2% from 2023 to 2024, with Alberta up 2.5% and Ontario up just 0.1%. Alberta followed national RBC trends, while B.C. and Ontario fluctuated between growth and decline. O-positive issuance rose sharply in 2023, with B.C. showing a 5.7% increase; Alberta mirrored national pre-pandemic trends but has since often diverged. B-negative issuance increased nationally in 2023 and 2024: Ontario rose 4.4% in 2023 but declined in 2024; Alberta dropped 1.3% in 2023 but rose 0.5% in 2024; B.C. saw a 14.6% increase in 2024.

Conclusion:

These findings indicate a post-pandemic rebound and change in RBC issuance, with pronounced regional variability. Increases in O-negative and O-positive issuance-especially in Alberta and British Columbia-point to shifting provincial needs as well as a mismatch between aggregate patient demand and regional system capacity. This underscores the need for

adaptive supply management strategies. Enhanced data sharing and collection, both quantitative and qualitative, will enrich predictive modeling and be critical to proactively address changing demand across Canada.

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Development of Knowledge Translation Toolkit for the Canadian Transfusion Trials Group

Abstract Summary :

Development of Knowledge Translation Toolkit for the Canadian Transfusion Trials Group

Introduction/Objective: The Canadian Transfusion Trials Group (CTTG) is an investigator-led national network created to accelerate relevant, high-quality clinical trials in Transfusion Medicine. The CTTG is comprised of several working groups (WG), each tasked with distinct objectives to support its overall mission. The Knowledge Translation (KT) WG aims to facilitate the effective exchange of knowledge between Canadian Transfusion Medicine-focused investigators and targeted stakeholder groups, by assisting with study design and the dissemination and implementation of research outputs. To ensure consideration of KT at all stages of the research process, we sought to develop a KT Toolkit: a focused resource outlining practical strategies for KT integration by Transfusion Medicine investigators and research teams.

Design and Methods: The KT Toolkit was modelled according to the Knowledge To Action (KTA) framework, which provides a structured approach to carrying knowledge from creation to application (1). KT interventions were selected for inclusion in the Toolkit based on a review of commonly applied KT strategies both within the field of Transfusion Medicine and healthcare more broadly (2, 3). KT WG members collaborated to prepare a preliminary draft of the KT Toolkit, which was circulated to the CTTG Steering Committee for review. Based on the feedback received, the KT Toolkit was iteratively revised until it achieved consensus among all KT WG members.

Results: The KT Toolkit provides a comprehensive overview of suggested KT interventions for the diffusion, dissemination, and implementation of Transfusion Medicine research. Each KT intervention is assigned to one of five stages of the research process: study design, study execution, pre-publication, at-publication, and post-publication. KT interventions target a broad range of stakeholder groups, including researchers, clinicians, patients, and policymakers. To

improve practicality of the Toolkit, resources locally available within Canada are specified, such as relevant organizations and associations, policymakers, educational meetings, and social media platforms. The Toolkit encourages investigators to identify barriers and facilitators to KT implementation throughout the research process. Lastly, literature for background reading on the principles and application of KT is outlined.

Conclusions: Herein we describe the development of a KT Toolkit to support the integration of KT in Transfusion Medicine research. The Toolkit encompasses a range of KT interventions which target key stakeholders throughout major stages of the research process. Future work will focus on describing the application of the KT Toolkit to a real-world CTTG-funded study.

Acknowledgements :

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E-learning for Transfusion Consent: Developing a Novel Educational Tool

Abstract Summary :

Introduction

Blood transfusions are one of the most common medical procedures in hospitals. However, previous literature has demonstrated deficiencies in the consent process, with many conversations being hurried, mis-remembered, or inaccurate. Our objective was to create an educational tool that could be used to teach medical trainees how to obtain informed consent for red cell transfusions.

Methods

An interactive learning module was created through Articulate Rise, a web application for course creation. Information from recent guidelines and literature was emphasized. Content was also based on a peer-reviewed, published narrative for obtaining informed consent for transfusion. Prior to release, the module was piloted and it was revised based on feedback from stakeholders.

On the course landing page and at the end of the module, participants are offered the option to provide feedback on the course through a survey that include 5-point Likert scales and open-ended questions. The survey will remain open for 12 months, then the feedback will be used to revise and improve the course. The E-learning module was disseminated through the Canadian Society for Transfusion Medicine monthly communique and Canadian Blood Services' Research and Education newsletter.

Results

The module has been available on the Canadian Blood Services' Professional Education website for approximately 9 months. During this time, 873 users visited the webpage, and 40 participants completed the survey. Of the 35 participants that completed the optional demographic questions, 23% (8/35) were physicians, 31.4% (11/35) were nurses, and 25.7% (9/35) were medical laboratory technologists (MLTs). The majority of survey participants (77%, 27/35) worked in a hospital setting.

Most participants selected 'Agree' or 'Strongly agree' for the 5-point Likert scale questions that the module is easy to use, is appropriate in length, and has clinical utility. Those who provided free text feedback remarked positively on the interactivity of the module and its clarity. With regards to areas of improvement, users advised decreasing the use of acronyms and expanding upon the content in the case study.

Conclusions

Overall, the e-learning module was well-received by participants who completed the survey. Users felt that the module was informative and provided positive comments regarding its interactivity and ease of use.

Acknowledgements :

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Calculating Capacity: A Workload Model for Transfusion Medicine Physicians in Ontario

Abstract Summary :

Introduction

The ability to measure laboratory physician workload is vital to ensure hospital laboratories are appropriately staffed and supported. Workload models have been created such as the Level 4 equivalent (L4E) model by the Canadian Association of Pathologists. However, these models do not adequately capture the care provided by transfusion medicine (TM) physicians and their responsibilities. Our goal was to create a workload model for TM physicians in Ontario.

Methods

A working group of ten TM physicians from academic and community centres across Ontario was formed. An environmental scan found a TM physician workload model from British Columbia in 2016, but it has not been updated since that time. A time and motion study was performed by two TM physicians to understand how time was allocated to tasks related to lab oversight and clinical care. The working group then created a comprehensive list of TM physician activities and divided these into lab oversight and patient-specific activities. Clinical codes were created to capture the time required for patient-specific tasks. The model was iteratively updated with input from the working group. Once a draft workload model was developed, feedback was sought from a wider group of TM physicians on two occasions.

Results

The workload model proposes that approximately 80% of a TM physician's time is spent on laboratory oversight and the other 20% is dedicated to clinical care. Laboratory oversight is captured through data that are being submitted by TM labs and reported to the Ministry of Health. Laboratory workload data includes tasks such as testing, inventory management, and product issuing. The laboratory workload data of two large hospitals with sufficient TM physician support was used as a benchmark. Based on this, approximately 1 million lab workload units would require 0.8 TM physician full-time equivalent (FTE) for laboratory oversight. Codes would capture time spent on clinical care, which is estimated to be 0.2 FTE for every 1 million lab workload units. Thus, the overall estimate would be that one FTE is required for 1 million lab workload units.

Conclusions

Workload models are crucial for understanding physician resource requirements and to assess if current staffing is adequate. We developed a novel workload model for TM physicians that uses laboratory workload units to capture oversight activities. The working group also created a set of TM-specific codes to track the provision of clinical care.

Acknowledgements :

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Massive hemorrhage protocol activation in a tertiary hospital network: a 3-year retrospective quality improvement audit using quality indicators

Abstract Summary :

Introduction/Objective:

Massive bleeding (frequently defined as administration of 10 units red blood cells (RBC) or more in 24 hours) has a high mortality rate. Use of a Massive Hemorrhage Protocol (MHP) has been demonstrated to improve patient outcomes. In 2019, a multidisciplinary expert committee from Ontario published criteria for a successful MHP, which proposed eight quality-indicators (Q1-Q8). These guidelines were adopted in our Canadian tertiary-care hospital network in 2021. We undertook a quality-improvement audit of our revised MHP to evaluate compliance rates with these quality-indicators. Further, we sought to identify potential MHP under-activation rates based on patients receiving a massive transfusion of RBC, but an MHP was not activated, and see if there were differences in compliance rates compared to the MHP-activated group.

Methodology:

A retrospective chart review of patients from 3 urban hospital facilities between August 23, 2021 and August 23, 2024 was completed. Quality indicators included: Q1. Tranexamic acid administered within 1 hour of MHP activation; Q2. RBC transfusion initiated within 15 min of MHP activation; Q3. Call-for-transfer initiated within 60 min of MHP activation (if transferred from rural settings); Q4. Temperature 35°C or more achieved at MHP termination; Q5. Hemoglobin maintained between 60-110 g/L during MHP activation; Q6. Transition to group-specific RBC and plasma within 90 min of arrival/hemorrhage onset; Q7. Appropriate MHP activation (6 red cell units or more in first 24 h, or more than 40 mL/kg RBC in 24 h in pediatric patients); Q8. Blood component wastage (including plasma that is thawed and not used before expiry). Two patient lists were generated: the first including all MHP activations within the study period, and the second including all patients who received 10 RBC units or more in 24 hours. The "MHP Activated Group" and the "Massive Hemorrhage, no MHP" group will be cross-referenced and student t-test will be used to compare quality indicator compliance rates between the two groups.

Results:

Two patient lists were generated, including 184 events in the "MHP Activated Group", and 92 patients in the "Massive Hemorrhage, no MHP" group. To date, data assessing Q1-Q8 indicators have been collected on 7 patients with the following compliance rates: Q1. 60%, Q2. 60%, Q3. (N/A), Q4. 67%, Q5. 25%, Q6. 60%, Q7. 100%, Q8. 71%. Collecting all quality metric data can be challenging during an MHP, and the missing data rates ranged from 0% in Q8 to 57% in Q4. Complete data collection and statistical analysis will be presented at the CSTM 2025 Conference.

Conclusion:

Results of this audit will help identify areas of improving patient care in the context of future MHP activations.

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We would like to acknowledge the work of our laboratory technical and clinical staff for their dedication to coordinated patient care during MHP activations.

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Implementing Best Practice Guidelines for Sickle Cell Disease at a Community Teaching Hospital

Abstract Summary :

Objective: Adapt and implement best practice guidelines for sickle cell disease (SCD) at our healthcare facility, a pilot site for Evidence to Practice (E2P) Ontario.

Design and Methods: We received education and guidance from provincial SCD experts within the E2P Ontario framework and with funding through Ontario Health. A newly formed interdisciplinary hospital network implemented these quality standards into our existing models through specific SCD order sets for both inpatients and the emergency department (ED).

Some key areas of our focus were:

1. Creating a way to automatically notify the blood bank when a SCD patient presents, to ensure their genotype/phenotype information is uploaded into the blood bank system and transfusion care includes extended phenotype matching.
2. Updating current order sets to align with best practice guidelines for SCD and providing education to clinicians to use these order sets when SCD patients present to the hospital.
3. Educating clinicians in all areas of the hospital to improve awareness of the Ontario Quality Standards of Care and SCD best practices.

Results:

1. We created a laboratory communication notification in both the ED and inpatient order sets, creating a process where the laboratory will automatically receive a patient information printout in the blood bank printer when a SCD order set is activated. Go-Live target date is in March 2025.
2. With assistance from E2P, we collaborated with leaders in SCD care to successfully update and align our order sets with SCD leader hospitals.
3. Our electronic medical records system include a cross-encounter care plan for SCD patients, focusing on individualized care and treatments that were effective during their last hospital visit/admission, to improve continuity of care.
4. We have had a leading expert in SCD care present at our hospital, have had weekly E2P meetings working towards ongoing SCD education and best practice, and have grown the SCD advisory group through this process. The goal is ensuring ongoing education and care towards SCD patients.

Conclusion: We have aligned our healthcare facility with best practice guidelines for SCD and created a system of automatic SCD notification to our laboratory.

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Updating a provincial MHP through a modified Delphi: What has changed?

Abstract Summary :

Introduction/Objective: Five years after the province released the massive hemorrhage protocol (MHP) recommendation statements and companion toolkit (version 1.0), a multi-disciplinary expert panel reconvened to review new evidence and update 42 key principals in MHP version 1.0. The study aim was to develop MHP 2.0 using a structured, iterative modified Delphi approach.
Design and Methods: A Steering Committee led a seven-month modified Delphi exercise beginning April 15, 2024. The 29-member panel represented diverse clinical specialties (emergency medicine, critical care, anesthesiology, trauma, obstetrics, pediatrics, hematology, transfusion medicine, transport medicine and pre-hospital services, blood supplier, nursing and laboratory medicine) and the province's geographic and institutional landscape, including small, community, and large/academic hospitals. Panelist rated 46 statements across 12 domains related to massive bleeding management using a 7-point Likert scale (1 = strongly disagree, 7 = strongly agree) using LimeSurvey. Consensus median score thresholds were: ≥ 5.5-accepted as written; 2.6 to 5.4- reviewed/discussed and re-rated in the next round and ≤ 2.5-removed.

Results: The process involved three rounds of iterative surveys to achieve consensus, resulting in 44 finalized recommendation statements. Of these: 21 were modified from MHP 1.0; three were new added statements and two were removed due to low scores.
Major updates in MHP 2.0 included:

- Two-step activation to reduce inappropriate activation and blood wastage;
- Fibrinogen replacement guided by laboratory evidence for hypofibrinogenemia or viscoelastic testing, not empirically;
- Structured handover between pre-hospital and hospital teams;
- Ionized calcium testing guidance;
- Restricted volume replacement strategy in the acute resuscitation phase of major hemorrhage without brain injury;
- Caution around empiric tranexamic acid (TXA) use in gastrointestinal bleeding.

The statements were released and presented at an educational symposium on March 26, 2025, and disseminated to external stakeholders via email.

Conclusions: In March 2024, Ontario's 2019 MHP 1.0 recommendations underwent a rigorous second modified Delphi review producing MHP 2.0 with 44 up-to-date recommendation statements, including new pediatric principals. These recommendations were presented at a provincial educational symposium and will be distributed to key stakeholders. Next steps include revising the companion toolkit with the updated recommendation statements and assessing where gaps remain.

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Evolution of a Massive Hemorrhage Protocol Quality Metrics Portal

Abstract Summary :

INTRODUCTION

A provincial blood coordinating network developed and released the first provincial evidence-based Massive Hemorrhage Protocol(MHP) in May 2021, revised March 2025. A Quality Metrics(QM) reporting portal was developed to capture 8 MHP quality metrics as defined in the Provincial Massive Hemorrhage Protocol recommendations. Phase 1 included portal testing with 15 hospitals. Phase 2 included revisions to the portal and development of an interactive dashboard for QM tracking.

METHOD

Phase 2 comprised of two parts: Modification of existing portal; and development of dynamic and static dashboards for reports.

Utilizing feedback from provincial stakeholders the QM reporting portal was modified to streamline data collection. Dashboards built in Excel will enable hospitals to develop reports for tracking and evaluation of metrics and additional development of provincial reporting variables.

RESULTS

Phase 2a: Modifications of the QM portal included: credentialed survey; each MHP activation has a unique record; comprised of 2 collection instruments, hospital contact and QM; wording of 9 MHP Quality questions revised to best collect data and graded for quality of patient care representing 8 reporting QM; each hospital corporation assigned an unique Data Access Group(DAG). DAG users can create records and switch between DAGs if working in multiple sites; and, developed QM tracker for hospitals to safeguard patient identifiers locally and not in the data repository.

Revised portal contains Phase 1 and 2 data; 165 DAGs; 76 active DAGs, 64 users, 29 users in multiple DAGs and 1 electronic upload.

Phase 2 data entry began November 2023. MHP activation dates July 2022 to March 2025 account for 1443 records. Overall, 44% of these MHP activations were appropriate.

Phase 2b: Developed two Excel dashboards: one dynamic and one static. The dynamic dashboard is designed for hospitals to filter exported data by the following parameters: time, location, age, sex and medical condition allowing the filtered data to populate each quality metric providing visualization in both chart and pie graph format. The static report will visualize pre-selected data by the same parameters in chart, bar and pie graph.

CONCLUSION

The portal together with the dashboard provides a dynamic and interactive tool allowing users to quickly visualize and evaluate their metrics over time. Future work in phase 3 will include development of provincial benchmark report for hospital peer comparison.

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Compliance in Blood Administration: Insights from the 2023 Provincial Bedside Audit

Abstract Summary :

Introduction / Objective: The 2023 Provincial Bedside Audit of Blood Administration aimed to evaluate compliance with established transfusion requirements across multiple healthcare facilities. This audit reiterates the need for safe, consistent blood administration practices to enhance patient outcomes and support adherence to transfusion standards.

Design and Methods: A total of 309 component transfusion audits were conducted. The audit focused on five key sections: Pre-transfusion checks, patient identification checks, component checks, procedure checks, and post-transfusion documentation. Compliance was measured against specific criteria within each section, with data collected by direct observation and review of medical records. Compliance rates were categorized as optimal (100%), acceptable (95-99%), cautious observation (91-94%), and red alert requires investigation (≤90%).

Results

Pre-Transfusion Checks: Compliance was encouraging, with 100% documentation of authorized prescriber order and 95% documentation of informed consent.

Patient Identification Checks: Compliance was assessed using three parameters, achieving overall compliance rate of 90%. Each individual parameter had a compliance rate of 95% or higher. Additionally, these checks were accurately documented in the medical record 99% of the time.

Component Checks: The composite of parameters for ABO/Rh(D) compatibility verification achieved 92% compliance. For transfusions where blood group was not identical, compatibility was validated 98% of the time.

Procedure Checks: Use of appropriate blood administration tubing and IV fluids was nearly optimal (100% and 99%, respectively). Compliance for the composite of five vital signs temperature, blood pressure, pulse, respiration, oxygen saturation), at 82%, is a red alert necessitating investigation.

Post-Transfusion Documentation: The transfusion end time was documented in 92% of audits, with 97% of these transfusions completed within the safe 4-hour timeframe.

Conclusions: The audit identifies areas of optimal/acceptable compliance as well as and highlights opportunities for improvement, particularly patient identification and component checks, vital signs and transfusion end time documentation. The findings underscore the importance of continuous assessment and education to maintain and enhance transfusion safety. Future audits should focus on addressing the identified gaps and endorsing adherence to best practices.

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The Association Between Anemia and Bleeding in Thrombocytopenic Patients with a Hematological Malignancy

Abstract Summary :

Introduction/Objective: Patients with hematological malignancies who are receiving chemotherapy have a heightened risk of bleeding because of the presence of both anemia and thrombocytopenia. The objective of this study was to determine the association between severe anemia, defined as hemoglobin (Hb) < 70 g/L in the three days before the first major bleeding event, and the risk of major bleeding in patients with hematological malignancy. A major bleed was defined as Grade 2 or higher on the World Health Organization (WHO) scale.

Design and Methods: We did a substudy of patients from the PREPAReS trial, a randomized trial comparing the efficacy of pathogen-inactivated platelets versus untreated platelet products in patients with hematological malignancy undergoing chemotherapy treatment. Daily hemoglobin levels, platelet counts, and WHO-graded bleeding assessments were collected during the trial. Cox regression analysis was used to assess the effect of anemia on risk of the first major bleed. Anemia was defined as a daily binary covariate of lowest Hb < 70 g/L or >/=70 g/L in the past three days. Cox regression models were adjusted for potential risk factors including sex, age, diagnosis (acute myeloid leukemia [AML] or non-AML), country, treatment stage, and study randomization arm. The substudy was approved by the research ethics board.

Results: 565 patients were included from ten centres in three countries. 270 patients had AML (47.8%) and 182 patients were female (32.2%). In total, 321 patients (56.8%) developed a bleed of Grade 2 or higher. The first bleeding events were Grade 2 (n=309; 96.3%), Grade 3 (n=4; 1.2%) or Grade 4 (n= 8; 2.5%). A significant association between Hb < 70 and risk of bleeding was observed (Hazard ratio=1.71, p=0.009). Females had a higher risk of bleeding during the first seven days from randomization compared to males (HR=2.28, p< 0.001). Five (0.9%) females had vaginal-related bleeding. Difference in risk of major bleeding was observed between countries (p< 0.05).

Conclusions: Severe anemia was associated with major bleeding in patients with hematological malignancy undergoing chemotherapy. Maintaining a higher hemoglobin level for this patient group should be considered and evaluated in prospective trials.

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S1A

Clash of the Standards: An Institutional Approach to Fulfilling ABO Confirmation Mandates While Upholding Patient Blood Management Principles

Abstract Summary :

Introduction: IQMH standard VI.1 TM042 states there shall be a 2nd check of the ABO group (ABOConf) either by testing of a second sample or identifying supportive prior records, because verification is a pre-requisite for the provision of group-specific blood (GSB) for transfusion. The use of GSB in turn is valued in inventory management by decreasing the unnecessary use of group O red cells for non-O patients. However, Choosing Wisely advises against sampling more blood than is needed. As such, when lacking historical data, ABOConf demands additional venipuncture, though from the ensuing 7-10 ml specimen, only a few drops of blood are used. Our twin goal was to reduce ABOConf collections while decreasing turnaround times (TATs) by using existing samples. Avoiding new collections is patient-centred by eliminating repeat venipuncture discomfort and leveraging available alternative specimens, as iatrogenic blood loss is a known driver of anemia in healthcare. Furthermore, retroactive leveraging in a laboratory environment was recognized as uniquely free from the possibility of premeditated bedside "double-draw" fraud.

Design and Methods: When an order for red cell transfusion is received, the laboratory information system assists in determining if ABOConf is required. This flag recruits a technologist to determine if, among previously-collected CBCs, there is a sample meeting Transfusion Medicine (TM) labelling requirements (ie- an independent collection in the last 3 days). If present, the sample is retrieved and re-processed in an ABOConf order under the Confirmatory Blood Type Medical Directive. The original collection information (collector/date/time) is documented in the Clinical Information System (CIS). The ABOConf order process includes documentation of the specimen number used for testing, with verification that the sample was a collection distinct from the original Type and Screen. Only if an appropriate CBC is unavailable will a new blood draw occur.

Results: Six months (Jul-Dec 2024) were reviewed. Surgical order locations (Main Operating Room and Pre-operative Clinic) were assessed separately as a group exempt from the lab-ordered ABOConf process, owing to distinct expedient transfusion-readiness concerns. Of 567 non-surgical orders, 364 new collections (2,548 mL) were averted (64%), vs only 5 saved collections in 533 surgical samples (Z 22.2, $p < .00001$). A 10 day audit showed a TAT decrease as well in the use of previously-collected samples (average 12 minutes vs 77 for new collections).

Conclusions: The use of previously collected samples for ABOConf testing reduced sample collection significantly in the non-surgical population with significantly decreased TAT, while satisfying IQMH standards and Choosing Wisely recommendations. Future goals are to reduce specimen volume when ABOConf draws remain necessary, and to expand this process to Surgical locations.

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S1B

Four-Factor Prothrombin Complex Concentrate is Superior to Frozen Plasma for Coagulopathic Bleeding in Cardiac Surgery—The FARES-II (LEX-211) Phase 3, Multicentre, Randomized, Clinical Trial

Abstract Summary :

Introduction:

Cardiac surgery with cardiopulmonary bypass (CPB) is often complicated by coagulopathic bleeding, leading to morbidity and mortality. Although guidelines recommend using either frozen plasma (FP) or four-factor prothrombin complex (PCC) for bleeding management, the mainstay of therapy in North America is FP. This randomized controlled non-inferiority trial compared the efficacy and safety of PCC with FP in cardiac surgery.

Design and Methods:

FARES-II (LEX-211; NCT05523297) included patients aged ≥18 years undergoing cardiac surgery with CPB. After protamine administration, patients who developed coagulopathic bleeding with INR ≥1.5 were randomized 1:1 to receive PCC (1500 IU if ≤60 kg; 2000 IU if >60 kg) or FP (3 U if ≤60 kg; 4 U if >60 kg). The clinical team was blinded to group allocation until treatment initiation. The primary endpoint was hemostatic response (effective if no additional hemostatic interventions were administered from 60 min to 24 h after treatment initiation). Safety endpoints included 30-day treatment-emergent serious adverse events, thromboembolic events and death.

Results:

Of 538 enrolled patients at 12 sites, 420 were randomized, treated, consented and included in the analysis (PCC=213; FP=207). Baseline characteristics were comparable between groups; median (range) age was 66 years (20–88) and 74% of patients were male. Effective hemostasis was achieved in 77.9% (n=166) of PCC patients vs. 60.4% (n=125) of FP patients (difference 17.6%; 95% CI 8.7, 26.4; p< 0.0001 for non-inferiority and superiority). Overall, the mean (95% CI) number of allogeneic blood product units transfused within 24 h post-CPB, including intervention FP, was 6.6 (5.9, 7.5) in PCC patients and 13.8 (12.3, 15.5) in FP patients (ratio 0.48; 95% CI 0.41, 0.57; p< 0.0001). Treatment-emergent thromboembolic events and mortality occurred in 8.5% (n=18) and 3.3% (n=7) of PCC patients and 7.2% (n=15) and 3.9% (n=8) of FP patients, respectively. Treatment-emergent serious adverse events (36.2% vs. 47.3%; relative risk 0.76; 95% CI 0.61, 0.96; p=0.02) and acute

kidney injury (10.3% vs. 18.8%; relative risk 0.55; 95% CI 0.34, 0.89; p=0.02) were significantly less frequent in the PCC group compared with the FP group.

Conclusion:

PCC has superior hemostatic efficacy and may have safety advantages over FP in patients requiring coagulation factor replacement for bleeding during cardiac surgery. These findings support the use of PCC over FP for bleeding management in cardiac surgery.

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Rare Blood Program Review: Managing Transfusion Requirements During Pregnancy

Abstract Summary :

Introduction: Rare blood types are defined by red cell antigen frequencies of less than 1 in 1000. As such, there is limited information on the clinical impact of rare red cell antibodies during the perinatal period. The rate of rare red cell utilization during the perinatal period (inclusive of the fetus/neonate) is also unknown compared to the general population. Therefore, a review of perinatal cases managed by the rare blood program of a large blood supplier was undertaken.

Methods: Rare blood case files were extracted from the case management system from January 1, 2024, to December 31, 2024. Case files pertaining to testing and/or orders for rare blood in perinatal or neonatal patients were selected for review. Data collection included variables related to testing, donor recruitment, inventory management, and unit disposition.

Results: In 2024, there were 103 rare blood cases for 89 unique patients. Of these 21 patients were classified as prenatal (23.6%) and one was a related neonatal patient. Anti-U (7) was the most common rare antibody, followed by anti-Jra (3), anti-Inb (2) and anti-Lub (2). Other antibody specificities included Coa, H, Jk3, Jsb and Kpb. Two patients with a rare phenotype did not have the corresponding antibody. Five of 16 patients with available test results had a titre ≥ 16 (anti-U (3), anti-H, anti-Jsb). Nineteen of 21 cases have delivered. Ten of 19 (52.6%) requested liquid or thawed units on hand (median 1 unit (IQR 0-1)). The order fulfillment rate was 100% with 9 liquid (freshly donated) and 6 thawed units. Only two units (12.5%) were transfused, both to the same neonate (anti-Jk3, titre 8) as an intrauterine and post-natal transfusion. None of the pregnant individuals required transfusion. Six liquid units were returned for freezing, 4 were transfused as general inventory, and 3 discarded.

Conclusion: The provision of rare blood in pregnancy relies on a coordinated effort from a multi-disciplinary team at both the blood supplier and hospital, as well as our dedicated rare donors. The transfusion rate observed in our rare pregnant population was zero, which may speak to the added level of care provided in these cases (e.g., patient blood management, transfer to tertiary centre). The need for intrauterine or neonatal transfusion is also rare. Further work is underway to characterize this in a larger patient cohort.

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Blood consumption in patients with gunshot wounds: A Canadian single-centre experience

Abstract Summary :

Introduction: Gun violence in Canada has risen steadily in recent years. Patients with gunshot wounds (GSW) often demand complex multidisciplinary care, and frequently require transfusions. Utilization of blood products in this patient population has not been previously described in Canada. This study describes the transfusion requirements of GSW patients treated at a single level-one urban trauma centre located in the fourth most populous North American city.

DESIGN AND METHODS: This is a retrospective chart review at a level-one trauma centre in Toronto, Ontario, Canada. Hospital trauma registry of all trauma team activations was utilized to identify patients presenting with injuries from GSWs between January 1, 2017, and December 31, 2021. Patients under 16, those refusing transfusions, and patients with Absent Vital Signs for whom resuscitation was not initiated were excluded. We tallied type and amount of blood products transfused during the admission. Transfusion of Packed Red Blood Cells (PRBC), Fresh Frozen Plasma (FFP), and Platelets are described individually alongside total all-product transfusions.

RESULTS: Of 5452 Trauma team activations, 5% were GSWs (n=275). These patients were mostly male (n=251, 91.3%) with a median age of 26 (IQR 12) years. Median injury severity score was 9 (17) with 26.6% of patients having ISS of 1. Assault was the most common cause of GSW (97.1%). Massive Hemorrhage Protocols were activated in 49 patients (17.9%). In total, 77 patients received 1134 units of blood products while 198 patients did not require any transfusions. 716 units of red blood cells (RBC), 344 units of plasma, and 74 platelet pools were transfused to 75, 42, and 22 patients respectively. Average all-product requirement was 4.05 units for all GSW patients and 14.47 units for those requiring transfusions. The distribution of transfusion requirements was markedly skewed: 6.5% of patients consumed 70.5% of RBC transfusions, 3.3% of patients received 72.7% of plasma, and 1.1% of patients used 59.5% of platelet pools.

Conclusion: In this five-year review, GSW patients account for a small minority of trauma patients. However, our findings support previous reports that these patients require a significant number of blood products, with a few patients consuming majority of units. Increasing GSW incidences is bound to strain the blood supply, whereas preventing a single event may save hundreds of units.

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S1E

Intravenous Albumin Utilization and Guideline Compliance: A Multi-Center Audit of 607,304 Admissions at 16 Hospitals

Abstract Summary :

Introduction: Intravenous albumin use remains widespread in hospitalized patients despite a lack of evidence and the potential for harm. The aim of this study was to determine albumin transfusion practice in a multicenter dataset of hospitalized patients.

Methods: We performed a retrospective analysis of adults (age ≥18) admitted to hospitals in Ontario, Canada and included in the GEMINI database from January 1, 2017 to June 30, 2022. The primary objective was to characterize albumin transfusions and practice variability across hospital sites. Secondary objectives examined compliance with the ICTMG 2024 albumin guidelines using an electronic algorithm and change in practice over time. Unadjusted descriptive analyses examined albumin utilization in admissions and transfusion events. Effect size analyses explored differences in characteristics between different groups.

Results: This study included 607,304 hospital admissions across 16 sites. Of these admissions, 20,652 (3.4%) involved at least one albumin transfusion (range 0.7%-9.1%). There were 101,980 discrete albumin transfusion events (2.66 million grams of albumin), 52,038 (51.0%) transfused in the ICU and 49,942 (49.0%) on the ward. On average, the annual amount of albumin transfused in grams per 1,000ER/inpatient days at all sites was 434.6 (SD=252.6). The three most common diagnoses among transfused patients were liver disease or liver failure (12.9%), heart disease or heart failure (12.4%), and sepsis (10.8%). Excluding admissions with an apheresis procedure or burns, there was important variability in the proportion of 5% albumin transfused between sites (range 0.3%-38.7%). Overall, 34.9% of albumin transfusions were classified as compliant with guidelines -40.0% for 25% albumin and 9.8% for 5% albumin (Table 1). Nearly all sites (14/16) administered less than 1% of 5% albumin in accordance with guidelines. The admitting services most often ordering albumin for guideline non-compliant indications were cardiac surgery (67.8%) for 25% albumin and gastroenterology (94.3%) for 5% albumin. The most common indication for prescribing guideline non-compliant albumin was acute respiratory distress syndrome (13.6%) for 25% albumin and cirrhosis and its complications (73.8%) for 5% albumin.

Conclusion: We found substantial variability in the use of albumin across hospital sites, including high rates of albumin use non-compliant with guidelines. These findings will inform initiatives aimed at implementing evidence-based guidelines to improve transfusion practice.

	Albumin 25% (N=84,588)	Albumin 5% (N=17,392)	Overall (N=101,980)
Compliance with guidelines			

Compliant	33,854 (40.0%)	1,698 (9.8%)	35,552 (34.9%)
Possibly compliant	28,521 (33.7%)	4,351 (25.0%)	32,872 (32.2%)
Non-compliant	22,213 (26.3%)	11,343 (65.2%)	33,556 (32.9%)

Table 1: Guideline compliance of albumin transfusion events across all sites

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S1F

Modulating recombinant clotting factor X to improve clot-dissolution

Abstract Summary :

Introduction: Heart attacks and strokes are the leading causes of death worldwide, most often caused by clots that block the flow of blood. The favoured clot-dissolving (i.e. thrombolytic) drug is a recombinant (r) version of tissue plasminogen activator (tPA). The high rtPA dose required for clot lysis causes clinical hemorrhage in up to 6% of patients, resulting in part from systemic, rather than clot-localized, enzyme activity. The Pryzdial lab has discovered a thrombolytic function for the plasma protein, clotting factor X (FX), which acts non-enzymatically to accelerate tPA. Here we present a recombinant variant of FX (rFXic) with two key characteristics: an inhibitory (i) mutation that blocks the intrinsic clotting function, and a cleavage-resistant (c) mutation for increased half-life of tPA-accelerating function in plasma. We hypothesize that **rFXic is thrombolytic and has superior safety compared to rtPA.**

Methods: Wild type (rFXwt), single mutant (rFXi and rFXc), and double mutant (rFXic) FX were produced in HEK 293 cells and purified via conformational affinity chromatography. Their plasmin-cleavage profile and prothrombin clotting times functionally confirmed the successful insertion of mutations. Calcium-dependent binding to anionic phospholipid was tested to evaluate proper post-translational modification and clot-localizing function of the γ-carboxyglutamic acid (Gla)-domain, which is known to enable binding of FX to anionic phospholipid-containing membrane and fibrin. Acceleration of rtPA activity was evaluated using a plasmin-selective chromogenic substrate. In a mouse model of carotid artery occlusion, Doppler ultrasound recordings of blood flow were used to measure the ability of rFXic to affect clot dissolution.

Results: Compared to rFXwt, which was cleaved by plasmin into the predicted rFXβ and FXγ forms of FX, proteolysis of rFXic was limited to production of rFXβ. This is expected to stabilize thrombolytic activity in plasma. In contrast to rFXwt, rFXic had undetectable clotting activity in reconstituted FX-deficient plasma. Neither mutation impacted calcium-dependent binding to anionic phospholipid. *In vitro*, rtPA generated 10-fold more plasmin in the presence of rFXic than rFXwt, indicative of thrombolytic acceleration by the former. In mouse models of

thrombosis, rFXic decreased the thrombolytic dose of rtPA by at least 50% as an adjunctive therapeutic but did not promote thrombolysis without rtPA.

Conclusion: These data support the hypothesis that rFXic has thrombolytic activity in combination with rtPA. By lowering the therapeutic dose of rtPA, rFXic could be used as an adjunctive therapeutic to reduce the bleeding risk of thrombolysis. Next, we will assess the quantitative efficacy of rFXic *in vivo* and therapeutic safety *ex vivo*, and anticipate advocating for rFXic as both an effective and safer alternative to monotherapeutic rtPA.

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Challenging the “Low-Effector” Paradigm: IgG4-Based Monoclonal Antibodies Can Mediate Erythrophagocytosis

Abstract Summary :

Introduction/Objective

Immunoglobulin G4 (IgG4) is often considered a "low-effector" subclass due to its weak overall interactions with Fcγ receptors (FcγRs) and limited complement activation. As such, IgG4 is frequently employed in therapeutic antibodies where minimal inflammatory responses are desired. However, while IgG4 is considered to bind most FcγRs poorly, its affinity for FcγRI is comparable to IgG1. Recent observations from cancer immunotherapies indicate that IgG4-based monoclonal antibodies (mAbs) can lead to hematologic toxicities, suggesting a reappraisal of IgG4's effector functions. The aim of this study is to reassess one of the effector functions of IgG4, particularly its ability to mediate erythrophagocytosis. By evaluating the functional interaction of IgG4-based monoclonal antibodies with Fcγ receptors on macrophages, the study seeks to determine whether IgG4 can induce significant red blood cell (RBC) clearance.

Methods

We generated three different humanIgG4 mAbs against human and mouse RBC antigens to evaluate their capacity for antibody-dependent cellular phagocytosis (ADCP). These mAbs included anti-D, anti-human glycophoryin A and anti-mouse gylcophoryin A. Human macrophages were co-cultured with IgG4-opsonized human or mouse RBCs, and phagocytosis was quantified by phase contrast/brightfield microscopy. Parallel experiments using IgG1, IgG2, and IgG3 variants served as comparators.

Results

Despite its reputation for weak effector function, all of the IgG4 subclass antibodies consistently induced significant ADCP by THP-1 CD16A-derived macrophages expressing all Fcγ receptors. While the ADCP levels achieved were lower than that induced by IgG3, erythrophagocytosis was comparable to IgG1. In contrast, the IgG2 subclass induced only marginal RBC phagocytosis.

Conclusions

In the context of RBC targeting, these findings challenge the longstanding view that IgG4 inevitably exhibits low FcγR-mediated activity. Prior studies have shown that FcγRI appears to drive robust erythrophagocytosis and the current work demonstrates that IgG4 subclass mAbs can drive this activity in this *in vitro* system. Our study underscores the need for careful consideration of IgG4's potential to induce undesired RBC clearance, especially when developing therapeutic mAbs directed against, or cross-reactive with RBC antigens.

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S2B

Comparison of the in vitro quality of irradiated DEHP/SAGM and DEHT/PAGGSM red cell concentrates

Abstract Summary :

Introduction / Objective: The plasticizer di(2-ethylhexyl) phthalate (DEHP) is known to improve red blood cell (RBC) *in vitro* quality. However, upcoming regulatory changes in Europe effectively prohibiting use of DEHP in blood collection sets, have prompted evaluation of alternative plasticizers. Di(2-ethylhexyl) terephthalate (DEHT) with phosphate-adenine-glucose-guanosine-saline-mannitol (PAGGSM) additive solution (AS) has emerged as a promising alternative to DEHP sets with saline-adenine-glucose-mannitol (SAGM) AS for red cell concentrate (RCC) storage. RCCs commonly undergo modifications before transfusion to support certain clinical indications. For example, irradiation is used to prevent transfusion-associated graft versus host disease. Irradiation can impact RCC *in vitro* quality, but the extent of this impact has not been widely investigated for DEHT-RCCs. The objective was to compare *in vitro* quality of irradiated RCCs in DEHT and DEHP storage bags.

Design and Methods: Whole blood was collected into either 500 mL DEHP/SAGM (Macopharma REF#LQT710X) or prototype 475 mL DEHT/PAGGSM (Macopharma REF#PRORQT4-B) collection sets with citrate-phosphate-dextrose (CPD) anticoagulant. Leukoreduced RCCs were produced using a semi-automated top/bottom method and stored hypothermically. On day (D)14, RCCs were x-ray irradiated (Rad Source RS 3400, required dose 15-50 Gy). Hemolysis, supernatant potassium, and RBC deformability by Lorrca (RR Mechatronics) were measured on D29 (1-day post-expiry). Non-parametric Mood's Median or t-tests were performed (Minitab Software) to determine statistically significant differences between irradiated DEHP (n=10) and DEHT (n=10) RCCs.

Results: Expiry results are shown in Table 1. Irradiated RCCs in DEHT had statistically higher hemolysis. However, all RCCs in the study were < 0.8% hemolysis, the CAN/CSA-Z902:20 specification for non-irradiated RCCs. Differences in potassium were not statistically significant. Lorrca results indicate that DEHT/PAGGSM RBCs are less deformable (lower EI_{max}) and require greater force (K_{EI}) to deform.

Table 1 *In vitro* quality (mean ± SD) for DEHP and DEHT Irradiated RCCs

Parameter	DEHP (n=10)	DEHT (n=10)	P-value
Hemolysis (%)	0.24 ± 0.05	0.44 ± 0.14	0.000
Potassium, supernatant (mmol/L)	65.8 ± 3.1	69.0 ± 4.4	0.078
EI_{max}	0.622 ± 0.008	0.598 ± 0.021	0.006
K_{EI}	2.154 ± 0.129	2.995 ± 0.373	0.000

Conclusion: The removal of DEHP had slight impacts to hemolysis and RBC deformability in irradiated RCCs; however, quality of irradiated DEHT/PAGGSM RCCs is still anticipated to be acceptable.

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S2C

In Vivo Evidence Linking Loss of Red Blood Cell Deformability to Circulatory Clearance

Abstract Summary :

Introduction:
Red blood cells (RBCs) progressively lose deformability during cold storage, contributing to the storage lesion and premature circulatory clearance following transfusion. While reduced deformability is known to shorten circulation time, the extent to which recipient systems distinguish and remove donor RBCs based on deformability remains poorly understood. This study investigated whether donor RBCs with deformability distributions distinct from those of endogenous recipient RBCs are selectively cleared from circulation in a mouse transfusion model.

Methods:

To generate donor RBCs with altered deformability, murine RBCs were treated with aminotriazole (AMT), an irreversible catalase inhibitor that induces intracellular oxidative stress by impairing hydrogen peroxide breakdown, leading to reduced RBC deformability. Rigidified and untreated control RBCs were fluorescently labeled and transfused into syngeneic recipient mice. A microfluidic ratchet device was used to measure the deformability distribution of donor RBCs pre- and post-transfusion, alongside the recipient's endogenous RBCs. The relative abundance and deformability profiles of transfused RBC subpopulations were tracked at multiple timepoints post-infusion.

Results:
AMT-treated donor RBCs, which exhibited a widened deformability distribution, were selectively cleared within 24 hours post-transfusion, whereas control donor RBCs persisted. This selective removal resulted in a donor RBC population in circulation whose deformability distribution closely matched that of endogenous recipient RBCs. No further deformability-dependent clearance was observed over the following 35 days, indicating stable circulation of the remaining cells. These findings support a model in which the murine circulatory system selectively purges donor RBCs with reduced deformability.

Conclusions:
This study provides direct in vivo evidence that circulatory clearance of transfused RBCs depend on cell deformability. Rigidified donor RBCs are rapidly removed from circulation, leaving behind a population whose deformability distribution aligns with that of the recipient. These findings have potential implications for transfusion practice, particularly for chronically transfused patients. Future work may support development of deformability-based assays to identify long-circulating RBC units and improve product allocation strategies.

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S2D

Distinct IgG-sensitization levels drive macrophage preference for RBC trogocytosis versus phagocytosis

Abstract Summary :

Background: Red blood cell (RBC) alloimmunization presents a significant challenge in transfusion medicine and obstetrics. Rh immunoglobulin (RhIg) is the current standard for preventing hemolytic disease of the fetus and newborn (HDFN), but its donor dependency, supply constraints, and variability between batches highlight the need for alternatives. Recombinant antibodies (rAbs) are a promising option, however, none have superseded RhIg as the standard prophylaxis. Development of rAbs has primarily focused on RBC clearance through phagocytosis as the primary mechanism for antibody-mediated immune suppression (AMIS). However, recent findings indicate that trogocytosis-partial RBC membrane removal-may play a critical role in AMIS. This study examines how different IgG sensitization levels influence macrophage preference for RBC trogocytosis versus phagocytosis.

Methods: Mouse RBCs were fluorescently labeled to allow for visualization. Hen egg lysozyme (HEL) was chemically attached to the surface of RBCs, producing "HEL-RBCs". The HEL-RBCs were then sensitized with varying concentrations of a single anti-HEL monoclonal antibody (4B7 or 6D7), their mix, and an anti-HEL polyclonal antibody to generate a range of sensitization levels. Sensitized RBCs were incubated with murine (RAW) macrophages. Confocal microscopy was used to differentiate between whole RBCs and fragments of RBCs internalized by macrophages in order to distinguish between trogocytosis and phagocytosis. The indirect antiglobulin test (IAT) was also conducted by incubating the sensitized RBCs with a secondary antibody (rabbit anti-mouse IgG), followed by visualization and grading of agglutination to assess relative IgG sensitization levels.

Results: The uptake of small particles (trogocytosis) was predominant at lower RBC sensitization levels (i.e. low concentrations of antibody), whereas uptake of whole RBCs (phagocytosis) became more prominent as the sensitization levels increased (i.e. high concentrations of antibody). The mix of the monoclonal antibodies and the polyclonal antibody appear to be able to induce phagocytosis at lower concentrations as compared to the individual monoclonals. A continuum of RBC uptake was observed, ranging from small fragments acquired via trogocytosis to the ingestion of whole cells via phagocytosis. Higher IAT scores (2+ or 3+) correlated with phagocytosis whereas lower IAT scores (weak+ or 1+) leaned towards trogocytosis.

Discussion: Our results support the concept that low levels of RBC sensitization by IgG preferentially promote trogocytosis while higher levels of sensitization drive phagocytosis. Intermediate levels of sensitization were able to activate both processes. These findings advance our mechanistic understanding of AMIS by highlighting how the degree of RBC sensitization influences macrophage effector function, bringing us closer to elucidating how IgG-mediated modulation of immune responses may suppress alloimmunization.

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S2E

Donor Red Blood Cell Deformability as a Predictor of Circulatory Persistence in Transfusion-Dependent Thalassemia Patients

Abstract Summary :

Introduction

Transfusion-dependent thalassemia (TDT) patients require red blood cell (RBC) transfusions every 3-4 weeks to maintain adequate hemoglobin (Hb) levels. Frequent transfusions lead to iron-overload, which require treatment using iron chelation therapies. These therapies carry significant risks, including liver, kidney, and bone marrow toxicity. Selecting donor RBC units with longer circulatory persistence could reduce transfusion requirements to help manage iron-overload. Recent research indicates that more deformable RBCs can better navigate the microvasculature and may persist longer in circulation. In this study, we investigate the relationship between donor RBC deformability and transfusion longevity in TDT patients.

Design and Methods

To assess the relationship between RBC deformability and circulatory persistence, we recruited 10 TDT patients with β-Thalassemia receiving regular transfusions of 1-4 RBC units. For these recipients, we analyzed a total of 131 donor RBC units, which were used in 55 transfusions. RBC deformability was measured using the previously validated microfluidic ratchet device, which uses a matrix of tapered constrictions to sort RBCs based on deformability. The distribution of RBCs after sorting is used to calculate a rigidity score for each donor RBC unit. For each transfusion, the rigidity score of the donor RBCs were averaged and correlated with recipient Hb at 21 days post-transfusion.

Results

We found a mild yet statistically significant correlation between donor RBC deformability and recipient Hb at 21 days post-transfusion (r = -0.236, p = 0.042). Selecting the top 50% deformable donor RBC units would decrease recipient transfusion needs by 8%. This level of transfusion reduction is comparable to the average reduction reported for Luspatercept, an FDA-approved therapy for TDT-associated anemia. Moreover, selecting the top 25% deformable donor RBC units would decrease transfusion needs by 13%, translating to an average reduction of 2.0 transfusions per patient annually.

Conclusions

Our findings demonstrate a clinically significant link between donor RBC deformability and transfusion persistence in TDT patients. Implementing deformability-based selection of donor RBC units can meaningfully reduce transfusion frequency for TDT patients similar to or exceeding the pharmacological benefits reported for Luspatercept, but accomplished through an orthogonal mechanism. Reducing transfusion needs for chronic transfusion recipients will not only decrease transfusion-associated morbidities, such as iron-overload, but also increase available blood resources for all recipients.

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S2F