Centre for Innovation Annual Progress Report

2017–2018

June 7, 2018

Canadian Blood Services
it's in you to give

Canadian Blood Services
it's in you to give

Table of contents

Canadian Blood Services
it's in you to give

Canadian Blood Services
it's in you to give

Opening letter

7 June 2018

Dear reader,

We are delighted to present the Canadian Blood Services Centre for Innovation progress report for 2017-2018. This past year our team realized many achievements in support of the patients that we serve as part of Canadian Blood Services' mission.

As new leaders of this team, we are grateful to our predecessors, Dr. Dana Devine and Judie Leach Bennett, for their insightful leadership and for bringing to life Justice Krever's vision for a research program and innovation infrastructure that ensures the Canadian blood system is well-informed and supported by evidence. As a result of the work of the Centre for Innovation, Canadian Blood Services, along with the broader healthcare system, is better positioned to address emerging medical and scientific trends, risks, opportunities, and technologies, and to lead change for the benefit of Canadian donors and patients.

This report details achievements that have been made over the past year by our network of scientists, medical experts, research partners, and collaborators. A few key outcomes are highlighted below:

- In August 2017, we provided scientific knowledge and evidence to support Canadian Blood Services' transition from a five-day to a seven-day shelf life for platelets. The Centre optimized the procedure for detecting bacterial contamination of platelet products, and their co-components (red blood cells and plasma), to improve safety and reduce discards. The Centre completed simulations to study system-wide changes resulting from extending platelet shelf life to inform donor recruitment and hospital inventory management.
- In October 2017, we provided scientific and medical knowledge to inform the National Advisory Committee (NAC) Blood and Blood Products statement on cytomegalovirus (CMV)-safe products, and supported Canadian Blood Services' transition to providing primarily CMV-safe products.
- We developed a simulation model to support the optimization of Canadian Blood Services' Rare Blood Program, which was relaunched in May 2018.
- We provided product and process development expertise to support Canadian Blood Services' 2018 implementation of new equipment, and to optimize new manufacturing processes to produce red blood cells, plasma, and platelet products.
- Over the past year, we published paradigm-altering studies in the areas of intravenous immunoglobulins (IVIg and RhIg), and the immune disorders they treat. Our researchers uncovered a previously unknown mechanism of miscarriage in fetal and neonatal alloimmune thrombocytopenia, which suggests a new therapeutic target. We have shed light on the mechanisms by which red blood cell antibodies can suppress the immune system that may inform better treatments for immune disorders, such as hemolytic disease of the fetus and newborn. Our research teams have also identified several potential IVIg replacement drugs that may reduce the burden on IVIg supply and improve patient outcomes.

- We created valuable information for health care providers to help them choose between two common treatments for immune thrombocytopenia, ensuring appropriate treatment for patients, and potentially reducing the need for IVIg.
- In partnership with Héma-Québec, we initiated funding for 11 research projects investigating blood and plasma donors' eligibility criteria and screening process with the goal to evolve the current eligibility criteria for men who have sex with men (MSM). We also published a review of MSM deferral policies worldwide and the current state of science in this area.

Program outputs for the year include:

- Our research network published 332 peer-reviewed publications and delivered over 300 poster and oral presentations at local, national, and international conferences.
- We shared 30 technical reports within Canadian Blood Services and with partners to support decision-making.
- Over 70 major knowledge mobilization and educational events were organized or supported.
- Our team formalized 43 agreements with partners.

This year we received a successful program evaluation from Health Canada. The evaluation, which engaged our stakeholders and analyzed our performance over five years, noted the continued need for, and relevance of, our program. It acknowledged our progress toward identified outcomes, and praised its cost efficient and effective operation. Following this successful evaluation, the team submitted a proposal to Health Canada and secured continued funding for a new five-year cycle. This funding will complement the funding received from provincial and territorial ministries of health, and partners.

We remain deeply grateful for the ongoing support we receive from our funders, and our partners and colleagues across the transfusion and transplantation medicine communities. As we conclude the previous funding cycle and look ahead to the next five years, it is with renewed vigor to continue innovating and educating to support Canadian Blood Services in its vigilant stewardship of the safety, quality, and efficiency of the products and services it delivers for the benefit of Canadians.

Sincerely,

Dr. Isra Levy
Vice President, Medical Affairs and Innovation
Canadian Blood Services

Dr. Chantale Pambrun
Director, Centre for Innovation
Canadian Blood Services

Canadian Blood Services
it's in you to give

Executive summary

The 2017-2018 Canadian Blood Services Centre for Innovation annual progress report provides an update on the activities and achievements of the Centre for Innovation over the past fiscal year (April 2017 – March 2018). In this report, we provide an overview of the Centre for Innovation, which facilitates the creation, translation and application of new knowledge to support a safe, effective, and responsive system of blood and related biological products for Canada.

Complementing the achievements highlighted in the opening letter, we present several stories that illustrate the impact of the Centre's programs. In these stories, you will learn about: advances in the areas of donor and recipient health and safety; the large body of work conducted by the Centre to support last year's extension of platelet product storage time while ensuring continued safety; developments in understanding red blood cell biology to improve transfusion products; discovery research into immune and inflammatory diseases for which blood products are treatment options; and work to improve Canadian Blood Services' products and processes; research progress in the area of organ and tissue donation and transplantation; and the Centre's collaborative training and education programs engaging researchers and health care professionals and increasing knowledge in transfusion.

Through these stories, the interdisciplinary and collaborative nature of the Centre is evident. You will find contributions from the Centre's scientists, development staff, medical directors and consultants, project managers, as well as funding recipients, collaborators, and partners. Through the Centre for Innovation, the knowledge and expertise of this network, located across Canada, serves the Canadian blood system and ensures its continued safety, quality, and sufficiency.

The report concludes with appendices which comprehensively list the Centre's outputs for 2017-2018, including research projects funded through our programs, and the diverse publications resulting from these projects.

Canadian Blood Services
it's in you to give

Overview of the Centre for Innovation

Integrated within Canadian Blood Services, the Centre for Innovation is a unique and essential bridge that facilitates the creation of new knowledge and its translation into practical outcomes for the blood service and stakeholders working to maintain a safe, effective, and responsive system for blood and blood products for Canadian patients. The Centre focuses on making a measurable impact across four program areas: Research; Product and Process Development; Knowledge Mobilization and Education; and Policy Research and Leading Practices (Figure 1).

Over the last five years, the Centre has delivered value to the system as exemplified by the program performance metrics highlighted below (Table 1), and by the key achievements of the last year described throughout this report.

Fig. 1: The Centre for Innovation's four program areas.

		April 2013 – March 2018
Outputs	Knowledge products (see Appendix II)	1713
	Knowledge exchange mechanisms (e.g. symposiums, presentations)	1890
	Awards and grants (see Appendix I)	92-160 per year
	Partnerships/collaborative working arrangements	183
Immediate Outcome	Key stakeholders in the transfusion and transplantation community are knowledgeable about the evidence/knowledge generated by Centre for Innovation projects	Event attendees report knowledge gain (>85%)
		100% of Canadian Blood Services staff researchers with an H-index that meets the Canadian Science Standard of 10.6
		89 highly qualified people completing training
Intermediate Outcome	Key stakeholders in the transfusion and transplantation community apply knowledge created by Centre for Innovation projects	59 new or updated policies, procedures, practices, products, and standards
		Stakeholders report perception of knowledge created to be of high quality (98%) and useful (96%)

Table 1: Centre for Innovation performance measurement framework results, April 2013 – March 2018

Canadian Blood Services
it's in you to give

Research and development

The Centre for Innovation leads the primary coordinated research and development effort in Canada that addresses blood safety — it supports, connects and complements research efforts that are conducted at an organizational level at local Canadian academic and hospital centres.

Canadian Blood Services' mission is the guiding principle by which the Centre sets its research and development priority areas. In consultation with internal and external stakeholders, the Centre's resources are allocated into areas where they can be used to drive innovation and improve the blood system.

> Canadian Blood Services operates Canada's blood supply in a manner that gains the trust, commitment and confidence of all Canadians by providing a safe, secure, cost-effective, affordable and accessible supply of quality blood, blood products and their alternatives.
>
> Canadian Blood Services' mission (Read more)

Supporting discovery research

One unique element of the Centre's research strategy is the suite of competitive funding programs that are designed to facilitate discovery research in strategic priorities that include:

- Promoting appropriate blood product utilization;
- Ensuring an adequate blood product supply;
- Minimizing the adverse effects of blood product transfusion;
- Optimizing blood product quality;
- Replacing or improving blood products through new therapies or technologies.

Currently, six unique programs support research projects over a period of one to three years based on a rigorous peer-review process that promotes excellence, and ensures relevance. In 2017-2018, 54 research projects received funding through these programs, including 23 new projects (Appendix I). Of note are the new financial commitments awarded to support clinical research through the McMaster Centre for Transfusion Research and the University of Toronto Quality in Utilization, Education and Safety in Transfusion research programs.

Complementing the competitive funding programs, the Centre supports eight research staff scientists. These staff scientists have a range of expertise and knowledge in support of key strategic areas, hold university faculty appointments at institutions across Canada, and conduct their own research projects.

Together, these programs support a multidisciplinary network of more than 70 researchers based in British Columbia, Alberta, Ontario, Quebec, and Nova Scotia. The impact is seen in their significant contribution to the nearly 400 publications published in 2017-2018 (Appendix II) as well as the achievements described in this report.

> *"Much of our research is 'translational'. We are engaged in work that drives either practice change, or policy development that results in practice change, or that improves how the blood system operates. We do this always with patients in mind."*
>
> **Dana Devine**, Chief Scientist, Canadian Blood Services, in RED blog (Read more)

Canadian Blood Services
it's in you to give

Responding to emerging research needs

Leveraging its expertise in administration of competitive grants and programs, the Centre responded to emerging needs for the generation of adequate evidence-based research for alternative screening approaches for blood and plasma donors. Following the Health Minister's directive to evolve the deferral policy for men who have sex with men (MSM), the Centre with Héma-Québec launched the MSM Research Grant Program and, with funding from Health Canada, initiated 11 research projects in fall 2017. A second competition was launched in January 2018 with additional projects expected to begin in fall 2018.

Supporting product and process development

As well as supporting discovery research, the Centre leads product and process development in support of Canadian Blood Services supply chain. Priorities include:

- Deepening the understanding of our products and the processes used to manufacture them;
- Developing new or next generation products and the processes used to manufacture them;
- Improving current generation products and the processes used to manufacture them.

The Centre's Product and Process Development group includes a development team of 21 scientific, engineering, laboratory, and project management professionals, as well as dedicated development facilities in Vancouver and Ottawa. The development facilities include a smaller version of the regulated environment of supply chain where new products and processes can be tested and optimized before introduction by the organization. In addition, this group has strong partnerships with industry, with whom they work to develop and/or optimize processes and products.

The Centre also runs programs for the provision of biological products (blood, blood products, cord blood) and data to researchers at Canadian Blood Services and across Canada.

A hub-and-spoke model – building a better brain trust

Our discovery research and development research network, built around a distributed, hub-and-spoke model, connects highly accomplished Canadian researchers in the fields of transfusion and transplantation medicine and science, and integrates experts from complementary disciplines (Figure 2). The distributed research network allows Canadian Blood Services to tap into a wealth of research areas, expertise, opportunities and individual scientists who are affiliated in various ways with Canadian Blood Services. This approach creates a rich fabric of research areas that facilitate impactful, targeted research along the entire life-to-life continuum from donors to patients (Figure 3).

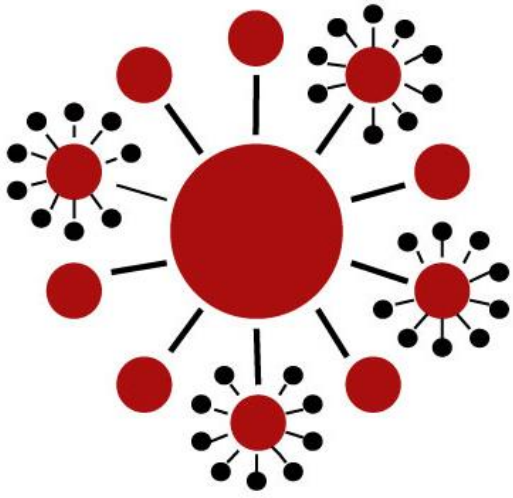


Fig. 2: The Centre for Innovation's hub-and-spoke research network model.

Education and knowledge mobilization

The Centre has a Knowledge Mobilization and Education Program that coordinates Centre-wide knowledge translation activities. Facilitated by dedicated knowledge broker staff, as well as support from the Canadian Blood Services communications group, this program has developed a knowledge mobilization toolbox to increase dissemination and awareness of the knowledge developed by the Centre.

The Centre also develops educational and learning opportunities for researchers and health care professionals to further disseminate knowledge to impact research and clinical practice. Supported by strong partnerships with engaged health care leaders and organizations, the Centre provides educational funding programs, resources, and organizes and supports educational events across Canada. The impact of the educational and training events is monitored through participants' surveys to evaluate knowledge gained and application of knowledge to practice.

Policy research and leading practices

One of the Centre's primary activities regarding policy research and leading practices is the continued support of the International Collaboration for Transfusion Medicine Guidelines (ICTMG), which was established in 2011. The ICTMG follows well-accepted methodologies to establish evidence-based transfusion medicine guidelines to optimize transfusion care, increase the credibility of guideline development for transfusion medicine, and enable more timely and cost-effective creation of transfusion medicine guidelines.

Guidelines are disseminated through publication and other methods, including podcasts and treatment algorithms. One systematic review, "Antenatal management in fetal and fetal/neonatal alloimmune thrombocytopenia", was published in 2017. This collaborative effort brings together experts from eight countries with administrative support from the Centre.

The selected stories that follow highlight the Centre's key achievements and publications over the past year. They demonstrate the Centre's commitment to research along the entire life-to-life continuum, demonstrate progress across the Centre's four focus areas, and exemplify the value and impact of our programs. The names of the Canadian Blood Services staff, including Centre for Innovation investigators, medical experts and epidemiologists, and the names of organizations and investigators receiving funding from the Centre, are bolded throughout the report.

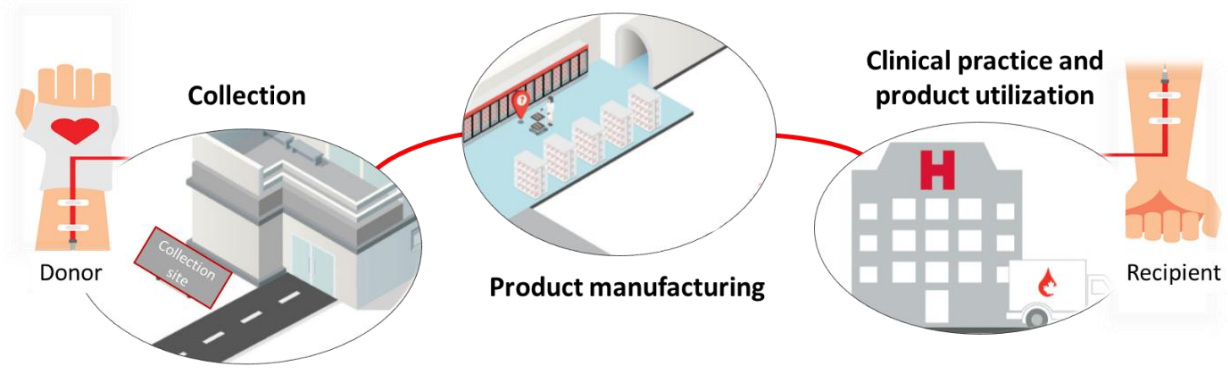


Fig. 3: The Centre for Innovation conducts research along the entire "life-to-life" continuum.

Canadian Blood Services
it's in you to give

Balancing safety and sufficiency of the blood supply

Blood donors provide the gift of life. A dedicated group of repeat donors account for close to 90 per cent of the donations received by Canadian Blood Services. Our donor recruitment and selection must balance sufficiency of supply with donor and recipient health and safety. Donor health questions, inter-donation interval and hemoglobin testing help to protect the health of donors. Donor deferrals, questionnaires, testing of collected blood, and timely surveillance help protect recipients against adverse reactions and transfusion transmissible diseases.

Donor demographics and health

An aging population, and consequently an older average donor base, presents challenges to both supply and demand. To understand the composition of the donor base and ensure future adequacy of the blood supply, an international Biomedical Excellence for Safer Transfusion (BEST) collaborative study compared donor and general population demographics over time, between 2001 and 2011.[1]

Led by **Mindy Goldman** and **Sheila O'Brien**, this study surveyed 17 blood centres in 12 countries. In all countries that participated, the general population is aging. Donor demographics in some jurisdictions suggested a reliance upon younger donors, who contribute disproportionately to the donor base. In North America, this reliance was most striking in the United States, and less so in Canada, where data showed the median age of donors is 43 years, while the median age of the general population is 46 years. Donor demographics have implications for donor health; teenage donors have lower iron stores than adults, so reliance on younger donors could disproportionately impact donor iron stores. Further research is needed to understand strategies to encourage donation across all age groups.

The previous study also showed that the oldest cohort of donors is contributing an increasing proportion of the overall blood supply. Canadian Blood Services removed the upper age limit for regular repeat donors in 2004 and recently removed the upper age limit for first time donors, a change also made by several other blood operators in recent years. **Goldman** and **O'Brien** reviewed data on older donors, and concluded that donation is safe in older individuals who continue to donate past their 71st birthday.[2] In Canada, approximately 1.5 per cent of whole blood donations are made by donors aged 71 or older. There are a greater number of healthy older individuals than ever before, and the evidence suggests that they can make a significant contribution to the blood supply.

While maintaining the safety of the blood supply, Canadian Blood Services aims to make blood donation as minimally restrictive as possible. Deferral policies are based on evidence and must take into consideration scientific and technology advances, as well as ethical and moral concerns. In early 2017, an international meeting hosted by Canadian Blood Services, Héma-Québec, and Health Canada reviewed deferral policies for men who have sex with men (MSM) worldwide, and the current state of science. The main goal of the meeting was to kick-start thinking about research priorities in this area that could be addressed under a new MSM Research Grant Program.

Goldman, **O'Brien**, and **Dana Devine**, together with Andrew Shih, summarized the past, present, and future of MSM criteria, with an emphasis on research priorities elaborated at the Toronto meeting intended to guide the research community.[3] The priorities identify multiple ways to address the interface between

blood safety and social justice, which will guide researchers, including those funded under the MSM Research Grant Program launched last year.

Read the ResearchUnit: Developing more inclusive deferral policies for blood and plasma donors.

Safety of the blood supply

Transfusion transmissible diseases

High quality and timely surveillance is key to the safety of the blood supply. This includes monitoring of transmissible disease markers that the blood is tested for, investigating reports of possible transfusion transmission, and horizon-scanning for pathogens that might present a risk now or in the future.[4] In the most recent Annual Surveillance Report (2016), **O'Brien** described very low transmissible disease rates detected. Residual risk estimates of a potentially infectious donation remain very low at 1 in 21.4 million donations for HIV, 1 in 12.6 million donations for HCV, and 1 in 7.5 million donations for HBV.

Emerging threats, including babesiosis and Chikungunya virus continue to be monitored. The mosquito-borne Zika virus remains a risk for travellers to affected areas. The risk and travel deferrals subsequently put in place for blood donors were well described in last year's annual report. This year, the impact and risk of Zika virus on cord blood donations and adult stem cell donations to the OneMatch Stem Cell and Marrow Registry was assessed.[5] Conducted by **David Allan**, and involving **Margaret Fearon** and **Heidi Elmoazzen**, this study demonstrated that the impact of screening (via donor questionnaire) for Zika virus exposure risk was minor, for both cord blood donations and unrelated adult stem cell donations. Only rarely did transplant centres cancel donor workups due to potential Zika virus exposure. The cord blood bank identified and discarded 25 (out of 875) cord blood units from women who had at least one risk factor for Zika. Continued surveillance and vigilance for emerging threats is necessary to maintain the safety of the blood supply.

Pathogen inactivation technologies

Technologies such as pathogen inactivation could further improve the safety profile of blood products by providing broad-spectrum, non-specific inactivation of pathogens. Currently two technologies are commercially available (INTERCEPT Blood System™ by Cerus and Mirasol® Pathogen Reduction Technology by TerumoBCT) and one is in clinical trials (THERAFLEX UV by Macopharma). INTERCEPT was recently licensed by Health Canada (April 2018), providing new opportunities for blood operators in Canada. Balancing the potential safety benefits of pathogen inactivated platelet and plasma products, against potential impacts on the quality and clinical effectiveness of these products remains an active area of research, with many unanswered questions that warrant further investigation.[6, 7]

Sandra Ramirez-Arcos investigated the efficiency of riboflavin and ultraviolet light (riboflavin/UV) pathogen inactivation against high levels of biofilm-derived *S. epidermidis* in platelet products.[8] In line with previous reports, this study showed that pathogen inactivation reduced but did not completely eliminate *S. epidermidis* when present in high concentrations, and that the effectiveness of the pathogen inactivation appeared to be dependent on the bacterial strain. However, it is worth noting that the bacterial concentrations used in the study were high enough that they would be unlikely to be found in a unit being pathogen inactivated, unless pathogen inactivation treatment was delayed, and the unit was contaminated with a fast-growing bacterium.

A separate study led by **Devine** looking at the timing of riboflavin/UV pathogen inactivation and its impact on platelet quality found that delaying pathogen inactivation until later in the platelet storage period lessened the negative impact on platelet quality.[9] This approach may allow blood operators to modify testing and pathogen inactivation regimes to maximise the benefit of pathogen inactivation while minimizing impact to product quality, but efficacy against high levels of bacteria would need to be considered.

Understanding TRALI

Transfusion-related acute lung injury (TRALI) is a serious adverse reaction. It is the leading cause of transfusion-related fatalities but its pathogenesis is poorly understood and no specific therapy is available. John Semple conducted a critical analysis of recent preclinical insights into TRALI pathogenesis.[10] Focusing on potential therapeutic approaches to combat this devastating complication of transfusion, his review identified some approaches that warrant further exploration in the laboratory and the clinic. The most promising of these approaches target the transfusion recipient, and include interleukin-10 therapy, down-modulating C-reactive protein levels, targeting reactive oxygen species, or blocking the interleukin-8 receptors.

Understanding and optimizing blood product utilization

While a sufficient and appropriate donor base is critical, appropriate utilization lies at the other end of the life-to-life continuum but is equally central to maintain a sufficient supply, reduce health care costs and protect the health of transfusion and transplantation recipients. Canadian Blood Services' medical officer, **Michelle Zeller** of the **McMaster Centre for Transfusion Research**, was the lead author on two international studies to understand utilization of blood products.[11, 12] One study looked at red blood cell utilization practices at hospitals around the world, with a focus on use of O-negative blood.[11] The supply of O-negative red blood cells is especially important because these "universal donor" products can be safely transfused to patients of any ABO and Rh blood type, making Type O red blood cells critical for emergency transfusions when the recipient's blood type is unknown, or if there is an insufficient supply of ABO-matched blood products available for a patient in need. This, and several other studies, showed that overall red blood cell use is decreasing, but the proportion of O-negative products used is increasing, particularly for non-Type O recipients.[13, 14] A large percentage of O-negative blood products are used for patients who are not O-negative.

While Type O is the universal donor for red blood cells, Type AB is the universal donor for plasma, and shortages can occur if there is increased demand for this product. In a study exploring AB plasma utilization in hospitals around the world, transfusion policies, and practices, patterns were found to be variable across sites, but overall, AB plasma units are frequently transfused to non-AB recipients.[12] Indeed only 27 per cent of AB plasma units were transfused to AB patients. Both studies provide data for benchmarking and determining best practices to optimize Type O-negative red blood cell and AB plasma utilization. Hospitals with higher use of these precious resources might be able to alter their policies to decrease non-essential use.

Read the RED blog post: International researchers collaborate to understand trends in blood product use.

Canadian Blood Services
it's in you to give

Blood donation and blood transfusion are very safe in Canada. Transmissible blood-borne infections are very rare in Canadian Blood Services donations, and surveillance, testing, horizon-scanning and other measures help keep patients safe. Careful utilization of blood products to ensure they are used optimally and efficiently helps ensure sustainability. Attention to both the extremes of the life-to-life spectrum is required for the continued safety and sufficiency of the blood supply.

Applying an old tool to a new process

Philip Berardi, Gwen Clarke and Goldman led a study investigating nucleic acid extraction from buccal tissue to predict red blood cell phenotype in donors.[15] Leveraging over 10 years of expertise using buccal swabs for DNA extraction and genotyping participants in the OneMatch Stem Cell and Marrow Registry, this non-invasive, cost-effective, and stable alternative to venipuncture was explored. The results, though preliminary, are promising, and support the use of buccal swabs for predicting red blood cell phenotypes with high accuracy. The Rare Blood Program launching in 2018 at Canadian Blood Services will use buccal swabs to genotype prospective rare donors identified through family studies. The buccal swab process allows for screening of donors that do not have access to a collection site.

Canadian Blood Services
it's in you to give

Supporting system change: The platelet story

Platelets are small cell fragments circulating in our blood that help stop bleeding. To maintain this biological function, blood operators store platelet products at room temperature with gentle agitation in gas permeable bags. Unfortunately, these conditions are favourable to bacterial growth making bacterial contamination of platelets the leading infectious risk from blood transfusion. The limited shelf life of platelet products is also a challenge in managing their inventory.

Safely extending the shelf life of platelets

Platelet contamination and adverse reactions

In 2017, Canadian Blood Services extended its platelet products shelf life from five to seven days.[16] This change was informed by research conducted at the Centre.

At Canadian Blood Services, safeguards against contamination of platelet products include disinfecting the donor's skin before venipuncture, discarding the first portion of the blood draw, performing sterility testing on all platelet products, and visual inspection of the platelet products. Summarizing six years of experience of sterility testing at Canadian Blood Services (2010 – 2016), **Ramirez-Arcos** and **Goldman** reported similar true positive rates in pooled and apheresis platelet products (approximately 1/10,000).[17] True positive results represent products for which the same bacterium is isolated during the initial and confirmatory sterility test. Products with positive sterility testing are immediately removed from inventory or recalled from hospitals if already distributed. During the same period, six transfusion adverse reactions associated with bacterial contamination of platelet products were reported by hospitals, giving a rate of reaction of 1 per 100,000, similar to rates reported in other jurisdictions. These findings suggest that, while platelet products are safe, a residual risk remains that merits further intervention.

Ramirez-Arcos and her team led the development of a new procedure designed to increase the sensitivity of bacterial detection in platelet products. Essentially, the new procedure involves delaying sampling for bacterial testing from 24 hours to 36 hours after collection to allow more time for bacteria to grow if present in a collection, and increasing the sampling volume to allow for bacterial testing in both aerobic and anaerobic conditions to improve our ability to detect different bacterial strains.[18] In addition, the new process includes a six-hour post-sampling quarantine of platelet products during which they are not issued to hospitals, to allow detection of fast growing or high levels of bacteria, and remove these products before release.[19, 20] Testing to confirm the results of initial positive bacterial screens, previously conducted by a third party, was brought in-house in March 2018. This is an important change. It permits an algorithm to allow release of co-components (four red blood cell units and three plasma units for every pooled platelet product) from the same donor if the initial result was false positive. If the results are true positive, and the platelet unit has been transfused, it allows the results of the microbial testing to be relayed to the recipient's physician. The physician can use this information to make informed decisions about the recipient's monitoring, treatment, and follow-up.

Devine and her team investigated whether an extended storage period would impact platelet quality.[21] They assessed platelet concentration, volume, metabolism, and markers of platelet activation and responsiveness in platelet units stored for five or seven days. All changes observed were small and consistent with the known effects of storage. They concluded that platelet products stored for seven days continued to fulfil quality control requirements, and thus extended storage should have no impact on their clinical effectiveness.

Read the article: Platelet product quality remains high after seven days of storage.

Predicting outcomes of system-wide change

Using a network simulation model, **John Blake** examined the potential impacts of the seven-day shelf life and the extended bacterial testing on the platelet inventory, and found that, compared to a five-day shelf life, extending to seven days should lead to an approximately 35 per cent reduction in product discards due to outdate, without increasing shortages.[22] The simulation also suggested that the lowest rates of outdating were seen when the hospital inventory was set at 1.1 days on hand and Canadian Blood Services inventory was set at 2 days on hand. Location was also a key factor, with the simulation indicating that wastage decreased more rapidly at hospitals than at Canadian Blood Services' sites, and smaller Canadian Blood Services sites had higher outdating rates that benefited less from extending the shelf life than larger sites. The detailed information from the simulations can help Canadian Blood Services manage donor recruitment to maintain a consistent platelet supply while accounting for the increased bacterial testing time. Data from this study can also guide hospital inventory policies.[23, 24]

Monitoring the impact of the change

Since introduction of the new sterility testing method, extended shelf life, and hospital adjustments to inventory levels and redistribution practices, data from hospitals and Canadian Blood Services indicates a system-wide reduction in the number of platelet units discarded due to outdate of 39.6 per cent, similar to the reduction anticipated by **Blake**'s simulation. The implementation of 7-day platelets impacted both production and collection scheduling, and optimization work continues. Importantly, there have been no shortages related to the change, and the rate of confirmed positives for bacterial testing has increased — suggesting that the new testing algorithm is more sensitive and captures more contaminated platelets at screening. The translation of evidence from multiple sources supported this important change, which has led to an improvement in health care delivery, safety, and efficiency (reducing waste).

Read the **Research**Unit: A model for change: predicting the impact of system-wide improvements.

Investigating biofilm formation

Ramirez-Arcos also made progress understanding the platelet safety implications of bacterial biofilms (bacterial aggregates, often found adhered to surfaces). Biofilms can be a virulence factor, and biofilm-producing bacteria can be more resilient to disinfection or detection efforts. For example, *S. epidermidis*, part of normal human skin flora and the predominant contaminant of platelet products, can form biofilms in human skin. These may not be destroyed by skin disinfection, could avoid detection by bacterial screening systems, and may not respond to pathogen inactivation. The team has shown that *S. epidermidis* adopts a

biofilm-forming phenotype in platelet products, regardless of its genetic background or origin. Positive selection of *S. epidermidis* biofilm-producers during blood donation and platelet product manufacturing was not observed.[25] The team has also investigated the ability of lytic bacteriophages to augment antibiotic activity against *S. aureus* biofilms in a proof-of-principle study that could guide future investigations into clinically effective ways to target infections.[26]

Collaborating with **William Sheffield**, **Ramirez-Arcos** has shown that bacterial attachment inside platelet bags is enhanced by plasma residues independent of the type of bags.[27-29] Adhesion of bacteria to storage bags has a negative impact on platelet safety, even with very low bacteria levels, as it decreases detection during routine screening. As platelets are pooled and stored in plasma, finding ways to reduce plasma residues attaching to the inside of storage bags could enhance the safety of platelet products by reducing bacterial attachment.

At the **Centre for Blood Research**, a team from the laboratory of **Don Brooks** and **Jayachandran Kizhakkedathu** has developed new surfaces to prevent bacteria/biofilms from adhering to platelet bags.[30] Based on dopamine chemistry, these surfaces are antifouling and bactericidal and aim to improve the biocompatibility of PVC bags used to store platelet products.

Platelets in the clinic

Research led by **Donald Arnold** at **McMaster Centre for Transfusion Research**, and including **Kathryn Webert**, looked at the effectiveness of platelets transfusions in critically ill patients with low platelet counts.[32] Although commonly used in this patient population, whether platelet transfusions are associated with a reduction in the risk of major bleeding is unknown. This study showed no difference in the rates of major bleeding for patients who did and did not receive platelet transfusions and suggests clinical trials are needed to better investigate the benefit versus harm of platelet transfusions for this high-risk population.

Webert and **Alan Tinmouth** were involved in an initiative by the BEST collaborative to assess a common bleeding assessment tool (BAT) to document bleeding during platelet transfusion trials in hematological malignancy. This initiative saw a high concordance across multiple sites for the consensus BAT which may ensure consistent measurement of this clinically important outcome.[33]

These recent research and development efforts to optimize platelet safety and enhance clinical outcomes exemplify the integrated, multi-disciplinary approach that the Centre for Innovation is known for. This is an approach that provides a solid, context-driven evidence base and facilitates system-wide improvements. From optimal collection and product inventory, to pathogen testing, product manufacturing, new technology assessment, clinical practice and clinical outcome assessment, these efforts encompass the full life-to-life spectrum, and demonstrate the value and impact of Canadian Blood Service's unique research model.

Establishing a repository of bacterial strains

Ramirez-Arcos is involved in an international effort led by the World Health Organization (WHO) Expert Committee on Biological Standardisation to establish a repository of standardized bacterial strains, a valuable resource necessary to validate bacterial detection systems and pathogen reduction technologies.[31]

Canadian Blood Services
it's in you to give

Red blood cells: Still vital after all these years

Red blood cells are the most common blood product Canadian Blood Services distributes, approximately 700,000 units per year. Stored for up to 42 days in the refrigerator, red blood cells are transfused to treat anemia and blood loss to improve oxygen delivery to tissues.

Investigating patient outcomes

How old is too old?

As noted at the Food and Drug Administration's public workshop on new red blood cell product regulatory science,[34] after 20 years with little change in how red blood cells were evaluated for transfusion, we have seen many fundamental questions raised in recent years, including when red blood cells should be transfused, how many should be transfused, and whether the storage age of red blood cells impacts patient outcomes. These questions probe how we can best use red blood cells for transfusion, and when the balance tips between benefit and harm for recipients.

Some answers are emerging, following a barrage of investigations aimed at providing a solid evidence-base. Randomized control trials have settled the question of whether "old" red blood cells are detrimental. These findings were further confirmed by a recent secondary analysis of the landmark INforming Fresh versus Old Red Cell Management (INFORM) trial, which was led by colleagues from the **McMaster Centre for Transfusion Research**, and included Canadian Blood Services medical director, **Webert**. This study concluded that "older" blood (stored for longer than 35 days) does not impact patient outcomes, measured by in-hospital mortality, and that current storage limits for these products are reasonable.[35]

While the question of "old" red cells seemed to be settled, those studies prompted many more fundamental questions that have become emerging areas of research. The impact of donor characteristics, such as age or sex, and red cell processing methods on patient outcomes continue to be studied by **McMaster Centre for Transfusion Research** and **The University of Ottawa Centre for Transfusion Research,** and are enabled by provision of Canadian Blood Services manufacturing and donor demographic data. **Shuoyan Ning**, Canadian Blood Services Transfusion Medicine residency fellow, along with **Nancy Heddle** from **McMaster Centre for Transfusion Research** and **Jason Acker** from the Centre for Innovation, summarized nicely the pre-clinical and clinical studies evaluating these associations.[36]

Clinical evidence to reduce transfusion

Avoiding red cell transfusions altogether can avoid the adverse reactions associated with transfusion while protecting a scarce resource and reducing costs. Clinical studies are ongoing to provide the evidence to ensure transfusion

Informing health care professionals about advances in red cell research

The 15th annual Canadian Blood Services International Symposium took place in September 2017. Host to 129 delegates, this CME-accredited event featured an international line up of speakers who presented on vital aspects of red blood cells, from blood banking, laboratory medicine and clinical perspectives.

avoidance is safe for patients. **Nadine Shehata** and Dean Fergusson participated in a multinational noninferiority randomized controlled trial, the TRICS III, to assess the transfusion requirements in cardiac surgery.[37, 38] The study found a restrictive red cell transfusion strategy to be non-inferior to a liberal strategy for certain clinical conditions.[39] In obstetric patients, red cell transfusions carry the risk of alloimmunization. **Shehata**, **Tinmouth** and Fergusson completed a retrospective study using administrative data to identify trends and risk factors of red cell transfusion in this patient population which can be used to improved patient blood management and transfusion practice for patients at highest risk of needing a transfusion.[40]

Selecting the optimum blood donor

Donor iron health

Ensuring donor health is of paramount importance to blood operators, not only to ensure public health but also to maintain the security of the blood supply. In 2016, Canadian Blood Services, with evidence provided through research, implemented new donor deferral policies to safeguard our donors from iron deficiency. Iron deficiency is common in whole blood donors, particularly female donors, frequent donors, and donors failing their hemoglobin screening test. Fatigue is the most commonly reported symptom of iron deficiency, but overall there is evidence that it impairs quality of life.

Safeguards introduced to help prevent iron deficiency in blood donors included increasing the waiting time between whole blood donations for females from 56 days to 84 days, and increasing the minimum hemoglobin for males from 125 g/L to 130 g/L. These measures reduced the low hemoglobin deferral rate overall, as deferrals in females decreased substantially from 13.9 per cent to 9.5 per cent of donation attempts, while the increases in deferrals in males was smaller, from 1.4 per cent to 2.3 per cent.

The Centre developed knowledge mobilization tools to inform donors and physicians about the impact of blood donation on iron storage and measures that can be taken to prevent iron deficiency. Canadian Blood Services' Donor Relations group leveraged these tools to inform the donor community via email. This information and resources appear to be desired by the community as two blog posts (developed in 2016) ranked among the most read of all blog posts during in 2017-18 (3,400 and 2,020 views, respectively) and the ResearchUnit on this topic was the most viewed article (1,100 views). Furthermore, the publication on Canadian Blood Services' Professional Education website targeted specifically at health care professionals received over 1,200 views.

"When individuals have iron deficiency (or iron deficiency anemia), they may experience decreased exercise tolerance, increased shortness of breath with activity," explains Dr. Pambrun, "possibly can also have a decrease in concentration or changes in mood."

Excerpt from a knowledge dissemination tool kit developed to inform the donor community and health care professionals about donor iron health.

Donor variation

Hemolysis, the rupture of red blood cell membranes, is an important quality marker when manufacturing red cell products for transfusion. There is a considerable donor-to-donor variation in hemolysis levels. Understanding the molecular mechanisms behind this inter-donor variation may shed light on how to improve donor screening and ultimately enhance transfusion products.

Devine's laboratory identified a group of 10 healthy volunteer donors who repeatedly exhibit high hemolysis levels when tested at product outdate and compared these donors to age- and sex-matched controls.[41] The research team identified notable differences at the red blood cell membrane and a reduction in proteins involved in oxidative response pathways in the donors with high hemolysis. Studies are ongoing to understand these markers and determine their potential use to develop a donor screening tool.

Blood type, characterized by the antigens expressed on red blood cells, is unique to each donor. Each red cell product needs to be carefully matched to the patient. For patients with rare blood types, finding a match can be difficult. For these patients, Canadian Blood Services, like many other blood operators, operates a rare blood program that includes a process to screen donors for rare phenotypes, a registry for rare blood donors, and a small inventory of frozen rare blood units. Over the last year, the organization has leaned on the expertise of our research and medical group to redefine this small yet crucial service provided to patients. **Blake** developed computational models to determine how rare blood must be before a frozen inventory is necessary, what donor screening rate is necessary to support a rare blood program and performed a simulation study to evaluate the impact of limits for frozen blood on patient access.[42]

Irradiating red blood cell products

Irradiation of red blood cell products is used to prevent transfusion-associated graft-vs-host disease (TA-GvHD) in vulnerable populations. Irradiation works by inflicting irreparable DNA damage to T-lymphocytes present in the products in order to prevent their replication. However, irradiation accelerates the progressive red blood cell storage lesion, and therefore storage time after irradiation is limited.

Jason Acker received the 2017 Canadian Society for Transfusion Medicine Ortho Award Read more

A research collaboration between Canadian Blood Services scientists **Sheffield** and **Devine** examined gamma irradiation and subsequent storage in the additive solution SAG-M.[43] Irradiation late in storage correlated with unacceptably high levels of hemolysis, promoted red blood cell microvesiculation, stress-sensitive phospholipid scrambling, and increased vulnerability to eryptosis. However, no harmful changes in irradiated red blood cell quality were seen earlier than 21 days after irradiation, supporting current regulations for red blood cell irradiation timing and storage limits.

Similarly, **Acker** was involved in a BEST collaborative study looking at the influence of timing of gamma irradiation and blood donor sex on red blood cell in vitro quality. This study provided support for the current Council of Europe guidelines on the time limitations for the irradiation of red blood cells, and showed an impact on manufacturing method and donor sex on hemolysis and potassium levels.[44]

Neonates represent a vulnerable population who need transfusion of irradiated red blood cells products. **Chantale Pambrun** and **Devine** optimized a process to prepare aliquots of gamma-irradiated red blood cell units for neonatal transfusions.[45] They determined that supernatant reduction by centrifugation effectively reduces potential harmful substances (potassium, mannitol and red blood cell microvesicles) in aliquots stored up to 21 days, producing safer transfusion.

New ways to assess red cell quality

There are many laboratory measures to assess red blood cell quality, particularly in the context of the cell storage lesion. The membrane is one of the most critical cellular components affected by storage, and **Acker**'s group examined membrane water permeability — an essential cell membrane function — as an indicator of red blood cell quality.[46] Measuring osmotic permeability, the group demonstrated that water parameters are a predictor of membrane damage and loss of membrane integrity in stored red blood cells. In a separate study, they showed that membrane water permeability differed depending on the manufacturing method used to produce the red blood cells.[47] In this study they also examined donor factors such as sex and age, but found no effect on membrane water permeability.

Devine, with Michael Blades and Robin Turner from the University of British Columbia, explored a non-conventional (in blood banking) analytical technique, Raman spectroscopy, to assess hemoglobin oxygenation in red blood cell concentrates.[48] Their results indicated comparability to traditional morphological assessment, a subjective microscopy-based technique which is often used to assess red blood cell quality, and suggest that Raman spectroscopy has promise as a rapid and objective measure of red blood cell quality.

Hongshen Ma from the University of British Columbia, in a collaboration with **Mark Scott**, used a microfluidic devise to analyze red blood cell deformability.[49] They applied this device to assess hemin-induced oxidative stress in red blood cells resulting from *Plasmodium falciparum* – malaria infection – and determined that it has potential to be used to perform clinical assessment of disease progression in severe malaria.

Canadian Blood Services
it's in you to give

The intersection of transfusion medicine, inflammation, and immunity

An immunomodulator is an agent that modifies the immune response or the functioning of the immune system. Immunomodulation plays a role in many of the disorders that rely on blood products, and in the mechanisms of action of many therapies derived from blood, including the plasma-derived antibody-based therapies, intravenous immunoglobulin (IVIg) and RhD immune globulin (RhIg).

IVIg was originally developed as an antibody replacement therapy for patients deficient in IgG, but its use has expanded greatly due to recognition of its immunomodulatory effects in autoimmune disorders.[50] RhIg, a polyclonal IgG against RhD on red blood cells, is isolated from alloimmunized donors, and is considered a type of IVIg.[51]

These are effective and important therapies in a wide range of immune disorders. However, IVIg and RhIg are expensive drugs in limited supply, that carry a theoretical biosafety risk. Developing replacements for these products is desirable, and a focus of research at the Centre for Innovation.

Understanding how therapies work

Several studies by **Alan Lazarus** and his team used mouse models to understand how RhIg therapy works to prevent hemolytic disease of the fetus and newborn (HDFN).[52, 53] This life-threatening disease is the result of an immune response due to an incompatibility between a mother and her baby's blood in pregnancy. Treatment with RhIg suppresses the mother's immune response by a not-yet-fully understood mechanism known as antibody-mediated immune suppression (AMIS).

It was thought that interactions between RhIg and receptors on immune cells, followed by red blood cell clearance, were required for AMIS to be effective, but **Lazarus**'s work demonstrated that this is not the case. In a separate case study, **Lazarus** and colleagues demonstrated that RhIg antibodies can induce changes in the level of detectable RhD antigen on red blood cells in a clinical setting.[54] This suggests that upon RhIg treatment, detectable RhD antigen on red blood cells is lost. This may influence red blood cell clearance. These studies can help shape future research to develop non-plasma-derived alternatives to RhIg to prevent HDFN.

Donald Branch was involved in a study which looked at a recombinant Fc hexamer as an alternative to high-dose IVIg.[55] This drug also shows promise as a potent anti-inflammatory in a model of arthritis, likely mediated by blockade of Fc receptors and its inhibition of complement activation. Fc hexamers have the potential to replace all IVIg indications except for IgG replacement therapy in IgG-deficient patients; this work was done in collaboration with CSL Behring, the pharmaceutical company developing these agents.

Read the **Research**Unit: How does anti-D prevent hemolytic disease of the fetus and newborn? Lessons from a mouse model

Laura Sly developed protocols for use with mouse models to assess the impact of biologics such as IVIg on the inflammatory state of macrophages, providing information on the role of macrophage activation in the efficacy of these drugs and providing insights into mechanisms of action.[56]

Understanding the mechanisms of immune disorders

Published in Nature Communications, work from **Heyu Ni**'s laboratory shed light on the mechanism of fetal loss in Fetal and Neonatal Alloimmune Thrombocytopenia (FNAIT), a life-threatening bleeding disorder which affects approximately 1 in 1,000 live births, though its incidence may be underestimated due to miscarriage.[57] FNAIT occurs when an immune response is mounted by the mother against antigens on the baby's platelets during pregnancy, leading to low platelet counts which can result in severe bleeding, brain hemorrhage, growth restriction, or death of the fetus or newborn.

"By understanding what causes reduced growth and miscarriages in fetal and neonatal alloimmune thrombocytopenia (FNAIT) cases, we are one step closer to being able to identify FNAIT cases early and reduce the rates of the devastating outcomes of this disease."

Heyu Ni, Scientist, Canadian Blood Service, in RED blog post, August 2017. (Read more)

In contrast to many previous studies that have focused on the bleeding symptoms of FNAIT, **Ni**'s study, using mouse models, examined maternal antibodies in the uterus and discovered that they activate immune cells called natural killer or NK cells. These NK cells destroy trophoblasts leading to dysfunction of the placenta, fetal growth restriction and miscarriage, providing a non-bleeding reason for fetal loss in this disorder. This previously unknown mechanism also suggests a new therapeutic target — NK cells — which could be exploited to help prevent fetal loss in this devastating disorder. IVIg treatment, which due to its immunomodulatory activities may prevent activated NK cells from attacking trophoblasts, may improve FNAIT, although developing other therapeutic options that are more efficient or lower cost would be beneficial.

Ni's work has also helped elucidate mechanisms underlying immune thrombocytopenia (ITP).[58] Some ITP patients do not respond to standard immunosuppressive treatments such as IVIg. **Ni** and colleagues uncovered a novel mechanism that may explain why. They showed that antibodies against the ligand-binding domain of a platelet antigen called GPIbalpha, which ITP patients refractory to IVIg often have, exert a mechanical force on GPIb-IX via platelet cross-linking, inducing Fc-independent, and thus IVIG-resistant, platelet clearance. Understanding this mechanism may help develop effective therapies for these patients.

Branch, in a study conducted with several Canadian Blood Services medical directors and adjunct scientists, used genetic testing of patients to determine who is more at risk of developing IVIg-related red cell hemolysis, a potentially serious adverse reaction that occurs in some patients following treatment with high dose IVIg.[59, 60] They showed that patients with blood group AB are more susceptible to the adverse reaction, and would benefit from close monitoring for signs of hemolysis following treatment. The team has also used the monocyte monolayer assay, a technique pioneered by **Branch**, to show that IVIg-related hemolysis appears to occur via delayed-onset phagocytosis of red blood cells by the patient's monocytes.

Canadian Blood Services
it's in you to give

Read the **Research**Unit: Patient blood group impacts susceptibility to IVIg-associated hemolysis.

The concept of immunomodulation can also be used to develop other therapies. **Scott** has been pioneering immunocamouflage as a means to fool the immune system. This approach has potential applicability in a variety of transfusion and transplantation scenarios, as well as in immune disorders. **Scott** has investigated immunocamouflaged (stealth) red blood cells, generated by the covalent grafting of biologically safe polymers to red blood cell membrane proteins. This masks non-A/B blood group antigens and could be used to improve blood inventory and transfusion safety.[62] **Scott** is researching a related method to trick the immune system to make tissue transplantation safer and more accessible. In this approach, polymer-based bioengineering of T-cells is used to prevent allorecognition, and could help prevent transplant rejection without the harmful side effects observed with anti-rejection drugs, increasing transplantation safety.[63, 64]

Systematic review to inform clinical guidelines

Shehata, Lieberman and Arnold were involved in a systematic review of antenatal management in fetal and neonatal alloimmune thrombocytopenia (FNAIT). Their review of four randomized controlled trials and 22 nonrandomized studies suggests that first-line antenatal management in FNAIT is weekly IVIg administration. This non-invasive management approach was found to be effective, without the relatively high rate of adverse outcomes seen in invasive strategies, such as serial fetal blood sample and intrauterine platelet transfusions.[61]

Canadian Blood Services
it's in you to give

Driving innovation for Canadian Blood Services' operations

Under the leadership of **Ken McTaggart**, the Centre for Innovation's development laboratories and dedicated facilities address the needs of Canadian Blood Services' supply chain by providing the evidence needed to introduce change.

The group works closely with industry partners, including Macopharma and TerumoBCT, to test or co-develop new instruments, reagents, equipment and products to facilitate innovation. In the last year, the Product and Process Development group has conducted 65 research projects (Appendix I) and published 30 technical reports (Appendix II) to develop and share evidence with partners and inform decisions. The group has also distributed significant amount of blood products to researchers.

Distributing research products across Canada

3,255 blood products supporting **73** projects

258 cord blood products supporting **11** projects

Supporting changes in manufacturing blood products

Centrifuges and blood extractors

Canadian Blood Services must update the equipment it uses for blood components processing, in particular when this equipment reaches its end-of-life. The in-house testing capabilities that the Centre for Innovation's netCAD facility offer are essential to support the organization in making informed decisions about the optimal processes and the associated impact to product before these changes are implemented in our supply chain.

Led by **Janet McManus** and **Craig Jenkins**, and working closely with supply chain staff, the Centre was involved in the Request for Proposals carried out to identify new centrifuges and blood extractors from several vendors. The Centre also conducted a series of studies with the selected pieces of equipment to test the quality of the products manufactured, as well as to develop new processes.[65] The findings from these studies provided the evidence necessary for Canadian Blood Services to select new equipment while being confident of the quality of the products provided to hospitals for patient care. The data also informed the organization about the number of equipment and the staff required to implement the new process while maintaining adequate productivity.

Incremental change in support of transformational change

When testing the new centrifuges, netCAD staff identified an opportunity to improve the inserts that are used to safeguard the collection bags when being centrifuged. Working with an industry partner and supply chain, the group developed a new insert that is made of silicone providing a more durable and easier to wash insert. With this improvement, it is expected that the useful life of the inserts will go from months to years.[65]

With the support of the development data that were produced over the last two years, in 2017 Canadian Blood Services submitted a licence amendment to the regulator, Health Canada. After receiving approval from our regulator in April 2018, the organization is now in the process of implementing these changes at its Dartmouth facility before deployment to its eight other manufacturing sites. The Centre continues to provide support as this change is being implemented.

Hematology analyzers

The Siemens ADVIA 120 hematology analyzers used for quality control program have reached end-of-life and are being replaced with Sysmex XN-1000 hematology analyzers. These analyzers are used to determine platelet count, which together with unit volume determines the dose of platelets in a unit. Different counting technologies and methods mean there is a recognized discordance in platelet counts obtained among different analyzers. To account for this potential discordance and support the organization-wide change in analyzers, the Product and Process Development group, with expert support from **Devine**'s laboratory, established and tested a flow-cytometry based platelet counting 'reference' method.[67] This method, based on a clinical reference method for counting platelets developed by the BEST Collaborative, helped supply chain manage and understand the inter-instrument shift in quality control measurements as the new analyzers were implemented.

Collection bags

Canadian Blood Services uses two different collection bags (or collection sets) and manufacturing processes to produce blood components from whole blood. The Buffy Coat (B1) method is used to produce all three components, red blood cells, platelets and plasma components. However, this process requires the cooling of the collected whole blood to room temperature and its processing within 24 hours of collection.

In contrast, the Whole Blood (B2) method allows cooling of the whole blood to 4°C which extends the processing to up to 72 hours after collection but prevents the production of platelets due to their fragility in cold temperature. The Product and Process Development group is supporting supply chain in exploring the feasibility of using the B1 collection set in a "cold" (between 1 and 10°C) processing method to produce red blood cells and plasma.

This change could help better manage B1 manufacturing timelines, and could potentially replace or reduce reliance on the B2 collection set. The research study, conducted at netCAD, showed that red cell and plasma components manufactured using the B1 collection set and a "cold" processing method passed quality control acceptance criteria and were non-inferior to currently produced B1 components.[68] This suggests cold-processed B1 collection sets could be a suitable replacement for the B2 collection set.

Incremental change in support of transformational change

When reviewing the processing steps for preparing platelet products from pooled donors, netCAD staff identified an opportunity to remove a two-hour "resting" period after components extraction. With this improvement, the process is more streamlined without impacting platelet product quality.[66]

Non-destructive testing

In accordance with Health Canada regulations, Canadian Blood Services conducts ongoing quality control testing on a small fraction of its blood products. However, the current procedure requires that entire blood products be removed from the inventory, precluding their entry into the inventory and transfusion to patients. Over the last few years, the Centre for Innovation has lead an initiative to determine the feasibility of using small aliquots, drawn from units at production, to use in the quality control testing. Led by **McTaggart** and **Peter Schubert**, this approach, called non-destructive testing, could improve product availability and reduce production costs while maintaining quality control testing.

Leveraging the expertise from multiple researchers, the Product and Process Development team has focused its efforts on the following three areas: optimizing the design of the small aliquots containers to ensure appropriate representation of product quality parameters compared with the "mother unit", assessing the impact of small aliquot removal on the dose of the final blood product, and developing new sterility testing algorithms.

In the last year, **Blake** used a product simulator to determine the impact of aliquot removal on red blood cell unit volumes and hemoglobin dosage.[69] Performance was evaluated based on current Canadian Standards Association quality control criteria for hemoglobin levels in red blood cell units. The preliminary findings indicate that, after the removal of aliquots for non-destructive testing, most red blood cell units should meet criteria. However, this simulation study will need to be repeated once the new equipment and processes described above are fully implemented. Simulation studies are essential in predicting the impact a process change may have on the quality and efficacy of blood products.

Supporting implementation of new blood products

CMV-safe products

The National Advisory Committee on Blood and Blood Products (NAC) made a public statement in February 2017 recommending that leukoreduced cellular blood products be considered equivalent to Cytomegalovirus (CMV) IgG-seronegative blood products for all patient populations except for intrauterine transfusion. Later that year, Canadian Blood Services stopped testing the majority of donor blood for anti-CMV antibodies and implemented a new process to maintain only a small inventory of CMV seronegative blood components for the sole purpose of intrauterine transfusion. This recommendation was based on the review of available literature which included numerous research publications supported by Canadian Blood Services dating back to 2000 thus demonstrating the long-term impact of the Centre's research on the blood system.

To inform health care professionals about this change and ensure appropriate blood products utilization for optimum patient care, the Centre participated in several knowledge mobilization efforts. Chapters 13[70, 71] and 15[72, 73] of the Clinical Guide to Transfusion, edited by **Clarke** and **Sophie Chargé**, were updated and posted in both French and English on Canadian Blood Services Professional Education website, and attracted 10,000 views during the period September 2017 to March 2018.

In addition, an educational presentation and two accompanying videos were produced by Canadian Blood Services with **Jeannie Callum** from the University Health Network to provide an overview of the evidence and use of CMV-

seronegative and CMV-safe (leukoreduced) blood and blood products. These resources were published on the Professional Education website, and received 637 views.[74, 75]

To increase awareness of these tools amongst the transfusion medicine community, links were provided in a Canadian Blood Services Customer Letter sent to the approximately 720 hospitals served by our organization and presentations were made by Canadian Blood Services Hospital Liaison Specialists. Knowledge mobilization tools are essential to inform health care professionals impacted by the change and to support them in their continued provision of the best care possible for transfusion recipients across Canada (except Quebec).

Supporting changes in manufacturing hematopoietic stem cell products

According to best practices in the field of hematopoietic stem cell transplantation, Canadian Blood Services stores its cord blood units frozen at -196°C until they are required by physicians for transplantations. Standard protocols for storage or shipping of frozen cord blood units are not available although a transient warming of the units above critical subzero temperatures could impact cell viability and product efficacy. **Nicolas Pineault** and **Acker**, with expertise in cell biology and cryobiology, conducted research studies to optimize and standardize cord blood units handling and thawing procedures. These evidence-based procedures contributed to the success of Canadian Blood Services Cord Blood Bank in achieving FACT accreditation, a global standard for top quality patient care in cellular therapies.[76] The protocols are also expected to optimize Canadian Blood Services cord blood product quality and reduce variability between processing centres at Canadian Blood Services and hospitals.

Ramirez-Arcos and supply chain staff developed a protocol for neutralizing antibiotics that may be present in a collected cord blood unit.[77] This protocol can be applied to any culture-based bacterial screening method and ensures the accuracy of sterility tests performed to detect bacterially contaminated units that may pose a risk to patients. Considering that approximately one third of cord blood units donated in Canada are obtained from cesarean section deliveries, during which the mothers are undergoing prophylactic antibiotic treatment, the impact of this protocol is of importance.

"Every project we are involved in, no matter how big or small, has the goal of generating data that helps inform decisions. I am thrilled each time we can provide an answer and the organization can use our evidence to move forward."

Sandra Ramirez-Arcos, Development Scientist, Canadian Blood Service, in RED blog post, February 2018. (Read more)

Allan studies Canadian policy on the responsible use of umbilical cord blood for proven indications in regenerative therapy. To balance heightened public expectations and ensure appropriateness of emerging cell-based treatment choices, **Allan** notes the importance of regular evidence-based assessment of novel umbilical cord blood-derived therapies.[78] In a systematic review of the literature and meta-analysis of studies using umbilical cord blood in clinical studies of cell-based transplantation, **Allan** identified neurologic diseases as the most commonly reported novel indication of therapy. Of the 57 studies identified that looked at novel uses for umbilical cord blood, only 16 included a control group. A clearer understanding of the

clinical benefit of umbilical cord blood for specific indications is anticipated once more controlled studies are reported. Blood establishments, transplantation centers, and regulatory bodies need to prepare for greater clinical demand.

As part of Canadian Blood Services horizon scanning for novel uses of cord blood donations, **Pineault, Acker, Scott** and **Sheffield** conducted a review of the literature.[79] This indicated that finding new medical uses for existing cord blood products and developing new biological products from cord blood donations could increase the value of the Cord blood Bank for Canadians. Creating new or improved therapeutic products from cord blood donations is an area in which there are extensive preclinical and clinical research efforts, some of which are generating excitement in the scientific community. While none of the innovations are approved clinical protocols, the review revealed, similar to the conclusions of **Allan's** systematic review, that they will likely lead to increased demand for cord blood units.

Read the RED blog post:
A Q&A with Dr. David Allan.

Canadian Blood Services
it's in you to give

Organ and tissue donation and transplantation

The Centre for Innovation, in consultation with Canadian Blood Services' Organ and Tissue Donation and Transplantation (OTDT) group, supports research in the area of organ and tissue donation and transplantation. Both the James Kreppner Award Program and the Kenneth J. Fyke Award identify research priorities related to the issues of organ and tissue donation and are open to all Canadian researchers, while our Small Project Funding Program is open to internal staff, including those affiliated with the OTDT group. The Centre also partnered with CIHR to support the Canadian National Transplant Research Program (CNTRP).

This year, the Canadian Critical Care Trials Group and the CNTRP published the Canada-DONATE study protocol a prospective national observational study of the medical management of deceased organ donors.[80] This ongoing prospective observational study, led by **Maureen Meade** and Frederick D'Aragon aims to build a national platform for future clinical trials in donor management. Currently, research on the management of deceased organ donors is limited in Canada by the regionalization of donation services within provinces, as well as the separation of donation from transplantation services.

By engaging collaborators at donation hospitals and organ donation organizations, and gathering information about current practices, the study hopes to evaluate interventions and assess the feasibility of future clinical trials.

Jennifer Chandler and **Vanessa Gruben** are supported by the James Kreppner Award. Studying legal and ethical challenges around organ donation, and understanding public and stakeholder attitudes towards organ donation are central themes of their work. Together they have conducted preliminary work to understand organ donation in the context of new medical assistance in dying legislation, which was introduced in 2016 in Canada.[81, 82]

They are addressing the challenging issue of whether those accessing medical assistance in dying would be eligible to donate organs and tissues, and the associated ethical and legal questions this poses – a topic that has not been studied or addressed in detail thus far.

Canadian Blood Services
it's in you to give

Building transfusion and transplantation capacity through training and education

The Centre for Innovation facilitates the development of professionals in transfusion and transplantation science and medicine by providing formal training and education opportunities and by promoting knowledge dissemination. One of the focus of the Centre is to collaborate and partner to accelerate local activities and amplify their reach to the broader Canadian community.

A national training program

The Centre administers programs to provide financial supports for training professionals at various stages in their careers. Over the last year, the Centre's Graduate and Postdoctoral Fellowship Programs provided salary support to 16 junior researchers conducting projects aligned with our research priorities and in academic laboratories across Canada. In addition, the Centre's 11 scientists and development scientists supervised more than 20 graduate trainees and postdoctoral fellows with funding from research grants or external sources.

In 2017, the Centre also entered into a new partnership with the Canadian Institutes for Health Research (CIHR) to fund a CIHR Health System Impact fellow. **Jennie Haw** began her fellowship in September to conduct qualitative research to gain new perspectives on cord blood donor experiences and motivations, and the public banking process. The academic expertise she brings to our organization through this Fellowship will help the cord blood bank gather the data it requires to inform future policy development to best serve the needs of patients and donors.

Read the RED blog post: Unique fellowship brings academic expertise to an organizational challenge.

Mariam Taha studies bacteriophages — viruses that infect and consume bacteria. Taha is part of a project at Ottawa Hospital Research Institute looking at how to use bacteriophages in conjunction with antibiotics to treat biofilm infections in prosthetic joints.

Taha credits her work with Centre for Innovation scientist Ramirez-Arcos — made possible through the Canadian Blood Services Graduate Fellowship Program — for giving her the necessary experience and training to partake in this innovative medical work.

RED blog (read more)

In partnership with **Robert Skeate**, Canadian Blood Services associate medical director, the Centre continues to provide support to the training of transfusion medicine specialists via the Transfusion Medicine Areas of Focused Competency (AFC) diploma program. In 2017-2018, **Ziad Sohl** and **Jacqueline Trudeau** completed their diplomas. **Sohl** joined the London Health Sciences Centre and St. Joseph's Health Care London facility as a transfusion specialist and **Trudeau** is at the Vancouver General Hospital. Through their affiliation with

Canadian Blood Services
it's in you to give

Canadian Blood Services, these research and clinical specialists gain a unique exposure to the Canadian blood system that prepares them to contribute to new advances in this field and engages them in a national network.

The Centre continues to provide administrative support to facilitate the national expansion of Transfusion Camp. This unique program is targeted at postgraduate medical trainees from various specialties that use blood products. It consists of five one-day events that include lectures and team based learning sessions. In 2015, the Centre partnered with the Toronto based team to deliver this unique training on a national scale. In 2017-2018, Western University joined the seven Canadian universities (University of Toronto, University of British Columbia, University of Saskatchewan, McMaster University, Queen's University, University of Ottawa and Dalhousie University) and Oxford University in delivering this program to their medical trainees. In addition, more medical programs joined bringing the number of trainees registered to 302 (134 more than in 2016-17) from a total of 18 specialties. The impact of this training program on knowledge acquisition, postgraduate trainee attitudes, and self-reported behavior vis-à-vis transfusion practice is currently being evaluated.

Webinars and symposiums for health care professionals and researchers

Since 2007, Canadian Blood Services, under the leadership of medical director **Peter Lesley**, and the Ontario Regional Blood Coordinating Network (ORBCoN) co-chair an annual transfusion medicine symposium in partnership with a community hospital. The involvement of the community hospital is key in identifying topics of relevance to the transfusion issues faced by their health care professionals. The community hospital also serves as the host site for the symposium, from where the speakers present to the local audience and from where the lectures are webcasted to more participants.

In April 2017, the education program focused on managing patients with gastrointestinal (GI) bleeding. Speakers shared tools to assess the severity of the GI bleed, provided best practices for treating bleeding in patients with advanced liver disease, compared the available options for anticoagulant reversal in the GI bleed setting, and discussed strategies for red blood cell utilization. In recent years, with videoconferencing and webcasting technology provided by the Ontario Telemedicine Network, the reach of this symposium has been extended to include more hospitals across Ontario and Canada. In fact, this year, 136 healthcare facilities participated, including nine Canadian Blood Services sites, two pharmaceutical companies and one post-secondary institution, engaging more than a thousand professionals.

"This is a great learning experience, with wonderful speakers. I was able to come away with a better overall picture as to the care and decisions towards a patient."

Feedback from a 2017 attendee of the Annual Transfusion Medicine symposium, RED blog (read more)

Through its collaboration with the **Centre for Blood Research**, the Centre supports the annual Norman Bethune and Earl W. Davie symposia. These events feature expert presentations from Canadian and international leaders as well as from patients, and are broadcast to facilitate remote attendance. With attendance in the hundreds, these events inspire researchers to further innovative research and provide opportunities for students and early career researchers to network.

Canadian Blood Services
it's in you to give

Read the RED blog post: Earl W. Davie Symposium - Eleven years and counting.

Dr. Earl W. Davie, Dr. Ross T. MacGillivray and Dr. Edmond H. Fischer at the 2017 Symposium in Vancouver. (Photo courtesy of the Centre for Blood Research.)

Educational resources made available online

In collaboration with the Canadian transfusion medicine community, the Centre develops educational resources for health care professionals that are made available free of charge via the new Canadian Blood Services Professional Education website (profedu.blood.ca). In 2017-2018, the website recorded 163,000 sessions engaging 130,000 users with over 300,000 page views. Users are primarily from Canada (45 per cent of users) but also from the United States as well as francophone countries which seek French content. The most sought-after resources are the 18 chapters of the Clinical Guide to Transfusion, with over 60,000 page views and an average of 3.5 minutes spent on each page, as well as an article on TRALI with 50,000 page views.

Through its BloodTechNet competitive program, the Centre continues to fund projects aimed at delivering educational tools and resources that support the development of skills, knowledge, and expertise of health professionals in the transfusion, cellular therapy, and transplantation communities in Canada. In 2017-2018, **Andrew Shih** (a former Transfusion Medicine AFC diploma recipient) received funding to develop an online curriculum dedicated to the management of bleeding and thrombosis with transfusion medicine as a central concept. **Shih's** project developed Blood&Clots resources that are now housed on CanadiEM, an online portal for emergency medicine specialists.

Also in 2017-2018, **Clinton Campbell** led a multidisciplinary team to bring the Choosing Wisely Canada transfusion recommendations to life in video form. The five short videos are housed on Canadian Blood Services professional education website as well as on the Canadian Society for Transfusion Medicine website. To date, they have attracted more than 1500 views.

Video developed through the BloodTechNet program.

These resources are further disseminated via the Centre's Research and Education monthly e-newsletter, which currently has 849 subscribers, the RED blog, and partners' newsletters including Canadian Blood Service's Circulation and BloodNotes.

When appropriate, educational resources are also included in Canadian Blood Services Customer Letters and in presentations delivered by Canadian Blood Services Hospital Liaison Specialists to hospital stakeholders.

Canadian Blood Services
it's in you to give

Good governance and a collaborative approach increase impact

As illustrated throughout this report, the achievements of the Centre's strategic activities are complemented and enhanced by strategic partnerships and collaborations. Internally, the Centre continues to benefit from sound governance from Canadian Blood Services, with oversight provided by the external Scientific and Research Advisory Committee and by the Safety, Research and Ethics Committee of Canadian Blood Services' Board of Directors. Program administration is strongly supported by Canadian Blood Services' enabling functions: Talent Management, Finance, Legal, Information Technology, and others. Significant value and rigour are achieved by the contributions of these support services and the infrastructure surrounding the programs operated by the Centre for Innovation.

External stakeholders and partners include other blood operators and related organizations, academic and research institutes, not-for-profits, industry, and government partners. These bring value and contribute greatly to the impact of the Centre for Innovation.

The broad spectrum of partners enhances our national and international standing, establishes the Centre as a leader in the field, and allows us to benefit from the expertise and resources of global endeavors in transfusion and transplantation. Strong connections with our partners also facilitate dissemination and uptake of knowledge created by the Centre, maximizing our impact and helping attain our outcome of a safe, effective, and responsive system for blood and blood products in Canada.

Through the contributions of the Centre for Innovation, the Canadian blood system is well-positioned to address emerging scientific and clinical knowledge, risks, opportunities and technologies. This annual progress report highlights many of the important accomplishments of the Centre for Innovation and, together with the outputs and outcomes reported as part of its performance measurement framework (Table 1, Appendices I and II), demonstrates the value of the Centre's activities in improving patient outcomes and system performance while ensuring maximal cost-efficiency.

Centre for Innovation research network: Canadian Blood Services' scientists, medical directors, trainees, team members, and external researchers participated in the Centre for Innovation annual research day.

Canadian Blood Services
it's in you to give

References cited

(see Appendix II for a full list of the Centre for Innovation's publications for fiscal year 2017–2018)

1. **Goldman M**, Steele WR, Di Angelantonio E, van den Hurk K, Vassallo RR, Germain M, **O'Brien SF**. Comparison of donor and general population demographics over time: a BEST collaborative group study. *Transfusion* 2017; 57: 2469-76.
2. **Goldman M**, **O'Brien S**. Our older population: donors as well as recipients? *ISBT Sci Ser* 2017; 12: 401-4.
3. **Goldman M**, Shih AW, **O'Brien SF**, **Devine D**. Donor deferral policies for men who have sex with men: past, present and future. *Vox Sang* 2018; 113: 95-103.
4. **O'Brien SF**. Surveillance report 2016. *Blood.ca website* 2017.
5. Adams Z, Morris G, Campbell T, Mostert K, Dibdin N, **Fearon M**, Elmoazzen H, Mercer D, Young K, **Allan D**. Risk of exposure to Zika virus and impact on cord blood banking and adult unrelated donors in hematopoietic cell transplantation: the Canadian Blood Services experience. *Biol Blood Marrow Transplant* 2018; 24: 861-5.
6. **Devine DV**. Pathogen inactivation strategies to improve blood safety: Let's not throw pathogen-reduced platelets out with their bath water. *JAMA Oncol* 2018; 4: 458-9.
7. Magron A, Laugier J, Provost P, Boilard E. Pathogen reduction technologies: The pros and cons for platelet transfusion. *Platelets* 2018; 29: 2-8.
8. Taha M, Culibrk B, Kalab M, Schubert P, Yi QL, Goodrich R, **Ramirez-Arcos S**. Efficiency of riboflavin and ultraviolet light treatment against high levels of biofilm-derived Staphylococcus epidermidis in buffy coat platelet concentrates. *Vox Sang* 2017; 112: 408-16.
9. Schubert P, Culibrk B, Karwal S, Serrano K, Levin E, Yi Q, Thiele T, Greinacher A, Marschner S, **Devine DV**. Altered timing of riboflavin and ultraviolet light pathogen inactivation improves platelet in vitro quality. *Transfusion* 2017; 57: 2026-34.
10. Semple JW, McVey MJ, Kim M, Rebetz J, Kuebler WM, Kapur R. Targeting transfusion-related acute lung injury: the journey from basic science to novel therapies. *Crit Care Med* 2018; 46: e452-8.
11. **Zeller MP**, Barty R, Aandahl A, Apelseth TO, **Callum J**, Dunbar NM, Elahie A, Garritsen H, Hancock H, Kutner JM, Manukian B, Mizuta S, Okuda M, Pagano MB, Poglod R, Rushford K, Selleng K, Sorensen CH, Sprogoe U, Staves J, Weiland T, Wendel S, Wood EM, van de Watering L, van Wordragen-Vlaswinkel M, Ziman A, Jan Zwaginga J, Murphy MF, Heddle NM, Yazer MH. An international investigation into O red blood cell unit administration in hospitals: the GRoup O Utilization Patterns (GROUP) study. *Transfusion* 2017; 57: 2329-37.
12. **Zeller MP**, Barty R, Dunbar NM, Elahie A, Flanagan P, Garritsen H, Kutner JM, Pagano MB, Poglod R, Rogers TS, Staves J, van Wordragen-Vlaswinkel M, Zwaginga JJ, Murphy MF, Heddle NM, Yazer MH. An international investigation into AB plasma administration in hospitals: how many AB plasma units were infused? The HABSWIN study. *Transfusion* 2018; 58: 151-7.
13. **Zeller M**, Heddle N, **Devine D**. ResearchUnit: Where is the blood going? Understanding red blood cell utilization to inform policies. *Blood.ca website* 2017.
14. **Zeller M**, Heddle N, **Devine D**. Concentré de recherche: Mais où va le sang? Analysons la consommation des concentrés de globules rouges pour l'éetablissement des politiques. *Blood.ca website* 2017.

15. **Berardi P**, Cote J, **Clarke G**, Scalia V, **Liwski R**, **Goldman M**. Nucleic acid extraction from buccal tissue for prediction of red blood cell phenotype. *Transfusion* 2017; 57: 2547-8.
16. **Jenkins C**. Circular of Information for the use of human blood components: Platelets. *Blood.ca website* 2017.
17. **Ramirez-Arcos S**, DiFranco C, McIntyre T, **Goldman M**. Residual risk of bacterial contamination of platelets: six years of experience with sterility testing. *Transfusion* 2017; 57: 2174-81.
18. **Ramirez-Arcos S**. Expansion of the in-house proficiency testing program to include anaerobic bacteria. *Internal report submitted to Canadian Blood Services* 2018.
19. **Ramirez-Arcos S**, Taha M, Kou Y, Mastronardi C, Yi Q, **Goldman M**. Improved bacterial detection algorithm supports extension of platelet storage from 5 to 7 days at Canadian Blood Services. *Vox Sang* 2017; 112: 197.
20. Taha M, Kou Y, Mastronardi C, Yi Q, **Goldman M**, **Ramirez-Arcos S**. New bacterial detection algorithm supports extension of platelet storage from 5 to 7 days at Canadian Blood Services. *Canadian Society for Transfusion Medicine Website* 2017.
21. Serrano K, Schubert P, **Devine D**. Platelet product quality remains high after seven days of storage. *Blood.ca website* 2017.
22. **Blake J**. Determining the inventory impact of extended shelf life platelets with a network simulation model. *Transfusion* 2017; 57: 3001-8.
23. **Blake J**. ResearchUnit: A model for change: predicting the impact of system-wide improvements. *Blood.ca website* 2018.
24. **Blake J**. Concentré de recherche: Un modèle de changement : prédiction de l'impact d'améliorations à l'échelle du système. *Blood.ca website* 2018.
25. Taha M, Kohnen C, Mallya S, Kou Y, Zapata A, **Ramirez-Arcos S**. Comparative characterisation of the biofilm-production abilities of Staphylococcus epidermidis isolated from human skin and platelet concentrates. *J Med Microbiol* 2018; 67: 190-7.
26. Kumaran D, Taha M, Yi Q, **Ramirez-Arcos S**, Diallo JS, Carli A, Abdelbary H. Does treatment order matter? Investigating the ability of bacteriophage to augment antibiotic activity against Staphylococcus aureus biofilms. *Front Microbiol* 2018; 9: 127.
27. Loza-Correa M, Kalab M, Yi QL, Eltringham-Smith L, **Sheffield W**, **Ramirez-Arcos S**. Comparison of bacterial attachment to platelet bags with and without preconditioning with plasma. *Vox Sang* 2017; 112: 401-7.
28. **Ramirez-Arcos S**. ResearchUnit: Plasma residues enhance bacterial attachment to platelet storage bags. *Blood.ca website* 2017.
29. **Ramirez-Arcos S**. Concentré de recherche: La présence de résidus de plasma favorise l'adhérence des bactéries à la paroi des poches utilisées pour les concentrés de plaquettes. *Blood.ca website* 2017.
30. Hadjesfandiari N, Weinhart M, Kizhakkedathu JN, Haag R, Brooks DE. Development of antifouling and bactericidal coatings for platelet storage bags using dopamine chemistry. *Adv Healthc Mater* 2018; 7: 1700839.
31. Spindler-Raffel E, Benjamin RJ, McDonald CP, **Ramirez-Arcos S**, Aplin K, Bekeredjian-Ding I, de Korte D, Gabriel C, Gathof B, Hanschmann KM, Hourfar K, Ingram C, Jacobs MR, Keil SD, Kou Y, Lambrecht B, Marcelis J, Mukhtar Z, Nagumo H, Niekerk T, Rojo J, Marschner S, Satake M, Seltsam A, Seifried E, Sharafat S, Stormer M, Sussner S, Wagner SJ, Yomtovian R. Enlargement of the WHO international repository for platelet transfusion-relevant bacteria reference strains. *Vox Sang* 2017; 112: 713-22.

32. **Arnold DM**, Lauzier F, Albert M, Williamson D, Li N, Zarychanski R, Doig C, McIntyre L, Freitag A, Crowther M, Saunders L, Clarke F, Bellomo R, Qushmaq I, Lopes R, Heels-Ansdell D, **Webert K**, Cook D. The association between platelet transfusions and bleeding in critically ill patients with thrombocytopenia. *Res Pract Thromb Haemost* 2017; 1: 103-11.
33. Dyer C, Alquist CR, Cole-Sinclair M, Curnow E, Dunbar NM, Estcourt LJ, Kaufman R, Kutner JM, McCullough J, McQuilten Z, Potiphar L, Rioux-Masse B, Slichter S, **Tinmouth A**, **Webert K**, Yokoyama AP, Stanworth SJ. A multicentred study to validate a consensus bleeding assessment tool developed by the biomedical excellence for safer transfusion collaborative for use in patients with haematological malignancy. *Vox Sang* 2018; 113: 251-9.
34. Vostal JG, Buehler PW, Gelderman MP, Alayash AI, Doctor A, Zimring JC, Glynn SA, Hess JR, Klein H, **Acker JP**, Spinella PC, D'Alessandro A, Palsson B, Raife TJ, Busch MP, McMahon TJ, Intaglietta M, Swartz HM, Dubick MA, Cardin S, Patel RP, Natanson C, Weisel JW, Muszynski JA, Norris PJ, Ness PM. Proceedings of the Food and Drug Administration's public workshop on new red blood cell product regulatory science 2016. *Transfusion* 2018; 58: 255-66.
35. Cook RJ, Heddle NM, Lee KA, **Arnold DM**, Crowther MA, Devereaux PJ, Ellis M, Figueroa P, Kurz A, Roxby D, Sessler DI, Sharon Y, Sobieraj-Teague M, Warkentin TE, **Webert KE**, Barty R, Liu Y, Eikelboom JW. Red blood cell storage and in-hospital mortality: a secondary analysis of the INFORM randomised controlled trial. *Lancet Haematol* 2017; 4: e544-e52.
36. Ning S, Heddle NM, **Acker JP**. Exploring donor and product factors and their impact on red cell post-transfusion outcomes. *Transfus Med Rev* 2018; 32: 28-35.
37. **Shehata N**, Whitlock R, Fergusson DA, Thorpe KE, MacAdams C, Grocott HP, Rubens F, Fremes S, Lellouche F, Bagshaw S, Royse A, Rosseel PM, Hare G, Medicis E, Hudson C, Belley-Cote E, Bainbridge D, Kent B, Shaw A, Byrne K, Syed S, Royse CF, McGuiness S, Hall J, Mazer CD. Transfusion requirements in cardiac surgery III (TRICS III): study design of a randomized controlled trial. *J Cardiothorac Vasc Anesth* 2018; 32: 121-9.
38. Garg AX, **Shehata N**, McGuinness S, Whitlock R, Fergusson D, Wald R, Parikh C, Bagshaw SM, Khanykin B, Gregory A, Syed S, Hare GMT, Cuerden MS, Thorpe KE, Hall J, Verma S, Roshanov PS, Sontrop JM, Mazer CD. Risk of acute kidney injury in patients randomized to a restrictive versus liberal approach to red blood cell transfusion in cardiac surgery: a substudy protocol of the transfusion requirements in cardiac surgery III noninferiority trial. *Can J Kidney Health Dis* 2018; 5: 2054358117749532.
39. Mazer CD, Whitlock RP, Fergusson DA, Hall J, Belley-Cote E, Connolly K, Khanykin B, Gregory AJ, de Medicis E, McGuinness S, Royse A, Carrier FM, Young PJ, Villar JC, Grocott HP, Seeberger MD, Fremes S, Lellouche F, Syed S, Byrne K, Bagshaw SM, Hwang NC, Mehta C, Painter TW, Royse C, Verma S, Hare GMT, Cohen A, Thorpe KE, Juni P, **Shehata N**. Restrictive or liberal red-cell transfusion for cardiac surgery. *N Engl J Med* 2017; 377: 2133-44.
40. **Shehata N**, Chassé M, Colas JA, Murphy M, Forster AJ, Malinowski AK, Ducharme R, Fergusson DA, **Tinmouth A**, Wilson K. Risks and trends of red blood cell transfusion in obstetric patients: a retrospective study of 45,213 deliveries using administrative data. *Transfusion* 2017; 57: 2197-205.
41. Chen D, Schubert P, **Devine DV**. Proteomic analysis of red blood cells from donors exhibiting high hemolysis demonstrates a reduction in membrane-associated proteins involved in the oxidative response. *Transfusion* 2017; 57: 2248-56.
42. **Blake J**. Technical report on rare blood study. *Internal report submitted to Canadian Blood Services* 2017.

43. Qadri S, Chen D, Schubert P, **Devine D**, **Sheffield W**. Early γ-irradiation and subsequent storage of red cells in SAG-M additive solution potentiate energy imbalance, microvesiculation and susceptibility to stress-induced apoptotic cell death. *Vox Sang* 2017; 112: 480-3.
44. de Korte D, Thibault L, Handke W, Harm SK, Morrison A, Fitzpatrick A, Marks DC, Yi QL, **Acker JP**. Timing of gamma irradiation and blood donor sex influences in vitro characteristics of red blood cells. *Transfusion* 2018; 58: 917-26.
45. Serrano K, **Pambrun C**, Levin E, **Devine DV**. Supernatant reduction of stored gamma-irradiated red blood cells minimizes potentially harmful substances present in transfusion aliquots for neonates. *Transfusion* 2017; 57: 3009-18.
46. Alshalani A, **Acker JP**. Red blood cell membrane water permeability increases with length of ex vivo storage. *Cryobiology* 2017; 76: 51-8.
47. Alshalani A, Howell A, **Acker JP**. Impact of blood manufacturing and donor characteristics on membrane water permeability and in vitro quality parameters during hypothermic storage of red blood cells. *Cryobiology* 2018; 80: 30-7.
48. Atkins CG, Schulze HG, Chen D, **Devine DV**, Blades MW, Turner RF. Using Raman spectroscopy to assess hemoglobin oxygenation in red blood cell concentrate: an objective proxy for morphological index to gauge the quality of stored blood? *Analyst* 2017; 142: 2199-210.
49. Matthews K, Duffy SP, Myrand-Lapierre M-E, Ang RR, Li L, **Scott MD**, Ma H. Microfluidic analysis of red blood cell deformability as a means to assess hemin-induced oxidative stress resulting from Plasmodium falciparum intraerythrocytic parasitism. *Integr Biol* 2017; 9: 519-28.
50. Khan R, **Lazarus A**. Mechanisms of action and immunomodulation by IVIg. In *Antibody Therapy: Substitution - Immunomodulation - Monoclonal Immunotherapy*. Edited by Imbach P. Published by Springer International Publishing, 2018.
51. Khan R, **Lazarus A**. Anti-D; a type of IVIg. In *Antibody Therapy: Substitution - Immunomodulation - Monoclonal Immunotherapy*. Edited by Imbach P. Published by Springer International Publishing, 2018.
52. Cruz-Leal Y, Marjoram D, **Lazarus AH**. Erythrocyte saturation with IgG is required for inducing antibody-mediated immune suppression and impacts both erythrocyte clearance and antigen-modulation mechanisms. *J Immunol* 2018; 200: 1295-305.
53. Marjoram D, Cruz-Leal Y, Bernardo L, Le NPL, Crispin M, Yu X, Uchikawa M, **Lazarus AH**. Immunoglobulin G Fc glycans are not essential for antibody-mediated immune suppression to murine erythrocytes. *Blood* 2017; 130: 2902-5.
54. Sullivan HC, Arthur CM, Thompson L, Patel SR, Stowell SR, Hendrickson JE, **Lazarus AH**. Anti-RhD reduces levels of detectable RhD antigen following anti-RhD infusion. *Transfusion* 2018; 58: 542-4.
55. Spirig R, Campbell IK, Koernig S, Chen CG, Lewis BJB, Butcher R, Muir I, Taylor S, Chia J, Leong D, Simmonds J, Scotney P, Schmidt P, Fabri L, Hofmann A, Jordi M, Spycher MO, Cattepoel S, Brasseit J, Panousis C, Rowe T, **Branch DR**, Baz Morelli A, Kasermann F, Zuercher AW. rIgG1 Fc hexamer inhibits antibody-mediated autoimmune disease via effects on complement and FcgammaRs. *J Immunol* 2018; 200: 2542-53.
56. Kozicky L, Sly LM. Assessment of antibody-based drugs effects on murine bone marrow and peritoneal macrophage activation. *J Vis Exp* 2017: e56689.
57. Yougbare I, Tai WS, Zdravic D, Oswald BE, Lang S, Zhu G, Leong-Poi H, Qu D, Yu L, Dunk C, Zhang J, Sled JG, Lye SJ, Brkic J, Peng C, Hoglund P, Croy BA, Adamson SL, Wen XY, Stewart DJ, Freedman J, **Ni H**. Activated NK cells cause placental dysfunction and miscarriages in fetal alloimmune thrombocytopenia. *Nat Commun* 2017; 8: 224.

58. Quach ME, Dragovich MA, Chen W, Syed AK, Cao W, Liang X, Deng W, De Meyer SF, Zhu G, Peng J, **Ni H**, Bennett CM, Hou M, Ware J, Deckmyn H, Zhang XF, Li R. Fc-independent immune thrombocytopenia via mechanomolecular signaling in platelets. *Blood* 2018; 131: 787-96.
59. **Branch DR**, Hellberg Å, Bruggeman CW, Storry JR, Sakac D, Blacquiere M, Tong TN, Burke-Murphy E, Binnington B, Parmar N, Riden LS, Willie K, Armali C, Aziz J, Lieberman L, Laroche V, **Callum J**, Lin Y, **Shehata N**, Pavenski K, **Lau W**, **Hannach B**, Kuijpers TW, Olsson ML, Cserti-Gazdewich C, Pendergrast J. ABO zygosity, but not secretor or Fc receptor status, is a significant risk factor for IVIG-associated hemolysis. *Blood* 2018; 131: 830-5.
60. Pendergrast J, Binnington B, Tong TN, **Callum J**, Cserti-Gazdewich CM, **Lau W**, Lieberman L, Lin Y, Pavenski K, **Shehata N**, Yeung R, **Branch DR**. Incidence and risk factors for IVIG-mediated hemolysis. *Blood* 2017; 130: 2398.
61. Winkelhorst D, Murphy MF, Greinacher A, **Shehata N**, Bakchoul T, Massey E, Baker J, Lieberman L, Tanael S, Hume H, **Arnold DM**, Baidya S, Bertrand G, Bussel J, Kjaer M, Kaplan C, Kjeldsen-Kragh J, Oepkes D, Ryan G. Antenatal management in fetal and neonatal alloimmune thrombocytopenia: a systematic review. *Blood* 2017: 1538-47.
62. **Scott M**, Toyofuku W, Yang X, Raj M, Kang N. Immunocamouflaged RBC for alloimmunized patients. In *Transfusion Medicine and Scientific Developments*. Edited by Koopman-van Gemert AWMM. Published by InTech, 2017.
63. Kang N, Toyofuku WM, Yang X, **Scott MD**. Inhibition of allogeneic cytotoxic T cell (CD8+) proliferation via polymer-induced Treg (CD4+) cells. *Acta Biomat* 2017; 57: 146-55.
64. **Scott M**. ResearchUnit: Using immunocamouflage to increase transplantation safety. *Blood.ca website* 2017.
65. McManus J. Evaluation of production equipment identified by the RFP. *Internal report submitted to Canadian Blood Services, Supply Chain - Production Process Management* 2017.
66. McManus J. Evaluation of buffy coat rest time on pooled platelet yields. *Internal report submitted to Canadian Blood Services, Supply Chain - Production Process Management* 2017.
67. Schubert P. Counting platelets: Correlation between different hematology analyzers and a flow cytometry based method. *Internal report submitted to Canadian Blood Services* 2017.
68. McManus J. B1 cold processing study. *Internal report submitted to Canadian Blood Services, Supply Chain - Production Process Management* 2017.
69. **Blake J**. A technical analysis of the impact of sample removal on unit volume and dose in red blood cell collections. *Internal report submitted to Canadian Blood Services* 2018.
70. **Lau W**. Neonatal and pediatric transfusion. in **Clarke G**, **Charge S**, (eds) Clinical Guide to Transfusion. ProfessionalEducation.blood.ca, Canadian Blood Services, 2017.
71. **Lau W**. Pratiques transfusionnelles chez le nouveau-né et l'enfant. In *Guide de la pratique transfusionnelle*. Edited by **Clarke G**, **Chargé S**. Published in ProfessionalEducation.blood.ca by Canadian Blood Services, 2017.
72. Prokopchuk-Gauk O, Solh Z. CMV seronegative, irradiated and washed blood components. in **Clarke G**, **Charge S**, (eds) Clinical Guide to Transfusion. ProfessionalEducation.blood.ca, Canadian Blood Services, 2017.
73. Prokopchuk-Gauk O, Solh Z. Composants sanguins négatifs pour les anti-CMV, irradiés et lavés. In *Guide de la pratique transfusionnelle*. Edited by **Clarke G**, **Charge S**. Published in ProfessionalEducation.blood.ca by Canadian Blood Services, 2017.
74. Ryan J. Utilisation des produits sanguins CMV négatifs. *Blood.ca website* 2017.
75. Ryan J. Use of cytomegalovirus (CMV) seronegative blood products. *Blood.ca website* 2017.

76. Howell A, **Pineault N**, **Acker J**, Halpenny M, Elmoazzen H. Understanding transient warming events in cord blood units and their impact on product quality. *Internal report submitted to Canadian Blood Services* 2017.
77. Kou Y, Halpenny M, Elmoazzen H, **Ramirez-Arcos S**. Development of a proof of principle for universal neutralization of antibiotics in cord blood by-products used for sterility testing. *Transfusion* 2018.
78. Rizk M, Aziz J, Shorr R, **Allan DS**. Cell-based therapy using umbilical cord blood for novel indications in regenerative therapy and immune modulation: an updated systematic scoping review of the literature. *Biol Blood Marrow Transplant* 2017; 23: 1607-13.
79. **Pineault N**, **Acker JP**, **Scott MD**, **Sheffield W**. Environmental scan: novel uses for cord blood donations. *Internal report submitted to Canadian Blood Services* 2017.
80. D'Aragon F, Dhanani S, Lamontagne F, Cook DJ, Burns K, Akhtar A, Chasse M, Frenette AJ, Keenan S, Lize JF, Kutsogiannis DJ, Kramer A, Hand LE, Arseneau E, Masse MH, Ribic C, Ball I, Baker A, Boyd G, Rochwerg B, Healey A, Hanna S, Guyatt GH, Meade MO. Canada-DONATE study protocol: a prospective national observational study of the medical management of deceased organ donors. *BMJ Open* 2017; 7: e018858.
81. Gruben V, Chandler J. Organ Donation and Medical Assistance in Dying in Canada. *Transplantation* 2017; 101: S14.
82. Chandler J, Gruben V. Organ donation in the context of MAiD: Ethics, Law and Policy. *Conference on End of Life Law Ethics Policy and Practice Website* 2017.

Canadian Blood Services
it's in you to give

Appendix I: Funded projects

Summary of funded research projects by program

Projects receiving funding in fiscal year 2017-2018	Total: 152
Research Program	**54**
Canadian Blood Services/CIHR partnership operating grants	20
Canadian Blood Services/CIHR partnership new investigator awards	1
Intramural research grants	9
MSM Research Grants	11
James Kreppner awards	2
Kenneth J. Fyke awards	2
Blood efficiency accelerator awards	2
Small projects funding	6
CIHR partnership: transplantation research	1
Development Program	**65**
Deepening the understanding of our products and the processes used to manufacture them	21
Developing next generation and/or new products and the processes used to manufacture them	11
Improving current generation products and the processes used to manufacture them	18
Improving and/or enabling the product and process development group	11
Improving and/or enabling Canadian Blood Services	4
National Training Program	**21**
Transfusion medicine fellowships	4
Postdoctoral fellowships	5
CIHR health system fellowship	1
Graduate fellowships	11
Education Program	**7**
Education research grant	1
Program support collaboration	1
BloodTechNet awards	5
Transfusion Medicine Program Support Award	**5**

Canadian Blood Services
it's in you to give

Titles of projects funded by Research program

* Note: Projects that are italicized are those for which funding was initiated in fiscal year 2017–2018

Canadian Blood Services/CIHR Partnership National Operating Grant Program
Purpose: Transfusion science
**Expanding treatment options for inflammatory bowel disease: a novel mechanism of antibody-based*
Fetal and neonatal alloimmune thrombocytopenia: novel mechanisms and therapeutic approaches
Novel mechanisms of platelet aggregation: roles of non-classical beta-3 integrin ligands and fibronectin in thrombosis and hemostasis
Purpose: Blood supply risk
Examining the relationship between repeated blood donations in female donors on maternal/neonatal outcomes: a cohort study
Exploratory analyses to determine if method of donor blood processing affects outcome in transfused recipients
Transfusion-related Epstein-Barr Virus (EBV) infection among allogeneic stem cell transplant pediatric recipients: a multicenter prospective cohort study (TREASuRE Study)
Purpose: Blood utilization and conservation
Aneurysmal SubArachnoid HemorrhAge - Red blood cell transfusion And outcome (SAHaRA): a pilot randomized controlled trial
Characterization of the hematopoietic reconstitution enhancing activity of osteoblasts derived from human mesenchymal stromal cells
Defining disease mechanisms in Immune Thrombocytopenia (ITP) and their association with clinical outcomes
Design and implementation of circulatory oxygen therapeutics derived from human hemoglobin by improved systematic chemical coupling and cross-linking
Microfluidic devices to measure the deformability of stored red blood cells
Myocardial Ischemia and Transfusion. The MINT rollover trial
Pathogenesis and treatment of immune thrombocytopenia: Are there fundamental differences between anti-GPIba- and anti-GPIIbIIIa-mediated thrombocytopenia?
Polyhemoglobin catalase superoxide dismutase carbonic anhydrase: a novel soluble biotherapeutic with no cardiac toxicity for hemorrhagic shock and other uses
Polymer-based manufacturing tolerogenic miRNA-based therapeutics
Release, delivery and cell programming effects of platelet microparticles and microRNAs
Understanding transcriptional and epigenetic control by Gfi1b towards the development of a therapy for sickle cell disease
Purpose: Transfusion-related acute lung injury
Identification of host cellular immune mechanisms responsible for the initiation and/or modulation of transfusion related acute lung injury (TRALI)
Mechanisms of antibody-independent transfusion-related acute lung injury (TRALI)
Transfusion-related acute lung injury and delayed TRALI: a prospective study in critically ill children

Canadian Blood Services/CIHR Partnership New Investigator Program
Code sepsis: defining and translating optimal resuscitation and care for children with septic shock

Canadian Blood Services
it's in you to give

Intramural Research Grant Program
Influence of eryptosis and storage on transfused red cell recovery in sepsis
Monovalent Fc receptor blockade using novel fusion proteins: the road towards an IVIg replacement
Optimization of monoclonal anti-erythrocyte antibodies for improved immunoprophylaxis in a murine model
A multifaceted intervention to optimize red blood cell transfusion practice in two provinces
Elucidation of the mechanism of IVIg-associated hemolysis
Human monoclonal CD44 antibodies as potential IVIg replacements
Monoclonal antibodies with anti-D-like activity in the amelioration of murine immune thrombocytopenia
Plasma versus plasma protein concentrate transfusion for coagulopathic control
Role of blood component manufacturing on microvesicle-induced transfusion-related immune modulation

MSM Research Grant Program
A longitudinal analysis of behavioural and biological risk among men who have sex with men in metro Vancouver
ACB and MSM - it's not an oxymoron: a research project that explores the importance of ACB people in MSM blood donation research
Assessing alternative Canadian Blood Services blood donor deferral screening policies for men who have sex with men
Assessing unintentional creation of bias against MSM as a function of exposure to blood donor screening questionnaire and assessing sexual behaviour risk factors of those successfully passing blood donor screening
Attitudes, behaviours, and acceptability related to current and future blood donation policy: A qualitative study of gay, bisexual, and other men who have sex with men in Vancouver, Toronto, and Montreal
Estimating the probability of HIV risk in MSM donor policies through biobehavioural and mathematical modelling studies
Évaluation de l'acceptabilité et de la faisabilité d'un programme de dons de plasma destiné au fractionnement, pour les hommes ayant des relations sexuelles avec d'autres hommes de la communauté gaie montréalaise
Mathematical modeling - comparing HIV risk between MSM donation strategies
Operational impact of individual risk assessment options
Safety, Acceptance, Fairness & Equality (SAFE project): acceptable risk and donor selection
Sex Now 2018: A national survey on blood donation and undiagnosed blood borne infections

James Kreppner Award Program
The role of stakeholder trust in organ and tissue donation and transplantation policy change: public and professional attitudes to ante-mortem interventions in organ donation
Organ donation in Canada: engaging with stakeholders and proposing solutions to current legal and ethical challenges

Kenneth J. Fyke Award Program
Developing a Canadian policy on the responsible use of umbilical cord blood for proven indications in regenerative therapy
Prospective observational study of organ deceased donor management in three ICUs – a pilot study (the DONATE pilot study)

Blood Efficiency Accelerator Award Program
A program to minimize preventable and inappropriate blood product transfusions in liver surgery
Feasibility in Canada for a non-invasive prenatal testing using single-exon fetal RHD determination

Canadian Blood Services
it's in you to give

Small Projects Funding Program
Data sharing with CBMTG registry
National evaluation of platelet transport bags to reduce wastage
Neonatal outcomes after transfusion of ABO non-identical blood (Neo-ABO)
Pre-transfusion furosemide for TACO
ROTEM-guided transfusion protocols – impact on the manufacturer
Use of red blood cell antigen genotyping to assess RhD diversity in sickle cell disease patients

CIHR Partnership: Transplantation Research
The Canadian National Transplant Research Program: increasing donating and improving transplantation

Titles of projects conducted by Product and Process Development program

Deepening the understanding of our products and the processes used to manufacture them
ACP215 cryopreserved international unit exchange
An international investigation into O red blood cell unit administration in hospitals: the Group O Utilization Patterns (GROUP) study
Bacterial growth in red blood cells prepared in different additive solutions
Characterizing blood bag defects/failures
Comparison of donor and general population demographics over time: a BEST collaborative group study
Cord blood and registry composition analysis
Cord blood transient warming events
Critical review whitepaper on in vitro and in vivo platelet product quality characteristics
Evaluation of irradiation conditions for red cell concentrates
Frozen red blood cell products international standardization
Platelet leukoreduction filter from various manufacturers: performance comparison
Post thaw hematopoietic stem cell product quality attributes cord blood unit to segment correlation
Preliminary assessment of residual IgG and IgM in cryoprecipitate products
The effects of room temperature exposure on plasma
Understanding of impact of freezing profile/freezing time on plasma quality project
Understanding of, and feasibility of predicting changes in, product quality attributes during red cell storage in various anticoagulant and additive solution combinations
Understanding the impact of pre-processing delay on the potency of cord blood units
Understanding the impact of time to test on product quality attributes for frozen plasma products
Vox Sanguinis international forum on platelet cryopreservation
Where are the platelets? Understanding causes for platelet production yield and quality attribute variation to identify opportunities to better optimize the process
WHO international repository for platelet transfusion-relevant bacteria reference strains

Canadian Blood Services
it's in you to give

Developing new or next generation products and the processes used to manufacture them
Cord blood derived products whitepaper
Gamma versus x-ray irradiation whitepaper
Mirasol whole blood pathogen inactivation technology assessment study – product quality perspective
Modeling platelet unit doses after introduction of 7-day platelets and non-destructive quality control testing
Neo-pack and pedi-pack divided red cell units for neonate and pediatric transfusion feasibility
Pathogen inactivation technology whitepaper
Platelet pooling bag request for proposal
SSP+ platelet additive solution assessment – product quality perspective
SSP+ platelet additive solution assessment – safety perspective
Understanding "orange" plasma
Understanding whole blood and red cell concentrate blocked filters

Improving current generation products and the processes used to manufacture them
B2 study – evaluation of the 16 hour hold at 24°C
BacT curve analysis to differentiate false positive BacT bottles
Biosafe Sepax2 large volume cord blood unit processing protocol evaluation
Bringing follow-up of initial testing – positive BacT/ALERT cultures in-house
Contact freezer software evaluation
Counting platelets: Correlation between hematology analyzers and BEST flow cytometer reference method study
Developing a model to optimize the rare red blood cell program
Evaluation of alternative donor skin disinfection methods
Feasibility study into increasing the collection of hematopoietic progenitors from cord blood using alternative collection methodologies
Introduction of anaerobic bacteria to the BacT proficiency testing program
New apheresis collection set
Non-destructive quality control testing for platelet products
Non-destructive quality control testing for red blood cell products
Non-destructive quality control testing for red cell products supplementary studies
Optimization of the flow cytometry staining protocol for post-thaw cord blood samples
Product volume reduction – adult hematopoietic cell stem cell manufacturing
Production equipment request for proposal feasibility and confirmation studies
Sterility stem cells BACTEC validation

Improving and/or enabling the product and process development group
Acquisition and installation of ACP-215 blood processing technology at netCAD
Build the netCAD (Network Centre for Applied Development) donor base
eProgesa for netCAD assessment and options
Evaluation of Vitek 2 Compact for bacteria identification
Investigation into netCAD2 – a blood4research 'east' applied development facility
Product and process development overhead streamlining
Product and process development project portfolio database
Product and process development test method validation: standardization and qualification of test assays in Centre for Innovation labs supporting product and process group projects
Project management lessons learned
Regulatory asset management entry initiative

Understanding plasma short course for product and process development and supply chain process management staff

Improving and/or enabling Canadian Blood Services
Extended shelf life platelets – post implementation optimization modeling
Holiday platelet planner
Modeling and simulation education and training
Canadian Blood Services clinic simulator

Titles of projects funded by National Training Program

Note: Projects that are italicized are those for which funding was initiated in fiscal year 2017–2018.

Postdoctoral Fellowship Program
The mechanism of action of monoclonal antibody blends in the potential replacement of anti-D in HDFN
Development of a small molecule-based stem and progenitor expansion protocol to accelerate engraftment after cord blood transplantation
DNA aptamers for detection of red blood cells destined for rapid post-transfusion clearance
Transfusion options in coagulopathy: efficacy in controlling bleeding
Understanding the factors that influence bacterial proliferation and biofilm formation in platelet concentrates

CIHR Health System Fellowship Program
Process evaluation of the Canadian Blood Services' cord blood bank: managerial and donor perspectives

Graduate Fellowship Program
Investigating the mechanism of anti-CD44 antibody amelioration of IVIg-treatable disease
Novel cell-surface engineering methods to increase immune-tolerance of allogenic cell transplantation
Studying and alleviating the effects of platelet microparticles induced by pathogen reduction of platelet
Synthesis of carbohydrate derivatives for the improvement of red blood cell storage
Impact of storage on the function of cord blood hematopoietic stem and progenitor cells
Improving pathogen inactivation: the dengue virus-induced platelet proteome
MRI-guided focused ultrasound facilitated IVIg immunotherapy as a therapeutic approach for Alzheimer's disease
Platelet desialylation: novel mechanism of platelet clearance and immune tolerance
Recombinant Fc multimers to replace IVIg
Small molecule ice recrystallization inhibitors as cryo-additives for red blood cell cryopreservation
Study of the mechanisms implicated in platelet microparticle internalization by blood cells

Titles of projects funded by Education Program

Note: Projects that are italicized are those for which funding was initiated in fiscal year 2017–2018.

Program Support Collaboration
Centre for Blood Research program support collaboration agreement

Education Research Grant Program
An evaluation of learner perspectives and outcomes following completion of the transfusion medicine area of focused competence

BloodTechNet Award Program
An innovative digital strategy for dissemination of Choosing Wisely Canada guidelines in transfusion medicine
PID (Primary Immune Deficiency) toolkit app

Canadian Blood Services
it's in you to give

Podcast for FNAIT and ICTMG red cell specifications for hemoglobinopathies guidelines
Social media for knowledge translation and education 3 (SoMe-KTE3): Transfusion, thrombosis, and hemostasis
The Stem Cell Club: educating medical and nursing students to develop professional skills

Titles of projects funded Transfusion Medicine Program Support Award Program

Note: Projects that are italicized are those for which funding was initiated in fiscal year 2017–2018.

Program Support Award for Canadian Transfusion Medicine and Science Research
Centre for Blood Research
McMaster Transfusion Research Program
University of Ottawa Centre for Transfusion Research

Transfusion Medicine Research Program Support Award
McMaster Centre for Transfusion Research
University of Toronto QUEST research program

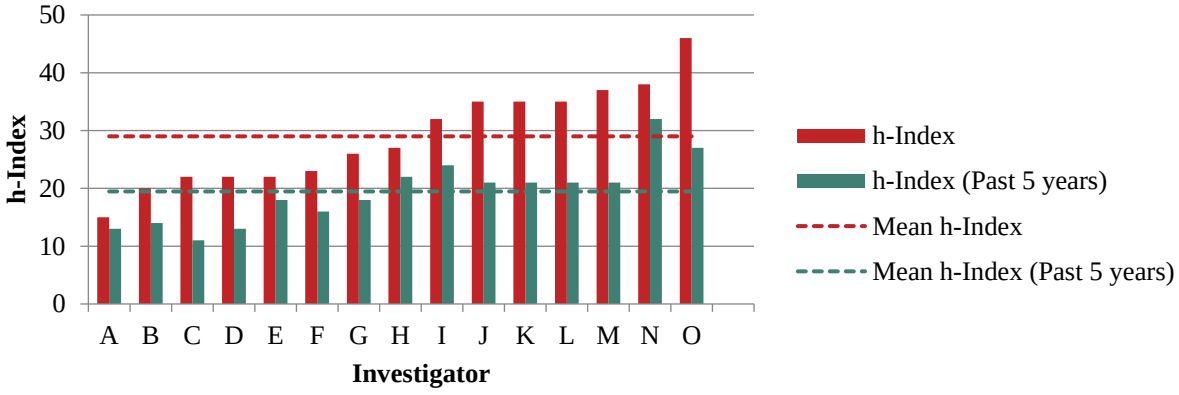
Canadian Blood Services
it's in you to give

Appendix II: Publications

Summary of peer-reviewed and non-peer-reviewed publications from fiscal year 2017-2018

# of peer-reviewed and non-peer-reviewed publications in fiscal year 2017-18	416
Peer-Reviewed Publications	**332**
Journal Articles	113
Review Articles	23
Clinical Guidelines	1
Comments/Letters/Editorials	21
Books/Book Sections	7
Published Abstracts	164
Canadian Blood Services Circular of Information	3
Non-Peer-Reviewed Publications	**84**
Canadian Blood Services Website Publications	41
Technical Reports	30
Other	13

Summary of h-index factor analysis



Notes: i) H-Index factors measured using GoogleScholar on April 3 2018. ii) Mean H- index calculated using H-Index factors from the 15 core investigators. Core investigators include (Jason Acker, John Blake, Donald Branch, Dana Devine, Margaret Fearon, Mindy Goldman, Alan Lazarus, Heyu Ni, Sheila O'Brien, Nicolas Pineault, Ed Pryzdial, Sandra Ramirez-Arcos, Mark Scott, William

Sheffield, and Kathryn Webert). iii) H-Index is a single bibliometric indicator that is a measure of both the productivity and impact of published work. H-Index is an indicator of research users being aware of and valuing published research evidence. Average H-index for Canadian university professors in the biological sciences is 10.6.

Publications' Details

Author Legend:

Bold – Centre for Innovation investigators and senior staff; Canadian Blood Services medical directors; Directors of transfusion medicine research programs receiving funding via the Transfusion Medicine Research Program Support Award.

Underlined – Non-Canadian Blood Services investigators leading projects funded in part by Canadian Blood Services.

Journal Articles

1. Adams Z, Morris G, Campbell T, Mostert K, Dibdin N, **Fearon M**, Elmoazzen H, Mercer D, Young K, **Allan D**. Risk of exposure to Zika virus and impact on cord blood banking and adult unrelated donors in hematopoietic cell transplantation: the Canadian Blood Services experience. *Biol Blood Marrow Transplant* 2018; 24: 861-5.
2. Alabdullatif M, Boujezza I, Mekni M, Taha M, Kumaran D, Yi QL, Landoulsi A, **Ramirez-Arcos S**. Enhancing blood donor skin disinfection using natural oils. *Transfusion* 2017; 57: 2920-7.
3. Alshalani A, **Acker JP**. Red blood cell membrane water permeability increases with length of ex vivo storage. *Cryobiology* 2017; 76: 51-8.
4. Alshalani A, Howell A, **Acker JP**. Impact of blood manufacturing and donor characteristics on membrane water permeability and in vitro quality parameters during hypothermic storage of red blood cells. *Cryobiology* 2018; 80: 30-7.
5. Alsheikh M, Abu-Khader A, Michalicka M, Pasha R, **Pineault N**. Impact of osteoblast maturation on their paracrine growth enhancing activity on cord blood progenitors. *Eur J Haematol* 2017; 98: 542-52.
6. **Arnold DM**, Lauzier F, Albert M, Williamson D, Li N, Zarychanski R, Doig C, McIntyre L, Freitag A, Crowther M, Saunders L, Clarke F, Bellomo R, Qushmaq I, Lopes R, Heels-Ansdell D, **Webert K**, Cook D. The association between platelet transfusions and bleeding in critically ill patients with thrombocytopenia. *Res Pract Thromb Haemost* 2017; 1: 103-11.
7. **Arnold DM**, Nazy I, Clare R, Jaffer AM, Aubie B, Li N, Kelton JG. Misdiagnosis of primary immune thrombocytopenia and frequency of bleeding: lessons from the McMaster ITP Registry. *Blood Adv* 2017; 1: 2414-20.
8. **Arnold DM**, Vrbensky JR, Karim N, Smith JW, Liu Y, Ivetic N, Kelton JG, Nazy I. The effect of rituximab on anti-platelet autoantibody levels in patients with immune thrombocytopenia. *Br J Haematol* 2017; 178: 302-7.
9. Atkins CG, Schulze HG, Chen D, **Devine DV**, Blades MW, Turner RF. Using Raman spectroscopy to assess hemoglobin oxygenation in red blood cell concentrate: an objective proxy for morphological index to gauge the quality of stored blood? *Analyst* 2017; 142: 2199-210.
10. Aziz J, Morris G, Rizk M, Shorr R, Mercer D, Young K, **Allan D**. Cryopreservation of adult unrelated donor products in hematopoietic cell transplantation: the OneMatch experience and systematic review of the literature. *Transfusion* 2017; 57: 2782-9.
11. Bennett S, Ayoub A, Tran A, English S, **Tinmouth A**, McIsaac DI, Fergusson D, Martel G. Current practices in perioperative blood management for patients undergoing liver resection: a survey of surgeons and anesthesiologists. *Transfusion* 2018; 58: 781-7.
12. **Berardi P**, Cote J, Vege S, Aeschlimann J, Cserti-Gazdewich C, Westhoff CM. Two novel ABCG2 alleles resulting in a Jr(a−) phenotype. *Transfusion* 2017; 57: 2811-2.

13. **Blake J**. Determining the inventory impact of extended shelf life platelets with a network simulation model. *Transfusion* 2017; 57: 3001-8.
14. **Blake JT**, **McTaggart K**, Killeen D. Modeling the optimal ethnic composition of an adult stem cell registry. *Eur J Oper Res* 2018; 264: 884-93.
15. Bryant A, Mallick R, Huebsch L, **Allan D**, Atkins H, Anstee G, Sabloff M, Scrivens N, Maze D, Bredeson C, Kekre N. Low-dose antithymocyte globulin for graft-versus-host-disease prophylaxis in matched unrelated allogeneic hematopoietic stem cell transplantation. *Biol Blood Marrow Transplant* 2017; 23: 2096-101.
16. Chai-Adisaksopha C, Iorio A, Hillis C, Siegal D, Witt DM, Schulman S, Crowther M. Warfarin resumption following anticoagulant-associated intracranial hemorrhage: a systematic review and meta-analysis. *Thromb Res* 2017; 160: 97-104.
17. Chan TM, Jo D, Shih AW, Bhagirath VC, Castellucci LA, Yeh C, Thoma B, Tseng EK, de Wit K. The Massive Online Needs Assessment (MONA) to inform the development of an emergency haematology educational blog series. *Perspect Med Educ* 2018.
18. Chaturvedi S, **Arnold DM**, McCrae KR. Splenectomy for immune thrombocytopenia: down but not out. *Blood* 2018; 131: 1172-82.
19. Chen D, Schubert P, **Devine DV**. Proteomic analysis of red blood cells from donors exhibiting high hemolysis demonstrates a reduction in membrane-associated proteins involved in the oxidative response. *Transfusion* 2017; 57: 2248-56.
20. Cloutier N, Allaeys I, Marcoux G, Machlus KR, Mailhot B, Zufferey A, Levesque T, Becker Y, Tessandier N, Melki I, Zhi H, Poirier G, Rondina MT, Italiano JE, Flamand L, McKenzie SE, Cote F, Nieswandt B, Khan WI, Flick MJ, Newman PJ, Lacroix S, Fortin PR, Boilard E. Platelets release pathogenic serotonin and return to circulation after immune complex-mediated sequestration. *Proc Natl Acad Sci U S A* 2018; 115: E1550-9.
21. Cook RJ, Heddle NM, Lee KA, **Arnold DM**, Crowther MA, Devereaux PJ, Ellis M, Figueroa P, Kurz A, Roxby D, Sessler DI, Sharon Y, Sobieraj-Teague M, Warkentin TE, **Webert KE**, Barty R, Liu Y, Eikelboom JW. Red blood cell storage and in-hospital mortality: a secondary analysis of the INFORM randomised controlled trial. *Lancet Haematol* 2017; 4: e544-52.
22. Cruz-Leal Y, Marjoram D, **Lazarus AH**. Erythrocyte saturation with IgG is required for inducing antibody-mediated immune suppression and impacts both erythrocyte clearance and antigen-modulation mechanisms. *J Immunol* 2018; 200: 1295-305.
23. D'Aragon F, Dhanani S, Lamontagne F, Cook DJ, Burns K, Akhtar A, Chasse M, Frenette AJ, Keenan S, Lize JF, Kutsogiannis DJ, Kramer A, Hand LE, Arseneau E, Masse MH, Ribic C, Ball I, Baker A, Boyd G, Rochwerg B, Healey A, Hanna S, Guyatt GH, Meade MO. Canada-DONATE study protocol: a prospective national observational study of the medical management of deceased organ donors. *BMJ Open* 2017; 7: e018858.
24. de Korte D, Thibault L, Handke W, Harm SK, Morrison A, Fitzpatrick A, Marks DC, Yi QL, **Acker JP**. Timing of gamma irradiation and blood donor sex influences in vitro characteristics of red blood cells. *Transfusion* 2018; 58: 917-26.
25. Diep C, Shih AW, Jamula E, Heddle NM, Parvizian M, Hillis CM. Impact of organizational interventions on reducing inappropriate intravenous immunoglobulin (IVIG) usage: A systematic review and meta-analysis. *Transfus Apher Sci* 2018.
26. Doan M, Sebastian JA, Pinto PN, McQuin C, Goodman A, Wolkenhauer O, Parsons MJ, **Acker JP**, Rees P, Hennig H, Kolios MC, Carpenter AE. Label-free assessment of red blood cell storage lesions by deep learning. *bioRxiv* 2018.

27. Donkor DA, Bhakta V, Eltringham-Smith LJ, Stafford AR, Weitz JI, **Sheffield WP**. Selection and characterization of a DNA aptamer inhibiting coagulation factor XIa. *Sci Rep* 2017; 7: 2102.
28. Douketis JD, Spyropoulos AC, Anderson JM, **Arnold DM**, Bates SM, Blostein M, Carrier M, Caprini JA, Clark NP, Coppens M, Dentali F, Duncan J, Gross PL, Kassis J, Kowalski S, Lee AY, Le Gal G, Le Templier G, Li N, MacKay E, Shah V, Shivakumar S, Solymoss S, Spencer FA, Syed S, Tafur AJ, Vanassche T, Thiele T, Wu C, Yeo E, Schulman S. The perioperative anticoagulant use for surgery evaluation (PAUSE) study for patients on a direct oral anticoagulant who need an elective surgery or procedure: design and rationale. *Thromb Haemost* 2017; 117: 2415-24.
29. Duffett M, Choong K, Foster J, Meade M, Menon K, Parker M, Cook DJ. High-quality randomized controlled trials in pediatric critical care: a survey of barriers and facilitators. *Pediatr Crit Care Med* 2017; 18: 405-13.
30. Duncan J, Nahirniak S, Onell R, **Clarke G**. Two cases of the variant RHD* DAU5 allele associated with maternal alloanti-D. *Immunohematology* 2017; 33: 60-3.
31. Dyer C, Alquist CR, Cole-Sinclair M, Curnow E, Dunbar NM, Estcourt LJ, Kaufman R, Kutner JM, McCullough J, McQuilten Z, Potiphar L, Rioux-Masse B, Slichter S, **Tinmouth A**, **Webert K**, Yokoyama AP, Stanworth SJ. A multicentred study to validate a consensus bleeding assessment tool developed by the biomedical excellence for safer transfusion collaborative for use in patients with haematological malignancy. *Vox Sang* 2018; 113: 251-9.
32. Ezekwudo DE, Chacko R, Gbadamosi B, Batool S, Gaikazian S, Warkentin TE, Sheppard JI, Jaiyesimi I. Apixaban for treatment of confirmed heparin-induced thrombocytopenia: a case report and review of literature. *Exp Hematol Oncol* 2017; 6: 21.
33. **Fearon MA**, **O'Brien SF**, Delage G, Scalia V, Bernier F, **Bigham M**, Weger S, Prabhu S, Andonov A. Hepatitis E in Canadian blood donors. *Transfusion* 2017; 57: 1420-5.
34. Fennell K, Hoffman R, Yoshida K, Iwamoto S, Govender L, Vather K, Sookraj A, Jentsch U, **Pambrun C**, McAuley C, Keller M, Ochoa-Garay G. Effect on gene expression of three allelic variants in GATA motifs of ABO, RHD, and RHCE regulatory elements. *Transfusion* 2017; 57: 2804-8.
35. Fingrut W, Parmar S, Cuperfain A, Rikhraj K, Charman E, Ptak E, Kahlon M, Graham A, Luong S, Wang YG, Yu J, Arora N, Suppiah R, Li EW, Lee A, Welsh C, Benzaquen M, Thatcher A, Baharmand I, Ladd A, **Petraszko T**, **Allan D**, Messner H. The Stem Cell Club: a model for unrelated stem cell donor recruitment. *Transfusion* 2017; 57: 2928-36.
36. Garg AX, **Shehata N**, McGuinness S, Whitlock R, Fergusson D, Wald R, Parikh C, Bagshaw SM, Khanykin B, Gregory A, Syed S, Hare GMT, Cuerden MS, Thorpe KE, Hall J, Verma S, Roshanov PS, Sontrop JM, Mazer CD. Risk of acute kidney injury in patients randomized to a restrictive versus liberal approach to red blood cell transfusion in cardiac surgery: a substudy protocol of the transfusion requirements in cardiac surgery III noninferiority trial. *Can J Kidney Health Dis* 2018; 5: 2054358117749532.
37. Germain M, Delage G, **O'Brien SF**, Grégoire Y, **Fearon M**, **Devine D**. Mitigation of the threat posed to transfusion by donors traveling to Zika-affected areas: a Canadian risk-based approach. *Transfusion* 2017; 57: 2463-8.
38. Giwa S, Lewis JK, Alvarez L, Langer R, Roth AE, Church GM, Markmann JF, Sachs DH, Chandraker A, Wertheim JA, Rothblatt M, Boyden E, Eidbo E, Lee A, Pomahac B, Brandacher, Weinstock D, Elliott G, Nelson D, **Acker JP**, Uygun K, Schmalz B, Weegman B, Tocchio A, Fahy GM. The promise of organ and tissue preservation to transform medicine. *Nat Biotechnol* 2017; 35: 530-42.

39. **Goldman M**, Steele WR, Di Angelantonio E, van den Hurk K, Vassallo RR, Germain M, **O'Brien SF**. Comparison of donor and general population demographics over time: a BEST collaborative group study. *Transfusion* 2017; 57: 2469-76.
40. Gorlin J, Kinney S, Fung M, **Tinmouth A**. Prothrombin complex concentrate for emergent reversal of warfarin: an international survey of hospital protocols. *Vox Sang* 2017; 112: 595-7.
41. Greco-Stewart V, Kiernan J, Killeen D, Haun S, Mercer D, Young K, **Liwski RS**, **Allan DS**. Unrelated donor choices for allogeneic hematopoietic cell transplantation in Canada: an evaluation of factors influencing donor selection. *Transfusion* 2018; 58: 718-25.
42. Gu W, Chen J, Patra P, Yang X, Gu Q, Wei L, **Acker J**, Kong B. Nanoformulated water-soluble paclitaxel to enhance drug efficacy and reduce hemolysis side effect. *J Biomater Appl* 2017; 32: 66-73.
43. Guo Q, Duffy SP, Matthews K, Islamzada E, Ma H. Deformability based cell sorting using microfluidic ratchets enabling phenotypic separation of leukocytes directly from whole blood. *Sci Rep* 2017; 7: 6627.
44. Hadjesfandiari N, Weinhart M, Kizhakkedathu JN, Haag R, Brooks DE. Development of antifouling and bactericidal coatings for platelet storage bags using dopamine chemistry. *Adv Healthc Mater* 2018; 7: 1700839.
45. Husseinzadeh HD, Gimotty PA, Pishko AM, Buckley M, Warkentin TE, Cuker A. Diagnostic accuracy of IgG-specific versus polyspecific enzyme-linked immunoassays in heparin-induced thrombocytopenia: a systematic review and meta-analysis. *J Thromb Haemost* 2017; 15: 1203-12.
46. Huynh A, **Arnold DM**, Moore JC, Smith JW, Kelton JG, Nazy I. Development of a high-yield expression and purification system for platelet factor 4. *Platelets* 2017: 1-8.
47. Ilboudo Y, Bartolucci P, Rivera A, Sedzro JC, Beaudoin M, Trudel M, Alper SL, Brugnara C, Galacteros F, Lettre G. Genome-wide association study of erythrocyte density in sickle cell disease patients. *Blood Cells Mol Dis* 2017; 65: 60-5.
48. Iorio A, Blanchette V, Blatny J, Collins P, Fischer K, Neufeld E. Estimating and interpreting the pharmacokinetic profiles of individual patients with hemophilia A or B using a population pharmacokinetic approach: communication from the SSC of the ISTH. *J Thromb Haemost* 2017; 15: 2461-5.
49. Iorio A, Fischer K, Blanchette V, Rangarajan S, Young G, Morfini M. Tailoring treatment of haemophilia B: accounting for the distribution and clearance of standard and extended half-life FIX concentrates. *Thromb Haemost* 2017; 117: 1023-30.
50. Iorio A, Iserman E, Blanchette V, Dolan G, Escuriola Ettingshausen C, Hermans C, Negrier C, Oldenburg J, Reininger A, Rodriguez-Merchan C, Spannagl M, Valentino LA, Young G, Steinitz-Trost KN, Gringeri A. Target plasma factor levels for personalized treatment in haemophilia: a Delphi consensus statement. *Haemophilia* 2017; 23: e170-e9.
51. Kang N, Guo Q, Islamzada E, Ma H, **Scott MD**. Microfluidic determination of lymphocyte vascular deformability: effects of intracellular complexity and early immune activation. *Integr Biol* 2018; 10: 207-17.
52. Kang N, Toyofuku WM, Yang X, **Scott MD**. Inhibition of allogeneic cytotoxic T cell (CD8+) proliferation via polymer-induced Treg (CD4+) cells. *Acta Biomat* 2017; 57: 146-55.
53. Karkouti K, **Callum J**, **Acker JP**, Yip P, Rao V. Red cell transfusion-associated hemolysis in cardiac surgery: an observational cohort study. *Anesth Analg* 2017; 124: 1986-91.
54. Keepanasseril A, Stoffman J, Bouskill V, Carcao M, Iorio A, Jackson S. Switching to extended half-life products in Canada - preliminary data. *Haemophilia* 2017; 23: e365-e7.

55. Kou Y, Halpenny M, Elmoazzen H, **Ramirez-Arcos S**. Development of a proof of principle for universal neutralization of antibiotics in cord blood by-products used for sterility testing. *Transfusion* 2018.
56. Kozicky L, Sly LM. Assessment of antibody-based drugs effects on murine bone marrow and peritoneal macrophage activation. *J Vis Exp* 2017: e56689.
57. Kumaran D, Taha M, Yi Q, **Ramirez-Arcos S**, Diallo JS, Carli A, Abdelbary H. Does treatment order matter? Investigating the ability of bacteriophage to augment antibiotic activity against Staphylococcus aureus biofilms. *Front Microbiol* 2018; 9: 127.
58. Lagerquist O, Poseluzny D, Werstiuk G, Slomp J, Maier M, Nahirniak S, **Clarke G**. The cost of transfusing a unit of red blood cells: a costing model for Canadian hospital use. *ISBT Sci Ser* 2017; 12: 375-80.
59. Lai AT, **Zeller MP**, Millen T, Kavsak P, Szczeklik W, Elahie A, Alhazzani W, D'Aragon F, Jaeschke R, Lamontagne F, Karachi T, Cook D, Meade M, Rochwerg B. Chloride and other electrolyte concentrations in commonly available 5% albumin products. *Crit Care Med* 2018; 46: e326-e9.
60. Lieberman L, Lin Y, Cserti-Gazdewich C, Yi QL, Pendergrast J, **Lau W**, **Callum J**. Utilization of frozen plasma, cryoprecipitate, and recombinant factor VIIa for children with hemostatic impairments: An audit of transfusion appropriateness. *Pediatr Blood Cancer* 2018; 65: e26933.
61. Liesner RJ, Abashidze M, Aleinikova O, Altisent C, Belletrutti MJ, Borel-Derlon A, Carcao M, Chambost H, Chan AKC, Dubey L, Ducore J, Fouzia NA, Gattens M, Gruel Y, Guillet B, Kavardakova N, El Khorassani M, Klukowska A, Lambert T, Lohade S, Sigaud M, Turea V, Wu JKM, Vdovin V, Pavlova A, Jansen M, Belyanskaya L, Walter O, Knaub S, Neufeld EJ. Immunogenicity, efficacy and safety of Nuwiq® (human-cl rhFVIII) in previously untreated patients with severe haemophilia A-Interim results from the NuProtect Study. *Haemophilia* 2017; 24: 211-20.
62. Lin Y, Cohen R, Armali C, **Callum J**, Cserti-Gazdewich C, Lieberman L, Pendergrast J. Transfusion-associated circulatory overload prevention: a retrospective observational study of diuretic use. *Vox Sang* 2018.
63. Loza-Correa M, Kalab M, Yi QL, Eltringham-Smith L, **Sheffield W**, **Ramirez-Arcos S**. Comparison of bacterial attachment to platelet bags with and without preconditioning with plasma. *Vox Sang* 2017; 112: 401-7.
64. Lucier KJ, Movilla RV, Parvizian MK, Siddiqui R, Gabriele EH, Bourque M, MacIsaac J, Moorehead PC, Chan AK, Heddle NM, Lane SJ. A brief survey of clinicians' perceptions of parent preferences for involvement in obstetrical and perinatal management decisions in haemophilia. *Haemophilia* 2018; 24: e80-e3.
65. Martin RMG, Ricci MJ, Foley R, Mian HS. The relationship of CD34+ dosage and platelet recovery following high dose chemotherapy and autologous CD34+ reinfusion in multiple myeloma. *Transfus Apher Sci* 2017; 56: 552-7.
66. Matthews K, Duffy SP, Myrand-Lapierre M-E, Ang RR, Li L, **Scott MD**, Ma H. Microfluidic analysis of red blood cell deformability as a means to assess hemin-induced oxidative stress resulting from Plasmodium falciparum intraerythrocytic parasitism. *Integr Biol* 2017; 9: 519-28.
67. Mazer CD, Whitlock RP, Fergusson DA, Hall J, Belley-Cote E, Connolly K, Khanykin B, Gregory AJ, de Medicis E, McGuinness S, Royse A, Carrier FM, Young PJ, Villar JC, Grocott HP, Seeberger MD, Fremes S, Lellouche F, Syed S, Byrne K, Bagshaw SM, Hwang NC, Mehta C, Painter TW, Royse C, Verma S, Hare GMT, Cohen A, Thorpe KE, Juni P, **Shehata N**. Restrictive or liberal red-cell transfusion for cardiac surgery. *N Engl J Med* 2017; 377: 2133-44.

68. McEneny-King A, Chelle P, Henrard S, Hermans C, Iorio A, Edginton AN. Modeling of body weight metrics for effective and cost-efficient conventional factor VIII dosing in hemophilia A prophylaxis. *Pharmaceutics* 2017; 9: 47.
69. McVey MJ, Spring CM, Kuebler WM. Improved resolution in extracellular vesicle populations using 405 instead of 488 nm side scatter. *J Extracell Vesicles* 2018; 7: 1454776.
70. Michalicka M, Boisjoli G, Jahan S, Hovey O, Doxtator E, Abu-Khader A, Pasha R, **Pineault N**. Human bone marrow mesenchymal stromal cell-derived osteoblasts promote the expansion of hematopoietic progenitors through Beta-catenin and Notch signaling pathways. *Stem Cells Dev* 2017; 26: 1735-48.
71. Millar D, Murphy L, Labrie A, Maurer-Spurej E. Routine screening method for microparticles in platelet transfusions. *J Vis Exp* 2018; 131: 56893.
72. Mistry N, Mazer CD, Sled JG, **Lazarus AH**, Cahill LS, Solish M, Zhou Y-Q, Romanova N, Hare AG, Doctor A, Fisher JA, Brunt KR, Simpson JA, Hare GMT. Red blood cell antibody induced anemia causes differential degrees of tissue hypoxia in kidney and brain. *Am J Physiol Regul Integr Comp Physiol* 2018; 314: R611-R22.
73. Montroy J, Hutton B, Moodley P, Fergusson NA, Cheng W, **Tinmouth A**, Lavallée LT, Fergusson DA, Breau RH. The efficacy and safety of topical tranexamic acid: A systematic review and meta-analysis. *Transfusion Medicine Reviews* 2018.
74. Nazy I, Kelton JG, Moore JC, Clare R, Horsewood P, Smith JW, Ivetic N, D'Souza V, Li N, **Arnold DM**. Autoantibodies to thrombopoietin and the thrombopoietin receptor in patients with immune thrombocytopenia. *Br J Haematol* 2018; 181: 234-41.
75. Pasha R, Elmoazzen H, **Pineault N**. Development and testing of a stepwise thaw and dilute protocol for cryopreserved umbilical cord blood units. *Transfusion* 2017; 57: 1744-54.
76. Peyvandi F, Makris M, Collins P, Lillicrap D, Pipe SW, Iorio A, Rosendaal FR. Minimal dataset for post-registration surveillance of new drugs in hemophilia: communication from the SSC of the ISTH. *J Thromb Haemost* 2017; 15: 1878-81.
77. Poudel DR, Ghimire S, Dhital R, Forman DA, Warkentin TE. Spontaneous HIT syndrome post-knee replacement surgery with delayed recovery of thrombocytopenia: a case report and literature review. *Platelets* 2017; 28: 614-20.
78. Qadri S, Chen D, Schubert P, **Devine D**, **Sheffield W**. Early γ-irradiation and subsequent storage of red cells in SAG-M additive solution potentiate energy imbalance, microvesiculation and susceptibility to stress-induced apoptotic cell death. *Vox Sang* 2017; 112: 480-3.
79. Qadri SM, Donkor DA, Nazy I, **Branch DR**, **Sheffield WP**. Bacterial neuraminidase-mediated erythrocyte desialylation provokes cell surface aminophospholipid exposure. *Eur J Haematol* 2018; 100: 502-10.
80. Quach ME, Dragovich MA, Chen W, Syed AK, Cao W, Liang X, Deng W, De Meyer SF, Zhu G, Peng J, **Ni H**, Bennett CM, Hou M, Ware J, Deckmyn H, Zhang XF, Li R. Fc-independent immune thrombocytopenia via mechanomolecular signaling in platelets. *Blood* 2018; 131: 787-96.
81. Raj M, Langley M, McArthur SJ, Jean F. Moonlighting glycolytic enzyme glyceraldehyde-3-phosphate dehydrogenase (GAPDH) is required for efficient hepatitis C virus and dengue virus infections in human Huh-7.5.1 cells. *J Gen Virol* 2017; 98: 977-91.
82. **Ramirez-Arcos S**, DiFranco C, McIntyre T, **Goldman M**. Residual risk of bacterial contamination of platelets: six years of experience with sterility testing. *Transfusion* 2017; 57: 2174-81.
83. **Ramirez-Arcos S**, **Jenkins C**, **Sheffield W**. Bacteria can proliferate in thawed cryoprecipitate stored at room temperature for longer than 4 h. *Vox Sang* 2017; 5: 477-9.

84. **Ramirez-Arcos S**, McDonald CP, Benjamin RJ, for the ISBT Working Party Transfusion Transmitted Infectious Diseases Bacterial Subgroup. Survey for bacterial testing of platelet components in Latin America. *ISBT Sci Ser* 2017; 12: 336-9.
85. Raschke RA, Gallo T, Curry SC, Whiting T, Padilla-Jones A, Warkentin TE, Puri A. Clinical effectiveness of a Bayesian algorithm for the diagnosis and management of heparin-induced thrombocytopenia. *J Thromb Haemost* 2017; 15: 1640-5.
86. Ren J, Ding X, Trudel M, Greer JJ, MacLean JE. Cardiorespiratory pathogenesis of sickle cell disease in a mouse model. *Sci Rep* 2017; 7: 8665.
87. Rizk M, Aziz J, Shorr R, **Allan DS**. Cell-based therapy using umbilical cord blood for novel indications in regenerative therapy and immune modulation: an updated systematic scoping review of the literature. *Biol Blood Marrow Transplant* 2017; 23: 1607-13.
88. Rochwerg B, Millen T, Austin P, **Zeller M**, D'Aragon F, Jaeschke R, Masse MH, Mehta S, Lamontagne F, Meade M, Guyatt G, Cook DJ. Fluids in sepsis and septic shock (FISSH): protocol for a pilot randomised controlled trial. *BMJ Open* 2017; 7: e017602.
89. Roshan TM, Rajput AB, **Berardi P**, Padmore R. Acute megakaryoblastic transformation from essential thrombocythemia. *Hum Pathol* 2017; 8: 37-40.
90. Schneider C, Wicki S, Graeter S, Timcheva TM, Keller CW, Quast I, Leontyev D, Djoumerska-Alexieva IK, Käsermann F, Jakob SM, Peyta D, **Branch D**, Cummings J, Kaufmann T, Simon H, Von Gunten S. IVIG regulates the survival of human but not mouse neutrophils. *Sci Rep* 2017; 7: 1296.
91. Schubert P, Culibrk B, Karwal S, Serrano K, Levin E, Yi Q, Thiele T, Greinacher A, Marschner S, **Devine DV**. Altered timing of riboflavin and ultraviolet light pathogen inactivation improves platelet in vitro quality. *Transfusion* 2017; 57: 2026-34.
92. Seheult JN, Shaz B, Bravo M, Croxon H, **Devine D**, Doncaster C, Field S, Flanagan P, Germain M, Gregoire Y, Kamel H, Karafin M, Kelting N, Lewis M, O'Brien C, Murphy MF, Rossmann S, Sayers M, Shinar E, Takanashi M, Titlestad K, Yazer MH. Changes in plasma unit distributions to hospitals over a 10-year period. *Transfusion* 2018; 58: 1012-20.
93. Serrano K, **Pambrun C**, Levin E, **Devine DV**. Supernatant reduction of stored gamma-irradiated red blood cells minimizes potentially harmful substances present in transfusion aliquots for neonates. *Transfusion* 2017; 57: 3009-18.
94. **Sheffield WP**, Eltringham-Smith LJ, Bhakta V. Fusion to human serum albumin extends the circulatory half-life and duration of antithrombotic action of the kunitz protease inhibitor domain of Protease Nexin 2. *Cell Physiol Biochem* 2018; 45: 772-82.
95. **Shehata N**, Chassé M, Colas JA, Murphy M, Forster AJ, Malinowski AK, Ducharme R, Fergusson DA, **Tinmouth A**, Wilson K. Risks and trends of red blood cell transfusion in obstetric patients: a retrospective study of 45,213 deliveries using administrative data. *Transfusion* 2017; 57: 2197-205.
96. **Shehata N**, Whitlock R, Fergusson DA, Thorpe KE, MacAdams C, Grocott HP, Rubens F, Fremes S, Lellouche F, Bagshaw S, Royse A, Rosseel PM, Hare G, Medicis E, Hudson C, Belley-Cote E, Bainbridge D, Kent B, Shaw A, Byrne K, Syed S, Royse CF, McGuiness S, Hall J, Mazer CD. Transfusion requirements in cardiac surgery III (TRICS III): study design of a randomized controlled trial. *J Cardiothorac Vasc Anesth* 2018; 32: 121-9.
97. Shih AW, Sheppard JI, Warkentin TE. Platelet count recovery and seroreversion in immune HIT despite continuation of heparin: further observations and literature review. *Thromb Haemost* 2017; 117: 1868-74.

98. Spindler-Raffel E, Benjamin RJ, McDonald CP, **Ramirez-Arcos S**, Aplin K, Bekeredjian-Ding I, de Korte D, Gabriel C, Gathof B, Hanschmann KM, Hourfar K, Ingram C, Jacobs MR, Keil SD, Kou Y, Lambrecht B, Marcelis J, Mukhtar Z, Nagumo H, Niekerk T, Rojo J, Marschner S, Satake M, Seltsam A, Seifried E, Sharafat S, Stormer M, Sussner S, Wagner SJ, Yomtovian R. Enlargement of the WHO international repository for platelet transfusion-relevant bacteria reference strains. *Vox Sang* 2017; 112: 713-22.
99. Spirig R, Campbell IK, Koernig S, Chen CG, Lewis BJB, Butcher R, Muir I, Taylor S, Chia J, Leong D, Simmonds J, Scotney P, Schmidt P, Fabri L, Hofmann A, Jordi M, Spycher MO, Cattepoel S, Brasseit J, Panousis C, Rowe T, **Branch DR**, Baz Morelli A, Kasermann F, Zuercher AW. rIgG1 Fc hexamer inhibits antibody-mediated autoimmune disease via effects on complement and FcgammaRs. *J Immunol* 2018; 200: 2542-53.
100. Taha M, Culibrk B, Kalab M, Schubert P, Yi QL, Goodrich R, **Ramirez-Arcos S**. Efficiency of riboflavin and ultraviolet light treatment against high levels of biofilm-derived Staphylococcus epidermidis in buffy coat platelet concentrates. *Vox Sang* 2017; 112: 408-16.
101. Taha M, Kohnen C, Mallya S, Kou Y, Zapata A, **Ramirez-Arcos S**. Comparative characterisation of the biofilm-production abilities of Staphylococcus epidermidis isolated from human skin and platelet concentrates. *J Med Microbiol* 2018; 67: 190-7.
102. Tong Y, Pang XL, Mabilangan C, Preiksaitis JK. Determination of the biological form of human cytomegalovirus DNA in the plasma of solid-organ transplant recipients. *J Infect Dis* 2017; 215: 1094-101.
103. Trudel M, Sedzro JC. Approaches for analysis of erythroid cell parameters and hemoglobinopathies in mouse models. *Methods Mol Biol* 2018; 1698: 103-15.
104. Vostal JG, Buehler PW, Gelderman MP, Alayash AI, Doctor A, Zimring JC, Glynn SA, Hess JR, Klein H, **Acker JP**, Spinella PC, D'Alessandro A, Palsson B, Raife TJ, Busch MP, McMahon TJ, Intaglietta M, Swartz HM, Dubick MA, Cardin S, Patel RP, Natanson C, Weisel JW, Muszynski JA, Norris PJ, Ness PM. Proceedings of the Food and Drug Administration's public workshop on new red blood cell product regulatory science 2016. *Transfusion* 2018; 58: 255-66.
105. Warkentin TE, **Arnold DM**, Kelton JG, Sheppard JI, Smith JW, Nazy I. Platelet-activating antibodies are detectable at the earliest onset of heparin-induced thrombocytopenia, with implications for the operating characteristics of the serotonin-release assay. *Chest* 2018.
106. Warkentin TE, Pai M, Linkins LA. Direct oral anticoagulants for treatment of HIT: update of Hamilton experience and literature review. *Blood* 2017; 130: 1104-13.
107. Wilson K, Atkinson KM, Fergusson DA, Brown A, Forster A, Murphy MS, **Tinmouth AT**, Keelan J. Problems with precaution: the transfusion medicine experience. *J Risk Res* 2017: 1-13.
108. Yang Z, Jiang B, Wang Y, **Ni H**, Zhang J, Xia J, Shi M, Hung L, Ruan J, Mak T, Li Q, Han J. 2-HG inhibits necroptosis by stimulating DNMT1-dependent hypermethylation of the RIP3 promoter. *Cell Rep* 2017; 19: 1846-57.
109. Yao Y, Chen Y, Adili R, McKeown T, Chen P, Zhu G, Li D, Ling W, **Ni H**, Yang Y. Plant-based food cyanidin-3-glucoside modulates human platelet glycoprotein vi signaling and inhibits platelet activation and thrombus formation. *J Nutr* 2017; 147: 1917-25.
110. Yougbare I, Tai WS, Zdravic D, Oswald BE, Lang S, Zhu G, Leong-Poi H, Qu D, Yu L, Dunk C, Zhang J, Sled JG, Lye SJ, Brkic J, Peng C, Hoglund P, Croy BA, Adamson SL, Wen XY, Stewart DJ, Freedman J, **Ni H**. Activated NK cells cause placental dysfunction and miscarriages in fetal alloimmune thrombocytopenia. *Nat Commun* 2017; 8: 224.
111. **Zeller MP**, Barty R, Aandahl A, Apelseth TO, **Callum J**, Dunbar NM, Elahie A, Garritsen H, Hancock H, Kutner JM, Manukian B, Mizuta S, Okuda M, Pagano MB, Poglod R, Rushford K,

Selleng K, Sorensen CH, Sprogoe U, Staves J, Weiland T, Wendel S, Wood EM, van de Watering L, van Wordragen-Vlaswinkel M, Ziman A, Jan Zwaginga J, Murphy MF, Heddle NM, Yazer MH. An international investigation into O red blood cell unit administration in hospitals: the GRoup O Utilization Patterns (GROUP) study. *Transfusion* 2017; 57: 2329-37.

112. **Zeller MP**, Barty R, Dunbar NM, Elahie A, Flanagan P, Garritsen H, Kutner JM, Pagano MB, Poglod R, Rogers TS, Staves J, van Wordragen-Vlaswinkel M, Zwaginga JJ, Murphy MF, Heddle NM, Yazer MH. An international investigation into AB plasma administration in hospitals: how many AB plasma units were infused? The HABSWIN study. *Transfusion* 2018; 58: 151-7.
113. Zufferey A, Speck ER, Machlus KR, Aslam R, Guo L, McVey MJ, Kim M, Kapur R, Boilard E, Italiano JE, Jr., Semple JW. Mature murine megakaryocytes present antigen-MHC class I molecules to T cells and transfer them to platelets. *Blood Adv* 2017; 1: 1773-85.

Review Articles

1. Cohn C, Dumont L, Lozano M, Marks D, Johnson L, Ismay S, Bondar N, T'Sas F, Yokoyama A, Kutner J, **Acker J**, Bohonek M, Sailliol A, Martinaud C, Poglod R, Antoniewicz-Papis J, Lachert E, Pun P, Lu J, Cid J, Guijarro F, Puig L, Gerber B, Alberio L, Schanz U, Buser A, Noorman F, Zoodsma M, van der Meer P, de Korte D, Wagner S, O'Neill M. Vox Sanguinis international forum on platelet cryopreservation: summary. *Vox Sang* 2017; 112: 684-8.
2. Cohn CS, Dumont LJ, Lozano M, Marks DC, Johnson L, Ismay S, Bondar N, T'Sas F, Yokoyama APH, Kutner JM, **Acker JP**, Bohonek M, Sailliol A, Martinaud C, Poglod R, Antoniewicz-Papis J, Lachert E, Pun PBL, Lu J, Cid J, Guijarro F, Puig L, Gerber B, Alberio L, Schanz U, Buser A, Noorman F, Zoodsma M, van der Meer PF, de Korte D, Wagner S, O'Neill M. Vox Sanguinis International Forum on platelet cryopreservation. *Vox Sang* 2017; 112: e69-e85.
3. Cruz-Leal Y, Marjoram D, **Lazarus AH**. Prevention of hemolytic disease of the fetus and newborn: what have we learned from animal models? *Curr Opin Hematol* 2017; 24: 536-43.
4. Fingrut W, Rikhraj K, **Allan D**. Targeted recruitment of male donors for allogeneic haematopoietic cell transplantation: A review of the evidence. *Vox Sang* 2018.
5. **Goldman M**, **O'Brien S**. Our older population: donors as well as recipients? *ISBT Sci Ser* 2017. 12: 401-4.
6. **Goldman M**, Shih AW-Y, **O'Brien SF**, **Devine D**. Donor deferral policies for men who have sex with men: past, present and future. *Vox Sang* 2018; 113: 95-103.
7. Greinacher A, Selleng K, Warkentin TE. Autoimmune heparin-induced thrombocytopenia. *J Thromb Haemost* 2017; 15: 2099-114.
8. Heddle NM. From cytokines to pragmatic designs: changing paradigms. *Transfusion* 2017; 57: 2298-306.
9. Iorio A. Using pharmacokinetics to individualize hemophilia therapy. *Hematology Am Soc Hematol Educ Program* 2017; 2017: 595-604.
10. Iorio A, Fischer K, Makris M. Large scale studies assessing anti-factor VIII antibody development in previously untreated haemophilia A: what has been learned, what to believe and how to learn more. *Br J Haematol* 2017; 178: 20-31.
11. Kapur R, Semple JW. Platelet immunobiology: platelets as prey and predator. *ISBT Sci Ser* 2018; 13: 87-92.
12. Lang E, Bissinger R, Qadri SM, Lang F. Suicidal death of erythrocytes in cancer and its chemotherapy: A potential target in the treatment of tumor-associated anemia. *Int J Cancer* 2017; 141: 1522-8.

13. Magron A, Laugier J, Provost P, Boilard E. Pathogen reduction technologies: The pros and cons for platelet transfusion. *Platelets* 2018; 29: 2-8.
14. Marcoux G, Boilard E. Mitochondrial damage-associated molecular patterns in blood transfusion products. *ISBT Sci Ser* 2017; 12: 501-5.
15. Morton S, Stanworth S, Lozano M, Harrison S, Hong F, Dennington P, McQuilten Z, Worel N, Compernolle V, Kutner J, Yokoyama A, Nahirniak S, Germain M, Hume H, Robitaille N, Wilson A, **Tinmouth A**, Massey E, Boulat C, Woimant G, Tiberghien P, Schulze T, Bux J, Pierelli L, Ballester C, Netelenbos T, West K, Conry-Cantilena C, Eder A, Haley N, Yazer M, Triulzi D. Vox Sanguinis international forum on provision of granulocytes for transfusion and their clinical use: summary. *Vox Sang* 2017; 112: 680-3.
16. Morton S, Stanworth S, Lozano M, Harrison S, Hong F, Dennington P, McQuilten Z, Worel N, Compernolle V, Kutner J, Yokoyama A, Nahirniak S, Germain M, Hume H, Robitaille N, Wilson A, **Tinmouth A**, Massey E, Boulat C, Woimant G, Tiberghien P, Schulze T, Bux J, Pierelli L, Ballester C, Netelenbos T, West K, Conry-Cantilena C, Eder A, Haley N, Yazer M, Triulzi D. Vox Sanguinis international forum on provision of granulocytes for transfusion and their clinical use. *Vox Sang* 2017; 112: e48-e68.
17. Ning S, Heddle NM, **Acker JP**. Exploring donor and product factors and their impact on red cell post-transfusion outcomes. *Transfus Med Rev* 2018; 32: 28-35.
18. Qadri SM, Bissinger R, Solh Z, Oldenborg PA. Eryptosis in health and disease: A paradigm shift towards understanding the (patho)physiological implications of programmed cell death of erythrocytes. *Blood Rev* 2017; 31: 349-61.
19. Semple JW, McVey MJ, Kim M, Rebetz J, Kuebler WM, Kapur R. Targeting transfusion-related acute lung injury: the journey from basic science to novel therapies. *Crit Care Med* 2018; 46: e452-8.
20. Staibano P, **Arnold DM**, Bowdish DM, Nazy I. The unique immunological features of heparin-induced thrombocytopenia. *Br J Haematol* 2017; 177: 198-207.
21. Wu G, Zhou Y, Li L, Zhong Z, Li H, Li H, Yu M, Shen W, **Ni H**. Platelet immunology in China: research and clinical applications. *Transfus Med Rev* 2017; 31: 118-25.
22. Xu XR, Yousef GM, **Ni H**. Cancer and platelet crosstalk: opportunities and challenges for aspirin and other anti-platelet agents. *Blood* 2018; 131: 1777-89.
23. Yougbaré I, Zdravic D, **Ni H**. Fetal and neonatal alloimmune thrombocytopenia: Novel mechanisms of miscarriage learned from placental pathology in animal models. *J Pediatr Pediatr Med* 2018; 2: 28-33.

Clinical Guidelines

1. Johnson J, MacDonald K, **Clarke G**, Skoll A. No. 343-routine non-invasive prenatal prediction of fetal RHD genotype in Canada: The time is here. *J Obstet Gynaecol Can* 2017; 39: 366-73.

Comments/Letters/Editorials

1. **Berardi P**, Cote J, **Clarke G**, Scalia V, **Liwski R**, **Goldman M**. Nucleic acid extraction from buccal tissue for prediction of red blood cell phenotype. *Transfusion* 2017; 57: 2547-8.
2. **Blake J**. Introduction to the special issue: Teaching healthcare operations research, part 2. *INFORMS Transactions on Education* 2017; 17: 91-2.
3. **Branch DR**, Hellberg Å, Bruggeman CW, Storry JR, Sakac D, Blacquiere M, Tong TN, Burke-Murphy E, Binnington B, Parmar N, Riden LS, Willie K, Armali C, Aziz J, Lieberman L, Laroche V, **Callum J**, Lin Y, **Shehata N**, Pavenski K, **Lau W**, **Hannach B**, Kuijpers TW, Olsson ML, Cserti-

Gazdewich C, Pendergrast J. ABO zygosity, but not secretor or Fc receptor status, is a significant risk factor for IVIG-associated hemolysis. *Blood* 2018; 131: 830-5.

4. Chassé M, Fergusson DA. Blood donor characteristics on transfusion outcomes-should obesity be assessed in future clinical trials?-reply. *JAMA Intern Med* 2017; 177: 599-600.
5. **Devine DV**. Implementation of pathogen inactivation technology: How to make the best decisions? *Transfusion* 2017; 57: 1109-11.
6. **Devine DV**. Pathogen inactivation strategies to improve blood safety: Let's not throw pathogen-reduced platelets out with their bath water. *JAMA Oncol* 2018; 4: 458-9.
7. Elmoazzen H, **Petraszko T**. Questioning some recommendations in the umbilical cord blood guideline. *J Obstet Gynaecol Can* 2018; 40: 153-4.
8. Iorio A, Edginton AN. Exploring some intersections between pharmacokinetics, factor VIII measurement and human morphometrics - impact of recent advances in haemophilia study design on our understanding of optimal haemophilia treatment. *Haemophilia* 2017; 23: 488-90.
9. Kapur R, Catalina MD, Aslam R, Speck ER, Francovitch RF, Semple JW. A highly purified form of staphylococcal protein A alleviates murine immune thrombocytopenia (ITP). *Br J Haematol* 2017.
10. Kapur R, Kim M, Rebetz J, Rondina MT, Porcelijn L, Semple JW. Low levels of interleukin-10 in patients with transfusion-related acute lung injury. *Ann Transl Med* 2017; 5: 339.
11. Lawson W, Uy M, Strike K, Iorio A, Stein N, Koziol L, Chan A. Point of care ultrasound in haemophilia: Building a strong foundation for clinical implementation. *Haemophilia* 2017; 23: 648-51.
12. Marchesini E, Oliovecchio E, Coppola A, Santagostino E, Radossi P, Castaman G, Valdre L, Santoro C, Tagliaferri A, Ettorre C, Zanon E, Barillari G, Cantori I, Caimi TM, Sottilotta G, Iorio A, Mannucci PM. Comorbidities in persons with haemophilia aged 60 years or more compared with age-matched people from the general population. *Haemophilia* 2018; 24: e6-e10.
13. Marjoram D, Cruz-Leal Y, Bernardo L, Le NPL, Crispin M, Yu X, Uchikawa M, **Lazarus AH**. Immunoglobulin G Fc glycans are not essential for antibody-mediated immune suppression to murine erythrocytes. *Blood* 2017; 130: 2902-5.
14. Mian H, Warkentin TE, Sheppard JI, MacDonald A, Linkins LA, Benger A, Foley R. Autoimmune HIT due to apheresis catheter heparin flushes for stem cell harvesting before autotransplantation for myeloma. *Blood* 2017; 130: 1679-82.
15. Ning S, Warkentin TE. IV immunoglobulin for autoimmune heparin-induced thrombocytopenia. *Chest* 2017; 152: 453-5.
16. Parker MJ, Kissoon N. Neuroimaging in sepsis: panacea or Pandora's box? *Pediatr Crit Care Med* 2017; 18: 716-7.
17. **Pryzdial ELG**. Maestro tissue factor reaches new hEIGHT. *Blood* 2017; 130: 1604-5.
18. Qadri SM, Eltringham-Smith LJ, Bhakta V, **Sheffield WP**. Thromboelastometry reveals similar hemostatic properties of purified fibrinogen and a mixture of purified cryoprecipitate protein components. *Clin Chem Lab Med* 2018.
19. Sullivan HC, Arthur CM, Thompson L, Patel SR, Stowell SR, Hendrickson JE, **Lazarus AH**. Anti-RhD reduces levels of detectable RhD antigen following anti-RhD infusion. *Transfusion* 2018; 58: 542-4.
20. Visram A, Bredeson C, **Allan D**, Sabloff M, Huebsch L, Tay J, Kekre N, McDiarmid S, Mallick R, **Tinmouth A**, Martin L, Hamelin L, Maze D. Long-term graft function following autologous hematopoietic cell transplantation and the impact of preemptive plerixafor in predicted poor mobilizers. *Blood Cancer J* 2018; 8: 14.

21. Warkentin TE. Fondaparinux for treatment of heparin-induced thrombocytopenia: too good to be true? *J Am Coll Cardiol* 2017; 70: 2649-51.

Books/Book Sections

1. **Goldman M**. Blood donation testing and the safety of the blood supply. In *Practical Transfusion Medicine, 5th Edition*. Edited by Murphy MF, Roberts DJ, Yazer MH. Published by John Wiley & Sons, 2017.
2. Greinacher A, Warkentin T. Heparin-induced thrombocytopenia. In *Practical Transfusion Medicine, 5th Edition*. Edited by Murphy MF, Roberts DJ, Yazer MH. Published by John Wiley & Sons, 2017.
3. Khan R, **Lazarus A**. Anti-D; a type of IVIg. In *Antibody Therapy: Substitution - Immunomodulation - Monoclonal Immunotherapy*. Edited by Imbach P. Published by Springer International Publishing, 2018.
4. Khan R, **Lazarus A**. Mechanisms of action and immunomodulation by IVIg. In *Antibody Therapy: Substitution - Immunomodulation - Monoclonal Immunotherapy*. Edited by Imbach P. Published by Springer International Publishing, 2018.
5. **Ramirez-Arcos M**, **Goldman M**. Bacterial contamination. In *Practical Transfusion Medicine, 5th Edition*. Edited by Murphy MF, Roberts DJ, Yazer MH. Published by John Wiley & Sons, 2017.
6. **Scott M**, Toyofuku W, Yang X, Raj M, Kang N. Immunocamouflaged RBC for alloimmunized patients. In *Transfusion Medicine and Scientific Developments*. Edited by Koopman-van Gemert AWMM. Published by InTech, 2017.
7. **Webert K**, Heddle N. Investigation of acute transfusion reactions. In *Practical Transfusion Medicine, 5th Edition*. Edited by Murphy MF, Roberts DJ, Yazer MH. Published by John Wiley & Sons, 2017.

Published Abstracts

1. **Acker J**. Impact of cryopreservation and the interconnectedness of advances in cryobiology. *Cryobiology* 2018; 80.
2. Adam M, Charlton T, Ben R, Jahan S, **Pineault N**. Development of a probe to elucidate the role of N-aryl aldonamides in the cryopreservation of heamtopoietic stem and progenitor cells. *Canadian Society for Chemistry Website* 2017.
3. Al Khan S, **Bigham M**. Proposal for revision of Canadian Blood Services donor eligibility criteria for heart murmur. *Canadian Society for Transfusion Medicine Website* 2017.
4. Al Khan S, Khaketla M, Deonarine A, Aiken C, Buxton J, Wong A, Loftus P, **Bigham M**. British Columbia Centre for Disease Control and Canadian Blood Services transfusion transmissible infection data sharing initiative. *Canadian Society for Transfusion Medicine Website* 2017.
5. Alabdullatif M, Boujezza I, Taha M, Yi Q, Mekni M, Landoulsi A, **Ramirez-Arcos S**. Enhancing blood donor skin disinfection using natural oils. *Canadian Society for Transfusion Medicine Website* 2017.
6. Aljedani H, Campbell C, Selegean S, Watson S, Sadek I, **Kahwash E**. Implementation of plasma transfusion policy. *Canadian Society for Transfusion Medicine Website* 2017.
7. Aljedani H, Rickards N, Foster T, Huang M, Distefano L, **Skeate R**, **Kahwash E**. Severe allergic transfusion reactions reported to Canadian Blood Services Eastern medical services from 1st January 2014 through 31st December 2016. *Canadian Society for Transfusion Medicine Website* 2017.

8. Aljedani H, Watson S, Sadek I, **Kahwash E**, Conrad D. Most common red blood cell antibodies. *Canadian Society for Transfusion Medicine Website* 2017.
9. Almizraq R, Inglis HC, Norris P, Muszynski JA, Juffermans NP, Holovati J, **Acker J**. Characteristics of extracellular vesicles in stored red blood cell products influenced by component manufacturing method. *Transfusion* 2017; 57: 81A.
10. Almizraq RJ, Holovati J, **Acker J**. Manufacturing methods impact extracellular vesicle characteristics in stored red blood cell products. *Cryobiology* 2018; 80: 194.
11. Almizraq RJ, Holovati J, **Acker JP**. Whole blood manufacturing methods affect the quality of stored red cell concentrates. *Cryobiology* 2018; 80: 194.
12. Andonov A, Serrano K, Levine E, **Devine D**. Reducing risk of Zika virus transmission by whole blood mirasol treatment or cell washing. *Vox Sang* 2017; 112: 4A.
13. Arbaeen AF, Schubert P, **Devine D**. Pathogen inactivated whole blood: supplementation with a fibrinogen partially corrects treatment damage in a ROTEM model of massive transfusion. *Vox Sang* 2017; 112: 22
14. Au N, Pressey T, **Branch D**, **Clarke G**. Anti-Jra causing hemolytic disease of the fetus/newborn with suppression of erythropoiesis. *Canadian Society for Transfusion Medicine Website* 2017.
15. Aziz J, Morris G, Rizk M, Short R, Mercer D, Young K, **Allan D**. Cryopreservation of adult unrelated donor products in hematopoietic cell transplantation: the OneMatch experience and systematic review of the literature. *Canadian Society for Transfusion Medicine Website* 2017.
16. Barr G, Ciurcivich L, Dolnik T, Fallis R, Grabner L, **Hannon J**, Ison T, **Lane D**, **Lau W**, Madey D, McDonald B, To L, Villaseran B, **Clarke G**. Anti G testing and titration strategy in prenatal patients. *Canadian Society for Transfusion Medicine Website* 2017.
17. Beaudin L, Fallis R, **Clarke G**, **Nickerson P**. Platelet immunology investigations and results in Canada. *Canadian Society for Transfusion Medicine Website* 2017.
18. Bennett S, Ayoub A, Tran A, Gostimir M, English S, **Tinmouth A**, McIsaac D, Fergusson D, Martel G. Current practices in perioperative blood management for patients undergoing liver resection: a survey of surgeons and anesthesiologists. *HPB* 2017; 19: S123.
19. Bennett S, Fergusson D, **Tinmouth A**, McIsaac D, English S, Pawlik T, Hebert P, Karanicolas P, Barkun J, Turgeon-Fournier A, Martel G. The Ottawa criteria for appropriate transfusion in hepatectomy (OCATH): Using the RAND/UCLA appropriateness method. *Canadian Society for Transfusion Medicine Website* 2017.
20. Bloch E, Leger R, **Branch D**. Two distinct types of warm autoimmune hemolytic anemia showing differential tyrosine phosphorylation of Band-3. *Transfusion* 2017; 57: 31A-2A.
21. Boilard E. Role of extracellular vesicles in platelet transfusion medicine. *Vox Sang* 2017; 112: 60.
22. Boilard E. The release of mitochondria as damage associated molecular pattern. *American Physiological Society website* 2017.
23. Cayer M, Cloutier L, de Grandmont M, Laforce-Lavoie A, Brouard D, Girard M, Kou Y, **Ramirez-Arcos S**, Cloutier M. Bacterial growth in red blood cell units prepared with different additive solutions. *Canadian Society for Transfusion Medicine Website* 2017.
24. Cayer M, Cloutier L, de Grandmont MJ, Laforce-Lavoie A, Brouard D, Girard ME, Kou Y, **Ramirez-Arcos S**, Cloutier M. Analysis of the effect of additive solution on the bacterial growth and survival in red blood cell units. *Transfusion* 2017; 57: 11A-2A.
25. Chandler J, Gruben V. Organ donation in the context of MAiD: Ethics, Law and Policy. *Conference on End of Life Law Ethics Policy and Practice Website* 2017.

26. Chang T. Individual roles of (1) oxygen carriers, (2) oxygen carries with antioxidant and (3) oxygen carries with antioxidant and CO2 transport. *XVI ISBS International Symposium Blood Substitutes & Oxygen Therapeutics website* 2017.
27. **Chargé S**, Alam A, Callum J, Lee C, Cserti-Gazdewich C, **Lau W**, Lieberman L, Nixon P, Owens W, Pavenski K, Pendergrast J, Saidenberg E, **Shehata N**. Expanding the reach of Transfusion Camp: a novel approach to assessing and addressing the transfusion medicine knowledge gap. *Canadian Society for Transfusion Medicine Website* 2017.
28. Charlton T, Adam M, Ben R, Jahan S, **Pineault N**. Synthesis of small molecule, sulfated N-arylaldonamids for the cryopreservation of human hematopoietic stem and progenitor cells. *Canadian Society for Chemistry Website* 2017.
29. Charlton T, Adam M, Ben R, Jahan S, **Pineault N**, **Acker J**. Successful cryopreservation of human hematopoietic stem and progenitor cells using novel ice recrystallization inhibitors. *Canadian Society for Chemistry Website* 2017.
30. Chassé M, Liu Y, Hsia C, Thompson T, Heddle N, Eckert K, Kinney J, McIntyre L, **Tinmouth A**. Albumin utilization 2011-14. The data collection strategy: Albumin proof of concept project. *Canadian Society for Transfusion Medicine Website* 2017.
31. **Clarke G**, Au N, Berry B, Blain H, Buyukdere H, Gillett R, **Hannon J**, **Lane D**, Logan D, Musuka C, Nahirniak S, Robinson A, Sutherland S, To L. Providing Kell negative red cells to female patients in Canada: The time has come. *Canadian Society for Transfusion Medicine Website* 2017.
32. Cloutier N, Allaeys I, Marcoux G, Mailhot B, Levesque T, Becker Y, Rondina M, Mckenzie S, Cote F, Nieswandt B, Khan W, Matthew F, Newman P, Lacroix S, Fortin P, Boilard E. Platelets release pathogenic serotonin in response to immune complexes. *Res Pract Thromb Haem* 2017; 1: 469.
33. Compernolle V, Chou S, Tanael S, Savage W, Howard J, Josephson C, Odame I, Hogan C, Denomme G, **Shehata N**. Red cell specifications for patients with hemoglobinopathies: A systematic review and guideline. *Vox Sang* 2017; 112: 266.
34. Cote J, Morden J, **Berardi P**. Two novel ABCG2 alleles resulting in a Jr(a-) phenotype. *Canadian Society for Transfusion Medicine Website* 2017.
35. Crow AR, Kapur R, Jen M, Mott PJ, Marjoram D, Amash A, Kahlon SS, Yougbare I, **Ni H**, Kim M, Semple JW, **Lazarus AH**. Erythrocyte-specific antibodies as a potential new therapeutic modality in autoimmune and inflammatory disorders beyond immune thrombocytopenia (ITP). *Blood* 2017; 130: 231.
36. Cruz Leal Y, Marjoram D, **Lazarus A**. Antibody levels on murine erythrocytes are a key factor in inducing antibody-mediated immune suppression to erythrocyte alloimmunization and impacts both erythrocyte clearance and erythrocyte antigen loss. *Canadian Society for Transfusion Medicine Website* 2017.
37. Cruz-Leal Y, Marjoram D, **Lazarus A**. Erythrocyte saturation with IgG was a key factor for inducing antibody-mediated immune suppression to erythrocyte alloimmunization and impacted both erythrocyte clearance and erythrocyte antigen modulation. *Transfusion* 2017; 57: 6A.
38. da Silveira Cavalcante L, **Acker J**, Holovati J. Liposomes and rejuvenation: new approach for improving quality of stored red blood cells. *Transfusion* 2017; 57: 86A.
39. Darnel S, **Bigham M**, Mueller D, Feenstra S, Danielson J, Beauchamp A, Gee A. The development of a provincial transfusion related adverse reaction reporting tool using a multidiscipline collaborative process. *Canadian Society for Transfusion Medicine Website* 2017.

40. Delage G, **Fearon M**, Stramer S, Nguyen M, Bernier F, **O'Brien S**, Scalia V, Smith S, Grégoire Y, Hogema B. Preliminary results on the prevalence of acute hepatitis E virus infection in Canadian blood donors. *Transfusion* 2017; 57: 199A.
41. Delage G, **Fearon M**, Stramer S, Nguyen M, Bernier F, **O'Brien S**, Scalia V, Smith S, Grégoire Y, Hogema B. Preliminary results on the prevalence of acute hepatitis E virus infection in Canadian blood donors. *Vox Sanguinis* 2017; 112: 187.
42. Donkor D, Bhakta V, Eltringham-Smith L, Stafford A, Weitz J, **Sheffield W**. Characterization of an aptamer inhibiting coagulation factor XIa identified through in vitro screening of a single-stranded DNA library. *Res Pract Thromb Haemost* 2017; 1: 385.
43. Dubey S, Kim B, **Branch DR**, Hynynen K, Aubert I. Effects of natural antibodies delivered to the brain using focused ultrasound on the neuroinflammatory environment in a mouse model of amyloidosis. *13th International Conference on Alzheimer's & Parkinson's Diseases website* 2017.
44. Duncan J, Lima A, Cserti-Gazdewich C, Cober N, Ditomasso J, De Biasio L, Harrison L, McShane K, Syer K, Heddle N. Ontario's transfusion transmitted injury surveillance system; new tools to reduce complexity in adverse transfusion event reporting. *Canadian Society for Transfusion Medicine Website* 2017.
45. Elmoazzen H, Guilivi A, Halpenny M, Martin L, Perron D, Bredeson C, McGann L, Birch P, **Acker J**. Replacement of pentastarch with hetastarch for cryopreservation of hematopoietic progenitor cells, aphaeresis. *Transfusion* 2017; 57: 77A.
46. Emeriaud G, M P, Ilona S, De Cloedt L, Tucci M, Lacroix J, Jouvet P. Transfusion practices in children with pediatric acute respiratory distress syndrome: a retrospective cohort study. *Ann Intensive Care* 2018; 8: F-16.
47. **Fearon M**, **O'Brien S**, Scalia V, Delage G, Bernier F, Nguyen M, Stramer S. Hepatitis E prevalence in Canada - a large blood donor survey. *Canadian Society for Transfusion Medicine Website* 2017.
48. Fingrut W, Cuperfain A, Parmar S, Rikhraj K, Ptak E, Kahlon M, Naidu A, **Petraszko T**. Characterizing commitment and knowledge of stem cell donors following initial recruitment: a preliminary analysis. *Canadian Society for Transfusion Medicine Website* 2017.
49. Flahr F, Loftus P, Parmar S, **Petraszko T**. Medical enquiries: To do or not to do? Evaluating the first 1500 medical enquiries processed in West medical services. *Canadian Society for Transfusion Medicine Website* 2017.
50. Foster T, Chin-Yee B, Lazo-Lagner A, Hsia C, **Chin-Yee I**. Blood donation and testosterone replacement therapy. *Canadian Society for Transfusion Medicine Website* 2017.
51. Fournier D, Simard C, Sutherland DR, Elmoazzen H, **Pineault N**, Koegler G, Querol S, Saccardi R, Prasath A, Neron S. CD34 and CD45 post-thaw analysis: A multicenter study. *Transfusion* 2017; 57: 6A-7A.
52. Gallant RC, Wang YG, Lei X, Neves M, Roelho R, **Ni H**. Alpha-dystroglycan plays important roles in platelet aggregation and hemostatic plug formation. *Vox Sang* 2017; 112: 181.
53. Gerges H, **Clarke G**, Nahirniak S. Rh immune globulin (RhIG) prophylaxis post transfusion of Rh positive red cells in females of child bearing potential. *Canadian Society for Transfusion Medicine Website* 2017.
54. **Goldman M**, **O'Brien SF**. The older donor. *Vox Sang* 2017; 112: 9.
55. **Goldman M**, Yi Q, **O'Brien S**. Contribution of older donors to the blood supply. *Canadian Society for Transfusion Medicine Website* 2017.
56. **Goldman M**, Yi Q-L, **O'Brien S**. Changes in minimal hemoglobin and interdonation intervals; impact on hemoglobin deferral. *Transfusion* 2017; 57: 213A-4A.

57. Gozde D, Tocchio A, Howell A, Sridhar K, **Acker J**, Demirci U. A magnetic levitation system to study the impact of donor gender, age and blood storage conditions on red blood density profile. *Transfusion* 2017; 57: 32A.
58. Gruben V, Chandler J. Organ Donation and Medical Assistance in Dying in Canada. *Transplantation* 2017; 101: S14.
59. Guo C, Chang T. Immunological study of bovine poly-[Hb-CAT SOD CA]: a nanobiotherapeutic *XVI ISBS International Symposium Blood Substitutes & Oxygen Therapeutics website* 2017.
60. Guo C, Gynn M, Chang T. Extraction of superoxide dismutase, catalase and carbonic anhydrase from stroma-free red blood cell hemolysate for the preparation of the nanobiotechnological complex of polyhemoglobinsuperoxide dismutase-catalase-carbonic anhydrase *XVI ISBS International Symposium Blood Substitutes & Oxygen Therapeutics website* 2017.
61. **Hannon J**, Barr G, Dolnik T, Ciurcivich L, **Alport T**, **Clarke G**. Summary of cell-free fetal DNA (cffDNA) testing in pregnant women in Western Canada. *Canadian Society for Transfusion Medicine Website* 2017.
62. **Hannon J**, Barr G, Dolnik T, Ciurcivich L, **Alport T**, **Clarke G**. An approach to ensuring quality in cell-free fetal DNA (cffDNA) testing. *Canadian Society for Transfusion Medicine Website* 2017.
63. Heddle N, Cook R, Lee K, **Arnold D**, Crowther M, Devereaux P, Ellis M, Figueroa P, Kurz A, Roxby D, Sessler D, Sharon Y, Sobieraj-Teague M, Warkentin T, **Webert K**, Barty R, Liu Y, Eikelboom J. Analysis of red blood cell storage duration and in-hospital mortality using time dependent exposure: Is the oldest blood bad? *Transfusion* 2017; 57: 33A.
64. Higgins A, Lahmann J, Lusianti R, Benson J, **Acker J**. Design of methods for expedited deglycerolization of cryopreserved red blood cells. *Cryobiology* 2018; 80: 176.
65. Hill A, Howell A, Turner T, **Acker J**. Evaluation of Beckman Coulter StatSpin centrifuges for supernatant hemoglobin determination in whole blood and red cell concentrates. *Canadian Society for Transfusion Medicine Website* 2017.
66. Holovati J, da Silveira Cavalcante L, **Acker J**. Combination of liposomes and rejuvenation treatment for minimizing hypothermic storage lesion of red blood cells. *Canadian Society for Transfusion Medicine Website* 2017.
67. Howell A, Hill A, Dennis B, **Acker J**. Deglycerolization of manually glycerolized, frozen RCCs using a closed system cell processor. *Transfusion* 2017; 57: 83A.
68. Howell A, Hill A, Murphy K, Letcher B, Langevin S, Holovati J, **Acker J**, **Pineault N**. Use of buffy coat derived leukocyte enriched products for evaluation of a plasma reduction stem cell manufacturing protocol. *Transfusion* 2017; 57: 78A.
69. Howell A, Hill A, Murphy K, Letcher B, Langevin S, Holovati J, Elmoazzen H, **Acker P**, **Pineault N**. Use of buffy coat derived leukocyte enriched products for evaluation of a plasma reduction stem cell manufacturing protocol. *Canadian Society for Transfusion Medicine Website* 2017.
70. Howell A, Hill A, Turner T, Xu A, Dennis B, **Acker J**. Red cell concentrate volume and manufacturing method impact post-thaw quality in cryopreserved products processed using a closed cell processor. *Transfusion* 2017; 57: 88A.
71. Jahan S, **Pineault N**. Loss of hematopoietic stem cell activity in cord blood units due to processing delay could impair engraftment in patients. *Canadian Society for Transfusion Medicine Website* 2017.
72. Jahan S, **Pineault N**. Extended preprocessing storage impairs cord blood hematopoietic stem cell activity. *Transfusion* 2017; 57: 54A-5A.

73. Jansen A, Qu M, Liu Q, Zhao H, Peng J, **Ni H**, Hou M. Low platelet count is an independent risk factor for infection in patients with primary immune thrombocytopenia. *Res Pract Thromb Haemost* 2017; 1: 67.
74. Kapur R, Kim M, Rebetz J, Takabe-French A, Kim N, Shanmugabhavananthan S, Speck ER, Semple JW. Gastrointestinal flora dictates the biological response in murine transfusion related acute lung injury (TRALI). *Blood* 2017; 130: 766.
75. Kei T, Curley G, Pavenski K, Ward S, **Shehata N**, Tanzini R, Gauthier M, Mistry N, Mazer D, Hare G. Efficacy and safety of erythropoietin and iron therapy to reduce red blood cell transfusion in surgical patients: A systematic review and meta-analysis. *Transfusion* 2017; 57: 114A.
76. Kiernan J, **Liwski R**, Elmoazzen H, **Allan D**. Harnessing immune tolerance of non-inherited maternal HLA antigens in the CBS Cord Blood Bank. *Canadian Society for Transfusion Medicine Website* 2017.
77. Kiernan J, Maiers M, Gragert LA, **Blake J**, Killeen D, Young K, Mercer D, **Liwski R**, **Allan D**. HLA match probabilities of stem cell grafts for ethnic sub-populations within the OneMatch stem cell and marrow network. *Hum Immunol* 2017; 78: 79.
78. Kipkeu B, Shyian M, da Silveira Cavalcante L, **Branch D**, **Acker J**, Holovati J. Evaluation of the functional properties of buffy coat-derived monocytes for monocyte monolayer assay. *Canadian Society for Transfusion Medicine Website* 2017.
79. Kipkeu BJ, **Branch D**, **Acker J**, Holovati J. Cryopreserved buffy coat-derived monocytes for the assessment of alloantibody clinical significance. *Transfusion* 2017; 57: 36A-7A.
80. Kjaer M, Bertrand G, Bakhoul T, Massey E, Baker J, Lieberman L, Tanael S, Greinacher A, Murphy M, **Arnold D**, Baidya S, Bussel J, Kaplan C, Hume H, Oepkes S, Ryan G, Savoia H, **Shehata N**, Kjeldsen-Kragh J. The detection of maternal HPA-1a antibodies and their role in predicting the severity of FNAIT: A systematic review. *Vox Sang* 2017; 112: 237.
81. Kluger R, Wang A. HBOCs from Hb-Hb coupling deliver oxygen and avoid nitric oxide. *XVI ISBS International Symposium Blood Substitutes & Oxygen Therapeutics website* 2017.
82. Kou Y, Loza-Correa M, Taha M, Kalab M, Ronholm J, Schlievert P, Cahill M, **Skeate R**, Cserti-Gazdewich C, **Ramirez-Arcos S**. False negative septic transfusion case caused by a platelet pool showing visible clotting due to contamination with Staphylococcus aureus. *Canadian Society for Transfusion Medicine Website* 2017.
83. Kumaran D, DiFranco C, McIntyre T, **Ramirez-Arcos S**. Evidence of the covert risk: Propionibacterium acnes, a predominant red blood cell contaminant, involved in a septic transfusion reaction. *Vox Sang* 2017; 112: 197.
84. Kumaran D, **Ramirez-Arcos S**. Evidence of the covert risk: Propionibacterium acnes associated with a septic transfusion reaction involving red blood cell concentrates. *Canadian Society for Transfusion Medicine Website* 2017.
85. **Lane D**, Grabner L, Herdman B, Fallis R, Kabani A, Musuka C. Implementation of electronic solution to reduce risk of mistransfusion in a regional transfusion service. *Transfusion* 2017; 57: 174A.
86. **Lau W**, Sumner C, Oldfield L, Hawes J, Cserti-Gazdewich C, Lemay A. Anti-sc2 of the Scianna blood group system can cause hemolytic transfusion reactions: Serendipity and monocyte monolayer assay confirm clinical significance. *Canadian Society for Transfusion Medicine Website* 2017.
87. Law K, Hovey O, **Pineault N**. Insulin-like growth factor-II released by osteoblasts promotes the growth of cord blood progenitors. *Transfusion* 2017; 57: 8A.

88. Law K, **Pineault N**. Insulin-like growth factor-2 released by osteoblasts promotes the growth of cord blood cells. *Canadian Society for Transfusion Medicine Website* 2017.
89. Leatherdale A, Parker DA, Tasneem S, Wang Y, Bonna A, Gross PL, **Ni H**, Doble B, Farndale RW, Hayward CPM. Multimerin-1 binds to specific motifs in vessel wall collagens and contributes to thrombosis: Novel insights regarding the mechanisms that support human and mouse platelet adhesion. *Blood* 2017; 130: 549.
90. Lewis B, Spirig R, Kaesermann F, **Branch D**. Recombinant FC hexamers as a promising alternative to intravenous immunoglobulin (IVIg) for the treatment of antibody-mediated autoimmune diseases. *Vox Sang* 2017; 112: 21.
91. Li J, Wang Y, Yucel Y, Freedman J, **Ni H**. Platelet desialylation: A novel immune tolerance pathway with therapeutic potential in decreasing alloimmunization in transplants and transfusions. *Canadian Society for Transfusion Medicine Website* 2017.
92. Li J, Wang Y, Yucel Y, Freedman J, **Ni H**. Platelet desialylation: Novel mechanism of immune tolerance. *Res Pract Thromb Haemost* 2017; 1: 248.
93. Loza-Correa M, Ayala J, Perelman I, Taha M, Yi Q, de Pedro M, **Ramirez-Arcos S**. Cell wall modification during biofilm formation might confer Staphylococcus epidermidis advantageous growth in platelets. *Canadian Society for Transfusion Medicine Website* 2017.
94. Loza-Correa M, Ayala J, Perelman I, Taha M, Yi Q, de Pedro M, **Ramirez-Arcos S**. Biofilm matrix and cell wall modification during biofilm formation might confer Staphylococcus epidermidis advantageous growth in platelets. *Vox Sang* 2017; 112: 197.
95. MacIsaac J, Siddiqui R, Jamula E, Li N, Baker S, **Webert K**, Heddle N, **Arnold D**. Rituximab as an alternative in intravenous immune globulin for autoimmune diseases. *Canadian Society for Transfusion Medicine Website* 2017.
96. MacIsaac J, Sidiqqi R, Jamula E, Li N, Baker S, **Webert KE**, Heddle N, **Arnold DM**. Anti-CD20 monoclonal antibody therapy for immune modulation across a range of autoimmune diseases. *Blood* 2017; 130: 4936.
97. Mannard E, **Acker J**, Tien H, Beckett A. Canadian Forces fresh whole blood donors in Afghanistan: a descriptive study. *Can J Surg* 2017; 60: S14.
98. Maurer-Spurej E, Almizraq R, Millar D, **Acker J**. Screening of red blood cell concentrates for micro particle content as quality indicator. *Transfusion* 2017; 57: 91A.
99. McVey M, Maishan M, Srbely V, Lee W, Spring C, Semple J, Kuebler W. Microparticles from aged stored platelets impair microvascular pulmonary endothelial cell barrier function. *FASEB J* 2017; 31: 1074.2.
100. McVey M, Spring S, Tang V, Langlois M-A, Kuebler W. Improved resolution in extracellular vesicle populations using 405 instead of 488 nanometer wavelength side scatter. *International Society for Extracellular Vesicles website* 2017.
101. Meyer J, Ben R, Turner T, **Acker J**, Burger D. Microparticle formation in red blood cells stored with ice recrystallization inhibitors. *Canadian Society for Chemistry Website* 2017.
102. Mistry N, Solish M, Cahill L, Zhou Y-Q, Hare AG, Doctor A, **Lazarus AH**, Sled JG, Mazer CD, Hare GM. Cardiovascular adaptations to moderate anemia maintain cerebral perfusion but are inadequate to prevent renal and splanchnic tissue hypoxia. *FASEB J* 2017; 31: 700.1.
103. Morden J, Cote J, **Clarke G**, **Berardi P**. Anti-D, antibody profiling. *Canadian Society for Transfusion Medicine Website* 2017.
104. Movilla R, Lucier K, Parvizian M, Siddiqui R, Gabriele E, Bourque M, MacIsaac J, Moorehead P, Chan A, Heddle N, Lane S. Parent preferences in obstetrical and perinatal care in hemophilia: a

survey of hemophilia treatment centre providers. *Canadian Society for Transfusion Medicine Website* 2017.

105. Mukhtar A, Toupin M, Bondy C, **Tinmouth A**. Transfusion practice in sickle disease patients in Ottawa. *Canadian Society for Transfusion Medicine Website* 2017.
106. Muszynski JA, Menocha S, Rogers T, Norris P, Juffermans NP, Wirtz M, Almizraq R, Spinella P, **Acker J**. Component manufacturing method affects immunomodulatory activity of red cell products. *Transfusion* 2017; 57: 32A.
107. Neves M, Wang Y, Zhu G, Gallant R, Stratton T, Thompson M, **Ni H**. Novel anti-fouling coatings for platelet research and clinical diagnostics. *Canadian Society for Transfusion Medicine Website* 2017.
108. Neves M, Wang Y, Zhu G, Gallant R, Stratton T, Thompson M, **Ni H**. Novel integrin αiibβ3 and GPibα coatings that feature anti-fouling properties for platelet research and clinical diagnostics. *Res Pract Thromb Haemost* 2017; 1: 17.
109. Neves M, Wang YG, Zhu G, Gallant R, Stratton T, Thompson M, **Ni H**. Development of anti-fouling detection methods for novel platelet lignds and pathogenic platelet antibodies. *Vox Sang* 2017; 112: 147.
110. Noone D, Chai-Adisaksopha C, Curtis R, Frick N, Nichol M, O'Mahony B, Page D, Stonebraker J, Iorio A, Skinner M, on behalf of Patient Reported Outcomes and Experiences (PROBE) Investigator Group. Occurrence and impact of pain among patients living with hemophilia: An analysis from the patient reported outcomes, burdens and experiences (PROBE) study. *Haemophilia* 2018; 24: 26.
111. Norris PAA, Wang Y, Zhu G, Wang L, Huo M, Fairn GD, **Ni H**, **Lazarus AH**. Antibodies against macrophage CD44 protect platelets from fcγr-mediated phagocytosis: A potential mechanism for CD44 antibody amelioration of murine immune thrombocytopenia. *Blood* 2017; 130: 3639.
112. **O'Brien S**, Scalia V, Osiowy C, Carpenter M, Andonov A, **Fearon M**. Molecular surveillance of hepatitis B and C in Canadian blood donors. *Transfusion* 2017; 57: 194A.
113. **O'Brien S**, Yi Q, **Fearon M**. Residual risk of cytomegalovirus after leukoreduction in the Canadian blood supply. *Canadian Society for Transfusion Medicine Website* 2017.
114. **O'Brien S**, Yi Q, **Fearon M**. Residual risk of cytomegalovirus after leukoreduction in the Canadian blood supply. *Vox Sanguinis* 2017; 112: 27.
115. **Pambrun C**, Fournier E, **Skeate R**, **Goldman M**. Donor reactions at Canadian Blood Services between 2013 and 2016. *Canadian Society for Transfusion Medicine Website* 2017.
116. **Pambrun C**, Robillard P, Romans R, **Goldman M**. Autologous blood collection in Canada. *Transfus Med Rev* 2017; 31: 193.
117. **Pambrun C**, Robillard P, Romans R, **Goldman M**. Autologous blood collection in Canada. *Canadian Society for Transfusion Medicine Website* 2017.
118. Pasha R, Halpenny M, Elmoazzen H, **Pineault N**. When it comes to cord blood banking, what is the relationship between segments and bag. *Canadian Society for Transfusion Medicine Website* 2017.
119. Pavenski K, Stanworth S, Tanael S, Hume H, Nahirniak S, **Webert K**, Landry D, **Shehata N**. Quality of evidence-based guidelines for transfusion of red blood cells and plasma: A systematic review. *Vox Sang* 2017; 112: 259.
120. Pendergrast J, Binnington B, Tong TN, **Callum J**, Cserti-Gazdewich CM, **Lau W**, Lieberman L, Lin Y, Pavenski K, **Shehata N**, Yeung R, **Branch DR.** Incidence and risk factors for IVIG-mediated hemolysis. *Blood* 2017; 130: 2398.

121. Perelman I, **Tinmouth A**, Fergusson D. The spread and timing of transfusions for premature, very low birth weight neonates: A secondary analysis of the ARIPI trial. *Canadian Society for Transfusion Medicine Website* 2017.
122. Poisson JS, Cottee M, Ben R, Turner T, **Acker J**. Modulating the amphiphilicity of ice recrystallization inhibitors to improve red blood cell recovery. *Canadian Society for Chemistry Website* 2017.
123. **Pryzdial E**, Lin B, Sutherland M. Host coagulation initiated on the virus surface. *Canadian Society for Transfusion Medicine Website* 2017.
124. Qadri S, Eltringham-Smith L, **Sheffield W**. Purified prothrombin transfused at the time of injury reduces bleeding in both normal and coagulopathic mice. *Vox Sang* 2017; 112: 49.
125. Qiu Y, Vuong J, La M, **Clarke G**, Meier K, Cembrowski G. Poverty-associated changes in pediatric complete blood count reference intervals. *Int J Lab Hematol* 2017; 39: 96.
126. Quach M, Dragovich M, Chen W, Syed A, Liang X, Deng W, **Ni H**, De Meyer S, Ware J, Deckmyn H, Zhang F. Fc-independent immune thrombocytopenia via mechanomolecular signaling in platelets. *Res Pract Thromb Haemost* 2017; 1: 66.
127. **Ramirez-Arcos S**, DiFranco C, McIntyre T, **Goldman M**. Residual risk of bacterial contamination of platelets: Six years of experience with sterility testing at Canadian Blood Services. *Canadian Society for Transfusion Medicine Website* 2017.
128. **Ramirez-Arcos S**, DiFranco C, McIntyre T, **Goldman M**. Residual risk of bacterial contamination of platelets: 6 years of experience with sterility testing at Canadian Blood Services. *Transfus Med Rev* 2017; 31: 193-4.
129. **Ramirez-Arcos S**, DiFranco C, McIntyre T, **Goldman M**. Residual risk of bacterial contamination of platelets: Six years of experience with sterility testing at Canadian Blood Services. *Vox Sang* 2017; 112: 46.
130. **Ramirez-Arcos S**, Taha M, Kou Y, Mastronardi C, Yi Q, **Goldman M**. Improved bacterial detection algorithm supports extension of platelet storage from 5 to 7 days at Canadian Blood Services. *Vox Sang* 2017; 112: 197.
131. Ren J, Ding X, Trudel M, Greer JJ. Pathogenesis of cardiorespiratory impairments in a mouse model of sickle cell disease. *Am J Respir Crit Care Med* 2017; 195: A1235.
132. Rezs I, Cote J, Gill B, **Berardi P**, **Clarke G**. A new antibody in your patient .... was the donor really antigen negative? *Canadian Society for Transfusion Medicine Website* 2017.
133. Sadeghi P, Aljedani H, Hasegawam W, **Kahwash E**. Treatment of delayed hemolytic transfusion reaction with red blood cell exchange: a case report. *Canadian Society for Transfusion Medicine Website* 2017.
134. Schubert P, Johnson L, Culibrk B, Chen Z, Tan S, Marks D, **Devine D**. Cryopreserved platelets synthesize proteins upon thawing with packaging of a defined protein subset into microvesicles. *Transfusion* 2017; 57: 83A.
135. **Scott M**. Modulating the immune system via bioreactor produced miRNA-based therapeutics. *XVI ISBS International Symposium Blood Substitutes & Oxygen Therapeutics website* 2017.
136. **Scott M**. Stealth erythrocytes: Treatment and prevention of RBC alloimmunization by polymer-grafting. *XVI ISBS International Symposium Blood Substitutes & Oxygen Therapeutics website* 2017.
137. Semple JW, Zufferey A, Speck ER, Machlus KR, Aslam R, Guo L, McVey MJ, Kim M, Kapur R, Boilard E, Italiano JE, Jr. Mature murine megakaryocytes process and present both exogenous and endogenous antigens to CD8+ T cells and transfer this ability to platelets. *Res Pract Thromb Haem* 2017; 1: 248.

138. **Sheffield W**, Eltringham-Smith L, Bhakta V. Fusion to albumin extends the circulatory half-life and antithrombotic effects of the Kunitz protease inhibitor domain of protease nexin 2 in mice. *Res Pract Thromb Haemost* 2017; 1: 360.
139. **Sheffield W**, Eltringham-Smith L, Qadri S, Wang Y, Bhakta V, **Pryzdial E**, **Ni H**. Purified prothrombin substitutes for prothrombin complex concentrates in reducing bleeding in both normal and coagulopathic mice. *Canadian Society for Transfusion Medicine Website* 2017.
140. Shehata M, Zaffar N, **Shehata N**. Assessing the usefulness of direct antiglobulin test (DAT) in all neonates in the neonatal intensive care unit (NICU). *Canadian Society for Transfusion Medicine Website* 2017.
141. Shih A, Jo D, De Wit K, Bhagirath V, Castellucci L, Yeh C, Thoma B, Elahie A, Heddle N, Chan T. Performing a massive online needs assessment for developing a learner-centered online curriculum for the management of bleeding through the use of social media: A SoMe-KTE3 project. *Canadian Society for Transfusion Medicine Website* 2017.
142. Shih A, Li N, Barty R, Cook R, Crowther M, Heddle N. Utilizing electronic health records to audit red blood cell transfusion ordering practices in four Ontario tertiary care centres *Canadian Society for Transfusion Medicine Website* 2017.
143. Shih AW, Lane SJ, Barty RL, Crowther MA, Heddle NM. Determining the factors for reassessment after transfusion: a Canadian survey. *Canadian Society for Transfusion Medicine Website* 2017.
144. Solh Z, Rajagopal R, Thachil J, Chan A, Heddle N, Monagle P. Availability of age-specific coagulation laboratory values in pediatric hospitals vs. combined pediatric/adult hospitals: an international perspective. *Res Pract Thromb Haemost* 2017; 1: 530.
145. Solh Z, Rajagopal R, Thachil J, Chan A, Heddle N, Monagle P. International survey of the management of disseminated intravascular coagulation among pediatric and neonatal health care practitioners. *Res Pract Thromb Haemost* 2017; 1: 1198.
146. Staibano P, Lombardi J, Perelman I, Davis A, **Tinmouth AT**, Carrier M, Saidenberg E. Usage of patient-centered outcomes in the management of anemia: a systematic review. *Blood* 2017; 130: 5646.
147. Sullivan J, Oswald BE, Vadasz B, Li J, Chen P, Poncz M, Freedman JJ, **Ni H**. Maternal Anti-αIIb Antibodies Target Fetal Hematopoietic Stem Cells and May Lead to Pancytopenia and Miscarriage in Fnait. *Blood* 2017; 130: 233.
148. Taha M, Culibrk B, Schubert P, Yi Q, Goodrich R, **Ramirez-Arcos S**. Inactivation of biofilm-derived Staphylococcus epidermidis in platelet concentrates with riboflavin and ultraviolet light treatment. *Vox Sang* 2017; 112: 197.
149. Taha M, Culibrk B, Schubert P, Yi Q, Goodrich R, **Ramirez-Arcos S**. Testing the efficiency of riboflavin and ultraviolet light treatment for inactivation of high titers of biofilm-derived Staphylococcus epidermidis in platelet concentrates. *Canadian Society for Transfusion Medicine Website* 2017.
150. Taha M, Kou Y, Mastronardi C, Yi Q, **Goldman M**, **Ramirez-Arcos S**. New bacterial detection algorithm supports extension of platelet storage from 5 to 7 days at Canadian Blood Services. *Canadian Society for Transfusion Medicine Website* 2017.
151. Tao L, Zeng Q, Li J, Xu M, Pan Y, Wang H, Tao Q, Chen Y, Peng J, Hou M, Jansen A, Zhai Z, **Ni H**. Platelet desialylation correlates with efficacy of first-line therapies for immune thrombocytopenia. *Canadian Society for Transfusion Medicine Website* 2017.
152. Trudeau J, Gilmore J, **Skeate R**. Learn Transfusion seminar series - A vital component of transfusion medicine education in Canada. *Canadian Society for Transfusion Medicine Website* 2017.

153. Turner T, Hill A, Ahluwalia A, **Acker J**. VIA Freeze™ research controlled-rate freezer as a high throughput tool for evaluating mesenchymal stem cell cryopreservation methods. *Canadian Society for Transfusion Medicine Website* 2017.
154. Unrau J, **Petraszko T**, Roland K, Au N, Morrison D, Chipperfield K, Feenstra S, Dallas K, **Bigham M**. Affecting decreased hospital requests for cmv-seronegative blood components in BC and Yukon region. *Canadian Society for Transfusion Medicine Website* 2017.
155. van den Hurk K, Zalpuri S, Romeijn B, Allara E, **Goldman M**, Kamel H, Gorlin J, Vassallo RR, Di Angelantonio E. Variations in hemoglobin screening and deferral practices across blood services explain differing hemoglobin deferral rates: A BEST collaborative study. *Transfusion* 2017; 57: 58A.
156. Visram A, Aziz J, Morris G, Zhang T, Bryant A, Kekre N, Bredeson C, **Allan D**. Effect of donor age and whether donors related or unrelated on time to allogeneic hematopoietic stem cell transplantation. *Canadian Society for Transfusion Medicine Website* 2017.
157. Visram A, Kekre N, Bredeson C, Tay J, Huebsch L, McDiarmid S, Mallick R, Sabloff M, Atkins H, **Allan D**, **Tinmouth A**, Martin L, Hamelin L, Maze D. Factors influencing long-term hematopoietic function following autologous stem cell transplantation. *Canadian Society for Transfusion Medicine Website* 2017.
158. Wang Y, Chang T. Biodegradable nanocapsules containing a nanobiotechnological complex for the suppression of a melanoma cell line B16F10. *XVI ISBS International Symposium Blood Substitutes & Oxygen Therapeutics website* 2017.
159. Wang Y, Neves M, Zhang D, Xu X, Lei X, Zhu G, Wang Y, Xuan L, Ding J, **Ni H**. Salvianolic acids inhibit blood coagulation and platelet aggregation: A new class of herb derived dabigatran analogs. *Res Pract Thromb Haemost* 2017; 1: 359.
160. Wilson R, VanSpronsen A, Shea R, Parrish M, Lazarenko B, Wong C, **Clarke G**. Simulating the urgent release of blood-type irrelevant products in a hospital setting. *Canadian Society for Transfusion Medicine Website* 2017.
161. Wirtz M, Tuip-de Boer A, Almizraq R, **Acker J**, Norris P, Muszynski JA, Juffermans NP. The interaction between red blood cell transfusion and lung injury: the influence of blood component manufacturing methods. *Transfusion* 2017; 57: 31A-2A.
162. Xu M, Zhu G, Li J, Carrim N, Kunishima S, Ware J, Ruggeri Z, Freedman J, **Ni H**. GPIbalpha is required for platelet-mediated TPO production from liver and TPO-induced platelet generation from bone marrow. *Canadian Society for Transfusion Medicine Website* 2017.
163. Xu M, Zhu G, Li J, Carrim N, Kunishima S, Ware J, Ruggeri Z, Freedman J, **Ni H**. Platelet GPiba is important for liver thrombopoietin (TPO) production. *Res Pract Thromb Haemost* 2017; 1: 231.
164. Zapata A, Kumaran D, **Ramirez-Arcos S**. Assessment of the stability of bacterial frozen stocks used in quality control testing procedures. *Canadian Society for Transfusion Medicine Website* 2017.

Canadian Blood Services Circular of Information

1. **Jenkins C**. Circular of information for the use of human blood components: Plasma components. *Blood.ca website* 2018.
2. **Jenkins C**. Circular of Information for the use of human blood components: Platelets. *Blood.ca website* 2017.
3. **Jenkins C**. Circular of Information for the use of human blood components: Red Blood Cells, Leukocytes Reduced (LR). *Blood.ca website* 2017.

Canadian Blood Services
it's in you to give

Canadian Blood Services Website Publications

1. **Arnold D**. Concentré de recherche: Amélioration des résultats pour les patients présentant des troubles auto-immuns de la fonction plaquettaire. *Blood.ca website*. 2017.
2. **Arnold D**. ResearchUnit: Improving outcomes for patients with autoimmune platelet disorders. *Blood.ca website* 2017.
3. **Blake J**. Concentré de recherche: Un modèle de changement : Prédiction de l'impact d'améliorations à l'échelle du système. *Blood.ca website*. 2018.
4. **Blake J**. ResearchUnit: A model for change: predicting the impact of system-wide improvements. *Blood.ca website* 2018.
5. **Callum J**. Donner au suivant : Pourquoi nous avons besoin que VOUS donniez du sang. *Blood.ca website*. 2017.
6. **Callum J**. Paying it forward: Why we need YOU to give blood. *Blood.ca website*. 2017.
7. **Clarke G**, Côté J, **Lane D**. Pratiques à suivre en matière de sérologie: Anti-M. *Blood.ca website*. 2017.
8. **Clarke G**, Côté J, **Lane D**. Serological best practices: Anti-M. *Blood.ca website* 2017.
9. **Clarke G**. Blood components. In *Clinical Guide to Transfusion*. Edited by **Clarke G**, **Chargé S.** Published in Professionaleducation.blood.ca by Canadian Blood Services, 2017.
10. **Clarke G**. Les composants sanguins. In *Guide de la pratique transfusionnelle*. Edited by **Clarke G**, **Charge S**. Published in ProfessionalEducation.blood.ca by Canadian Blood Services, 2017.
11. **Goldman M**. IgA deficiency. *Blood.ca website* 2018.
12. **Goldman M**. Le déficit en IgA. *Blood.ca website*. 2018.
13. **Goldman M**, **O'Brien S**, **Devine D**. Concentré de recherche: Vers une uniformisation des politiques d'exclusion du don de sang et de plasma. *Blood.ca website*. 2018.
14. **Goldman M**, **O'Brien S**, **Devine D**. ResearchUnit: Developing more inclusive deferral policies for blood and plasma donors. *Blood.ca website* 2018.
15. **Lane D**. Épreuves prétransfusionnelles. In *Guide de la pratique transfusionnelle*. Edited by **Clarke G**, **Chargé S**. Published in Professionaleducation.blood.ca by Canadian Blood Services, 2017.
16. **Lane D**. Pre-transfusion testing. In *Clinical Guide to Transfusion*. Edited by **Clarke G**, **Chargé S.** Published in Professionaleducation.blood.ca by Canadian Blood Services, 2017.
17. **Lau W**. Neonatal and pediatric transfusion. In *Clinical Guide to Transfusion*. Edited by **Clarke G**, **Chargé S.** Published in Professionaleducation.blood.ca by Canadian Blood Services, 2017.
18. **Lau W**. Pratiques transfusionnelles chez le nouveau-né et l'enfant. In *Guide de la pratique transfusionnelle*. Edited by **Clarke G**, **Chargé S**. Published in ProfessionalEducation.blood.ca by Canadian Blood Services, 2017.
19. **Ni H**. Concentré de recherche: Cellules tueuses naturelles : Quand les cellules perdent le nord! *Blood.ca website*. 2017.
20. **Ni H**. ResearchUnit: Natural killers: when cells go wrong. *Blood.ca website* 2017.
21. **O'Brien SF**. Rapport de surveillance 2016. *Blood.ca website*. 2017.
22. **O'Brien SF**. Surveillance report 2016. *Blood.ca website* 2017.
23. **Pambrun C**. Don autologue préopératoire. In *Guide de la pratique transfusionnelle*. Edited by **Clarke G**, **Charge S**. Published in ProfessionalEducation.blood.ca by Canadian Blood Services, 2017.
24. **Pambrun C**. Pre-operative autologous donation. In *Clinical Guide to Transfusion*. Edited by **Clarke G**, **Chargé S.** Published in Professionaleducation.blood.ca by Canadian Blood Services, 2017.

25. Prokopchuk-Gauk O, Solh Z. CMV seronegative, irradiated and washed blood components. In *Clinical Guide to Transfusion*. Edited by **Clarke G**, **Chargé S.** Published in Professionaleducation.blood.ca by Canadian Blood Services, 2017.
26. Prokopchuk-Gauk O, Solh Z. Composants sanguins négatifs pour les anti-CMV, irradiés et lavés. In *Guide de la pratique transfusionnelle*. Edited by **Clarke G**, **Charge S**. Published in ProfessionalEducation.blood.ca by Canadian Blood Services, 2017.
27. **Ramirez-Arcos S**. Concentré de recherche: Comment se comprtent les bactéries lors de la fabrication des plaquettes? *Blood.ca website*. 2017.
28. **Ramirez-Arcos S**. ResearchUnit: How do bacteria behave during platelet production? *Blood.ca website* 2017.
29. **Ramirez-Arcos S**. Concentré de recherche: La présence de résidus de plasma favorise l'adhérence des bactéries à la paroi des poches utilisées pour les concentrés de plaquettes. *Blood.ca website*. 2017.
30. **Ramirez-Arcos S**. ResearchUnit: Plasma residues enhance bacterial attachment to platelet storage bags. *Blood.ca website* 2017.
31. Ryan J. Use of cytomegalovirus (CMV) seronegative blood products. *Blood.ca website*. 2017.
32. Ryan J. Utilisation des produits sanguins CMV négatifs. *Blood.ca website*. 2017.
33. **Scott M**. Concentré de recherche: L'immunocamouflage au service des greffés et des transplantés. *Blood.ca website*. 2017.
34. **Scott M**. ResearchUnit: Using immunocamouflage to increase transplantation safety. *Blood.ca website* 2017.
35. Semple J. Concentré de recherche: La sécrétion de cellules immunitaires peut protéger les patients contre le syndrome respiratoire post-transfusionnel. *Blood.ca website*. 2017.
36. Semple J. ResearchUnit: An immune cell secretion may protect patients from transfusion-related lung injury. *Blood.ca website* 2017.
37. Serrano K, Schubert P, **Devine D**. Platelet product quality remains high after seven days of storage. *Blood.ca website* 2017.
38. Trudeau J. Massive hemorrhage and emergency transfusion. In *Clinical Guide to Transfusion*. Edited by **Clarke G**, **Chargé S.** Published in Professionaleducation.blood.ca by Canadian Blood Services, 2017.
39. Trudeau J. Transfusion d'urgence. In *Guide de la pratique transfusionnelle*. Edited by **Clarke G**, **Charge S**. Published in ProfessionalEducation.blood.ca by Canadian Blood Services, 2017.
40. **Zeller M**, Heddle N, **Devine D**. Concentré de recherche: Mais où va le sang? Analysons la consommation des concentrés de globules rouges pour l'éetablissement des politiques. *Blood.ca website*. 2017.
41. **Zeller M**, Heddle N, **Devine D**. ResearchUnit: Where is the blood going? Understanding red blood cell utilization to inform policies. *Blood.ca website* 2017.

Technical Reports

1. **Acker J**, Adkins S, Alves A, Horna D, Toll J. Feasibility study for a safety back-up cryopreservation facility. *External report submitted to Bioversity International* 2017.
2. **Blake J**. Technical report on rare blood study. *Internal report submitted to Canadian Blood Services* 2017.
3. **Blake J**. A technical analysis of the impact of sample removal on unit volume and dose in red blood cell collections. *Internal report submitted to Canadian Blood Services* 2018.

4. **Branch DR**. Assessment: Use of x-rays versus gamma-irradiation for the prevention of transfusion-associated graft-versus-host disease. *Internal report submitted to Canadian Blood Services, Product Innovation Operating Committee* 2017.
5. Halpenny M, Ganz PR, Dibdin N, **Acker J**. CBB stability program - pentaspan versus hespan in cord blood processing. *Internal report submitted to Canadian Blood Services* 2017.
6. Howell A, **Pineault N**, **Acker J**, Halpenny M, Elmoazzen H. Understanding transient warming events in cord blood units and their impact on product quality. *Internal report submitted to Canadian Blood Services* 2017.
7. McManus J. Evaluation of production equipment identified by the RFP. *Internal report submitted to Canadian Blood Services, Supply Chain - Production Process Management* 2017.
8. McManus J. Multi-plasma apheresis collection study. *Internal report submitted to Canadian Blood Services* 2017.
9. McManus J. BTS study evaluation - final report. *Internal report submitted to Canadian Blood Services, Logistics Process Management* 2017.
10. McManus J. Evaluation of buffy coat rest time on pooled platelet yields. *Internal report submitted to Canadian Blood Services, Supply Chain - Production Process Management* 2017.
11. McManus J. B1 cold processing study. *Internal report submitted to Canadian Blood Services, Supply Chain - Production Process Management* 2017.
12. **Petraszko T**. HLA selected apheresis platelet assessment. *Internal report submitted to Canadian Blood Services* 2017.
13. **Petraszko T**. Coagadex briefing note. *Internal report submitted to Canadian Blood Services, Product Innovation Operating Committee* 2017.
14. **Petraszko T**. Canadian Blood Services national HLA/HPA selected platelet program. *External report submitted to Ontario and Atlantic hospitals* 2017.
15. **Petraszko T**. Cytomegalovirus in cord blood. *Internal report submitted to Canadian Blood Services, Cord Blood Bank and Stem Cell Manufacturing* 2017.
16. **Pineault N**, **Acker JP**, **Scott MD**, **Sheffield W**. Environmental scan: novel uses for cord blood donations. *Internal report submitted to Canadian Blood Services* 2017.
17. **Pineault N**. Biosafe Sepax2 large volume CBU processing protocol evaluation. *Internal report submitted to Canadian Blood Services* 2018.
18. **Pineault N**. Relationship between quality attributes of cryobag and tubing segment contents in cord blood units – post thaw. *Internal report submitted to Canadian Blood Services* 2017.
19. **Ramirez S**, Kumaran D. Investigation on Calgary NEO phenotype discrepancies. *Internal report submitted to Canadian Blood Services* 2018.
20. **Ramirez-Arcos S**. Transfusion reactions 40-17-800001. *Internal report submitted to Canadian Blood Services* 2017.
21. **Ramirez-Arcos S**. Transfusion reaction PP C055617014814008 [Confidential]. *Internal report submitted to Canadian Blood Services* 2017.
22. **Ramirez-Arcos S**. Certificate of conformance - BPA and BPN lots. *Internal report submitted to Canadian Blood Services, Quality Assurance* 2017.
23. **Ramirez-Arcos S**. Bacterial detection testing - proficiency test kit 2017-05 and proficiency testing results reports. *Internal report submitted to Canadian Blood Services, Supply Chain – Production Process Management* 2017.
24. **Ramirez-Arcos S**. Bacterial detection testing - proficiency test kit 2017-10 and proficiency testing results reports. *Internal report submitted to Canadian Blood Services, Supply Chain – Production Process Management* 2017.

25. **Ramirez-Arcos S**. Effect of air entry during inoculation of anaerobic BacT/ALERT culture bottles. *Internal report submitted to Canadian Blood Services* 2017.
26. **Ramirez-Arcos S**. Expansion of the in-house proficiency testing program to include anaerobic bacteria. *Internal report submitted to Canadian Blood Services* 2018.
27. **Schubert P**. Counting platelets: Correlation between different hematology analyzers and a flow cytometry based method. *Internal report submitted to Canadian Blood Services* 2017.
28. **Sheffield W**, Bhakta V. Investigation of cryoprecipitate units returned by hospital customer in Newfoundland. *Internal report submitted to Canadian Blood Services* 2017.
29. Turner T, **Acker J**. MSC cryopreservation optimization 1mL scale up final technical report. *External report submitted to Ottawa Hospital Research Institute* 2017.
30. Turner T, **Acker J**. MSC optimization - Phase 1. *External report submitted to Ottawa Hospital Research Institute* 2017.

Other

1. **Branch D**. IVIG-associated hemolysis: Its causes and potential resolution. *GBS/CIDP Foundation Spring/Summer 2017 Newsletter* 2017: 5.
2. de Wit K. Blood and clot series: How can I tell whether this patient has a deep vein thrombosis? *CanadiEM website* 2018.
3. **Goldman M**, Van den Burg P. Do we know if we deplete or treat the donor's iron? *Transfusion Today* 2017; 111.
4. Parmar S, Rikhraj K, Hartsook S, Afford M, Longmuir C, Brar R, Ladd A, Thatcher A, Cuperfain A, Tigert A, Arora N, Suppiah R, Mcintosh S, Devito V, Leigh J, Yu J, Naidu A, Wang G, Sedra S, Hanna Y, Aziz D, Winquist L, Cheon S, Fingrut W. The Stem Cell Club –spearheading stem cell donor recruitment at medical schools across Canada. *2017 CFMS Annual Review* 2017: 38-9.
5. **Sheffield WP**, Donkor DA. Factor XIa-specific aptamers. Canadian Blood Services US15586581. Filed: 2017/11/09.
6. Shih A. Blood and clot series: What are the risks of reversing DOAC-associated intracranial bleeding? *CanadiEM website* 2018.
7. Shih A, Tseng E, de Wit K, Chan T. Blood and clots quizlet 2: Trauma in a patient on warfarin. *CanadiEM website*. 2017.
8. Tseng E. Blood and clot series: My patient has a pulmonary embolism. Should I screen them for cancer? *CanadiEM website* 2018.
9. Tseng E. Blood and clot series: Which antithrombotic therapy should I start for my patient with acute VTE? *CanadiEM website* 2018.
10. Tseng E, Shih A, de Wit K, Chan T. Blood and clots quizlet 3: Procedures on warfarin. *CanadiEM website*. 2017.
11. Tseng E, Shih A, de Wit K, Chan T. Blood and clots quizlet 4: Antithrombotic therapy for atrial fibrillation. *CanadiEM website*. 2017.
12. Tseng E, Shih A, de Wit K, Chan T. Blood and clots quizlet 5: Should I screen my patient for occult cancer after unprovoked vte? *CanadiEM website*. 2017.
13. Tseng E, Yeh C, Shih A, de Wit K, Chan T. Blood and clots quizlet 1: Oral contraceptives and pulmonary embolism. *CanadiEM website*. 2017.

Canadian Blood Services
it's in you to give

Appendix III: Health Canada financial contribution

Summary of Expenditures – April 1 2017 to March 31 2018

Note: The Health Canada financial contribution is complemented by funding from the Provincial and Territorial ministries of health and partners.

Schedule 1: Overview

Operating funds (Schedule 2)		$ 2,334,092
Funding programs (Schedule 3)		$ 2,792,577
MSM research program (Schedule 4)		$ 1,250,000
	Total	**$ 6,376,668**

Schedule 2: Operating funds

Centre for Innovation research laboratories operations		$ 2,111,377
Intellectual property protection and other legal activities		$ 212,818
Capital purchases		$ 9,896
	Total	**$ 2,334,092**

Schedule 3: Funding programs

Canadian Blood Services/CIHR partnership operating grant program		$ 829,917
Canadian Blood Services/CIHR new investigator program		$ 60,000
Canadian Blood Services intramural research grant program		$ 940,686
Kenneth J. Fyke award program		$ 100,000
James Kreppner award program		$ 50,000
Blood efficiency accelerator award program		$ 40,000
Transfusion Medicine Research Program Support Award		$ 702,806
CIHR partnership: Transplantation research		$ 50,000
Additional funding for research projects		$ 19,167
	Total	**$ 2,792,577**

Canadian Blood Services
it's in you to give

Schedule 4: MSM research program

MSM research grant program (Schedule 2)		$ 1,228,837
MSM research program administration (Schedule 3)		$ 21,163
	Total	**$ 1,250,000**

Notes:

- Funding programs include capital expenditures under $10,000
- Appendix III is considered draft until the completion of our external audit and the approval of the financial statements by the Canadian Blood Services Board of Directors