Héma Québec

BLOOD and PLASMA
MOTHER'S MILK
STEM CELLS
HUMAN TISSUES

2024 SCIENTIFIC ACTIVITIES REPORT

Here for life.

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This report is published by the Vice-présidence aux affaires médicales et à l'innovation in collaboration with the Vice-présidence à la médecine transfusionnelle and the Vice-présidence à l'expérience clientèle et aux communications.

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INTRODUCTORY REMARKS

We have the privilege to present the 2024 edition of Héma-Québec's Scientific Activities Report. The projects described herein were carried out by the teams of the Vice-présidence aux affaires médicales et à l'innovation and the Vice-présidence à la médecine transfusionnelle.

As always, our teams of seasoned scientists have exceeded all expectations. Their achievements have contributed to making our operations more efficient, improving the health of Québec's population and preserving the health of donors of biological products.

In 2024, our scientists quickly developed a new method in response to a patient's urgent need. More specifically, a screening method was created to assess the expression of CD36 on the surface of donor platelets. This breakthrough, achieved in record time, illustrates the agility of Héma-Québec scientists in the management of medical emergencies.

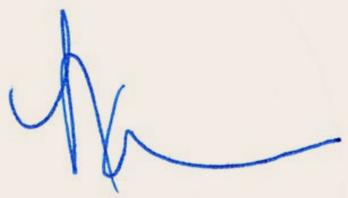
Always on the lookout for risks to recipients, our organization has also analyzed the risk of tuberculosis transmission through tissue transplantation. Indeed, this risk was recently highlighted by two outbreaks of tuberculosis in the United States, both caused by contaminated bone grafts. The analysis revealed that the risk to transplant recipients in Québec is marginal, notably because the musculoskeletal tissues prepared by our organization are irradiated and therefore contain no living cells.

Héma-Québec has also put considerable effort into evaluating a pathogen inactivation technology (INTERCEPT™). Once implemented, this technology could improve transfusion safety by offering additional protection against emerging pathogens or agents that are not routinely screened. Progress to date has enabled to launch INTERCEPT™'s technology transfer.

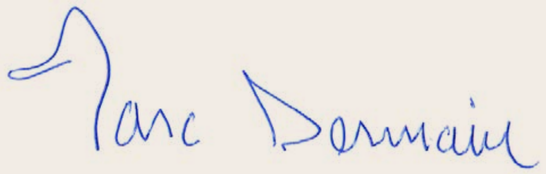
These highlights, however, are only a glimpse of the magnitude of our scientific achievements this year. Thus, we invite you to consult the various sections of this report to learn more about our scientific activities.

Finally, we would like to thank the donors of biological products who have taken part in our various projects, without whom many of these achievements would have never taken shape.

Enjoy the read!



Nathalie Fagnan, CPA, IAS.A, FCPA
President and Chief Executive Officer



Marc Germain, MD, PhD, FRCPC
Vice-President, Medical Affairs and Innovation

“Our close collaborations with our partners within the healthcare system enable the conduct of innovative research projects that benefit Québec patients.”

Nancy Robitaille, MD, FRCPC
Vice-President, Transfusion Medicine

“Our scientific teams are committed to improving and ensuring the quality of our products as well as the well-being of donors and those who receive their donations. Once again, this year has been marked by numerous achievements.”

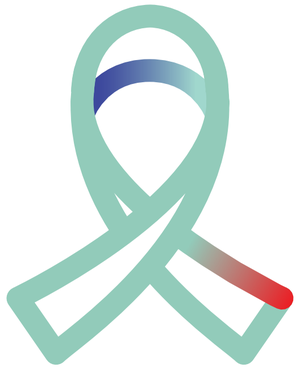
Renée Bazin, PhD
Scientific Director
Medical Affairs and Innovation

“The expertise, proactivity and agility of our scientists, coupled to the contribution of generous research donors, support Héma-Québec’s mission for the tangible benefit of the Québec population.”

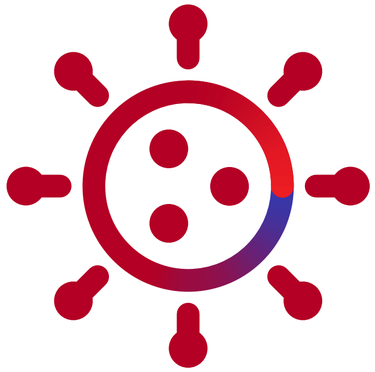
Mélanie Dieudé, PhD
Director of Research Operations
Medical Affairs and Innovation

HIGHLIGHTS

In response to a patient's urgent need, Héma-Québec rapidly developed a screening method to assess the expression of CD36 on the surface of HLA-typed platelets.



An analysis conducted by Héma-Québec revealed that the risk of tuberculosis transmission through tissue transplantation was very low in Québec, showing the adequacy of current eligibility criteria.



Our organization has evaluated a pathogen inactivation technology that, once implemented, could alleviate—or even eliminate—some exclusion criteria for blood donation.

OVERVIEW OF OUR TEAMS

Several of our teams use their knowledge to drive forward Héma-Québec's scientific activities.

Vice-présidence aux affaires médicales et à l'innovation
Marc Germain, MD, PhD, FRCPC

Direction médicale, microbiologie et épidémiologie
Christian Renaud, MD, MSc, FRCPC

Direction médicale, donneurs et receveurs
Sylvie Lachance, MD, FRCPC, DRCPC

Direction de l'exploitation des tissus humains
Étienne Fissette, BSc, MBA

Direction scientifique
Renée Bazin, PhD

Direction des opérations de recherche
Mélanie Dieudé, PhD

Unité d'épidémiologie, de vigie et de gestion des risques biologiques
Antoine Lewin, PhD, MPH

Direction des services infirmiers
Isabelle Rabusseau, inf.

Vice-présidence à la médecine transfusionnelle
Nancy Robitaille, MD, FRCPC

Direction médicale, hématologie et cellules souches
Catherine Latour, MD

Direction des cellules souches
Diane Fournier, PhD

Direction des laboratoires de référence
Marie-Claire Chevrier, MSc
Sandrina Da Fonseca, PhD

Direction du partenariat clinique avec les centres hospitaliers
Marie-Hélène Robert, TM, RT

To find out more and to contact the members of our teams, see Our teams'scientific roles and responsibilities section.

Portrait

GABRIEL ANDRÉ LEIVA

Medical Laboratory Scientist at Héma-Québec's reference laboratories

For almost five years now, Héma-Québec has been privileged to rely on Gabriel's expertise as a scientist in the medical laboratory. Before joining Héma-Québec, he honed his unparalleled skills in immunology and human genetics, an invaluable asset to our organization.

In his current role, he serves as a consultant in erythrocyte genotyping to optimize the services offered by Héma-Québec's reference laboratories.

“This essential work relies on close collaboration between experts with diverse backgrounds, whether in technical, clinical, or research fields. It is gratifying to see that our efforts improve patients’ health.”

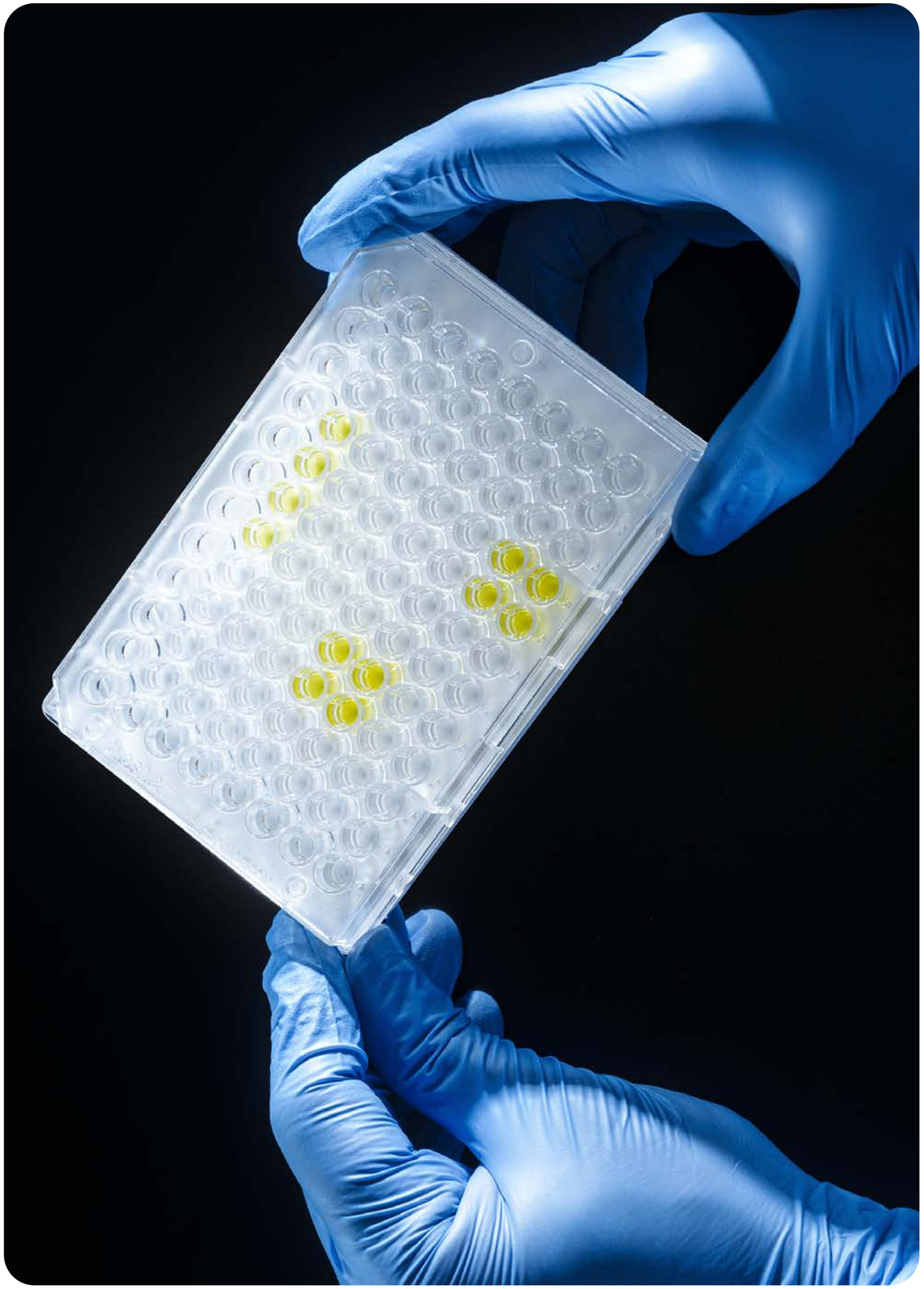
Specifically, Gabriel analyzes complex transfusion cases and assists our partner hospital teams in selecting or identifying the most suitable product for patients. He also helps laboratories implement and keep pace with new medical technologies.

The analysis of blood groups and their genetics using state-of-the-art tools ensures patients’ access to the blood products that are best suited to them.

Gabriel’s expertise also raises our organization’s profile internationally, notably through his involvement in a working group of the International Society of Blood Transfusion (ISBT). Héma-Québec is fortunate to rely on a seasoned scientist such as Gabriel!

HEALTH OF QUÉBEC'S POPULATION

Héma-Québec's research and development initiatives contribute concretely to the health of our citizens. Many of the projects undertaken in 2024 have indeed improved the health of the Québec population.



BLOOD PRODUCTS

A new analytical approach unveils the epidemiology of COVID-19 in Québec

Héma-Québec introduced a new analytical approach ("ratio-based approach") in 2023 so as to improve antibody detection against SARS-CoV-2 among vaccinated subjects. Two research projects conducted in 2024 drew on this approach.

The first tested this approach by assessing the sensitivity of four immunoassays (including three commercial assays) in two ways: the so-called "conventional" approach and the "ratio-based" approach. Ultimately, the ratio-based approach

significantly enhanced the performance of all four tests evaluated, demonstrating its usefulness in seroprevalence investigations in vaccinated populations. The results of this study were published in the journal *Vox Sanguinis*.

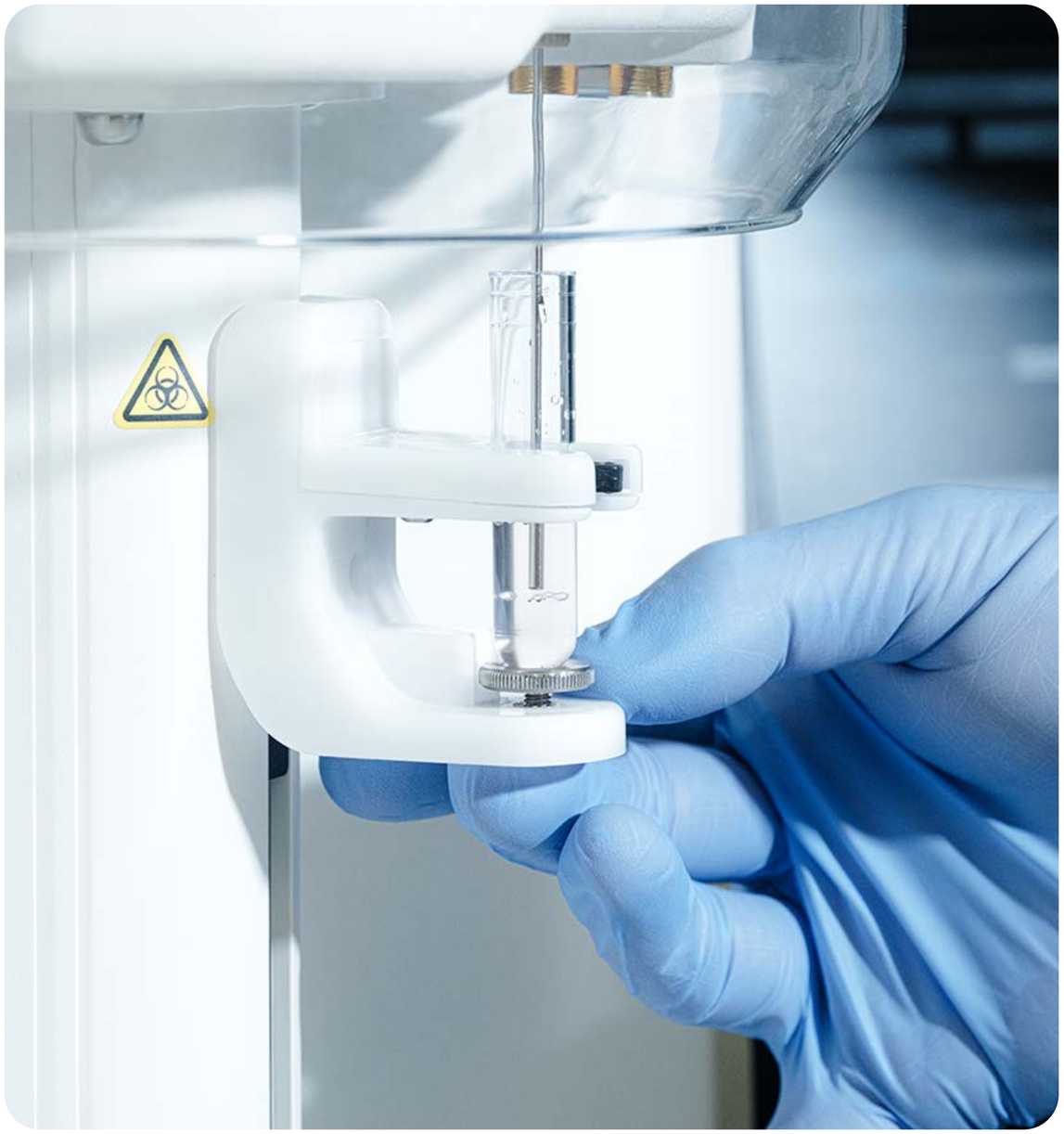
The second used the ratio-based approach to estimate SARS-CoV-2 incidence among plasma donors tested during the Omicron wave. The results of this study, published in the *Canadian Journal of Public Health*, indicate that nearly 90% of Québec's population contracted SARS-CoV-2 during the Omicron wave.

BLOOD PRODUCTS

An innovation from Héma-Québec in the face of a medical emergency

Héma-Québec's reference laboratories occasionally encounter urgent situations. Patients, for example, may have an urgent need for platelets of a particularly rare nature, for which no specific characterization tests are readily available.

A recent emergency of this kind required the rapid development of a new method. Specifically, our teams developed a screening method based on flow cytometry to identify donors whose platelets do not express CD36 (GP1V). The new test could also be leveraged for the creation of a bank of donors with this unusual characteristic. This achievement highlights the know-how of Héma-Québec's research teams in managing medical emergencies.



BLOOD PRODUCTS

Red blood cell and hematopoietic stem cell needs of patients with sickle cell disease

Patients with sickle cell disease often receive blood transfusions to cope with their symptoms, and some are even referred for hematopoietic stem cell (HSC) transplants. Nevertheless, these patients frequently develop antibodies (“alloimmunization”) directed against red blood cells, which hinders the identification of compatible red blood cells in hospital blood banks and may render access to HSC transplantation problematic.

Two Héma-Québec studies have shed light on these patients’ needs.

The first one, published in the journal *Transfusion*, evaluated how Rh genotype and alloimmunization influence the inventory of compatible blood units in children with sickle cell disease. The study concluded that Héma-Québec’s current inventory adequately addresses the genetic diversity of the Rh locus. Yet the current inventory might be inadequate to meet urgent transfusion needs for incompatibilities involving other blood groups or considering the expanded phenotype. Héma-Québec must therefore pursue its recruitment efforts among the black communities.

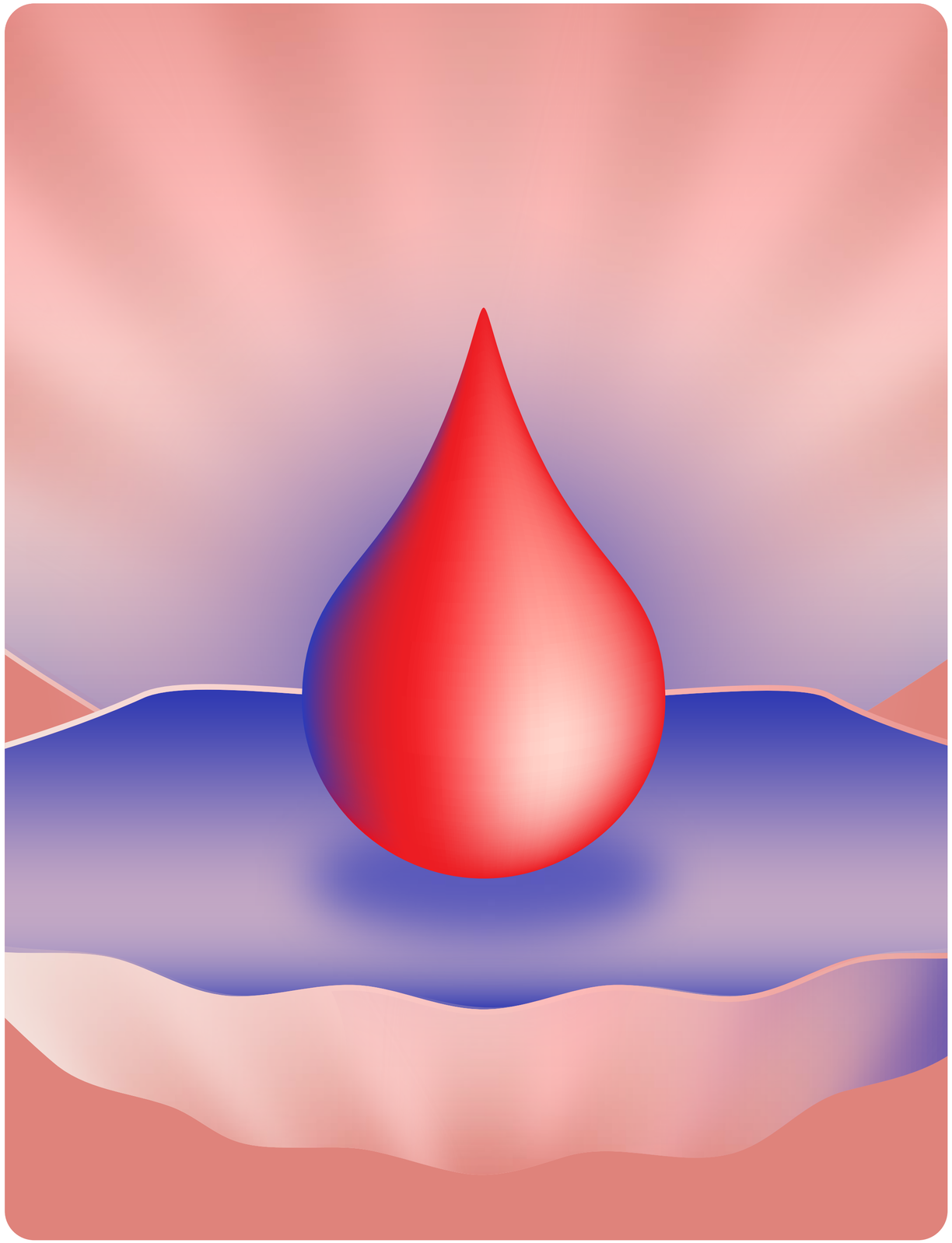
The second, also published in *Transfusion*, described the case of a child who underwent haploidentical transplantation in the presence of a severe form of sickle cell disease, several alloantibodies and a hyperhemolysis syndrome. This patient did not show any transfusion reaction after receiving seven units of red blood cells from two genotyped donors, and his hemoglobin levels remained stable six months after transplantation. This case underlines the need for proactive management and donor genotyping to achieve donor-recipient compatibility.

BLOOD PRODUCTS

Planning maternal blood donations for neonatal cardiac surgery in the absence of compatible products

A fetus was in need of neonatal cardiac surgery due to transposition of the great arteries. His mother, however, had rare blood (i.e., homozygous for the RN haplotype; with anti-Sec, anti-c and anti-e) and was alloimmunized. Sadly, no compatible blood units could be sourced for the surgery. In addition, the mother carried the sickle cell trait, which rendered it difficult to freeze her blood.

In light of this situation, the mother donated blood units during and after her pregnancy to meet her newborn's transfusion needs. This case, published in the journal *Transfusion*, emphasizes the challenges of managing donations of rare blood, including the risks of leukodepletion failure, gelation during deglycerolization, and inventory management to meet perinatal and surgical needs.



MOTHER'S MILK

Mother's milk expression habits: a survey of Héma-Québec donors

Mother's milk expression habits shape its composition. Hindmilk, expressed three minutes after the start of expression, could be advantageous for premature babies thanks to its high fat and calorie content. The purpose of this survey, conducted in collaboration with the Centre hospitalier universitaire Sainte-Justine, aimed at assessing Héma-Québec's donor milk expression habits.

The survey revealed that milk expression habits varied from one donor to another. Only 12% of donors donated their hindmilk to Héma-Québec's mother's milk bank. Nevertheless, a majority would agree to change their habits to help more fragile babies. The survey results were published in the journal *Breastfeeding Medicine*.

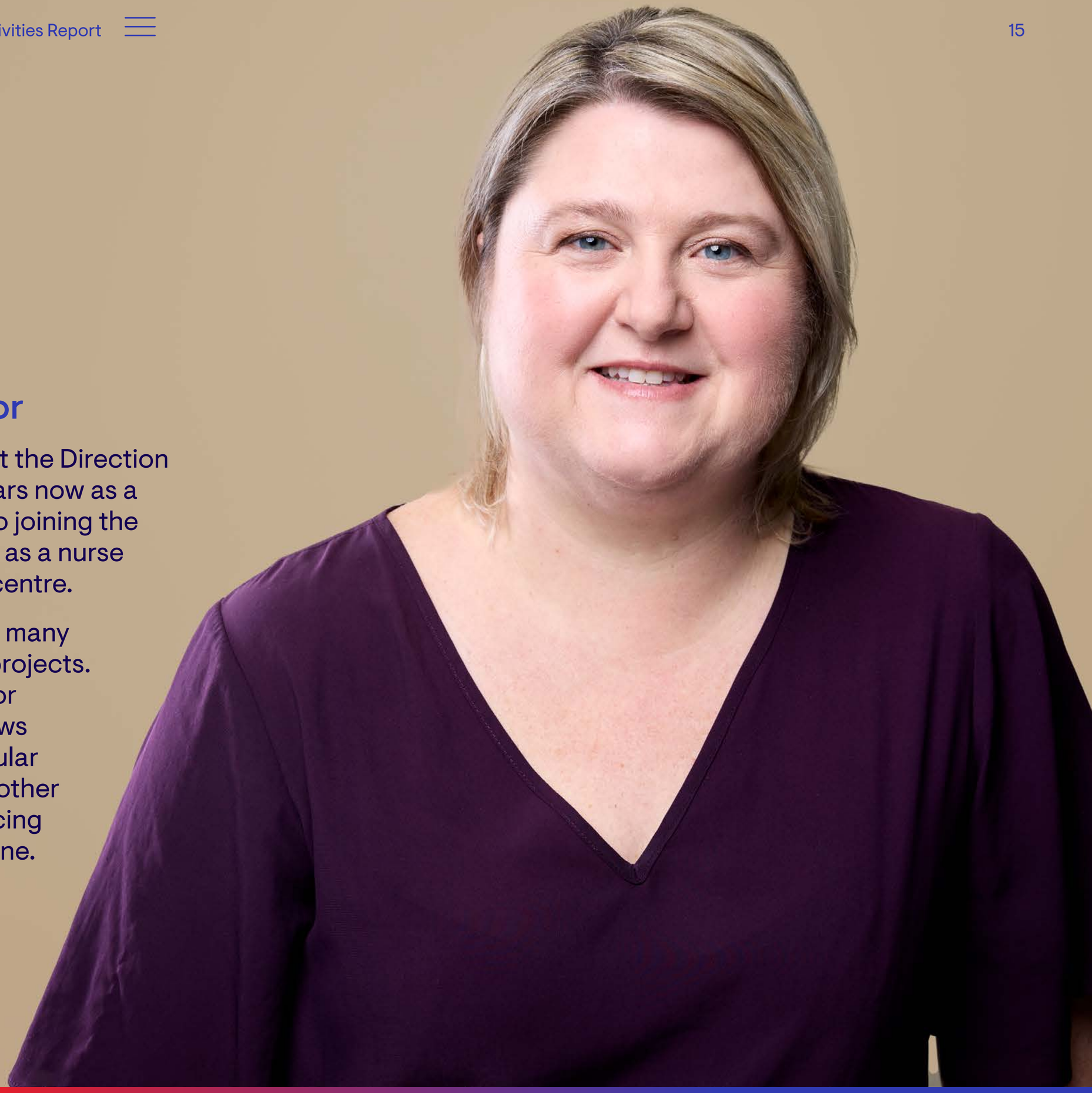
Portrait

MARIE-ÈVE ALLARD

Collection Coordinator

Marie-Ève has been working at the Direction de la recherche (DR) for 12 years now as a collection coordinator. Prior to joining the DR, she spent almost six years as a nurse at a Héma-Québec donation centre.

Marie-Ève's expertise is key to many of Héma-Québec's research projects. She coordinates the Donors for Research program, which allows people—eligible or not for regular donation—to participate in another equally important way: advancing research in transfusion medicine.



Marie-Ève also contributes to reviewing research ethics consents, planning collections, monitoring file compliance, and recruiting donors and collecting their blood.

Under her guidance, the research donations program has expanded tremendously, with the number of donations more than tripling since 2013. Our organization acknowledges Marie-Ève's important contribution; her expertise and dedication towards our mission are remarkable.

Working in the DR entails teamwork and collaboration across several sectors. Everybody's experience and expertise are harnessed for the same purpose: to support operations and participate in innovative projects.

"I am proud to coordinate research donations and make sure that our donors enjoy their experience; they are crucial to the conduct of many projects."

INNOVATION

Héma-Québec offers innovative solutions to transfusion medicine challenges. The year 2024 was marked by a host of innovations.

BLOOD PRODUCTS

Introduction and assessment of INTERCEPT™ in Héma-Québec's operations: Testing and outlook

Pathogen inactivation technology (PIT) minimizes the risk of transfusion-transmitted infections, and could eventually alleviate—or even eliminate—certain exclusion criteria for blood donations. Health Canada recently approved the use of a PIT called INTERCEPT™ and the additive solution SSP+ for platelet concentrates collected by apheresis. In view of the considerable advantages this technology brings, Héma-Québec plans to implement PIT over the next few years.

The first phase of this project consisted in confirming the compatibility of INTERCEPT™ with platelet concentrates collected by apheresis.

This phase showed that INTERCEPT™-treated platelets complied with the manufacturer's specifications as well as with the Canadian Standards Association guidelines throughout storage.

Rigorous monitoring of collection, processing and illumination parameters were vital to optimizing the number of eligible units within standards. Productivity can be further maximized by controlling yields and settings on the Trima Accel® instrument.

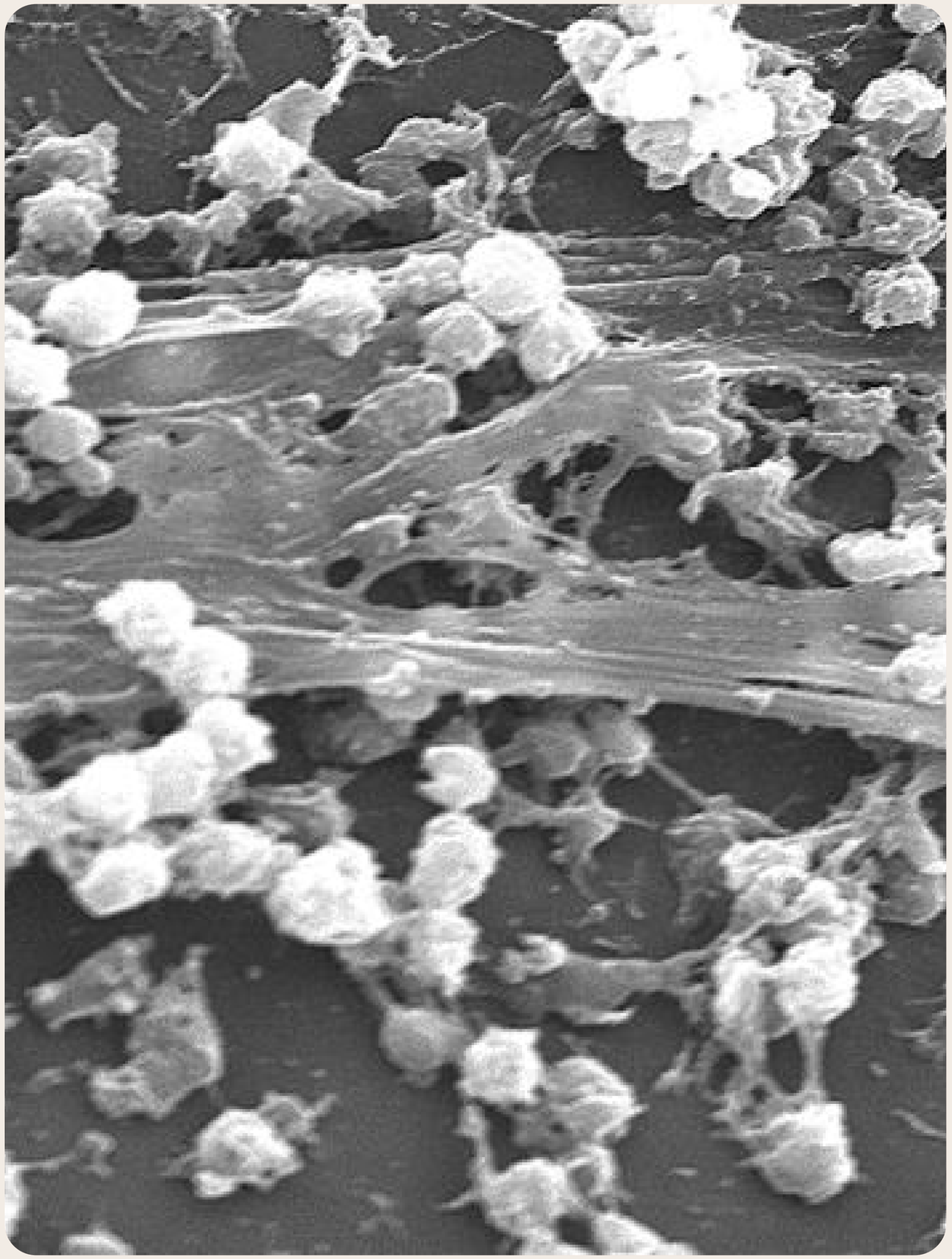
Promising results paved the way for the second phase of the project, namely validation of the process efficacy with a view to technology transfer. Double and single donations of apheresis platelets were collected. Double donations were used to determine treatment effectiveness on Day 0 and Day 1, with and without INTERCEPT™. Single donations were all treated with INTERCEPT™.

BLOOD PRODUCTS

Synthesis and antibacterial properties of polydopamine coatings to prevent blood-borne infections

Platelet concentrates are particularly susceptible to bacterial contamination, mainly because of their storage at room temperature. Such contaminations can elude screening tests when they proliferate as bacterial biofilms on the surface of storage bags (among other reasons). While rare, these cases can provoke serious infections in patients who receive blood products. These infections could be prevented by antibacterial coatings applied inside storage bags or on the medical devices' surface.

Our teams and those of Université Laval have assessed the cytotoxicity (<6%) and antibacterial properties (>90%–99% bacterial reduction) of such polydopamine coatings. Finally, rougher and thicker coatings proved especially effective. A polydopamine coating could thus prevent bacterial infections acquired by transfusion. Nevertheless, its antibacterial properties must be optimized according to the nature of the bacteria and the considered applications. This study was published in the journal *Next Materials*.



BLOOD PRODUCTS

Growth of biofilms in blood products

Bacterial biofilms are a significant issue for blood products' safety, notably platelet concentrates. In fact, this type of contamination is more likely to elude systematic screening tests and may lead to recipient infections.

This project aimed to study the growth of *Staphylococcus epidermidis* and the storage conditions leading to the formation of biofilms in platelet concentrate bags.

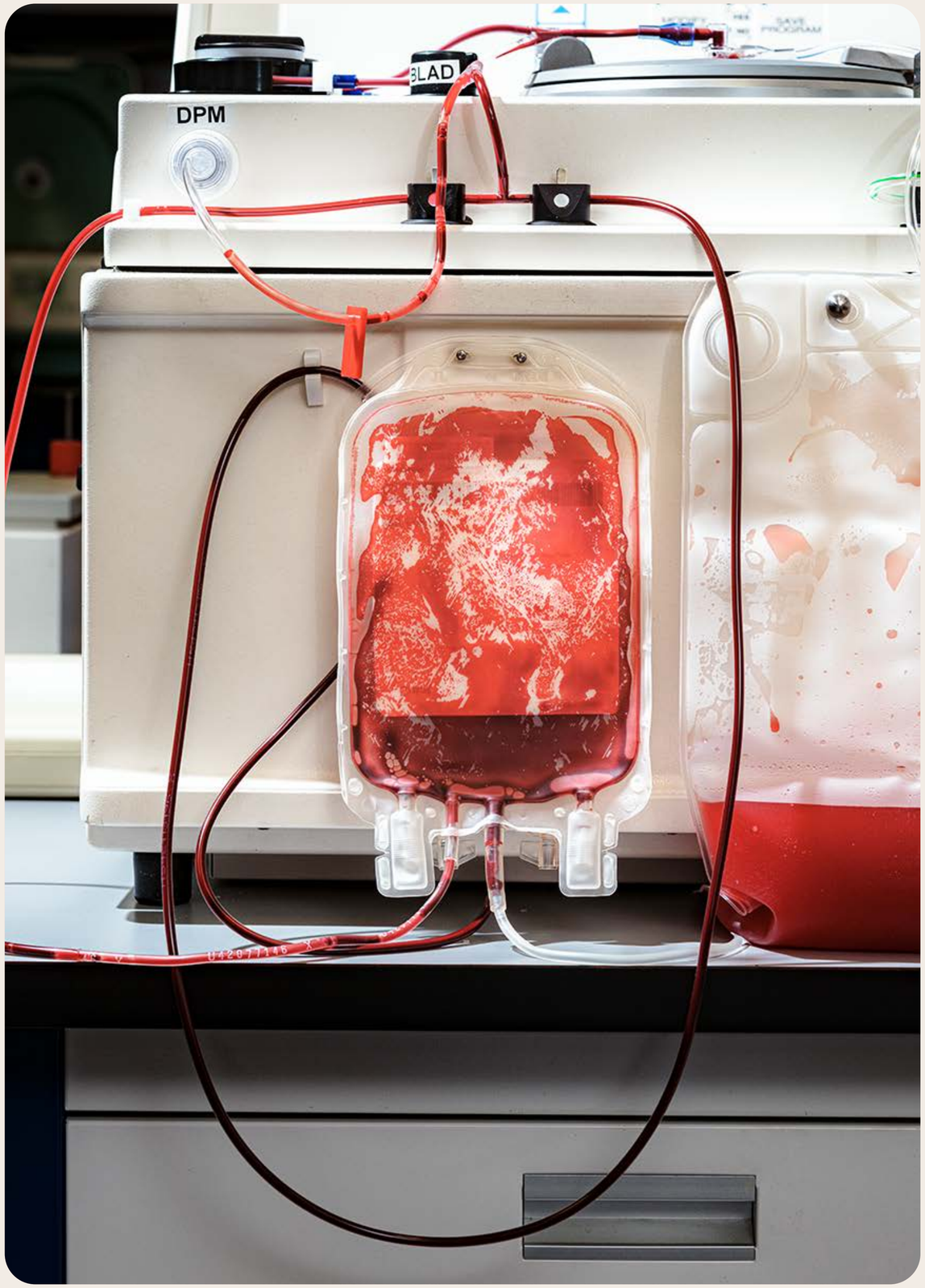
The results indicated that platelets and physical properties of polymeric materials may lead to the formation of bacterial biofilms on the surface of storage bags for platelet concentrates.

BLOOD PRODUCTS

Optimization of a protocol for deglycerolizing cryopreserved red blood cell units using the Meryman method

The cryopreservation of red blood cells in glycerol promotes their preservation for several years, or even decades. Yet several blood banks are using a device to deglycerolize cryopreserved red blood cells with the Meryman method (i.e., the COBE® 2991), which will soon not be supported by its manufacturer anymore.

Our teams have thus established a new protocol that leveraged the ACP® 215 cell washer to deglycerolize frozen red blood cells using the Meryman method. During the optimization phase, units of red blood cells were thawed and separated into two components: with and without centrifugation to remove glycerol. Centrifugation lowered hemolysis rates and improved biochemical parameters, in compliance with Canadian standards. This optimized protocol provides a reliable option for the deglycerolization of rare blood units.



Portrait

CATHERINE THIBEAULT

Assistant Director, Medical Affairs

Catherine has joined Héma-Québec in 2020 in her capacity of Assistant Director, Medical Affairs. Prior to joining our organization, she worked in the Québec healthcare system for almost ten years as a clinical nurse, notably with recipients of stable and labile blood products. This clinical background in hemostasis and transfusion medicine is a huge asset for Héma-Québec.

In her current functions, Catherine contributes to analyzing adverse events related to blood donation and reviewing and implementing new selection criteria for blood donors. She ensures that donations are compliant with the highest safety standards. This way, she helps monitor the health of blood product donors and recipients. Her knowledge is key to Héma-Québec's mission!

Research conducted at Héma-Québec is crucial to our mission of offering safe biological products for recipients, while ensuring a positive donation experience for generous donors who put their health to work to benefit our mission.

"I am proud to contribute to projects that generate evidence which, in turn, helps optimize blood donation selection criteria while ensuring their safety and equity."

PRODUCT SAFETY AND EFFICACY, AND DONOR HEALTH

Héma-Québec consistently allocates resources to ensure that Québec's population receives safe and effective blood products. We also strive to ensure that donors get the best possible support, before, during and after their donation.

BLOOD PRODUCTS

Blood donation eligibility for men who have sex with men: Impacts since changes in criteria

Improving the inclusiveness of blood donation—particularly for sexual minorities—is a top organizational priority that rests largely on our organization's scientific activities. Two projects undertaken in 2024 contributed to reaching this objective.

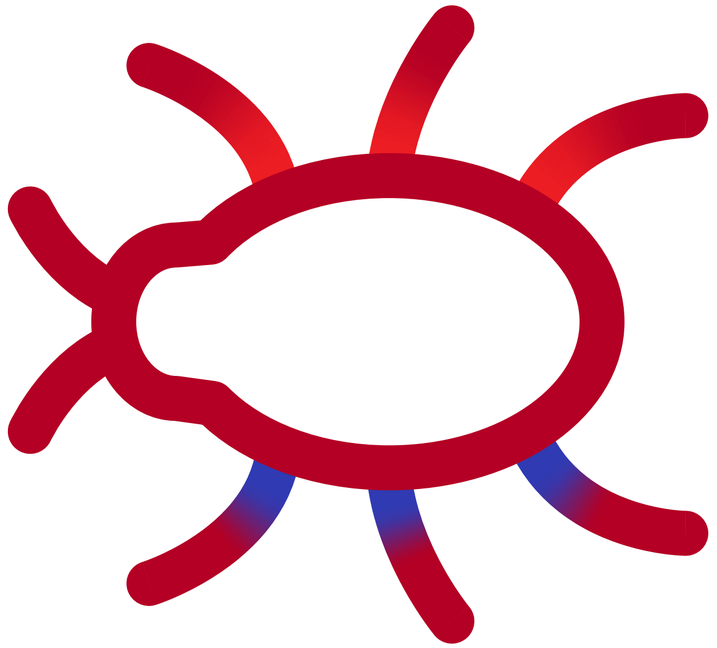
One of these two projects, published in the journal *Vox Sanguinis* and led in cooperation with the Université du Québec à Montréal, evaluated the acceptability to male and female recipients (and their parents) of a program of source plasma donation by men who have sex with men (MSM). Participating recipients and parents expressed general support for the program, viewing it as a positive and necessary change. Yet comments noted the importance of properly communicating the program to recipients and parents—notably with regard to the evidence underlying it—as this could improve its acceptability to recipients and their parents.

The other project, led in cooperation with the Canadian Blood Services, assessed human immunodeficiency virus (HIV) positivity rates since introducing the new criteria that permit many MSM to donate blood. The findings of this study, published in the journal *Transfusion*, show that HIV rates remained unchanged before and after the new criteria were introduced. These results validate the safety of the new approach which relies on an individualized assessment of risky practices and behaviours.

BLOOD PRODUCTS

Deferral of potential donors who have travelled in a region where Chagas disease is endemic: An international survey

Chagas disease (CD) is endemic to several regions in the southern part of the American continent. In non-endemic areas, many blood services test donors who have previously travelled to an endemic zone—regardless of any other known risk factors. Nevertheless, the effectiveness of this approach is still unknown.



An international survey carried out by Héma-Québec in cooperation with the International Society of Blood Transfusion (ISBT) found that a minority of blood product suppliers tested for CD donors who travelled to a high-risk area (with no other risk factors).

Furthermore, the very low number of positive tests in these donors could not justify this approach. These results were published in the journal *Vox Sanguinis*.

BLOOD PRODUCTS

Relevance of blood pressure measurements in blood donors to decrease the risk of adverse reactions

Until recently, and like most blood product suppliers, Héma-Québec measured the blood pressure of its donors before their donation. Yet this practice is not evidence-based, and preliminary data suggest that it might be unnecessary in addition to hindering donor recruitment.

Our organization therefore undertook a survey to assess risks of adverse reactions associated with non-standard blood pressure readings prior to donation.

Over 18 months, no association was observed between low pre-donation blood pressure and the risk of vasovagal reactions. Moreover, no cardiovascular complications were noted in donors with non-standard blood pressure over the period. These results support the withdrawal of blood pressure measurement prior to donation—a measure made permanent as of June 2, 2024.

BLOOD PRODUCTS

A passive basophil activation test to screen for allergic transfusion reactions

Allergic transfusion reactions (ATR) represent the most frequent adverse event following a transfusion or a stem cell transplantation. However, the cause and effect relationship between the transfused blood product and the allergic reaction is difficult to establish. A test called passive basophil activation test (pi-BAT) could detect ATRs and help determine if the transfused blood product appears to be the cause.

Héma-Québec tested the pi-BAT as part of a study undertaken in conjunction with the Biomedical Excellence for Safer Transfusion (BEST) Collaborative

Group. Findings revealed that the test was able to recognize a particular donor's plasma as responsible for ATR, four times out of five.

BLOOD PRODUSCTS

Effect of cannabis on the survival and functionality of natural killer cells

Cannabis may alter the function of immune cells, including natural killer (NK) cells. The scientific literature, however, shows a contradictory picture of this effect, hence the need for further investigation.

A study based on a laboratory model by Héma-Québec revealed that an extract of cannabis joint (ECJ) induced NK cell death. Mortality was exacerbated by oxidative stress and autophagy. In addition, NK cells exposed to ECJ killed cancer cells less effectively in culture. Based on these results, cannabis may impair the survival and functionality of NK cells.

Did you know that...

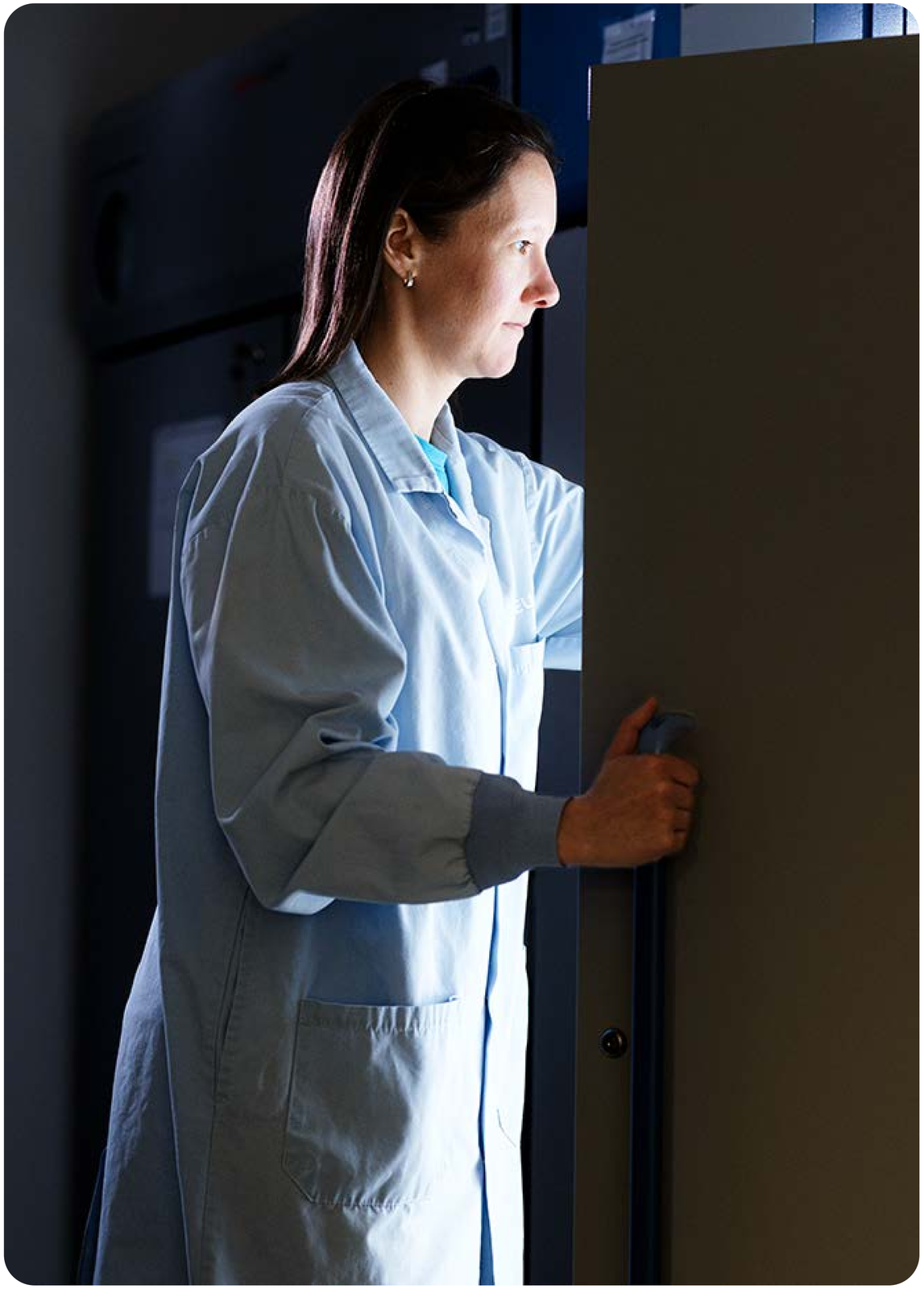
Our organization has been studying the effects of cannabis on the quality of blood products for many years. In fact, a laboratory study by Héma-Québec indicated that cannabinoids have a damaging effect on B lymphocytes, which are important cells of the immune system. Another study is currently underway to determine whether cannabis consumption prior to donation could influence blood product quality.

BLOOD PRODUCTS

Extended freezing of rare red blood cells and transient heating: Is there any effect on red blood cell quality?

For regulatory purposes, Héma-Québec's reference laboratories must defrost their freezers once a year. As a result, frozen blood units may be exposed to transient heating, potentially affecting their quality.

Héma-Québec thus analyzed red blood cells that had been glycerolized for several years—and therefore had undergone several such transient heating processes. Expired red blood cells were thawed and washed. Hemolysis levels and biochemical parameters were evaluated. Finally, only one of the 22 red blood cells analyzed failed to meet the quality criteria, but the storage time of the red blood cells correlated strongly with hemolysis levels. Furthermore, before washing the pellets, the hemolysis levels were 13 times higher than the post-deglycerolization reference value set according to operational standards. This study indicates that the vast majority of red blood cells still comply with the quality criteria established by Héma-Québec. It may, however, have underestimated the effects of heating or other events that may occur during storage. Further studies may be needed to confirm these results.



BLOOD PRODUCTS

Fibrinogen content of cryoprecipitates: An interlaboratory comparison of assay methods

The methods used by blood product suppliers to quantify fibrinogen in their cryoprecipitates vary. Such differences could be the reason for significant discrepancies (i.e. ~30%) in the fibrinogen content of cryoprecipitates produced by Héma-Québec and Canadian Blood Services (CBS).

Héma-Québec therefore carried out a study in conjunction with CBS to explore this option. Ultimately, the fibrinogen content was lower with the method derived from prothrombin time than with the Clauss method, on the same detection device. Moreover, the observed differences between the two suppliers could be replicated using cryoprecipitates prepared by Héma-Québec, thus excluding any contribution from the cryoprecipitate preparation process. Other factors not considered in this study, such as the choice of analyzer, could therefore explain discrepancies in fibrinogen content between the cryoprecipitates of Héma-Québec and CBS.

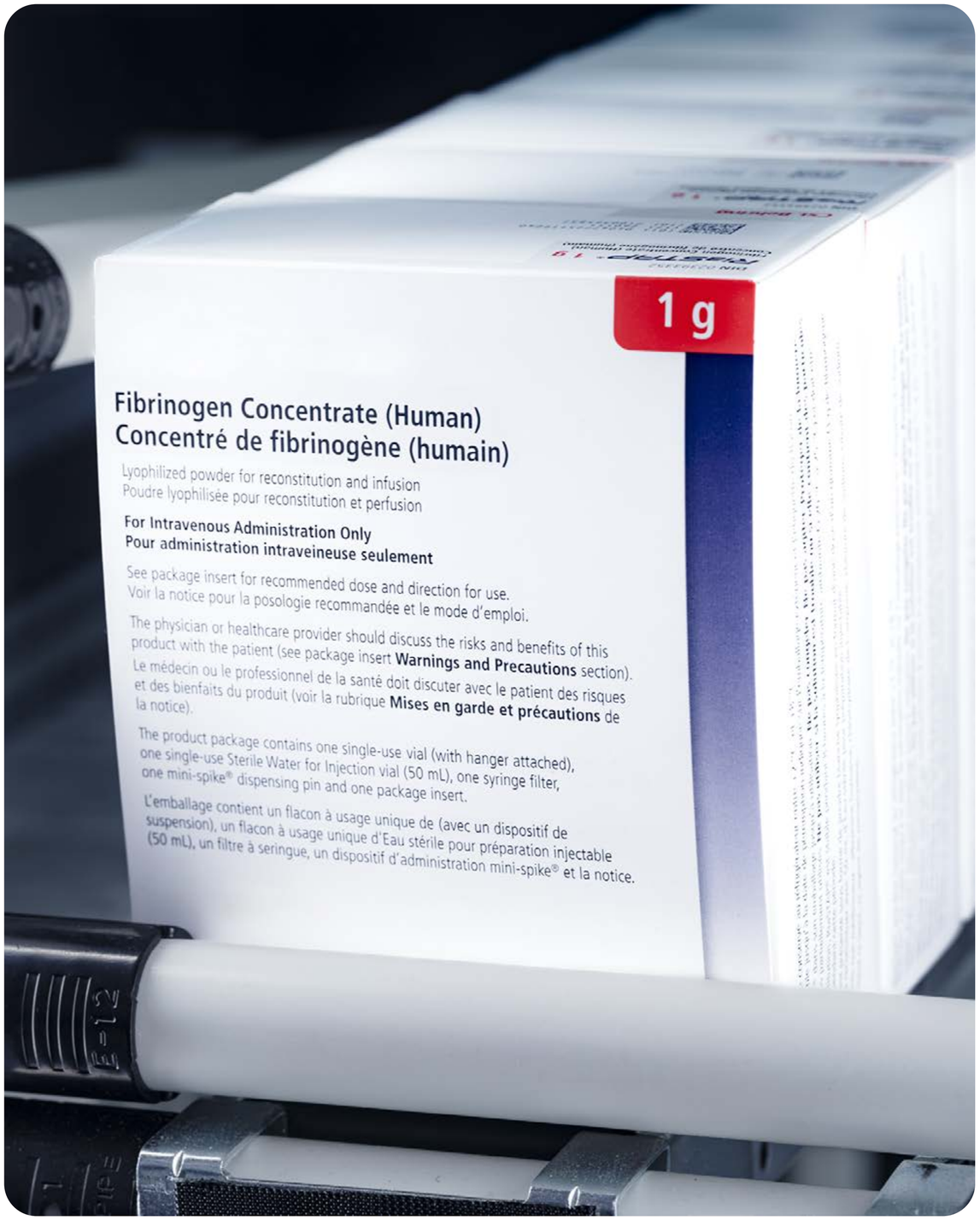
STABLE PRODUCTS

Fibrinogen concentrates: Reconstitution problems reported by hospitals

Fibrinogen concentrate is a promising alternative to cryoprecipitate. Yet many hospitals have encountered problems in reconstituting this lyophilized product.

As a result, the demand for fibrinogen concentrate has diminished in favour of that for cryoprecipitates—exacerbating supply problems for this product.

Our teams thus revisited the phases to reconstitute fibrinogen concentrates and demonstrated that reconstitution was adequate when the procedure recommended by the manufacturer is duly followed. In addition, the reconstituted product offered suitable operational leeway. Such reassuring results were presented to the Transfusion Medicine Roundtable to support the use of fibrinogen concentrates in hospitals.



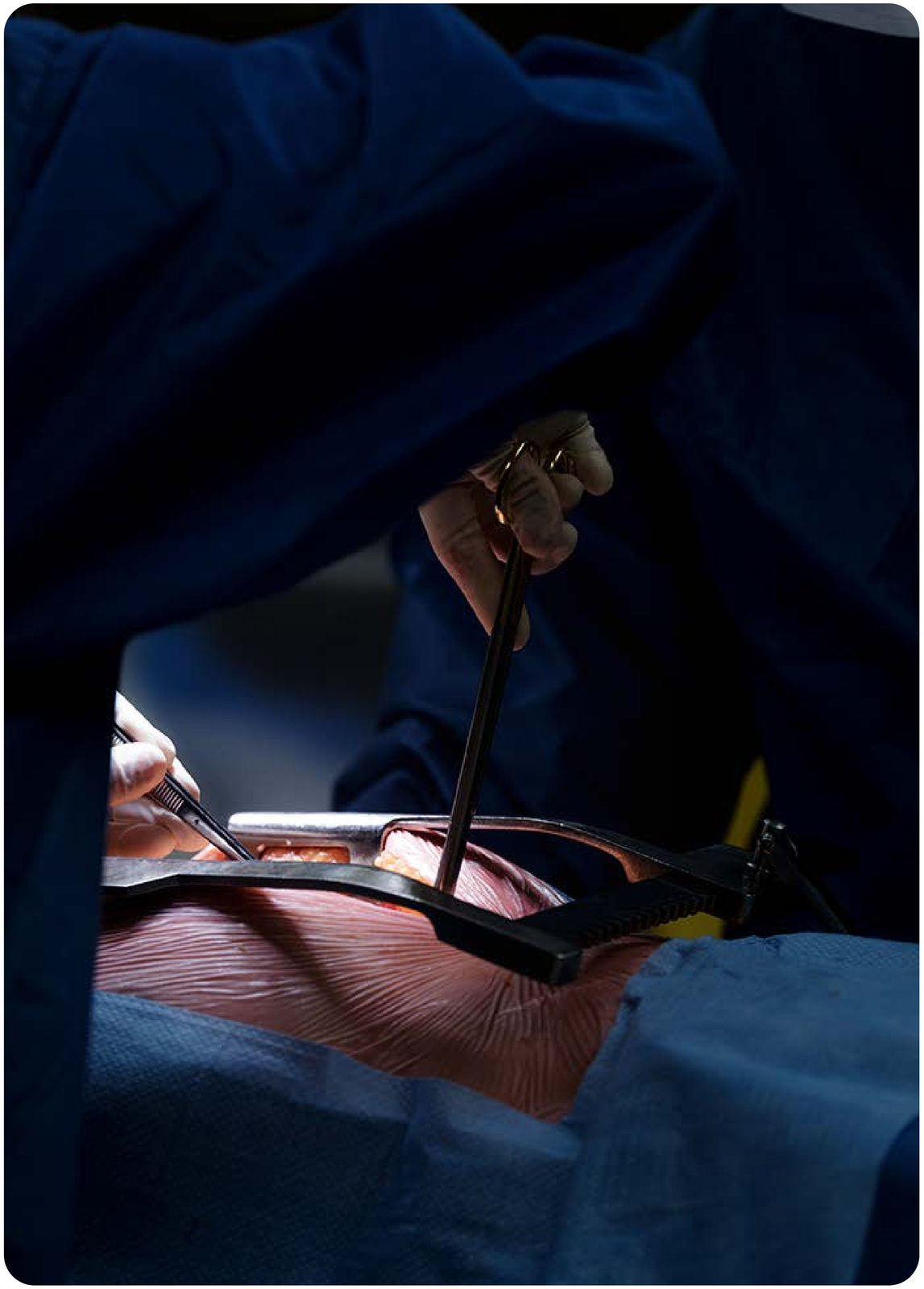
HUMAN TISSUES

Risk of tuberculosis transmission through tissue transplant

In the United States, two outbreaks of tuberculosis recently emerged among recipients of bone grafts harvested from infected donors. Such events could be prevented by more stringent selection criteria for tissue donors. Ideally, these criteria would rely on an estimate of the risk of transmission by transplantation, but this figure remains unknown.

Héma-Québec thus developed a statistical model to assess the risk of tuberculosis transmission by transplantation of skin, cardiovascular, musculoskeletal, and ocular tissues.

Ultimately, the risk proved to be very low for all the tissues analyzed and did not justify the implementation of new selection criteria, especially as the musculoskeletal tissues prepared by our organization are irradiated and therefore contain no living cells.



Portrait

CLAUDE GIROUX

Laboratory Assistant

Claude has been a research laboratory assistant for slightly more than five years. But he has no less than 26 years of service with Héma-Québec! Before joining the Direction de la recherche (DR), he was a laboratory technical assistant in the production department for 20 years. Blood product processing is no longer a secret for him!

“It is a privilege for me and my team to work in research and development. I am deeply motivated to act as a technical support to passionate research teams, all dedicated to the same mission.”

As a laboratory assistant, Claude has a huge influence on the day-to-day work of the staff of the DR. Along with the team of laboratory assistants, he looks after the maintenance, cleaning, and performance testing of the laboratory’s many equipments, and manages rolling stock, biomedical waste, shipments, and transport between different laboratories and sectors. He also serves as team leader and trainer for the auxiliary team. Claude’s expertise is a crucial cog in Héma-Québec’s scientific activities.

OPERATIONS SUPPORT

Héma-Québec undertakes a number of scientific activities related to its operations.

BLOOD PRODUCTS

Implementation of the VIP-PE-PCM5 thermoregulatory system

Cold chain management guarantees the quality of blood products and is especially vital when blood drives are held at sites far from processing centres.

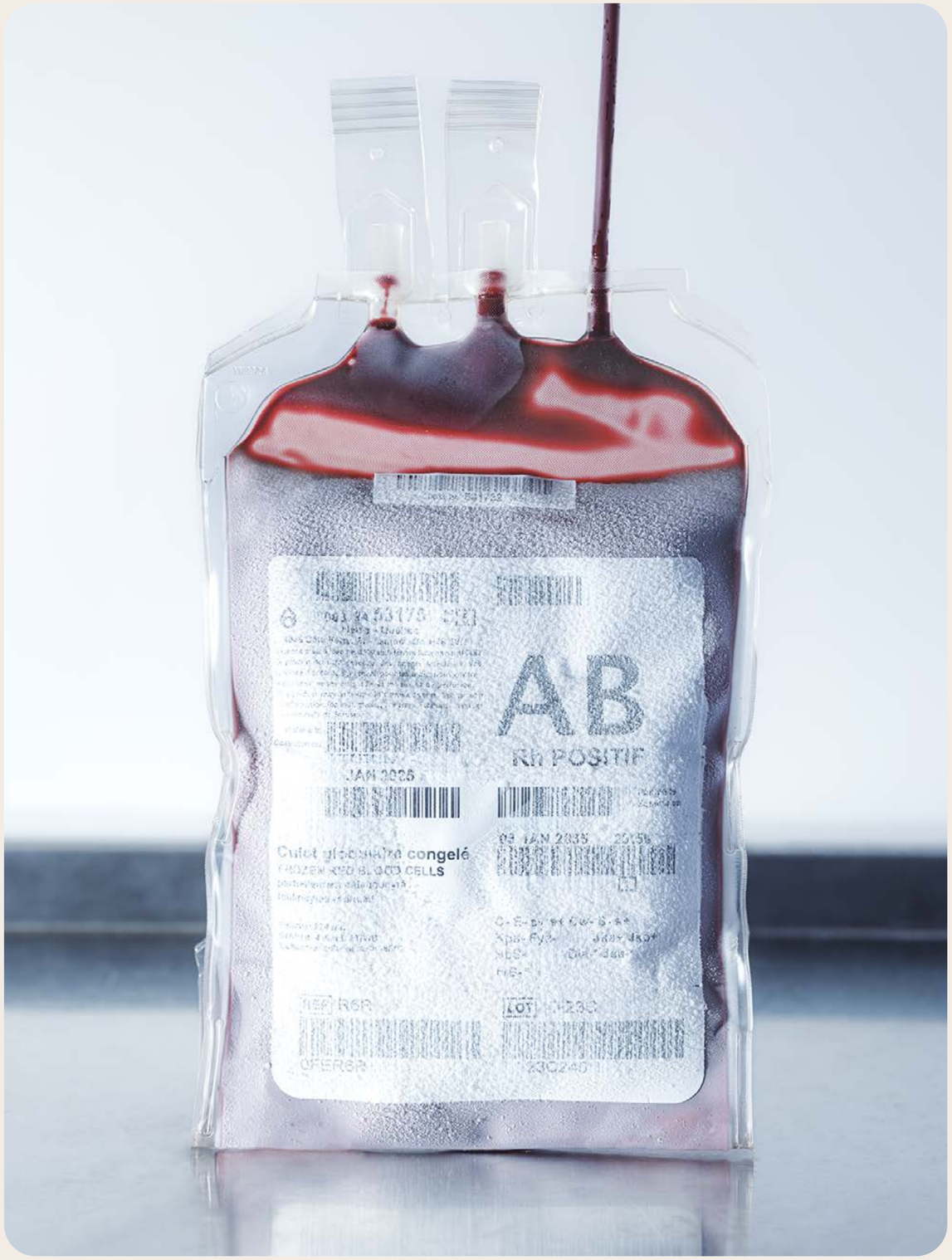
This project focused on the implementation of a thermoregulatory system adapted to blood donation transportation. Our teams have developed a thermoregulatory system that works for two-day blood drives, ensuring adequate cooling and enabling four blood donations to be stored for almost 24 hours. This system, used in day-to-day operations since the summer of 2024, allows to comply with regulatory requirements.

BLOOD PRODUCTS

Establishment of a red cell freezing protocol with a modified device

Héma-Québec's device for freezing red blood cells used as laboratory reagents ("erythrocytes") is no longer on the market and needs replacing. Moreover, the proposed new device does not feature a drop-by-drop system, thus raising the problem of glycerol circulation.

This project was designed to develop a new process for freezing erythrocytes using the modified device, while ensuring their continued quality. Three donors provided blood which was then processed and glycerolized using a set-up built around available components. Tests carried out showed that this set-up enabled glycerolization without glycerol returning to the bottle, and that glycerolized erythrocytes kept a reactivity equivalent to that of fresh samples in identifying their phenotypes. This set-up, which is simple and benefits from available products, effectively glycerolizes red blood cells without compromising their quality.



BLOOD PRODUCTS

Impact of the glycerolization of packed red blood cells stored for up to 21 days

Héma-Québec currently uses an ACP® 215 device to glycerolize its packed red blood cells (pRBCs; i.e., addition of glycerol for freezing). This method does not, however, enable the storage of pellets for more than seven days prior to glycerolization.

This study sought to determine the feasibility of extending the glycerolization time of rare pRBCs from 7 to 21 days. pRBCs were stored for 7, 14 or 21 days and then glycerolized with ACP® 215 before being frozen at -80°C. The pRBCs were then thawed and deglycerolized, and their quality parameters (i.e., hemolysis, hematocrit, hemoglobin, sterility) were tested 24 hours and 7 days after deglycerolization. Findings indicate that pRBCs meet quality standards even after 21 days of storage prior to glycerolization. This extended storage period offers greater flexibility in the management of rare pRBCs.

BLOOD PRODUCTS

Impact of numerous centrifugations of packed red blood cells prior to glycerolization

Héma-Québec centrifuges its red blood cells to compact them before glycerolization. Occasionally, though, a second or even third centrifugation is necessary. Such numerous centrifugations can affect red blood cell quality—as well as causing rejections and non-compliances when technical problems prevent adequate initial compaction.

Our teams have thus evaluated how numerous centrifugations affect the quality of rare red blood cells prior to cryopreservation with ACP® 215.

Findings revealed that red blood cells could be released for transfusion after three centrifugations, in spite of longer handling times.

Other support activities to operations

In order to meet the increasing demand for cryoprecipitates, bags of frozen plasma had to be transferred from the Montréal facility to the Québec City facility. Our teams consequently developed and assessed a packaging and transport method adapted to frozen plasma, which helped define optimal transport conditions.

Over the past year, two whole blood collection devices were reviewed to replace those used in our operations. These assessments allow Héma-Québec to come up with informed choices that meet the expectations of the sectors handling blood collection, along with the quality criteria prescribed by regulatory agencies (such as Health Canada).

Our teams undertook an operational and performance evaluation of the Aurora Xi™ plasmapheresis technology. The purpose of this evaluation was to ascertain that the equipment met qualification criteria, and fulfilled the needs of permanent centres with a view to achieving our plasma self-sufficiency targets. Some of the issues raised were solved, and the Aurora Xi™ technology will soon be used in our donation centres.

As part of the acquisition of the new NEO Iris® automated immunohematology analyzer, our organization assessed whether samples remain stable when stored for up to three days prior to analysis. Equipment usage approach and stability study protocol were also defined for implementation following the approval of Health Canada in August 2024.

Héma-Québec undertook a project to check that the labels placed on the secondary and tertiary packaging of stable products adhere to the different substrates when exposed to the products' storage conditions (i.e., room temperature, during refrigeration or freezing, and at different humidity levels). Adhesion properties were evaluated using equipment designed by our organization.

TRAINING AND KNOWLEDGE DISSEMINATION

Héma-Québec contributes to the training of the next generation of specialists in fundamental and applied research in fields related to its activities. Furthermore, our organization regularly welcomes physicians seeking to specialize in transfusion medicine. In 2024, Héma-Québec's scientific staff launched a series of training activities.

2
erythrocyte immunology trainings were offered to laboratory technicians working in hospitals' blood banks. This training is also offered online in several countries.

5
university courses were offered by Héma-Québec's researchers and physicians.

4
continuing education workshops were offered by Héma-Québec's researchers and physicians.

5
master's and PhD students are being trained at our Québec City and Montréal facilities, and 4 of them received financial support from Mitacs.

20

resident physicians in hemato-oncology were trained at the Montréal facility. Resident training has been redesigned to offer a hybrid format, reflecting feedback from previous cohorts of residents. Comments received so far indicate that this program redesign is highly valued.

1

postdoctoral researcher is conducting work at our facility thanks to funding from Mitacs.

1

fellow in transfusion medicine completed training thanks to financing from Héma-Québec's scientific training program.

Hats off!

Notably, a master's student was given travel and development grants from Cell Therapy and Transplant Canada, the ThéCell Network and the Stem Cell Network to attend two scientific conferences and undertake a one-month internship in a laboratory in British Columbia. This experience honed her scientific and technical skills, which she now applies to a research project.

CONTRIBUTIONS TO EXTERNAL STUDIES

Besides managing research projects, Héma-Québec strives to contribute to projects conducted by external collaborators.

In 2024, these collaborations resulted in the publication of 28 studies, including 8 studies on blood-borne diseases and 4 on immunity to SARS-CoV-2.

In addition, Héma-Québec contributes to external projects by providing research teams with unused biological material collected during blood product donations (e.g., leukocytes in leukoreduction cones). In 2024, 11 research teams across Québec took advantage of this material, further enriching the value of our donors' blood products.

Call to collaboration

If you are interested in collaborating with our scientific teams, we invite you to contact the manager of the appropriate sector, whose contact details are listed in the **Our teams' roles and responsibilities** section.

OUTREACH

Knowledge developed by Héma-Québec's scientific staff are shared with the community. In addition, this contribution testifies to its expertise in the field of life sciences.

47
articles published in peer-reviewed scientific journals

22
conferences as guest speakers

6
oral presentations at congresses

1
book chapter

48
poster presentations at congresses

Publications

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Book chapter

Zabeida A, Robitaille N. SickKids Handbook of Pediatric Thrombosis and Hemostasis. 3rd, revised and extended edition Appendix III- Common Products Used to Manage Disorders of Hemostasis and Thrombosis. 2024; doi: 10.1159/000538210.

Journée de la recherche 2024: an opportunity to celebrate Héma-Québec's scientific wisdom

The Direction de la recherche (Vice-présidence aux affaires médicales et à l'innovation) and its close collaborators gathered in Montréal in November 2024 for the Journée de la Recherche, to share the scientific advances completed in 2024 with representatives of all sectors of the organization.

CONTRIBUTIONS TO SCIENTIFIC GROUPS

Héma-Québec's scientific staff is involved in a number of scientific groups, many of which are international in scope.

Association for the Advancement of Blood & Biotherapies (AABB)

The AABB is an international non-profit association of individuals and institutions specializing in transfusion medicine and biotherapies. Its mission is to improve the safety, accessibility and efficacy of transfusion medicine and biotherapies worldwide. In 2024, Héma-Québec was involved in the AABB by acting as an expert on the Standards Program Committee and on a sub-committee exploring the effects of the withdrawal of the COBE® 2991 device on blood banking activities.

Biomedical Excellence for Safer Transfusion (BEST) Collaborative

The BEST Collaborative is an international group of blood product providers and academic and industry specialists, of which Héma-Québec is a member. It conducts research and makes recommendations on operational and clinical practices in transfusion medicine and cellular therapy. Héma-Québec participates in BEST activities by proposing new projects or by participating in projects proposed by other working group members. Our organization was involved in 11 BEST projects at the end of 2024.

European Milk Bank Association (EMBA)

This association brings together mother's milk banks with the aim of promoting mother's milk donation in Europe and encouraging collaboration between European banks. Our organization is a member of the EMBA Donor Human Milk Processing Group and contributes to the evaluation of new technologies related to the quality and safety of mother's milk.

International Society of Blood Transfusion (ISBT)

The ISBT promotes the sharing of knowledge in transfusion medicine and provides professionals in this field with educational resources to optimize their clinical practice. Héma-Québec considers itself privileged to be able to help the ISBT by being involved in several working groups, including the one on infectious agents transmissible by transfusion, the one on pediatric transfusion, and the one on red cell genotyping.

International Society for Research in Human Milk and Lactation (ISRHML)

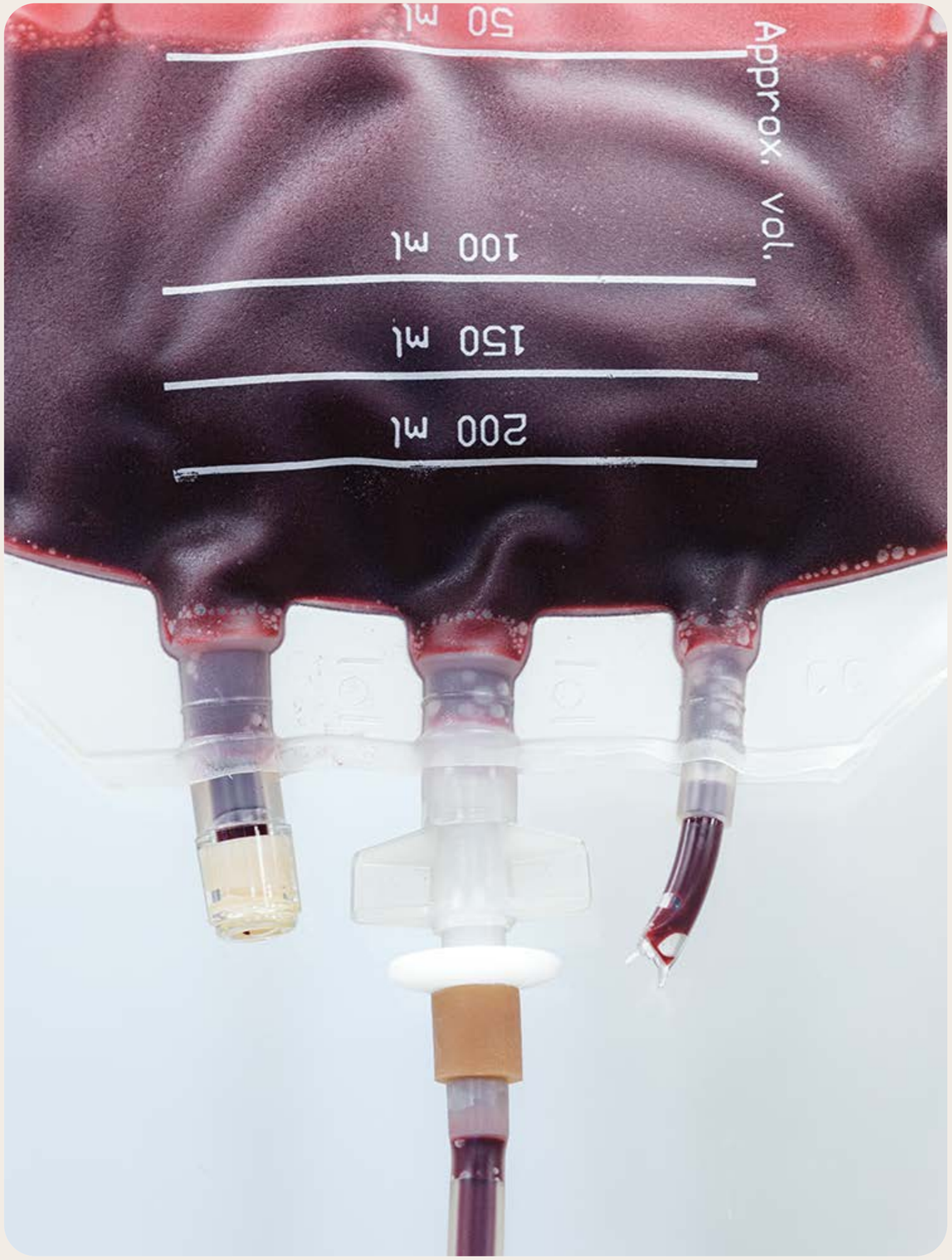
The ISRHML is a non-profit organization that promotes excellence in research and the dissemination of research findings on human milk and lactation. Héma-Québec is a member of ISRHML and participates in various committees to exchange ideas with other professionals working in the field of mother's milk and lactation research.

Canadian Society for Transfusion Medicine (CSTM)

The Canadian Society for Transfusion Medicine promotes excellence in transfusion medicine in Canada. More specifically, it promotes the adoption of safe practices, guides hospital transfusion services to help them adopt best practices, creates opportunities for research and education in transfusion medicine, and encourages regional, national, and international collaborations. Héma-Québec is involved in the CSTM's Board of Directors and committees responsible for the scientific organization of annual meetings.

World Marrow Donor Association (WMDA)

The WMDA is a non-profit organization whose mission is to ensure a reliable supply of hematopoietic stem cells. The WMDA brings together registries, cord blood banks, donation centres, HLA experts, researchers, and technologists working throughout the world. In doing so, this organization greatly facilitates the identification of compatible donations of high quality. Héma-Québec is involved in the WMDA's SPEAR committee and the organization of the 2025 edition of the WMDA's international donor registry conference to be held in Québec City.



RESEARCH PARTNERS

Year after year, Héma-Québec associates with several partners to perform scientific studies.

Association professionnelle des chargés de sécurité transfusionnelle du Québec (APCSTQ)

The APCSTQ brings together Québec's transfusion safety officers whose work is vital to maintaining the highest standards of quality and improving transfusion practices. Héma-Québec is collaborating with the APCSTQ to prepare various deliverables for transfusion safety officers, among others.

Centre de recherche du Centre hospitalier Universitaire de Québec – Université Laval (CRCHU de Québec-UL)

This network includes five hospital centres, as well as the CRCHU de Québec-UL, which stands out for the quality and originality of its fundamental, translational, and clinical research teams. This centre collaborates with our organization on genome-editing projects.

Centre de recherche du Centre hospitalier de l'Université de Montréal (CRCHUM)

The CRCHUM is a research centre that brings together experienced scientists working in various fields associated with health improvement and covering a broad spectrum, from basic to clinical research. Héma-Québec is privileged to be able to count on the expertise of researchers affiliated with this centre.

Centre hospitalier universitaire de Sherbrooke (CHUS)

The CHUS provides health care to the population that meets the highest standards and is a leader in medical research. Héma-Québec collaborates with the CHUS in the production of reference documents for professionals working in transfusion medicine.

Centre hospitalier universitaire Sainte-Justine (CHU Sainte-Justine)

The CHU Sainte-Justine is a health institution that—in addition to fulfilling its mission to provide care to Québec children, adolescents and mothers—is home to top-level research activities. Our organization is frequently involved in research partnerships with the CHU Sainte-Justine for innovative research projects, such as the one on milk expression patterns of donors to Héma-Québec's mother's milk bank (page 14).

Fondation Émergence

The Fondation Émergence is a non-profit organization whose mission is to educate, inform and raise awareness among the population on the plurality of gender identities and expressions and the realities of persons who see themselves in the sexual diversity. This organization has played an important role in several research projects aimed at making blood donation more inclusive.

Institut national de santé publique du Québec (INSPQ)

The INSPQ is a centre of expertise in public health whose mission is to advance knowledge and formulate strategies aimed at improving the health and wellbeing of the Québec population. Héma-Québec is privileged to be able to count on the expertise of the INSPQ, notably in the context of a seroprevalence study of SARS-CoV-2 during the Omicron wave (page 10).

Ordre professionnel des technologistes médicaux du Québec (OPTMQ)

The OPTMQ aims to protect the public by ensuring that its members provide quality medical laboratory services. Héma-Québec is collaborating with the OPTMQ to prepare various deliverables intended for medical technologists, among others.

Ministère de la Santé et des Services sociaux (MSSS)

The MSSS provides healthcare and social services to the Québec population to improve citizens' health and wellbeing. In collaboration with Héma-Québec, the MSSS has contributed to advances in our

understanding of SARS-CoV-2 by providing data on COVID-19 vaccination rates in Québec. Furthermore, the recent creation of Santé Québec needs to be stressed. Héma-Québec will ensure to collaborate with this new entity, which will undoubtedly play a crucial role in the healthcare network.

Réseau de thérapie cellulaire, tissulaire et génique du Québec (ThéCell)

The ThéCell Network brings together more than 140 researchers (including several from Héma-Québec) and aims to promote potential cell, tissue, and gene therapies developed by Québec universities. The ThéCell Network mobilizes and coordinates the players working in these fields to carry out clinical studies and make these new therapies accessible to Québec patients. Our organization is grateful to be a member of this influential network and to partner with it in order to generate productive discussions with the scientific ecosystem on the future of cell therapy in Québec.

Canadian Blood Services (CBS)

CBS is Héma-Québec's counterpart and main supplier of human biological products in the rest of Canada. Héma-Québec has collaborated with CBS for a long time on numerous research projects, and 2024 was no exception: in collaboration with CBS, Héma-Québec evaluated the positivity rate of donations to the human immunodeficiency virus since the implementation of new criteria that allow many MSM to donate blood (page 24), as well as conducting a study on fibrinogen assay methods (page 29).

Université de Montréal (UdeM)

The UdeM ranks as a first-class academic institution in Canada and the world, notably due to the quality of its research activities. Héma-Québec considers itself privileged to have been able to count on the many partners affiliated with this institution, particularly in the fields of analytical chemistry, physical chemistry, and public health.

Université Laval

This university is a leading research centre in Canada and the world. The scientists affiliated with the Université Laval were partners of choice in a number of research projects, notably to evaluate an antibacterial coating made from polydopamine (page 19) and to study the formation of bacterial biofilms (page 20). In addition, several of these projects were carried out as part of graduate student training.

Université du Québec à Montréal (UQAM)

Héma-Québec was able to count on the expertise of researchers from UQAM's Department of Sexology for several projects aimed at making blood donation more inclusive of gay, bisexual and other men who have sex with men (page 24), as well as trans and non-binary people. Héma-Québec is continuing its collaboration with this team as part of its work on diversity and inclusion in blood donation.

Vitalant Research Institute (VRI)

This research institute is affiliated with Vitalant, one of the largest suppliers of blood products in the United States. VRI's mission is to advance the safety of blood products through research, education and policies based on sound data. Héma-Québec considers itself privileged to have collaborated with the VRI on numerous projects, including some COVID-19 projects still underway in 2024.

OUR TEAMS' SCIENTIFIC ROLES AND RESPONSIBILITIES

Vice-présidence aux affaires médicales et à l'innovation

Marc Germain, MD, PhD, FRCPC

Provides medical, scientific and nursing expertise, in addition to monitoring activities, which enable the offering of services and safe biological products of human origin that integrate the most recent technological advances while ensuring the development and production of human tissues.

Direction médicale, microbiologie et épidémiologie

Christian Renaud, MD, MSc, FRCPC
christian.renaud@hema-quebec.qc.ca

- Follows up suspected transfusion-transmitted infections.
- Contributes to knowledge improvement through innovative projects in microbiology and epidemiology.
- Provides expertise in risk management of biological products prepared by Héma-Québec.
- Provides medical expertise in microbiology and infectious diseases.
- Participates in the evaluation of reported transfusion reactions and donor selection criteria.

Direction médicale, donneurs et receveurs
Sylvie Lachance, MD, FRCPC, DRCPC
sylvie.lachance@hema-quebec.qc.ca

- Provides a medical expertise in hematology, cell transplantation and cell therapy.
- Participates in the determination and the revision of donor eligibility criteria for the different product lines.
- Contributes to donor and recipient safety by revising and analyzing adverse events associates with the donation, collection or administration of a blood product, cells, or a tissue.
- Contributes to knowledge improvement through innovative projects related to the donation, donor selection and safety of donors and recipients.

Direction de l'exploitation des tissus humains
Étienne Fissette, BSc, MBA
etienne.fissette@hema-quebec.qc.ca

- Is responsible for collecting, processing, qualifying, storing and distributing human tissues.
- Collaborates with the Direction de la recherche to develop new products and processing procedures for human tissues.

Direction scientifique
Renée Bazin, PhD
renee.bazin@hema-quebec.qc.ca

- Supervises and supports all scientific activities within the Vice-présidence aux affaires médicales et à l'innovation as well as those of the rest of the organization.
- Oversees the training program for the next generation of scientists.

Direction des opérations de recherche

Mélanie Dieudé, PhD
melanie.dieude@hema-quebec.qc.ca

- Contributes to improving knowledge through innovation projects in all activity sectors of the organization.
- Develops and contributes to projects in collaboration with university and industry sectors locally, nationally and internationally.
- Carries out projects aimed at developing new products, tests and processes.
- Develops and carries out projects in response to the technical or operational needs of the entire organization.
- Provides scientific expertise to all sectors of the organization.

Unité d'épidémiologie, de vigie et de gestion des risques biologiques
Antoine Lewin, PhD, MPH
antoine.lewin@hema-quebec.qc.ca

- Leads epidemiological research projects.
- Is responsible for strategic monitoring in Héma-Québec's areas of activity.
- Provides expertise in risk management of biological products prepared by Héma-Québec.
- Provides scientific, biostatistical and methodological support to the design, management, execution, analysis and publication of scientific studies and research protocols.
- Trains students in epidemiology and statistics.

Direction des services infirmiers
Isabelle Rabusseau, inf.
isabelle.rabusseau@hema-quebec.qc.ca

- Ensures that best practices are maintained and recommends the actions aimed at improving practices to preserve the safety of blood product donors and recipients.
- Participates in the knowledge development of collection staff and in the implementation of changes related to blood drives, and analyzes the effects of these changes in collaboration with other sectors of the organization.
- Evaluates and determines the eligibility of blood product, mothers' milk and stem cell donors who have a special condition.
- Supports the management and monitoring of donation-related risks and assesses transfusion-related adverse event files.

Vice-présidence à la médecine transfusionnelle

Nancy Robitaille, MD, FRCPC

Provides testing, services and specialized products in transfusion medicine and stem cell transplantation that help hospitals and our international partners provide their patients with the care they need on a timely basis, in addition to participating in the production of educational material related to transfusion medicine.

Direction médicale, hématologie et cellules souches

Catherine Latour, MD
catherine.latour@hema-quebec.qc.ca

- Supervises transfusion medicine fellows and is responsible for training days intended for resident physicians in hematology and oncology.
- Provides medical expertise in hematology and cell therapy.
- Takes part in the assessment of declared transfusion reactions and donor selection criteria.
- Helps manage rare blood cases by providing expertise in erythrocyte and platelet immunology.

Direction des cellules souches

Diane Fournier, PhD
diane.fournier@hema-quebec.qc.ca

- Manages the activities of the Stem Cell Donor Registry, including the enrollment, qualification, research, selection and support of donors.
- Ensures all the operations of the Public Cord Blood Bank, from donor enrollment to product distribution.
- Provides an autologous peripheral stem cell cryopreservation service for five hospitals.
- Manages the registration and qualification of mother’s milk donors.

Direction des laboratoires de référence
Sandrina Da Fonseca, PhD
sandrina.dafonseca@hema-quebec.qc.ca

- Conducts specialized erythrocyte, platelet and leukocyte immunology (HLA) tests for hospitals' blood banks.
- Maintains an inventory of phenotyped and frozen pellets.
- Conducts HLA tests for the Stem Cell Donor Registry, the Public Cord Blood Bank and the Platelet Registry with compatible HLA profiles.
- Selects specialized blood products that are compatible with patients.
- Is responsible for the rare blood program.

Direction du partenariat clinique avec les centres hospitaliers
Marie-Hélène Robert, TM, RT
marie-helene.robert@hema-quebec.qc.ca

- Reinforces Héma-Québec's partnership role.
- Develops a personalized client-centered approach based on the client's needs.
- Promotes and communicates the hospital's perspective on each project.

Héma-Québec

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