

# The 2022 NHLBI and OASH State of the Science in Transfusion Medicine Symposium

Virtual Workshop: August 29-30, 2022



## Sponsored by:

National Heart, Lung, and Blood Institute (NHLBI), National Institutes of Health (NIH)  
Office of the Assistant Secretary for Health (OASH), Department of Health and Human Services (DHHS)

## Executive Summary

On August 29-30, 2022, NIH's NHLBI and DHHS' OASH held a virtual [transfusion medicine workshop](#). The goal was to identify current basic, translational, and clinical key research areas, that if addressed over the next decade, would increase and diversify the volunteer blood donor pool, identify which blood products from which donors would best match the needs of specific recipient populations, and help ensure safe and effective transfusion strategies. Watch [day one](#) and [day two](#) of the videocast.

Prior to the event, six working groups met regularly to identify draft key research areas/questions to present and discuss at the workshop. Multidisciplinary experts addressed the following topics:

- Blood donors and the supply
- Optimizing transfusion outcomes for recipients
- Emerging infections
- Mechanistic aspects of components and transfusion
- New computational methods in transfusion science, such as artificial intelligence and machine learning
- Donor and recipient health disparities in transfusion medicine

Organizers asked the working groups to identify key basic and translational research areas. During the workshop, more than 400 researchers, clinicians, industry experts, government officials, community members, and patient advocates came together to discuss, refine, and summarize the draft research areas. The discussions centered around the five highest priority research areas presented by each working group and included the rationale, proposed approaches, feasibility, and research barriers.

In addition, the workshop featured three keynote speakers who discussed the state of the science in transfusion medicine, how blood donor diversity can impact transfusion product quality, and transfusion medicine research. Participants also discussed how the research topics may apply to the field of blood banking and transfusion medicine, such as:

- Biology of blood and blood components and the effect of RBC transfusion on tissue oxygenation, hemostasis, and the immune system
- The integration of discovery science with clinical practice and patient outcomes
- Applications of computational analysis on large-scale datasets, artificial intelligence, and machine-learning
- Socio-behavioral research aimed at understanding motivations and barriers to donation and strategies to ensure a robust and diverse blood donor population
- Health policy and implementation research to improve outcomes
- Expanded research in health disparities

## Major Research Questions & Key Areas of Focus

Participants identified the major research questions for each area of focus. These include:

Blood Donors and the Blood Supply: Diversifying while Maintaining the Donor Pool, Donor Selection, and Optimizing Blood Availability and Safety

- **Motivators and barriers for U.S. blood donors (initial and repeat)**
  - Are these motivators and barriers different among young adults?
  - Are they different among those from diverse backgrounds?
  - Are they different among those not represented in the donor pool?
- **Experiences from the donor perspective**
  - What is the donor experience?
  - How does it vary?
  - How does it affect subsequent donation behavior?

- **Blood donation incentive strategies**
  - What incentive strategies are most effective for encouraging blood donation (whole blood/certain blood components) among different types of donors?
  - Would providing compensation impact donor behavior and the blood supply?
- **Tailored messaging to reach diverse blood donors**
  - What are the characteristics to which messages should be tailored?
  - What content will resonate most with these audiences?
  - What channels or modalities are most effective at reaching these groups?
  - How do you best measure effectiveness?
- **Information and communication technologies to raise blood donation awareness**
  - How can these technologies help raise awareness about blood donation?
  - Can they help with blood donor recruitment and retention methods?
  - How could blood collection organizations effectively use these technologies in innovative and inclusive ways?

Optimizing Transfusion Clinical Outcomes for Recipients: Clinical Research, Randomized Clinical Trials (RCTs) and Pragmatic Trials, Patient Blood Management (PBM), and Observational Epidemiology

- **Optimal transfusion practices**
  - With no current published guidelines, how can clinicians in acute hospital settings best make red blood cell (RBC) transfusion decisions?
  - What are the best practices for using preventive platelet transfusion in patients without cancer in clinical settings?
    - Can we maximize patient benefit by reducing bleeding risk or transfusion-associated complications?
    - How do we handle critical illness, surgery, or extracorporeal support (medical support systems outside the body, such as breathing machines)?
    - Should special populations, such as children, newborns, or patients on antiplatelet therapies require different guidance?
    - How do donor and recipient characteristics affect these decisions?
      - How do you handle product storage, ABO blood type compatibility, and donor physiology?
      - How do you consider risk stratification beyond platelet count?
  - What are the effects of platelet transfusion on hemostatic and non-hemostatic processes (processes that stop bleeding and repair the damage), such as immune function, inflammation, and angiogenesis (the development of new blood vessels)?
  - What mechanisms mediate these effects in transfusion recipients of different ages (from extremely preterm newborns to older adults) and with variable underlying conditions, such as critical illnesses, compromised immune systems, cancer, or patients on extracorporeal support?
  - What are optimal transfusion strategies for outpatients who require chronic transfusion therapy?
- **Bleeding management**
  - How can we best manage bleeding?
  - What are the research areas of need?

- Comparing indications for transfusion of products, such as goal-directed therapies (e.g., viscoelastic or microfluidic flow-based assays) compared to empiric (e.g., ratio-based) strategies
- Comparing how blood component manufacturing methods affect the efficacy/safety of products used for bleeding
- Evaluating the use of hemostatic agents or other biologics (e.g., antifibrinolytics, coagulation factor concentrates)
- Considering the need for biologic data on oxygen delivery and immune, endothelial, and hemostatic function to allow for the use of multi-omics platforms. These platforms can determine endotypes (genetic predispositions) for the response to bleeding and for the biologic response to therapeutic approaches.
- Conducting implementation research to determine which methods most effectively change practice, and improve outcomes for patients with bleeding
- Pursuing methods to generate accurate clinical bleeding scores that predict bleeding risk, correlate with clinical outcomes, and are feasible and reproducible.

#### Emerging Infections: Impact on Blood Science, the Blood Supply, Blood Safety, and Public Health

- **Infections and infectious diseases**
  - How can we use blood products and derivatives, such as convalescent plasma, to treat emerging infectious diseases (EIDs)?
  - How can we leverage donor populations to study the epidemiology and pathogenesis of transfusion-transmissible infections and EIDs?
  - What are the best surveillance methods to scan for EIDs?
- **Blood safety**
  - How can we best use blood donor populations to advance epidemiological surveillance and pathogenesis research of established and EIDs?
  - How can we integrate pathogen reduction into routine blood transfusion operations to ensure blood safety from emerging pathogens while still preserving potency?
  - In terms of performance characteristics and operational efficiency, how can we adapt enhanced detection methods to predict, confirm, and evaluate an EID event as a risk to blood transfusion safety?

#### Mechanistic Aspects of Blood Components and Transfusion: Omics, Effectiveness, Quality, and Safety, Oxygen Delivery, and Therapeutics Delivery by Blood Components

- **Quality and improvement measures**
  - How can we better define blood product quality?
    - What innovative methods can assess blood product quality, including developing alternatives to current quality control measures or regulatory needs?
    - How can we better understand the mechanisms for how quality markers affect different outcomes at the molecular and functional level?
    - What novel strategies could improve quality using personalized transfusion medicine approaches?
  - Are there better ways to evaluate transfusion needs and effectiveness?

- What novel methods and strategies could assess blood product efficacy, including alternatives to the current ways we assess transfusion needs?
    - How can we better understand the mechanisms by which blood product transfusion affect relevant outcomes, such as tissue oxygenation for red cells and coagulation and bleeding risk for plasma and platelet components?
  - Can we improve the safety of noninfectious transfused blood products?
    - How can we identify compounds in transfused blood products that could lead to adverse effects in susceptible recipients?
    - How can we better understand the mechanisms by which blood products, and compounds found therein, interact with recipient cells and organ systems?
    - What novel strategies could we use to improve safety by preventing the occurrence of the “wrong” product getting into the “right” recipient or the “right” product getting into the “wrong” recipient?
- **Transfusion in pregnancy**
  - With regards to pregnancy, what strategies could we use to reduce transfusion responses to RBC or other antigens and consequences of antibodies?
    - What prevention methods could we use to:
      - Avoid complications associated with evanescent RBC antibodies from a nationwide RBC alloantibody registry
      - Identify “responders” to antigens on transfused products
      - Test genotypic matching between donors and recipients
      - Employ novel immune-protection strategies in the setting of pregnancy
    - How can we understand the mechanisms that give rise to production of antibodies against self-blood components, including the role that donor/component characteristics may play?
    - What novel strategies or therapeutics could minimize:
      - Complications of alloantibodies (immune antibodies that are only produced following exposure to foreign red blood cell antigens) including hyperhemolysis (an uncommon but potentially fatal RBC transfusion reaction)?
      - Autoantibodies to RBC antigens; and antibodies to IgA or haptoglobin? (An autoantibody is an antibody produced by the immune system that is directed against one or more of the individual's own proteins.)
- **Blood supply testing**
  - How do we design and test the next generation of blood products/blood-derived therapeutics?
  - How do we ensure the safety of blood products repurposed for non-transfusion indications?

## New Methods in Transfusion Science: Data Science, Multifactorial Analyses, and Use of Artificial Intelligence/Machine Learning

- **Communication and data-driven tools**
  - How can we use social media and other emerging communication technologies to better understand donor motivations and barriers to donation as well as facilitate donor recruitment?

- How can we curate and use multidimensional vein-to-vein (V2V) databases to answer transfusion medicine research questions and support analysis of unique special populations and/or rare outcomes and exposures?
- How can we best use data visualization tools to evaluate and improve transfusion medicine and patient blood management quality?
- How can we apply data-driven approaches to improve the accuracy and applicability of economic evaluations for blood banking and transfusion medicine?
- **Machine learning (ML) and artificial intelligence (AI) tools**
  - As hospital, clinical, and blood bank staff evaluate and adopt AI & ML tools for predicting patient transfusion requirements, blood use, and blood demand forecasting, how can we ensure that these tools are generalizable, robust, and scalable?
  - How can we better integrate genomics into clinical transfusion workflows, with the objective of providing the best donor for every recipient (V2V clinical transfusion)?

### Blood Donor and Recipient Health Disparities in Transfusion Medicine

- **Blood donor diversity**
  - How can we increase the diversity of blood donor and clinical research participants (e.g., race, socioeconomic status, language, etc.)?
  - What are effective strategies for overcoming barriers to blood donation experienced by minority populations?
- **Health equity in transfusion care**
  - How can we overcome cultural, financial, and geographic barriers to accessing transfusion care?
  - What are effective measures to lower the rate of severe adverse events from blood product transfusions as well as prevent further development of adverse events in patients of minority and diverse backgrounds?
  - What are the structural societal elements that impact access to transfusion medicine therapies, and how can we overcome these barriers to achieve equitable healthcare?

### Next Steps

The symposium co-chairs, organizers, speakers, and working group participants will develop a summarized report for publication in a peer-reviewed journal. The report will describe in more depth the discussions and research areas/questions, including those under each working group breakout session of the symposium.

### Contact

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### Workshop Chairs

- Brian Custer, Ph.D., M.P.H., Director, Vitalant Research Institute
- Nareg Roubinian, M.D., M.P.H., Associate Professor, University of California in San Francisco

## Keynote Speakers

- Michael Busch, M.D., Ph.D., Director Emeritus, Vitalant Research Institute
- Dana Devine, Ph.D., Chief Scientist, Canadian Blood Services
- Steven Spitalnik, M.D., Professor of Pathology & Cell Biology, Columbia University

## Guest Speaker

- Admiral Rachel L. Levine, M.D., Assistant Secretary for Health, U.S. Department of Health and Human Services

## Working Group Co-Chairs

**Group 1:** Blood Donors and the Supply: Diversifying while Maintaining the Donor Pool, Donor Selection, and Optimizing Blood Availability and Safety

- Barbara Bryant, M.D., Chief, Department of Transfusion Medicine, NIH Clinical Center
- Merlyn Sayers, M.D., President & CEO, Carter BloodCare

**Group 2:** Optimizing Transfusion Outcomes for Recipients: Clinical Research, RCTs, and Pragmatic Trials, PBM, Observational Epidemiology

- Cassandra Josephson, M.D., Professor, Pathology/Laboratory Medicine, John Hopkins University
- Darrell Triulzi, M.D., Director, Division of Transfusion Medicine, University of Pittsburgh

**Group 3:** Emerging Infections: Impact on Blood Science, the Supply, Safety, and Public Health (e.g., SARS-CoV-2, including use of CCP, Arboviruses, Agents of Concern)

- Evan Bloch, M.D., Associate Professor of Pathology, Johns Hopkins University
- Louis Katz, M.D., Chief Medical Officer, ImpactLife

**Group 4:** Mechanistic Aspects of Components and Transfusion: Omics, Effectiveness, Quality, and Safety, Oxygen Delivery, Therapeutics Delivery by Blood Components

- Angelo D'Alessandro, Ph.D., Associate Professor, University of Colorado Cancer Center
- Eldad Hod, M.D., Associate Professor of Pathology & Cell Biology, Columbia University

**Group 5:** New Methods in Transfusion Science: Data Science, Multifactorial Analyses, Use of Artificial Intelligence/Machine Learning

- Ruchika Goel, M.D., Medical Director, Simmons Cancer Institute, SIU School of Medicine
- Jansen Seheult, M.D. - Senior Associate Consultant and Assistant Professor, Mayo Clinic

**Group 6:** Donor and Blood Recipient Health Disparities in Transfusion Medicine

- Meghan Delaney, D.O., Chief, Division of Pathology & Laboratory Medicine Children's National Hospital

- Yvette Miller, M.D., Executive Medical Officer, American Red Cross

#### NHLBI and OASH Planning Committee

- James Berger, M.S., Senior Advisor for Blood, Tissue, and Tick Safety, OASH, DHHS
- Simone Glynn, M.D., M.Sc., M.P.H., Branch Chief, NHLBI, NIH
- Benyam Hailu, M.D., M.P.H., Medical Officer, NHLBI, NIH
- Shimian Zou, Ph.D., Program Director, NHLBI, NIH