



# A more accurate and efficient way to manage blood demand and supply

## What is this research about?

Blood transfusion is a life-saving treatment used across all disciplines of medicine. In hospital blood banks, the red blood cell (RBC) supply chain faces challenges due to highly variable ordering decisions and over-frequent urgent orders. Hospitals tend to cope with this variability by holding excess inventory, which increases risk of wastage. This also prevents Canadian Blood Services, the manufacturer of blood components, from understanding the real need for RBCs.

Although there have been several initiatives aimed at reducing blood wastage, current hospital inventory management practice cannot adaptively respond to highly variable changes in demand and supply. For example, in Ontario over the last three years there were over 5,000 units of outdated red blood cells. This study proposes more accurate and efficient ways to manage blood demand and supply by improving demand forecasting and inventory management methods for RBCs.

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**IN BRIEF: A data-driven ordering strategy can achieve significant cost savings for healthcare systems and blood suppliers.**

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## What did the researchers do?

The researchers summarized the key challenges in blood inventory management and used historical data to show the need for a comprehensive approach for addressing these issues. They combined statistical modeling, machine learning and resource optimization methods to develop a framework for data-driven demand forecasting and inventory management for RBCs.

- The researchers looked at the time series data of daily RBC transfusion and found different association patterns between various factors (e.g., seasonality) and clinical indicators. They then developed and validated a hybrid demand forecasting model to predict future RBC demand using clinical predictors and showed the hybrid model provided robust and accurate predictions for short-term RBC demand forecasting.
- They then developed a model for optimizing inventory management decisions, considering inventory and reorder constraints and based on demand estimates from the hybrid demand forecasting model.

## What did the researchers find?

This study led to two proposed ordering decision strategies for RBCs: (1) daily hospital blood orders from hospital transfusion services to a Canadian Blood Services regional distribution centre or (2) a twice-per-week ordering strategy to handle an issue called the “last-mile split delivery problem,” which means multiple shipments are delivered to the same location multiple times during a short period of time. Both strategies were evaluated using a database from the McMaster Centre for Transfusion Research (MCTR) that contains blood component, demographic and clinical information on all hospitalizations at four Hamilton, Ontario, hospitals from 2008 to 2018, including 368,481 RBC transfusions for 60,141 patients.

Compared with historical data, the proposed integration strategy reduced the hospital inventory level by 40% and decreased ordering by 60%, with low incidence of shortages and wastage due to expiration.

## How can you use this research?

Through the use of real data, this study shows that data-driven decision making can reduce hospital blood bank inventory and ordering frequency, leading to significant cost savings. The proposed strategy achieves three goals: (1) a more accurate forecasting method that reflects actual RBC demand at hospital blood banks, (2) a leaner and fresher inventory at hospital blood banks and (3) a simpler ordering strategy that requires less frequent orders on scheduled days.

The researchers plan to develop a software application for implementation at hospital blood banks in Hamilton. They also plan to expand their work to consider data-driven ordering strategies for RBCs by ABO and Rh types, for platelet components, and for plasma protein products and related products such as intravenous immunoglobulin (IVIG).

### This Research Unit is derived from the following publication:

Li N, Chiang F, Down DG, Heddle NM. A decision integration strategy for short-term demand forecasting and ordering for red blood cell components. *Oper Res Heal Care* [Internet]. 2021;29. <https://doi.org/10.1016/j.orhc.2021.100290>.

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**Acknowledgements:** This work received funding support from Canadian Blood Services (Blood Efficiency Accelerator Program) and Mitacs. MCTR receives funding support from Canadian Blood Services (Transfusion Medicine Research Program Support Award), funded by the federal government (Health Canada) and the provincial and territorial ministries of health. The views herein do not necessarily reflect the views of Canadian Blood Services or the federal, provincial or territorial governments of Canada.

**Keywords:** blood demand and supply chain, demand forecasting, inventory management, machine learning, time series models

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