Smart Blood Toolkit for Automated Red Blood Cell Exchange (RBCX)
Terumo BCT is committed to supporting providers who care for sickle cell disease patients

The coronavirus pandemic poses many challenges, including to our healthcare system and how sickle cell disease (SCD) patients are receiving care. In times of uncertainty and crisis, we’re working to help you provide SCD patients with ongoing access to care.
One thing that has not changed: people living with SCD still need blood

Some communities are facing potential blood shortages. We have heard about the potential impact this could have on transfusion-dependent SCD patients.
Automated red blood cell exchange (RBCX)
An established transfusion therapy for SCD patients

Unlike other transfusion therapies, RBCX efficiently and rapidly removes sickled cells and replaces them with healthy donor cells.¹ For SCD patients who are on a chronic RBCX program, there are some options that can be implemented to potentially minimize costs and decrease the number of units of blood required to complete an RBCX procedure while still realizing all the benefits.

“Red blood cell exchange is an alternative therapy that improved my quality of life.”
Rona Wiggins, sickle cell patient, U.S.
How can changing fraction of cells remaining (FCR) impact blood usage?

The programmed FCR value determines the amount of replacement fluid needed. Allowing the system to calculate the FCR by using the patient’s starting hemoglobin S (HbS) value and targeting a specific post-procedure HbS target may help decrease the number of red blood cell (RBC) units needed to complete the procedure.
FCR is the percentage of the patient’s original RBC present at the end of the procedure. The ending RBC is made up of both defective and non-defective RBCs.

One method of entering FCR on the run values screen on the Spectra Optia® Apheresis System is to enter the patient data and then allow the system to calculate the value. To get a system-calculated FCR, enter the patient’s starting (pre-procedure) percentage of defective cells and the target (post-procedure) percentage of defective cells.

For patients with sickle cell disease, these values would be the pre-procedure HbS and the target or post-procedure HbS. After you enter these values, the system-calculated FCR is displayed.

FCR% and HbS%:
They Are Not the Same

Some practitioners believe that FCR% and HbS% are the same thing. FCR% = HbS% only if the patient’s HbS is 100 percent (such as in a sickle cell disease patient who has not received a blood transfusion in a long time).
Let’s look at some different ways to configure RBCX run values for this example patient.
Run Values Scenario 1

Sample Values Entered Into Spectra Optia

- Target Hct 30%
- Target fluid balance 100%
- Pre-procedure HbS 50%
- Physician-ordered post-procedure HbS target 18%

Spectra Optia Calculated Values

- Required replacement fluid = 1658 mL
- Procedure time = 123 min
- FCR = 36%

Post-Procedure Predicted Values

- HbS 18%

If you want a system-calculated FCR, enter the starting HbS of 50% and the physician-ordered target HbS of 18%. The system then calculates the target FCR for the procedure to be 36% and the RBC replacement fluid required to be **1658 mL**.

Run Values Scenario 2

Sample Values Entered Into Spectra Optia

- Target Hct 30%
- Target fluid balance 100%
- FCR target 36%

Spectra Optia Calculated Values

- Required replacement fluid = 1658 mL
- Procedure time = 123 min

Post-Procedure Predicted Values

- HbS 18%

If you choose to manually calculate FCR, divide the physician-ordered HbS of 18% by the starting HbS of 50% and multiply by 100. Again, FCR will be 36% and you can enter that value directly into the system. Since the manually calculated FCR is the same as the system-calculated FCR in scenario 1, the system gives the same run values, including the RBC replacement fluid required and procedure time.

Run Values Scenario 3

Sample Values Entered Into Spectra Optia

- Target Hct 30%
- Target fluid balance 100%
- FCR target 30%

Spectra Optia Calculated Values

- Required replacement fluid = 1954 mL
- Procedure time = 145 min

Post-Procedure Predicted Values

- HbS 15%

If the patient’s pre-procedure HbS% is unknown and the physician has determined that an FCR of 30% is best for the patient, you can directly enter that value into the system. Note that with the lower FCR target, the procedure requires an additional **296 mL** of RBC replacement fluid. Note that the estimated post-procedure HbS is also lower than the physician’s original post-procedure HbS order of 18%.
### Summary of how changing FCR impacts blood usage

**Impact of Entering FCR for RBCX Procedures**

(Below are sample values entered into Spectra Optia)


Patient: 3000 mL TBV; Hct 30%; Hct replacement fluid 55%; Fluid balance 100%; Starting HbS 50%; Target HbS 18%; Target Hct 30%

<table>
<thead>
<tr>
<th></th>
<th>Starting Defective RBC</th>
<th>Target Defective RBC</th>
<th>FCR</th>
<th>Required Replacement Fluid</th>
<th>Procedure Time</th>
<th>Estimated Post-Procedure HbS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spectra Optia calculated FCR</td>
<td>50%</td>
<td>18%</td>
<td>36%</td>
<td>1658 mL</td>
<td>123 min</td>
<td>18%</td>
</tr>
<tr>
<td>Entering manually calculated FCR</td>
<td>Not entered</td>
<td>Not entered</td>
<td>36%</td>
<td>1658 mL</td>
<td>123 min</td>
<td>18%</td>
</tr>
<tr>
<td>Entering FCR with no pre-procedure defective RBC%</td>
<td>Not entered</td>
<td>Not entered</td>
<td>30%</td>
<td>1954 mL</td>
<td>145 min</td>
<td>15%</td>
</tr>
</tbody>
</table>
How can the type of RBCX procedure impact blood usage?

For some patients, a depletion/exchange procedure may require less replacement fluid than just an exchange.

This example shows the replacement fluid volume difference required to achieve the same target Hct and target FCR.

As you can see, the depletion/exchange requires less replacement volume than the exchange alone.

<table>
<thead>
<tr>
<th></th>
<th>Exchange</th>
<th>Depletion/Exchange</th>
</tr>
</thead>
<tbody>
<tr>
<td>Min Hct (%)</td>
<td>26</td>
<td>22</td>
</tr>
<tr>
<td>Target Hct (%)</td>
<td>32</td>
<td>32</td>
</tr>
<tr>
<td>Target FCR (%)</td>
<td>30</td>
<td>30</td>
</tr>
<tr>
<td>Replace Vol (mL)</td>
<td>3148</td>
<td>2921</td>
</tr>
</tbody>
</table>

Understanding types of RBCX procedures

Exchange

- Red blood cells (RBCs) are removed and simultaneously* replaced with healthy RBCs.

Depletion/Exchange

- Depletion phase: The system performs the RBC depletion to lower the patient’s Hct to a prescribed level while maintaining isovolemia. This is done by removing the patient’s RBCs and replacing them with a noncellular fluid such as saline.

- Exchange phase: After the depletion phase, the system performs the RBC exchange to increase the patient’s Hct to the prescribed target Hct. This is done by removing the patient’s RBCs and replacing them with healthy donor RBCs.

When considering depletion/exchange procedures the physician should:
1. Identify an appropriate safe minimum Hct that can be tolerated by the patient.
2. Consider the risks versus benefits of the depletion/exchange compared to the exchange.

*Simultaneous when using dual needles.
Additional resources

- **Red Blood Cell Exchange (RBCX)** — Understanding Fraction of Cells Remaining (FCR)
- **In the Know, On the Go** — Spectra Optia Apheresis System RBCX Calculation Tool
- **Spectra Optia Apheresis System Red Blood Cell Exchange (RBCX) Student Handbook**
  - FCR: Pages 21-24
  - Exchange vs. Depletion/Exchange: Pages 16, 19-29
  - Exchange Procedures: Pages 19-29
  - Depletion/Exchange Procedures: Pages 40-48
- **Spectra Optia Apheresis System Operator’s Manual**
  - Table: Data entry ranges for RBCX procedure parameters
  - Table: Descriptions of run targets for RBCX procedures
Safety Information:
Contraindications for the use of the Spectra Optia system are limited to those associated with the infusion of solutions and replacement fluids as required by the apheresis procedure and those associated with all types of automated apheresis systems.

Adverse events of apheresis procedures can include: Anxiety, headache, light-headedness, digital and/or facial paresthesia, fever, chills, hemATOMA, hyperventilation, nausea and vomiting, syncope (fainting), urticaria, hypotension, allergic reactions, infection, hemolysis, thrombosis in patient and device, hypocalcemia, hypokalemia, thrombocytopenia, hypoalbuminemia, anemia, coagulopathy, fatigue, hypomagnesemia, hypogammaglobulinemia, adverse tissue reaction, device failure/disposable failure, air embolism, blood loss/anemia, electrical shock, fluid imbalance, inadequate separation of blood components.

Reactions to blood products transfused during procedures can include: Hemolytic transfusion reaction, immune mediated platelet destruction, fever, allergic reactions, anaphylaxis, transfusion-related acute lung injury (TRALI), alloimmunization, posttransfusion purpura (PTP), transfusion-associated graft-versus-host disease (TA-GVHD), circulatory overload, hypothermia, metabolic complications, and transmission of infectious diseases and bacteria.2,3

Restricted to prescription use only: Operators must be familiar with the system's operating instructions. Procedures must be performed by qualified medical personnel.

The Spectra Optia Apheresis System can be used to perform automated RBCX procedures for the transfusion management of sickle cell disease in adults and children.*

References:

*Approved RBCX use varies by country.
Unlocking the potential

We believe in the potential of blood and cells to do even more for patients than they do today.

Everything we do starts and ends with patients.

John Musagala and his wife, Beth
Sickle cell disease patient, Uganda