Red Blood Cell Transfusion

Inpatient

Nationwide Children's — When your child needs a hospital, everything matters.

Center for Clinical Excellence

Initial Assessment:
Initial clinical findings suggestive of need for red cell transfusion and meeting inclusion criteria††

Patient in hemorrhagic shock or with life-threatening bleeding?

Yes

- Transfuse RBC : Plasma : Platelets in **ratio of 2:1:1 or 1:1:1** and
- Consider Massive Transfusion Protocol **activation** if blood product support is anticipated to continue at this level.

Surgical Options:

- Pre-operative medical optimization of patient
- Intraoperative blood salvage

Medical Options:

- Anemia:
  - Iron
  - Erythropoietin
- Bleeding Control
  - Tranexamic Acid
  - Aminocaproic Acid

No

Verify hemoglobin (Hgb) value

Candidate for adjunct therapies?

Yes

No

Patient improved?

- Increased Hgb
- Improved physical exam
- Normalized vitals

No

Yes

Do NOT transfuse:
Re-asses patient as needed and follow Hgb values

Meets Transfusion Criteria?

Yes

No

Do NOT transfuse:
Re-asses patient as needed and follow Hgb values

- Obtain consent and verify or send Type and screen
- Identify special needs (e.g. irradiated, CMV negative) safe volume, and safe rate to be transfused
- Refer to the recent transfusion history and labs in the blood admin order in the EMR
- Provide appropriate verbal and written information to patient/caregiver and clinical team (including orders and progress notes)

Transfuse RBCs

- Administer RBCs @10-15 mL/kg** not to exceed 1 unit if < 30 kg or 1 unit at a time if ≥ 30 kg
- Reassess after administration for both clinical improvement and for transfusion reaction+

Patient improved?

- Increased Hgb
- Improved physical exam
- Normalized vitals

No

Consider additional transfusion

Yes

Manage as appropriate to clinical findings

Inclusion Criteria:

- Known anemia
- Suspected anemia
- Clinical findings suggestive of ongoing or acute blood loss

Exclusion Criteria:

- ECMO/VAD
- Hemolytic anemia
- Conditions requiring chronic or exchange transfusions
- Pregnancy
- Treatment in a neonatal intensive care unit

Differential Diagnoses

††If primary admission reason is for Iron Deficiency Anemia refer to IDA pathway

If primary admission reason is for Abnormal Uterine Bleeding refer to AUB pathway

**Note: In certain diagnoses, such as severe chronic anemia, transfusing 5mL/kg of RBCs at a time may be clinically necessary to prevent adverse events.

+**Note on transient responders:** A patient whose source of blood loss is not corrected may initially improve post-transfusion and then deteriorate rapidly requiring further evaluation.

Diagnosis & Definition

Transfusion of erythrocytes (“red blood cells”or “RBCs”) may be used therapeutically to increase the oxygen carrying capability of blood when hemoglobin (Hgb) concentration is low and/or the oxygen carrying capacity is reduced in the setting of insufficient means of physiological compensation.

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Differential Diagnoses

Possible causes of anemia include, but are not limited to:

- Traumatic hemorrhage
- Non-traumatic hemorrhage
- Iron deficiency anemia
- Other nutritional deficiencies
- Neoplastic process involving bone marrow
- Congenital or acquired marrow failure
- Intrinsic red blood cell defects (including hemoglobinopathies)
- Therapy-related (including chemotherapy)
- Inherited red blood cell membrane defects
- Autoimmune conditions
- Hemolytic anemia (immune and non-immune)
- Infection
- Chronic liver or kidney failure

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Severity Assessment

History

- Bleeding history
- Fatigue
- Previous transfusion requirements
- Known underlying cause of anemia
- Willingness to consent to receipt of blood products

Physical Examination

- Active bleeding
- Vital signs
  - Blood pressure
  - Heart rate
  - Respiratory rate
  - Temperature
- Pallor
- Mental status changes
- Functional status changes
- Oxygen saturation (if necessary)

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Testing

Complete blood count (along with reticulocyte count and peripheral smear) is recommended especially in instances the etiology of anemia is unknown

- Note: It is recommended that **decision-making leading up to transfusion not be based entirely on the hemoglobin concentration**, but also on the overall clinical context, and the risks, benefits, and alternatives to transfusions.
- There is a preference for complete blood count over point-of-care hemoglobin/hematocrit if available

Hemoglobin and hematocrit (H&H) measured from whole blood can be used if the patient has a known bleeding source (i.e. trauma or surgical)

Type and screen is recommended if there is thought to be reasonable possibility of transfusion within the next few days, as this may mitigate a future delay in the release of cross-match red blood cells in the case of antibodies requiring further workup being detected at the time of screen.

Laboratory studies for the underlying cause of anemia are recommended if the cause of anemia is unknown. Examples include, but are not limited to, iron studies, B12 levels, LDH, direct antiglobulin test (DAT), haptoglobin.

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Medical Treatments

Alternative/preventative therapies to transfusions:

- **Tranexamic acid** and **aminocaproic acid** may be used in patients undergoing procedures expected to result in high amounts of blood loss as a means of controlling bleeding and limiting blood product usage.

- **Iron** can be given intravenously for iron-deficient children who are non-compliant with or fail oral iron therapy as a means of reducing RBC product usage.

- **Iron** may also be used intravenously in patients who have decreased capability to absorb oral iron preparations to limit requirements for RBC transfusions.

- **Erythropoietin** can be considered in certain patients who either refuse or are contraindicated from receiving RBC transfusions, are post bone marrow transplant, or whom are difficult to obtain compatible blood for. However, it is not recommended for routine use in a general patient population to treat anemia.

- In specific patients, erythropoietin may be a consideration prior to undergoing procedures expected to result in high amounts of blood loss to increase patient RBC production.

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Transfusion Thresholds

We agree with the strength of recommendations and quality of evidence evaluations of the Texas Children's Evidence-Based Guideline on Red Blood Cell Transfusions and the 2018 TAXI guidelines reproduced below.

Route of red blood cell administration:
Red blood cell units should be administered using a ≥23 gauge through a vein unless otherwise indicated by practitioner.

Blood Product Ordering and Guidelines

HgB Threshold	Qualifying Conditions
≤ 5	• In critically ill pediatric patients or those at risk for deterioration, a RBC transfusion is recommended when the hemoglobin concentration is less than 5 g/dL
≤ 7	• Hemodynamically unstable • No coexisting conditions listed below • cardiac patients with 2 ventricle physiology (unrepaired or palliated) with evidence of end organ dysfunction/decreased oxygen delivery • For most categories of critically ill patients with **hemoglobin concentrations between 5.0 - 7.0 g/dL**, there is insufficient evidence to make a declarative statement regarding transfusion thresholds, and for these patients, clinical judgment should be used to determine the necessity of RBC transfusion.**
≤ 8	• Active, non-life-threatening bleeding • Oncologic diagnosis • Hemoglobinopathy • Hematopoietic stem cell transplant • Scheduled for surgery (NO cardiac/pulm disease and NOT high risk of significant blood loss)
≤ 9	• Cardiac patients with single ventricle physiology (regardless of palliation stage) should be transfused at Hgb levels **7 to 9** when there is evidence of end organ dysfunction/decreased oxygen delivery. Transfusion for these cardiac patients is rarely recommended above Hgb concentrations of 9 • Acute brain injury
≤ 10	• Special populations scheduled for surgery such as those with pulmonary disease or those at high risk for significant blood loss • Hemodynamically unstable shock

****Red cell transfusion is not recommended in most categories of critically ill children or those at risk of becoming critically ill in **hemodynamically stable** children with hemoglobin concentration greater than or equal to 7 g/dL(unless otherwise noted as a special population in the table): Clinical judgment may merit a looser transfusion strategy based on signs or symptoms of anemia intolerance.

- This specifically includes, but is not necessarily limited to, the following patient subcategories(if hemodynamically stable):
  - Biventricular repair of CHD if adequate oxygenation and normal end organ function
  - Postoperative PICU patients after noncardiac surgeries in the absence of clinically significant hemorrhage.
  - Respiratory failure without severe acute hypoxemia, chronic cyanotic condition, or hemolytic anemia
  - Hemodynamically stabilized sepsis or septic shock

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Deterioration & Escalation of Care

Clinical goals following transfusion:

- In critically ill children or those at risk of developing critical illness, it is recommended that the post transfusion goal be to relieve the indication for transfusion rather than solely to normalize hemoglobin concentrations. However, a proposed post transfusion hemoglobin goal is roughly 7.0 to 9.5 g/dL for most patients.
- A patient whose source of blood loss is not corrected may initially improve post-transfusion and then deteriorate rapidly requiring further evaluation.
- For patients not responsive to transfusion therapy, consider ongoing blood loss or hemolysis and consult the appropriate clinical teams for further evaluation.
- Patients should be assessed during and following transfusion for signs of possible transfusion reactions. Refer to details in section **Assessment & Monitoring.**

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Assessment & Monitoring

- Repeat a CBC or H&H to assess response prior to ordering further red blood cell units (if patient is hemodynamically stable)
- Clinical assessment for symptomatic and vital sign improvement
- Following transfusion, patients should be assessed for transfusion reactions, which include:
  - During or within 1 hour of cessation of transfusion
    - Hypotensive transfusion reaction: Hypotension (> 25% drop in BP) not meeting the criteria for any other transfusion reactions
  - During or within 4 hours of cessation of transfusion
    - Allergic reaction: Edema of conjunctivae, lips, tongue, uvula, generalized flushing, edema and erythema of periorbital area, hypotension, localized angioedema, maculopapular rash, itching, respiratory distress, hives
    - Febrile non-hemolytic transfusion reaction: Fever > 38°C with increase of ≥ 1°C OR rigors/chills
  - During or within 6 hours of cessation of transfusion
    - Transfusion-associated circulatory overload (TACO): Acute respiratory changes (dyspnea, orthopnea, cough), ↑BNP, ↑CVP, CXR evidence of pulmonary edema, positive fluid balance, evidence of left heart failure
    - Transfusion-related acute lung injury (TRALI): New acute lung injury and hypoxemia with bilateral radiological infiltrate with no evidence of circulatory overload.
  - During or within 24 hours of cessation of transfusion
    - Acute hemolytic transfusion reaction: Back/flank pain, chills/rigors/fever, DIC, epistaxis, hematuria, hypotension, oliguria/anuria, oozing/pain at IV site, kidney failure, AND laboratory evidence of hemolysis
      - Note: Onset is typically much more rapid than 24 hours
    - Transfusion-associated dyspnea (TAD): Acute respiratory distress not meeting criteria for TACO, TRALI, or allergic reaction.
  - Within 24 hours to 28 days after cessation of transfusion
    - Delayed hemolytic transfusion reaction: Positive DAT with alloantibody detected and inadequate rise in post-transfusion hemoglobin concentration or rapid fall of hemoglobin.
  - Between 2 days and 6 weeks following transfusion
    - Post transfusion purpura: Significant decrease of platelet count post-transfusion associated with platelet alloantibody
      - Note: Usual onset is between 5-12 days post-transfusion
    - Transfusion-associated graft vs. host disease: Rash, diarrhea, hepatomegaly, liver dysfunction, marrow aplasia with and pancytopenia, with GVHD confirmed by tissue biopsy
  - Variable
    - Transfusion-transmitted infection
      - Note: The time-frame of symptoms depends on the organism, as some bacteria may cause rapid symptoms, while certain viral infections might only be detected years later.

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Patient & Caregiver Education

The following Helping Hands™ are available on ANCHOR to assist with education of transfusions of blood products:

- **Blood Transfusion Aftercare**

Also available for patient and family education are the following resources from the Krames-Staywell library on ANCHOR:

- Understanding Blood and Blood Components
- When Your Child Needs a Blood Transfusion
- When You Need a Blood Transfusion (Adult)
- Blood Management
- Understanding Blood Donation Before Surgery
- Self Blood Donation
- Blood Type and Crossmatch

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Quality Measures

Pathway Goal

- Reduce unnecessary transfusions

Quality Metrics

- Number of red blood cell orders for hemoglobin concentrations above the given thresholds
- Number of orders for products with dosing > 15mL/kg (if patient < 30 kg), or for more than one unit of RBC (if patient ≥ 30 kg)
- Rate/number of transfusion reactions
- Wrong patient/wrong product transfusion events and “near misses”

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Clinical Pathway Development

This clinical pathway was developed using the process described in the NCH Clinical Pathway Development Manual Version 6, 2022. Clinical Pathways at Nationwide Children's Hospital (NCH) are standards which provide general guidance to clinicians. Patient choice, clinician judgment, and other relevant factors in diagnosing and treating patients remain central to the selection of diagnostic tests and therapy. The ordering provider assumes all risks associates with care decisions. NCH assumes no responsibility for any adverse consequences, errors, or omissions that may arise from the use or reliance on these guidelines. NCH's clinical pathways are reviewed periodically for consistency with new evidence; however, new developments may not be represented, and NCH makes no guarantees, representations, or warranties with respect to the information provided in this clinical pathway.

For more information about our pathways and program please contact:
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