Blood Ordering Pathway v8.1: **Table of Contents**

Stop and **Review**

Inclusion Criteria

- Blood product needed

Exclusion Criteria

- None

Blood Ordering Care

Appendix

Blood Ordering Pathway v8.1:
Place Orders - Inpatient, Outpatient, and ED

Stop and **Review**

Inclusion Criteria

- Blood product administration needed

Exclusion Criteria

- Outpatient preadmission for surgery (see Place Orders - Pre-Admit for Surgery)
- OR procedure
- Bedside procedure

Off Pathway

Transfusion Needed?
Refer to GOC: Blood Product Transfusion Threshold Guideline (12008) (*for SCH only*)

Emergent Bleed → **Obtain Uncrossmatched Blood from Emergency Fridge**

- Activate MTP. See P&P: Massive Transfusion Protocol (10668) (*for SCH only*)

Non-emergent

Review and Update Blood Administration Navigator

- Add Blood Special Requirements based on diagnosis**.** Once charted, blood special requirements will automatically be added to blood orders
- Document transfusion thresholds and reason for thresholds in **Transfusion Profile SmartForm**
- Documentation of Suggested Premedications in **Transfusion Profile** displays in blood order sets

Routine

Specimens Needed

RBCs

- < 4 months of age:
  - One type and screen needed for each hospital admission
- ≥ 4 months of age:
  - Type and Screen within 3 days of transfusion
  - One time only: Confirmatory ABO/Rh or prior Type and Screen

Platelets, Plasma, and Cryoprecipitate

- **All patients**: one type and screen needed

Inpatient and ED

- Use **Blood Administration** order set
  - See Blood Special Requirements
  - For platelet transfusion, see CSW Platelet Transfusion Pathway
- EHR automatically selects:
  - ABO/RhD and Antibody Screen (Type & Screen)
  - ABO/RhD (confirmatory)
- Order premedications, if needed
- Complete **Prepare and Transfuse** orders
- Determine dose and rate of transfusion, see Job Aid: Blood Transfusions - Transfusion and Dosing (12056) (*for SCH only*)

Outpatient

- Use **Outpatient Blood Administration SmartSet** or Blood Therapy Plan
  - See Blood Special Requirements
- Select appropriate pre-transfusion specimens:
  - ABO/RhD and Antibody Screen (Type & Screen)
  - ABO/RhD (confirmatory)
  - Exception: check specimen availability for blood orders via Therapy plans
- Order premedications, if needed
- Complete **Prepare and Transfuse** orders
- Determine dose and rate of transfusion, see Job Aid: Blood Transfusions - Transfusion and Dosing (12056) (*for SCH only*)

Blood Sample(s) Required?

Yes → **Draw Sample(s)**

- Refer to the Job Aid: Transfusion Specimen Collection (13143) (*for SCH only*)
- If 2 ABO/RhD samples required, draw separately
- Use Blood Testing for Transfusion (PE1712) for education

No → **Requesting and Administering Blood Products**

- See Product Turnaround Time
- See Transfusion Workflow - Nursing

Blood Ordering Pathway v8.1:
Place Orders - OR or Bedside Procedure

Stop and **Review**

Inclusion Criteria

- Blood needed
- Patient in Emergency Department (ED) or Inpatient
- Primary care team placing orders

Exclusion Criteria

- Outpatient preadmission for surgery (see Place Orders - Pre-Admit for Surgery)
- Non-emergent, routine transfusions by RN
- Anesthesia placing orders
- ECLS (Extracorporeal Life Support)

Off Pathway

Transfusion expected?

Emergent Bleed → **Obtain Uncrossmatched Blood from Emergency Fridge**

- Activate MTP. See P&P: Massive Transfusion Protocol (10668) (*for SCH only*)

Non-Emergent

OR

- Use **Prepare Blood Products for Procedure in OR** order panel
- *EHR automatically selects:*
  - *ABO/RhD and Antibody Screen (Type & Screen)*
  - *ABO/RhD (confirmatory)*

Bedside Procedure

- Use **Blood Administration** order set
- Select transfusion indication “Prepare only”
- *EHR automatically selects:*
  - *ABO/RhD and Antibody Screen (Type & Screen)*
  - *ABO/RhD (confirmatory)*

Blood Sample(s) Required?

Yes → **Collect and Send Blood Sample(s)**

- Refer to the Job Aid: Transfusion Specimen Collection (13143) (*for SCH only*)

No

Requesting Blood Products (if not already at bedside)

- See Product Turnaround Time
- OR: Call to release blood product
- Inpatient and ED RN**:** Complete in **Blood Administration Navigator** (see Transfusion Workflow - Nursing)

!

Send runner to pick-up cooler or provide tube station location

Additional Information

For Multiple RBC, FFP or need for cooler

- Pick up products from Blood Bank

Required Documentation After Receiving Blood Product

- Complete attestation (pink sticker) when adding additional RBC and FFP to cooler

Transfuse by Anesthesia or RN?

Anesthesia → **Anesthesia: Administer Product as Needed**

- See Job Aid: Blood Transfusions - Transfusion and Dosing (12056) (*for SCH only*) for handling instructions
- Order premedications, if needed

RN → **Provider: Modify Transfuse Order**

- For inpatients with "Prepare only" orders placed using **Blood Administration** order set, modify existing **Transfuse** order to indicate volume and rate when ready to transfuse blood product
- See Job Aid: Blood Transfusions - Transfusion and Dosing (12056) (*for SCH only*) for handling instructions
- Order premedications, if needed

Returning Products

- Send runner to return the cooler
- Red cells and plasma should be returned in the cooler
- Platelets and cryoprecipitate should be returned at room temperature

!

Do not place platelets or cryoprecipitate in cooler

Blood Ordering Pathway v8.1:
Place Orders - Pre-Admit for Surgery

Stop and **Review**

Inclusion Criteria

- Blood ordered preoperatively in outpatient setting

Exclusion Criteria

- OR or Bedside procedure (see Place Orders - OR or Bedside Procedure)
- Routine Inpatient, Outpatient, or ED (see Place Orders - Inpatient, Outpatient, and ED)

Is patient pregnant or been transfused in the past 3 months?

Yes

No

History of Positive Antibody

- Consider ordering additional RBCs for surgery
- Allow time to acquire additional units from blood supplier (see Product Turnaround Time)
- May need additional sample and time for crossmatching

Document Special Blood Needs in Blood Administration Navigator

- Add Blood Special Requirements based on diagnosis**.** Once charted, blood special requirements will automatically be added to blood orders
- Document transfusion thresholds and reason for thresholds in **Transfusion Profile SmartForm**
- Documentation of Suggested Premedications in **Transfusion Profile** displays in blood order sets

Order Samples and Products

- Collect ABO/RhD and Antibody Screen (Type & Screen) within 3 days of surgery
- Order Confirmatory ABO/RhD if required

Order Pre-Admission Type and Screen

- Obtain Pre Admission Type and screen within 30 days of surgery
- Order Confirmatory ABO/RhD if required (no historical ABO type on file)

Order Blood Products

- Order blood (see Product Turnaround Time):
  - For OR, order **Prepare Blood Products for Procedure in OR** order panel or **Anesthesia Blood Administration** order set
  - For bedside procedure, order **Blood Administration** order set which will allow RN transfusion using BPAM

For questions concerning this pathway, contact:
bloodordering@seattlechildrens.org

If you are a patient with questions contact your medical provider, Medical Disclaimer

Blood Ordering Pathway v8.1: **Transfusion Workflow - Nursing**

Stop and **Review**

Inclusion Criteria
- Non-emergent transfusions
- Machine prime

Exclusion Criteria
- OR
- Emergent transfusions (ECPR, MTP)

Emergency or Downtime Blood Administration
- Follow downtime/ emergency blood verification and documentation process
- Refer to Job Aid: Blood Transfusion Downtime Resource (14086) (*for SCH only*)

Requesting Blood Product
- **Before** selecting **"Release":** Complete Pre-Transfusion Documentation in Blood Administration Navigator:
  - Ensure Release to location is completed and correct
  - Confirm blood consent is current and not expired
  - Administer pre-medications, if ordered
- Check if blood product ready before selecting release (see Product Turnaround Time)

Receive Product

Perform 2-Person Verification
- Refer to verification and administration details in Job Aid: Blood Transfusion Workflow (12307) (*for SCH only*)
- Document "New Bag", vital signs, and starting rate
  - **Exception**: For CRRT, ECLS and Apheresis document "Machine Prime"

"Machine Prime" →

Complete Transfusion
- Complete each flowsheet row
- For transfusion in mLs, complete the order in the Blood Administration Navigator

Within 15-minutes

Does patient have signs or symptoms of a transfusion reaction?
Refer to Job Aid: Transfusion Reaction Decision Tree (13158) (*for SCH only*)

Yes →

No

Assess Patient
- Obtain and document:
  - Vital signs
  - Suspected reaction (yes/no)
- If needed, increase transfusion per provider order using "Rate Changed"

STOP Transfusion and Proceed to Transfusion Reaction

During Transfusion

Does patient have signs or symptoms of a transfusion reaction?
Refer to Job Aid: Transfusion Reaction Decision Tree (13158) (*for SCH only*)

Yes →

No

Complete Transfusion
- Document "Stopped" and volume administered
- Obtain and document:
  - Vital signs
  - Suspected reaction (yes/no)
- Complete flowsheet row
- For transfusions in mLs, complete the order in the Blood Administration Navigator

Additional Information
- When to start transfusion:
  - **Before** expiration date and time
  - Within 4-hours of issue date and time *and spiking the bag*
- If patient clinical condition changed after receiving blood product
  - Inform provider, do NOT return blood product unless expired or unable to administer before expiration

Required Documentation
- "Release to" location and consent
- 2-person verification
- Pre-transfusion, 15-minute and post-transfusion vital signs include temperature, pulse, respiratory rate, blood pressure, and oxygen saturation (pulse oximetry)
- Suspected reaction at 15-minutes and at end of transfusion
- Volume administered, transfusion "stopped", flowsheet row and order completed

Blood Ordering Pathway v8.1: **Transfusion Reaction**

Stop and **Review**

Inclusion Criteria

- Blood transfusion in process or completed

Exclusion Criteria

- None

For reactions, symptoms, and intervention, go to Job Aid: Transfusion Reaction Decision Tree (13158) (*for SCH only*)

For questions regarding transfusion diagnosis or management, call the Transfusion Service physician on call, available 24/7.

Immediate Actions

- STOP TRANSFUSION (do not discard blood product or tubing)
- Provide supportive care
  - Stay with patient; ask for help
  - Notify the patient's provider
  - Monitor vital sign frequently
- Maintain IV access (do not flush existing line; use new IV tubing if required)
- Repeat patient/component ID check:
  - Patient ID/arm band
  - Blood bag label
  - Transfusion Report

Report

- Order **Transfusion Reaction Workup** in EHR (for RNs: per protocol)
- Fill out transfusion reaction form (pink)
- Send 1 EDTA (lavender top) tube along with the blood product, infusion set, and attached IV fluids with the completed transfusion reaction form to Seattle Children's Transfusion Service
  - Exception: For hives only reaction, a specimen is not required
- Report fatalities, unanticipated reactions, serious complications, or suspected disease transmission possibly related to transfusion of blood or blood components to the Transfusion Service as soon as possible

Product Turnaround Time (TAT)

Product	Turnaround Time	Product Information
Red Blood Cells • Specific volume ordered is provided by mL up to 150 mL • Unit volume (~200-400 mL)	**20-30 minutes** if product pre-ordered and testing complete. **2-4 hours** if new sample, aliquot or supernatant removal required**	• **If antibody screen is positive, several hours may be required to complete testing and acquire matched RBCs. • Washed RBCs are not washed on-site and requires discussion with transfusion provider.
Platelets • Single donor apheresis full unit (~200-400mL) • Apheresis units may be aliquoted (mLs)	Full unit: **20-30 minutes** Aliquot or Plasma reduced: **45-60 minutes** Washed: **60-90 minutes**	• Platelets in Platelet additive solution (PAS) are acceptable for all patients, all ABO types. • Platelets in plasma prioritized for massive transfusion, cardiac and liver surgeries, ECMO, and patients receiving plasma. • HLA matched platelets require discussion with transfusion provider.
Plasma • 50 mL divided units • 200 - 400mL units	**20-45 minutes**	• Plasma may be ordered in mL or units.
Cryoprecipitate • Single (order in mLs): ~ 10 mL • 5-pool (order in Units): ~75 mL	**20-30 minutes**	• Each single cryo unit is ~10mL, and orders can be placed in mL to receive 1-3 single cryo. • Orders above 30mL may be dispensed as a 5-pool product.

Return To Place Orders - Inpatient, Outpatient, and ED | **Return To Place Orders - OR or Bedside Procedure** | **Return To Place Orders - Pre-Admit for Surgery** | **Return To Transfusion Workflow - Nursing**

To Table of Contents

Blood Special Requirements

DO NOT modify blood special requirements unless you are a licensed independent provider (e.g. MD, NP).

ALL red blood cells (RBCs) and platelets are leukocyte reduced and considered CMV-safe.

All RBCs and platelets are irradiated unless "Do not irradiate RBCs" or “Irradiation not required” is selected and approved by Transfusion physician on-call.

Patient Type	Select blood special requirement
• Oncology • Severe immunodeficiency • Cardiac surgery (If LESS THAN 2 years)	Irradiated or Psoralen treated
Heart Transplant candidate or recipient	• Irradiated or Psoralen treated • Supernatant removed RBCs for ABO-incompatible Heart transplant protocol < 24 months old
Hematopoietic stem cell transplant (HSCT)	Irradiated or Psoralen treated Other Instructions: • Fred Hutch transfusion service office manages patients on BMT service • For patients not managed by Fred Hutch (e.g., immunotherapy patient), complete “HSCT information” section of HSCT_Organ Transplant smart forms under “More menu”
Hemoglobinopathy	• Rh/K antigen-selected • If sickle cell disease: Sickle Cell (Hgb S) Negative
History of repeated or moderate allergic transfusion reaction	• Allergic reaction (plasma reduced or PAS platelets) • Consider if plasma required: Octaplas (pooled plasma) preferred for allergic reaction
History of SEVERE allergic transfusion reaction	• Washed Platelets* • Supernatant removed RBCs or Washed RBCs* • If plasma required: Octaplas (pooled plasma) preferred for allergic reaction • *Requires Transfusion Service Physician On-call approval
Hyperkalemic/renal failure AND does not meet any other requirement for irradiated blood products	Consider: Do not irradiate RBCs
Infant less than 4 months	• Irradiated or Psoralen treated • Sickle Cell (Hgb S) Negative
Liver transplant candidate or recipient	Irradiation not required (in most cases unless intestine transplant and/or other indication listed above {e.g., oncology, severe immunodeficiency, HSCT})
Patient receiving frequent (daily) RBC transfusions <100mL	Consider: Dedicated RBCs for multiple aliquots <100mL
Volume sensitive/overload	Volume overload (plasma reduce all platelets)

Return To Place Orders - Inpatient, Outpatient, and ED

Return To Place Orders - Pre-Admit for Surgery

To Table of Contents

Definitions

Serious Complications:

- Death
- Hemolytic transfusion reaction
- Bacterial contamination
- Transfusion-related acute lung injury
- Transfusion-associated graft versus host disease
- Post-transfusion purpura

Suspected disease transmission (transfusion-transmitted infection) may include:

- Bacterial contamination
- Hepatitis A, B, or C
- Chagas Disease
- HTLV-1 and HTLV-2
- Syphilis
- West Nile Virus
- Human Immunodeficiency Virus (HIV)

Return To Transfusion Reaction

Summary of Version Changes

- **Version 1.0 (2/11/2015):** Go live.
- **Version 2.0 (5/27/2015):** Fixed box errors in Preadmit phase.
- **Version 3.0 (7/29/2015):** Implemented electronic process to request and verify receipt of blood products.
- **Version 4.0 (6/28/2016):** Updated dosing guidance for blood products.
- **Version 4.1 (3/11/2019):** Removed erroneous “to bibliography” button.
- **Version 5.0 (10/3/2020):** Updated algorithm to align with Epic.
- **Version 6.0 (4/1/2021):** Updated the Blood Special Requirements page in response to new platelet products being received from the American Red Cross and Bloodworks NW.
- **Version 7.0 (4/29/2022):** Periodic review go live with new formatting style and no changes to recommendations. Removed Blood Special Requirements page.
- **Version 8.0 (2/5/2024):** Added Transfusion Nursing workflow, Blood Special Requirements, and Product Turnaround Time. Updated algorithms to align with user feedback in order to increase utilization.
- **Version 8.1 (2/9/2024):** Added Blood Special Requirements links to TOC and Place Orders – Inpatient, Outpatient, and ED flow diagram. In Blood Special Requirements table, adjusted dedicated RBCs for multiple aliquots from <150mL to <100mL.

Approval and Citation

Authored by Clinical Standard Work Blood Ordering Pathway team for February 5, 2024, go-live
(*Denotes final approval)

Transfusion Services, Co-Owner	Nabiha Huq Saifee, MD, PhD*
Transfusion Services, Co-Owner	Ann-Marie Taroc, MSN, RN, CPN*
Emergency Medicine, Collaborator	Brian Burns, DNP, ARNP-CS, CPEN*
Surgical Unit, Collaborator	Andrea Campbell, DNP, ARNP-CS, ACCNS-P, CCRN*
Library and Information Commons, Librarian	Sue Groshong, MLIS
Clinical Effectiveness, Literature Reviewer	Jennifer Hrachovec, PharmD, MPH
Cancer and Blood Disorders, Collaborator	Leah Kroon, MA, MN, RN, CPHON
Clinical Effectiveness, Literature Reviewer	Eileen Reichert, ARNP
Transfusion Services, Team Member	Kristin Ricci, MD*
Clinical Effectiveness, Project Manager	Yoshino Sakamoto, MHA, PMP, CPPS
Clinical Effectiveness, Medical Director	Darren Migita, MD

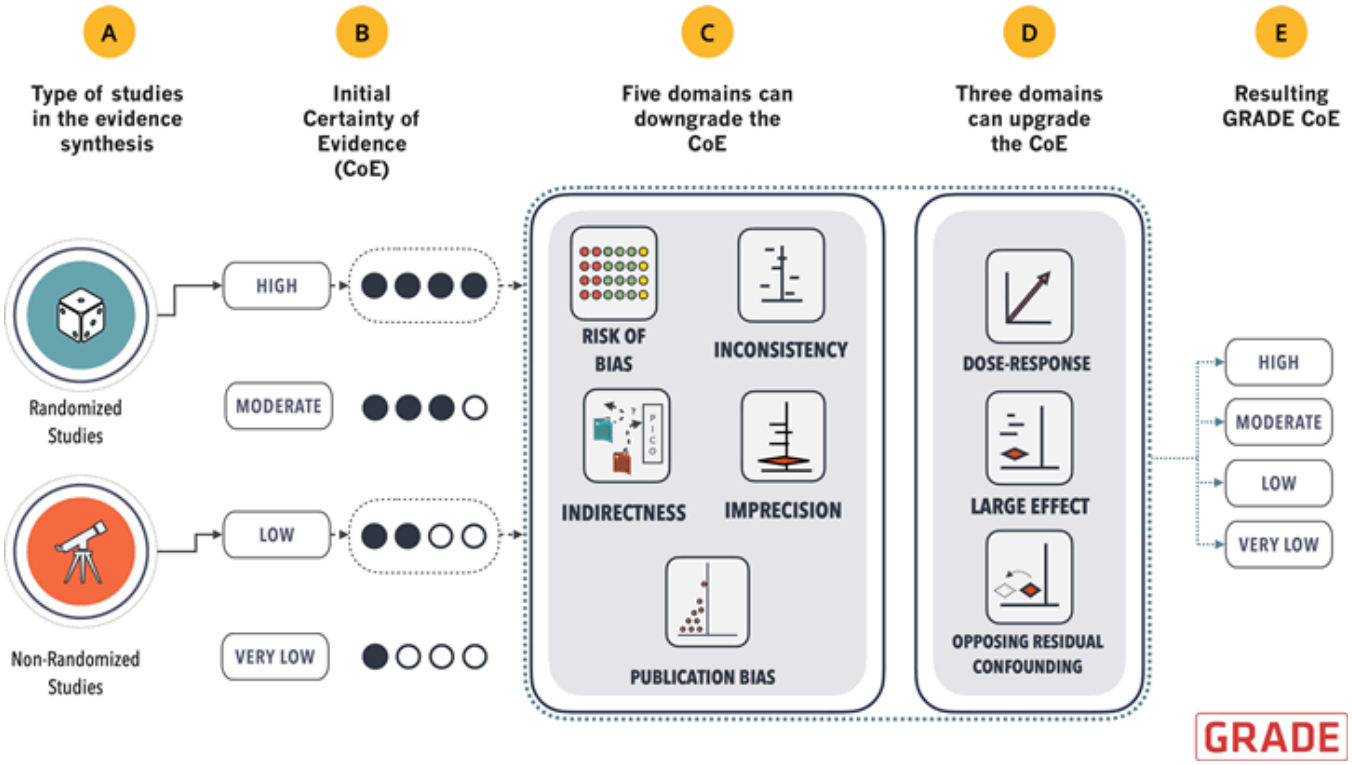
Recommended Citation

Huq Saifee, N., Taroc, A., Burns, B., Campbell, A., Groshong, S., Hrachovec, J., Kroon, L., Reichert, E., Ricci, K., Sakamoto, Y., & Migita, D. (2024, February 9). *Blood ordering pathway*. Seattle Children's, Center for Quality and Patient Safety. https://www.seattlechildrens.org/pdf/blood-ordering-pathway.pdf

Evidence Ratings

This pathway was developed through local consensus based on published evidence and expert opinion as part of Clinical Standard Work at Seattle Children's. Pathway teams include representatives from Medical, Subspecialty, and/or Surgical Services, Nursing, Pharmacy, Clinical Effectiveness, and other services as appropriate.

When possible, we used the GRADE method of rating evidence quality. Evidence is first assessed as to whether it is from randomized trial or cohort studies. The rating is then adjusted in the following manner (from: Guyatt G et al. J Clin Epidemiol. 2011;4:383-94, Hultcrantz M et al. J Clin Epidemiol. 2017;87:4-13, Klugar et al. J Clin Epidmiol. 2021 Nov 11;S0895-4356(21)00361-9.):



Source: Carlos Cuello

Certainty of Evidence

✪✪✪✪ High certainty: The authors have a lot of confidence that the true effect is similar to the estimated effect
✪✪✪○ Moderate certainty: The authors believe that the true effect is probably close to the estimated effect
✪✪○○ Low certainty: The true effect might be markedly different from the estimated effect
✪○○○ Very low certainty: The true effect is probably markedly different from the estimated effect
Guideline: Recommendation is from a published guideline that used methodology deemed acceptable by the team
Expert Opinion: Based on available evidence that does not meet GRADE criteria (for example, case-control studies)

Deductions labeled 1=risk bias, 2=indirectness, 3=imprecision, 4=inconsistency, 5=publication bias

Bibliography

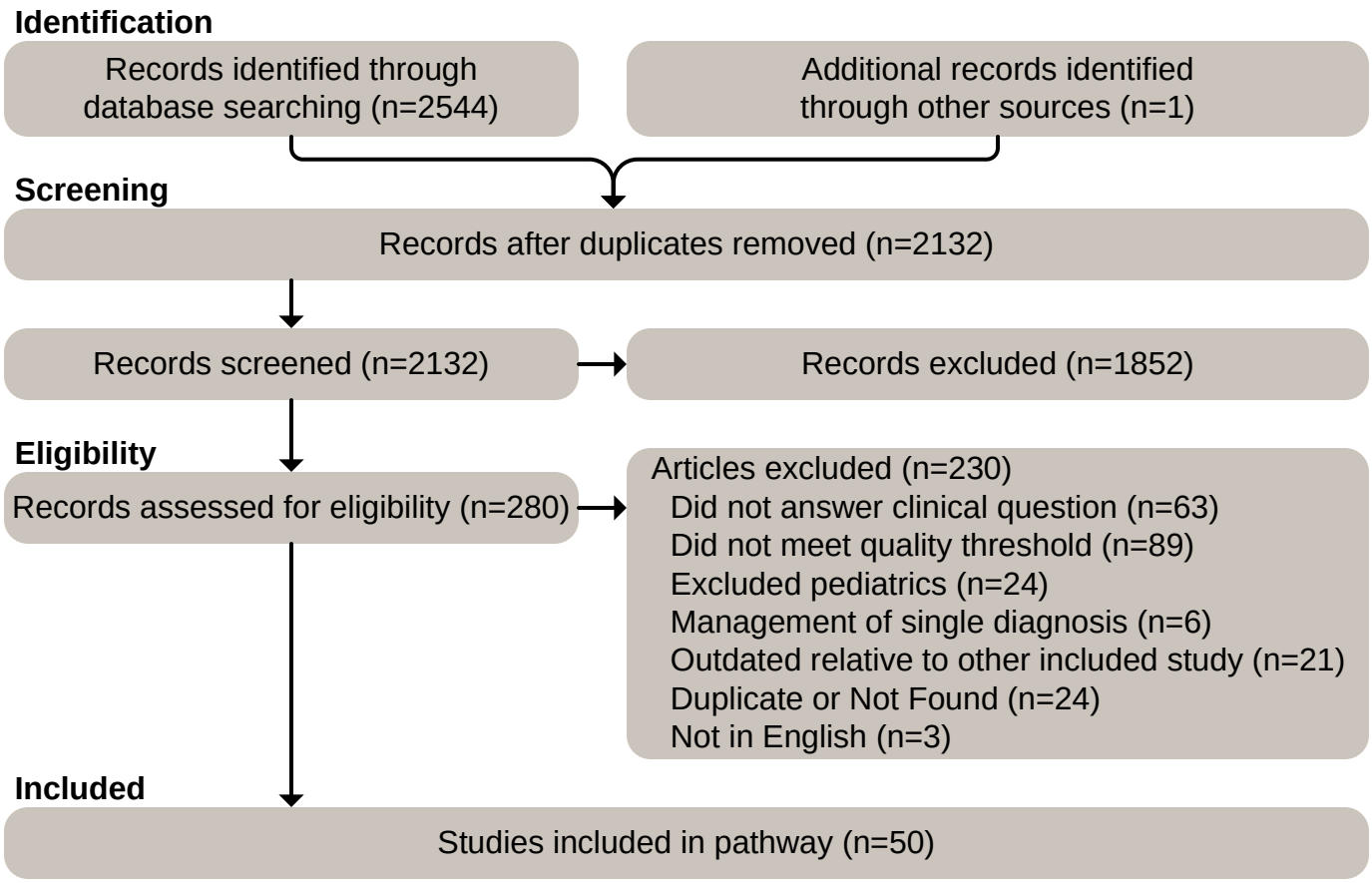
Literature Search Methods
For this update, we revised the search strategies in line with current Library practices. A literature search was conducted in September 2020 to target synthesized literature on patient blood management, blood specimen collection, blood administration, blood transfusion and blood safety for 2015 to current and limited to English and humans. The search was executed in Ovid Medline, Embase, Cochrane Database of Systematic Review (CDSR), and Turning Research into Practice database (TRIP).

Screening and data extraction were completed using DistillerSR (Evidence Partners, Ottawa, Canada). Two reviewers independently screened abstracts and included guidelines and systematic reviews that addressed blood management, specimen collection, administration, transfusion, and safety. One reviewer screened full text and extracted data and a second reviewer quality checked the results. Differences were resolved by consensus.

Literature Search Results
The searches of the 4 databases (see Electronic searches) retrieved 2544 records. Our searches of other resources (known guidelines) identified 1 additional study that appeared to meet the inclusion criteria.

Once duplicates had been removed, we had a total of 2132 records. We excluded 1852 records based on titles and abstracts. We obtained the full text of the remaining 280 records and excluded 230.

We included 50 studies. The flow diagram summarizes the study selection process.



Flow diagram adapted from Moher D et al. BMJ 2009;339:bmj.b2535

Bibliography

Included Studies

Alvikas, J., Myers, S. P., Wessel, C. B., Okonkwo, D. O., Joseph, B., Pelaez, C., . . . Neal, M. D. (2020). A systematic review and meta-analysis of traumatic intracranial hemorrhage in patients taking prehospital antiplatelet therapy: Is there a role for platelet transfusions? The Journal of Trauma and Acute Care Surgery, 88(6), 847-854. doi:https://dx.doi.org/10.1097/TA.0000000000002640

American Society of Anesthesiologists Task Force on Perioperative Blood, M. (2015). Practice guidelines for perioperative blood management: an updated report by the American Society of Anesthesiologists Task Force on Perioperative Blood Management. Anesthesiology, 122(2), 241-275. doi:https://dx.doi.org/10.1097/ALN.0000000000000463

Bembea, M. M., Cheifetz, I. M., Fortenberry, J. D., Bunchman, T. E., Valentine, S. L., Bateman, S. T., . . . Sepsis Investigators, N. (2018). Recommendations on the Indications for RBC Transfusion for the Critically Ill Child Receiving Support From Extracorporeal Membrane Oxygenation, Ventricular Assist, and Renal Replacement Therapy Devices From the Pediatric Critical Care Transfusion and Anemia Expertise Initiative. Pediatric Critical Care Medicine, 19(9S Suppl 1), S157-S162. doi:https://dx.doi.org/10.1097/PCC.0000000000001600

Bembea, M. M., Valentine, S. L., Bateman, S. T., Wilson, L. M., Anton, B., Harger, N., . . . Sepsis Investigators, N. (2018). The Pediatric Critical Care Transfusion and Anemia Expertise Initiative Consensus Conference Methodology. Pediatric Critical Care Medicine, 19(9S Suppl 1), S93-S97. doi:https://dx.doi.org/10.1097/PCC.0000000000001593

Blood transfusion. (2015). National Institute for Health and Clinical Excellence - Clinical Guidelines.

Brogi, E., Corbella, D., Coccolini, F., Gamberini, E., Russo, E., Agnoletti, V., & Forfori, F. (2020). The Role of Platelet Transfusions After Intracranial Hemorrhage in Patients on Antiplatelet Agents: A Systematic Review and Meta-Analysis. World Neurosurgery, 141, 455-466.e413. doi:https://dx.doi.org/10.1016/j.wneu.2020.03.216

Brunskill, S. J., Wilkinson, K. L., Doree, C., Trivella, M., & Stanworth, S. (2015). Transfusion of fresher versus older red blood cells for all conditions. Cochrane Database of Systematic Reviews(5), CD010801. doi:https://dx.doi.org/10.1002/14651858.CD010801.pub2

Cannon, J. W., Khan, M. A., Raja, A. S., Cohen, M. J., Como, J. J., Cotton, B. A., . . . Duchesne, J. C. (2017). Damage control resuscitation in patients with severe traumatic hemorrhage: A practice management guideline from the Eastern Association for the Surgery of Trauma. The Journal of Trauma and Acute Care Surgery, 82(3), 605-617. doi:https://dx.doi.org/10.1097/TA.0000000000001333

Cholette, J. M., Willems, A., Valentine, S. L., Bateman, S. T., Schwartz, S. M., Pediatric Critical Care, T., . . . Sepsis Investigators, N. (2018). Recommendations on RBC Transfusion in Infants and Children With Acquired and Congenital Heart Disease From the Pediatric Critical Care Transfusion and Anemia Expertise Initiative. Pediatric Critical Care Medicine, 19(9S Suppl 1), S137-S148. doi:https://dx.doi.org/10.1097/PCC.0000000000001603

Chou, S. T., Alsawas, M., Fasano, R. M., Field, J. J., Hendrickson, J. E., Howard, J., . . . Akl, E. A. (2020). American Society of Hematology 2020 guidelines for sickle cell disease: transfusion support. Blood advances, 4(2), 327-355. doi:https://dx.doi.org/10.1182/bloodadvances.2019001143

Compernolle, V., Chou, S. T., Tanael, S., Savage, W., Howard, J., Josephson, C. D., Odame, I., Hogan, C., Denomme, G., Shehata, N., International Collaboration for Transfusion Medicine, Guidelines (2018). Red blood cell specifications for patients with hemoglobinopathies: a systematic review and guideline Transfusion, 58(6), 1555-1566

Bibliography

Demaret, P., Emeriaud, G., Hassan, N. E., Kneyber, M. C. J., Valentine, S. L., Bateman, S. T., . . . Sepsis Investigators, N. (2018). Recommendations on RBC Transfusions in Critically Ill Children With Acute Respiratory Failure From the Pediatric Critical Care Transfusion and Anemia Expertise Initiative. Pediatric Critical Care Medicine, 19(9S Suppl 1), S114-S120. doi:https://dx.doi.org/10.1097/PCC.0000000000001619

Deng, X., Wang, Y., Huang, P., Luo, J., Xiao, Y., Qiu, J., & Yang, G. (2019). Red blood cell transfusion threshold after pediatric cardiac surgery: A systematic review and meta-analysis. Medicine, 98(11), e14884. doi:https://dx.doi.org/10.1097/MD.0000000000014884

Desborough, M. J. R., Colman, K. S., Prick, B. W., Duvekot, J. J., Sweeney, C., Odutayo, A., . . . Stanworth, S. J. (2017). Effect of restrictive versus liberal red cell transfusion strategies on haemostasis: systematic review and meta-analysis. Thrombosis & Haemostasis, 117(5), 889-898. doi:https://dx.doi.org/10.1160/TH17-01-0015

Doctor, A., Cholette, J. M., Remy, K. E., Argent, A., Carson, J. L., Valentine, S. L., . . . Sepsis Investigators, N. (2018). Recommendations on RBC Transfusion in General Critically Ill Children Based on Hemoglobin and/or Physiologic Thresholds From the Pediatric Critical Care Transfusion and Anemia Expertise Initiative. Pediatric Critical Care Medicine, 19(9S Suppl 1), S98-S113. doi:https://dx.doi.org/10.1097/PCC.0000000000001590

Estcourt, L. J., Malouf, R., Doree, C., Trivella, M., Hopewell, S., & Birchall, J. (2018). Prophylactic platelet transfusions prior to surgery for people with a low platelet count. Cochrane Database of Systematic Reviews, 9, CD012779. doi:https://dx.doi.org/10.1002/14651858.CD012779.pub2

Estcourt, L. J., Malouf, R., Hopewell, S., Doree, C., & Van Veen, J. (2018). Use of platelet transfusions prior to lumbar punctures or epidural anaesthesia for the prevention of complications in people with thrombocytopenia. Cochrane Database of Systematic Reviews(4). doi:10.1002/14651858.CD011980.pub3

Estcourt, L. J., Malouf, R., Trivella, M., Fergusson, D. A., Hopewell, S., & Murphy, M. F. (2017). Restrictive versus liberal red blood cell transfusion strategies for people with haematological malignancies treated with intensive chemotherapy or radiotherapy, or both, with or without haematopoietic stem cell support. Cochrane Database of Systematic Reviews, 1, CD011305. doi:https://dx.doi.org/10.1002/14651858.CD011305.pub2

Faraoni, D., Meier, J., New, H. V., Van der Linden, P. J., & Hunt, B. J. (2019). Patient Blood Management for Neonates and Children Undergoing Cardiac Surgery: 2019 NATA Guidelines. Journal of Cardiothoracic and Vascular Anesthesia, 33(12), 3249-3263. doi:10.1053/j.jvca.2019.03.036

Garg, P., Pinotti, R., Lal, C. V., & Salas, A. A. (2018). Transfusion-associated necrotizing enterocolitis in preterm infants: an updated meta-analysis of observational data. Journal of Perinatal Medicine, 46(6), 677-685. doi:https://dx.doi.org/10.1515/jpm-2017-0162

Giovacchini, F., Bensi, C., Paradiso, D., Docimo, R., & Tullio, A. (2020). Association between blood transfusions and complications in head and neck reconstruction: a systematic review and meta-analysis. European Archives of Oto Rhino Laryngology, 01, 01. doi:https://dx.doi.org/10.1007/s00405-020-06286-z

Green, L., Bolton-Maggs, P., Beattie, C., Cardigan, R., Kallis, Y., Stanworth, S. J., . . . Zahra, S. (2018). British Society of Haematology Guidelines on the spectrum of fresh frozen plasma and cryoprecipitate products: their handling and use in various patient groups in the absence of major bleeding. British Journal of Haematology, 181(1), 54-67. doi:10.1111/bjh.15167

He, Y. K., Li, H. Z., & Lu, H. D. (2019). Is blood transfusion associated with an increased risk of infection among spine surgery patients?: A meta-analysis. Medicine, 98(28), e16287. doi:https://dx.doi.org/10.1097/MD.0000000000016287

Bibliography

Jeong, Y., Park, H., Jung, M. J., Kim, M. S., Byun, S., & Choi, Y. (2019). Comparisons of laboratory results between two blood samplings: Venipuncture versus peripheral venous catheter-A systematic review with meta-analysis. Journal of Clinical Nursing, 28(19-20), 3416-3429. doi:https://dx.doi.org/10.1111/jocn.14918

Kapoula, G. V., Kontou, P. I., & Bagos, P. G. (2017). The impact of pneumatic tube system on routine laboratory parameters: a systematic review and meta-analysis. Clinical Chemistry & Laboratory Medicine, 55(12), 1834-1844. doi:https://dx.doi.org/10.1515/cclm-2017-0008

Karam, O., Russell, R. T., Stricker, P., Vogel, A. M., Bateman, S. T., Valentine, S. L., . . . Sepsis Investigators, N. (2018). Recommendations on RBC Transfusion in Critically Ill Children With Nonlife-Threatening Bleeding or Hemorrhagic Shock From the Pediatric Critical Care Transfusion and Anemia Expertise Initiative. Pediatric Critical Care Medicine, 19(9S Suppl 1), S127-S132. doi:https://dx.doi.org/10.1097/PCC.0000000000001605

Keir, A., Pal, S., Trivella, M., Lieberman, L., Callum, J., Shehata, N., & Stanworth, S. J. (2016). Adverse effects of red blood cell transfusions in neonates: a systematic review and meta-analysis. Transfusion, 56(11), 2773-2780. doi:https://dx.doi.org/10.1111/trf.13785

Lesser, F. D., Lanham, D. A., & Davis, D. (2020). Blood sampled from existing peripheral IV cannulae yields results equivalent to venepuncture: a systematic review. JRSM Open, 11(5), 2054270419894817. doi:https://dx.doi.org/10.1177/2054270419894817

McQuilten, Z. K., French, C. J., Nichol, A., Higgins, A., & Cooper, D. J. (2018). Effect of age of red cells for transfusion on patient outcomes: a systematic review and meta-analysis. Transfusion Medicine Reviews, 32(2), 77-88. doi:https://dx.doi.org/10.1016/j.tmrv.2018.02.002

Mueller, M. M., Van Remoortel, H., Meybohm, P., Aranko, K., Aubron, C., Burger, R., . . . Group, I. P. F. (2019). Patient Blood Management: Recommendations From the 2018 Frankfurt Consensus Conference. JAMA, 321(10), 983-997. doi:https://dx.doi.org/10.1001/jama.2019.0554

Munoz, M., Stensballe, J., Ducloy-Bouthors, A. S., Bonnet, M. P., De Robertis, E., Fornet, I., . . . Hardy, J. F. (2019). Patient blood management in obstetrics: prevention and treatment of postpartum haemorrhage. A NATA consensus statement. Blood Transfusion, 17(2), 112-136. doi:https://dx.doi.org/10.2450/2019.0245-18

Muszynski, J. A., Guzzetta, N. A., Hall, M. W., Macrae, D., Valentine, S. L., Bateman, S. T., . . . Sepsis Investigators, N. (2018). Recommendations on RBC Transfusions for Critically Ill Children With Nonhemorrhagic Shock From the Pediatric Critical Care Transfusion and Anemia Expertise Initiative. Pediatric Critical Care Medicine, 19(9S Suppl 1), S121-S126. doi:https://dx.doi.org/10.1097/PCC.0000000000001620

New, H. V., Berryman, J., Bolton-Maggs, P. H., Cantwell, C., Chalmers, E. A., Davies, T., . . . Stanworth, S. J. (2016). Guidelines on transfusion for fetuses, neonates and older children. British Journal of Haematology, 175(5). doi:10.1111/bjh.14233

Rahouma, M., Kamel, M., Jodeh, D., Kelley, T., Ohmes, L. B., e Biasi, A. R., . . . Gaudino, M. (2018). Does a balanced transfusion ratio of plasma to packed red blood cells improve outcomes in both trauma and surgical patients? A meta-analysis of randomized controlled trials and observational studies. American Journal of Surgery, 216(2), 342-350. doi:https://dx.doi.org/10.1016/j.amjsurg.2017.08.045

Robinson, S., Harris, A., Atkinson, S., Atterbury, C., Bolton-Maggs, P., Elliott, C., . . . Taylor, C. (2018). The administration of blood components: a British Society for Haematology Guideline. Transfusion Medicine, 28(1), 3-21. doi:https://dx.doi.org/10.1111/tme.12481

Rygard, S. L., Jonsson, A. B., Madsen, M. B., Perner, A., Holst, L. B., Johansson, P. I., & Wetterslev, J. (2018). Effects of shorter versus longer storage time of transfused red blood cells in adult ICU patients: a systematic review with meta-analysis and Trial Sequential Analysis. Intensive Care Medicine, 44(2), 204-217. doi:https://dx.doi.org/10.1007/s00134-018-5069-0

Bibliography

Saadah, N. H., van Hout, F. M. A., Schipperus, M. R., le Cessie, S., Middelburg, R. A., Wiersum-Osselton, J. C., & van der Bom, J. G. (2017). Comparing transfusion reaction rates for various plasma types: a systematic review and meta-analysis/regression. Transfusion, 57(9), 2104-2114. doi:https://dx.doi.org/10.1111/trf.14245

Schiffer, C. A., Bohlke, K., Delaney, M., Hume, H., Magdalinski, A. J., McCullough, J. J., . . . Anderson, K. C. (2018). Platelet Transfusion for Patients With Cancer: American Society of Clinical Oncology Clinical Practice Guideline Update. Journal of Clinical Oncology, 36(3), 283-299. doi:https://dx.doi.org/10.1200/JCO.2017.76.1734

Shehata, N., Mistry, N., Costa, B. R., Pereira, T. V., Whitlock, R., Curley, G. F., . . . Mazer, C. D. (2019). Restrictive compared with liberal red cell transfusion strategies in cardiac surgery: a meta-analysis. European Heart Journal, 40(13), 1081-1088. doi:https://dx.doi.org/10.1093/eurheartj/ehy435

Simancas-Racines, D., Arevalo-Rodriguez, I., Urrutia, G., Buitrago-Garcia, D., Nunez-Gonzalez, S., Martinez-Zapata, M. J., . . . Hidalgo-Ottolenghi, R. (2019). Leukodepleted Packed Red Blood Cells Transfusion in Patients Undergoing Major Cardiovascular Surgical Procedure: Systematic Review and Meta-Analysis. Cardiology Research & Practice, 2019, 7543917. doi:https://dx.doi.org/10.1155/2019/7543917

Sommer, N., Schnuriger, B., Candinas, D., & Haltmeier, T. (2019). Massive transfusion protocols in nontrauma patients: A systematic review and meta-analysis. The Journal of Trauma and Acute Care Surgery, 86(3), 493-504. doi:https://dx.doi.org/10.1097/TA.0000000000002101

Soril, L. J. J., Noseworthy, T. W., Dowsett, L. E., Memedovich, K., Holitzki, H. M., Lorenzetti, D. L., . . . Clement, F. M. (2018). Behaviour modification interventions to optimise red blood cell transfusion practices: a systematic review and meta-analysis. BMJ Open, 8(5), e019912. doi:https://dx.doi.org/10.1136/bmjopen-2017-019912

Steiner, M. E., Zantek, N. D., Stanworth, S. J., Parker, R. I., Valentine, S. L., Lehmann, L. E., . . . Sepsis Investigators, N. (2018). Recommendations on RBC Transfusion Support in Children With Hematologic and Oncologic Diagnoses From the Pediatric Critical Care Transfusion and Anemia Expertise Initiative. Pediatric Critical Care Medicine, 19(9S Suppl 1), S149-S156. doi:https://dx.doi.org/10.1097/PCC.0000000000001610

Tasker, R. C., Turgeon, A. F., Spinella, P. C., Pediatric Critical Care, T., Anemia Expertise, I., Pediatric Critical Care Blood Research, N., . . . Sepsis Investigators, N. (2018). Recommendations on RBC Transfusion in Critically Ill Children With Acute Brain Injury From the Pediatric Critical Care Transfusion and Anemia Expertise Initiative. Pediatric Critical Care Medicine, 19(9S Suppl 1), S133-S136. doi:https://dx.doi.org/10.1097/PCC.0000000000001589

Trappey, A. F., Thompson, K. M., Kuppermann, N., Stephenson, J. T., Nuno, M. A., Hewes, H. A., . . . Nishijima, D. K. (2019). Development of transfusion guidelines for injured children using a Modified Delphi Consensus Process. Journal of Trauma and Acute Care Surgery, 87(4), 935-943. doi:10.1097/TA.0000000000002432

Valentine, S. L., Bembea, M. M., Muszynski, J. A., Cholette, J. M., Doctor, A., Spinella, P. C., . . . Sepsis Investigators, N. (2018). Consensus Recommendations for RBC Transfusion Practice in Critically Ill Children From the Pediatric Critical Care Transfusion and Anemia Expertise Initiative. Pediatric Critical Care Medicine, 19(9), 884-898. doi:https://dx.doi.org/10.1097/PCC.0000000000001613

Wang, Y., Shi, X., Du, R., Chen, Y., & Zhang, Q. (2018). Impact of red blood cell transfusion on acute coronary syndrome: a meta-analysis. Internal & Emergency Medicine, 13(2), 231-241. doi:https://dx.doi.org/10.1007/s11739-016-1594-4

Whitehead, N. S., Williams, L. O., Meleth, S., Kennedy, S. M., Ubaka-Blackmoore, N., Geaghan, S. M., . . . Graber, M. L. (2019). Interventions to prevent iatrogenic anemia: a Laboratory Medicine Best Practices systematic review. Critical Care (London, England), 23(1), 278. doi:https://dx.doi.org/10.1186/s13054-019-2511-9

Bibliography

Zantek, N. D., Parker, R. I., van de Watering, L. M., Josephson, C. D., Bateman, S. T., Valentine, S. L., . . . Sepsis Investigators, N. (2018). Recommendations on Selection and Processing of RBC Components for Pediatric Patients From the Pediatric Critical Care Transfusion and Anemia Expertise Initiative. Pediatric Critical Care Medicine, 19(9S Suppl 1), S163-S169. doi:https://dx.doi.org/10.1097/PCC.0000000000001625

Zhang, W., Yu, K., Chen, N., & Chen, M. (2019). Age of red cells for transfusion and outcomes in critically ill patients: A meta-analysis. Transfusion Medicine and Hemotherapy, 46(4), 248-256. doi:10.1159/000498863

Medical Disclaimer

Medicine is an ever-changing science. As new research and clinical experience broaden our knowledge, changes in treatment and drug therapy are required.

The authors have checked with sources believed to be reliable in their efforts to provide information that is complete and generally in accord with the standards accepted at the time of publication.

However, in view of the possibility of human error or changes in medical sciences, neither the authors nor Seattle Children's Healthcare System nor any other party who has been involved in the preparation or publication of this work warrants that the information contained herein is in every respect accurate or complete, and they are not responsible for any errors or omissions or for the results obtained from the use of such information.

Readers should confirm the information contained herein with other sources and are encouraged to consult with their health care provider before making any health care decision.