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Prehospital blood transfusion coalition clinical practice guideline for civilian emergency medical services

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PURPOSE

This Clinical Practice Guideline (CPG) provides essential instructions for prehospital blood product transfusion in civilian emergency medical service (EMS) systems. This guideline supports early resuscitation with blood products for patients experiencing hemorrhagic shock, regardless of etiology, with the objective of reducing mortality and improving clinical outcomes. Implementation of a prehospital blood transfusion program requires careful planning, appropriate training, quality control measures, adherence to regulations, close physician medical oversight, and coordination with regional blood suppliers and receiving facilities.

INTRODUCTION

Early administration of blood products to patients experiencing hemorrhagic shock, irrespective of etiology, has been demonstrated to improve survival.[1–7] Research indicates that patients who receive blood products within the initial minutes after injury or onset of hemorrhagic shock exhibit significantly decreased mortality compared with those who receive delayed transfusion.[2 3] Prehospital transfusion programs are, by their nature, resuscitation programs intended for patients with clear evidence of hemorrhagic shock. The body of evidence surrounding prehospital transfusion continues to evolve. When creating this CPG, the recent literature was reviewed, including, but not limited to, the 2025 Prehospital Trauma Compendium: Transfusion of Blood Products in Trauma–A Position Statement and Resource Document of the National Association of Emergency Medical Services Physicians (NAEMSP) by Brown *et al*. 1

This CPG represents the current position of the prehospital blood transfusion coalition and is meant to complement existing recommendations, while building on established principles. It is based on current evidence and best practices and is expected to evolve as the body of evidence expands. These guidelines serve to reaffirm the importance of robust clinical planning and implementation while addressing evolving needs in prehospital transfusion programs. As such, this CPG represents a living document intended to outline the indications, procedures, equipment, and monitoring required to safely administer blood products in the prehospital setting. [8 9] The coalition expects to review this document semi-annually. Updates to this CPG can be found at https://prehospitaltransfusion.org. Blood products encompass therapeutic substances derived from human blood, including components such as red blood cells (RBCs), plasma, platelets, and whole blood (WB), which are considered safe and effective treatments for hemorrhagic hemodynamically unstable patients.[10 11]

Effective team communication and coordination constitute the cornerstone of successful resuscitation from hemorrhagic shock. Team members are often tasked with multiple urgent interventions occurring in parallel; therefore, effective communication is essential to ensure positive patient outcomes and to prevent adverse effects. Structured handoffs between prehospital clinicians and hospital resuscitation teams are essential to ensure that relevant information is conveyed without delaying critical interventions. EMS systems seeking to implement prehospital blood transfusion are encouraged to implement standardized team communication and structured handoff procedures to enhance patient care continuity from the prehospital environment to definitive care.

These guidelines should be implemented in concert with local medical oversight and are not intended to supersede local protocols or medical direction. Successful prehospital blood programs must be thoughtfully planned, incorporate multiple safeguards, ensure adequate training and credentialing processes, and involve responsible stewardship of blood resources. Implementation requires clear indications for transfusion, both clinical and programmatic accountability, and appropriate documentation procedures.[12]

PREHOSPITAL PRINCIPLES OF RESUSCITATION AND TRANSFUSION

1. Rapid recognition of life-threatening hemorrhagic shock[1]:
   - Clinical assessment remains the cornerstone for recognition, including physiological parameters such as vital signs, shock index, end-tidal carbon dioxide ($ETCO_2$), and others.
   - Consider point-of-care testing devices if available, such as lactate measurement.
2. Hemorrhage control with appropriate adjuncts [13]:
   - Pressure dressings and wound packing (preferably with hemostatic products) for severe wounds.
   - Tourniquets for significant extremity hemorrhage.
   - Pelvic binders for suspected pelvic fractures.

- Wound packing or junctional tourniquets for junctional hemorrhage.

3. Vascular access must be promptly obtained:
   - Intravenous access (18 g or greater) is preferred.
   - If intravenous access cannot be rapidly established, obtain intraosseous access.
     - Humeral intraosseous access is preferred over tibial access due to significantly higher flow rates.
4. Hemostatic resuscitation:[14 15]
   - WB when available.
     - Low-titer O WB.
   - Plasma.
   - Packed RBCs.
     - Aim for balanced 1:1 ratio of plasma to RBCs when possible.
5. Minimize crystalloid use:
   - Limit crystalloid resuscitation to less than 500 mL.
   - Excessive crystalloid worsens coagulopathy and contributes to hemodilution.
6. Prevent hypothermia:
   - Use appropriate warming devices for blood products.
   - Maintain patient temperature with passive warming measures.
   - Consider active warming devices when available.
7. Tranexamic Acid (TXA) administration:
   - For patients who will receive blood and are within 3 hours of injury.
   - Adult dose options:
     - 2 g intravenous/intraosseous once.
     - 1 g intravenous/intraosseous over 10 min, followed by 1 g over 8 hours.
   - Pediatric dose:
     - 15 mg/kg (maximum 1 gram) intravenous over 10 min.
8. Calcium replacement: [16]
   - Consider calcium intravenous after 2 units of blood products have been administered and after other hemostatic interventions are completed.
     - Calcium Gluconate 3 g (less caustic to tissue).
     - Calcium chloride 1 g.
     - Monitor for signs of hypercalcemia.
   - Pediatric dose:
     - 60 mg/kg calcium gluconate.
     - 20 mg/kg calcium chloride.
   - Flush the line with a minimum of 10 mL of saline
   - Monitor closely for signs of intravenous/intraosseous infiltration/extravasation.

CRITERIA FOR TRANSFUSION

Clinical indications

Suspected hemorrhagic shock from trauma or medical cause

Adults

- Systolic blood pressure (SBP) less than 90 mm Hg (or less than 100 mm Hg in patients 65 years and older), or weak or absent radial pulse, and.[17]
- Heart rate (HR) greater than or equal to 100 bpm unresponsive to initial interventions, or.
- Shock Index (HR/SBP) greater than 1.0.

Pediatrics

- SBP less than 70+ (age in years×2).
- HR:
  - 1 year: greater than 190.
  - 2–10 years: greater than 140.

Table 1 Clinical indicators of hemorrhagic shock

Clinical indicator	Description
Hypotension	Systolic BP<90 mm Hg
Tachycardia	Heart rate >100 bpm; unresponsive to initial interventions
Respirations	Rapid/shallow respirations
Pulse quality	Weak, thready pulse
Capillary refill	>2 s
Mental status	Decreased (excluding head injury and/or intoxication)
$ETCO_2$	<25 mm Hg
Skin	Pale, cool, clammy
Bleeding	Active hemorrhage from non-compressible source
Shock Index	>1.0 (heart rate/systolic BP)

BP, blood pressure; $ETCO_2$, end-tidal carbon dioxide.

AND (for all patients)

One or more of the following physiological criteria indicative of hypoperfusion

- Altered mental status (not believed to be due to intoxication or head injury).
- Pale, cool, clammy skin; pale mucosa.
- Delayed capillary refill (>2 s).
- Tachypnea.
- $ETCO_2$ <25 mm Hg (table 1).

Exclusions from transfusion

- Conscious patients, with decision-making capacity, should be evaluated for refusal of blood transfusion, whether for religious, cultural, social, or personal reasons.
- Unconscious or incapacitated patients should be briefly assessed for the presence of medical alert identifiers, power of attorney wallet cards, or other obvious documents indicating patient objection to receiving blood products.
  - This good-faith effort shall not delay transfusion more than 1 min and should ideally occur in approximately 30 s.

Examples of patient presentations consistent with suspected hemorrhagic shock necessitating prehospital blood transfusion

Trauma patients with uncontrolled hemorrhage

- Any proximal amputation above knee/elbow or amputations requiring a tourniquet.
- Penetrating trauma to neck/chest/abdomen/pelvis with signs of shock.
- Evidence of significant blood loss (>500 mL estimated).
- Unstable pelvic fracture with hemodynamic instability.

Medical patients with significant hemorrhage

- Gastrointestinal bleeding.
- Ruptured ectopic pregnancy.
- Peripartum hemorrhage.
- Ruptured aortic (thoracic or abdominal) aneurysm.
- Ruptured arteriovenous (AV) fistulas/grafts.
- Postsurgical complications.
- Epistaxis.
- Post-tonsillectomy bleeding.
- Other causes of significant blood loss.

Special populations

Patients with known bleeding disorders who are in hemorrhagic shock

- Resuscitation priority should be given to the administration of blood products first, followed by appropriate treatment for the specific bleeding disorder.

Pregnant patients

- Consider early blood administration for suspected obstetric or postpartum hemorrhage with signs of hemorrhagic shock.[18 19]
- Place in left-lateral recumbent position (left side down).
- When O-positive blood is administered to females of childbearing potential, ensure that it is communicated to the receiving attending physician that Rhesus Factor positive (Rh+) blood was transfused.

Special considerations

- If O-positive blood is administered to Rh-negative females of childbearing potential, inform receiving facility for potential postdischarge consultation with hospital transfusion services and maternal-fetal medicine.[20]
  - Additional information and resources can be found at https://allohopefoundation.org.
- There is no role for the administration of RhoGAM in the acute resuscitation of hemorrhagic shock.

EQUIPMENT REQUIREMENTS

1. FDA-approved blood storage container/cooler validated for prehospital use (table 2).
2. Temperature monitoring devices with local alarms, as well as remote tracking and audit capabilities consistent with established requirements.
3. Blood administration sets with 170–260 µm filter.
4. Blood warming devices.
5. Rapid infusion devices.
6. Large-bore intravenous/intraosseous access equipment.
7. Vital signs monitoring equipment.

PROCEDURE

Preparation and storage

1. Maintain blood products in approved storage containers between 1°C and 6°C or as outlined in the agency Blood Services Agreement.
2. Monitor and document temperature continuously.
3. Inspect blood products for:
   - Expiration date.
   - Integrity of the bag.
   - Evidence of hemolysis, clotting, or contamination.
   - Temperature indicator compliance.

Adult dosing guidance

- Initial dose: One unit of any blood product.
- Reassess vital signs and clinical response every 3 min and after each unit.
  - As with all medications, monitoring the response to blood products needs to be performed continuously. While there is a small risk of over-resuscitation with multiple units of prehospital blood products being transfused, this risk can be mitigated by reassessment of vital signs and the patient's physiological response.
- Administer additional units as indicated.

Table 2 Blood product cold chain storage requirements

Parameter	Requirement
Temperature	1°C–6°C (storage) 1°C–10°C (transport)
Monitoring	Continuous with audible alarm capability
Documentation	Temperature log maintained
Container	Validated by blood supplier
Maximum time outside controlled storage	4 hours for transfusion
Maximum time in an approved, locally validated cooler	Per cooler (typically 24–48 hours)

- Target SBP 90–100 mm Hg (permissive hypotension) for hemorrhagic shock from trauma or obstetric/medical conditions.
- Target higher SBP (>110 mm Hg) for patients with traumatic brain injury (TBI) or suspected neurological injury.

Pediatric dosing guidance

- Initial dose:
  - <35 kg: 10 mL/kg of unit of any blood product.
  - >35 kg: One unit of any blood product.
- Reassess vital signs and clinical response after each unit.
- Additional units based on clinical response and transport time.
- Target age-appropriate SBP for hemorrhagic shock from trauma or obstetric/medical conditions.
- Target higher SBP (>110 mm Hg) for patients with TBI or suspected neurological injury.

TRANSFUSION PROCESS

1. Obtain preferably two points of intravenous/intraosseous access (18 gauge or larger preferred) (box 1).
2. Quickly assess for any indicators that the patient would not want to receive blood products (verbal religious preference, medical alert tag, wallet card).
   - This should not delay patient care.
3. Verify and document blood product identification:
   - Product type
   - Unit/donor number.
   - Expiration date
   - Blood type.
   - Temperature indicator status (if present).
4. Connect administration set with appropriate filter to blood product.
5. Prime straight-type blood tubing with blood (no saline).
6. Prime Y-type blood tubing with saline.
7. Connect to warming device and/or rapid infusion device.
   - Strongly encouraged, if available.
8. Connect the blood tubing directly to the intravenous/intraosseous hub. Do not connect the blood through an extension set that is smaller in diameter than the blood tubing. For intraosseous access, if using manufacturer-provided 90° angle extension, consider removal to facilitate easier flow.
9. Infuse over 3–5 min as clinically indicated.
10. Monitor vital signs every 5 min during transfusion (before, during, and after transfusion):
    - BP.
    - HR.
    - Respiratory rate.
    - Oxygen saturation
    - $ETCO_2$.
    - Temperature when possible.

Box 1 Prehospital blood transfusion procedure checklist

Before transfusion:
⇒ Confirm indication for transfusion meets criteria.
⇒ Quickly assess for indicators that the patient would not want to receive blood (verbal consent if possible, medical alert tag, wallet card).
⇒ Establish adequate intravenous/intraosseous access (ideally 2 points of access).
⇒ Obtain and record baseline vital signs.
⇒ Verify blood product unit information and expiration.
⇒ Check temperature indicator on blood bag (if present).
⇒ Inspect blood product for abnormalities.
⇒ Prepare administration set with appropriate filter.

During transfusion:
⇒ Monitor vital signs every 5 min before, during, and after transfusion.
⇒ Watch for signs of transfusion reaction.
⇒ Document time transfusion started.

After transfusion:
⇒ Record post-transfusion vital signs.
⇒ Document time transfusion completed.
⇒ Document total volume infused.
⇒ Notify receiving facility of blood administration.
⇒ Transport all blood product bags to hospital.
⇒ Complete all required documentation.
⇒ Return unused products according to protocol.

Quality management:
⇒ Maintain detailed records of all blood products deployed in the field including daily check-off procedures.
⇒ Have a local database of all prehospital blood cases to track administration and patient outcomes.
⇒ Immediate post-transfusion hot-wash with emergency medical service clinicians.
⇒ Review case in detail: Indications, procedure, documentation, outcomes.
⇒ Ensure that a prescriber's authorization note is attached/uploaded to the prehospital chart.

11. Document vital signs before, during, and after transfusion.
12. Monitor for signs of transfusion reaction.

TRANSFUSION REACTIONS

Signs and symptoms

Acute anaphylactic reaction

- Hypotension or hypertension.
- Flushed face, urticaria, or rash.
- Wheezing or respiratory distress.
- Fever or chills.
- Flank pain.
- Chest pain or back pain.
- Nausea/vomiting.

Management

1. Stop transfusion immediately.
2. Maintain intravenous access to keep the line open.
3. Administer oxygen as needed.
4. For anaphylaxis:
   - Epinephrine 0.3–0.5 mg of 1:1000 intramuscular.
   - Diphenhydramine 25–50 mg intravenous/intraosseous/intramuscular.
   - Consider methylprednisolone 125 mg or dexamethasone 4-8g intravenous for severe reactions.
5. Notify receiving facility of suspected transfusion reaction.
6. Transport all blood product bags/documentation to hospital.

DOCUMENTATION REQUIREMENTS

1. Blood products are documented as a medication.
2. Every transfusion should have two procedures listed:
   - 1. Route (intravenous/intraosseous).
   - 2. Transfusion of blood products.
3. Blood product information:
   - Type of blood product.
   - Unit/donor number.
   - Expiration date.
   - Time of removal from storage.
   - Temperature status during storage and transport.
4. Transfusion details:
   - Time transfusion started and completed.
   - Total volume transfused.
   - Route of administration.
   - Post-transfusion physician authorization statement with signature (see online supplemental appendix A).
5. Patient assessment:
   - Verification of consent (verbal or implied).
   - Vital signs pretransfusion, during (every 3 min), and post-transfusion.
   - Clinical presentation and indication for transfusion.
   - Patient response to transfusion.
6. Additional interventions:
   - Hemorrhage control.
   - Calcium administration.
   - TXA administration.
   - Other medications or interventions.
7. Adverse events:
   - Description of any reaction.
   - Interventions performed.
   - Patient response
8. Handoff information:
   - Notification to receiving facility.
   - Blood product bag(s) with segments attached.
   - Transfusion-related paperwork.
   - Disposition of unused blood products.

QUALITY CONTROL MEASURES

1. Storage and transport:
   - Continuous temperature monitoring with documentation.
   - Regular inspection of storage containers.
   - Proper handling procedures.
2. Equipment maintenance:
   - Regular checks of administration equipment.
   - Calibration of warming devices, if needed.
3. Personnel:
   - Initial and ongoing training.
   - Skills verification for all providers.
   - Competency-based assessment annually.
4. Program management:
   - Case review of all prehospital transfusions (consider as sentinel event).
   - Tracking of clinical outcomes (see online supplemental appendix B).
   - Regular reporting to medical director.
   - Blood product utilization analysis.

- Wastage monitoring and reduction strategies.

TRAINING REQUIREMENTS

1. Initial training[21]:
   - Pathophysiology of hemorrhagic shock.
   - Blood product overview and indications.
   - Recognition of hemorrhagic shock.
   - Transfusion procedures and equipment.
   - Recognition and management of transfusion reactions.
   - Storage and transport requirements.
   - Documentation requirements
   - Practical skills demonstration.
   - Processes for non-conformance, recall, quarantine, and discard of blood products.
2. Continuing education:
   - Annual refresher training.
   - Annual skills verification and simulation.
   - Case reviews and lessons learned.
   - Updates to protocols or equipment
3. Competency validation:
   - Written examination.
   - Practical skills assessment.
   - Simulation scenarios.
   - Clinical oversight during initial cases

PROGRAM IMPLEMENTATION CONSIDERATIONS

1. Training and education:[20]
   - Initial didactic training.
   - Hands-on skills practice and sign-off.
   - Simulation and case-based training.
   - Ongoing demonstration of procedural competency and skills currency.
2. Medical oversight[22] :
   - Transfusion Administration Service Medical Director shall have authority and responsibility for all medical and technical policies, processes, and procedures that relate to the care and safety of the transfusion recipient.
   - Regular protocol review and updates.
   - Credentialing of all personnel who are authorized to administer prehospital blood.
   - 100% total quality review on every prehospital transfusion case.
   - Reports, reviews, audits, and follow-up of transfusion-related reactions, including Food and Drug Administration Fatality Reporting events.
3. Blood product management:
   - Coordination with blood suppliers.
   - Storage and transport requirements.
   - Rotation protocols to minimize wastage.
   - Documentation requirements.
   - Return policies for unused products.
4. Hospital coordination:
   - Communication protocols with receiving facilities including the hospital blood bank.
   - Handoff procedures for transfused patients.
   - Handoff procedures for blood products.
   - Tracking of patient outcomes.
5. Infrastructure requirements:
   - Proper storage facilities.
   - Temperature monitoring systems.
   - Administration equipment.
6. Community engagement:
   - Outreach to local EMS agencies regarding operational questions, the handling of mutual aid requests, and deployment strategies.
   - Public messaging and communication with general and healthcare community members including resources and frequently asked questions.
   - Support from policy-makers to help facilitate program implementation.
7. Administrative considerations:
   - Costs and billing procedures.
   - Legal and regulatory compliance.
   - Document control, reviewed minimum of every 2 years.
   - Data collection for quality improvement.
   - Outcomes reporting, registry participation.

Correction notice This article has been corrected since it published online to correct the author name to Randall M Schaefer.

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