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Prehospital blood transfusion coalition core competencies for emergency medical services personnel

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ABSTRACT

Prehospital blood transfusion is increasingly recognized as a critical intervention for patients in hemorrhagic shock, yet wide variability in training and practice persists. This competency framework is aligned with the AABB (American Association of Blood and Biotherapies) *Standards for Emergency Prehospital and Scheduled Out-of-Hospital Transfusions*. This document defines the core knowledge, skills, and abilities required of emergency medical services personnel authorized to administer blood products in the prehospital setting. Competencies include transfusion administration, complication recognition and management, and adherence to quality and safety standards. Implementation requires structured curricula, competency validation, ongoing education, and continuous quality improvement under medical oversight. These recommendations are intended to integrate with local regulations and agency policies, with regular updates to maintain relevance. Standardized competencies strengthen workforce preparedness and enhance the safety and effectiveness of prehospital transfusion programs.

PURPOSE

These competencies establish the coalition's recommendations for comprehensive educational standards and competency requirements for emergency medical services (EMS) personnel authorized to administer blood products in the prehospital environment. This guideline serves as a resource document to ensure that EMS clinicians possess the requisite knowledge, skills, and competencies to safely and effectively perform blood transfusions, recognize and manage complications, and maintain quality standards. Implementation of standardized training programs requires systematic curriculum development in alignment with established educational principles, competency validation, ongoing education, quality improvement measures, and close medical oversight in accordance with established standards and best practices.[1–3]

The content and recommendations within this document should be implemented in coordination with local medical oversight, regulatory requirements, and organizational policies, along with accepted pedagogical and evaluative principles. Regular review and updates ensure continued relevance and effectiveness in preparing EMS clinicians for safe and competent blood product administration.

WHAT IS ALREADY KNOWN ON THIS TOPIC

⇒ Prehospital transfusion programs continue to increase, but there is great variability and a paucity of established training standards for emergency medical service (EMS) clinicians.

WHAT THIS STUDY ADDS

⇒ We provide an evidence-based, best-practice approach to guide the development of educational content on prehospital transfusion for EMS clinicians.

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

⇒ These core competencies can help minimize variability in educational content by providing a standardized foundation for EMS educators to develop learning materials.

INTRODUCTION

The administration of blood products in the prehospital setting requires specialized training beyond standard paramedic education. As prehospital blood transfusion programs continue to expand across civilian EMS systems, there is a critical need for standardized training competencies to ensure patient safety and optimal clinical outcomes.[4–6] Early blood product administration significantly improves survival in patients with hemorrhagic shock, making proper training essential for successful program implementation.[7–10]

This document establishes evidence-based training standards that address the unique challenges of prehospital blood administration. These competencies encompass medical knowledge requirements, operational competencies, administrative responsibilities, technical skills, and ongoing professional development. These standards should be implemented in coordination with local medical oversight and are designed to complement existing EMS education frameworks while addressing the specialized requirements of blood product administration.[11 12]

Effective training programs must incorporate multiple educational modalities, including didactic instruction, simulation-based learning, practical skills assessment, transfusion case study analysis and ongoing competency validation, using established frameworks such as Kern's six-step model.[13] The goal of this training should be to develop clinicians who can confidently identify appropriate

candidates for blood transfusion, perform the procedure safely, recognize and manage complications, and maintain proper documentation and quality standards.

TRAINING PRINCIPLES AND FRAMEWORK

1. Competency-based education model
   - All learning objectives must have corresponding educational content delivery strategies.[13]
   - Training must include both asynchronous and synchronous learning components.[13]
   - Assessment strategies must validate both knowledge and practical performance.
   - Competency validation must occur under realistic simulated scenarios.[14 15]
2. Systematic curriculum development
   - Use established educational frameworks (eg, Kern's six-step model).[13]
   - Align training objectives with National EMS Education Standards.[11 12]
   - Incorporate evidence-based best practices and current research.[1 2]
   - Address system-specific protocols and procedures.[3 16]
3. Multimodal learning approach
   - Didactic instruction for theoretical knowledge.[13]
   - Simulation-based training for practical skills.[14 15]
   - Case-based learning for clinical decision-making.[13]
   - Scenario-based assessment for competency validation.[13]
4. Continuous training quality improvement
   - Regular evaluation of training effectiveness.[17]
   - Integration with ongoing quality assurance processes.[2 3]
   - Feedback mechanisms for continuous program improvement.[13]
   - Outcomes tracking and performance measurement.[17]

CORE COMPETENCY DOMAINS

Domain 1: medical knowledge competencies

A. Hemorrhagic shock recognition and management

Learning objectives:

- Describe common etiologies of hemorrhagic shock, including traumatic, medical, and obstetric causes.[7 8]
- Identify clinical signs and symptoms of hemorrhagic shock:
  - Altered mental status.
  - Tachycardia and hypotension.
  - Weak pulses and delayed capillary refill.
  - Low $ETCO_2$ and other physiological parameters.
  - Comprehensive patient physical assessment and history, coupled with scene details.
- Explain vital sign variability and shock index calculation (SI=HR/SBP).[1]
- Assess external and internal blood loss estimation challenges.
  - Training should include techniques to estimate volumetric blood loss.
- Explain pathophysiological effects on tissue perfusion, cellular metabolism, and hemostasis.[1]
- Identify high-risk patients in the prehospital environment.
- Apply comprehensive hemorrhage control guidelines (TECC/TCCC/RDCR).[18]

B. Blood component knowledge and physiology

Learning objectives:

- Differentiate between blood product types:
  - Whole blood (low-titer O positive).[19 20]
  - Packed red blood cells.
  - Plasma (liquid and dried formulations).[21]
- Explain indications, contraindications, and physiological rationale for each product.[1 2]
- Compare the benefits and risks of blood products versus crystalloid/colloid volume expanders.[1]
- Understand cold-chain storage requirements and handling procedures while noting common complicating factors and potential system deficiencies.[2 16]

C. Clinical decision-making and indications

Learning objectives:

- Identify field indications for blood transfusion based on protocols and patient assessment.
- Evaluate contraindications and protocol exclusion criteria.
- Apply clinical decision tools and algorithms for transfusion candidacy.
- Demonstrate appropriate patient selection and timing decisions.

D. Transfusion reactions and complications

Learning objectives:

- Classify transfusion reactions:
  - *Acute reactions*: allergic, anaphylactic, febrile.
  - *Delayed reactions*: TRALI, TACO, hemolytic.
  - *Special considerations*: hemolytic disease of the fetus and newborn.[22–24]
- Recognize clinical manifestations through scenario review.
- Describe immediate management protocols for suspected reactions.[1 2]
- Understand reporting requirements and documentation standards.[16]

E. Special populations and cultural considerations

Learning objectives:

- Identify considerations for pediatric, obstetric, and geriatric patients.[22 23]
- Address religious and cultural sensitivities regarding blood products.[1 2]
- Document patient refusals and preferences appropriately while establishing patient capacity for this decision.
- Understand consent processes and ethical considerations.[1]

Domain 2: operational competencies

A. Protocols and practice guidelines

Learning objectives:

- Demonstrate familiarity with local EMS transfusion protocols.
- Understand medical oversight, authorization, and documentation standards.
- Communicate clinical findings using standardized handoff tools.
- Integrate with receiving facility procedures and expectations.

B. Quality improvement and safety

Learning objectives:

- Participate in mandatory transfusion case reviews at the local/regional EMS systems level.
- Identify and report adverse incidents and near misses.
- Engage in reflective practice following cases and simulation exercises.
- Contribute to continuous quality improvement initiatives.

Domain 3: administrative and regulatory competencies

A. Blood product logistics and stewardship

Learning objectives:

- Understand blood product requisition, storage, and transport procedures.

- Demonstrate temperature monitoring and chain-of-custody documentation.
- Apply blood stewardship principles to minimize unnecessary use and wastage.
- Coordinate with blood suppliers and receiving facilities.

B. Regulatory compliance and documentation

Learning objectives:

- Understand laws, regulations, and guidelines governing prehospital blood administration.[16]
- Maintain complete and accurate records per local, state, and federal requirements.[2 16]
- Comply with adverse event reporting procedures.[2 16]
- Understand liability and legal considerations.

Domain 4: technical and practical skills

A. Product preparation and verification

Practical skills:

- Demonstrate proper blood handling, including pre-use inspection and warming procedures.
- Perform verification processes: patient identification, product matching, expiration verification.
- Conduct a physical inspection to ensure product integrity.
- Assemble department-specific equipment: intravenous/intraosseous access, infusion devices, filters, warming equipment.

B. Transfusion administration

Practical skills:

- Initiate transfusion according to protocol with appropriate flow rates and monitoring.
- Implement structured assessment and reassessment procedures, including patient vital signs, before and during transfusion.
- Monitor for clinical response and early complication signs.
- Appropriately interrupt the transfusion if complications arise.
- Perform emergency medical treatment for transfusion reactions.

C. Post-transfusion management and documentation

Practical skills:

- Document transfusion details: time, product, lot number, patient information, complications.
- Communicate transfusion history during transport and hospital handoff.
- Provide a complete clinical summary and transfusion documentation to the receiving facility on patient turnover.
- Ensure proper disposition of blood products and documentation.

Domain 5: teamwork and professional development

A. Team communication and system integration

Learning objectives:

- Coordinate team roles for safe and efficient blood administration.
- Demonstrate closed-loop communication during resuscitative efforts.
- Engage effectively with hospital staff, blood banks, and regional partners.
- Prioritize transparency in all interactions and nurture a collaborative and inclusive environment for all stakeholders.
- Establish a process where system participants can voice concerns to either the American Association of Blood and Biotherapies (AABB) or appropriate system leadership.
- Facilitate seamless care transitions and continuity.

B. Ongoing education and professional development

Learning objectives:

- Complete initial credentialing requirements for blood administration.
- Participate in regular (annual at a minimum) refresher training and simulation assessments.
- Engage in case periodic reviews (semiannual at a minimum) and continuing education activities.
- Maintain active credentialing through competency demonstration.
- Identify personal learning needs and pursue knowledge advancement.

TRAINING IMPLEMENTATION REQUIREMENTS

1. Initial training program

Minimum requirements:

- Duration: minimum 8 hours of instruction (based on successful program models).[13]
  - *Didactic component*: comprehensive curriculum covering all competency domains.[13]
  - *Simulation component*: hands-on skills training with realistic scenarios.[14 15]
- Assessment:
  - Written examination and practical skills evaluation.[13]
  - Demonstrated proficiency, by way of competency validation in all required skills.[2]

2. Practical skills assessment

Required demonstrations:

- Blood product inspection and verification procedures.
- Transfusion initiation and monitoring protocols.
- Complication recognition and management.
- Documentation and communication requirements.
- Equipment setup and troubleshooting.

3. Simulation-based training

Scenario requirements:

- Hemorrhagic shock recognition and decision-making.[1 7]
- Transfusion reaction management.[2]
- Equipment failure and problem solving.[13]
- Communication and teamwork exercises.[1]
- High-stress environment training.[13]

4. Competency validation process

Assessment methods:

- Written examination (minimum 80% passing score).[13]
- Practical skills checklist completion.[13]
- Simulation scenario performance evaluation.[14 15]
- Clinical oversight during initial cases.[17]
- Ongoing performance monitoring.[17]

CONTINUING EDUCATION REQUIREMENTS

1. Annual refresher training

Required components:

- Review of core competencies and recent updates.[17]
- Case-based learning from local experiences.[13 17]
- Skills practice and validation.[2]
- Quality improvement review and feedback.[17]
- Protocol updates and regulatory changes.[16]

2. Ongoing competency maintenance

Requirements:

- Annual skills assessment and validation.[2 13]
- Participation in case review processes.[17]
- Completion of continuing education hours.[2]
- Demonstration of current competency.[17]
- Peer review and feedback processes.[17]

3. Advanced training opportunities

Optional enhancements:
- Pediatric blood transfusion specialization.[22 23]
- Mass casualty event training.[4 5]
- Cultural competency education.[24]
- Leadership and mentorship development.[17]
- Research and quality improvement projects.[17]

QUALITY ASSURANCE AND PROGRAM MANAGEMENT

1. Training program oversight

Requirements:
- Medical director supervision and approval.[17]
- Regular curriculum review and updates.[2 13]
- Instructor qualification and training.[13]
- Program effectiveness evaluation.[13]
- Continuous improvement processes.[17]

2. Documentation and record keeping

Requirements:
- Individual training records and certifications.[16]
- Competency assessment documentation.[2 16]
- Continuing education tracking.[2]
- Quality metrics and outcomes measurement.[17]
- Regulatory compliance documentation.[16]

3. Performance monitoring

Metrics:
- Training completion rates and success.[13]
- Competency assessment scores.[13]
- Field performance outcomes.[17]
- Incident and adverse event rates.[2 16]
- Patient safety indicators.[17]

IMPLEMENTATION CONSIDERATIONS

1. System readiness assessment
- Evaluate organizational capacity for training program.[3 13]
- Assess available resources and infrastructure.[13]
- Identify training personnel and expertise.[13]
- Determine equipment and facility requirements.[2]
- Establish partnerships with educational institutions.[13]

2. Phased implementation approach
- Pilot program with selected personnel.[13 17]
- Gradual expansion based on experience.[17]
- Continuous feedback and program refinement.[13 17]
- Integration with existing training programs.[11 12]
- Coordination with operational deployment.[17]

3. Resource requirements

Personnel:
- Medical director oversight.[17]
- Qualified instructors and simulation specialists.
- System accountability officer and outside agency liaison.[13–15]
- Administrative support staff.[13]
- Clinical mentors and preceptors.[17]

Equipment and facilities:
- Simulation laboratory and equipment.[14 15]
- Training materials and resources.[13]
- Assessment tools and documentation systems.[13]
- Blood products or an acceptable substitute for training purposes.[14 15]

Financial considerations:
- Training development and implementation costs.[13]
- Personnel time and compensation.[13]
- Equipment and facility expenses.[13]
- Ongoing maintenance and updates.[17]

EVALUATION AND OUTCOMES MEASUREMENT

1. Training effectiveness metrics
- Knowledge retention and skill maintenance.[13]
- Competency assessment performance.[13]
- Field performance and protocol compliance.[17]
- Patient safety and clinical outcomes.[17]
- Provider confidence and satisfaction.[13]

2. Program quality indicators
- Training completion and certification rates.[13]
- Time to competency achievement.[13]
- Remediation and additional training needs.[13]
- Instructor effectiveness and feedback.[13]
- Curriculum relevance and currency.[17]

3. Continuous improvement process
- Regular program evaluation and review.[17]
- Stakeholder feedback and input.[17]
- Best practice identification and sharing.[1 2]
- Research and evidence integration.[1 2]
- Adaptation to changing requirements.[3]

REGULATORY COMPLIANCE AND STANDARDS

1. National standards alignment
- Compliance with National EMS Education Standards.[11]
- Integration with National EMS Scope of Practice.[12]
- Adherence to AABB standards and guidelines.[16]
- Coordination with state and local regulations.

2. Accreditation and certification
- Alignment with accreditation requirements.
- Integration with existing certification processes.
- Documentation of regulatory compliance.
- Maintenance of professional standards.

3. Legal and ethical considerations
- Understanding of liability and risk management.
- Compliance with informed consent requirements.
- Protection of patient rights and privacy.
- Adherence to professional ethical standards.

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