Key Question for Prehospital EMS Blood Transfusion

PURPOSE:

To support the development of a systematic review (SR) on the feasibility, effectiveness, and safety of blood and blood product transfusions administered in the prehospital setting. The statement of work (SOW) will set the scope for a medium topic refinement and an option for a medium or large SR. The results of the SR will inform future prehospital care evidence-based guidelines (EBG), protocols, and state and local EMS agency decision-making.

BACKGROUND:

The NHTSA Office of Emergency Medical Services (OEMS) mission is to reduce death and disability by providing leadership and coordination to the emergency medical services (EMS) community in assessing, planning, developing, and promoting comprehensive, evidence-based emergency medical services systems.

NHTSA is the federal leader for motor vehicle and traffic safety, with a history of successfully promoting and advancing injury prevention in its policies, programs, and practices. EMS also plays a significant role in ensuring the safety and care of crash victims across the nation's highways and roadways. The U.S. Department of Transportation's (DOT) 2022 National Roadway Safety Strategy (NRSS) emphasizes a safe system approach that identifies post-crash care as one of five key objectives in creating a transportation system safe for all people.

Motor vehicle crashes are a leading cause of trauma-related deaths, often resulting in severe bleeding and hypovolemic shock. The potential impact of prehospital blood transfusion in such scenarios is substantial, as early intervention could mitigate the consequences of hemorrhage and improve survival rates. Recognizing the importance of evidence-based practices, there is a pressing need for a systematic review of the existing literature on prehospital blood transfusion. This review would critically assess the available studies, evaluating the efficacy, safety, and risks of administering blood transfusions in the prehospital environment.

The history of prehospital blood transfusion dates to the early 20th century, with the advent of World War I which highlighted the need for rapid and effective blood transfusions on the battlefield. However, the logistics and limitations of early medical technologies made prehospital blood transfusions a challenging feat. Over the years, advancements in medical science and technology have facilitated the development of more portable and efficient blood transfusion methods. Despite these improvements, prehospital blood transfusion remains a complex and debated topic, as the benefits must be carefully weighed against potential risks and logistical challenges.

Prehospital blood transfusion studies and pilot programs have explored the feasibility, safety, and effectiveness of such interventions. While some regions have implemented programs successfully, the science behind these practices is continually evolving. Training and equipment advances have empowered prehospital providers to administer whole blood and blood components, such as packed red blood cells and plasma, to trauma patients on scene, potentially improving outcomes, particularly in cases of severe hemorrhage.

The results of a systematic review would serve as a crucial resource for prehospital care evidence-based guidelines, protocols, and state and local EMS agency decision-making. By synthesizing the existing evidence, the review would offer insights into the overall effectiveness of prehospital blood transfusion in different contexts, helping to refine guidelines and inform training programs for EMTs and paramedics. Additionally, it could address concerns related to potential adverse effects and logistical challenges, ensuring a balanced approach to implementation. Ultimately, a systematic review would contribute to evidence-based practices in prehospital care, shaping policies that maximize the potential benefits of blood transfusions while minimizing associated risks.

An interagency agreement funded the Agency for Healthcare Research and Quality (AHRQ) for a medium topic refinement with an option for a medium or large systematic review on EMS prehospital blood transfusion**.**

Approach/Methods:

The proposed systematic review will be conducted using a methodology established by the AHRQ EPC program, with the work conducted by a one of AHRQ's designated Evidence-based Practice Centers (EPC). These EPCs develop evidence reports to inform clinical decision-making and actions. The SR would address key questions developed under the topic refinement. The draft key questions are included below.

DRAFT KEY QUESTIONS:

Key Question 1

a. What are the comparative benefits and harms of low-titer group O whole blood transfusion compared with component blood therapy transfusion for patients requiring prehospital hemostatic resuscitation?

b. Are the comparative benefits and harms modified by:

   i. Prehospital emergency medical services protocol (including transfusion volume, adjuvant medication co-administration, or isotonic fluid co-infusion)?

   ii. Patient characteristics (including age, gender, nature of illness, or mechanism of injury)?

   iii. Characteristics of the emergency medical services system (including air medical versus ground ambulance, personnel certification, or service delivery model)?

Key Question 2

a. What are the comparative benefits and harms of low-titer group O whole blood transfusion compared with fluid resuscitation for patients requiring prehospital hemostatic resuscitation?

b. Are the comparative benefits and harms modified by:

   i. Prehospital emergency medical services protocol (including transfusion volume, adjuvant medication co-administration, or isotonic fluid co-infusion)?

   ii. Patient characteristics (including age, gender, nature of illness, or mechanism of injury)?

   iii. Characteristics of the emergency medical services system (including air medical versus ground ambulance, personnel certification, or service delivery model)?

Key Question 3

a. What are the comparative benefits and harms of component blood therapy transfusion compared with fluid resuscitation for patients requiring prehospital hemostatic resuscitation?

b. Are the comparative benefits and harms modified by:

   i. Prehospital emergency medical services protocol (including transfusion volume, adjuvant medication co-administration, or isotonic fluid co-infusion)?

ii. Patient characteristics (including age, gender, nature of illness, or mechanism of injury)?

iii. Characteristics of the emergency medical services system (including air medical versus ground ambulance, personnel certification, or service delivery model)?

Key Question 4

What are the comparative benefits and harms of different protocols for the three hemostatic resuscitation interventions (low-titer group O whole blood, component blood therapy, fluid resuscitation) for patients requiring prehospital hemostatic resuscitation?

a. Prehospital emergency medical services protocol (including transfusion volume, adjuvant medication co-administration, or isotonic fluid co-infusion)?

b. Patient characteristics (including age, gender, nature of illness, or mechanism of injury)?

c. Characteristics of the emergency medical services system (including air medical versus ground ambulance, personnel certification, or service delivery model)?

Key Question 5

What specific areas of future research are essential for closing existing evidence gaps surrounding prehospital hemostatic resuscitation and prehospital blood product transfusion? Consideration should be given to the formulation of precise scientific questions, optimal study design, targeted study populations, and the exploration of various blood transfusion intervention protocols.

Contextual Question 1

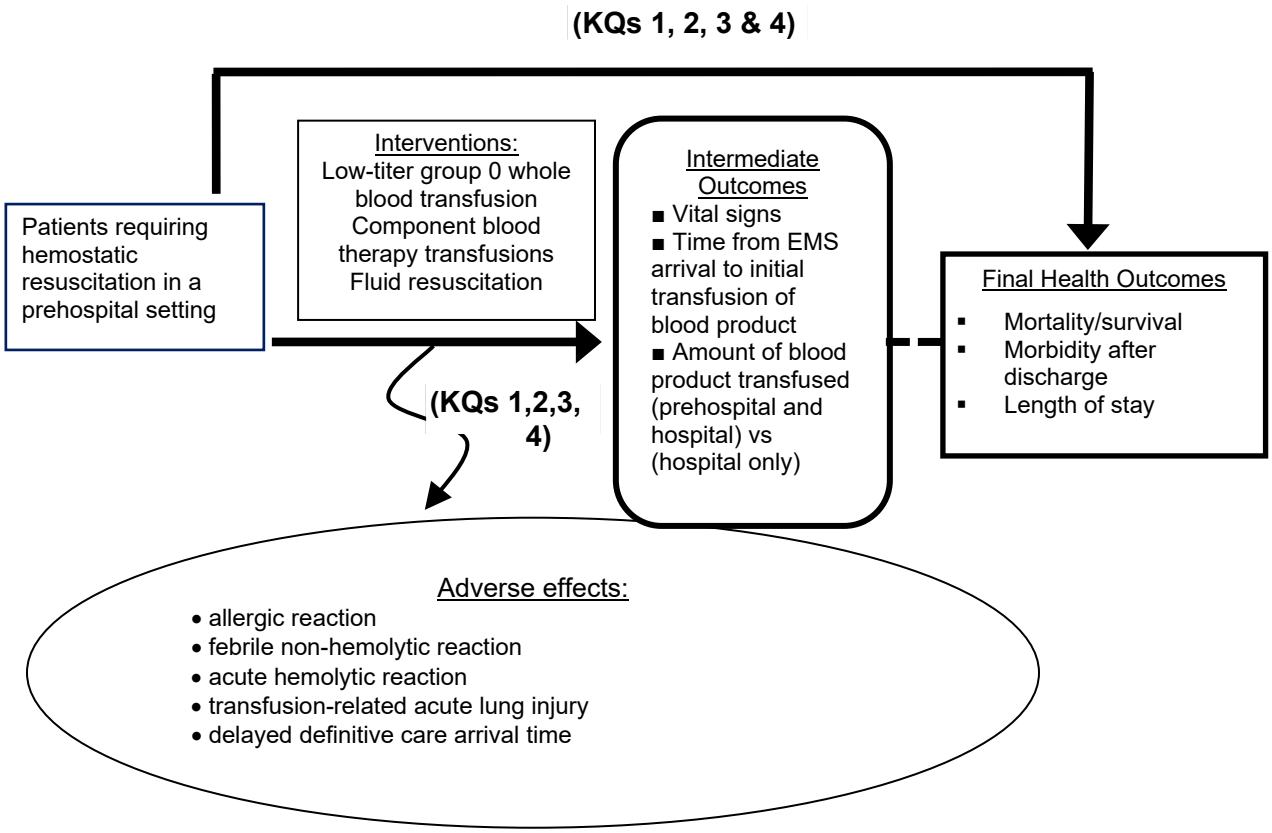
What are the implementation facilitators and barriers of effective prehospital blood product transfusion programs? Distinguishing factors may include emergency medical services agency costs, emergency medical services agency reimbursement, cost effectiveness, blood product maintenance and logistics, partnerships with blood banks, medical oversight including real-time medical direction, and diagnostic tools.

PICOS	Inclusion Criteria	Exclusion Criteria
Populations	Patients requiring prehospital hemostatic resuscitation who are treated in the prehospital setting by emergency medical services clinicians	Individuals who do not require prehospital hemostatic resuscitation; individuals not treated by emergency medical services clinicians
Intervention and Comparator	• KQ1: low-titer group O whole blood vs. blood component therapy (i.e., packed red blood cells, fresh frozen plasma, platelets) • KQ2: low-titer group O whole blood vs. fluid resuscitation (i.e., 0.9% sodium chloride, Ringer's lactate, other balanced crystalloid solution, etc.) • KQ3: blood component therapy vs. fluid resuscitation • KQ4: different protocols for any one of the three hemostatic resuscitation interventions • KQ5: n/a	Other type of resuscitation

Outcomes	<u>Patient Health Outcomes (highest priority)</u>
	• Mortality/survival
	  o To arrival at hospital
	  o To hospital discharge
	  o Any period less than or equal to 30 days post-emergency
	• Morbidity after discharge
	  o Glasgow Outcome Scale, Glasgow Outcome Scale Extended, Modified Rankin Scale, Cerebral Performance Category
	• Length of Stay
	  o Hospital length of stay (days)
	  o ICU length of stay (days)
	
	<u>Intermediate Outcomes</u> in the prehospital or ED setting
	• Vital signs
	  o Systolic blood pressure
	  o Diastolic blood pressure
	  o Heart rate
	  o Respiratory rate
	  o Shock index
	  o Glasgow Coma Scale
	  o Alert, Verbal, Painful, Unconscious
	  o Body temperature
	  o Lactate level
	  o End tidal Co2
	• Time from EMS arrival to initial transfusion of blood product
	• Amount of blood product transfused (prehospital and hospital) vs. (hospital only)
	
	<u>Adverse events/harms</u>
	• allergic reaction
	• febrile non-hemolytic reaction
	• acute hemolytic reaction
	• transfusion-related acute lung injury [TRALI]
	• transfusion-associated circulatory overload [TACO]
	• infection
	• iron overload	

	• citrate toxicity • delayed definitive care arrival time	
Setting	• Prehospital • ED only if needed to fill important gaps where there are no prehospital studies • International studies in English language	
Study Design	• RCTs • Prospective comparative studies • Retrospective comparative studies • Case control studies	• Systematic reviews (we will use reference lists to identify studies for possible inclusion) • Case series • Descriptive studies • Letters to the editor • Opinion papers • Studies published prior to 1990

Draft Analytic Framework



Definition of Acronyms

Acronyms	Definition
AHRQ	Agency for Healthcare Research and Quality
CO_2	Carbon Dioxide
DOT	Department of Transportation
EMS	Emergency Medical Services
EMT	Emergency Medical Technician
EPC	Evidence-Based Practice Centger
NHTSA	National Highway and Transportation and Safety Administration
O_2	Oxygen
OEMS	Office of Emergency Medical Services
RCT	Randomized Controlled Trial
SR	Systematic Review

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