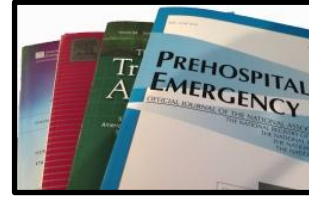


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IPHMI Literature Review

Keeping You Up to Date with Current EMS Literature and Studies

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1. **Advanced vs. basic life support outcomes in treatment of out-of-hospital-cardiac-arrest: A registry-based cohort study.** Silvagi R, Rodriguez-Fohn E, Reece RJ, et al. *Amer J Emerg Med* 2026;109:263-267.
 2. **Efficacy and safety of prehospital whole blood resuscitation in traumatic haemorrhagic shock: a systematic review and meta-analysis.** Khana YY, Alzahrani AA, Alghamdi RS, et al *Amer J Emerg Med* 2026;109:229-237
 3. **Increased Prehospital to Total Blood Product Administration Associated with Improved Hospital Outcomes: A Secondary Analysis of Hemorrhagic Shock Trials.** Furman L, Feeney EV, Bizri N, et al. *J Trauma Acute Care Surg.* 2026;101:39–47.
 4. **Tourniquet Application by Bystanders Fails to Improve Acuity.** Flyer Z, Giron A, Painter R, et al. *J Emerg Med* 2026;88:144–151.
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1. **Advanced vs. basic life support outcomes in treatment of out-of-hospital-cardiac-arrest: A registry-based cohort study.** Silvagi R, Rodriguez-Fohn E, Reece RJ, et al. *Amer J Emerg Med* 2026;109:263-267.

After almost fifty years of ALS in the field, survivability from OHCA remains less than 10% across the United States. There are many variables that can contribute to a successful OHCA resuscitation. Those variables include time to first chest compression (witnessed vs. unwitnessed), the patient's presenting rhythm (shockable vs. non-shockable), the level of care provided in the field (BLS: manual CPR, automated rhythm interpretation and defibrillation, airway without endotracheal intubation and no vascular access and associated medications. ALS: manual rhythm interpretation and defibrillation, endotracheal intubation and vascular access with drug administration) and lastly the receiving hospital's care also contributes to the patient's ultimate outcome.

The question remains: Does prehospital advanced life support level of care improve out of hospital cardiac arrest (OHCA) return of spontaneous circulation (ROSC) rates and ultimately survival rates to hospital discharge? The authors of this paper tried to determine to what extent ALS versus BLS EMS care, in conjunction with other documented variables, result in ROSC and survival to hospital discharge neurologically intact. This retrospective study used data from the Cardiac Arrest Registry to Enhance Survival (CARES) database. All data for the study came from Detroit, Michigan EMS and were entered into CARES between January 2016 and December 2021. During this time period, Detroit was not using a call determinate system for dispatch. Ambulances, whether ALS and BLS, were dispatched based on their proximity to a call. In this time period, less than 1% of BLS cardiac arrests received ALS back up.

In addition to standard patient demographics, the authors collected data on the patient's presenting rhythm and whether that initial rhythm was shockable or non-shockable. The average age of all patients was 62.6 years old. The vast majority of patients were Black (84.6%) and there were more men than woman (56.3% male). Shockable rhythms accounted for 4.9% (330) of ALS-treated patients versus 6.9%

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(466) of the BLS-treated patients. ALS non-shockable rhythms were associated with 41.4% (2,793) of the patients and the remaining 46.8% (3,157) cohort of patients were BLS non-shockable rhythms.

Sustained ROSC occurred in 37.9% of ALS shockable patients and 19.5% of BLS shockable patients. In the patients with non-shockable rhythms 18.6% of ALS patients versus 9.3% of BLS patients achieved sustained ROSC. The discharged from hospital rates were 17.9% ALS shockable and 11.8% BLS shockable. For non-shockable rhythms, 4.0% of BLS patients survived to discharge versus 3.7% of the ALS patients. The cohort of patients that were discharged from the hospital neurologically intact included 13.3% of the ALS shockable group and 6.9% of the BLS shockable patients. Neurologically intact discharge for ALS non-shockable patients was 1.6% for BLS and 1.4% for ALS. Favorable neurologic outcome decreased 5% for each 1-minute increase in response time. Finally, compared to CARES data in 2021, Detroit EMS OHCA data versus national averages were ROSC 15.2% v 27.1%, and simple discharge from hospital 5.1% v 9.1% and discharge from hospital neurologically intact 2.5% v 7.2%.

The authors concluded that ALS care was associated with improved ROSC for all initial presenting cardiac arrest rhythms, improved discharge from hospital rates and hospital discharge with good neurological function post OHCA with initial shockable rhythms versus BLS care.

The authors acknowledge multiple limitations of their work, the first being the retrospective, single agency dataset of their work. Along with the variables previously mentioned there are many more contributing factors to cardiac resuscitation not addressed in this work; citizen CPR and AED use, the quality and consistency of chest compressions, duration of resuscitation out of and in hospital to name a few. Unique BLS and ALS interventions were not taken into account or if they weighed into patient outcomes and ROSC.

OHCA care begins the time the call is answered in dispatch. The principles of emergency medical dispatch and prioritizing call assignments represent an EMS system's first patient contact. Regardless of the ALS versus BLS configuration of EMS crews, prehospital providers should do their best to optimize care for patients suffering from OHCA. This includes focusing on early recognition and defibrillation of shockable rhythms while maintaining quality and consistent chest compressions. Meaningful ALS interventions should be performed in concert with good BLS procedures and not delay or interrupt chest compression cycles during prehospital treatment of out-of-hospital cardiac arrest.

2. Efficacy and safety of prehospital whole blood resuscitation in traumatic haemorrhagic shock: a systematic review and meta-analysis. Khana YY, Alzahrani AA, Alghamdi RS, et al *Amer J Emerg Med* 2026;109:229-237

Hemorrhage is the leading cause of preventable traumatic death. It is estimated that 30-56% of these deaths occur during the prehospital or acute hospital phase from uncontrolled bleeding, coagulopathy or incomplete resuscitation.

Much of the early military whole blood experience used ABO type-specific whole blood, distinct from cold-stored, low titer type O blood product. Type O whole blood has "re-emerged as an attractive prehospital product, delivering red cells, plasma, and platelets in a single crossmatched unit". However, these advantages are offset by cost, limited and inconsistent donor supply, and the cold-chain and titer-screening logistics needed to limit wastage and ensure safety."

The objective for this study was to determine the efficacy and safety of prehospital blood transfusion compared to standard blood components therapy in patients with traumatic hemorrhagic shock and whether the investment translates into a survival advantage. To accomplish this, they conducted a review and meta-analysis of published studies. Three randomized controlled trials (RCTs) involving patients in the US and the UK were identified and included. Their study population was adult civilian patients aged 16 years or older, with traumatic hemorrhagic shock requiring prehospital blood.

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They also searched databases for patient records that fit their search criteria. Patients with non-traumatic hemorrhagic shock were excluded from their study. They also excluded military personnel injured in combat settings. Their focus was prehospital administration of whole blood administered by either ground or air transport teams and continued in the hospital.

The primary outcome measure was all-cause mortality at 24 hours after randomization. They chose this time frame as all three studies reported results on this time frame and this time period falls within the period of great risk of death for the patients and greater potential benefit from prehospital blood administration. Secondary outcomes were longer term (28-30 days) all-cause mortality, total blood product administration within 24 hours, incidence of massive transfusion, and thromboembolic complications.

After review of the three RCTs, 2,048 randomized patients met their search criteria, 1,681 contributed to the primary 24-hour mortality analysis and 1,658 contributed to the 28–30-day mortality analysis. There were no significant differences in 24-hour all-cause mortality or 28–30-day mortality between the whole blood and blood component patients. There were also no significant differences in the need for massive transfusion within 24 hours or thromboembolic complications.

This study is limited in that they selected only studies published in English which resulted in only three papers being analyzed. As a result, the three studies were of limited size and quality.

The authors concluded that “among adults with traumatic hemorrhagic shock, pooled randomized evidence showed no significant mortality benefit for prehospital whole blood over standard blood-component therapy.” Further, they stated that as much of the observational evidence compared whole blood with crystalloids or no transfusion rather than blood component therapy, their results served to refine rather than overturn those results.

3. Increased Prehospital to Total Blood Product Administration Associated with Improved Hospital Outcomes: A Secondary Analysis of Hemorrhagic Shock Trials. Furman L, Feeney EV, Bizri N, et al. *J Trauma Acute Care Surg.* 2026;101:39–47.

Early blood product administration is an important component of resuscitation for patients with severe traumatic hemorrhage. This study examined whether receiving a greater proportion of blood products during the prehospital phase was associated with improved outcomes after hospital admission. The authors hypothesized that administration of red blood cells (RBCs) or whole blood closer to the time of injury would improve survival and other clinical outcomes. The study used a harmonized database from six previous hemorrhagic shock trials conducted between 2012 and 2023. The investigators focused on the ratio of prehospital RBC or whole blood administration to the total amount of RBC and whole blood received during the first 24 hours.

The primary outcome was 24-hour mortality, while secondary outcomes included 28-day mortality, ICU-free days, ventilator-free days, and acute lung injury (ALI). The investigators used multivariable statistical models that adjusted for important factors including age, sex, mechanism of injury, Injury Severity Score, interfacility transfer, mode of transportation, arrival systolic blood pressure, Glasgow Coma Scale, treatment group, trial, and total transfusion volume. They also performed several sensitivity analyses, including analyses limited to patients who received prehospital blood, patients transported directly from the scene, and patients without severe traumatic brain injury.

This retrospective secondary analysis included 2,340 patients, after excluding patients who died within 4 hours and those who did not receive blood products. Of these patients, 1,024 (43.8%) received at least one unit of RBCs or whole blood before hospital arrival. The study found that increasing the proportion of blood products administered before hospital arrival was associated with a lower incidence of acute lung injury. For every 10% increase in the prehospital-to-total blood ratio, the odds of ALI decreased by 8.8%. However, there was no significant association between the prehospital blood ratio

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and either 24-hour or 28-day mortality in the primary analysis. There was also no significant association with ventilator-free days or ICU-free days in the primary analysis. In the categorical analysis, patients receiving moderate or high proportions of their blood products in the prehospital setting had lower odds of ALI, and the moderate-ratio group had more ICU-free days. Among patients who received prehospital blood, each 10% increase in the prehospital-to-total ratio was associated with a 16.7% decrease in the odds of ALI and an average increase of 0.21 ICU-free days.

There are several important limitations to this study. Most importantly, this was a retrospective secondary analysis, so the findings demonstrate an association rather than proving that earlier blood administration directly caused the improved outcomes. The authors also identified the possibility of survival bias because patients who received additional blood products at the hospital had to survive long enough to reach the hospital. The six trials that were included to combine data also had different inclusion criteria, methodologies, and available outcome data. In addition, the database did not consistently contain information about the time from injury to hospital arrival or prehospital transport time, both of which could influence the benefit of early transfusion. The investigators were also unable to fully evaluate balanced resuscitation because the available data primarily focused on prehospital RBCs and whole blood rather than all blood components, including plasma and platelets.

This study provides additional evidence supporting early administration of blood products to patients with traumatic hemorrhage, although it does not establish a specific optimal amount of prehospital blood or demonstrate a survival benefit from increasing the prehospital-to-total transfusion ratio. The most consistent finding was a reduction in acute lung injury, while improvements in ICU-free days were seen in some analyses. The authors suggest that earlier blood administration may be beneficial because it reduces reliance on crystalloid and provides a more physiologic resuscitation strategy, although the exact mechanism could not be determined from this dataset. Overall, the study supports efforts to increase access to prehospital blood products while highlighting the need for additional prospective research to determine which patients benefit most, the optimal quantity and composition of prehospital transfusion, and whether earlier transfusion ultimately improves survival. The results of this study should not necessarily change practice, but it does emphasize the importance of early, aggressive prehospital intervention with blood product transfusion in the hemorrhaging trauma patient.

4. Tourniquet Application by Bystanders Fails to Improve Acuity. Flyer Z, Giron A, Painter R, et al. *J Emerg Med* 2026;88:144–151.

The application of tourniquets has long been shown to reduce the morbidity and mortality of seriously injured soldiers in the military tactical environment. After success in the combat setting, civilian EMS agencies began investigating tourniquet use by first responders. As studies suggested a benefit in the civilian population, their training and use became standard procedure in the United States. Subsequently, educational programs were developed to train non-medical civilians in bleeding control.

The authors of this retrospective review investigated tourniquet application by all types of responders to patients suffering from prehospital hemorrhage with a goal of assessing changes in acuity, comparing civilians to first responders and EMS personnel.

The authors accessed the National Emergency Medical Services Information System (NEMSIS) database for 2017 to 2020 and queried tourniquet applications documented in the records for patients over age 20 years. Positive improvement findings were defined as a change in the patient's criticality after tourniquet application, defined as a change from critical to emergent status. A secondary outcome was successful application of the tourniquet defined as control of bleeding beyond the tourniquet.

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A total of 3003 patients were identified to be enrolled in the cohort. The majority (2551) were applied by EMS, 216 by first responders, and 236 by bystander civilians. Tourniquet application success rates were similar among EMS (96.9%) and first responders (96.6%) but lower for civilian bystanders (89.8%, $p < 0.001$). Patient criticality decreased at a greater rate among the EMS and first responder groups compared to the bystanders. Of note, no patients in the bystander group experienced worsening criticality between EMS arrival and hospital delivery.

The authors noted the following limitations. The database itself may introduce bias, as the data rely on documentation from EMS providers. The study only accessed patients' prehospital and arrival-phase care. The study did not track morbidity or complications resulting from tourniquet application. The database does not capture bystander training in bleeding control, only whether they applied a tourniquet. The documentation did not specify the type of tourniquet used. While EMS and first-responder communities generally use only commercially available tourniquets, the study did not determine whether the tourniquet applied by bystanders was a field-expedient improvised tourniquet or a commercially available tourniquet.

Tourniquets have saved countless lives worldwide. First used in the military and then in EMS, tourniquets have now made their way into training programs for the general public, such as the Stop the Bleed course. This study showed that while bystanders can successfully apply a tourniquet, it did not document improvement in the patient's criticality/acyuity. However, many factors may not have been identified. Acuity was evaluated only by EMS during their contact period, not during the time from tourniquet application until EMS arrival. It would be plausible to speculate that the acuity changed during this period of time. Further study into the efficacy of bystander-applied tourniquets is needed to better understand the direction for future development of bystander bleeding control programs