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Review Article

REVIEW ARTICLE

High-Yield Blood-Centric Logistics for Locking-In GWOT and Ukraine Medical Lessons: Ready for Tomorrow's Large-Scale Combat Operations

Dr. Randy Michael,[1] Conner Smith,[2] Sara Hey[3] and Dr. Rosalyn Clemente-Fuentes[4]

[1]United States Air Force Special Operations Command (US), [2]United States Air Force Special Operations Command (US), [3]University of Oklahoma (US) and [4]United States Air Force Special Operations Command (US)

Abstract

Hemorrhagic shock remains the leading cause of preventable death in combat trauma, particularly before casualties reach definitive surgical care, making blood-centric damage control resuscitation a critical priority for future large-scale combat operations. This manuscript synthesizes lessons from the Global War on Terror, Ukraine, and allied military experience to argue that low-titer group O whole blood must be treated as a mission-essential capability in forward and austere environments, but its effectiveness depends on reliable cold-chain storage, active blood warming, calcium replacement, trained personnel, and standardized protocols. Failure of any link in this system can lead to product wastage, delayed transfusion, hypothermia, coagulopathy, acidosis, hypocalcemia, and, ultimately, increased mortality. Recent conflicts further demonstrate that centralized medical infrastructure and evacuation-dependent models are vulnerable to disruption, requiring decentralized, mobile, and technologically adaptive blood logistics such as forward storage, compact refrigeration and warming devices, micro-hospitals, and unmanned delivery platforms. Preparing for tomorrow's combat casualty care environment requires a resilient blood-centric logistics paradigm that ensures lifesaving blood products are available at or near the point of injury whenever and wherever they are needed.

Key words: whole blood, logistics, combat operations

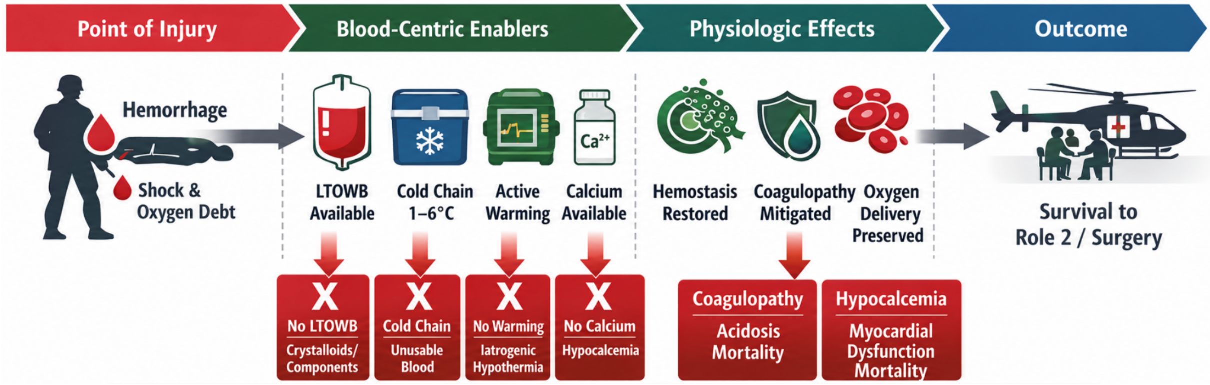
Background

Hemorrhagic shock remains the leading cause of preventable death in combat trauma, with the majority of fatalities occurring in the prehospital or forward care phase, before casualties reach definitive surgical intervention. The evolution of damage control resuscitation (DCR) doctrine over the past two decades, particularly during the Global War on Terror (GWOT) and the ongoing conflict in Ukraine, has underscored the necessity of a blood-centric approach to trauma care in austere and combat environments. Central to this approach is the early administration of low-titer group O whole blood (LTOWB), supported by reliable refrigeration and blood warming technologies. After-action reviews (AARs) and operational data from these conflicts have repeatedly identified the availability of LTOWB, maintenance of the cold chain, and the use of effective blood warmers as critical, rate-limiting steps in prehospital and forward care. When these elements are absent or fail, the entire DCR strategy is compromised, resulting in increased morbidity and mortality. This section synthesizes recent data from Ukraine and GWOT AARs to elucidate the indispensable role of these factors and the imperative for a blood-centric logistics paradigm in modern combat medicine.

LTOWB: The Foundation of Prehospital and Forward DCR

The introduction and forward deployment of LTOWB have transformed the management of hemorrhagic shock in combat settings. LTOWB provides red blood cells, plasma, and platelets in physiologic ratios, enabling hemostatic resuscitation that addresses both oxygen debt and coagulopathy. The U.S. Armed Services Blood Program (ASBP) and allied military medical systems have demonstrated that the early use of LTOWB, particularly when administered at or near the point of injury, is associated with improved survival in the most severely injured patients.[1-5] In a prospective multicenter cohort, LTOWB resuscitation was independently associated with a 48% reduction in 4-hour mortality and a 30% reduction in 28-day mortality among patients with an elevated prehospital probability of death.[5] Retrospective analyses of combat casualties in Afghanistan further support these findings, with warm fresh whole blood (WFWB)

Fig. 1. Blood-Centric Damage Control Resuscitation Failure Cascade.



This figure illustrates the sequential dependencies required for effective damage control resuscitation in prehospital and forward combat care. Hemorrhage at the point of injury produces shock and oxygen debt that can only be reversed through early access to low-titer group O whole blood supported by intact cold chain storage and active blood warming. When these elements function together, hemostasis is restored, trauma-induced coagulopathy is mitigated, and oxygen delivery is preserved, enabling survival to a higher level of care. Failure of any component, including lack of whole blood, breakdown of refrigeration, absence of blood warming, or lack of supplemental calcium administration, results in ineffective resuscitation, hypothermia, worsening coagulopathy, acidosis, hypocalcemia, and increased mortality.

resuscitation linked to a significant reduction in early mortality compared to component therapy, especially in those with critical injury severity.[4,6,7]

Operational experience from the GWOT and the Ukraine conflict has shown that the ability to deliver LTOWB to the point of injury is fundamentally constrained by the supply chain, storage, and transport limitations inherent to the combat environment.[1,8,10-13] The shelf life of LTOWB, extended from 21 to 35 days with the transition from CPD to CPDA-1 anticoagulant, has improved operational flexibility but does not eliminate the logistical challenges of maintaining a steady supply in distributed and prolonged operations.[1,12] The Israel Defense Forces (IDF) Medical Corps, during the 2023 war, implemented a model in which every combat brigade-level mobile intensive care unit was equipped with LTOWB, enabling transfusion within minutes of injury and demonstrating both clinical benefit and logistical feasibility.[3,10,14] In Ukraine, the destruction of medical infrastructure and the need for highly mobile, distributed care have driven the adoption of decentralized, on-demand blood logistics, including the use of drones for delivery to forward positions.[8,9,15]

Refrigeration: The Cold Chain as a Logistical Bottleneck

The efficacy and safety of LTOWB are critically dependent on strict adherence to cold chain requirements. LTOWB must be stored at 1–6°C to preserve red cell viability, platelet function, and coagulation factor activity. Any break in the cold chain can render blood products unusable, leading to product wastage and missed opportunities for life-saving transfusion.[1,11,16,17] The ASBP's expansion of LTOWB availability in CENTCOM was contingent on the deployment of portable refrigeration units and the establishment of cold chain management protocols.[1,12] However, current commercially available blood transporters, while improved, are still not fully adequate for the demands of military operations, particularly in environments with extreme temperatures, unreliable power, and the need for rapid mobility.[18]

Recent innovations, such as the Golden Hour Box (GHB), have improved the ability to maintain blood at the required temperature range for extended periods, even in extreme cold.[17] Nevertheless, the effectiveness of these containers is highly dependent on correct preconditioning and operational discipline, as improper handling can lead to rapid temperature excursions outside the safe range. The destruction of power infrastructure and supply depots in Ukraine has further complicated cold chain maintenance, resulting in increased blood wastage and compromised resuscitation capability.[8,9,19,20] The French Military Medical Service and the IDF have similarly emphasized the need for robust, field-adapted refrigeration solutions to support forward deployment of LTOWB.[3,10,13]

Blood Warmers: Preventing Iatrogenic Hypothermia

The administration of cold blood products without appropriate warming can precipitate or exacerbate hypothermia, which is a well-established contributor to trauma-induced coagulopathy and increased mortality.[21-24] Reliable blood warmers are therefore essential adjuncts to DCR in the prehospital and forward combat environment. Data from the GWOT indicate that hypothermia remains a persistent and under-addressed problem, with a significant proportion of casualties arriving at the first medical treatment facility hypothermic and experiencing high mortality rates.[21] The American Association for the Surgery of Trauma and the American College of Surgeons Committee on Trauma recommend continuous temperature monitoring and aggressive active rewarming for any trauma patient with a temperature below 37°C, emphasizing that hypothermia is independently associated with increased blood product needs and mortality.[24]

Recent years have seen the deployment and evaluation of advanced portable blood warmers, such as the

Buddy Lite and °M Warmer, which are capable of rapidly and reliably warming blood to near-physiological temperatures at clinically relevant flow rates.[10,25,26] The IDF's experience with integrating blood warmers into prehospital protocols has demonstrated improved patient outcomes and reduced rates of hypothermia.[3,10,23] However, challenges remain, including battery life limitations, device maintenance, and the need for user training under high-stress conditions.[21,23] In Ukraine, the destruction of infrastructure and the need for mobility have further complicated the deployment of reliable blood warming solutions, reinforcing the need for field-adapted, portable devices that can function in resource-constrained settings.[8,9]

Clinical Consequences of Failure: When Blood Does Not Flow

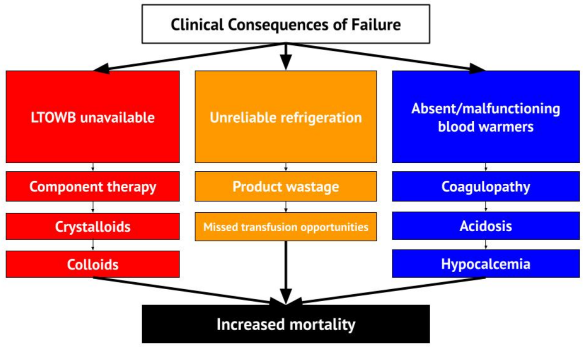
The failure to provide LTOWB, maintain reliable refrigeration, or ensure adequate blood warming in prehospital and forward care has direct and profound consequences for DCR effectiveness and patient survivability. When LTOWB is unavailable, providers are forced to rely on component therapy, crystalloids, or colloids, all of which are inferior in addressing the physiologic needs of hemorrhagic shock and are associated with increased mortality.[6,7,22,24,27] Breakdowns in the cold chain result in product wastage and missed transfusion opportunities, directly limiting the ability to provide timely resuscitation.[1,11,16,17] The absence or malfunction of blood warmers leads to iatrogenic hypothermia, which exacerbates coagulopathy and acidosis, further increasing the risk of death.[21-24]

After-action reviews from Ukraine have repeatedly identified limited access to prehospital blood, including LTOWB, as a major gap contributing to preventable deaths from hemorrhage.[8,9] The lack of robust blood supply chains and forward storage solutions has forced reliance on less optimal fluids or delayed transfusion until higher echelons of care, with negative implications for survival.[8,9,19,20] In the GWOT, the majority of battlefield casualties still died in the prehospital environment, before reaching a medical treatment facility, with hemorrhage as the leading cause of potentially survivable death.[6,7,24,29,30]

Blood-Centric Logistics: The Imperative for Modern Combat Medicine

The cumulative experience from GWOT, Ukraine, and other recent conflicts has established that a blood-centric approach to medical logistics is essential for optimizing trauma outcomes in austere and combat environments.[1,6,7,9-11,14,22,24,29,32] This approach prioritizes the early, forward deployment of LTOWB, supported by robust refrigeration and blood warming technologies, as the foundation of DCR. The American Association for the Surgery of Trauma and the American College of Surgeons Committee on Trauma, in their 2024 clinical protocol, explicitly state that whole blood is the "resuscitation product of choice for the treatment of hemorrhagic shock for all casualties at all roles of care".[24] The ASBP's strategy of setting minimal LTOWB on-hand supply benchmarks for expeditionary units, and the

Fig. 2. Clinical Consequences of LTOWB Preservation and Administration Failure



This flowchart exhibits the consequences of a defective supply chain at each step of LTOWB preservation. If LTOWB is not available, medical providers are forced to use component therapy, crystalloids, and colloids, all of which are suboptimal compared to LTOWB for replenishing blood lost in hemorrhage. If refrigeration is unavailable or unreliable, the LTOWB cannot be used and therefore becomes a wasted product. If blood warmers are unavailable or unreliable, LTOWB cannot be rewarmed to appropriate body temperatures, increasing risk of hypothermia. Failures at any level of the supply chain lead to increased mortality rates.

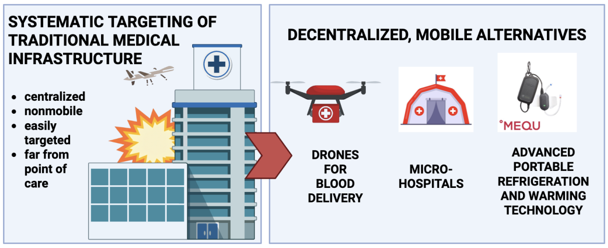
corresponding reduction in packed red blood cell orders, exemplifies the operational impact of this paradigm shift, leading to a decline in expired blood products and near-100% fulfillment rates for blood requests in deployed settings.[1,12]

The operational lessons from Ukraine, where systematic targeting of medical infrastructure and evacuation routes has forced a shift to decentralized, mobile, and technologically adaptive supply chains, highlight the vulnerabilities of traditional, centralized models and the necessity for resilient, on-demand logistics.[8,9,15,19,20,33] The use of drones for blood delivery, the proliferation of "micro-hospitals," and the integration of advanced portable refrigeration and warming devices are direct responses to the challenges of modern hybrid warfare.[8,9,15,33] These innovations are informing ongoing reforms in NATO and allied doctrine, emphasizing the need for flexible, decentralized medical logistics capable of supporting distributed care under fire.[9,12,13,15]

The Role of Training, Protocols, and Team Integration

The successful implementation of blood-centric logistics in prehospital and forward care is contingent upon multidisciplinary training, protocol standardization, and team integration.[1,3,10,23,34] Comprehensive training initiatives ensure that all team members are proficient in the technical and clinical aspects of blood product handling, storage, and administration. Standardized protocols reduce variability, minimize errors, and ensure the reliability of LTOWB, refrigeration, and blood warming processes across diverse operational settings. The integration of multidisciplinary teams with clear roles and seamless communication enables the timely and effective delivery of blood products, even in the most challenging environments.[3,10,23,34,35]

Fig. 3. Potential Alternatives for Future Blood Logistics in Forward or Austere Environments



Represented on the left is current, traditional medical infrastructure that is immobile and easily targeted. While still necessary, this kind of infrastructure is usually far from the site of injury and cannot mobilize quickly enough to render care in the case of traumatic hemorrhage. Smaller, decentralized, and mobile alternatives may be deployed as first line treatment, utilized to stabilize the patient until they are transported to a medical facility with expanded capabilities. Innovations such as delivery drones, micro-hospitals, and advanced compact blood warmers have proven increasingly essential by recent conflicts like Ukraine.

Future Directions

Recent expert consensus and military doctrine project several key areas for ongoing research and development, including the continued optimization of LTOWB production and supply chains, the development of more robust and user-friendly portable refrigeration and blood warming technologies, and the refinement of protocols for decentralized, mobile blood logistics in contested environments.[1,3,12,17,24,36] The American Association for the Surgery of Trauma and the American College of Surgeons Committee on Trauma recommend continuous evaluation and refinement of guidelines and training programs, informed by trauma registry data and after-action reviews, to ensure the ongoing effectiveness of blood-centric resuscitation strategies.[24] The Joint Trauma System (JTS), as the Department of Defense's (DoD) center of excellence for trauma, utilizes a continuous "Act, Learn, Adjust" cycle to evaluate and refine clinical practice guidelines and training programs. This process, codified in DoD Instruction 6040.47, relies on data from the Department of Defense Trauma Registry (DTR) to bridge the gap between combat casualty care research, trauma skills training, and clinical practice.[37]

Review

The necessity of LTOWB, reliable refrigeration, and effective blood warmers as rate-limiting steps in prehospital and forward care is strongly supported by recent data from Ukraine and GWOT AARs.[1,6,8,10,11,17,18.25.30-32] These elements are foundational to the success of DCR and the survivability of combat casualties in austere and high-threat environments.[7,22,24,29] When blood does not flow, whether due to supply chain failures, cold chain breakdowns, or inadequate warming, the entire resuscitation strategy collapses, resulting in preventable morbidity and mortality.[15,17-20,25,35,36,39,40] The imperative for a blood-centric approach to medical logistics, supported by robust training, standardized protocols, and integrated teams, is clear.[1,22,24,29,32,37] Ongoing innovation and adaptation are essential to meet the evolving challenges of modern warfare and to ensure that life-saving blood products are available whenever and wherever they are needed most.[6,8,10,11,15,30,31,33,35,36]

Competing Interests

No competing interest is declared.

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References

1. Taylor AL, Corley JB, Cap AP, et al. The U.S. Armed Services Blood Program Support to U.S. Central Command 2014-2021: Transformation of Combat Trauma Resuscitation Through Blood Product Innovation and Expansion of Blood Availability Far Forward. Transfusion. 2022;62 Suppl 1:S167-S176. doi:10.1111/trf.16951
2. Fisher AD, Miles EA, Broussard MA, et al. Low Titer Group O Whole Blood Resuscitation: Military Experience From the Point of Injury. J Trauma Acute Care Surg. 2020;89(4):834-841. doi:10.1097/TA.0000000000002863.
3. Almog O, Benov A, Beer Z, et al. Deploying Whole Blood to the Battlefield-the Israel Defense Forces Medical Corps Initial Experience During the 2023 War. Transfusion. 2024;64 Suppl 2:S14-S18. doi:10.1111/trf.17718.
4. Gurney JM, Staudt AM, Del Junco DJ, et al. Whole Blood at the Tip of the Spear: A Retrospective Cohort Analysis of Warm Fresh Whole Blood Resuscitation Versus Component Therapy in Severely Injured Combat Casualties. Surgery. 2022;171(2):518-525. doi:10.1016/j.surg.2021.05.051.
5. Sperry JL, Cotton BA, Luther JF, et al. Whole Blood Resuscitation and Association With Survival in Injured Patients With an Elevated Probability of Mortality. J Am Coll Surg. 2023;237(2):206-219. doi:10.1097/XCS.0000000000000708.
6. Gurney J, Staudt A, Cap A, et al. Improved Survival in Critically Injured Combat Casualties Treated With Fresh Whole Blood by Forward Surgical Teams in Afghanistan. Transfusion. 2020;60 Suppl 3:S180-S188. doi:10.1111/trf.15767.
7. Spinella PC. Warm Fresh Whole Blood Transfusion for Severe Hemorrhage: U.S. Military and Potential Civilian Applications. Crit Care Med. 2008;36(7 Suppl):S340-5. doi:10.1097/CCM.0b013e31817e2ef9.
8. Quinn J, Panasenko SI, Leshchenko Y, et al. Prehospital Lessons From the War In Ukraine: Damage Control Resuscitation And Surgery Experiences From Point of Injury to Role 2. Mil Med. 2024;189(1-2):17-29. doi:10.1093/milmed/usad253
9. Bongartz LG, Quinn V JM, Fransen CM, et al. A Call for Comprehensive Reform of Military Medical Planning of NATO and Its Allies Based on Lessons From the Ukraine War-Cultural Context

and the Human Factor. Mil Med. 2025;:usaf217. doi:10.1093/milmed/usaf217.

10. Talmy T, Malkin M, Esterson A, et al. Low-Titer Group O Whole Blood in Military Ground Ambulances: Lessons From the Israel Defense Forces Initial Experience. Transfus Med. 2023;33(6):440-452. doi:10.1111/tme.12995.
11. Vanderspurt CK, Spinella PC, Cap AP, et al. The Use of Whole Blood in US Military Operations in Iraq, Syria, and Afghanistan Since the Introduction of Low-Titer Type O Whole Blood: Feasibility, Acceptability, Challenges. Transfusion. 2019;59(3):965-970. doi:10.1111/trf.15086.
12. Hall A, Olsen C, Comes R, et al. Military Blood Supply and Distribution in USCENTCOM. Mil Med. 2024;189(9-10):249-252. doi:10.1093/milmed/usad493.
13. Riff JC, Duranteau O, Ausset S, et al. The First Two Years of the Use of Low Titer Group O Whole Blood During French Military Overseas Operations: A Retrospective Study. Transfusion. 2024;64 Suppl 2:S34-S41. doi:10.1111/trf.17776.
14. Katzman D, Kalman G, Almog O, Fogel I. Deployment of Physician Resources and Innovative Medical Strategies in the 2023-2024 Israel-Hamas War: Israel's Strategy to Deliver Advanced Life Support and Whole Blood Transfusion to the Battlefield via Forward Medical Teams and the Impact on the Case Fatality Rate. Mil Med. 2024;:usae553. doi:10.1093/milmed/usae553.
15. Lammers DT, Williams JM, Conner JR, et al. Airborne! UAV Delivery of Blood Products and Medical Logistics for Combat Zones. Transfusion. 2023;63 Suppl 3:S96-S104. doi:10.1111/trf.17329.
16. Schaefer R, Long T, Wampler D, et al. Operationalizing the Deployment of Low-Titer O-Positive Whole Blood Within a Regional Trauma System. Mil Med. 2021;186(Suppl 1):391-399. doi:10.1093/milmed/usaa283.
17. Vuong A, Derkenne C, Travers S, et al. Performance of Far Forward Iceless Blood Storage Containers in Controlled Cold Environments. Transfusion. 2024;64 Suppl 2:S50-S57. doi:10.1111/trf.17745.
18. Martin SM, Fisher AD, Meledeo MA, et al. More Sophisticated Than a Drink Cooler or an Old Sphygmomanometer but Still Not Adequate for Prehospital Blood: A Market Review of Commercially Available Equipment for Prehospital Blood Transport and Administration. Transfusion. 2021;61 Suppl 1:S286-S293. doi:10.1111/trf.16461.
19. Haque U, Bukhari MH, Fiedler N, et al. A Comparison of Ukrainian Hospital Services and Functions Before and During the Russia-Ukraine War. JAMA Health Forum. 2024;5(5):e240901. doi:10.1001/jamahealthforum.2024.0901.
20. Baker MS, Baker J, Burkle FM. Russia's Hybrid Warfare in Ukraine Threatens Both Healthcare & Health Protections Provided by International Law. Ann Glob Health. 2023;89(1):3. doi:10.5334/aogh.4022.
21. Pumiglia L, Williams JM, Prey BJ, et al. Hypothermia and the Global War on Terror: 18 Years of Minimal Progress. Mil Med. 2024;189(Suppl 3):190-195. doi:10.1093/milmed/usae072.
22. Cap AP, Pidcoke HF, Spinella P, et al. Damage Control Resuscitation. Mil Med. 2018;183(suppl_2):36-43. doi:10.1093/milmed/usy112.
23. Talmy T, Mitchnik IY, Malkin M, et al. Adopting a Culture of Remote Damage Control Resuscitation in the Military: Insights From the Israel Defense Forces Decade of Experience. Transfusion. 2023;63 Suppl 3:S83-S95. doi:10.1111/trf.17357.
24. LaGrone LN, Stein D, Cribari C, et al. American Association for the Surgery of Trauma & American College of Surgeons Committee on Trauma: Clinical Protocol for Damage-Control Resuscitation for the Adult Trauma Patient. J Trauma Acute Care Surg. 2024;96(3):510-520. doi:10.1097/TA.0000000000004088.
25. Milligan J, Lee A, Gill M, et al. Performance Comparison of Improvised Prehospital Blood Warming Techniques and a Commercial Blood Warmer. Injury. 2016;47(8):1824-7. doi:10.1016/j.injury.2016.05.038.
26. Weatherall A, Gill M, Milligan J, et al. Comparison of Portable Blood-Warming Devices Under Simulated Pre-Hospital Conditions: A Randomised in-Vitro Blood Circuit Study. Anaesthesia. 2019;74(8):1026-1032. doi:10.1111/anae.14680.
27. Gerhardt RT, Strandenes G, Cap AP, et al. Remote Damage Control Resuscitation and the Solstrand Conference: Defining the Need, the Language, and a Way Forward. Transfusion. 2013;53 Suppl 1:9S-16S. doi:10.1111/trf.12030.
28. Hooper TJ, De Pasquale M, Strandenes G, Sunde G, Ward KR. Challenges and Possibilities in Forward Resuscitation. Shock. 2014;41 Suppl 1:13-20. doi:10.1097/SHK.0000000000000096.
29. Hooper TJ, Nadler R, Badloe J, Butler FK, Glassberg E. Implementation and Execution of Military Forward Resuscitation Programs. Shock. 2014;41 Suppl 1:90-7. doi:10.1097/SHK.0000000000000081.
30. Banerjee RC, Castillejos JA, Krewson SP, et al. A Scoping Review of Military Combat Casualty Data on Submassive, Massive, and Supermassive Transfusions. Mil Med. 2025;190(1-2):e99-e106. doi:10.1093/milmed/usae349.
31. Shackelford SA, Del Junco DJ, Riesberg JC, et al. Case-Control Analysis of Prehospital Death and Prolonged Field Care Survival During Recent US Military Combat Operations. J Trauma Acute Care Surg. 2021;91(2S Suppl 2):S186-S193. doi:10.1097/TA.0000000000003252.
32. Bahr M, Cap AP, Dishong D, Yazer MH. Practical Considerations for a Military Whole Blood Program. Mil Med. 2020;185(7-8):e1032-e1038. doi:10.1093/milmed/usz466.
33. Nowadly CD, Maddry JK, Vargas CR, et al. The Medical Implications of Emerging Unmanned Aircraft Systems in Military and Combat Environments: A Narrative Review. Mil Med. 2025;:usaf189. doi:10.1093/milmed/usaf189.
34. Dion PM, Nolan B, Funk C, et al. Blood Far Forward: A Cross-Sectional Analysis of Prehospital Transfusion Practices in the Canadian Armed Forces. Injury. 2025;56(1):111771. doi:10.1016/j.injury.2024.111771.
35. Puzio TJ, Meyer DE, Heft N, Nealy W, Osborn L. Continuum of Care: A Multiagency Approach to Seamless Warmed Prehospital

Whole Blood Resuscitation of a Patient With Noncompressible Truncal Hemorrhage. Prehosp Emerg Care. 2023;27(6):790-793. doi:10.1080/10903127.2022.2104976.
36. Dawood ZS, Keeney-Bonthrone TP, Russo RM, et al. Designing the Prolonged Field Care Kit (PFAK) to Address the Logistical Challenges of Future Combat Casualty Care. Mil Med. 2024;189(Suppl 3):366-372. doi:10.1093/milmed/usae132.
37. U.S. Department of Defense. DoD Instruction 6040.47: Joint Trauma System. September 28, 2016; incorporating Change 2, June 14, 2022.
38. Braverman MA, Smith A, Pokorny D, et al. Prehospital Whole Blood Reduces Early Mortality in Patients With Hemorrhagic Shock. Transfusion. 2021;61 Suppl 1:S15-S21. doi:10.1111/trf.16528.
39. Guyette FX, Zenati M, Triulzi DJ, et al. Prehospital Low Titer Group O Whole Blood Is Feasible and Safe: Results of a Prospective Randomized Pilot Trial. J Trauma Acute Care Surg. 2022;92(5):839-847. doi:10.1097/TA.0000000000003551.
40. Coulthard SL, Kaplan LJ, Cannon JW. What's New in Whole Blood Resuscitation? In the Trauma Bay and Beyond. Curr Opin Crit Care. 2024;30(3):209-216. doi:10.1097/MCC.0000000000001140.
41. Epstein A, Lim R, Johannigman J, et al. Putting Medical Boots on the Ground: Lessons From the War in Ukraine and Applications for Future Conflict With Near-Peer Adversaries. J Am Coll Surg. 2023;237(2):364-373. doi:10.1097/XCS.0000000000000707.