2023 Urban Fire Forum Position Statement

First-In Responders Providing Neuroprotective ("Heads-Up") CPR as the Standard of Care for Emergency Medical Services Systems

Introduction

Annually, nearly one million individuals experience sudden non-traumatic, out-of-hospital cardiac arrest (OHCA) (1-2) in North America and Europe combined. A significant majority of these patients, exceeding 80%, present with "non-shockable" (NS) electrocardiographic patterns, such as asystole or pulseless electrical activity (PEA) (1-10). Despite the swift response times of our 9-1-1 emergency medical services (EMS) systems, the immediate administration of basic cardiopulmonary resuscitation (CPR), and other well-established advanced life support (ALS) measures, an overwhelming majority do not survive to hospital discharge (1-12).

A small fraction of OHCA patients displaying shockable rhythms may be highly salvageable, but this possibility hinges on specific conditions, notably early and effective CPR performed by bystanders, coupled with rapid defibrillation within minutes (3, 6, 13-14). Nevertheless, when considering all OHCA cases in the United States (U.S.), including those presenting with shockable rhythms, the overall survival rate to hospital discharge was below 10% within the context of progressive EMS systems that monitor outcomes. More notably, the rate of surviving with intact neurological function was below 7.5% (1, 3, 5-10).

In addition to a significant number of unwitnessed events and extended response times, unfavorable outcomes can be attributed to the inherent physiological limitations of traditional CPR. Even in cases of shockable rhythms, early and correctly administered conventional CPR (C-CPR) only manages to deliver approximately 20% of the normal cerebral perfusion pressure (15-21). While chest compressions generate forward-flowing arterial pressure waves, they also generate considerable retrograde venous pressure, resulting in pulsatile increases in intracranial pressure (ICP) with each compression. Consequently, these elevations in intracranial pressure hinder the flow of blood through cerebral arteries (15-21). When combined with the limited refilling of cardiac chambers, C-CPR becomes increasingly ineffective, especially as the duration of untreated cardiac arrest intervals lengthens (15, 16).

Nevertheless, thorough, systematic laboratory research conducted over the past decade, and ongoing clinical investigations, have unveiled novel approaches to alleviate some of the inherent limitations associated with C-CPR. Non-invasive CPR adjuncts, including the combined use of an impedance threshold device (ITD) attached to breathing devices, coupled with suction cup-based active-compression-decompression (ACD), lower intrathoracic pressure during the decompression phase of CPR, both individually and particularly in combination (17-24). By harnessing these complementary mechanisms, ITD/ACD-CPR effectively reduces intracranial pressure, enhances cardiac preload, and improves coronary and cerebral perfusion pressures (15, 17, 19). In clinical trials, the combined approach of ITD-ACD CPR has yielded a remarkable 50% enhancement in one-year survival rates with favorable neurological outcomes compared to C-CPR (24-28).

In more recent developments, the introduction of a gradual head and thorax elevation lasting over 2 minutes (following an initial 2-minute application of ACD-ITD CPR to prime the circulation), has consistently resulted in nearly complete restoration of cerebral perfusion pressures in laboratory experiments. This approach has shown remarkable enhancements in neurologically favorable survival rates, both in cases of shockable and non-shockable OHCA (17, 19, 20-23, 29-34).

Evidence, Analysis, and Rationale for Adopting This Evolving CPR Strategy

The three pivotal adjuncts responsible for achieving these harmonious physiological advantages now include an automated head/thorax-up positioning (AHUP) device (See Appendix). These non-invasive devices, including the ITD, ACD (both manual and automated variants), and AHUP, work in unison to enhance the blood flow generated by conventional CPR. Importantly, they have all received clearance from the U.S. Food and Drug Administration and are presently being introduced into numerous clinical settings throughout the United States (22, 34, 35).

EMS early adopters of the "ITD/ACD/AHUP-CPR" protocol delivered by first responders are already reporting significantly improved patient survival rates when assessing both shockable and non-shockable cases together (22, 38). As in the use of an AED, the more swiftly the ITD/ACD/AHUP-CPR combination is applied, the more favorable the outcome becomes. In general, when administered within 10 minutes after receiving the 9-1-1 call, it is linked to a threefold higher probability of patients experiencing neurologically intact survival, regardless of their electrocardiographic presentation.

However, the most compelling evidence comes from several studies that have demonstrated a remarkable benefit, especially when compared to matched C-CPR controls, in patients who have a non-shockable presentation. For instance, in the case of patients presenting with PEA, the rates of survival with favorable neurological function reach an impressive 10%, a milestone previously unseen. Furthermore, when administered within 15 minutes of receiving the 9-1-1 call (which accounts for 80% of cases), the chances of surviving with intact neurological function for patients with non-shockable rhythms (PEA or asystole) are nearly 14 times higher, even though over 70% of these patients are found with asystole and almost half of non-shockable cases are unwitnessed arrests.

Furthermore, the prospects of achieving neurologically intact survival for patients with unwitnessed arrests who present with asystole (a situation often viewed as futile for resuscitation efforts by most EMS systems) are nearly seven times higher when the ITD/ACD/AHUP-CPR strategy is employed. Although the “rates” of neurologically intact survival for these non-shockable cases predictably remain somewhat low due to the prevalence of unwitnessed arrest scenarios and the associated longer response times, the sheer volume of cases encountered in North America, numbering nearly 1,000 daily, suggests that using this augmented-CPR approach could potentially save tens of thousands of functional lives annually, especially if the time taken to apply ITD/ACD/AHUP-CPR can be consistently expedited.

Among the numerous survivors thus far, one individual, a 50-year-old seasoned EMT, unexpectedly experienced sudden cardiac arrest and underwent an extensive resuscitation effort in St. Johns County, FL, in June 2021. At the time of his cardiac arrest, he had been trained in the retrieval of organs for transplantation, a role that gave him a comprehensive understanding of the various causes of permanent cerebral brain damage. Upon regaining consciousness at the hospital, he discovered the methods employed by the county fire rescue teams to treat him. Astonished by his remarkable recovery, he coined the term "neuroprotective CPR" for this innovative "heads-up" technique. Thus, the term "neuroprotective CPR" (NPCPR) was born from the perspective of a survivor who found himself physically and mentally intact less than 48 hours after his own, albeit lengthy, cardiac arrest. The term NPCPR was swiftly embraced by those utilizing this intracranial pressure-lowering strategy, many of whom had personally witnessed similar successful rescues with positive functional outcomes.

While it is customary in the scientific community to advocate for traditional clinical trials for any new intervention, it is important to note that the "proof of concept" clinical trial involving the foundational devices (ACD-ITD CPR) had already been conducted and demonstrated robust improvements in neuro-intact outcomes. The addition of the heads-up component has clearly amplified this effect. Laboratory studies have consistently shown the normalization of cerebral perfusion pressures and now the achievement of normal end-tidal CO_2 levels in patients undergoing NPCPR offers strong clinical evidence of restored blood flow (in contrast to the mere 15-20% of normal cerebral blood flow achieved through conventional CPR alone).

Furthermore, in the context of OHCA, prominent scientists and biostatisticians have recently endorsed the use of propensity score matching when investigating interventions. This approach is particularly valuable in cardiac arrest studies since all the factors related to outcomes in OHCA are already well-documented. By employing propensity scoring, researchers can optimize their analysis while circumventing the numerous confounding variables and effect modifiers that have impacted OHCA clinical trials. Consequently, propensity-scoring techniques are now being applied to NPCPR studies and these have revealed remarkable distinctions in their outcomes.

Critical Role of the Fire Service in Neuroprotective CPR Delivery

Researchers initially exploring the NPCPR approach in the clinical context started to observe that the timing of the intervention significantly influenced the outcomes. Compared to systems that provided NPCPR equipment through paramedic ambulances only or responding supervisors, generally resulting in some delayed arrival, EMS systems that promptly delivered the equipment through their first responders, typically via fire suppression apparatus crews, achieved notably superior results.

In fact, the best survival rates were consistently seen in fire departments that had designed special backpacks to expedite transport of the NPCPR equipment to the scene and then, when opened, had resuscitation equipment strategically stored/placed in positions that would facilitate a true "pit-crew" approach (APPENDIX). *In turn, their time to application of the NPCPR devices was reduced significantly, and neuro-intact survival rates reflected those innovative approaches developed by the firefighters themselves.*

Moreover, the NPCPR devices are non-invasive tools that can be utilized by any trained rescuer, including firefighters, lifeguards, or other basic life support responders. A forthcoming scientific study set to be published in the esteemed journal, Critical Care Medicine, in the upcoming months, reveals that in more than 40% of cases, only two initial responders were responsible for applying the devices, and in over half of the cases, three or fewer responders were involved (34).

Hence, akin to the widespread use of AEDs, it becomes evident that the majority of NPCPR applications would preferably be administered by firefighters across the nation. Considering the substantial number of cases they encounter, the life-saving potential of NPCPR could rival, if not surpass, the life-saving impact of AEDs. Importantly, NPCPR not only proves more effective when applied early, akin to AEDs, but it also extends its life-saving potential to cases with longer response intervals. In either scenario, the fire service would once again take a leading role in saving lives.

Introducing new equipment to every response vehicle does have budgetary implications, but the costs are not prohibitively high. The expense of the head-elevating device is less than half that of a monitor defibrillator, and it is likely to remain operational for longer periods. Additionally, most departments already carry mechanical suction-cup CPR devices. While the ITD costs approximately $100 per unit used, this expenditure is relatively small compared to the overall resources currently allocated to OHCA response. In any case, even when considering the need to procure all of this equipment, the annualized pro-rated cost over several years remains finite and relatively insignificant when juxtaposed with the annual expenses of operating and staffing response vehicles. Most importantly, the return on investment in terms of improved outcomes is undeniably worthwhile.

Purpose of this Deliverable

All available data consistently point to the fact that, similarly to traditional CPR and AEDs, the more prompt the application of NPCPR, the higher the likelihood of achieving functional survival for the patient. What makes NPCPR exceptional is its potential to save many more patients, regardless of whether they present with shockable or non-shockable rhythms. Considering that the neighborhood fire station is typically the first public safety responder in the United States and other parts of the world, the Urban Fire Forum strongly advocates that all fire departments involved in EMS should adopt NPCPR as a standard operating procedure for managing OHCA.

Several regions in the United States are actively working on strategies to promote the widespread implementation of NPCPR. For instance, a coalition of EMS medical directors across the state of Florida is not only advocating for the routine use of NPCPR but is also in the process of establishing the concept of "Resuscitation Centers" throughout the state.

Therefore, the primary aim of this position statement is to firmly recommend the widespread adoption of NPCPR as a best practice standard of care for all firefighters involved in first response to OHCA cases. It also serves as a preliminary guide on budgeting, training, and implementing this life-saving strategy correctly, emphasizing the importance of avoiding incorrect implementation and ensuring rigorous quality assurance measures.

Adopted Position and Action Items

A Suggested Framework for Implementing Neuroprotective CPR

- The Urban Fire Forum and Metropolitan Fire Chiefs will adopt the definitive position that appropriate use and implementation of Neuroprotective CPR (NPCPR) should become the best practice standard of care for managing out-of-hospital cardiac arrest (OHCA) with the understanding that the fire service generally provides the first-in responders and thus would be most likely to provide the lifesaving effect.
- The Metropolitan Fire Chiefs should align, virtually or in-person, with the Metropolitan EMS Medical Directors Global Alliance (aka medical "Eagles") to promulgate the critical value of fostering NPCPR in the prehospital setting and advocate for this life-saving patient care in systems yet to adopt such programs. *A large number of the Eagles have become early adopters and have significant experience in proper implementation.*
- The Metropolitan Fire Chiefs will establish advocacy mechanisms, including virtual and in-person conferences, to facilitate networking and mentorship for those wishing to implement NPCPR programs and they will work alongside groups such as the not-for-profit "Take Heart America" initiative (https://takeheartamerica.org/about-us/) which are working on strategies to promulgate NPCPR including funding mechanisms (seed monies from donors, legislative actions, grants and all other avenues of support) to help launch such programs nationwide.
- A manufacturer of one of the three devices used to achieve NPCPR, has a team of train-the-trainer crews who have helped to guide program implementation across the nation, including strategic recommendations for pit crew approaches to expedite ITD/ACD/AHUP-CPR device placement, other patient care interventions including appropriate ventilatory techniques, and how to facilitate accurate data collection and reporting.
- Mentorship and educational programs should be developed to address pragmatic strategies to help overcome barriers such as budgetary considerations and accompanying justifications as well as purchasing considerations, staggered implementation over time, and strategies for optimal roll-out and deployment (along with training resources and receiving hospital staff education/in-servicing and mechanisms to acquire outcome data).
- Fire services using NPCPR should participate in the Heads-Up CPR registry based at Hennepin County Medical Center (Minneapolis, MN). Data collection should match registry requirements.
- It should be emphasized in training and protocols that application of ITDs, ACD-CPR (manual or mechanical), and heads-up/thorax-up elevation are not the lone tasks in terms of managing patients with OHCA; key concomitant actions are establishing airway and respiratory support (as indicated) while providing uninterrupted chest compressions at the right rate and depth and with optimal recoil and minimal interruptions.
- The EMS system should identify hospitals that will optimally manage patients. Several states, such as Arizona and Florida, have designated "Resuscitation Centers" or are in the process of doing so, to ensure optimal management such as early cardiac catheterization or therapeutic hypothermia as indicated.

- It should also be recognized that heads-up/thorax CPR alone could conceivably be detrimental if not implemented correctly or if elevating the head too rapidly without first producing circulatory priming with the ACD-ITD devices to push the blood uphill. Therefore, any elevation of the head and thorax needs to be performed using the ITD/ACD circulatory adjuncts and a patient positioning device that elevates the head and thorax in a controlled and sequential manner.

Some General Roadmaps for Proper Implementation:

1. Moore JC, Segal N, Debaty G, Lurie KG: The "do's and don'ts" of head up CPR: lessons learned from the animal laboratory. *Resuscitation* 2018;129:e6-e7. doi:10.1016/j.resuscitation.2018.05.023
2. Moore JC, Pepe PE, Bachista K, et al: Carry less, do more: properly implementing a basic life support approach to the head-up CPR bundle of care. *EMS World* 2021;50:2-6

REFERENCES

1. Tsao CW, Aday AW, Almarzooq ZI, et al. American Heart Association heart and stroke statistics - 2022 Update *Circulation* 22 February 2022;145(8):e153-e639 https://doi.org/10.1161/CIR.0000000000001052

2. Sudden Cardiac Arrest Foundation Website https://www.sca-aware.org/about-sudden-cardiac-arrest/latest-statistics#:~:text=According%20to%20the%20report%2C%20cardiac,nearly%201%2C000%20people%20each%20day

3. Cardiac Arrest Registry to Enhance Survival (C.A.R.E.S.) Website. Available at: https://mycares.net/sitepages/uploads/2022/2021_flipbook/index.html?page=34

4. Thomas AJ, Newgard CD, Fu R, Zive DM, Daya MR. Survival in out-of-hospital cardiac arrests with initial asystole or pulseless electrical activity and subsequent shockable rhythms. *Resuscitation* 2013;84:1261-1266

5. Sasson C, Rogers MAM, Dahl J, Kellermann AL. Predictors of survival from out-of-hospital cardiac arrest – a systematic review and meta-analysis. *Circulation Cardiovascular Quality and Outcomes* 2010:3:63-81

6. Pepe PE, Levine RL, Fromm RE, Curka PA, Clark PS, Zachariah BS: Cardiac arrest presenting with rhythms other than ventricular fibrillation: contribution of resuscitation efforts toward total survivorship. *Crit Care Med* 1993;21:1838-1843

7. Andrew E, Nehme Z, Lijovic M, Bernard S, Smith K: Outcomes following out-of-hospital cardiac arrest with an initial cardiac rhythm of asystole or pulseless electrical activity in Victoria, Australia. *Resuscitation* 2014;85:1633-1639

8. Herlitz J, Svensson L, Engdahl J, Silfverstolpe J: Characteristics and outcome in out-of-hospital cardiac arrest when patients are found in a non-shockable rhythm. *Resuscitation* 2008;76:31-36

9. Kuisma M, Jaara K: Unwitnessed out-of-hospital cardiac arrest: is resuscitation worthwhile? *Ann Emerg Med* 1997;30:69-75

10. Herlitz J, Engdahl J, Svensson L, Young M, Angquist KA, Holmberg S: Can we define patients with no chance of survival after out-of-hospital cardiac arrest? *Heart* 2004;90:1114-1118

11. Panchal AR, Bartos JA, Cabanas JG, et al, on behalf of the Advanced Life Support Writing Group: Part 3: Adult Basic and Advanced Life Support: 2020 American Heart Association Guidelines for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care. *Circulation* 2020;142:S366–S468

12. Perkins GD, Chen J, Deakin CD, et al: Randomized trial of epinephrine in out-of-hospital cardiac arrest. *N Engl J Med* 2018; 379:711-721

13. Caffrey SL, Willoughby PJ, Pepe, PE, Becker LB: Public use of automated defibrillators. *N Engl J Med* 2002;347:1242-1247

14. Song J, Guo W, Lu X, et al: The effect of bystander cardiopulmonary resuscitation on the survival of out-of-hospital cardiac arrests: a systematic review and meta-analysis. *Scand J Trauma Resusc Emerg Med* 2018;26:86 Available at https://doi.org/10.1186/s13049-018-0552-8 Accessed April 16, 2023

15. Lurie KG, Nemergut EC, Yannopoulos D, Sweeney M: The physiology of cardiopulmonary resuscitation. *Anesth Analg* 2016;122:767-783

16. Lee SK, Vaagenes P, Safar P, Stezoski SW, Scanlon M: Effect of cardiac arrest time on cortical cerebral blood flow during subsequent standard external cardiopulmonary resuscitation in rabbits. *Resuscitation* 1989;17:105-117

17. Ryu HH, Moore JC, Yannopoulos D, et al: The effect of head-up cardiopulmonary resuscitation on cerebral and systemic hemodynamics. *Resuscitation* 2016;102:29-34

18. Pirrallo RG, Aufderheide TP, Provo TA, Lurie KG. Effect of an inspiratory impedance threshold device on hemodynamics during conventional manual cardiopulmonary resuscitation. *Resuscitation* 2005;66:13-20

19. Moore JC, Segal N, Lick MC, et al: Head and thorax elevation during active compression decompression cardiopulmonary resuscitation with an impedance threshold device improves cerebral perfusion in a swine model of prolonged cardiac arrest. *Resuscitation* 2017;121:195-200

20. Moore JC, Salverda B, Rojas-Salvador C, Lick M, Debaty G, G Lurie K: Controlled sequential elevation of the head and thorax combined with active compression decompression cardiopulmonary resuscitation and an impedance threshold device improves neurological survival in a porcine model of cardiac arrest. *Resuscitation* 2021;158:220-227

21. Gazmuri RJ, Dhliwayo N. From a toilet plunger to head-up CPR; bundling systemic and regional venous return augmentation to improve the hemodynamic efficacy of chest compressions. *Resuscitation* 2020;149:225-227

22. Moore JC, Pepe PE, Scheppke KA, et al: Head and thorax elevation during cardiopulmonary resuscitation using circulatory adjuncts is associated with improved survival. *Resuscitation* 2022;179:9-17

23. Moore JC, Holley JE, Frascone RJ, et al: Consistent head-up cardiopulmonary resuscitation haemodynamics are observed across porcine and human cadaver translational models. *Resuscitation* 2018;132:133-139

24. Aufderheide TP, Frascone RJ, Wayne MA, et al : Standard cardiopulmonary resuscitation versus active compression-decompression cardiopulmonary resuscitation with augmentation of negative intrathoracic pressure for out-of-hospital cardiac arrest: a randomised trial. *Lancet*. 2011;377(9762):301-311

25. Plaisance P, Lurie KG, Payen D: Inspiratory impedance during active compression-decompression cardiopulmonary resuscitation: a randomized evaluation in patients in cardiac arrest. *Circulation* 2000;101:989-994

26. Plaisance P, Soleil C, Lurie KG, Vicaut E, Ducros L, Payen D: Use of an inspiratory impedance threshold device on a facemask and endotracheal tube to reduce intrathoracic pressures during the decompression phase of active compression-decompression cardiopulmonary resuscitation. *Crit Care Med* 2005;33:990-994

27. Wolcke BB, Mauer DK, Schoefmann MF, et al: Comparison of standard cardiopulmonary resuscitation versus the combination of active compression-decompression cardiopulmonary resuscitation and an inspiratory impedance threshold device for out-of-hospital cardiac arrest. *Circulation* 2003;108:2201-2205

28. Frascone RJ, Wayne MA, Swor RA, et al: Treatment of non-traumatic out-of-hospital cardiac arrest with active compression-decompression cardiopulmonary resuscitation plus an impedance threshold device. *Resuscitation* 2013;84:1214-1222

29. Debaty G, Shin SD, Metzger A, et al: Tilting for perfusion: head-up position during cardiopulmonary resuscitation improves brain flow in a porcine model of cardiac arrest. *Resuscitation* 2015;87:38-43

30. Moore JC, Salverda B, Lick M, et al: Controlled progressive elevation rather than an optimal angle maximizes cerebral perfusion pressure during head up CPR in a swine model of cardiac arrest. *Resuscitation* 2020;150:23-28

31. Rojas-Salvador C, Moore JC, Salverda B, Lick M, Debaty G, Lurie KG: Effect of controlled sequential elevation timing of the head and thorax during cardiopulmonary resuscitation on cerebral perfusion pressures in a porcine model of cardiac arrest. *Resuscitation* 2020;149:162-169

32. Putzer G, Braun P, Martini J, et al : Effects of head-up vs. supine CPR on cerebral oxygenation and cerebral metabolism - a prospective, randomized porcine study. *Resuscitation* 2018;128:51-55

33. Huang CC, Chen KC, Lin ZY, et al: The effect of the head-up position on cardiopulmonary resuscitation: a systematic review and meta-analysis. *Crit Care* 2021; 25:376 https://doi.org/10.1186/s13054-021-03797-x

34. Bachista KM, Moore JC, Labarère J, Crowe RP, Emanuelson LD, Lick CJ, Debaty GP, Holley JE, Quinn RP, Scheppke KA, MD, Pepe PE. Survival for non-shockable cardiac arrests treated with non-invasive circulatory adjuncts and head/thorax elevation. *Crit Care Med* 2024;52 (in press)

35. Moore JC, Duval S, Lick C, et al: Faster time to automated elevation of the head and thorax during cardiopulmonary resuscitation increases the probability of return of spontaneous circulation. *Resuscitation* 2022;170:63-69

36. Aufderheide TP, Nichol G, Rea TD, et al: A trial of an impedance threshold device in out-of-hospital cardiac arrest. *N Engl J Med* 2011;365:798-806

37. Aufderheide TP, Kudenchuk PJ, Hedges JR, et al; ROC Investigators. Resuscitation Outcomes Consortium (ROC) PRIMED cardiac arrest trial methods part 1: rationale and methodology for the impedance threshold device (ITD) protocol. *Resuscitation* 2008;78:179-185

38. Pepe PE, Aufderheide TP, Lamhaut L, et al: Rationale and strategies for development of an optimal bundle of management for cardiac arrest. *Crit Care Explor* 2020;2:e0214 doi:10.1097/CCE.0000000000000214

39. Geocadin RG, Callaway CW, Fink EL, et al: Standards for studies of neurological prognostication in comatose survivors of cardiac arrest: a scientific statement from the American Heart Association. *Circulation* 2019;140:e517-e542 doi:10.1161/CIR.0000000000000702

40. Thomas L, Li F, Pencina M: Using propensity score methods to create target populations in observational clinical reesearch. *JAMA* 2020;323:466-467

41. Austin PC: Balance diagnostics for comparing the distribution of baseline covariates between treatment groups in propensity-score matched samples. *Stat Med* 2009;28:3083-3107

42. Andersen LW, Grossestreuer AV, Donnino M: Resuscitation time bias - a unique challenge for observational cardiac arrest research. *Resuscitation* 2018;125:79–82

43. Paiva EF, Paxton JH, O'Neil BJ: The use of end-tidal carbon dioxide ($ETCO_2$) measurement to guide management of cardiac arrest: a systematic review. *Resuscitation* 2018;123:1-7

44. Scheppke K, Pepe PE, Antevy P, et al: Safety and feasibility of an automated patient positioning system for controlled sequential elevation of the head and thorax during cardiopulmonary resuscitation. *Prehosp Emerg Care* 2020;24:122-123

45. McVaney KE, Pepe PE, Maloney LM, et al, writing group on behalf of the Metropolitan EMS Medical Directors Global Alliance. The relationship of large city out-of-hospital cardiac arrests and the prevalence of COVID-19. *EClinicalMed*. (*Lancet* Open Access publication) 2021;34:e100815 https://doi.org/10.1016/j.eclinm.2021.100815

46. Pepe PE, Copass MK, Sopko G: Clinical trials in the out-of-hospital setting: rationale and strategies for successful implementation. *Crit Care Med* 2009;37:S91-101

47. Yannopoulos D, Aufderheide TP, Abella BS, et al: Quality of CPR: an important effect modifier in cardiac arrest clinical outcomes and intervention effectiveness trials. *Resuscitation* 2015;94:106–113

48. Duval S, Pepe PE, Goodloe JM, Debaty G, Labarère J, Sugiyama A, Yannopoulos D: Optimal combination of compression rate and depth during cardiopulmonary resuscitation to achieve favorable neurological survival. *JAMA Cardiol* 2019;4:900-908

49. Debaty G, Duhem H, Labarère J, Crespi C, Sanchez C, Lurie K. Neuroprotective cardiopulmonary resuscitation to improve outcomes of out-of-hospital cardiac arrest. *Acad Emerg Med* 2023;30;120. https://doi.org/10.1111/acem.14718 (p.120)

50. Moore JC, Segal N, Debaty G, Lurie KG: The "do's and don'ts" of head up CPR: lessons learned from the animal laboratory. *Resuscitation* 2018;129:e6-e7. doi:10.1016/j.resuscitation.2018.05.023

51. Moore JC, Pepe PE, Bachista K, et al: Carry less, do more: properly implementing a basic life support approach to the head-up CPR bundle of care. *EMS World* 2021;50:2-6

APPENDIX:

Components of Neuroprotective CPR (NPCPR) including the impedance threshold device, a mechanical active-compression/decompression device, and an automated head and thorax elevation device.

Specialized back-pack to facilitate rapid carriage of the equipment to the scene as well as expedite on-scene care in a pit-crew approach with strategic placement of interventions.

2023 Urban Fire Forum Position Statement

Establishing Prehospital Transfusion of Blood Products as Standard of Care for Emergency Medical Services Systems

Introduction

It is well-accepted that traumatic injury remains a leading cause of death and severe disability for adults and children, both across the United States (U.S.) and worldwide. According to the Gun Violence Archive, an independent data collection and research group, the United States has witnessed a concerning rise in mass shootings, with the number increasing from 273 in 2014 to 646 in 2022, peaking at 690 in 2021. As of mid-April, the archive had already documented nearly 150 mass shootings nationwide for 2023. In 2022, the FBI officially classified 50 of these incidents as active shooter events. Since 2018, the number of active shooter incidents has risen by 66.7% and resulted in near-daily multiple casualty incidents (MCI) in the U.S. alone. Regardless of the mechanism of injury, a significant percentage of those post-traumatic deaths are due to hemorrhagic shock and early exsanguination, be that secondary to penetrating injuries (gunshot, stabbings), motor vehicle crashes (MVCs), or other physical insults that disrupt major blood vessels and result in uncontrolled bleeding. Exsanguination remains the leading cause of preventable deaths among victims of trauma with nearly half of these patients dying in the prehospital setting. In addition, there are many other causes of hemorrhagic shock including uncontrolled obstetrical and gastrointestinal bleeding.

However, a growing body of evidence has begun to demonstrate that many of these deaths may be prevented with expedited transfusion of blood (or certain blood products) in the prehospital setting. Even in urban areas where trauma centers are in proximity to the scene of injury, accumulating data indicates that early intervention increases the chances of preventing death.

Until just a few years ago, paramedics in most states had not been authorized to initiate prehospital administration of blood products due to the traditional concern over possible transfusion reactions and an inability to perform tests for cross-matching to confirm blood type compatibility.

Fortunately, recent military and civilian experiences have demonstrated that most patients with O+ blood, the most common blood type, have low “titers” of the factors that would create such reactions. Blood donors with low titer blood types can now be identified by blood banks and those donors’ blood can be processed for prehospital use in multiple locales.

Currently, over 100 fire-based and single-service emergency medical services (EMS) agencies nationwide, both ground and air medical rescue service providers, are (logically) utilizing this therapy in suspected cases of severe, uncontrollable hemorrhage (i.e., restoring blood in the circumstance of blood loss). Moreover, in progressive EMS systems, prehospital transfusions are not only used for major injury cases with severe bleeding such as splenic rupture from an MVC or lacerations of major internal arteries and veins from gunshots or stabbings, but the blood can also be infused into patients with non-traumatic etiologies of bleeding such as gastrointestinal bleeding or obstetrical hemorrhage.

Purpose of this Deliverable

While this potentially lifesaving treatment is indeed logical and the evolving evidence (see below) supports its routine use, experience shows there are financial, logistical, political, and historical hurdles to overcome which are challenging and frustrating for those working to advance their care of patients with life-threatening hemorrhages.

The purpose of this position statement is to acknowledge these hurdles and to delineate the rationale and justifications for persevering and overcoming those barriers. The intention is to foster and steward the implementation of transfusion protocols nationwide as exemplified by medical leaders, organizations, and successful blood transfusions programs.

Evidence & Analysis

Two decades of military experience have indicated the safety and effectiveness of using blood products in far-forward conditions, including infusion of plasma products and low-titer whole blood. More recently, evolving data emanating from the civilian EMS experience have clearly indicated improvements in outcome-related variables including distinct effects on shock indices and historical improvements in hospital discharges. Some reports also indicate that prehospital blood infusions diminish the need for multiple transfusions in-hospital.

However, prehospital blood transfusion may not be helpful for all patients. Preliminary data indicate that patients initially found pulseless on-scene are unlikely to survive despite transfusions. While there are anecdotal cases of survival despite pulseless presentations, for the purposes of more effective utilization, more research should be performed to help better delineate subgroups of EMS patients for whom transfusions would be futile while also identifying any factors that predict potential salvage of such pulseless patients.

Data from numerous EMS systems uniformly indicate that the mean shock index (heart rate/systolic blood pressure) for patients meeting transfusion criteria can improve significantly, even after receiving a single unit of whole blood. In addition, most of those very ill patients survive to hospital discharge despite historically poor prognoses for such cases including those rapidly deteriorating. Among the smaller percentage of patients who do not survive, one generally finds that the patient had multiple organ systems severely injured or that there was irreparable vital organ tissue damage despite aggressive surgical intervention.

While, to date, traditional randomized clinical trials have not been conducted to demonstrate statistically significant decreases in mortality, most trauma center clinicians have now come to accept that there is no longer the equipoise needed to justify such trials. The marked improvements in shock index scores intuitively indicate that transfusion has clear physiological value in buying time to reach definitive surgical hemostasis as indicated.

Currently, there is consensus that there is enough outcome data to support prehospital blood transfusion as a standard of care. Moreover, leading trauma and EMS experts suggest that the strict criteria for providing transfusions, originally created to ensure optimal utilization of a limited resource, should now be liberalized. Many patients with internal bleeding requiring surgical repair can present to EMS with fairly normal vital signs and thus will have normal, non-eligible shock index criteria. Preliminary data also indicate that blood infusion can help to prevent deterioration and thus mitigate the need for advanced procedures such as endotracheal intubation and, furthermore, that the earlier the blood is administered, the better the outcome.

While costs per patient may average one thousand dollars (blood, equipment, variable costs), the lifesaving potential is significant, especially considering the years of functional lives saved with the observation that most exsanguinating patients are young. Compared to the resources used for other emergencies, it is quite in line.

Thus, there is widespread consensus that, regardless of 9-1-1 system configuration, local politics, and resources, the Metro Chiefs would do well to champion this cause and take a leadership role in fostering the implementation of this lifesaving intervention across our communities for the sake of the citizens we serve, including our own loved ones who could be a chance victim of an inebriated driver, active shooter or work-related severe injury.

Additional Resources and Partners in the Mix

Further supporting this call to action, in recent weeks, other organizations have taken similar positions to support the use of blood in the field including the ***American College of Surgeons*** *(ACS), and the* ***American College of Emergency Physicians*** *(ACEP). the* ***International Association of EMS Chiefs*** *(IAEMSC) and the* ***National Association of EMS Physicians*** *(NAEMSP). In an August 21, 2023, policy statement, IAEMSC announced that it "…. endorses prehospital blood product transfusion by paramedics to treat acute hemorrhagic shock." On June 20, 2023, NAEMSP, ACEP, and ACS published a joint position statement that also recommended prehospital blood transfusion, articulating that "… prehospital blood product resuscitation has demonstrated greater than predicted survival with a 37% reduction in 30-day mortality among severely injured civilian patients." Within the last several months alone, several states, most notably Florida, North Carolina, and Colorado, have established Blood Coalitions (e.g., Florida Whole Blood Coalition) that have helped to promote statewide implementation of such programs by EMS, many of which are fire-based services. Furthermore,* a group *of interested partners in the EMS, trauma services, and blood communities have now formed the* ***Prehospital Blood Transfusion Initiative Coalition*** *(PBTIC) which has recently been launched as a national advocacy coalition for espousing prehospital blood administration. The group will largely focus on educating healthcare communities and national leaders regarding the critical importance of blood transfusions (whole blood and blood components) in the prehospital setting. Four pillars of activity will include exploring reimbursement mechanisms, integrating blood administration into the national scope of practice for EMS, strategic preparedness (MCIs, disasters) and best practices for addressing regulatory issues.*

Drilling down, it will address and involve best practices for blood collectors, community sourcing of blood donors, EMS protocols, training, recommended equipment, strategic allocation and optimal utilization, critical data collection as well as reporting, quality improvement practices and collaborative research efforts that include a national registry of prehospital blood administration.

As a head start, various scholarly and operational groups such as the ***Association for the Advancement of Blood and Biotherapies*** *(AABB) and the* ***Trauma, Hemostasis, and Oxygenation Research*** *(THOR) Network have already addressed many of these tasks and have also created sample roadmaps for successful implementation.*

Proposed Deliverables and Action Items

With respect to prehospital blood product administration, the Urban Fire Forum recognizes that urban fire departments may have various service duties, with these ranging from basic life support (BLS) first responder duties and/or advanced life support-capable (ALS-C) fire apparatus response to firefighter paramedic ambulances and/or air medical rescue services providing ALS.

However, regardless of EMS system configuration or 9-1-1 response dynamics, support of prehospital blood product use still requires fire service involvement as an integral element. This includes first responder BLS procedures for controlling severe external bleeding in the severely injured (or other severe hemorrhage such as dialysis shunt ruptures/tears). BLS support should also include pit crew-like support for ALS medics such as providing help with setting up transfusion equipment, airway and supplemental oxygen support as well as measurement, monitoring, and documentation of cardinal signs (blood pressure, pulse rate, respirations).

Even if the fire service paramedics are not directly responsible for blood infusion in their jurisdiction, Metro Fire Chiefs can also help to support blood administration throughout the region by assisting other lesser-resourced services.

Depending on local politics, comfort zones, and a myriad of human and logistical factors, there is no singular roadmap for getting started with blood administration programs. Some systems providing prehospital blood get their supplies from blood collectors (i.e., blood "banks"), some from hospitals, and occasionally other sources. While most use low-titer whole blood, others use packed red blood cells or plasma infusions.

Notably, what has appeared to work best is establishing ongoing relationships with those who have successfully rolled out these programs. In addition, assimilating information from multiple models seems to be the most optimal approach to getting started successfully. Part of the job will be to arrange the introduction of key personnel such as blood collector specialists or trauma surgery specialists from the successful programs to counterparts in the developing program's system.

Accordingly, a suggested Framework for Implementing Prehospital Blood Administration:

- The Urban Fire Forum and Metropolitan Fire Chiefs should first adopt the definitive position that appropriate use of prehospital blood products and transfusions should become an acceptable standard of care for EMS agencies across the nation.
- The Metropolitan Fire Chiefs should align, virtually or in-person, with the Metropolitan EMS Medical Directors Global Alliance (aka medical "Eagles") to promulgate the critical value of fostering expedited blood transfusion in the prehospital setting and advocate for this life-saving patient care in systems yet to adopt such programs. *Many of the Eagles were the early adopters and they have garnered significant experience in developing, justifying, and maintaining these prehospital blood programs.*
- The Metropolitan Fire Chiefs will support advocacy mechanisms, including virtual and in-person conferences, to facilitate networking and mentorship for those wishing to implement these programs; again, these might be most useful if done in conjunction with the Eagles coalition and the *Prehospital Blood Transfusion Initiative Coalition* (PBTIC) as well as the highly-active *Florida Whole Blood Coalition* (and those of other state's evolving coalitions).
- Mentorship and educational programs should address pragmatic strategies for overcoming barriers such as blood-collector and/or hospital blood product sourcing, budgetary development and accompanying justifications, equipment choices/options, purchasing strategies (including economies of scale through coalitions), personnel assignments, on-site and vehicular storage mechanisms, deployment considerations, hospital and local politics, reimbursement mechanisms, logistics, training (trainers and budgeting) and assigning a dedicated champion for the program.

- Accurate and comprehensive data collection is required and must be accomplished in collaboration with receiving hospitals for quality assurance and joint research purposes. It also should include public relations and community outreach programs to establish a cadre of regular blood donors, preferably those with low-titer O+ blood types.
- It should be emphasized in training and protocols that blood administration is not the lone task in terms of managing patients with suspected hemorrhagic states; key concomitant actions are establishing airway and respiratory support (as indicated) while ruling out tension pneumothorax or other causes of shock states.
- Above all, a paramount focus should be on first stopping controllable bleeding (i.e., direct pressure, tourniquets, and hemostatic packing agents) as well as tranexamic acid (TXA) administration and potential calcium infusions, preferably given in a prescribed sequence of TXA, then blood products, and then calcium.
- The Metro Chiefs will work with the Eagles, the PBTIC, and others to develop, as needed, a usable toolkit and related educational programs to address the various elements and options when implementing a prehospital blood program as well as sustaining continuity with proven techniques that help with political, budgetary, and programmatic justifications.
- Similar to the concepts articulated by the IAEMSC writing group in their recent policy statement, the Metro Chiefs should also advocate that EMS medical directors, EMS regulatory agencies, healthcare systems, trauma systems, blood-bank managers; city/county administrators, legislators, and medical insurers (including the *Center for Medicare Services*) "support the rapid, reasonable, and regional implementation of prehospital paramedic blood product transfusion programs across the United States."
- Beyond the evolving assets to be provided by the Eagles, PBTIC, and other entities, the Metro Chiefs should work closely with the IAFF and IAFC to help with advocacy for funding these programs at the federal, state, and local levels of government.

Current Roadmap Samplings:

- *South Texas Regional Advisory Council* (STRAC). **Regional whole blood program: implementation guidance** video and slide show and sample applications (apps) and documents https://www.strac.org/blood

- Yazer MH, Spinella PC, Banks EA, Cannon JW, Cohn CD, Dunbar, NM, Frati K, Holcomb JB, Jackson BP, Jenkins D, Levy M, Pepe PE, Sperry JL, Stubbs JR, Winckler CJ. **THOR-AABB working party recommendations for a prehospital blood product transfusion program**. *Prehosp Emerg Care* November-December 2022;26:863-875. https://doi.org/10.1080/10903127.2021.1995089

- Coyle C, Zitek T, Pepe PE, Stotsenburg M, Scheppke KA, Antevy P, Giroux R, Farcy DA**. The Implementation of a prehospital whole blood transfusion program and early results**. *Prehosp Disaster Med* 26:1-5. doi: 10.1017/S1049023X23005952.

- Schaefer R, Long T, Wampler D, et al. **Operationalizing the deployment low-titer O-positive whole blood within a regional trauma system.** *Military Medicine* 2021: 186 (Supplement 1): 391-399. https://doi.org/10.1093/milmed/usaa283

- Creel N, Gibson J, Gibson K, Shirley L, Richart C. **Changing the playing field: a prehospital blood product pilot project in rural north Georgia**. *Am Surg* 2023 Feb 16:31348231157833. doi: 10.1177/00031348231157833

REFERENCES

1) Pepe PE**,** Roach JP, WInckler CJ. State-of-the-art review: Prehospital resuscitation with low titer O+ whole blood by civilian EMS teams -- rationale and evolving strategies for use. In: *2020 Annual Update in Intensive Care and Emergency Medicine*. Vincent JL (ed) Springer International Publishing, Berlin, 2020; Chapter 29;1-12.

2) Berry C, Gallagher JM, Goodloe JM, Dorlac WC, Dodd J, Fischer PE. Prehospital hemorrhage control and treatment by clinicians: a joint position statement, *Prehospital Emergency Care,* 27:5, 544-551, To link to this article: https://doi.org/10.1080/10903127.2023.2195487

3) Morrison JJ, Oh J, DuBose JJ, O'Reilly DJ, Russell RJ, Blackbourne LH, Midwinter MJ, Rasmussen TE. En-route care capability from point of injury impacts mortality after severe wartime injury. *Ann Surg* 2013;257(2):330–4. doi:10.1097/SLA.0b013e31827eefcf.

4) Apodaca A, Olson CM, Bailey J, Butler F, Eastridge BJ, Kuncir E. Performance improvement evaluation of forward aeromedical evacuation platforms in Operation Enduring Freedom. *J Trauma* 2013;75(2 Suppl 2):S157–S163. doi:10.1097/TA. 0b013e318299da3e.

5) Sperry JL, Guyette FX, Brown JB, Yazer MH, et al (PAMPer Study Group). Prehospital plasma during air medical transport in trauma patients at risk for hemorrhagic shock. *N Engl J Med* 2018 Jul 26;379(4):315-326.

6) Guyette FX, Sperry JL, Peitzman AB, Billiar TR, Daley BJ, Miller RS, Harbrecht BG, Claridge JA, Putnam T, Duane TM, et al. Prehospital blood product and crystalloid resuscitation in the severely injured patient: a secondary analysis of the prehospital air medical plasma trial. *Ann Surg* 2021;273(2):358–364. doi:10.1097/SLA.0000000000003324.

7) Rehn M, Weaver A, Brohi K, Eshelby S, Green L, Røislien J, Lockey DJ. Effect of prehospital red blood cell transfusion on mortality and time of death in civilian trauma patients. *Shock* 2019;51(3):284–288. doi:10.1097/SHK.0000000000001166.

8) Clear Creek EMS. 2 Texas EMS agencies first in U.S. to deploy whole blood. EMS One August 29, 2017 https://www.ems1.com/ems-products/medical-equipment/articles/2-texas-ems-agencies-first-in-us-to-deploy-whole-blood-2CoSwuKfzZXvFhqP/

9) Hughes I. New Castle, Sussex paramedics are now carrying blood for trauma patients. *Delaware New Journal* May 24, 2023. Anthttps://www.delawareonline.com/videos/news/2023/05/24/new-castle-sussex-paramedics-now-carrying-blood-trauma-patients-transfused-into-patient-pre hospital/11949623002/

10) Pepe PE (for the *Florida Whole Blood Coalition)*. TXA and calcium in the setting of hemorrhagic trauma. https://www.youtube.com/watch?v=pEmYOc0HAng

11) Shackelford SA, Del Junco DJ, Powell-Dunford N, Mazuchowski EL, Howard JT, Kotwal RS, Gurney J, Butler FK Jr, Gross K, Stockinger ZT. Association of prehospital blood product transfusion during medical evacuation of combat casualties in Afghanistan with acute and 30-day survival. *JAMA* 2017 Oct 24;318(16):1581-1591.

12) Zhu CS, Pokorny DM, Eastridge BJ, Nicholson SE, Epley E, Forcum J, Long T, Miramontes D, Schaefer R, Shiels M, Stewart RM, Stringfellow M, Summers R, Winckler CJ, Jenkins DH. Give the trauma patient what they bleed, when and where they need it: establishing a comprehensive regional system of resuscitation based on patient need utilizing cold-stored, low-titer O+ whole blood. *Transfusion* 2019 Apr;59(S2):1429-1438. doi: 10.1111/trf.15264. PMID: 30980748.

13) Weymouth W, Long B, Koyfman A, Winckler C. Whole blood in trauma: a review for emergency clinicians. J Emerg Med. 2019 May;56(5):491-498. doi: 10.1016/j.jemermed.2019.01.024. Epub 2019 Mar 20. PMID: 30904380.

14) Braverman MA, Smith A, Pokorny D, Axtman B, Shahan CP, Barry L, Corral H, Jonas RB, Shiels M, Schaefer R, Epley E, Winckler C, Waltman E, Eastridge BJ, Nicholson SE, Stewart RM, Jenkins DH. Prehospital whole blood reduces early mortality in patients with hemorrhagic shock. *Transfusion* 2021 Jul;61 Suppl 1:S15-S21. doi: 10.1111/trf.16528.

15) Mapp JG, Manifold CA, Garcia AM, Aguilar JL, Stringfellow ML, Winckler CJ. Prehospital blunt traumatic arrest resuscitation augmented by whole blood: a case report. *Transfusion* 2020 May;60(5):1104-1107. doi: 10.1111/trf.15740.

16) Newberry R, Winckler CJ, Luellwitz R, Greebon L, Xenakis E, Bullock W, Stringfellow M, Mapp J. Prehospital Transfusion of Low-Titer O + Whole blood for severe maternal hemorrhage: a case report. *Prehosp Emerg Care*. 2020 Jul-Aug;24(4):566-575. doi: 10.1080/10903127.2019.1671562.

17) McGinity AC, Zhu CS, Greebon L, Xenakis E, Waltman E, Epley E, Cobb D, Jonas R, Nicholson SE, Eastridge BJ, Stewart RM, Jenkins DH. Prehospital low-titer cold-stored whole blood: philosophy for ubiquitous utilization of O-positive product for emergency use in hemorrhage due to injury. *J Trauma Acute Care Surg* 2018 Jun;84(6S Suppl 1):S115-S119. doi: 10.1097/TA.0000000000001905.

18) Mapp J, Bank E, Osborn L, Stringfellow, M, Reininger D, Winckler C. Epidemiological and accounting analysis of ground ambulance whole blood transfusion. *Prehospital and Disaster Medicine* 2020;35:98-103. doi:10.1017/S1049023X1900517X

19) American College of Surgeons. (2022). National Trauma Databank: Annual Report. American College of Surgeons, Chicago, IL

20) National Academies of Sciences, Engineering, and Medicine. A national trauma care system: integrating military and civilian trauma systems to achieve zero preventable deaths after injury. *National Academies Press,* Washington, DC, 2016.

21) Spahn DR, Bouillon B, Cerny V, et al. The European guideline on management of major bleeding and coagulopathy following trauma: fifth edition. Critical Care, 2019:23(1):98

APPENDIX:

Conceptual Framework for Implementing Prehospital Blood Administration Programs

- Development of an Internal Roadmap that Outlines, the Rationale and Goals Beginning with Clinical Trauma Leaders, EMS Medical Directors/Chiefs, and Hospital Trauma Administrators/ Coordinators to Achieve Consensus on the Implementation of Prehospital Blood Product Administration and to Plan/Establish Integrated Prehospital, In-Hospital, and Discharge Data Collection and Sharing as well as Also Ascertain any Current State or Local Regulatory Limitations or Prohibitions Within the Given Jurisdiction

- Explore Various Models for Administration of Blood Products in the Prehospital Setting

- Facilitated by an Evolving Coalition of Trauma Teams and EMS Leadership, Departments Should Begin Communications with Blood Collectors and/or Hospital Blood Product Sourcing Managers to Establish Acceptable Mechanisms for Blood Storage and Delivery and Potential for Exchange Programs or Alternate Use if Blood Expiratory Dates are Approaching

- Following Negotiations on Cost, Storage and Return Privileges with Hospitals/Blood Collectors, Delineate the Proposed Initial Deployment and Allocations, likely in a Pilot Program, and Then Define Immediate Equipment Needs and Costs (e.g., Station-Base Storage Units, Insulated Carrying Coolers for On-Scene Use, Blood Warmer Units, Infusion Catheters, and Tubing, etc.) as well as Accompanying Medications (TXA, calcium); External Mentors, Including Professional Consultants, Can Help to Provide Information on Best Practices and Experience with These Tools and Procedures

- Prepare Budgetary Justifications and Costs (including training time) to Present to City/County Management Entities (Managers, Mayors, Commissioners, etc.) which Includes Equipment Fixed and Variable Costs and Options as well as Purchasing Strategies including Considerations of Using Economies of Scale through Coalitions and Mutual Aid Agreements

- Determine Personnel Assignments and Logistics of Training (including trainers' time) and Assign a Dedicated Champion for the Program

- Work Closely with Union Leadership, Public Relations Managers/Public Information Officers, and Even Likely Political Office Champions to not only Publicize the Life-saving Actions of the Program Overall But Also to Emphasize its Protection for All Members of Society (“It could be anyone’s child or anyone’s mother who will need this priceless intervention”)

- Such Publicity Activities Should Also Include Public Relations and Community Outreach Programs to Establish a Cadre of Regular Blood Donors (e.g., “San Antonio’s Heroes in Arms” program), which is also an Important Element of Advocacy for Blood Bank / Blood Collector Needs When Entering Negotiations with Them

- Again, to Ensure Optimal Cost-Effectiveness, Proper Utilization, and Need for Accurate Documentation of Related Outcomes to Justify Continuity and Expanded Deployment, Comprehensive Data Collection Must Be Performed and Reviewed in Conjunction with Receiving Trauma Centers for both Quality Assurance and Joint Research Purposes.

- Regularly Participate with Others Nationally such as the Whole Blood Academy based at the South Texas Regional Advisory Council (San Antonio), the Tulane Prehospital Blood Registry, the PBTIC, the Eagles, the *Florida Whole Blood Coalition,* and others.