

Leadership lessons learned in Tactical Combat Casualty Care

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The National Academy of Science, Education, and Medicine recently completed a comprehensive review of the US Military's advances in trauma care achieved as a result of the conflicts in Iraq and Afghanistan and the implications of those advances for the civilian sector in the United States.¹ Their report notes that the killed in action rate dropped from 21% in Vietnam to an all-time low of 7% in the recent conflicts in Iraq and Afghanistan. That decrease is certainly multifactorial; US combatants now wear better personal protective equipment, especially for the chest and upper back, than in previous conflicts. Also, as the battle space became more mature later in those two conflicts, evacuation times were very short.² But the improvements in prehospital trauma care that have resulted from the widespread use of Tactical Combat Casualty Care (TCCC) have also played a major role in reducing the killed in action rate by decreasing the number of preventable deaths in the prehospital phase of care.³⁻⁷ TCCC is a set of evidence-based, best-practice, prehospital trauma care guidelines that are customized for use on the battlefield. The TCCC Guidelines have been updated on an ongoing basis over the last 15 years through the work of the Committee on TCCC (CoTCCC) and the TCCC Working Group.

As a result of the multiple reports of lives saved through the use of TCCC concepts throughout the war years, TCCC has become the standard for the US Military and for many allied nations. It has been shown to dramatically improve casualty survival when all members of combat units are trained in TCCC.^{3-5,8,9} The process of developing improvements in battlefield trauma care and advocating for them to be implemented throughout the US Military was lengthy, challenging, and evolutionary. How did this transformation occur and what were the leadership lessons learned along the way?

BATTLEFIELD TRAUMA CARE IN 1992

Return for a moment to the end of the Vietnam conflict. A report from 1970 noted that there had been essentially no

improvement in battlefield trauma care for the past 100 years - a remarkable statement.¹⁰ Even more remarkable was that in 1992, that statement remained true.

Where were the battlefield trauma care lessons learned from Vietnam? They were not incorporated into military training, because training for combat medical personnel, (medics, corpsmen, and Air Force pararescuemen (PJs) in 1992 was based on civilian trauma courses not designed for prehospital trauma care, much less for use on the battlefield. Medics were taught not to use tourniquets because of the fear of ischemic damage to extremities; there were no hemostatic dressings; fluid resuscitation for hemorrhagic shock was based on large volume crystalloids; the medication used for battlefield analgesia was unchanged since the Civil War. (intramuscular morphine); there was little awareness of trauma-related coagulopathy and how to prevent it; and there was no tactical context for care rendered. Special Operations medics were taught to perform venous cutdowns if they encountered difficulty in establishing intravenous (IV) access. There was a strong emphasis on endotracheal intubation for prehospital airway management, despite a complete lack of evidence that combat medics could reliably accomplish this intervention in casualties with trauma to the airway.⁹

REVISITING THE EXTREMITY TOURNIQUET ISSUE

In 1990, the Naval Special Warfare (NSW) Biomedical Research and Development Program was established and directed to identify medical and physiologic research projects that would enhance Navy SEAL operations. One issue that was emerged from this review was the anomalous attitude towards tourniquet use in the trauma community, both civilian and military.

In 1992, tourniquet use was strongly discouraged, essentially banned, from prehospital trauma care practice because of the fear of ischemic damage to limbs. Yet tourniquets were used routinely during orthopedic surgery procedures and limbs were not being lost as a result of that practice. With exsanguination from extremity hemorrhage having been noted to be a leading cause of preventable death in Vietnam (causing an estimated 3400 deaths),^{7,10,11} it made little sense to exclude them from battlefield trauma care when they were being used safely for short durations in the operating room. Although the pneumatic tourniquets used in the operating room are inflated to a specified and constant pressure and are wider than those now used on the battlefield (thereby reducing the risk of compressive peripheral neuropathies), their safe use in the operating room indicated that they could be used on the battlefield for short durations without causing ischemic damage to limbs. The "No Tourniquet" rule was neither evidence-based nor logic-based, leading to the first major leadership lesson learned in TCCC:

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TCCC LEADERSHIP LESSON LEARNED NO. 1: NOTHING GETS A PASS BECAUSE “THAT’S THE WAY WE’VE ALWAYS DONE IT”

Once the remarkable disconnect between the available evidence and the current standard for battlefield trauma care with respect to limb tourniquets was identified, it was apparent that a review of the evidence base for all aspects of prehospital combat casualty care was needed. Further opportunities to improve were identified in the lack of tactical context, fluid resuscitation, battlefield analgesia, prevention of coagulopathy, spinal precautions, management of airway trauma, treatment of tension pneumothorax, battlefield cardiopulmonary resuscitation, and prehospital antibiotics. This comprehensive review was undertaken as an NSW project in which the evidence base for all of the areas listed above was undertaken—with current practice being held to the same standards of evidence as proposed new elements of care.^{12,13} Failure to apply standards for evidence to existing as well as proposed new recommendations would result in tradition-based medicine, rather than evidence-based medicine.

The development process for TCCC evolved into a joint effort between the Special Operations medical community and the Uniformed Services University of the Health Sciences. The project included literature reviews, multiple workshops with combat medical personnel, and extensive review of the proposed new TCCC recommendations by subject matter experts. Additionally, there was a sharp focus on reducing preventable deaths to the greatest extent possible. Further, throughout the process, consideration was given to the unique environment encountered in battlefield trauma care. At the end of 3 years, the research article that resulted from this project contained a comprehensive set of evidence-based, best-practice prehospital trauma care guidelines customized for use on the battlefield.^{9,12} Aggressive use of extremity tourniquets to stop life-threatening bleeding from arm or leg injuries was one of many recommendations that were at odds with the traditional standards of prehospital trauma care at the time.¹² In the course of the 20 years since the original TCCC article was published, significant advances have also been made in all of the other areas listed above.⁹

It quickly became apparent, however, that simply publishing these concepts in the medical literature fell far short of achieving the desired result of improving battlefield trauma care. Despite recommending a number of promising new approaches to caring for combat casualties, the article did not by itself inspire any change, therefore providing the second major TCCC leadership lesson learned.

TCCC LEADERSHIP LESSON LEARNED NO. 2: IT DOES NOT MATTER HOW GOOD THE PLAN IS—IF NOBODY IS USING IT

The original TCCC Guidelines were the result of a multi-year collaborative research effort between one of the US military’s foremost combat communities and its flagship institution for medical education. The product of this effort was a published article in a leading, peer-reviewed military medical journal. But no Soldier, Sailor, Airman, or Marine ever had his or her life saved by a research article. Research products have to be translated

into definitive action by the services and by combat units to improve the care provided to our nation’s combat wounded.

TCCC Senior Military Leader Briefings

The first major step towards translating the newly developed TCCC concepts into action was presenting them at a high-level Department of Defense (DoD) Biomedical Research review in 1996. The Joint Staff Surgeon at the time—MG Les Berger—attended that meeting and became an early advocate for TCCC. He subsequently arranged for TCCC concepts to be briefed to the Senior Military Medical Advisory Committee, a high-level group consisting of MG Berger, the Assistant Secretary of Defense for Health Affairs, and the Service Surgeons General. TCCC was also subsequently briefed to the Defense Medical Oversight Committee, comprised of the 4-star Service Deputy Chiefs of Staff, and to the US Special Operations Command (USSOCOM) Commander, another 4-star general. TCCC was also presented at the 1996 Joint Staff Surgeon-sponsored “Vision 2010” futures working group. In general, there was a favorable reception to the TCCC concepts presented, but no specific plan of action emerged.¹³

Early TCCC Presentations at Medical Conferences

Concurrently with the senior leader briefings described above, TCCC was also presented at a series of medical conferences. This served the dual purpose of giving medical audiences a chance to be exposed to TCCC concepts and respond to them, as well as to inform medical personnel who could help to help to bring about changes in prehospital trauma care an opportunity to do so. Early TCCC medical audiences included the Association of Military Surgeons of the United States, the annual military Tricare conference, the Special Operations Medical Association, the US Armed Forces Academy of Family Medicine, and the Wilderness Medical Society. Again—the response was generally favorable, although some attendees were reluctant to change long-held beliefs about the danger of using tourniquets to control extremity bleeding. But again, no specific plan of action to implement these proposed new battlefield trauma care recommendations emerged from this series of presentations.¹³

In retrospect, the major reason for this collective failure to act was accurately described in two articles published after the wars in Afghanistan and Iraq.^{14,15} There is no single individual, office, unit, organization, or agency in the DoD that has both the responsibility and authority to oversee combat casualty care throughout the US Military. For trauma care directives to effectively improve care in all components of the US Military, definitive action must be taken at the Secretary of Defense level.¹⁵ This did not happen, either in 1996 or by the time of this writing.

In terms of actually saving lives on the battlefield—despite the publication of the original TCCC article, senior leader briefings, and presentations at medical conferences—at the end of 1996, TCCC was exactly nowhere. So—how to proceed?

TCCC LEADERSHIP LESSON LEARNED NO. 3: IF WHAT YOU ARE DOING IS NOT WORKING, DO SOMETHING ELSE

TCCC Briefings for Combat Units

Although the Mabry article referenced above was 18 years away from being published in 1996, the next step in TCCC was

very much a practical exercise in determining “who owns battlefield trauma care?” as COL Mabry so precisely stated that question. For TCCC, the command that had first funded this effort was the logical place to seek to have these concepts implemented. The Commander of the NSW Command was briefed on the new TCCC Guidelines and the action proposed in that brief was to define TCCC as the standard for battlefield trauma care in NSW. This recommendation was accepted and in April of 1997, TCCC was established as the standard for battlefield trauma care in the SEAL community by Rear Admiral Tom Richards.^{9,16} Subsequent briefings were held for the 75th Ranger Regiment and the Army Special Missions Unit leadership after coordination with the officer and enlisted medical personnel at those commands. Both of these organizations also directed that TCCC be the standard for their units.^{4,9,13} This series of briefings and the original TCCC article also promoted awareness of TCCC within the military and a number of other units adopted TCCC as a unit-level action.^{6,17,18}

Even as these units were being briefed and TCCC was being implemented in the first military units to use it, there was awareness that TCCC would need to be updated in the future to reflect additional experience, new published prehospital trauma care literature, and new technology.

TCCC LEADERSHIP LESSON LEARNED NO. 4: THE COTCCC AND THE TCCC WORKING GROUP

The CoTCCC

The concept for a CoTCCC was first presented as a recommendation in the 1996 TCCC article:

“The Assistant Secretary of Defense for Health Affairs should establish a standing panel tasked with the development and periodic review of battlefield trauma care guidelines. This panel should monitor new developments in the field of prehospital trauma care and incorporate them into updated guidelines which are appropriate for the tactical battlefield environment.”¹²

The idea that the US Military should have a group chartered to produce a set of continually updated, evidence-based, best-practice, battlefield trauma care guidelines was a novel one in 1996 and it took five years to make that happen. The route chosen was to approach this undertaking as a USSOCOM medical research effort, but there was resistance to that proposal because battlefield trauma care is not unique to the Special Operations community, which was a consideration in obtaining Special Operations research funding. Eventually, in 2001, with the assistance of Colonel Dave Hammer, the Command Surgeon at USSOCOM, and Captains Doug Freer and Steve Giebner, the CoTCCC was established at the Naval Operational Medicine Institute. The group was resourced initially with USSOCOM medical research funding, and subsequently as a Navy Medicine program. The CoTCCC membership included trauma care experts from the Army, Navy, and Air Force as well as combat medics, corpsmen, and PJs. Over the ensuing years, the CoTCCC has had strong support from both the Navy and the Army Surgeons General, the Defense Health Board (DHB), and the US Army Institute of Surgical Research (USAISR). In 2013, at the direction of the Undersecretary of Defense for Personnel and Readiness, the CoTCCC was relocated to the DoD Joint Trauma System. The CoTCCC logo is shown in Figure 1.



Figure 1. CoTCCC Logo.

The TCCC Working Group

When the CoTCCC first began to function, since it was a Special Operations-funded entity, the group was focused on Special Operations missions, medical capabilities, and units. As the use of TCCC began to expand into the conventional forces and as the group began to be funded by both the Navy and the Army Surgeons General, the CoTCCC began to invite additional individuals from key organizations within the military services, from civilian interagency partners (Homeland Security, FBI, State Department, et al), and from allied nations to serve as CoTCCC liaison members. This action greatly expanded the input and the perspectives that go into the decision-making process of the group. The term “TCCC Working Group” includes the CoTCCC voting members (which are limited to 42 by charter), CoTCCC liaison members, and a group of designated TCCC Subject Matter Experts. Although liaison members and Subject Matter Experts do not vote (to comply with the size of the CoTCCC voting membership required by the charter and with military regulations governing advisory groups), they do participate fully in the crafting of proposed changes to the TCCC Guidelines. Since the CoTCCC change preparation process is designed to identify and focus on recommendations with which there is a strong favorable consensus and to defer consideration of items in the proposed changes which are more contentious, most proposed changes pass by a large majority. This inclusive modified Delphi approach to change development has served the TCCC process very well.

TCCC LEADERSHIP LESSON LEARNED NO. 5: MAINTAIN AN ACTIVE SEARCH FOR GOOD IDEAS—WHEREVER THEY CAN BE FOUND—AND PROCESS THEM AS THOUGH LIVES DEPENDED ON IT

Because, indeed, they do. The standard for modern medicine is that it be evidence-based, but there is wide misperception

about what level of evidence is sufficient to drive changes in medical practice accompanied by a failure to apply those standards of evidence to long-standing medical practice. Not every trauma care intervention will have a large, prospective, randomized, controlled trial to support it. Further, even when such a trial has been done^{19,20} and the findings are statistically significant, some will question the methodology of the study and therefore dispute the validity of the study's findings. Optimal and continuously learning combat casualty care requires that evidence be gathered from an array of sources, as shown in Figure 2 then discussed and acted on (or not) by a panel of subject matter experts. For the US Military, in the recent war years, this group has been the CoTCCC and the TCCC Working Group for battlefield trauma care issues.^{8,9}

Proposed new equipment, medications, and techniques proposed for TCCC are reviewed by the CoTCCC and TCCC Working Group through the prism of what is feasible for combat medical personnel and is most likely to save additional lives on the battlefield. Some interventions considered promising in trauma care, such as recombinant Factor VIIa, were discussed at CoTCCC meetings, but the cost per dose (estimated at \$6000 per dose at the time) and the need for refrigeration made this proposed intervention not practical for prehospital use by medics.

TCCC LEADERSHIP LESSON LEARNED NO. 6: MAKE NEEDED CORRECTIONS QUICKLY AS ADDITIONAL EVIDENCE AND EXPERIENCE IS GAINED

There should never be a perception that needing to change a previous recommendation is per se an indication of past poor performance. Poor performance occurs when the system fails to act on identified opportunities to improve. We should fully expect that battlefield trauma care will evolve during a time of conflict as additional evidence is gained and new challenges are confronted and overcome. This is precisely the definition of a continuously learning battlefield trauma care system. Numerous examples of needed change have been addressed by TCCC during the 14 years of war in Iraq and Afghanistan. For example, the needle that was commonly used to perform needle decompression at the start of the wars was found to be too short to reliably penetrate the chest wall of US military personnel.²¹ There were two potentially preventable deaths identified by the Armed

Forces Medical Examiner System as a result. Harcke et al subsequently performed a virtual autopsy study that found that a 3.25-inch needle was needed to achieve 99% success in reaching the pleural cavity.²¹ When this new evidence came to light, the US Army and TCCC began to recommend the use of a 3.25-inch needle instead of the previously used 2-inch needle. There have been no case reports of preventable deaths in the US Military due to failed needle decompression since this change was made. Further, a recent study from the Mayo Clinic clearly demonstrates the superiority of a 3.25-inch needle over a 2-inch needle for needle decompression. No complications were reported from the use of either length of needle.²²

Another example of the TCCC response to an identified opportunity to improve occurred after the sudden increase in dismounted Improvised Explosive Device (dIED) attacks in Afghanistan. After the Taliban lost the ground war to coalition forces, they shifted their tactics around 2010 to a strategy based on maiming coalition combatants who stepped on pressure-activated IEDs, creating a relative sudden increase in the severe injury pattern that these devices cause. The US Army Surgeon General formed a Task Force to address this new injury pattern that became known as Dismounted Complex Blast Injury (DCBI).²³ Because DCBI typically entails bilateral high proximal lower extremity amputations accompanied by groin and pelvic injuries (junctional hemorrhage), TCCC subsequently recommended the carriage and use of junctional tourniquets designed to compress the femoral artery at the level of the inguinal ligament and control inguinal and proximal lower extremity hemorrhage not controllable with extremity tourniquets.²⁴ These devices are now part of the standard medical equipment set carried by Army medics. (COL Lance Cordoni—personal communication)

A third example of a rapid response to an opportunity to improve was the adoption of oral transmucosal fentanyl (OTFC) as an alternative to IV morphine when opioid analgesia is needed to relieve the pain of combat wounds. IV morphine works much more quickly than IM morphine, but entails the added step of establishing IV access. OTFC, as pioneered for use on the battlefield by Kotwal and O'Connor and their colleagues, combines analgesic efficacy almost equivalent to IV morphine in terms of speed and potency of pain relief, but eliminates the requirement to start an IV.²⁵ Once this OTFC case series was published, TCCC moved quickly to incorporate OTFC as a new analgesic option in the TCCC Guidelines.^{26,27}

A key component of maintaining updated battlefield trauma care best-practice guidelines is the willingness to expeditiously reconsider previous recommendations in the TCCC Guidelines when new evidence indicates that this is necessary. A good example is the experience with the topical hemostatic agent WoundStat. Kheirabadi's study from USAISR in 2009 compared the efficacy of a number of new hemostatic agents with the previously recommended hemostatic dressings in TCCC.²⁸ This study found that the new hemostatic agents Combat Gauze and WoundStat were consistently more effective than HemCon and QuikClot, the TCCC hemostatic agents recommended at the time. There was also no significant exothermic reaction noted with either agent, in contrast to that found with QuikClot granules. Although Combat Gauze and WoundStat were both found to be more effective than the previously recommended

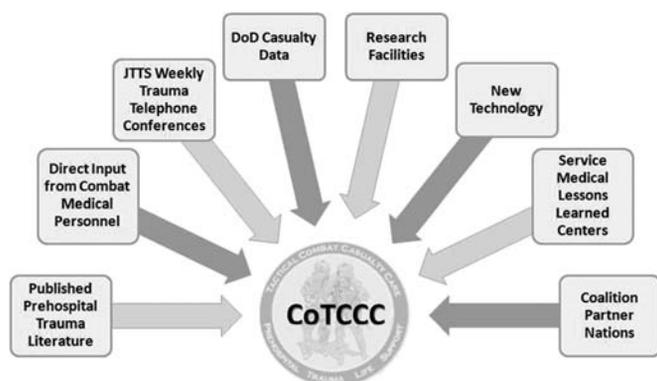


Figure 2. Kotwal.

hemostatic agents, combat medics on the CoTCCC expressed a strong preference for a gauze-type agent rather than a powder or granule. This preference was based on combat experience that found that powder or granular agents were problematic in windy environments or during helicopter evacuations with strong rotor wash. Powders and granules were also noted to work poorly in wounds where the bleeding vessel was at the bottom of a narrow wound tract.²⁶ Based on these observations, Combat Gauze was recommended as the first-line treatment for life-threatening hemorrhage that is not amenable to tourniquet placement and WoundStat was recommended as a back-up option should Combat Gauze not be effective at controlling bleeding. Subsequent studies at USAISR, however, found that WoundStat caused the formation of occlusive thrombi in the injured vessels as well as distal thrombosis in vital organs.²⁹ These safety concerns resulted in the removal of WoundStat from the TCCC Guidelines and discontinuation of its use in the US military.²⁶

TCCC LEADERSHIP LESSON LEARNED NO. 7: IMPROVED METHODOLOGY FOR REACHING DECISIONS ON BATTLEFIELD TRAUMA CARE RECOMMENDATIONS

The Maughon article noted in 1970 that there had been essentially no improvement in battlefield trauma care in the last 100 years.¹⁰ This statement was largely true, in part because of the myriad of challenges entailed in determining what best medical practice consists of when combat medics are working in the lethal chaos of the battlefield. Although the initial TCCC article provided a set of guidelines believed to be optimal in 1996, medicine changes continuously and the need for a process through which to make ongoing updates to TCCC was recognized in the original TCCC article.¹² Once the CoTCCC was established in 2001, there was a group charged to develop these changes.^{9,30} Since the establishment of the CoTCCC, however, there have been a number of evolutionary changes in the methodology used to update the TCCC Guidelines. Initially, changes to the TCCC Guidelines could be proposed, discussed, and voted on at the same meeting.

In contrast, at present, proposed TCCC changes are identified; evidence is gathered; the proposed change is incorporated into a draft change article; the change is circulated and discussed among the TCCC Working Group either at a meeting or by teleconference; the change is revised to reflect the consensus opinion; and the proposed change is then voted on. The process now typically takes 2 to 4 months for each change.

Also, at the start of the CoTCCC's existence, the rationale for changes in TCCC and the discussion of the evidence base were documented only in the minutes of that meeting. When the CoTCCC was relocated to become part of the DHB, a different process was developed. Once the proposed changes had been approved by the CoTCCC, they were subsequently presented to the DHB, and if approved by that group, forwarded to the Assistant Secretary of Defense as a DHB memorandum for his consideration.³¹⁻³⁸ These memos contained a review of the evidence base for the changes recommended and were posted to the DHB website once finalized. This sequence slowed the incorporation of needed changes into the TCCC Guidelines, but was nonetheless a positive step, in that it made for a better discussion

of the evidence and brought recommended changes in battlefield trauma care more directly to the attention of senior military medical leaders. Even though the DHB is the senior advisory board to defense medical leadership, however, some TCCC stakeholders noted that DHB memos are not a permanent entity in the published medical literature. When the CoTCCC was moved to the Joint Trauma System in 2013, the methodology for documenting changes to TCCC was reconsidered. Since that point in time, all TCCC changes approved by the voting membership have been published in the *Journal of Special Operations Medicine*, which is included in Index Medicus and searchable in PUBMED.^{24,27,39-45}

One consistent element of the TCCC change process has been the requirement for all proposed changes to be approved by a supermajority (at least 66%) of the CoTCCC voting members. This avoids the ambiguity of evidence grading systems that recommend changes, but potentially do so with a qualifier of the recommendation as being "weak." If a recommendation is truly weak, then the US Military should not spend millions of dollars implementing the change and ask combat medics to risk their lives on the battlefield to perform a "weakly" recommended intervention. The supermajority rule in effect makes all approved changes in TCCC "strong" recommendations. Any discussion about the evidence base for battlefield trauma care should be caveated by noting that "the prehospital environment does not lend itself well to the conduct of carefully designed, randomized controlled trials (RCTs) in trauma care; this is especially true in combat. Informed consent is not easily obtained from the recently wounded, the administrative aspects of RCTs are not appropriate for the battlefield, and rapid transport to the hospital is often lifesaving for the critically injured patient and should not be delayed for research purposes. The lack of RCTs, however, is not an excuse for inaction. Decisions about how best to care for the combat wounded must be made with the evidence at hand, not deferred for want of additional or higher quality evidence."⁴⁶

TCCC LEADERSHIP LESSON LEARNED NO. 8: EFFECTIVE STRATEGIC MESSAGING IS NEEDED TO INFORM AND INSPIRE DECISION MAKERS

The CoTCCC and the JTS have a great deal of responsibility but essentially no authority with which to direct improvements in trauma care. The military command structure does that. The Surgeons General of the US Armed Services oversee basic training and equipping of combat medical personnel, but combat unit commanders also oversee battlefield trauma care training and equipping. It is combat commanders that have the authority to mandate how battlefield trauma care will be executed for all units subordinate to them, unless otherwise ordered by superiors in the chain of command.^{2,4,14,15}

For both medical and combat leaders in the US Military to make optimal decisions about trauma care, the CoTCCC, the JTS, and other individuals advising them have an obligation to inform leadership as well as possible. To use the words of former US Surgeon General Richard Carmona at Hartford Consensus IV,⁴⁷ individuals and organizations seeking to improve medical care must "inform and inspire" those who have the authority to mandate these advances in care. Advances in trauma care do not just happen—they must be inspired to happen—and, in a

military structure, the more senior the leader who is inspired to act, the larger the segment of the military that will benefit.^{2,14,15} Progress in trauma care is not inevitable, as evidenced by the fact that the US Military lost an estimated 3400 service members to extremity hemorrhage in Vietnam, but most US forces nonetheless started the conflict in Afghanistan without tourniquets.⁷

The CoTCCC uses or is planning to use all 13 of the strategic messaging modalities listed in Table 1. The strategic messaging approach outlined in Table 1 is designed both to highlight successes obtained through TCCC use as well as to communicate opportunities to improve in battlefield trauma care that have been identified but not yet implemented.

The most significant example of strategic messaging is that used to describe the outcomes from tourniquet use in TCCC. This issue was especially important for two reasons: the first is that tourniquet use represented a radical departure from prehospital trauma care in the US—both military and civilian—as it existed 20 years ago. The second is that tourniquets have been the single most important lifesaving battlefield trauma care advance from our recent conflicts. The strategic messaging included both early reports of death from extremity hemorrhage^{48–50} and documentation of improved survival as the use of extremity tourniquets became more prevalent.^{5,6,51–54} This information had to be published and briefed to senior leaders quickly so that it could appropriately guide future decisions. CoTCCC messaging was assisted intermittently by reports in the media of preventable deaths among US casualties resulting from failures to field and use limb tourniquets. A notable example was the Baltimore Sun column entitled “Modern Combat Lacking in Old Medical Supply: Deaths Because of Blood Loss From Wounded Extremities Could Be Reduced if All Soldiers Carried \$20 Tourniquets, Some Doctors Say.” This column precipitated a letter from the Senate Armed Services Committee leadership to the Secretary of Defense and accelerated the fielding and use of tourniquets in the military.⁵⁴ CoTCCC members have also used messaging techniques such as the dissemination of “red/green” equipment status charts to help expedite the removal of ineffective tourniquets from military equipment sets.⁵⁴

TABLE 1. TCCC Strategic Messaging—2016

Published medical literature
Briefings for unit and senior leaders
Presentations at medical conferences
TCCC literature summaries
Joint trauma system website
Other websites (MHS, NAEMT, JSOM, SOMA)
TCCC email distribution list
PHTLS and other textbooks
“Red/green” progress charts
Participation in relevant working groups
Response to information requests
TCCC mobile—coming soon
Up to date—in negotiation

MHS, Military Health System; NAEMT, National Association of Emergency Medical Technicians; JSOM, Journal of Special Operations Medicine; SOMA, Special Operations Medical Association.

By the proclaimed end of the conflict in Afghanistan (2014), deaths from extremity hemorrhage had been reduced by 66%, even when the numerous deaths from extremity hemorrhage early in the war are included in the total.^{3,7} In the 75th Ranger Regiment, which had implemented TCCC before the start of the war, not a single life was lost in the prehospital environment due only to extremity hemorrhage.⁴ Even now, after the recent conflicts have (mostly) been concluded, this messaging continues to be critically important, as advances made in past wars have been lost during the ensuing peace interval.^{15,55}

TCCC LEADERSHIP LESSON LEARNED NO. 9: EVIDENCE DOES NOT DRIVE ADVANCES IN TRAUMA CARE. PEOPLE DO THAT

In the US military, the advocates for improvements in trauma care in Iraq and Afghanistan included the CoTCCC, the TCCC Working Group, the JTS, medical researchers, combat medical personnel, medical educators, unit medical officers, service medical leaders, combat unit commanders, Combatant Command commanders, and the Secretary of Defense.^{2,4,8,9}

The combat unit commanders who made the initial decisions to implement TCCC in their units all had substantial but imperfect evidence on which base their decisions, but that is the norm rather than the exception for decisions related to combat. Very few combat commanders ever have every piece of information that they would like to have when planning and executing missions. They must make life and death decisions with the information that they actually have, rather than the ideal information set that they would like to have. In medicine, even though we have the benefit of being able to perform well-designed clinical trials and produce high quality clinical evidence, change does not happen unless advocates for change recognize the need for change, gather and analyze the evidence, make a decision, develop their case, and engage successfully with the right decision makers.

In a like manner, initiatives undertaken by proactive medics, physicians, and line commanders in allied militaries have resulted in TCCC becoming widely used by many of our allied nations.⁸ This international spread of TCCC is due in significant part to the efforts of the National Association of Emergency Medical Technicians (NAEMT), who have teaching TCCC courses to militaries around the world since 2009.⁸ The Canadian military has reported their highest casualty survival rate in history and have credited a TCCC training program aimed at all combatants, not just medics, as a major factor in achieving that historic success.⁵

Things are much the same in the civilian sector, where each trauma center and each EMS system makes individual and autonomous decisions about the standards for prehospital trauma care in their system. Two years ago, most civilian trauma centers were not using tourniquets and almost none were using hemostatic dressings.⁵⁶ Largely unknown is how many EMS systems have adopted “sit-up and lean-forward positioning” for traumatized airways, 3.25-inch needles for needle decompression, the CricKey for surgical airways, and hypotensive resuscitation—despite an adequate evidence base on which to base these decisions. Where significant national progress has been made in the civilian sector, it has been largely due to the

actions of specific leaders. At the local level, examples include: Dr. John Holcomb in Houston;⁵⁷ Drs. Don Jenkins and Scott Zietlow at the Mayo Clinic;^{22,58} Dr. Peter Pons in Denver;⁵⁹ Dr. Peter Rhee in Tucson; Drs. Jay Johannigman, Warren Dorlac, and Mel Otten in Cincinnati; and Dr Alex Eastman in Dallas. At the national level, examples include Dr. Lenworth Jacobs with the Hartford Consensus program^{47,60-64} and Drs. Dave Marcozzi, Kathy Brinsfield, and Richard Hunt with the White House Stop the Bleed campaign.

The new evidence in prehospital trauma care emerging from the US Military experience in Iraq and Afghanistan is there for all to see - but it is the actions of these leaders and others like them that are turning new best-practice recommendations in prehospital trauma care into lives saved.

TCCC LEADERSHIP LESSON LEARNED NO. 10: LESSONS LEARNED ARE NOT REALLY LESSONS LEARNED—UNLESS WE ACTUALLY LEARN THEM

TCCC has had significant success in helping US Military medics, corpsmen, and PJs to improve casualty survival, but there are some significant performance improvement issues that have not yet been adequately addressed. Figure 3 shows a Red/Green Progress Chart for TCCC as of this writing.

Successes include: (1) the TCCC Guidelines are evidence-based and consider both the published medical literature as well as the real-time performance improvement evidence gathered by the weekly JTS trauma care teleconferences; (2) TCCC recommendations are continuously updated as the need to do so is identified; and (3) the spread of TCCC from a few Special Operations units to the entire US Military and many allied militaries, albeit slow, is an indication that the strategic messaging techniques that have been used were effective.

On the red (yet to be accomplished) side of Figure 3 is the number of important items:

	Yes	No
Evidence-Based	Green	
Continually Updated	Green	
Strategic Messaging	Green	
Medical Rapid Fielding Plan		Red
TCCC Training Standardized and Mandated		Red
Physician TCCC Training		Red
DoD-FDA Panel		Red
TCCC Documentation		Red
Preventable Death Analyses		Red

Figure 3. Current TCCC Red/Green Status Chart.

TCCC Rapid Fielding Initiative

Unit equipment sets and supporting medical logistics systems have not kept pace with the evolving battlefield trauma care recommendations in the TCCC guidelines.^{15,65} Despite the widespread acceptance of TCCC by the US Military, no DoD-wide program exists at present to ensure that newly recommended technology, techniques, and medications in TCCC are quickly and reliably made available to combat medical personnel. A TCCC Rapid Fielding Initiative is needed to expedite delivery of newly recommended combat casualty care equipment and training to deployed and deploying forces and to gather feedback on the initial experience with newly fielded equipment. The 2005 to 2006 TCCC Transition Initiative conducted as a joint effort of USSOCOM and USAISR provides an excellent model for such an initiative.⁵¹

TCCC TRAINING STANDARD

Many "TCCC" courses have been found to teach material that is substantially different from the TCCC recommendations developed by the JTS and the CoTCCC. These variations have been directly associated with observed bad outcomes.⁶⁶ Additionally, some courses have been found to use such potentially harmful training techniques such as: using medications to produce a hypotensive state in students for the purposes of demonstrating the signs and symptoms of hypotension; administering ketamine to students to demonstrate the alterations in mental status caused by this medication; and inserting sternal intraosseous devices on students, a painful and potentially harmful procedure.⁶⁶ In the absence of a standard TCCC course with a professionally developed curriculum, "TCCC Training" in the DoD can vary from being an hour of Powerpoint slides or 11 days of inappropriate training - or anything in between—with no controls over quality of instruction or accuracy of the messaging. The NAEMT provides TCCC training that uses the standard curriculum developed by the JTS and the CoTCCC. This training option has been used by both US Military and allied military units since 2009 at a minimal cost. NAEMT-offered courses also provide a TCCC certification card endorsed by the JTS, the CoTCCC, the NAEMT, and the American College of Surgeons Committee on Trauma.⁶⁶ No other training course offers this level of endorsement by nationally recognized trauma organizations.

TCCC for Physicians, PAs, Nurses, and Medical Service Corps Officers

The 2012 survey of prehospital trauma care in Afghanistan led by the JTS and the US Central Command found that the US military teaches physicians and other medical supervisors the Advanced Trauma Life Support course (maybe) and then assigns them to combat units and expects that they will be able to effectively supervise medics who have been taught battlefield trauma care based on TCCC concepts.^{15,65} This is disadvantageous for both combat medical personnel and the casualties that they will be expected to care for. Physicians, PAs, nurses, and medical service corps officers need to be taught TCCC concepts so they can effectively oversee the training and equipping of their medics and/or supervise the delivery of battlefield trauma care.

DoD–FDA Medical Panel

Battlefield trauma care is not well served by the current FDA regulatory structure. A panel to oversee the regulation of medications and blood products used for battlefield trauma care should be established as a cooperative effort of the DoD and the FDA.

For example, ketamine, which does not have an analgesic indication from the FDA, can be and is used extensively off-label by physicians for analgesia. Ketamine is especially useful for battlefield analgesia in casualties with hemodynamic or pulmonary compromise for whom opioids are contraindicated. Ketamine cannot, however, be marketed or produced in delivery systems designed for battlefield analgesia—despite this medication's proven success in combat - because of regulatory constraints. Because unit dose packaging for analgesic use is not allowed by the FDA, unit medical personnel are forced to either draw up the medication into syringes before combat actions, which leads to wastage and an increased potential for diversion, or to draw up the medication from multidose vials in the middle of a combat engagement, which increases the risk of medication error and slows the medic down as he or she attempts to treat multiple-injury casualties. Ketamine supplied in 50 or 100 mg manufactured unit dose delivery systems (that could be designed for intramuscular, intranasal, or intravenous use) would be a very useful addition to medical kits on the battlefield, but is not allowed at present because of FDA regulatory constraints.⁴⁶

Another example is dried plasma. The available evidence shows that colloids and crystalloids are the LEAST desirable options for fluid resuscitation of casualties in hemorrhagic shock.^{15,26,27} Dried plasma is a much better option and is used by most of our coalition partner nations, but is not available to most medics in the US Military because of the FDA regulatory structure.^{15,46} Medical devices, many of which are intended for battlefield use, and medications used to treat victims of weapons of mass destruction are already handled by the FDA using processes distinct from the usual regulatory approach for new medications. Appropriate special treatment should also be extended to medications and blood components that have been identified as the best-practice options for battlefield trauma care.

Documentation of Prehospital Care in Combat Casualties

Consistent documentation of prehospital combat casualty care is essential to optimally caring for the casualty, through noting such elements of care as time of tourniquet application, tranexamic acid dose and time, analgesic doses/times, and antibiotics given. This documentation is also essential to efforts to improve battlefield trauma care for all through the JTS performance improvement process. Despite the importance of this facet of combat casualty care, prehospital care documentation is often not accomplished.^{39,65} The 75th Ranger Regiment developed a simple and well-designed TCCC card as well as a more detailed electronic after-action report and demonstrated that reliable documentation of prehospital care is possible if the appropriate command emphasis is present.⁴ Building on the Ranger Regiment's success with these dual formats, TCCC has consistently advocated for the use of these

two documentation tools throughout the DoD and has updated them recently to include new treatment recommendations in the TCCC Guidelines, but it will take strong and sustained command emphasis in combat units to replicate the success of the 75th Ranger Regiment in this aspect of care throughout the US military.³⁹

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DISCLOSURE

Off-Label Use: Ketamine, tranexamic acid, and fentanyl oral transmucosal lozenges are recommended by TCCC for off-label use in battlefield trauma care. The author declares no conflict of interest.

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