

WWII

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LESSONS from HISTORY

The Origins of

# EMS in Military Medicine

IRAQ & AFGHANISTAN

How COMBAT MEDICINE influenced the Advent of TODAY'S EMS MODEL

By Daved van Stralen, MD

*“It is appropriate that experience during unavoidable epidemics of trauma be exploited in improving our national capability to provide better surgical and medical care for our citizens.”*

Spurgeon Neel,  
COLONEL, MEDICAL CORPS, U.S. ARMY<sup>1</sup>

Though EMS as medical treatment of a patient prior to and during transportation to the hospital may have roots dating back centuries, it is only since Napoleon's European campaigns that we can draw a direct line from his system for moving combat casualties to today's EMS. Napoleon's physician, Dominique-Jean Larrey, developed a system specifically for transportation of battle casualties (the "flying" ambulance), which was introduced into the U.S. Army during the Civil War.

In the trench warfare of WWI, the U.S. Army assigned nonphysicians to the trenches for treatment of casualties. In WWII, these first aid men entered combat, becoming the corpsmen and combat medics in service today.

During WWII, the Army also introduced air transport of the injured; this development was followed by helicopter transport directly from the scene of injury to the hospital in the Korean Conflict and the Vietnam War. As alluded to in Col. Neel's 1968 statement, each of these advances in prehospital care came from the epidemic of trauma that occurs during military combat.

From the current epidemic of trauma, the Global War on Terror in Iraq and Afghanistan, military combat medicine has further defined and validated Tactical Combat Casualty Care (TCCC)<sup>2</sup> with treatment guidelines for the use of tourniquets, hemostatic agents, needle chest decompression, and hypotensive resuscitation. This supplement presents some of what we've learned, which, in Col. Neel's words, will improve "our national capability to provide better surgical and medical care for our citizens."

The U.S. military constantly strives to improve the medical care provided to combat casualties with the indirect result of improvements to civilian emergency medical care over the past two centuries. In this article, I'll explore the development of emergency care from the military experience, including casualty movement, providing emergency care to the injured soldier at the point of wounding, use of aeromedical evacuation, clinical advancements in treatment and medical equipment, as well as critical decision-making skills.

## ***The Origins of EMS***

Napoleon used ambulances, or what's known today as our military field hospital, during his military campaigns, but army regulations kept them one league (about 3 miles) away from the army and several hours from where the battle occurred.

Larrey began to recognize that this distance, along with the difficulty of moving the wounded, delayed treatment and increased the mortality rate. During a retreat at one battle, Larrey marveled at how fast the "flying" horse-drawn artillery could move and thought of developing a "flying ambulance" (ambulance volante) to move the wounded from the battleground to the ambulance field hospital. He later designed a specialized horse-drawn cart to transport the sick and injured, which gradually evolved into our modern ambulance.<sup>3</sup>

Flying ambulances reached America in 1862, when Dr. Jonathan Letterman, a medical director in the Union Army, introduced them as a means to transport wounded soldiers. Prior to then, the Quartermaster Corps provided wounded transport as part of its duties to transport supplies.

After the Seven Days Battle in July 1862, Dr. Letterman transferred the Quartermaster Corps to the medical staff of the Union Army and introduced forward first-aid stations at the regiment level to administer medical care closer to the battle. Both of these decisions significantly reduced mortality rates at the Battle of Antietam and led the U.S. Congress to establish these procedures as the model medical procedure for the entire U.S. Army in 1864.<sup>4</sup>

During World War I, the U.S. Army's Medical Department assigned two enlisted men with first-aid training to each company stationed along the French front lines. These men treated the injured where they lay if they had only a few casualties to treat; otherwise, company litter bearers carried the injured to the company aid station and then to the battalion aid post. In the trenches, treatment also occurred where the man fell, at the point of wounding, and included control of hemorrhage and the splinting of fractures.

At the company aid station, medical personnel further controlled hemorrhage, adjusted bandages and splints, and administered antitetanic serum before moving the injured to the battalion aid post. From there, the soldier was evacuated to the ambulance dressing station, the farthest point forward that ambulances could reach safely and where battlefield placement of dressings and splints could be corrected and the wounded sorted for transport.<sup>5</sup>

Procedures that began in WWI carried over to WWII. Each company was again assigned two first-aid men, called company aid men and later known as combat medics or corpsmen (Navy medics assigned to a ship or company of Marines), but these medics brought emergency care to the injured soldier at the point of wounding—on the battlefield under exposure to enemy fire. To administer care that was safe for both the casualty and medic in this hazardous environment, the medic began to synthesize combat decision making with the principles of first aid. Medical aid measures during WWII included controlling hemorrhage (including tourniquet use), applying splints and dressings, administering booster dose of tetanus toxoid and initiating chemotherapy (in the form of antibiotics, such as sulfa powder sprinkled on wounds and given orally).<sup>6</sup>

## ***Air Transport of Combat Casualties***

Casualty evacuation of combat wounded by air has also continued to improve due to the experience of the military. In WWII, a Medical Air Ambulance Squadron was activated at Fort Benning, Ga., in May, 1942, and began training Army air force flight surgeons, flight nurses, and enlisted personnel for duty.<sup>7</sup> In August 1942, because of a mountain range, the Fifth Air Force used troop carrier and air transport units to fly 13,000 sick and injured patients to New Guinea to receive further medical care.

In Korea, as in WWII, the military used helicopters to rescue downed aviators, but soon began to use them for evacuating combat casualties in areas inaccessible to ground vehicles. This established the effectiveness of forward aerial evacuation by means of a helicopter and was the basis for helicopter evacuation in Vietnam.

In April 1962, the U.S. Army initiated helicopter evacuation of combat wounded on the battleground with the 57th Medical Detachment (HelAmb). Because of the dust kicked up during operations in the dry country, they adopted the call sign DUSTOFF. In a DUSTOFF operation,

*Combat veterans working with veterans of major emergencies began to influence the systematic approach public safety agencies (police, fire, EMS) used when working in hazardous or hostile environments.*

the patient is flown directly to the medical treatment facility best situated for the care required.

More similar to civilian EMS was the Army's FLATIRON Operation of the late 1950s. In FLATIRON rescues, the objective of the aerial crash rescue service is to save human life. It combines fire suppression, extrication, recovery of injured personnel, initial emergency medical treatment, and evacuation to an appropriate medical treatment facility. Neely described the use of FLATIRON rescues by Army teams for civilian highway accident victims and developed the concept of using helicopters for this mission in routine civilian operations for rural America.

## Civilian Applications

In the mid-1950s, physicians began to ask why lessons learned for emergency medical treatment and transportation during WWII and the Korean Conflict could not be applied for civilian use. Drs. J.D. "Deke" Farrington and Sam Banks used these combat lessons to develop a trauma training program for the Chicago Fire Department. This program later developed into the EMT-Ambulance (EMT-A) course.

The American Academy of Orthopaedic Surgeons had a previously established Committee on Trauma (COT), with an interest in prehospital care of the injured. In 1967, the COT, chaired by Dr. Walter A. Hoyt and including Dr. Farrington, developed the first EMT program for ambulance personnel that trained them to fully evaluate an injured patient before transportation. This resulted in the 1967 publication of "Emergency Care and Transportation of the Sick and Injured," which became the standard for EMT training in the 1970s.

During this period, cardiologists identified an epidemic plaguing modern society: death from myocardial infarction. Before reaching medical care in the hospital, 40–60% of heart attack victims would die. In 1967, Pantridge and Geddes in Belfast, Ireland, published their experience using morphine and lignocaine (lidocaine in the United States) to treat myocardial infarction in the field, bringing medical care to the patient rather than waiting for the patient to seek medical care. When they did this, no patient died, which represented a reduction of the mortality rate from about 50% to 0% because of one intervention.<sup>8</sup> The idea that intensive (cardiac) care units could become mobile led to the creation of the mobile intensive care unit (MICU), staffed by mobile intensive care paramedics.

In the 1950s and up through the 1970s, combat veterans working with veterans of major emergencies began to influence the systematic approach public safety agencies (police, fire, EMS) used when working in hazardous or hostile environments. During this period, physicians became more involved in prehospital medical care, which resulted in a synergistic relationship between medicine, public safety problem solving and leadership functions.

By the 1970s, the term "ambulance" no longer referred to a vehicle for transporting the sick and injured patient or non-ambulatory patient. The TV series *Emergency!* catapulted advances in life support and prehospital care into American living rooms and inspired an advanced prehospital care movement that spread across the country. Ambulances became specialized patient carriers, and other emergency workers, such as firefighters and police officers, started enrolling in first-aid programs to further their medical training.

Through the 1980s, EMT education merged with paramedic training to produce EMS professionals who treated trauma and medical illnesses before and during transportation. Building upon heavy experience and influence from military combat and major civilian emergencies, public safety veterans had developed a means to perform under time constraints, in austere conditions and in a hostile environment using what's described as "interactive, real-time risk assessment."<sup>9</sup> With these professionals, the medical community could now bring advanced medical care into the public safety environment.

## A Different Approach

Through the 1970s, medicine focused on diagnosis first, then treatment, but as the field of emergency medicine began to emerge, the focus shifted to medical care before the diagnosis. "First do no harm" began to give way to the public safety creed, "Duty to act; doing nothing is harmful."

"Duty to act; doing nothing is harmful."

This commonality—the need to intervene before knowing the situation—linked physicians and nurses to ambulance and rescue squads with a camaraderie based on response to a shared threat: knowing what to do in the uncertain situation. The collaboration had a measurable effect. For example, spinal cord injuries changed from predominantly complete lesions to predominantly incomplete lesions, meaning victims of trauma retained some function in their lower body, solely because of prehospital care. Heart attacks also changed from the dreaded sick call, which was a patient dying from myocardial infarction, to a routine, near-boring response.

Although medical decision-making skills have advanced slowly, in the past 20 years the military has made great advances in Tactical Combat Casualty Care (TCCC); the use of cognitive function in the face of uncertainty and the unexpected; and the use of decision-making processes, such as John Boyd's OODA Loop (Observe-Orient-Decide-Act), which provides a way to rapidly make sense of a changing and uncertain environment.<sup>10</sup>

Such advances are centered on the decisions combat medics must make to stop bleeding, support the respiratory system, prevent infection and transport the wounded as quickly as possible—decisions that our EMS providers routinely face as well.

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It makes sense for us to ask ourselves, “What approaches can we take from medics in Iraq and Afghanistan?”

## Physical Tactics

Other articles within this supplement detail some of the combat medical treatments that are applicable to civilian EMS. Briefly, these include:

### 1 Use of Tourniquets:

The most common cause of preventable death on the battlefield is exsanguination from extremity wounds, which is significantly diminished by the use of a tourniquet. The U.S. Army’s Institute of Surgical Research (USAISR) notes that the ideal tourniquet should be light, durable, easily applied, and capable of occlusion of arterial blood flow (cost is also a factor). With numerous tourniquets on the market, the Combat Application Tourniquet (C-A-T) (shown above) was selected as the tourniquet of choice by the Army for use by deployed individuals. The American College of Surgeons Committee on Trauma (PHTLS 6th Edition) no longer recommends elevation of the limb or use of pressure points because of insufficient data supporting these techniques. They recommend use of a tourniquet if external bleeding from an extremity cannot be controlled by pressure. Direct pressure by hand is problematic in the prehospital setting because of the difficulty maintaining pressure during extrication and patient movement.



### 2 Use of Hemostatic Agents:

USAISR also reports several lives saved in combat using hemostatic agents for bleeding not amenable to tourniquet placement. In May 2008, Combat Gauze and WoundStat were identified as the first- and second-line hemostatic agents, respectfully, because of successes in animal studies. A gauze agent, from experience, works better where the bleeding vessel is at the

bottom of a narrow wound tract and is more easily removable at the time of surgery.

### 3 Chest Decompression:

During the Vietnam War, tension pneumothorax followed exsanguinations as the second leading cause of preventable death, accounting for 3–4% of fatally wounded combat casualties.<sup>11,12</sup> Because of the success in treating tension pneumothorax in TCCC and the rarity of complications, USAISR recommended the diagnosis of tension pneumothorax and decompression with a 14-gauge x 3.25-inch needle if the casualty has unilateral penetrating chest trauma or blunt torso trauma and progressive respiratory distress. Today, all combatants should possess this skill, and non-medics should now be able to decompress the chest.



## Cognitive Tactics

Today in EMS and public safety, not enough emphasis is placed on how to teach and develop problem-solving skills when a rule for a particular scenario doesn’t exist or apply, or when rules compete or conflict with each other. For example, most protocols treat hypovolemia and severe dehydration via replenishment of blood volume with a fluid bolus of a balanced salt solution, such as normal saline. For symptomatic heart failure, most protocols would restrict fluids and salt by using a dextrose solution and may also use a diuretic. In hot regions, it’s quite common to find a patient in symptomatic heart failure and with symptomatic hypovolemia and dehydration. Does your system have a protocol for administration of fluids to a fluid-restricted patient?

The military and public safety professionals adapt their teams to threat and uncertainty by shifting team structure from a rigid, vertical hierarchy in stable situations to a more horizontal hierarchy in unstable situations. This allows information to flow more readily to those who need it and makes for shorter chains of command for decisions and actions, with increased safety and effectiveness. Their approach can help EMS providers increase safety in patient care.

In my experience, veterans of combat and those involved in early public safety followed the rules, but they also identified when a rule didn’t apply, particularly in an environment with uncertainty, time pressure and grave threat. Combat and public safety veterans approached knowledge-based error situations differently, because evidence-based approaches would not, nor could not, work. When uncertainty existed in a situation, these veterans would focus on a shared objective and problem solve with the resources at hand, requesting additional aid but accepting the fact that one could not delay problem solving.

Today, with protocols and evidence-based medicine, EMS personnel must identify the proper rule when faced with the uncertainty that occurs between the rules. Teaching and the use of discipline for error, even with due process, influence individuals to find a rule that could fit and, subsequently, offer protection from supervisors and regulators.

Emergency personnel must continually search for answers even when the initial solution appears to work. Learning what works through action or an interactive, real-time risk assessment involves a different type of decision-making process than algorithms or decision trees.

At times, EMS providers may not know with sufficient clarity the situation or the intervention that will likely work. When this occurs, they must move toward the objective, identifying what works through action, then reconstructing the initial problem by reviewing the course of events that led to the problem.



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Boyd's OODA Loop, developed for air combat during the Vietnam War, provides a framework to problem solve during moments of uncertainty and under grave threat. When the loop is used by a paramedic, one rapidly observes the scene or patient; becomes oriented through the culture of the organization, training, education, experience and awareness of one's immediate physiological limitations; decides what to do by creating a hypothesis of what might work; acts on that hypothesis by testing it; then closes the loop by observing the results of the test.

Learn more by reading *Boyd: The Fighter Pilot Who Changed the Art of War*,<sup>10</sup> or visit [http://en.wikipedia.org/wiki/OODA\\_Loop](http://en.wikipedia.org/wiki/OODA_Loop).

## A Final Word

Put simply: Just as the military anticipates combat, public safety personnel continue to anticipate the possibility of an event, or ease with which an event can occur, while civilians plan for the probability of an event, or the likelihood an event will occur. This contributes to the development of individuals who believe in themselves enough to move forward into a hazardous or hostile environment to help a fellow human being.

Military conflict has provided many of today's EMS tools. Safe transportation of the casualty to the hospital came from Larrey's lying ambulance. Treatment of a wounded soldier by enlisted men at the point of wounding derives from trench warfare in WWI through the combat medics of WWII. Use of aircraft

to expedite transport of the casualty to a hospital came from air evacuation procedures developed in WWII, culminating in DUSTOFF and FLATIRON operations by the military in Vietnam. Decision making in the face of uncertainty, under threat and in time-dependent situations derives from combat and public safety situations through the 1970s. And today, the War on Terror is producing better methods and equipment for treating victims of severe trauma utilizing TCCC guidelines, which call for the use of tourniquets, hemostatic agents, needle chest decompression and hypotensive resuscitation.

The U.S. military continues to identify better means of providing care to combat casualties. EMS can now learn from these experiences to improve the capability of the EMT and paramedic so they can provide better EMS care to our citizens. Civilian EMS will benefit from the military's experiences in treating the severe trauma seen in the War on Terror through advances in medical procedures and new, innovative equipment that is not only life saving to our soldiers, but also for treating the "epidemic of trauma" seen by our citizens. ■

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