In current practices, there are many ways hypothermia may be induced and propagated unintentionally to the detriment of the patient. Ambient temperature IV fluids administered pre-hospital to trauma patients is known to be an independent risk factor for developing hypothermia.

All EMS providers need to carry an awareness of the harm of hypothermia in trauma patients. Measures to prevent and mitigate the onset of hypothermia from the earliest point of contact are critical to reduce mortality and morbidity in trauma patients. These measures include:

- Remove and protect from immediate environmental exposure
- Remove wet clothing
- Limit exposure after initial assessment
- Bundle patient, use active warming measures concentrated on the torso such as catalyst warming blankets
- Warm the patient transport compartment

**Inline warming of all IV fluids and blood products**

Intravenous fluids administered even at room temperature contribute to unintended hypothermia as the gradient between the human body and room temperature is between 14°–16.6°C (26°–30°F). This issue is greatly exacerbated in the austere conditions military and pre-hospital Emergency Medical Services (EMS) operate.

Thus, along with other measures, warming of all intravenous infusions is a priority step in both the prevention and treatment of hypothermia starting at the point of injury.

**Inline warming during infusion is the most effective approach to controlling the temperature of IV infusions in the field.**

Studies show pre-warming an IV fluid bag is an ineffective method as the warmth gained is rapidly lost when the fluid is infused into the patient. This heat loss is greatest in the first five minutes of infusion, related to ambient temperature, and the most significant loss occurs in the tubing itself. Source: Air Med Journal Article: An Analysis of the temperature change in warmed IV fluids during administration in cold climates

The American College of Surgeons ATLS course has redefined the classification scale of hypothermia in trauma patients emphasizing to clinicians the importance of preventing and responding to even slight decreases in normal body temperature.

**The danger of not warming blood or IV solutions in trauma patients**

While improved outcomes have already been shown with early administration of blood products, administration of any cold fluids into a trauma patient carries a significant risk of inducing or worsening hypothermia leading to a synergistic effect of hypothermia on Trauma Induced Coagulopathy (TIC).

In addition, the delivery of warmed fluids and whole blood is crucial for a number of reasons, but many medics don’t fully appreciate the implications of the mantra beyond preventing hypothermia.

As part of the lethal triad (*fig. 1*), hypothermia can have a detrimental effect to trauma patients, especially those suffering from catastrophic hemorrhage, by affecting the coagulation pathways. A decrease in core body temperature has been demonstrated to increase mortality in patients suffering hemorrhagic shock. Mortality increases predictably with successive increases in lactate levels and the detrimental effects of acidemia are compounded while survival is markedly reduced by hypothermia with a core temperature <93°F.

Coagulation factor activity is reduced approximately 10%–15% for each 2°F drop in temperature, which is exacerbated by factor depletion secondary to dilution, leading to increased mortality.

**Patient temperature and its effect on oxygen delivery**

The above graph (*fig. 2*) depicts oxygens affinity for heme molecules in blood cells - the Oxygen-Hemoglobin dissociation curve. Several factors can adjust the curve left (which results in a decrease in oxygen unloading at the tissues) or right (which results in an increase in oxygen unloading at the tissues).

As patient temperature decreases, the curve shifts to the left which decreases oxygen delivery at the tissues and thus worsening shock. As patient temperature increases the curve shifts back to the right, which results in a
reduced affinity of hemoglobin for oxygen. Consequently, as temperatures increase towards normothermia, the unloading of oxygen at the tissues in enhanced resulting in improved treatment of hemorrhagic shock.

Cold store whole blood is a limited and valuable resource, it is imperative that it is administered for maximum efficacy.

Data demonstrates that optimizing the temperature of both fluids and blood should be integrated as a crucial part of the damage control resuscitation protocol for all trauma patients in prehospital environment thereby reducing the risk of cardiac anomalies, optimizing a greater unloading of oxygen to tissues by hemoglobin and ensuring end-organ hypoperfusion is minimized in a shocked state particularly in relation to catastrophic hemorrhage and those that have lost significant volumes of blood.

The Quantum Blood and Fluid Warmer is the next generation solution to point of injury infusion or transfusion warming. The Quantum is the enabling technology which reduces the set up and thermal control process to its most intuitive form.

It is the first blood and fluid warmer that the heating system is integrated into the form factor of a conventional transfusion or infusion set. It looks, handles, and primes exactly like a conventional infusion or transfusion set. And unlike any other warmer on the market, it requires no additional tubing or bulky cartridge to be carried or the extra steps of set up and complexity those systems require.

The Quantum was co-developed with support of the US DoD under the program management of the USSOCOM to fill the capability gap for an effective ultralight warmer to be carried far forward by a dismounted medic at the point of injury.

At only 22 ounces operational weight, it is the lightest battery powered blood warmer ever developed, and the most intuitive to set up and use.

The Quantum battery has capacity to warm 1000 mL of refrigerated blood from 39°F (4°C) to 100.4°F (38°C+/- 2°C) with a warm-up time of just 24 seconds, and recharges in only 90 minutes or less.

The significant performance advantages of the Quantum has led to quick adoption by top tier military units, as well as civilian EMS/HEMS fielding prehospital blood or warming IV solutions.

The Quantum is FDA cleared and indicated for warming blood, blood products, and intravenous solutions prior to administration in adults and infants greater than 28 days old and of normal birth weight. It is intended for use by healthcare professionals in the hospital, clinical, field, and transport environments to help prevent hypothermia. The Quantum is not indicated for use in neonates (0-28 days old) and infants of low birth weight. CE Mark for the European Union is pending.

Contact us for an onsite demo of the Quantum Blood and Fluid Warming System.