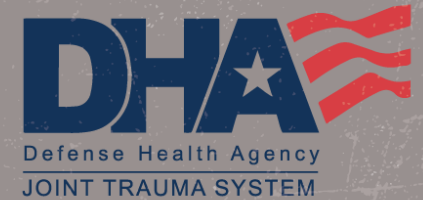




**COMBAT MEDIC/
CORPSMAN**



TACTICAL COMBAT CASUALTY CARE COURSE

MODULE 11:
HEMORRHAGIC SHOCK FLUID RESUSCITATION
IN TACTICAL FIELD CARE (TFC)



Committee on
Tactical Combat
Casualty Care
(CoTCCC)

TCCC TIER 1
All Service Members

TCCC TIER 2
Combat Lifesaver

TCCC TIER 3
Combat Medic/Corpsman

TCCC TIER 4
Combat Paramedic/Provider

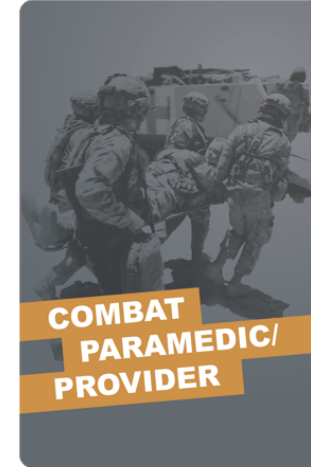
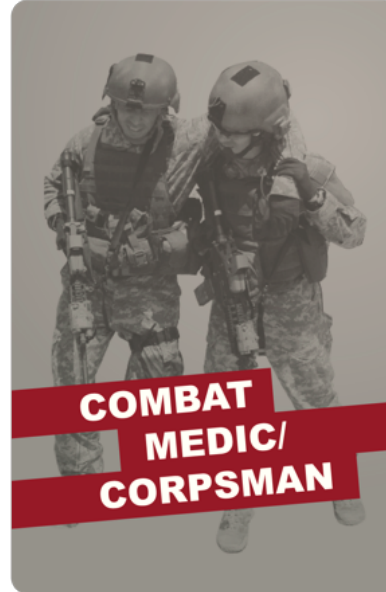
TACTICAL COMBAT CASUALTY CARE (TCCC) ROLE-BASED TRAINING SPECTRUM

ROLE 1 CARE

**NONMEDICAL
PERSONNEL**



**MEDICAL
PERSONNEL**



◀ **YOU ARE HERE**

STANDARDIZED JOINT CURRICULUM

1 x **TERMINAL LEARNING OBJECTIVES**

14 Given a combat or noncombat scenario, perform fluid resuscitation as part of the management of hemorrhagic shock on a trauma casualty during Tactical Field Care in accordance with CoTCCC Guidelines.

- 14.1 Identify progressive strategies, indications, and limitations of fluid resuscitation for hemorrhagic shock in Tactical Field Care.
- 14.2 Identify appropriate fluid resuscitation techniques to prevent or treat hemorrhagic shock in Tactical Field Care.
- 14.3 Identify the importance and advantages of early use of blood products in Tactical Field Care.
- 14.4 Identify the indications, contraindications, and administration methods of low-titer group O whole blood in Tactical Field Care.
- 14.5 Identify the considerations, indications, contraindications, and administration methods of fresh whole blood in Tactical Field Care.
- 14.6 Identify the indications, contraindications, and administration methods of plasma in Tactical Field Care.
- 14.7 Identify the indications, contraindications, and administration methods of packed red blood cells in Tactical Field Care.
- 14.8 Demonstrate administration of blood products to a trauma casualty in Tactical Field Care.
 - ⊗ a. EldonCard®
 - b. Donor blood product collection
 - c. Administration of blood products
- 14.9 Identify the signs, symptoms, considerations, and treatment strategies of blood transfusion complications.

9 x **ENABLING LEARNING OBJECTIVES**

MARCH PAWS

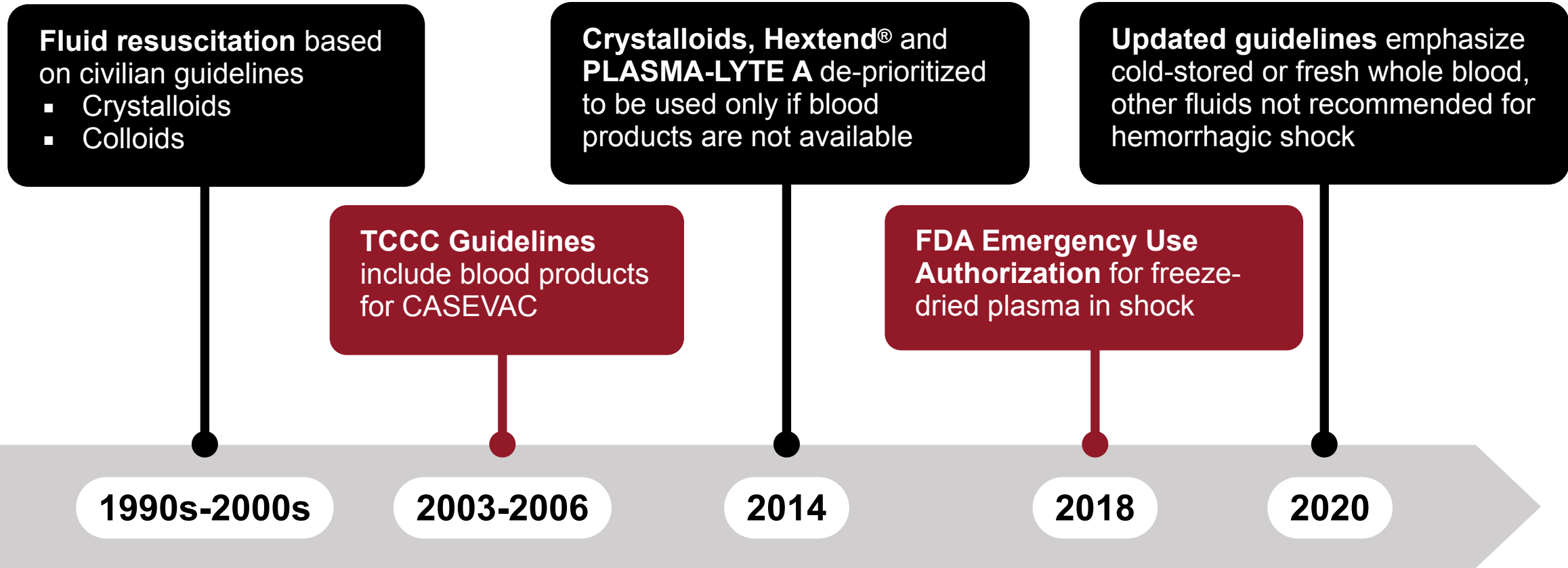
LIFE-THREATENING

- M** MASSIVE BLEEDING
#1 Priority
- A** AIRWAY
- R** RESPIRATION (*Breathing*)
- ▶ **C** CIRCULATION
- H** HYPOTHERMIA / HEAD INJURIES

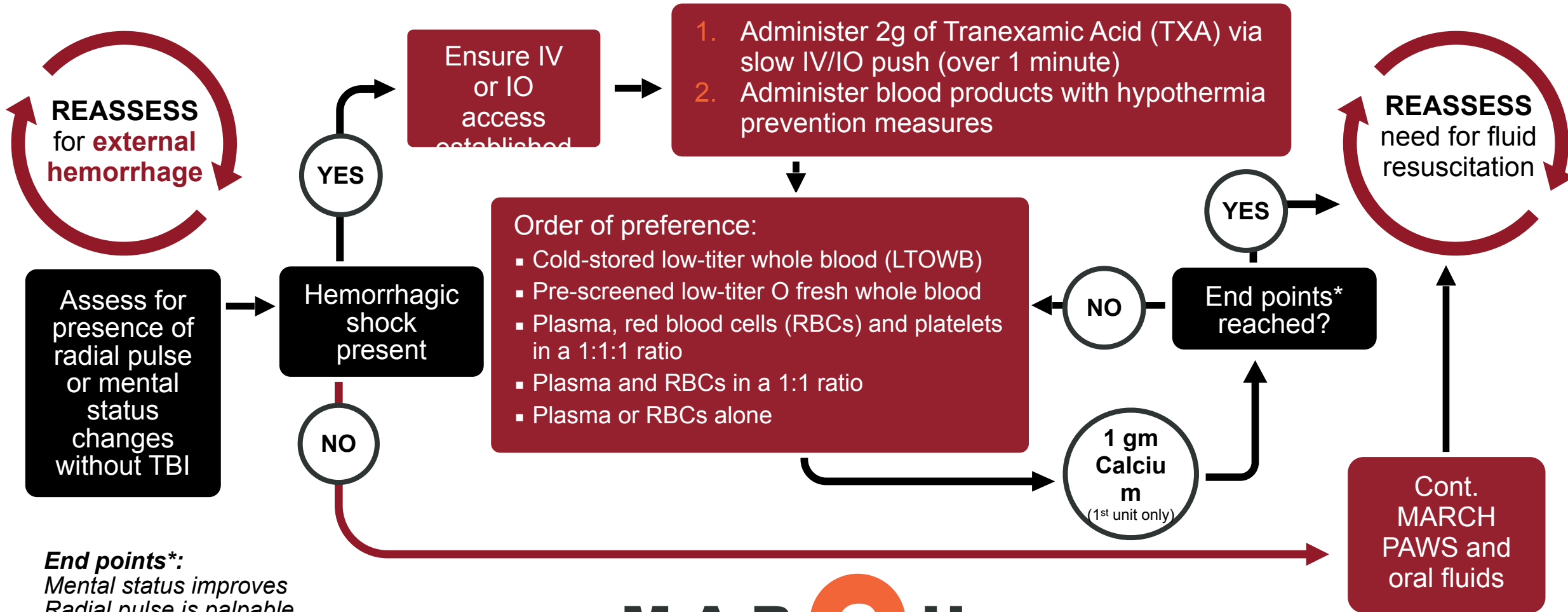
AFTER LIFE-THREATENING

- P** PAIN
- A** ANTIBIOTICS
- W** WOUNDS
- S** SPLINTING

INTRO TO **FLUID RESUSCITATION** FOR SHOCK



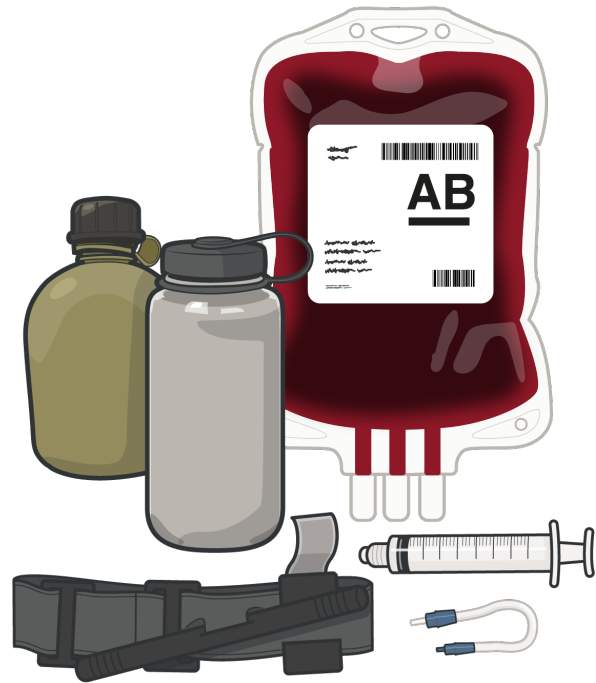
PROGRESSIVE STRATEGIES FOR FLUID RESUSCITATION IN HEMORRHAGIC SHOCK



End points*:
Mental status improves
Radial pulse is palpable
Systolic BP of 100 mm Hg

MARCH

TECHNIQUES FOR PREVENTION AND TREATMENT OF HEMORRHAGIC SHOCK



Oral rehydration, if the casualty can swallow, is appropriate and recommended

- Dehydration is a risk during treatment and evacuation
- Risk of emesis and aspiration is very low

Consider placing saline lock, if tactically feasible

Fluid selection priorities are:

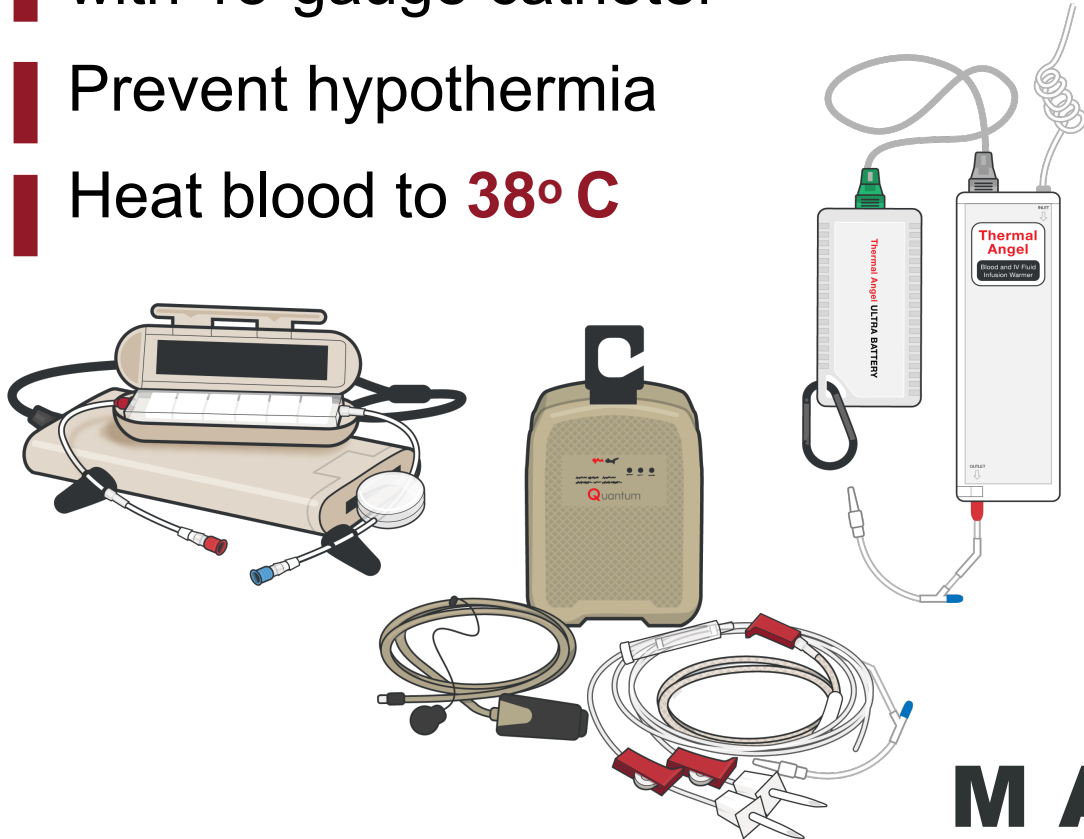
- Cold-stored low-titer O whole blood
- Pre-screened low-titer O fresh whole blood
- Plasma, red blood cells (RBCs) and platelets in a **1:1:1 ratio**
- Plasma and RBCs in a **1:1 ratio**
- Plasma or RBCs alone



Best prevention of hemorrhagic shock is **control** of all sources of **bleeding**

APPROPRIATE TECHNIQUES FOR TREATMENT OF HEMORRHAGIC SHOCK

- Establish IV or IO access with 18-gauge catheter
- Prevent hypothermia
- Heat blood to **38° C**



Gather blood products for transfusion:



Cold-stored whole blood



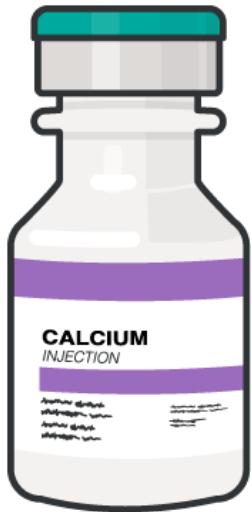
Fresh blood collected in the field



Plasma, RBCs, platelets

M A R C H

APPROPRIATE TECHNIQUES FOR TREATMENT OF HEMORRHAGIC SHOCK (CONT.)



RISK OF HYPOCALCEMIA
from citrate binding to
endogenous calcium

Replace with **1 gm Ca⁺⁺**



REASSESS after every transfusion
of a unit of blood products

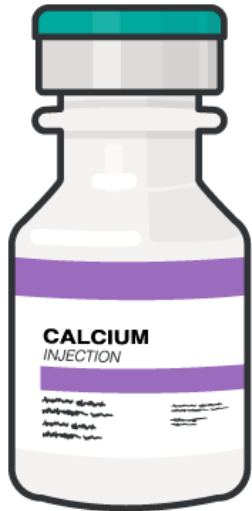
End points for **fluid resuscitation**:

- A palpable radial pulse
- Improved mental status
- Systolic BP of 100 mm Hg

More is **not necessarily** better

- Potential for clot disruption from
higher pressures
- Blood products are a valuable
resource to conserve, when possible

CALCIUM ADMINISTRATION



DOSAGE(S):

Calcium **1 gram** after the first unit of blood has been administered

ROUTE(S):

Calcium is available in IV or IO form

INDICATIONS:

For use after blood product transfusions

CONTRAINDICATIONS:

- Ventricular fibrillation
- Hypercalcemia
- Hypophosphatemia
- Renal calculi

Use cautiously in:

- Digitalized patients
- Patients with sarcoidosis
- Renal or cardiac disease
- Respiratory acidosis
- Respiratory failure potential

CALCIUM
ADMINISTRATION cont.**POTENTIAL SIDE EFFECTS:**

Tingling sensations, headache, irritability, weakness, syncope with rapid IV injection, mild decrease in blood pressure, vasodilation, bradycardia, arrhythmias, rebound hyperacidity, nausea, polyuria, renal calculi, hypercalcemia, and local reactions

DRUG INTERACTIONS:

Decreased bioavailability with atenolol, fluoroquinolones and tetracyclines, calcium channel blockers decrease calcium effectiveness, cardiac glycosides increase digitalis toxicity, thiazide diuretics cause a risk of hypercalcemia

ONSET/PEAK/DURATION:

Immediate/Immediate/1-2 hr

TACTICAL CONSIDERATIONS:

Administer one gram of calcium as either 30 ml of 10% calcium gluconate or 10 ml of 10% calcium chloride; immediately after the first transfused blood product. Monitor calcium chloride infusion closely as severe necrosis and skin sloughing can occur if peripheral IV extravasates.

IMPORTANCE AND ADVANTAGES OF **EARLY USE OF BLOOD** PRODUCTS

502 U.S. military combat casualties in Afghanistan (2012-2015):

*Time to initial blood product transfusion associated with **reduced** 24-hour and 30-day mortality*

Ensure processes to move
cold-stored LTOWB

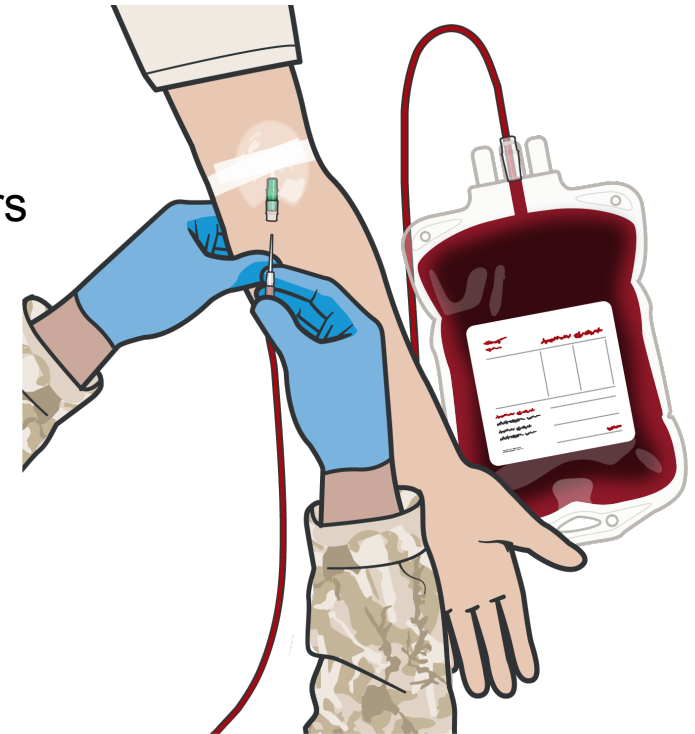
Electric-powered coolers
at distribution sites

Battery-operated
containers for
field use



Prepare alternate to
cold-stored LTOWB

Prescreen unit members
for potential donors



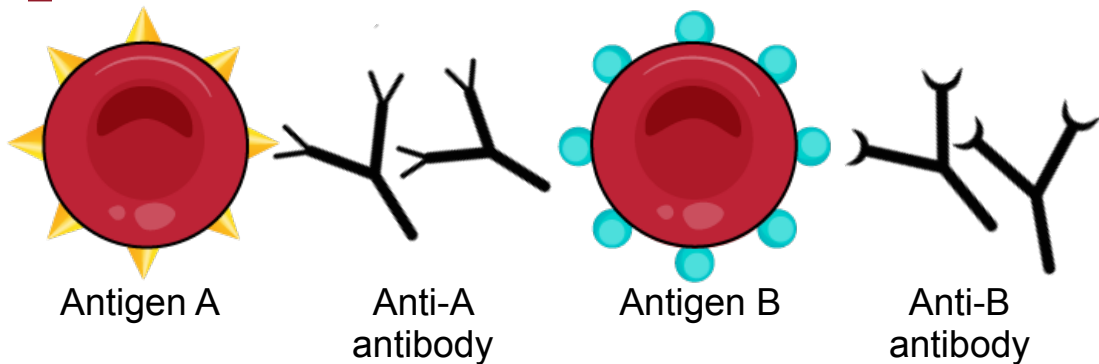
M A R **C** H

INDICATIONS AND ADVANTAGES OF USING LOW-TITER GROUP O WHOLE BLOOD

The preferred fluid for hemorrhagic shock resuscitation is **cold-stored low-titer O whole blood (LTOWB)**

Low-titer type O whole blood

- Titers refer to **anti-A/anti-B** in plasma
- WWII experience was mild reactions with titers **>512**
- Current threshold for low titer **<256**



Advantages of **cold-stored LTOWB**:

- Tested for diseases (FDA requirement)
- Titers and leukocyte reduction
- Ready for immediate transfusion
- Whole blood better than three-component replacement in at least one study

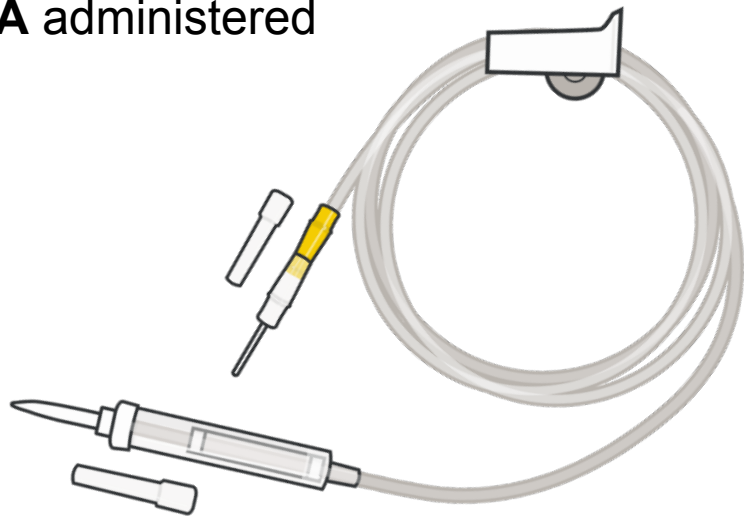
METHODS OF TRANSFUSING LOW-TITER GROUP O WHOLE BLOOD

Prior to fluid resuscitation ensure:



Begin transfusion within **5 min** of starting the process

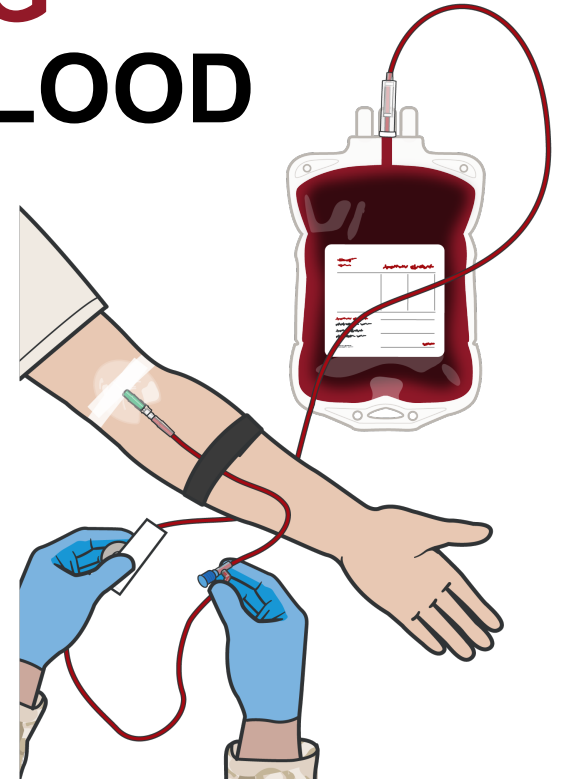
- **External Hemorrhage** is controlled
- **IV** or **IO** line with fluid is in place and functioning properly
- **TXA** administered



- Administer **1 gm of calcium** after the first unit

- Assess for and treat blood transfusion reactions:

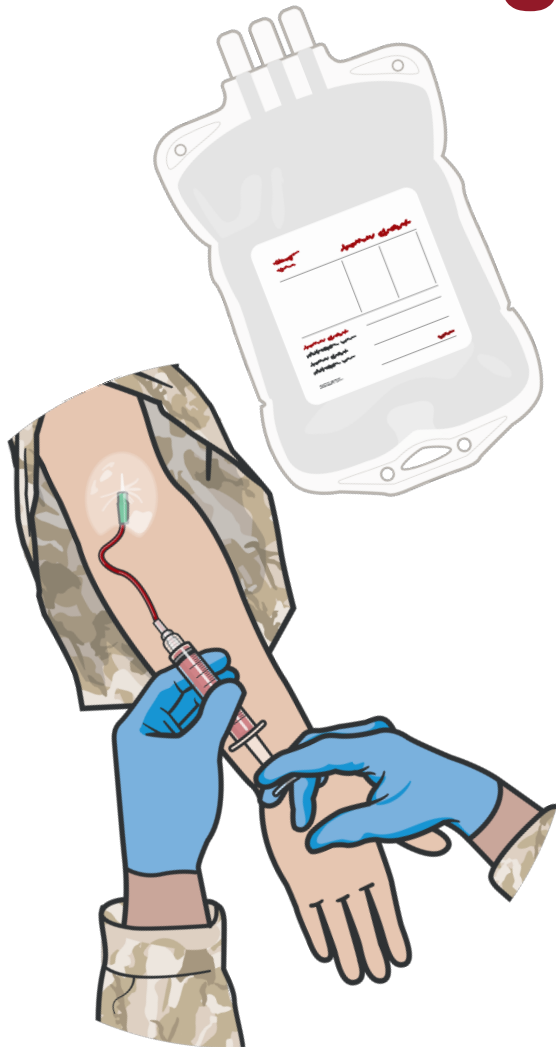
- **Anaphylactic reaction**
(hives, itching, stridor/shortness of breath, and/or hypotension)
- **Acute hemolytic reaction**
(arm pain, chest pain, back pain, nausea, disseminated intravascular coagulation, and/or fever)



Blood filters remove small clots that develop during collection and storage

M A R C H

INDICATIONS AND METHODS OF USING FRESH WHOLE BLOOD



If cold-stored **LTOWB** is not available, utilize **Pre-screened low titer O fresh whole blood**

Ideally, fresh whole blood donors are pre-screened

- Known low titers
- No transmissible diseases
- Group-specific (A-A, B-B), although up to 4% inaccuracy

POSSIBLE ADVANTAGES

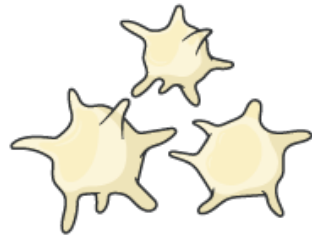
- Availability even when cold chain is not in place (or cold stores exhausted)
- Degree of hypothermia during transfusion may be less than cold-stored LTOWB

POTENTIAL ISSUES

- Time to collect blood may delay transfusion
- Unit members unavailable while donating

INDICATIONS AND METHODS OF USING RED BLOOD CELLS

In the absence of whole blood, either cold-stored or fresh, packed **red blood cells (RBCs)**, **platelets** and **plasma** in a **1:1:1 ratio** should be used



1 part **RBCs** : 1 part **platelets** : 1 part **plasma**

If three component therapy isn't available, then:

Plasma and RBCs in a 1:1 ratio

if unavailable then:

Plasma or RBC's alone



Separate blood components have **different active shelf-lives**

Platelets

5 days room temp, 15 days refrigerated

Plasma

40 days frozen, 5 days thawed

RBCs

35-42 days refrigerated, depending on preservative

TRANSFUSION COMPLICATION IDENTIFICATION AND MANAGEMENT STRATEGIES

Monitor all transfusions for complication and adverse reactions:

Anaphylaxis – life-threatening allergic reaction

Stridor/SOB

Hypotension

Early signs – hives, itching

 **STOP TRANSFUSION**

■ Initiate NS or LR infusion

■ 0.3 ml of 1:1000 epinephrine IM

■ 25 mg of diphenhydramine IM
or slow IV/IO push

■ If available, consider 10-40 mg
methylprednisolone slow IV/IO push



Acute hemolysis – rupture of RBCs

Flank, chest, arm or back pain

Fever

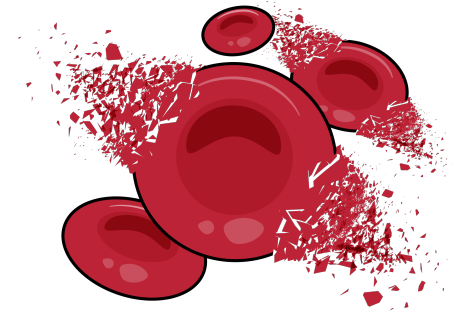
Disseminated intravascular coagulation

Early sign – nausea

 **STOP TRANSFUSION**

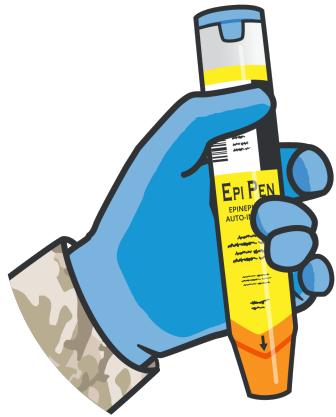
■ Initiate NS or LR infusion

■ 25 mg of diphenhydramine IM
or slow IV/IO push



M A R  H

EPINEPHRINE ADMINISTRATION



DOSAGE(S):

0.3 mg (3 ml of 1:1000 solution),
repeated every 5 to 10 minutes
as necessary

ROUTE(S):

IM or subcutaneous

INDICATIONS:

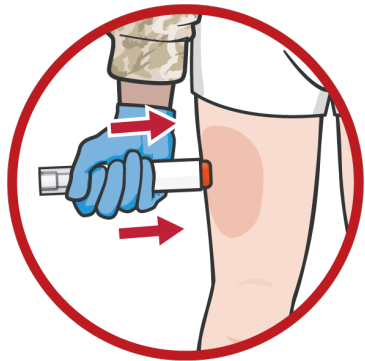
Emergency treatment of
anaphylaxis or allergic reactions.

CONTRAINDICATIONS:

None

POTENTIAL SIDE EFFECTS:

Anxiety, restlessness, tremor, weakness,
dizziness, sweating, palpitations, pallor,
nausea and vomiting, headache,
disorientation, and tachycardia



EPINEPHRINE ADMINISTRATION cont.

DRUG INTERACTIONS:

Antihypertensives reduce the pressor effects of epinephrine, thyroid hormones, antihistamines and some anti-arrhythmic medications increase its arrhythmogenic effects

ONSET/PEAK/DURATION:

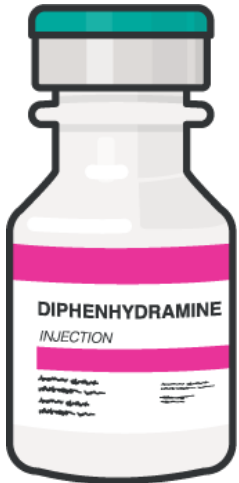
15-30 sec (IM<subcutaneous)/
20 sec to 4 min/5-10 min

TACTICAL CONSIDERATIONS:

Adult EpiPens® deliver the recommended 0.3 mg IM dose

Casualties in hemorrhagic shock have poor tissue perfusion to their extremities reducing the delivery of epinephrine; use large muscle groups closest to the torso (in order of preference: thigh > deltoid > gluteal).

DIPHENHYDRAMINE ADMINISTRATION



DOSAGE(S):

25 mg initial dose, may consider 50 mg based on clinical situation; repeat q 4-6 hr prn; max daily dose 300 mg

ROUTE(S):

IM or slow IV/IO push (over one minute)

INDICATIONS:

Emergency treatment of anaphylaxis or allergic reactions

CONTRAINDICATIONS:

Documented hypersensitivity to diphenhydramine, breastfeeding mothers, use in pregnancy if clearly needed

POTENTIAL SIDE EFFECTS:

Sedation/somnolence/sleepiness, drowsiness, unsteadiness, dizziness, headache, rare extrapyramidal effects, tremor, or convulsions

DIPHENHYDRAMINE
ADMINISTRATION cont.

DRUG INTERACTIONS:

Accentuates effects of other medications that cause drowsiness or decreased level of consciousness (sedatives, hypnotics)

ONSET/PEAK/DURATION:

10 sec-20 min (IV<IO<IM)/
15 min-2 hr/2-6 hr

TACTICAL CONSIDERATIONS:

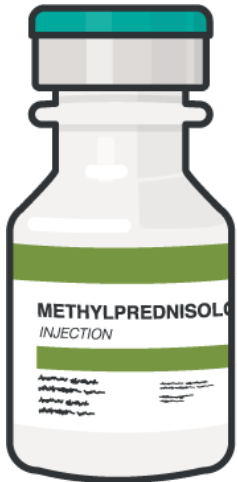
There is no evidence to support H1-antihistamines alone in emergency management of anaphylaxis – diphenhydramine should only be used as an adjunct to epinephrine during anaphylaxis management; the slower onset and longer duration may help sustain effects of successful treatment.

Useful for minor reactions that are not life-threatening

Casualty weapons, communications, and sensitive equipment should be secured.



METHYLPREDNISOLONE ADMINISTRATION



DOSAGE(S):

■ 10-40 mg

ROUTE(S):

■ *Slow IV or IO push
(over one minute)*

INDICATIONS:

■ Blood product transfusion
anaphylactic reaction

CONTRAINDICATIONS:

■ Systemic fungal infections and known hypersensitivity (prior allergic reaction); potential benefits may warrant use in pregnant women despite potential risks if the alternative is worse

POTENTIAL SIDE EFFECTS:

■ Sodium retention, fluid retention, potassium depletion, hyperglycemia, increased liver function tests, muscle weakness, impaired sweating, pancreatitis, esophagitis, urticaria or allergic reactions

METHYLPREDNISOLONE
ADMINISTRATION cont.

DRUG INTERACTIONS:

■ Accentuates effects of other medications that cause drowsiness or decreased level of consciousness (sedatives, hypnotics)

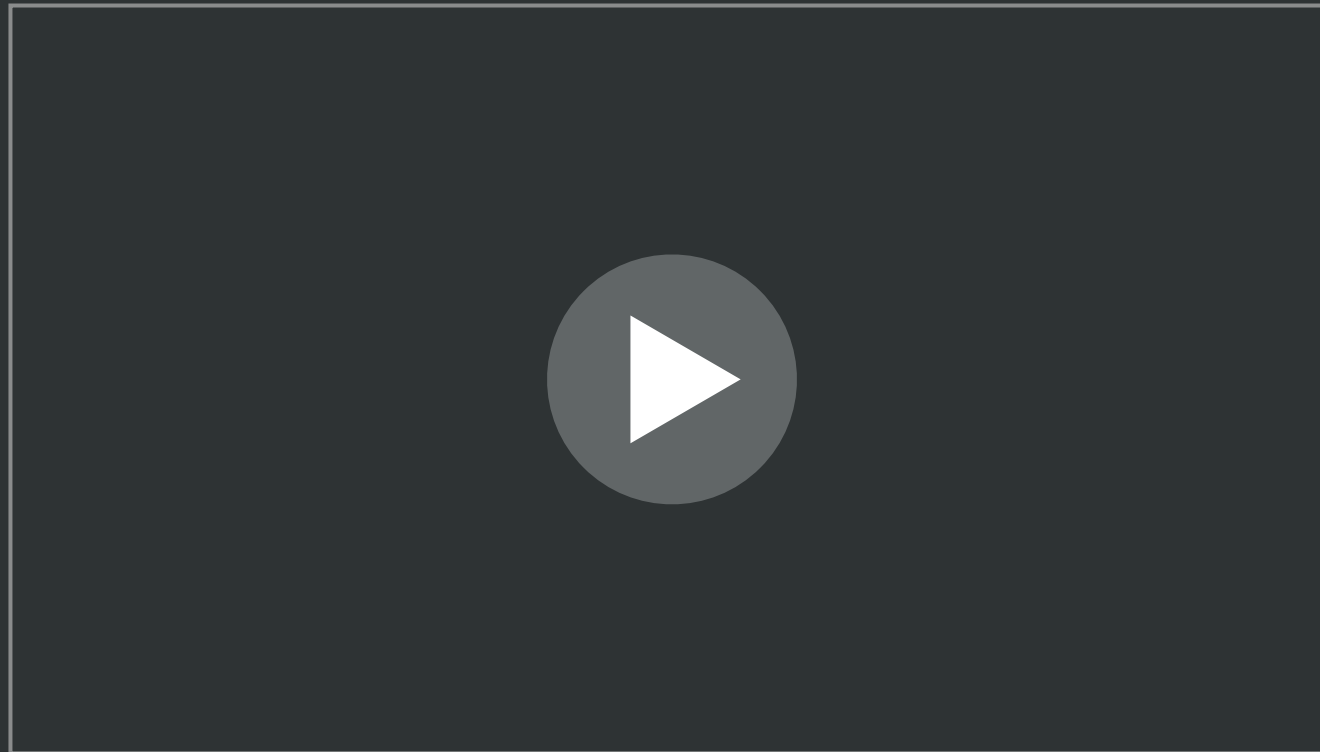
ONSET/PEAK/DURATION:

■ Immediate/1-2 min/1 hr

TACTICAL CONSIDERATIONS:

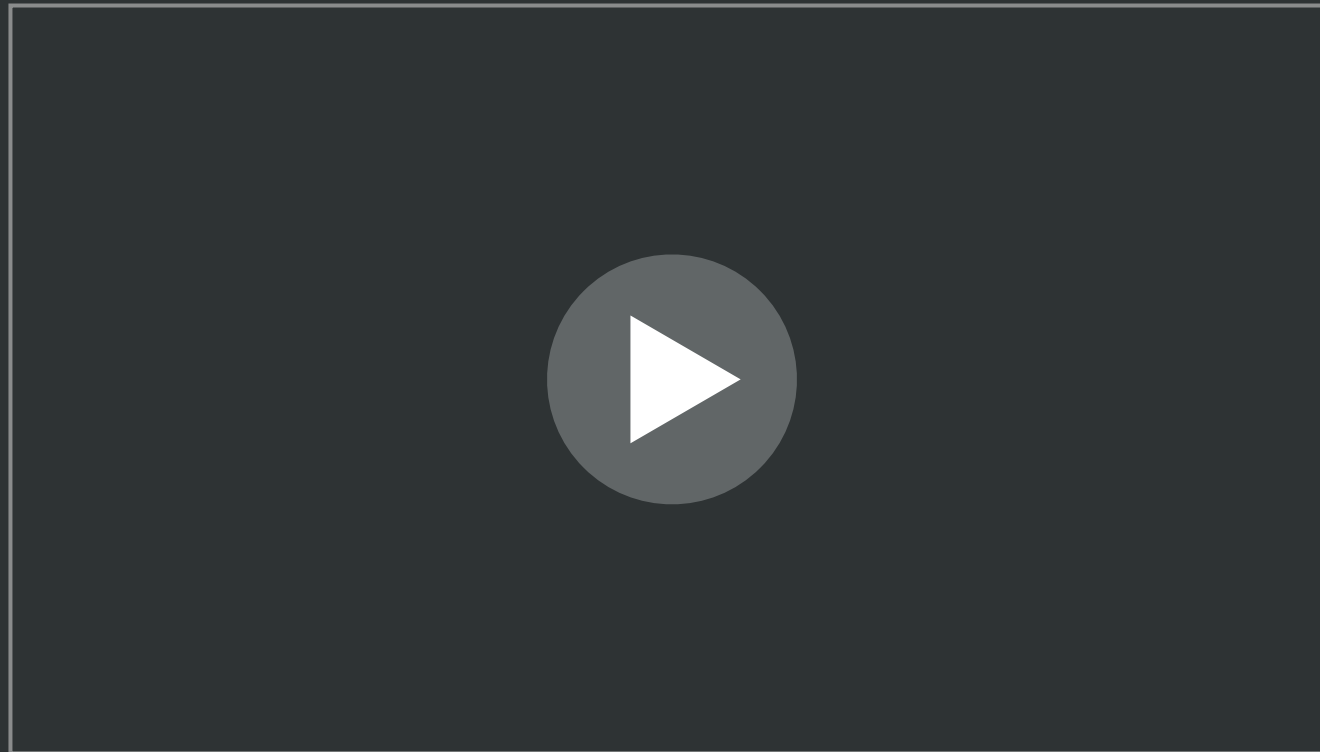
■ Administer 10-40 mg IV or IO, after first administering epinephrine and diphenhydramine, when treating an anaphylactic reaction from a blood product transfusion.

ADMINISTRATION OF BLOOD PRODUCTS IN TACTICAL FIELD CARE



Video can be found on deployedmedicine.com

ADMINISTRATION OF COLD STORED BLOOD PRODUCTS IN TACTICAL FIELD CARE



Video can be found on deployedmedicine.com

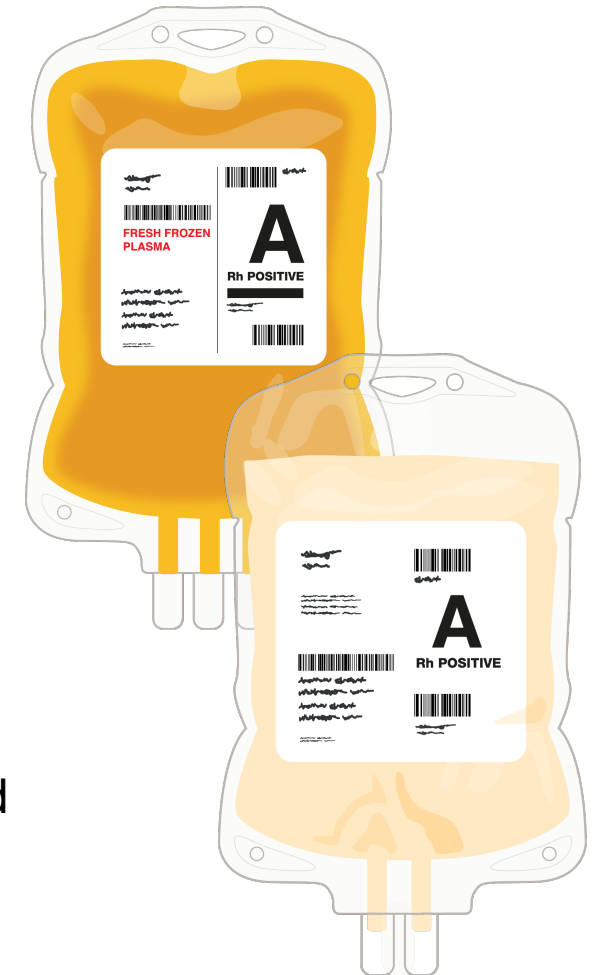
INDICATIONS AND METHODS OF USING **PLASMA**

Freeze-dried plasma (FDP)

- Developed in 1930s
- Used in WWII and Korea
- Stopped because of disease transmission
- Continued by other nations
- Rekindled interested by US military due to problems with access to whole blood at battlefield
- Approved for use in hemorrhagic shock in recent years

PLASMA

- Provides fibrinogen and hemostatic factors
- Although best with other blood products, can be used alone
- **FDP** can be stored without refrigeration
- **FDP** reconstituted in vials must be administered through vented tubing, but with collapsible bags standard blood tubing can be used



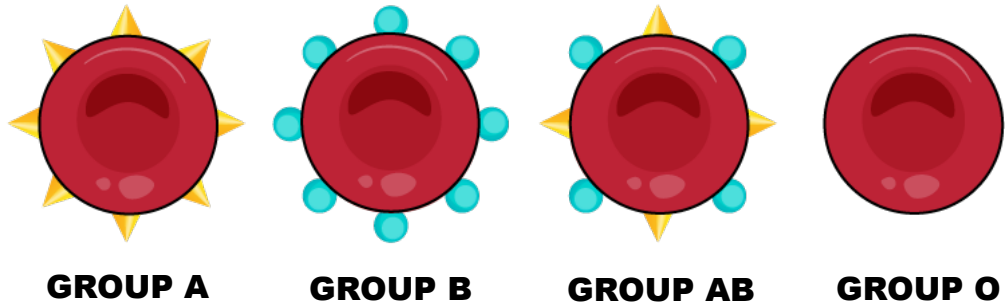
BLOOD TYPING

Surface markers (antigens) determine blood groups/types

A & B antigens determine ABO status

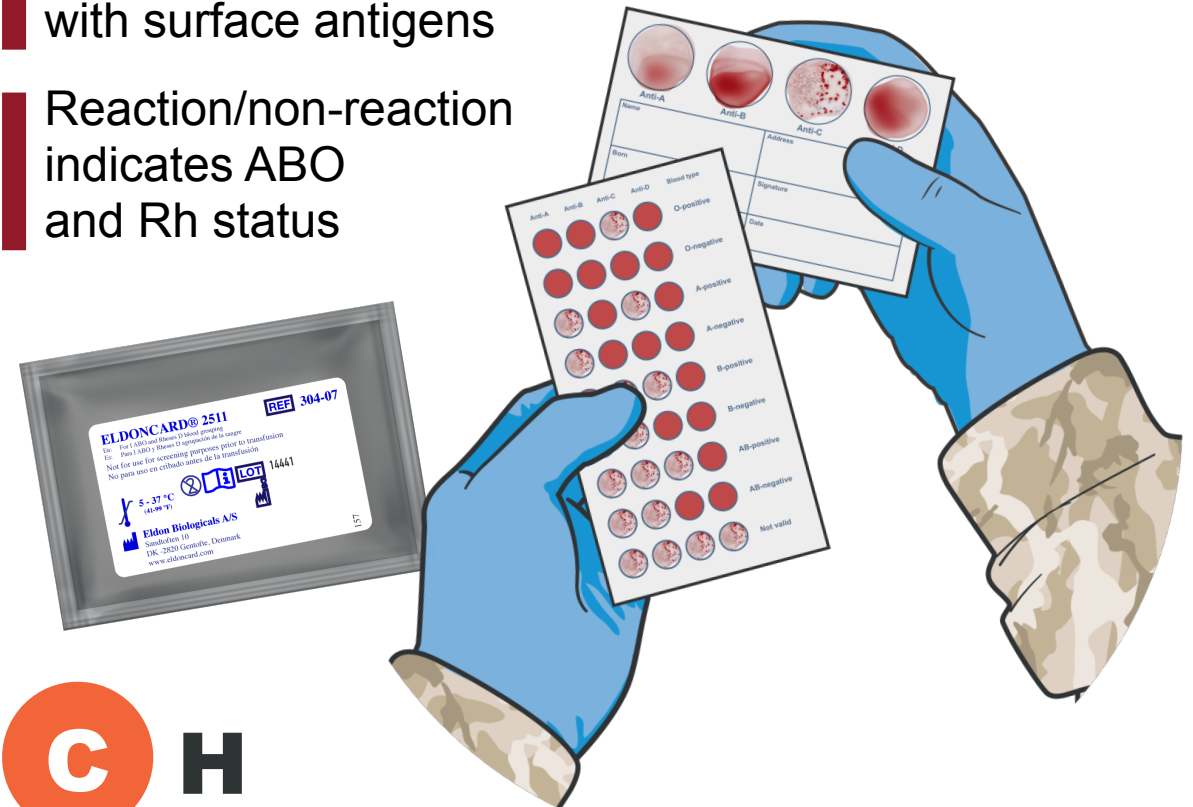
Rh antigen also a major marker

Minor markers require more advanced lab resources, but not tactically important

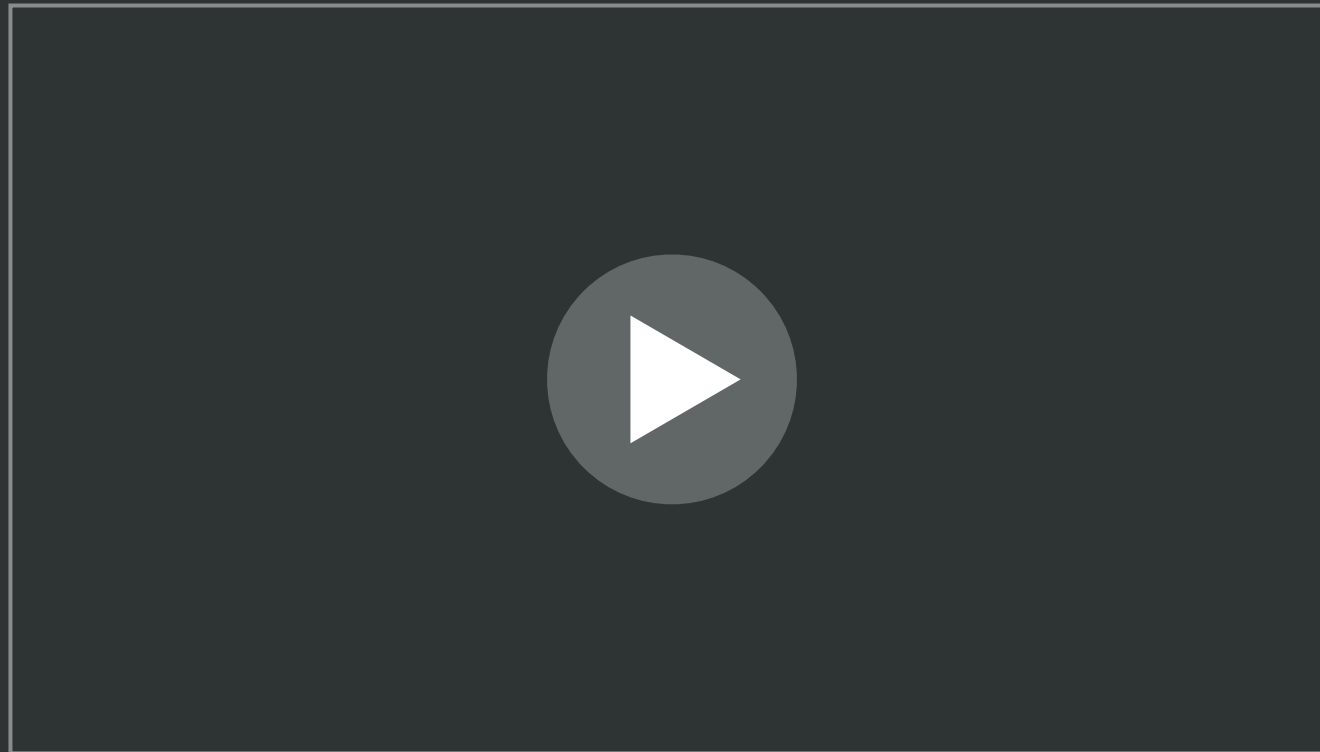


EldonCard®

- Antigen-impregnated surface
- Donor/casualty blood reacts with surface antigens
- Reaction/non-reaction indicates ABO and Rh status



**ELDONCARD TECHNIQUES
IN TACTICAL FIELD CARE**



Video can be found on deployedmedicine.com

BLOOD COLLECTION

Considerations in collecting blood

- Collection bags have needle attached (16-gauge)
- Lower collection bag below level of the heart
- Gently shake or agitate bag to mix citrate anticoagulants
- Don't overfill the bag
- Clamp and then tie off the collection tubing when bag is full



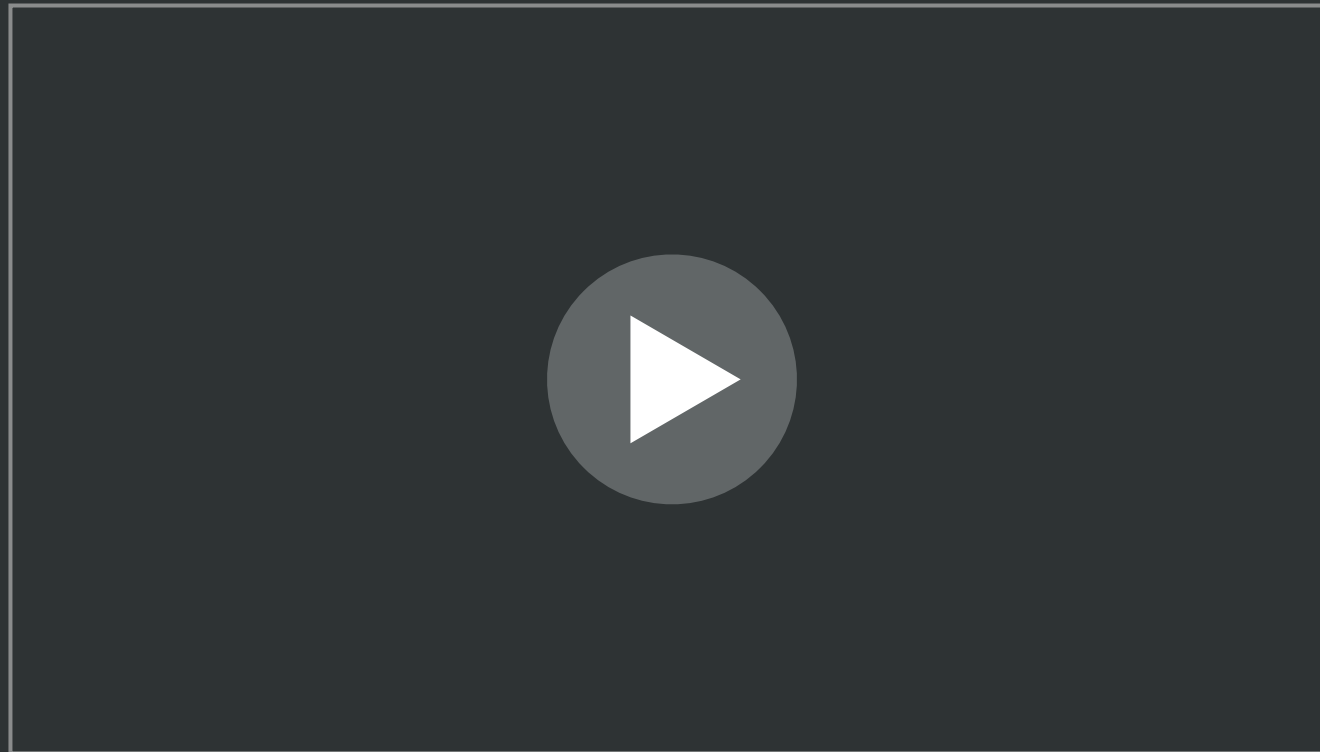
Methods to determine bag is full

- 6.5-inch beaded cable tie
- 6.5-inch zip tie
- Fold and clamp bottom 1-1½ inches of the bag
- Parachute 550 cord cut at 10 inches wrapped around center



Donors experience mild decline in oxygen-carrying capacity, but no decrease in performance or cognitive function after 1 unit of blood donation





**BLOOD DONOR COLLECTION
IN TACTICAL FIELD CARE**



Video can be found on deployedmedicine.com

SKILL STATION

Fluid Resuscitation in Hemorrhagic Shock






-  Blood-typing using an EldonCard
-  Collecting blood from a donor
-  Administering freeze-dried plasma
-  Transfusing blood products to a casualty

SUMMARY

- Early resuscitation with cold-stored low-titer type O whole blood
- Progressive strategies for fluid resuscitation
- Importance of early administration of blood products
- Indications and techniques for blood product administration
- Identification and management of blood transfusion complications
- Blood-type determination with EldonCards
- Donor blood collection techniques
- Blood administration skills training
- Blood typing and blood collection skills training

M A R C H

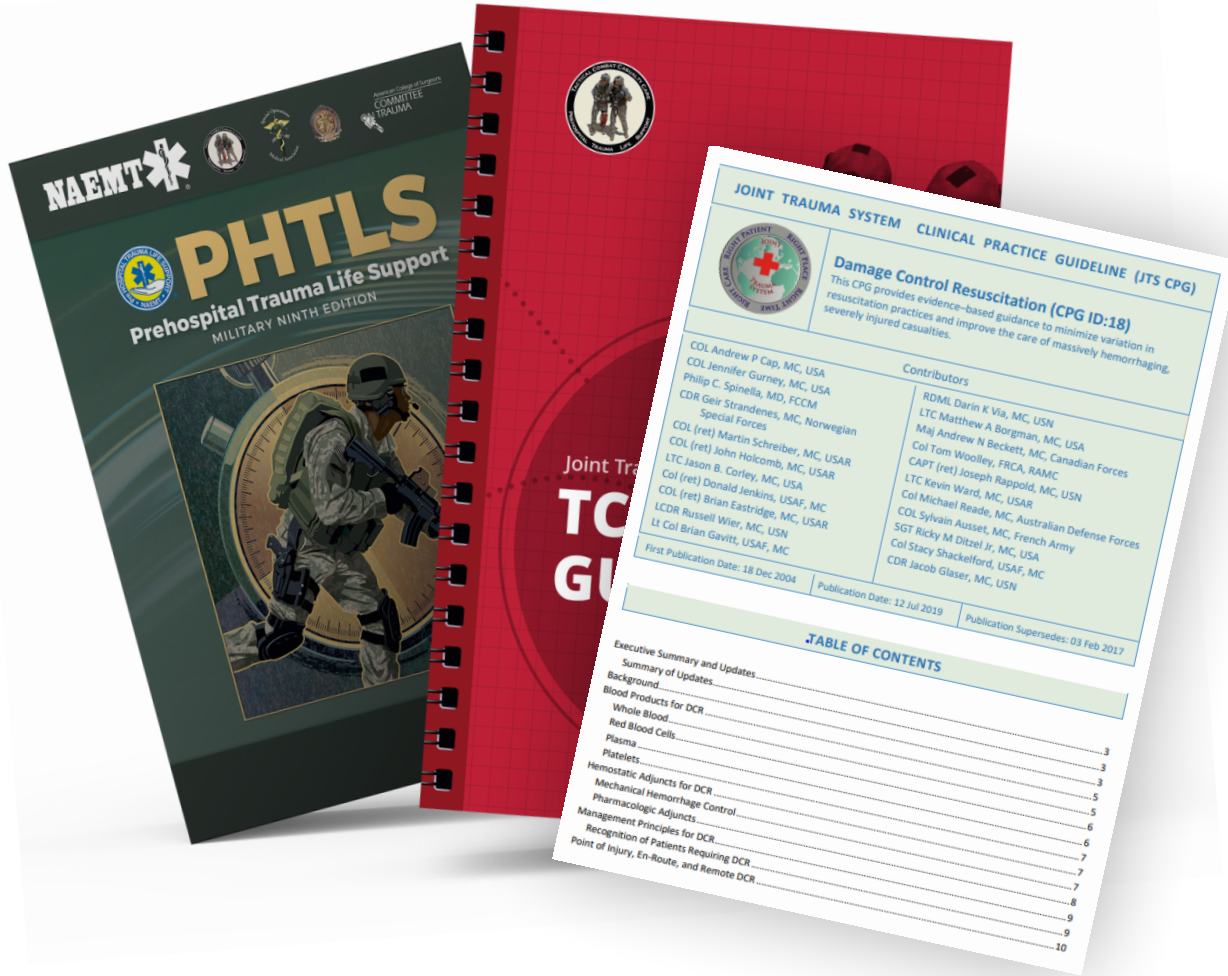
CHECK ON LEARNING

-  What signs of hemorrhagic shock are indications that fluid resuscitation is needed?
-  What is the preferred product for hemorrhagic fluid resuscitation?
-  When should calcium be administered during fluid resuscitation?
-  When should fluid resuscitation be discontinued?
-  What is an advantage of freeze-dried plasma?



ANY QUESTIONS?

REFERENCES



TCCC: Guidelines

by JTS/CoTCCC

Updated regularly – latest edition dated
5 November 2020

These guidelines are the result of decisions made by the Committee on Tactical Combat Casualty Care as they explore evidence-based research regarding best practices

PHTLS: Military Edition, Chapter 25

by NAEMT

Prehospital Trauma Life Support,
Military Ninth Edition

Damage Control Resuscitation CPG

Joint Trauma System

Damage Control Resuscitation (CPG ID:18),
Joint Trauma System Website