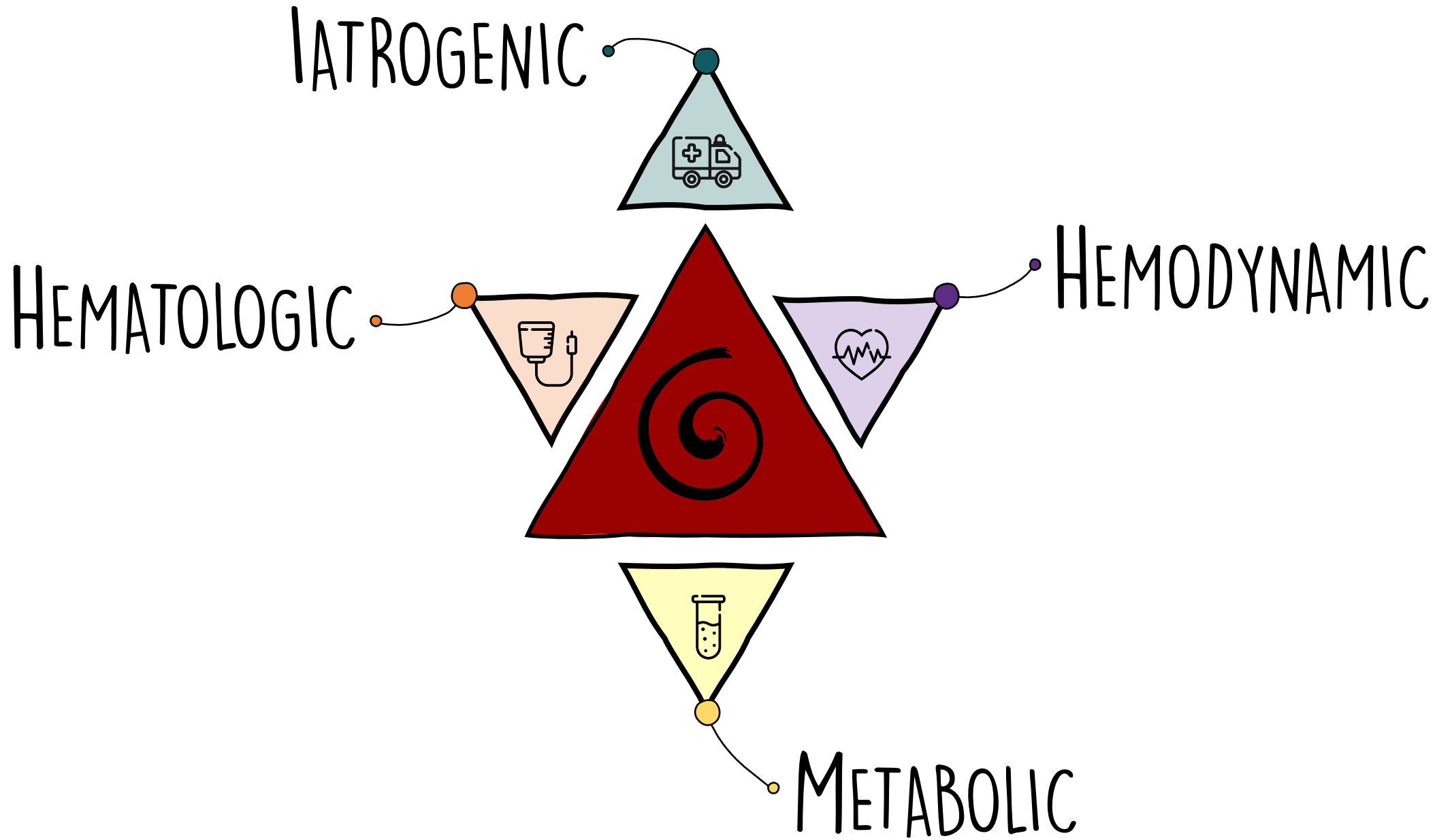
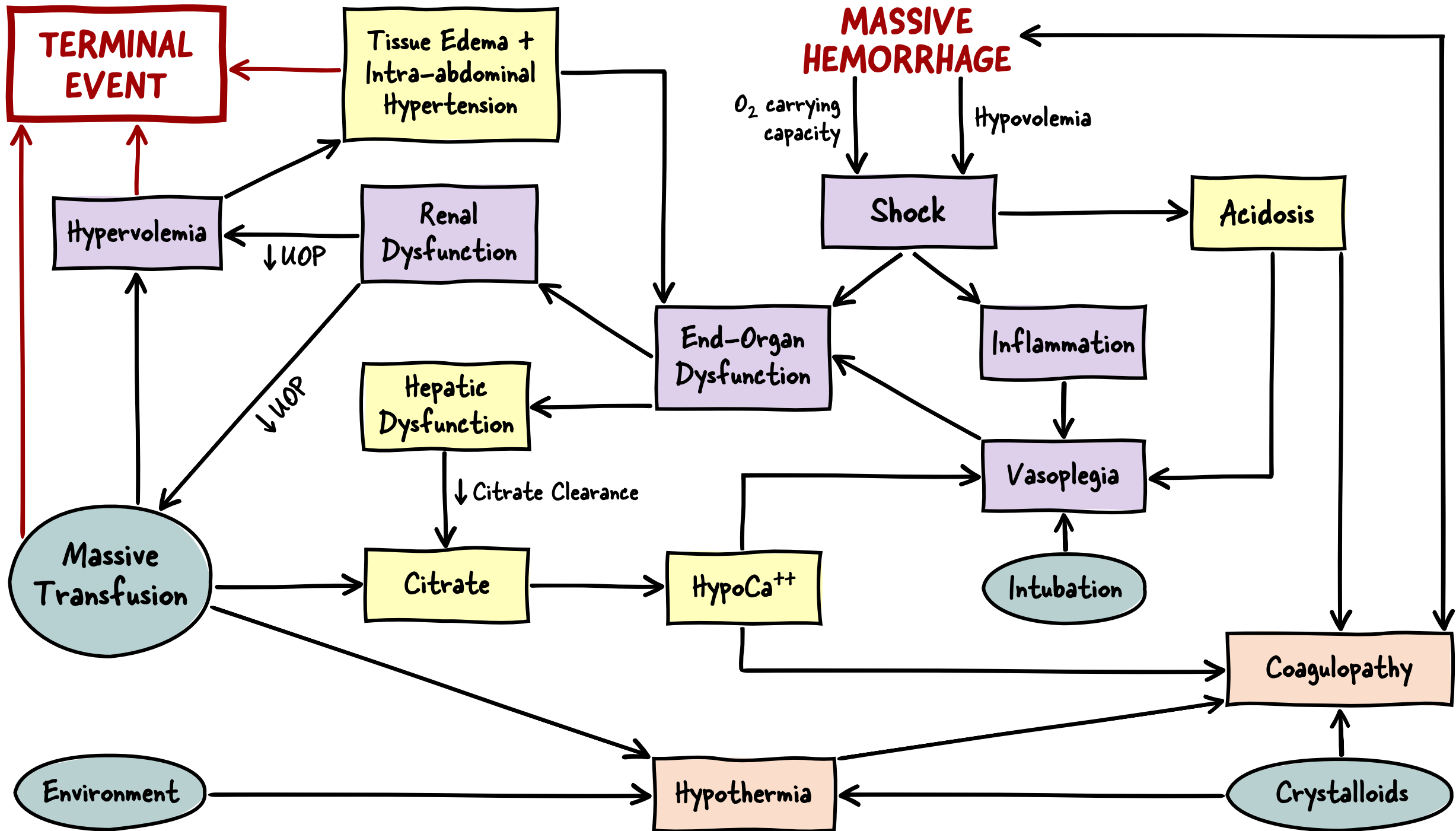


# HEMORRHAGIC SHOCK & MASSIVE TRANSFUSION









Transfusion-Related  
Acute Lung Injury  
(TRALI)

Transfusion-Associated  
Circulatory Overload  
(TACO)

Abdominal Compartment  
Syndrome  
(ACS)

# APPROACH TO HEMORRHAGIC SHOCK

- 1) Initiate massive transfusion
- 2) Restore blood volume
- 3) Correct metabolic derangements
- 4) Support hemodynamics
- 5) Stay focused on the big picture

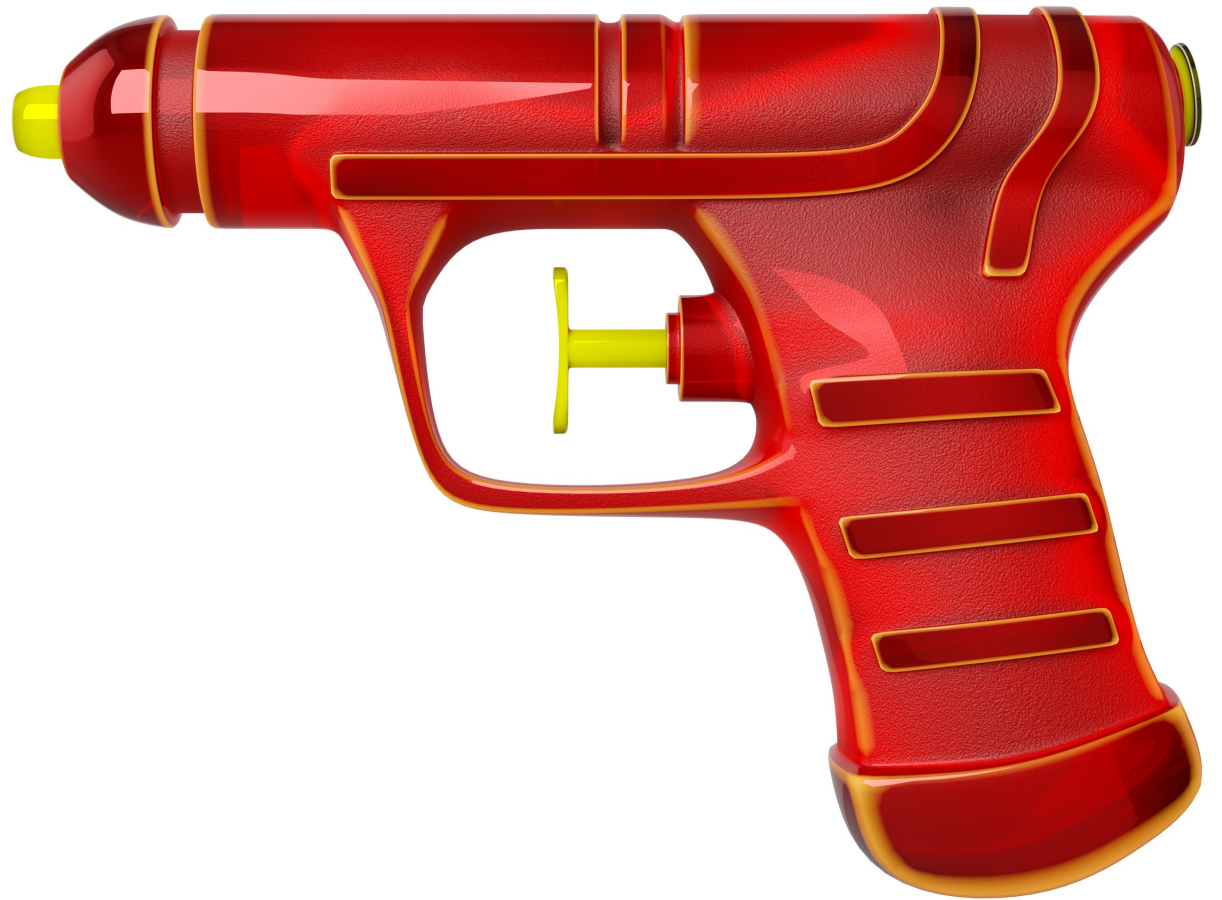


# APPROACH TO HEMORRHAGIC SHOCK

- 1) **Initiate massive transfusion**
- 2) Restore blood volume
- 3) Correct metabolic derangements
- 4) Support hemodynamics
- 5) Stay focused on the big picture



PULL THE  
MASSIVE  
TRANSFUSION  
TRIGGER





SPEED  
MATTERS





## Every minute counts: Time to delivery of initial massive transfusion cooler and its impact on mortality

Planned sub-analysis of PROPPR study (680 patients)

Median time from patient arrival to MTP activation: 9 minutes

Median time from MTP activation to blood delivery: 8 minutes

Controlling for injury severity, resuscitation intensity, and treatment arm (1:1:1 vs. 1:1:2), increased time to blood delivery was associated with increased 24h mortality (OR 1.05) and 30-day mortality (OR 1.05)



DECISION RULE TYPE-A:  
POSITIVE GRANDMOTHER SIGN



DECISION RULE

TYPE-B:

YOUR GUESS IS AS

GOOD AS MINE



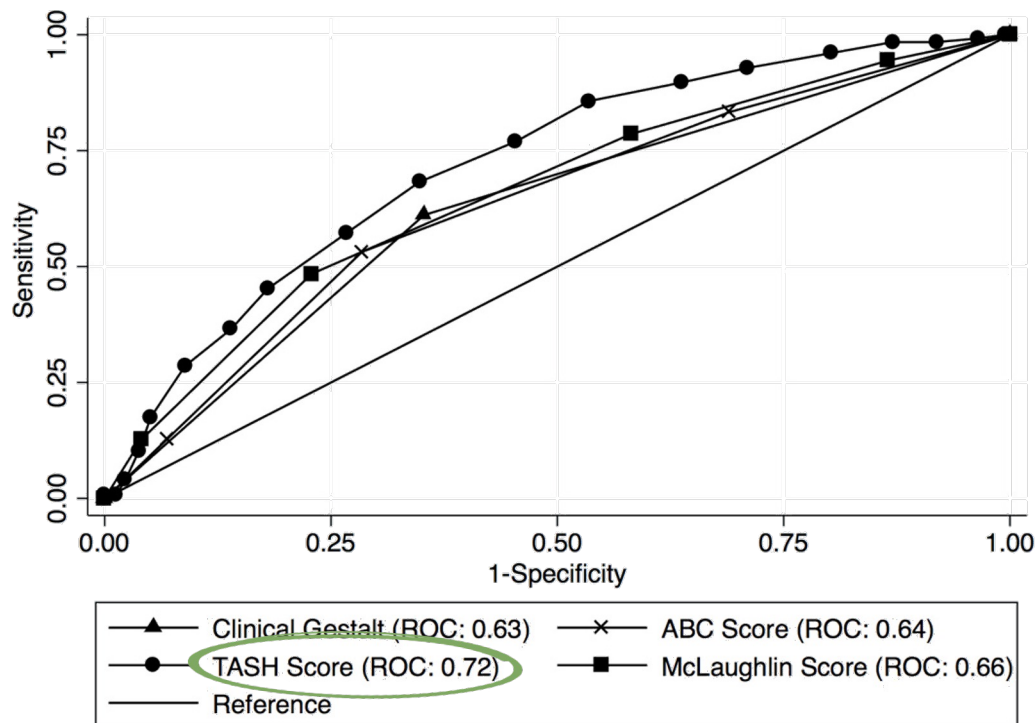
# Injury

Pommerening et al. Injury 2015;46(5):807-13

Clinical gestalt and the prediction of massive transfusion after trauma

Prospective observational trial of 966 patients

10-minutes after patient arrival trauma surgeons were asked: "Is the patient likely to be massively transfused?"



# TASH SCORE CALCULATION...

Sex	Female 0	Male +1
Hemoglobin	< 7 g/dL	+8
	< 9 g/dL	+6
	< 10 g/dL	+4
	< 11 g/dL	+3
	< 12 g/dL	+2
	≥ 12 g/dL	0
Base Excess	< -10 mmol/L	+4
	< -6 mmol/L	+3
	< -2 mmol/L	+1
	≥ -2 mmol/L	0

Systolic Blood Pressure	< 100 mm Hg	+4
	< 120 mm Hg	+1
	≥ 120 mm Hg	0
Heart Rate	>120 bpm	+2
	≤ 120 bpm	0
Positive FAST for Intra-Abdominal Fluid	<b>No 0</b>	Yes +3
Clinically Unstable Pelvic Fracture	<b>No 0</b>	Yes +6
Open or Dislocated Femur Fracture	<b>No 0</b>	Yes +3



## Multicenter Validation of the Revised Assessment of Bleeding and Transfusion (RABT) Score for Predicting Massive Transfusion

+RABT  $\geq 2$  of the following:

Penetrating injury

Positive FAST

Pelvic fracture

Shock index  $>1.0$

Found a sensitivity 78% and specificity 91% for predicting need for massive transfusion

(ROC 0.89)





# Injury

D'Souza et al. Injury 2023;54(1):19-24

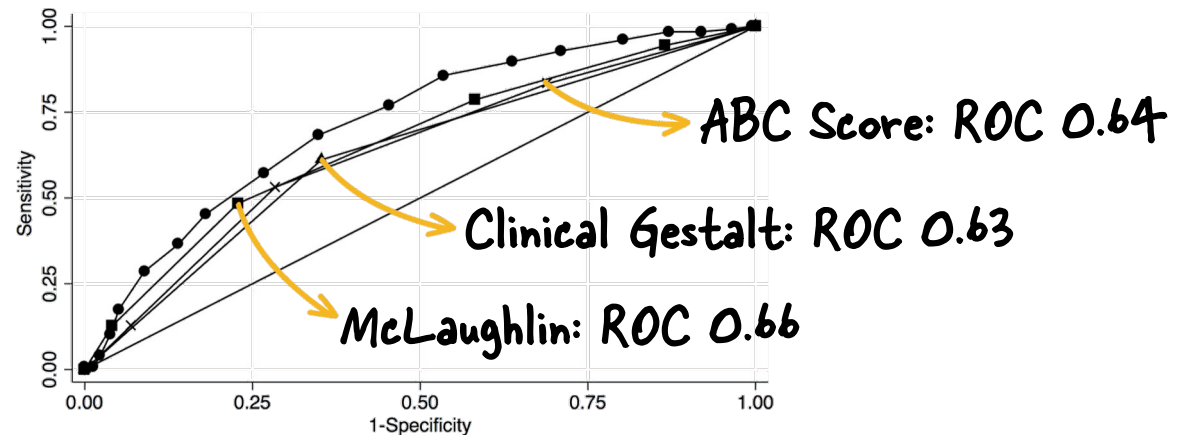
Prediction of massive transfusion with the Revised Assessment of Bleeding and Transfusion (RABT) score at Canadian level I trauma centers

Retrospective review 514 trauma patients comparing RABT score, ABC score, and Shock Index for predicting massive transfusion

Shock Index: ROC 0.69

ABC: ROC 0.64

RABT: ROC 0.67



IS MY PATIENT  
LIKLEY TO NEED  
MASSIVE  
TRANSUFSION?

How sick is my  
patient?

+

Is there a site of  
active bleeding?



IS MY PATIENT  
LIKLEY TO NEED  
MASSIVE  
TRANSUFSION?

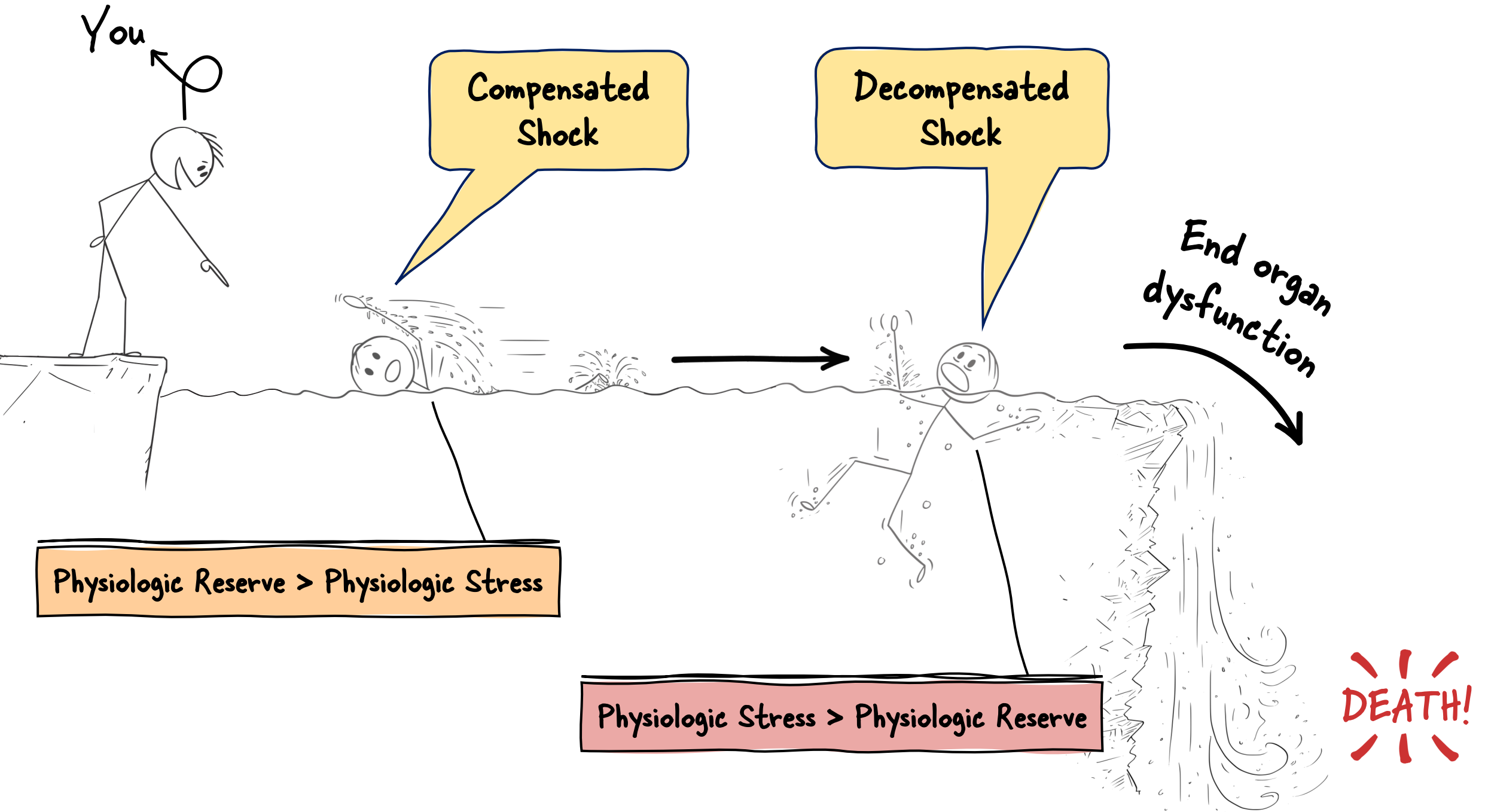
How sick is my  
patient?

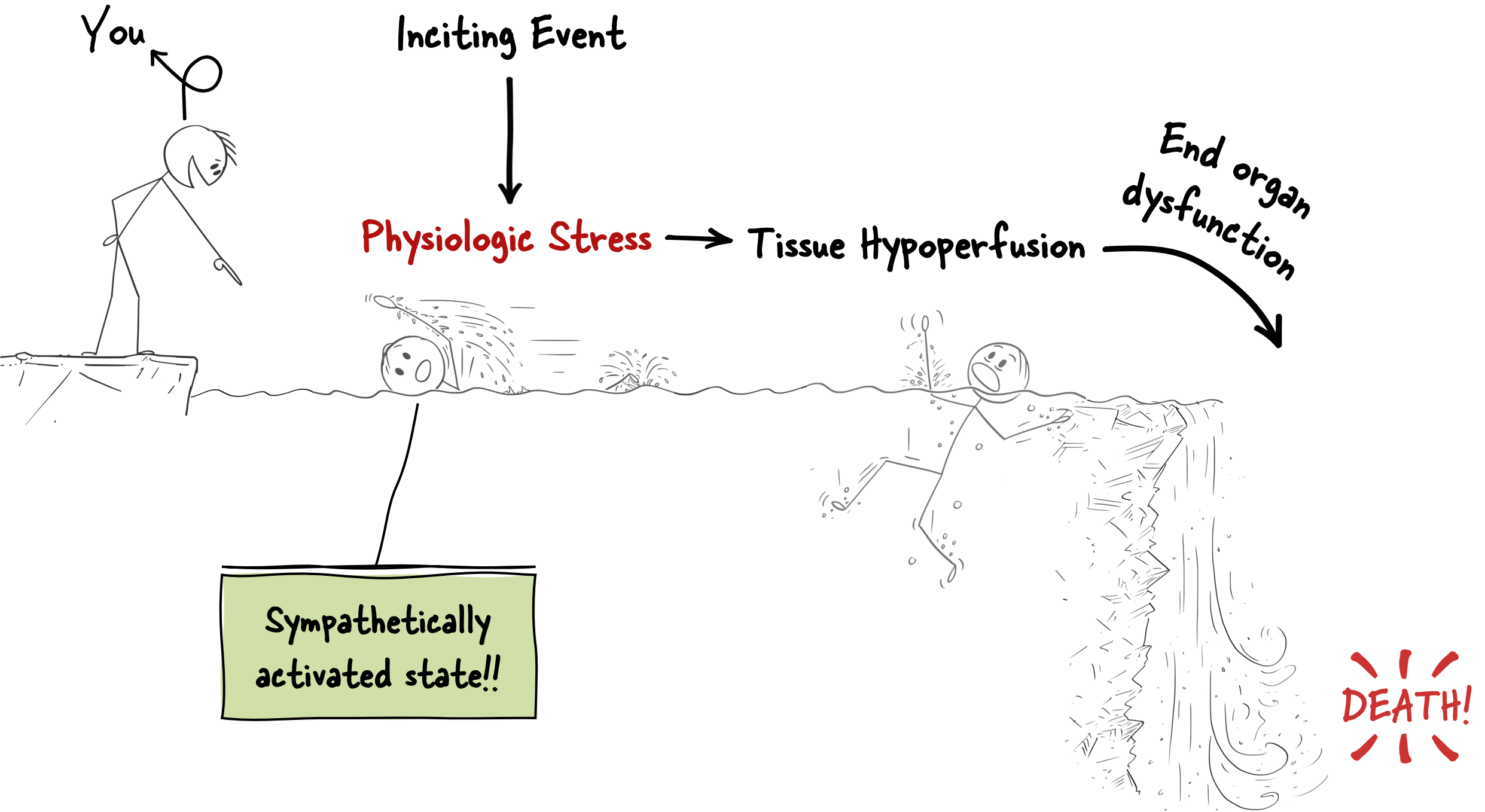
+

Is there a site of  
active bleeding?

NO SINGLE  
MAGIC NUMBER







# EXAM

Mental status

Work of breathing

Skin exam

Capillary refill time

Urine output

# MONITOR

Heart rate

Blood pressure

Shock Index

SpO<sub>2</sub> Waveform

Pleth perfusion index

# LABS

Physiologic stress +/-  
tissue hypoperfusion:

Lactate, Base excess,  
HCO<sub>3</sub>, WBC, glucose

Organ dysfunction:

Cr, BNP, INR, LFTs

IS MY PATIENT  
LIKLEY TO NEED  
MASSIVE  
TRANSUFSION?

How sick is my  
patient?

+

Is there a site of  
active bleeding?



**Chest**

**Abdomen**

**Pelvis**

**Extremities**



2 UNITS  
UNCROSSED  
PRBCs



# APPROACH TO HEMORRHAGIC SHOCK

- 1) Initiate massive transfusion
- 2) Restore blood volume**
- 3) Correct metabolic derangements
- 4) Support hemodynamics
- 5) Stay focused on the big picture





(ish)



## Do not forget the platelets: The independent impact of red blood cell to platelet ratio on mortality in massively transfused trauma patients

Retrospective multicenter study of transfusion balance (RBC:PLT and RBC:FFP of  $\leq 2$ )

9215 trauma patients who required massive transfusion ( $\geq 10$  units RBC in 24 hours)

Unbalanced PLT in 21% of patients, unbalanced FFP transfusion in 12% of patients

Significantly increased 24h mortality for unbalanced FFP (OR 1.66), unbalanced PLT (OR 2.48), and unbalanced FFP + PLT (OR 3.41)



TRANEXAMIC ACID

CRYOPRECIPITATE

RBC

|||| ||

FFP

|||| |

PLT

||

Cryo

|

TXA

1g



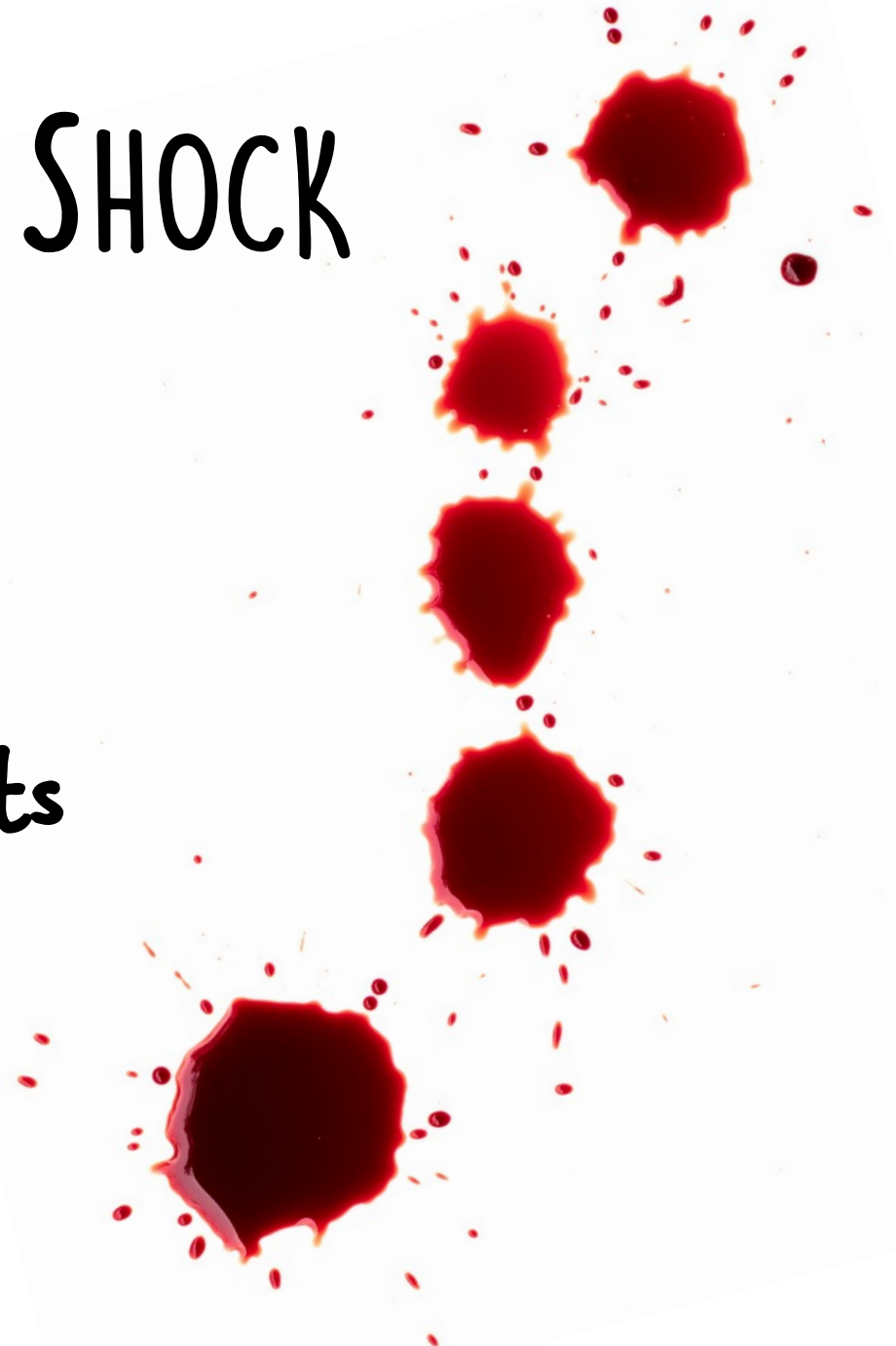
WARM BLANKETS  
+  
COLD BLOOD

VASCULAR  
ACCESS IN  
THE BLEEDING  
PATIENT



# APPROACH TO HEMORRHAGIC SHOCK

- 1) Initiate massive transfusion
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- 3) Correct metabolic derangements**
- 4) Support hemodynamics
- 5) Stay focused on the big picture







DON'T FORGET  
YOUR CALCIUM!

Calcium Chloride 1g for  
every ~4 units of product

RBC

|||| ||

FFP

|||| |

PLT

||

Cryo

|

TXA

1g

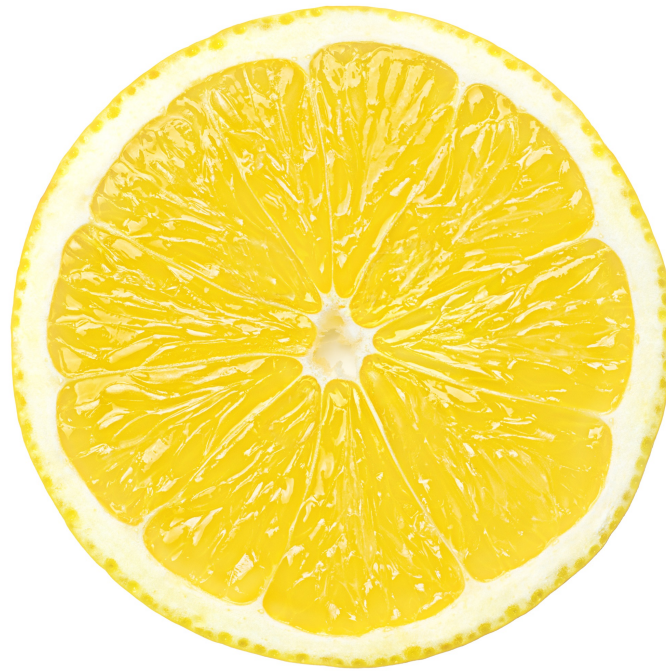
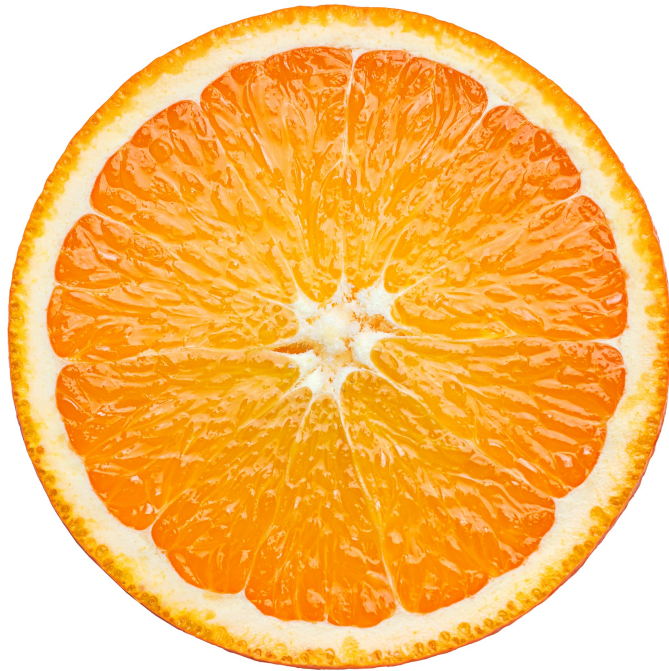
Ca<sup>++</sup>

|||

**HYPERKALEMIA CAN  
BECOME A PROBLEM...**



# METABOLIC ACIDOSIS



# APPROACH TO HEMORRHAGIC SHOCK

- 1) Initiate massive transfusion
- 2) Restore blood volume
- 3) Correct metabolic derangements
- 4) Support hemodynamics**
- 5) Stay focused on the big picture



PRESSORS IN HEMORRHAGIC  
SHOCK...?!?!?



**WARNING**

**PRESSORS DON'T  
FIX BLEEDING**



PRESSORS IN HEMORRHAGIC  
SHOCK ARE PROBABLY NOT EVIL





The impact of early administration of vasopressor agents for the resuscitation of severe hemorrhagic shock following blunt trauma

Single center retrospective trial of 40 blunt trauma patients who received norepinephrine and/or dopamine

Non-survivors were administered pressors significantly earlier after admission and at significantly higher doses

Total blood transfusion amount was significantly higher in survivors



**JAMA**  
**Surgery**

Uchida et al. JAMA Surgery 2019;154(5):994-1003

Effect of Low-Dose Supplementation of Arginine Vasopressin on Need for Blood Product Transfusions in Patients With Trauma and Hemorrhagic Shock

Randomized, double-blind placebo-controlled clinical trial of 100 trauma patients who got >6 units pRBC within 12h of injury

Vasopressin  $\leq 0.04$  U/min  $\times 48$ h

Vasopressin administration associated with significantly decreased blood product administration (median 1L), no difference in mortality



BJA

Gauss et al. British Journal of Anesthesia 2018;120(6):1237-1244

Effect of early use of noradrenaline on in-hospital mortality in haemorrhagic shock after major trauma: a propensity-score analysis

200 propensity matched patients from a 7141 multicenter prospective regional trauma registry database

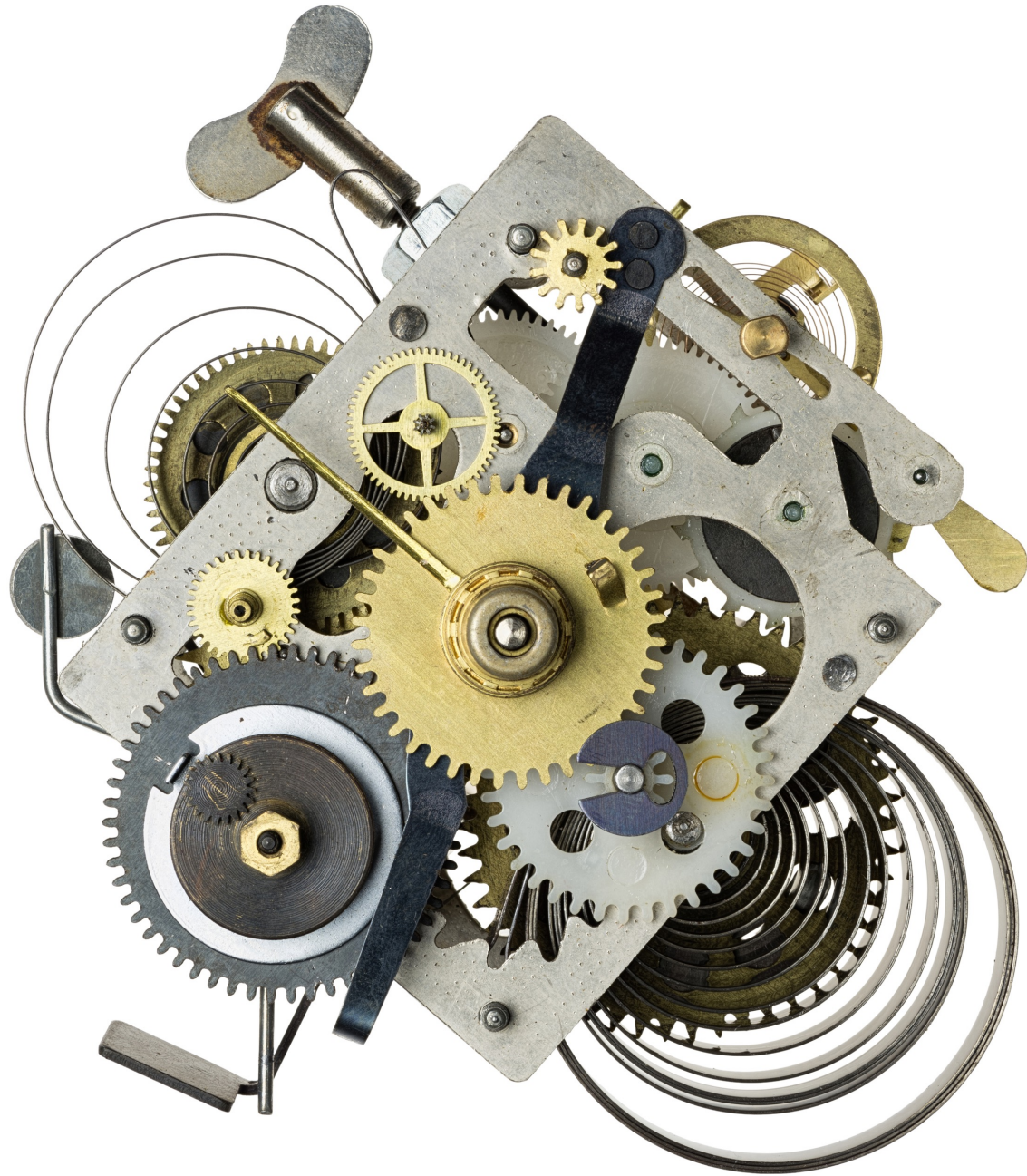
No difference for in-hospital mortality between patients who did and did not receive norepinephrine



Norepinephrine Administration With 24-Hour Mortality Among Patients  
With Blunt Trauma and Hemorrhagic Shock

Retrospective observational multicenter trial of 2164 blunt  
trauma patients

None of the 5 analytical strategies used suggested any  
statistically significant association between norepinephrine  
administration and 24-hour or in-hospital mortality



PRESSORS IN  
HEMORRHAGIC  
SHOCK?

DEPENDS HOW  
YOU USE THEM

YOU BREAK IT,  
YOU BUY IT



# PERMISSIVE HYPOTENSION

(AKA: you can't have everything  
you want at the same time...)



# APPROACH TO HEMORRHAGIC SHOCK

- 1) Initiate massive transfusion
- 2) Restore blood volume
- 3) Correct metabolic derangements
- 4) Support hemodynamics
- 5) **Stay focused on the big picture**





# IS MY HEMORRHAGIC SHOCK PATIENT IMPROVING?

IF NOT THEN...

1. Active ongoing bleeding vs behind with transfusion?
2. Surgical bleeding vs medical bleeding vs both?
3. Terminal trigger event?
4. Additional shock etiology developing?