Transfusion Associated Circulatory Overload (TACO)

Sarah Hall, RN, Transfusion Safety Officer
Lakeridge Health

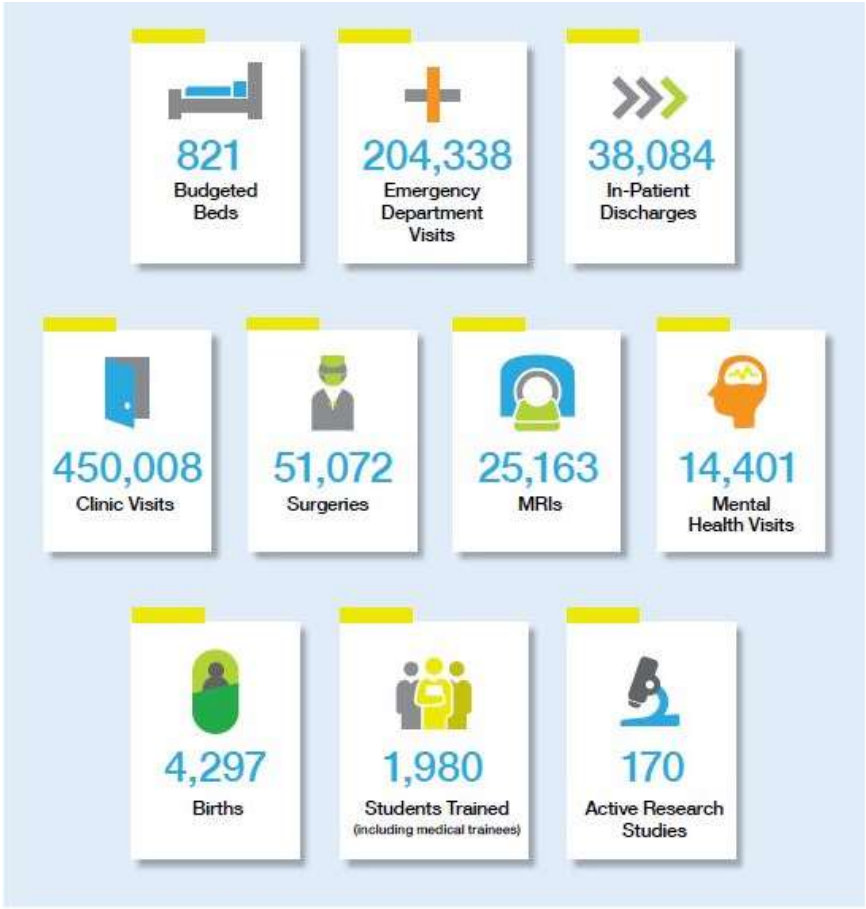
Declaration

- Nothing to declare

Background

- Me

- Lakeridge



Learning Objectives

At the end of this session, participants will be able to:

- Recognize the patient risk factors associated with TACO
- Identify a suspected TACO reaction based upon updated criteria

Question 1: Pre-Knowledge

Which transfused volume is most likely to cause a TACO reaction?

a. 300 mL (1 unit RBC)
b. More than 300 mL (more than 1 unit RBC)
c. 50 mL (less than 1/3 of a unit RBC)
d. Any volume can cause a TACO reaction

Question 2: Pre-Knowledge

What type of blood product can cause TACO?

a. RBC only
b. RBC, plasma, or platelets (only blood components)
c. IVIg, Albumin or Fibrinogen Concentrate (only plasma derivatives)
d. Any blood product can cause a TACO

Question 3: Pre-knowledge

What causes a TACO reaction?

a. patient-specific factors (e.g. underlying disease)
b. The volume of the transfusion (more products means more likely to have a TACO)
c. Product specific factors (e.g. mediators found within the blood product)
d. A combination of all of these

Overview

- Pathophysiology
- Criteria
- Risk Factors
- Incidence
- RBC case
- Albumin case

Transfusion Associated Circulatory Overload (TACO): pulmonary edema, caused by fluid overload

Transfusion Related Acute Lung Injury (TRALI): pulmonary edema, caused by immune-mediated response to factors within the transfused product

Transfusion Associated Dyspnea (TAD): a rule-out, catch-all for “other” respiratory reactions

Pathophysiology

- The full mechanism of action is yet unknown
- Originally hypothesized to be a straightforward “increased pulmonary pressure leading to pulmonary edema”
- Inflammatory component?
- Storage lesions?
- *Is there value in pulling apart different respiratory-type reactions, or should we really group them together?*

TACO criteria

New definition (AABB, 2018) Minimum 3 of:

- Respiratory compromise
- Within 12 h of transfusion
- Evidence of pulmonary edema
- Cardiovascular changes
- Evidence of fluid overload
- BNP (NTproBNP) elevated (> 2000 or pre/post ratio > 1.5)

(*TTISS 2007 definition: dyspnea, cyanosis, orthopnea, HTN, CHF within 6 h*)

v. 4 Oct 2020

IMMEDIATE ACTIONS!

1. **STOP** the transfusion
2. Maintain **IV access**
3. Check **vital signs**
4. Verify **patient ID matches** transfusion label/tag
5. **Notify physician**
6. **Patient care** per order, **report every reaction to Transfusion Medicine Lab (TML), document** per policy

TTISS-ON
Acute Transfusion Reaction Chart

SIGNS AND SYMPTOMS

FEVER, URTICARIA, DYSPNEA, HYPOTENSION

Airway or Facial Edema, Anxiety, Coughing, Diffuse bleeding/oozing, Hemoglobinuria, Hypertension, Itching, Nausea/Vomiting, Pain (Back, Headache, IV site), Rash, Shaking Chills/Rigors, Subjective chills, Tachycardia, Urine colour– dark/red, Wheezing

Consider Recommended Investigations and Suggested Treatment and Actions in the context of each patient's specific clinical scenario and blood component/product transfused.
The initial presenting sign/symptom may evolve, if so re-contact TML. Close patient monitoring is essential.
For additional assistance, call TML at extension: _____

SIGNS & SYMPTOMS		TIMING	POSSIBLE ETIOLOGY	RECOMMENDED INVESTIGATIONS	SUGGESTED TREATMENT AND ACTIONS
FEVER: Temperature of at least 38° C and an increase of at least 1° C from pre-transfusion **and/or** Shaking Chills/Rigors NOTE: Isolated symptom subjective chills, may consider as Low Risk	**Low Risk:** 38° C to 38.9° C but **NO** other symptoms	During or up to 4 hours post transfusion.	Febrile non-hemolytic transfusion reaction	No testing required	• Antipyretic • With physician order and if blood still viable, may resume transfusion with close patient assessment • If recurrent reactions, possible trial of antipyretic premedication
	High Risk: a) at least 38° C but **with** other symptoms **or** b) 39° C or greater **or** c) Shaking Chills/ Rigors	Often within first 15 minutes. During or up to 4 hours post transfusion.	Febrile non-hemolytic transfusion reaction Bacterial contamination Acute hemolytic transfusion reaction	• TML: Group & Screen, DAT • TML: Blood component culture • Patient blood culture (from a different peripheral site) • Urinalysis (first void post-reaction) • Hemolysis work-up: CBC, bilirubin, LDH, AST, haptoglobin, reticulocyte count, blood film • If indicated, assess for - AKI (Acute Kidney Injury) (electrolytes, creatinine) - DIC (Disseminated Intravascular Coagulation) (INR, PTT, fibrinogen, D-dimer)	**DO NOT restart transfusion** • Return blood to TML for clerical check & culture • Broad spectrum IV antibiotics; DO NOT wait for culture results • Aggressive hydration; maintain good urine output • Supportive care per physician's discretion: IV fluid, vasopressors, oxygen, respiratory support • Monitor for hypotension, renal dysfunction, DIC (Disseminated Intravascular Coagulation) • If severe rigors, consider meperidine (if no patient contraindications) • **Serious reaction, call TML immediately**
URTICARIA (Hives) Rash **or** Itching	Less than 2/3 body surface but **NO** other symptoms	During or up to 4 hours post transfusion.	Minor allergic	No testing required	• Antihistamine • With physician order and if blood still viable, may resume transfusion with close patient assessment • If recurrent/severe reactions, possible trial of antihistamine premedication
	2/3 body surface or more but **NO** other symptoms	Often early in transfusion. During or up to 4 hours post transfusion.	Minor allergic (Extensive)	No testing required	**DO NOT restart transfusion** • Antihistamine; may require steroid if symptoms slow to resolve • If recurrent/severe reactions, possible trial of antihistamine /steroid premedication • If continued reactions with premedication, possible trial of washed/plasma depleted components
	With other symptoms, i.e., Airway or Facial Edema, DYSPNEA, HYPOTENSION	Often early in transfusion. During or up to 4 hours post transfusion.	Anaphylactoid reaction /Anaphylaxis	• If also DYSPNEA: chest X-ray, • If also hypoxia: blood gases • Suggest consult Transfusion Medicine physician: explore if indication for - TML: Group & Screen, DAT - Haptoglobin - IgA level (if pre-transfusion sample available) - Anti-IgA testing (performed via Canadian Blood Services, TML will assist in sending samples)	**DO NOT restart transfusion** • **Epinephrine;** consider steroid, antihistamine • Return blood to TML for clerical check • Supportive care per physician's discretion: oxygen, respiratory support, vasopressors • Pending outcome of investigations, washed/plasma depleted components • **Serious reaction, call TML immediately**

SIGNS & SYMPTOMS		TIMING	POSSIBLE ETIOLOGY	RECOMMENDED INVESTIGATIONS	SUGGESTED TREATMENT AND ACTIONS
DYSPNEA **or** SpO_2 (oxygen saturation) of 90 % or less and a decrease of at least 5 % from pre-transfusion **or** intervention required to maintain SpO_2 (oxygen saturation)	With **Hypertension,** tachycardia, +/- FEVER	During or up to **12 hours** post transfusion	TACO* (Transfusion Associated Circulatory Overload)	• TML: Group & Screen, DAT • Consider chest x-ray: Findings - pulmonary edema, Kerley B lines, peri bronchial cuffing; may be pleural fluid • Cardiac biomarkers (as available)	**DO NOT restart transfusion** • Oxygen, high fowler's position, diuretics (document fluid balance) • **Future transfusion:** Slow transfusion rate Pre-transfusion diuretics ** Consider TML to divide unit (as available)
	ACUTE DYSPNEA With **HYPOTENSION,** tachycardia, +/- FEVER	During or up to **6 hours** post transfusion	TRALI (Transfusion Related Acute Lung Injury)	• TML: Group & Screen, DAT • Chest x-ray: Findings – bilateral interstitial /alveolar infiltrates without elevated pulmonary pressures • If also hypoxia: blood gases • Canadian Blood Services requires follow up information & patient blood tests, contact TML, will assist in sending samples	**DO NOT restart transfusion** • Supportive care per physician's discretion: oxygen, respiratory support, vasopressors (benefit uncertain for diuretics (document fluid balance), steroids, and bronchodilators) • **Serious reaction, call TML immediately**
	With FEVER +/- HYPOTENSION	Possible Etiology: Bacterial contamination, Acute hemolytic transfusion reaction **Consider/Follow FEVER, High Risk:** Timing, Recommended Investigations, Suggested Treatment and Actions			
	With URTICARIA, Airway or Facial Edema, HYPOTENSION	Possible Etiology: Anaphylactoid Reaction / Anaphylaxis **Consider/Follow URTICARIA, With other symptoms:** Timing, Recommended Investigations, Suggested Treatment and Actions			
	Mild respiratory symptoms that do not align with TACO or TRALI	During or up to **24 hours** post transfusion	TAD (Transfusion Associated Dyspnea)	• Consider chest x-ray: Findings - normal/unchanged, no pulmonary edema, No bilateral interstitial/alveolar infiltrates	**DO NOT restart transfusion** • Supportive care per physician's discretion: oxygen, respiratory support

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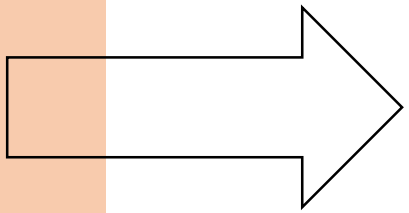

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Difficulty moving it around
Difficulty excreting it
Already too much
History of problems with it

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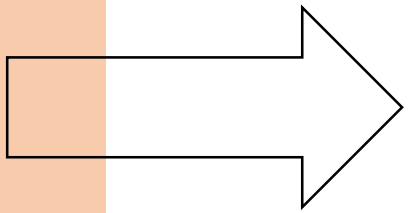
- Older age (> 60)
  - Paediatric/neonatal patients are more at risk as well



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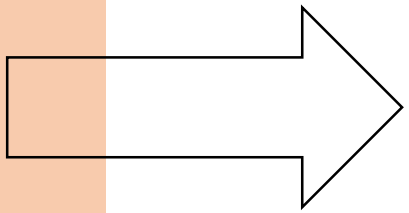

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SHOT UK 2021 Report

Weight based dosing for all populations

Transfusing non-bleeding patient doesn't treat the cause of anemia, more likely to over-transfuse

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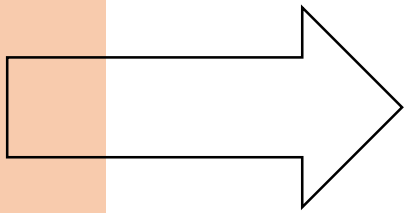

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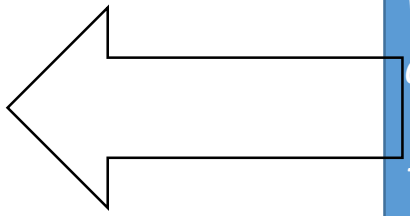
- Older age (> 60)
  - Paediatric/neonatal patients are more at risk as well
- *Weight*
- *Symptomatic anemia (non-bleeding)*



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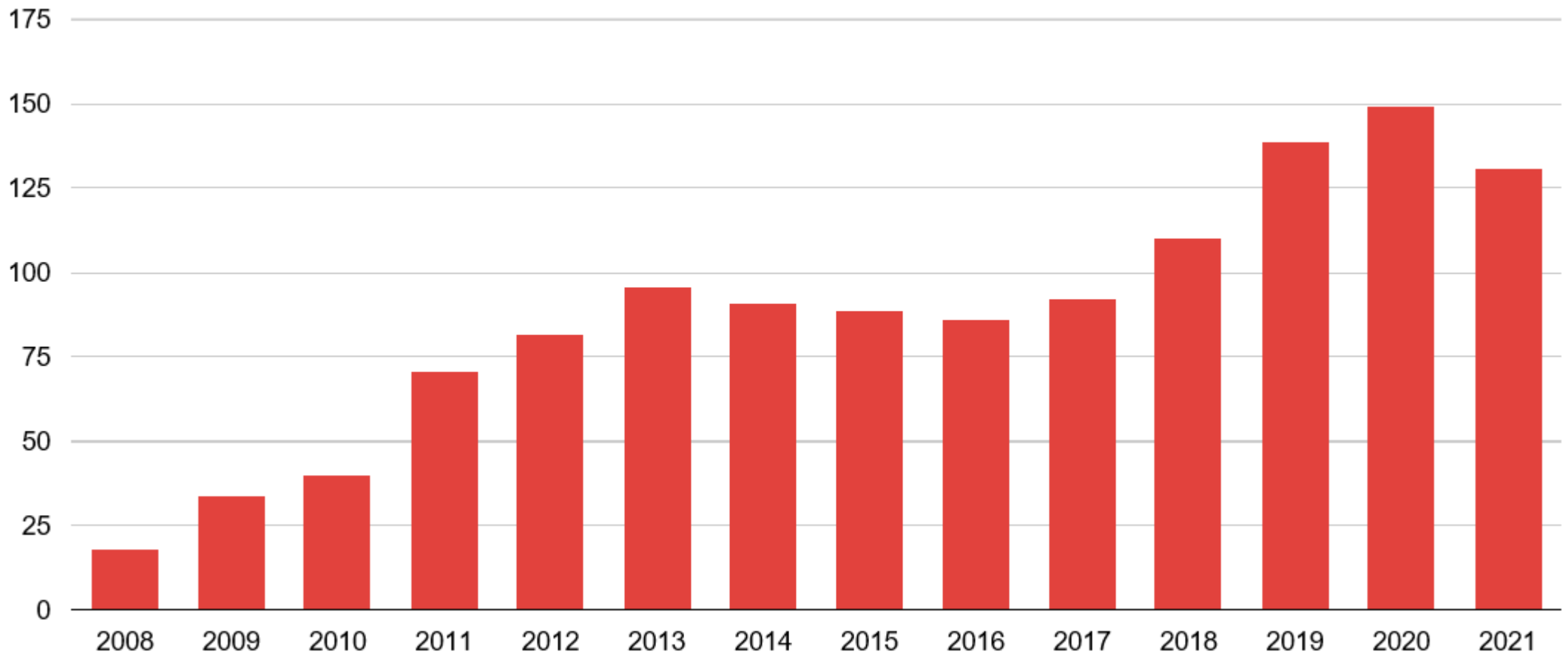
Weight based dosing for all populations

Transfusing non-bleeding patient doesn't treat the cause of anemia, more likely to over-transfuse

Incidence (Bloody Easy 4, 2020)

Risk of Event	Event
1 in 13	Red cell sensitization, increasing risk of hemolytic transfusion reaction and hemolytic disease of fetus and newborn
1 in 20	Febrile non-hemolytic transfusion reaction (FNHTR) per pool of platelets
1 in 100	Transfusion-associated circulatory overload (TACO)
1 in 100	Minor allergic reaction
1 in 300	Febrile non-hemolytic transfusion reaction per unit of RBC
1 in 7,000	Delayed hemolytic transfusion reaction
1 in 10,000	Transfusion-related acute lung injury (TRALI)
< 1 in 1,000,000	Transmission of West Nile Virus
1 in 4,000,000	Transmission of Chagas disease per unit of component
1 in 7,500,000	Transmission of Hepatitis B virus per unit of component
1 in 7,600,000	Transmission of HTLV per unit of component
1 in 13,000,000	Transmission of Hepatitis C virus per unit of component
1 in 21,000,000	Transmission of HIV per unit of component

TACO as per SHOT UK (Serious Hazards of Transfusion)



RBC Case

- 83 F
- Mod/severe Alzheimer's dementia, NIDDM. Lives at a nursing home
- Ongoing GI bleeding x 6 months, out of hospital Hb measured at 66 a few days prior. Family refuses scopes as patient "would not tolerate prep," nor would she "tolerate treatment if there was a diagnosis".

- 1 u RBC + Venofer infusion for anemia
- (Venofer administered 1 h prior to transfusion)

RBC Case

- Pre tx: afebrile; HR 98; BP 142/58; RR 20; 92% room air
- Start: 1700, rate 50 mL/h
- At 1752 (+ 1 h) BP 160/97 (+20); RR 22. Tx stopped; 50 mL transfused
- At 1854 (+ 2h) experienced sudden dyspnea and required BiPAP 45%; RR 29
- MD notes “diffuse crackles”
- ** in/outs not accurate, recorded (-) 1 L

Treatment:
Lasix 40 mg IV
Dumped 1400 mL post-lasix

Diagnostics:

CXR: diffuse bilateral interstitial markings, suspect edema

Post-cultures negative x 2

NTproBNP elevated
Troponins elevated

RBC Case

- At 2222 patient's oxygen requirements began steadily increasing. After Optiflow was applied, the family decided not to escalate care any farther. Pt expired 27 h post-transfusion.

?

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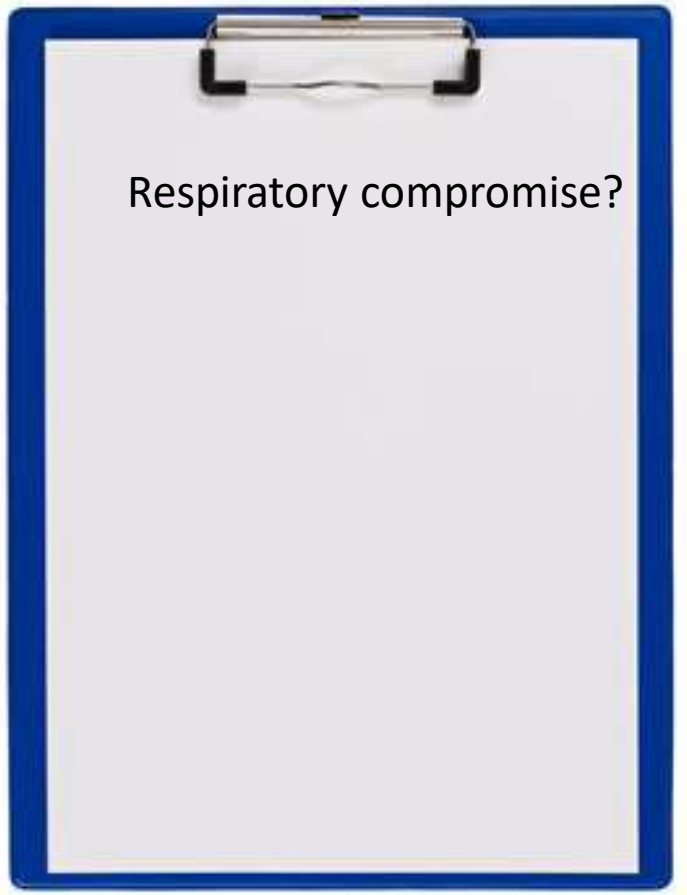

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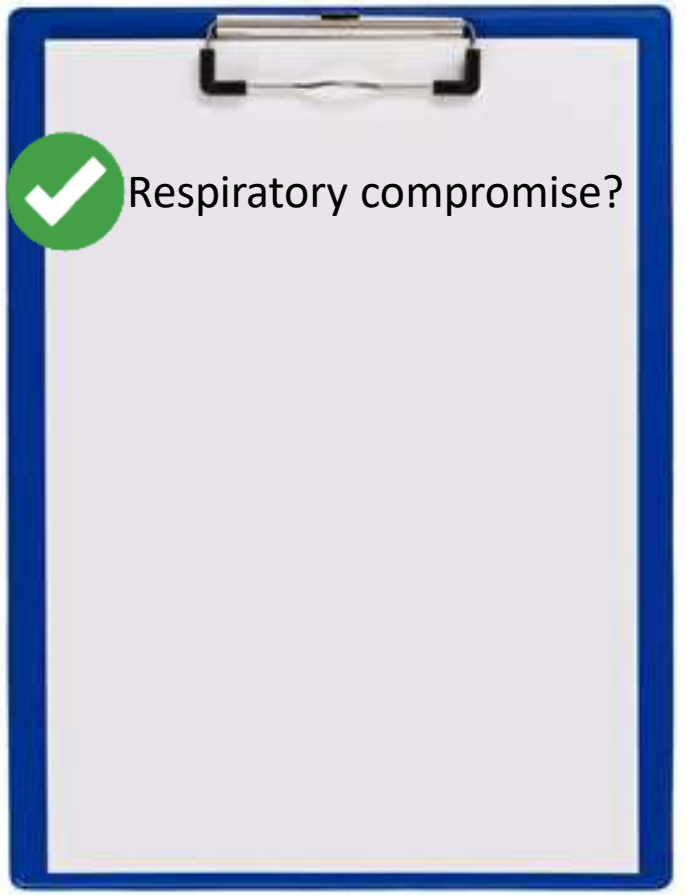

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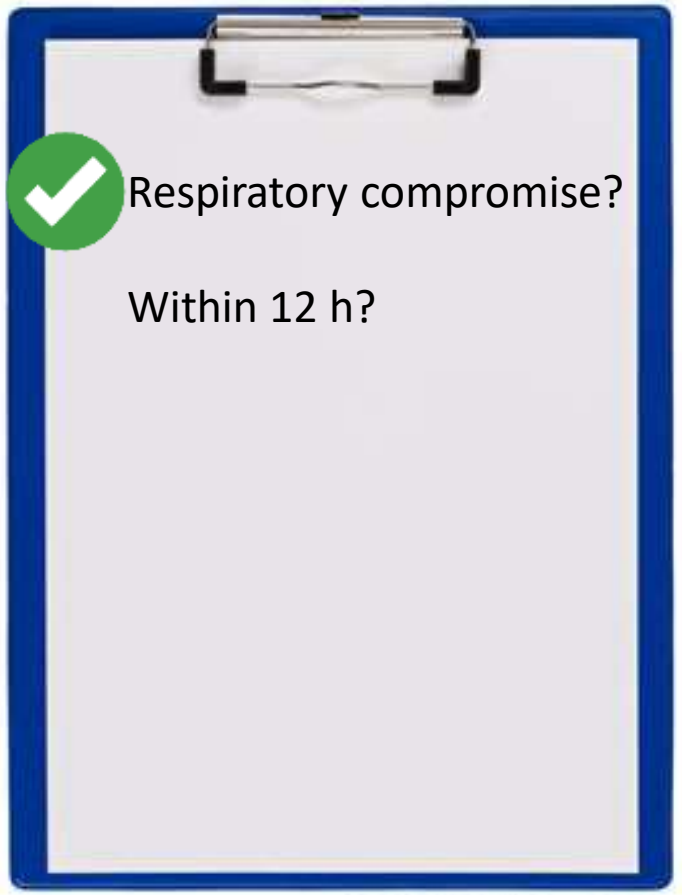

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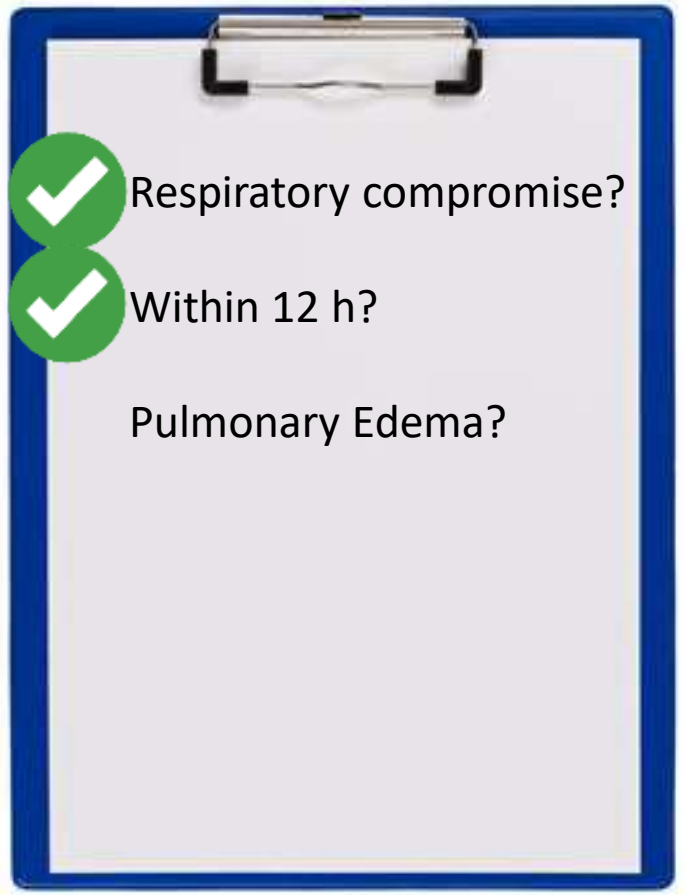

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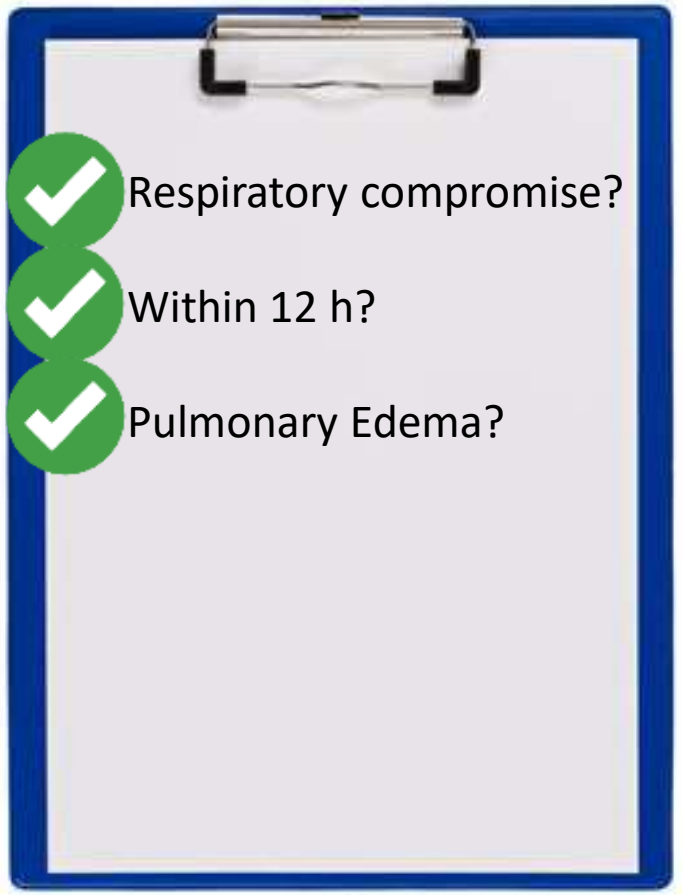

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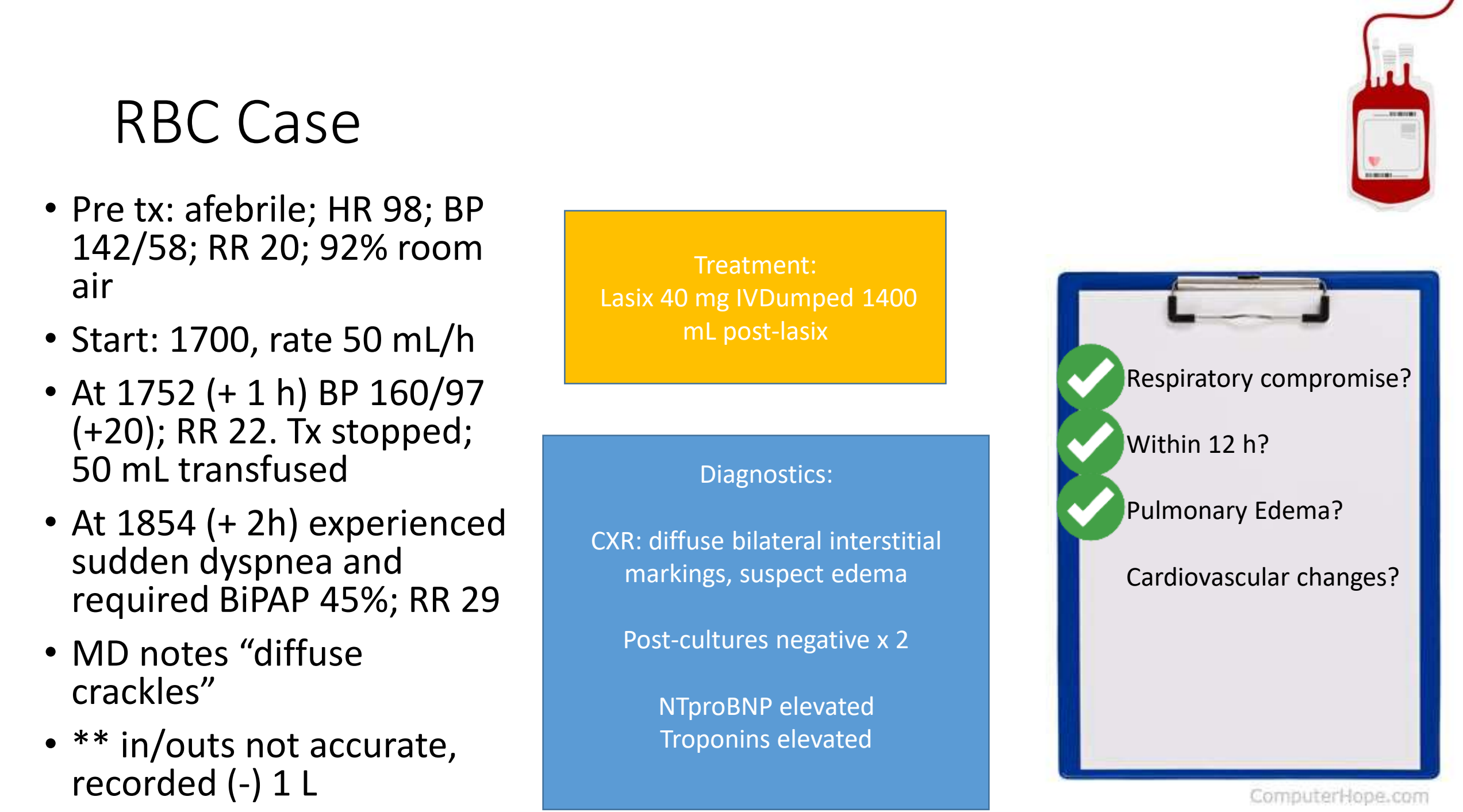

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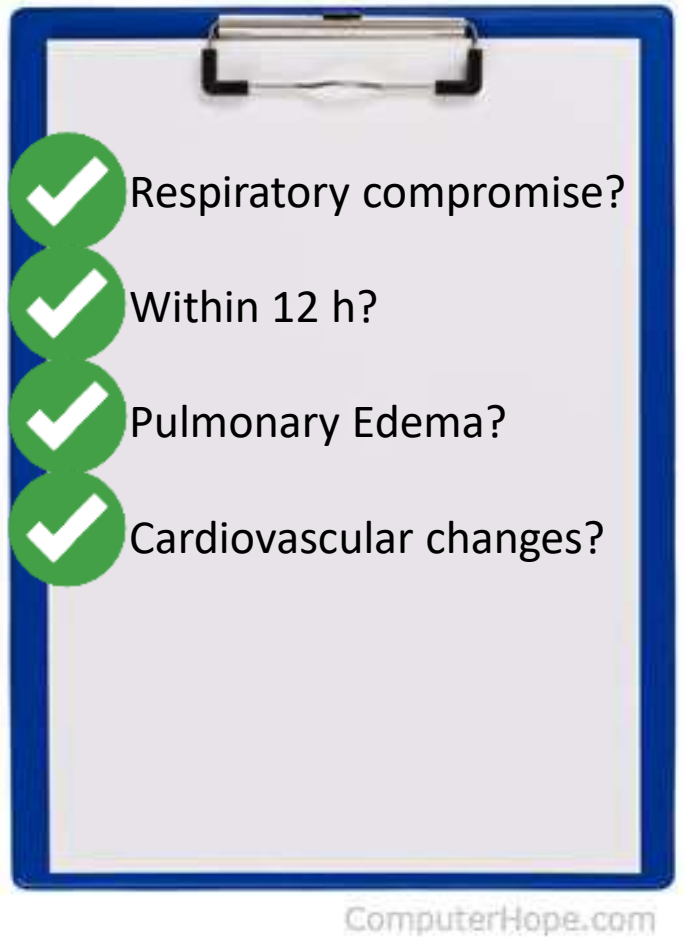

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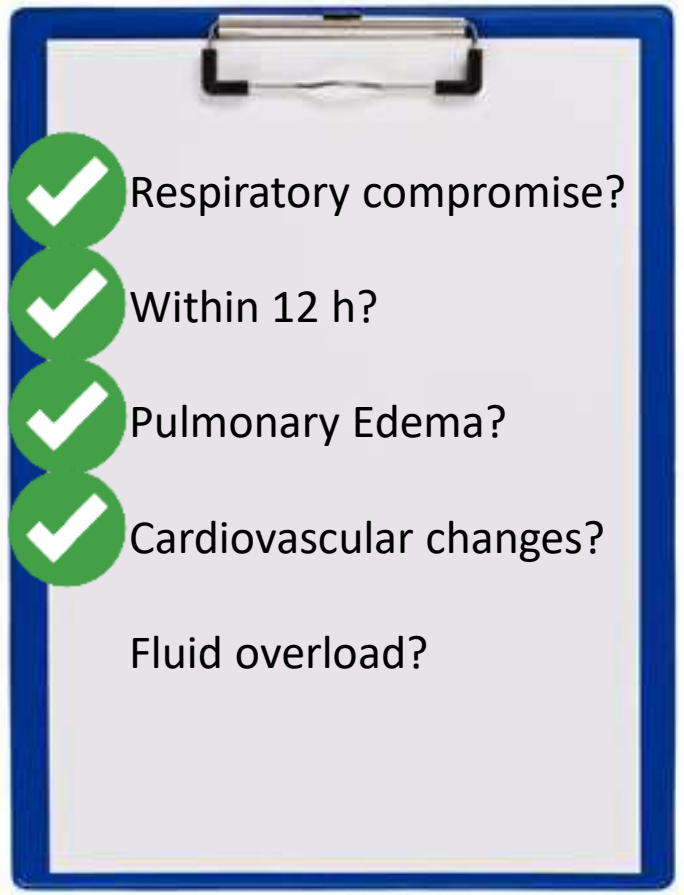

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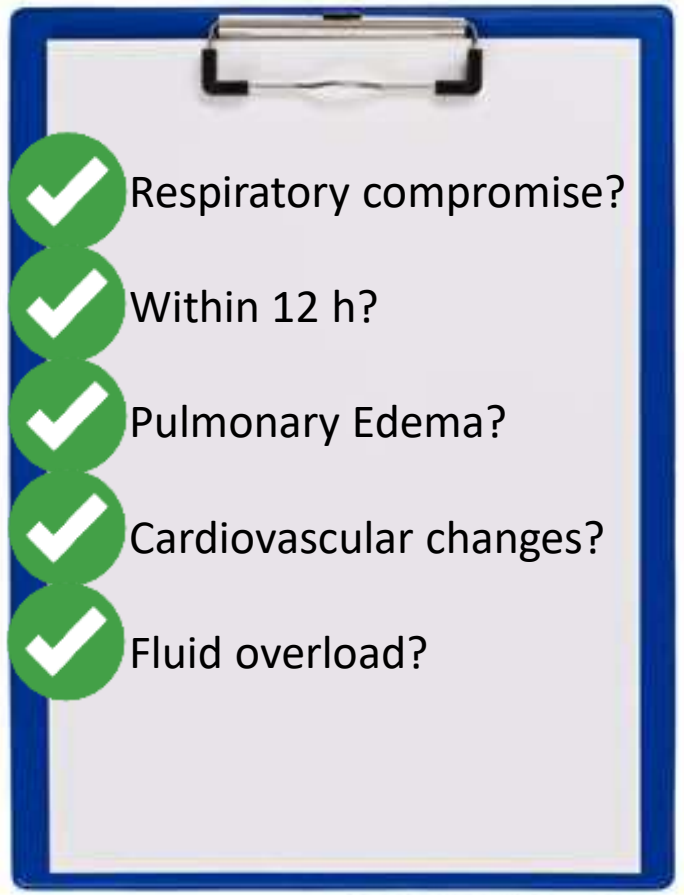

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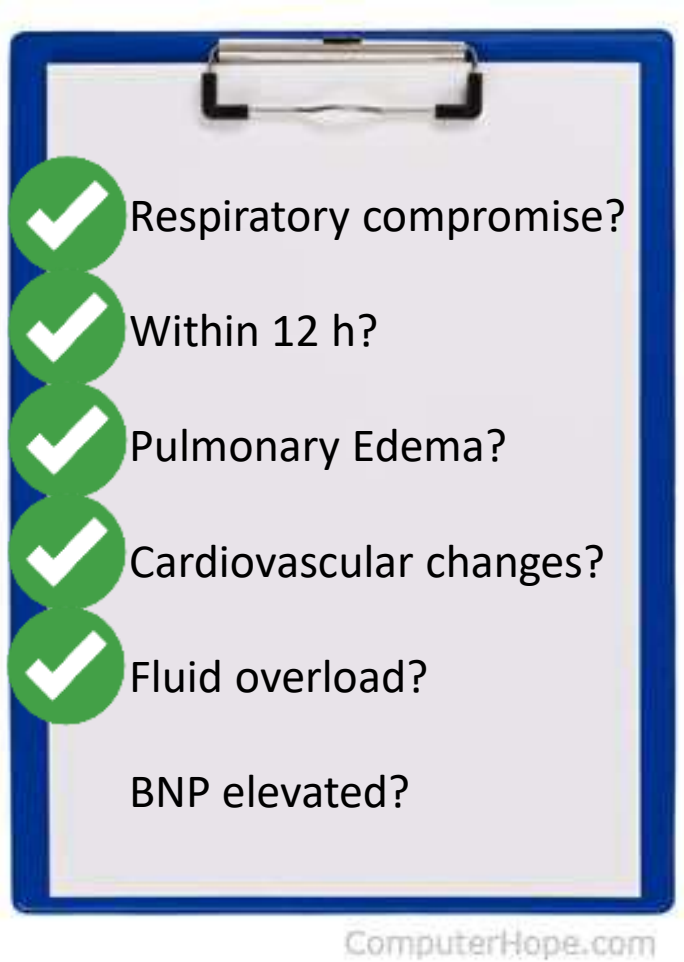


RBC Case

- Pre tx: afebrile; HR 98; BP 142/58; RR 20; 92% room air
- Start: 1700, rate 50 mL/h
- At 1752 (+ 1 h) BP 160/97 (+20); RR 22. Tx stopped; 50 mL transfused
- At 1854 (+ 2h) experienced sudden dyspnea and required BiPAP 45%; RR 29
- MD notes “diffuse crackles”
- ** in/outs not accurate, recorded (-) 1 L

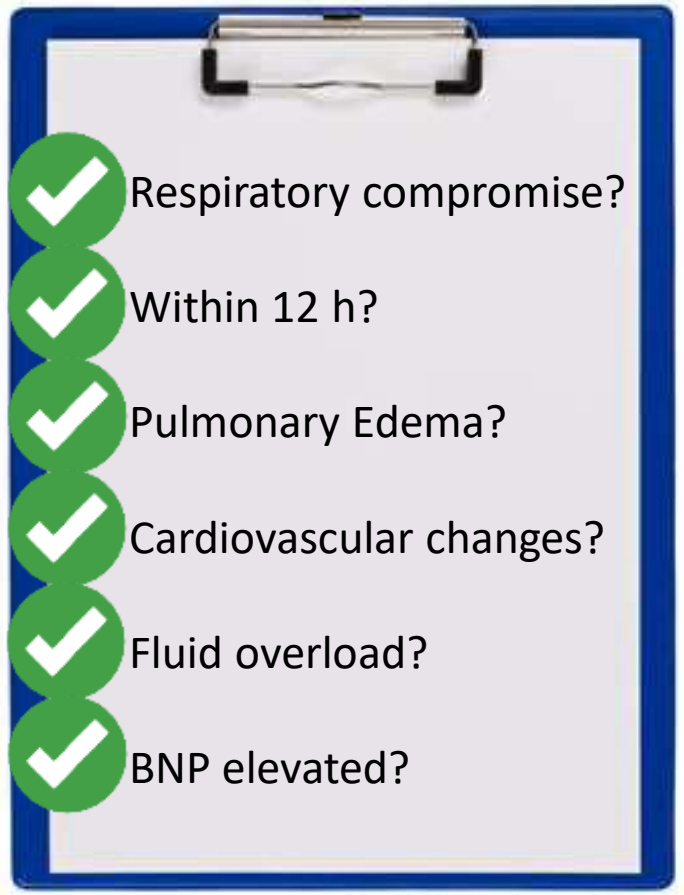
Treatment:
Lasix 40 mg IV
Dumped 1400 mL post-lasix

Diagnostics:

CXR: diffuse bilateral interstitial markings, suspect edema

Post-cultures negative x 2

NTproBNP elevated
Troponins elevated



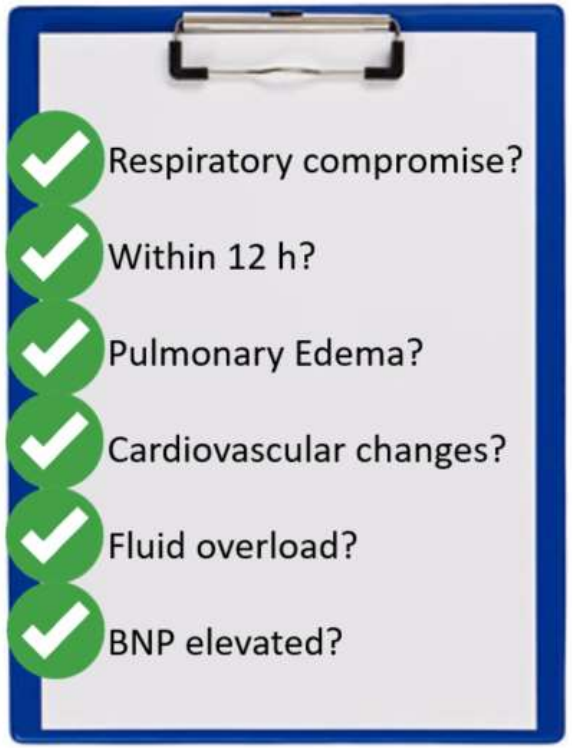
RBC Case

- AABB minimum 3 indicators

Confounding details:

- Venofer co-infusion (adverse drug response?)
- Elevated troponin (death caused by MI rather than TACO?)
- Missing/inaccurate documentation

?



RBC Case Summary

- Possibly transfusion-imputable
- Possible cardiorespiratory insult
- Possible role in death
- Reported to CBS as per guidelines/for donor flagging

Canadian Blood Services
BLOOD
PLASMA
STEM CELLS
ORGANS
& TISSUES

- Probable death relating to TACO

Risk Factors RBC Case

- Cardiac dysfunction
- Renal dysfunction
- Positive fluid balance
- Previous TACO
- Older age (> 60)
- *Weight*
- *Symptomatic anemia (non-bleeding)*

Albumin Case

25% Albumin is:

- Human plasma derived
- Increases blood volume by 3 – 4 times (ie 100 mL becomes 300 – 400 mL in vivo)
  - Draws fluid into blood from interstitial space
- Indicated for use as a volume expander post-paracentesis, hemodialysis, etc

Albumin case

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- Fall at home, presumed sepsis (leg cellulitis). Hypotension requiring ICU
- IN/OUT (+) 1.6 L; +3 pitting edema

- 100 mL 25% Albumin ordered for hypotensive 3rd spacing

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- IN/OUT (+) 1.6 L; +3 pitting edema
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Start: 2145

At 2245 (+1h): hypoxia (from 97% on room air to 86%)

75mL infused in total

RR from 17 pre to 24 (+7)

HR, BP unchanged (within baseline)

Afebrile

Restless

Albumin Case

Treatment:
Lasix 40 mg IV
Nasal prongs, 4 L/min

Start: 2145
At 2245: hypoxia (from 97% on room air to 86%)
RR from 17 pre to 24 (+7)
HR, BP unchanged (within baseline)
Afebrile
Restless

Diagnostics:

CXR: suspect CHF/pulmonary edema

No evidence of hemolysis

Post-cultures negative x 2

NTproBNP elevated

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wheeze
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Restless

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No evidence of hemolysis

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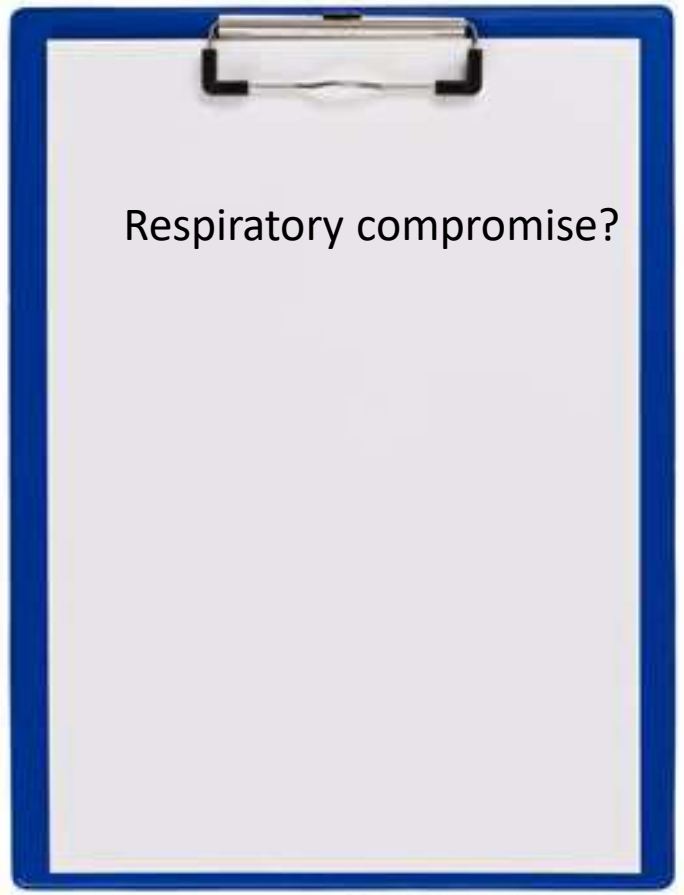

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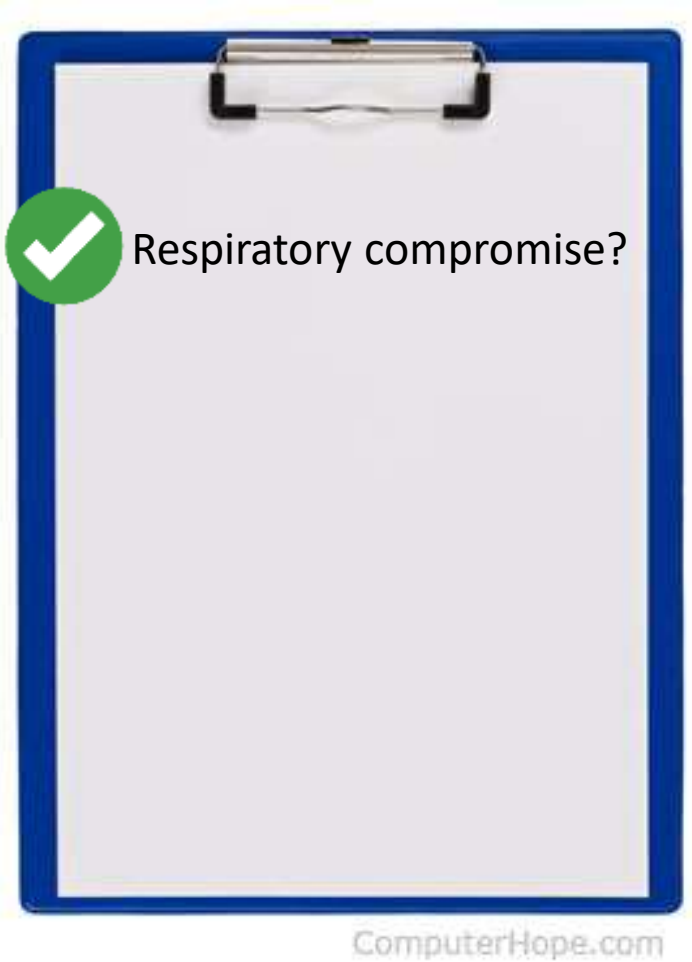

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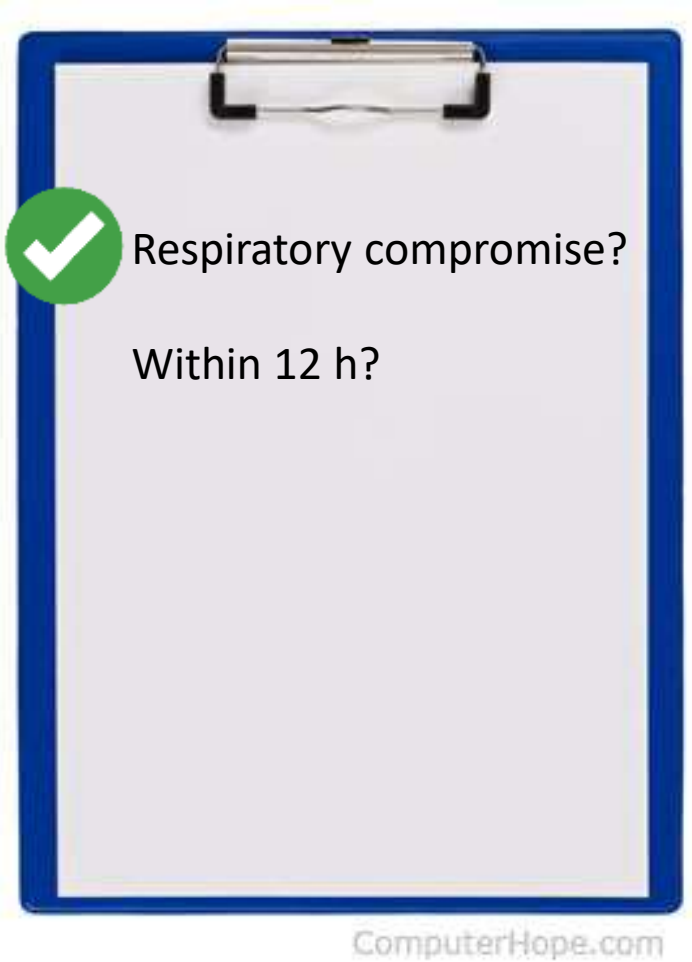

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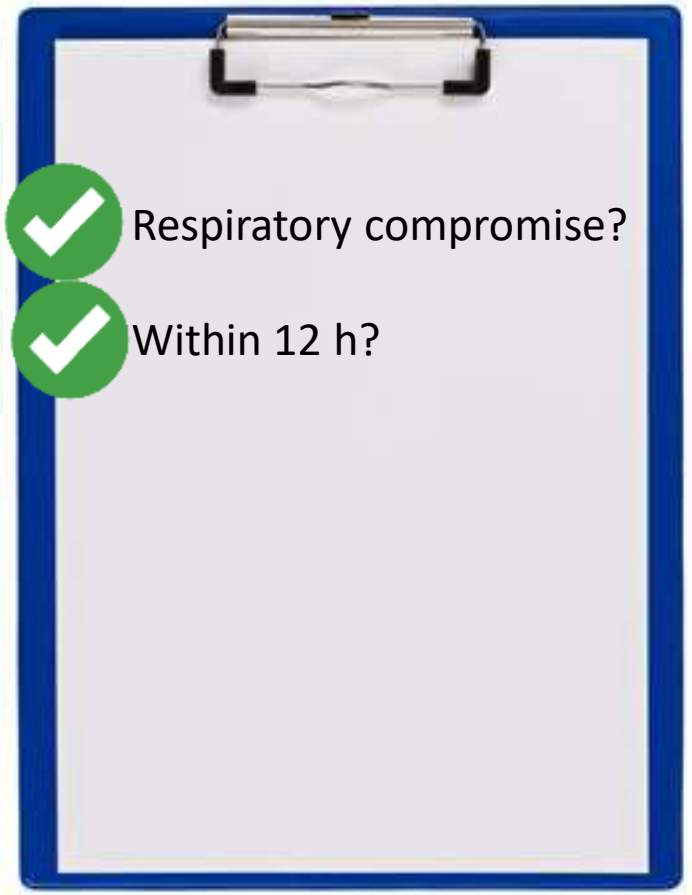

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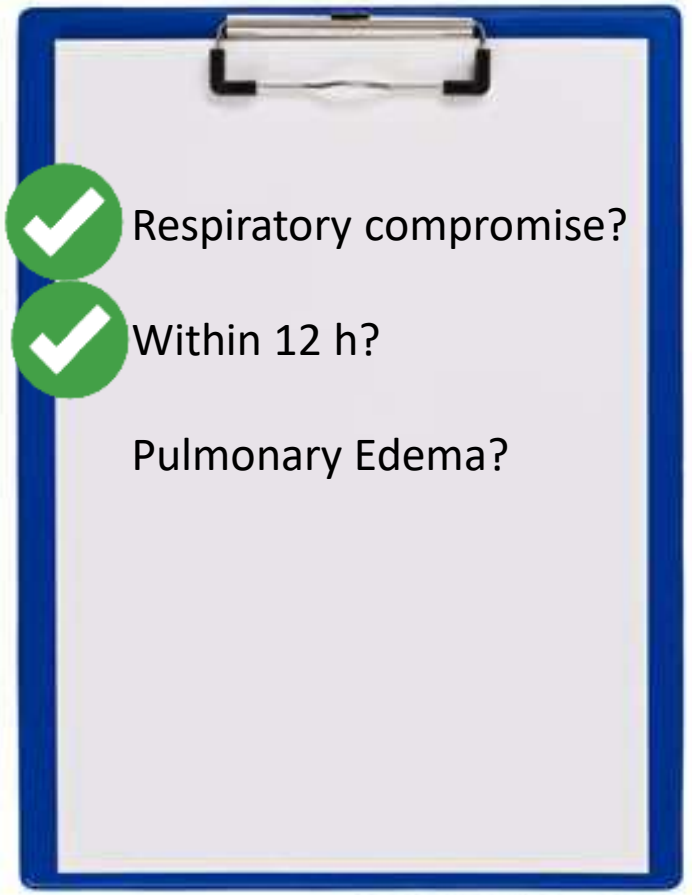

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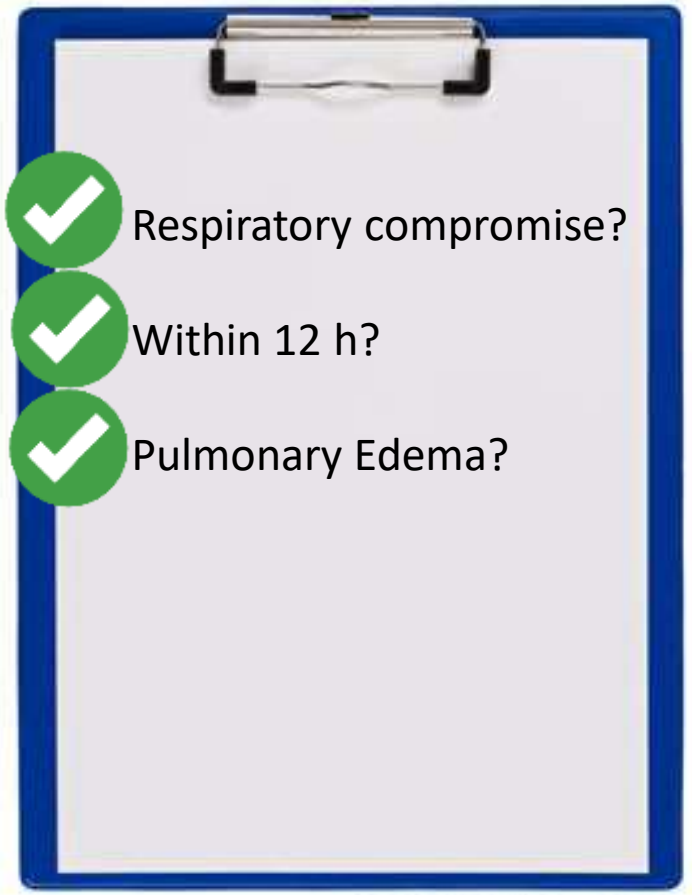

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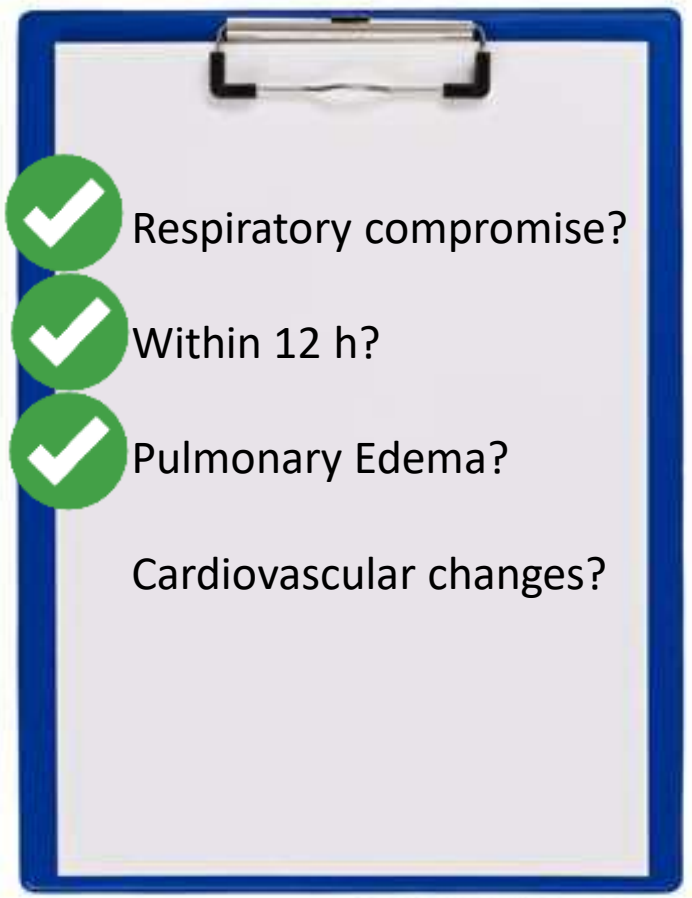

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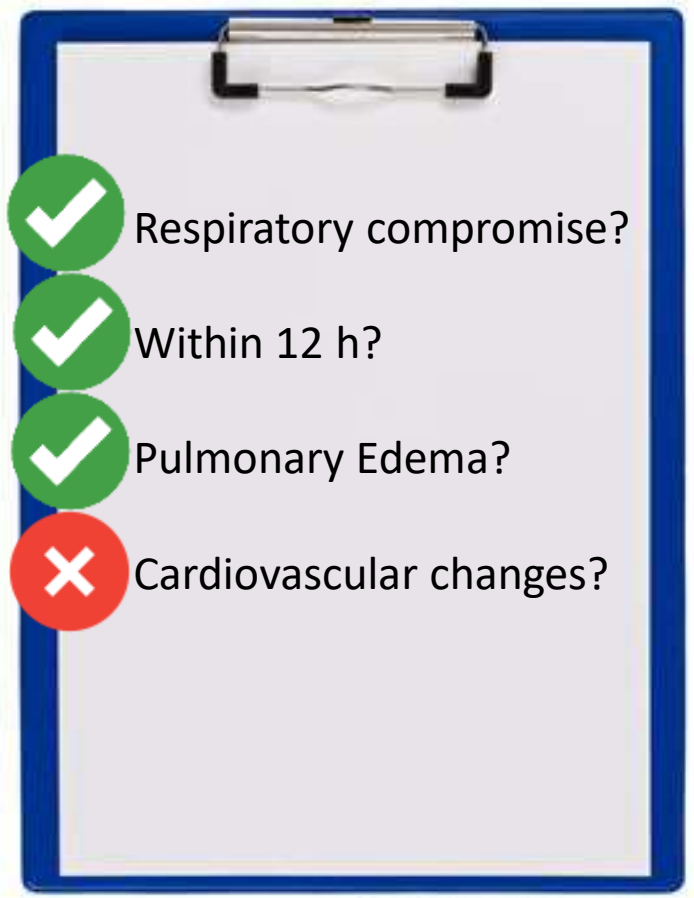

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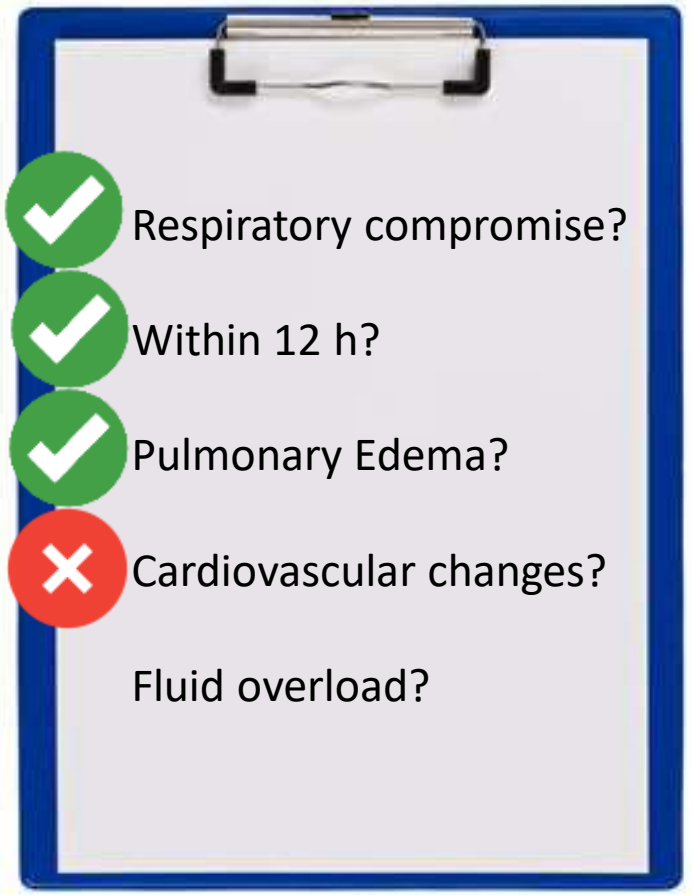

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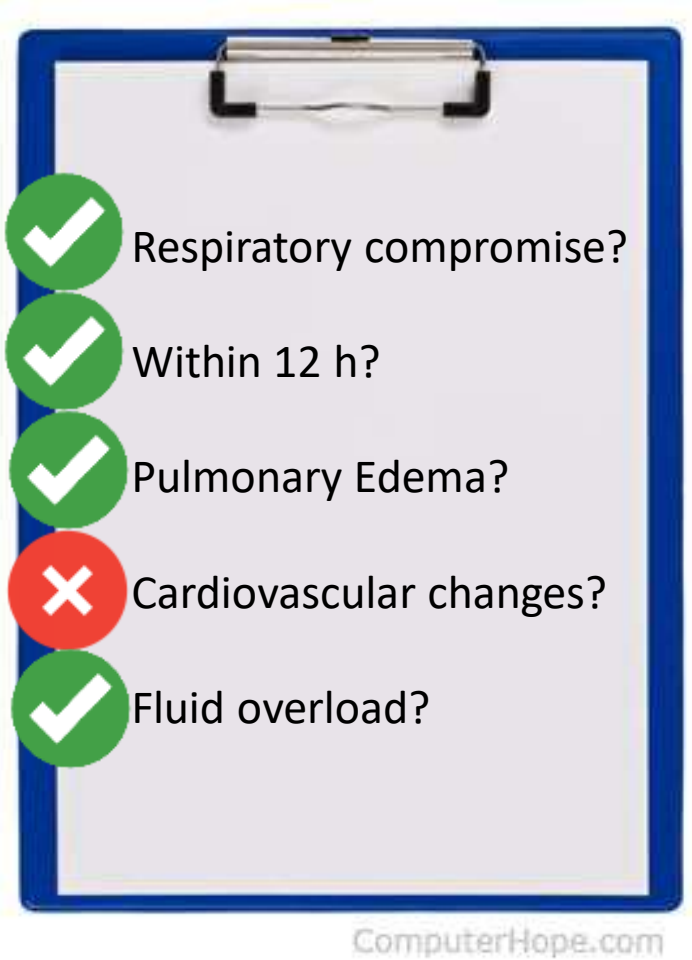

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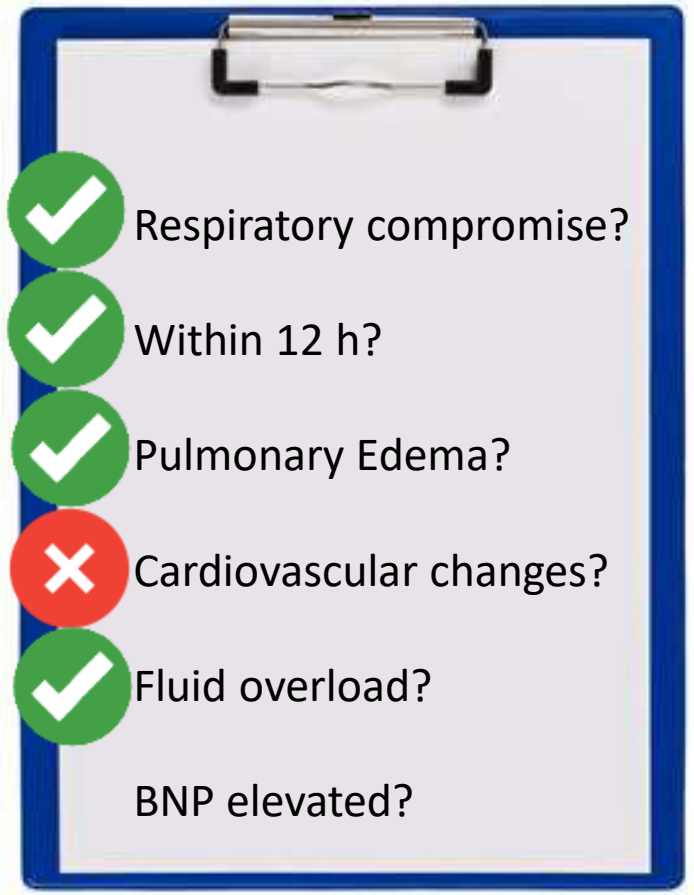

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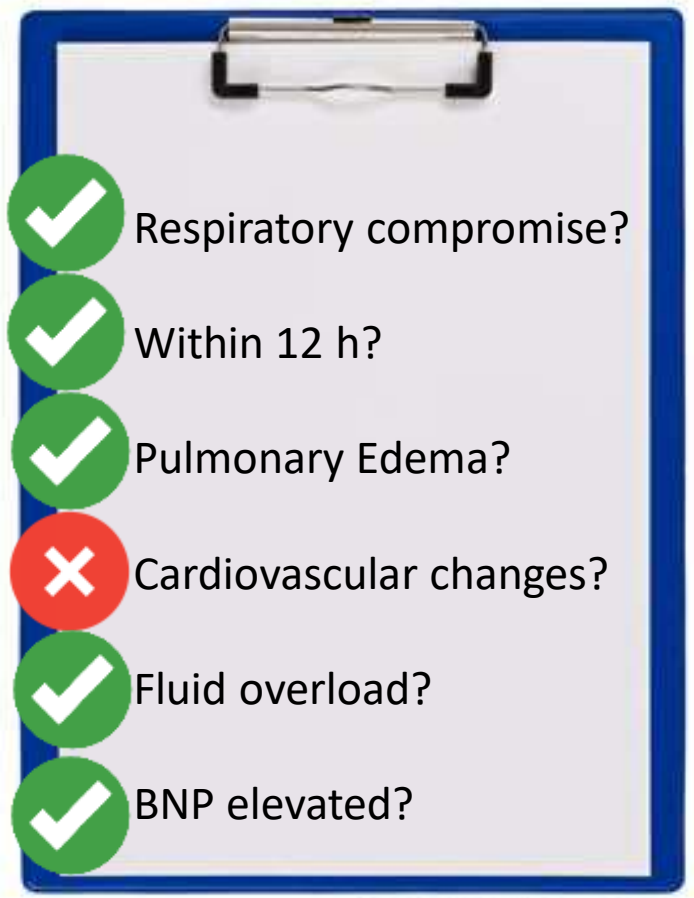

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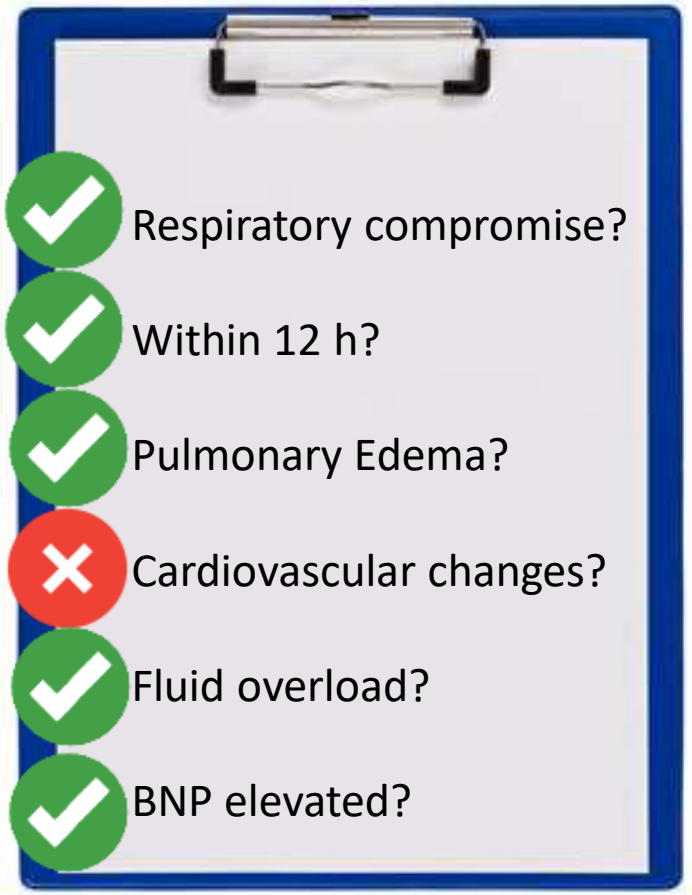
Albumin Case Summary

Treatment:
Lasix 40 mg IV
Nasal prongs, 4 L/min

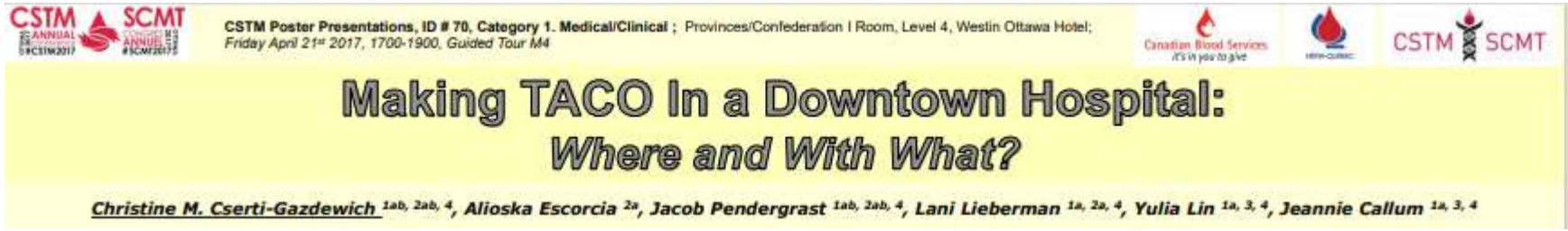
- AABB: minimum 3 indicators
- Lasix responsiveness is often a deciding factor
- WE CONCLUDE A LIKELY TRANSFUSION ASSOCIATED CIRCULATORY OVERLOAD (TACO), GIVEN THE VOLUME CLEARANCE IMPAIRMENTS / VOLUME-ASSOCIATED HYPOXIC DYSPNEA + WHEEZING WITH RADIOGRAPHIC CHANGES, AND THE OBSERVED MANAGEMENT APPROACH, THOUGH WE CANNOT RULE OUT EMERGENT FEATURES OF UNDERLYING RESPIRATORY PATHOLOGIES.



Risk Factors Albumin Case

- Cardiac dysfunction
- Renal dysfunction ✓
- Positive fluid balance ✓
- Previous TACO
- Older age (> 60) ✓
- *Weight*
- *Symptomatic anemia (non-bleeding)*

TACO in Albumin


CSTM SCMT

CSTM Poster Presentations, ID # 70, Category 1. Medical/Clinical ; Provinces/Confederation I Room, Level 4, Westin Ottawa Hotel;
Friday April 21st 2017, 1700-1900, Guided Tour M4

Canadian Blood Services

CSTM SCMT

Making TACO In a Downtown Hospital:
Where and With What?

Christine M. Cserti-Gazdewich [1ab, 2ab, 4], Alioska Escorcia [2a], Jacob Pendergrast [1ab, 2ab, 4], Lani Lieberman [1a, 2a, 4], Yulia Lin [1a, 3, 4], Jeannie Callum [1a, 3, 4]

- CSTM (Canadian Society of Transfusion Medicine) 2017 conference
- *"Some of our worst cases of TACO have happened with albumin.*
- *In this audit of 241 cases of TACO, we had 2 with only albumin bottle exposures (2 or more bottles) that led to the reaction.*
- *Since this poster, I've had several more cases."*

Prevention Measures

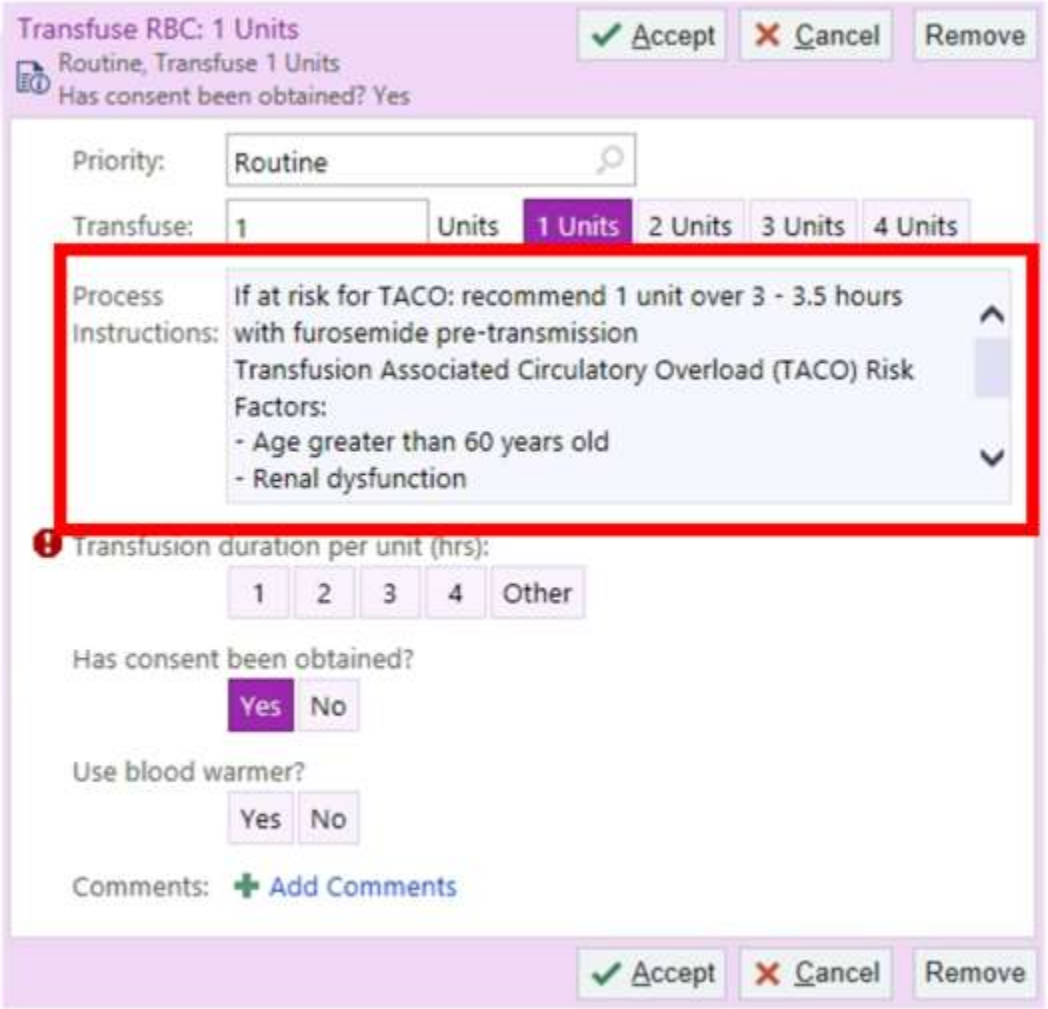
TACO: Accreditors Now Expect Lab-to-Bedside Prevention Efforts

WHO IS AT RISK?

- cardiac dysfunction
  - MI, CHF, diuretics, abnormal cardiac studies
  - tachypnea [RR>20], ambient air hypoxia [SpO2 <92%], JVP >3cm ASA, bilateral chest rales, extra heart sounds [S3, S4]
- renal dysfunction
- older age (>60-70 years)
- positive fluid balance
  - weights, ins/outs, physical signs

HOW TO CHANGE THE ORDER

- depress the trigger
- cancel
  - alternatives?
- reduce order size/volume
  - 1 instead of 2u RBC
  - PCC instead of FP
  - pdFI instead of cryoppt
- slow the infusion rate
- (advance) volume decanting
  - diuretics, more UF on dialysis



Risk Factors	Age > 60 (cardiac dysfunction)	Age > 60 Renal dysfunction Positive fluid balance
Volume Infused	50 mL	75 mL * volume expansion to 225 – 300 mL
Indicators	6/6	5/6

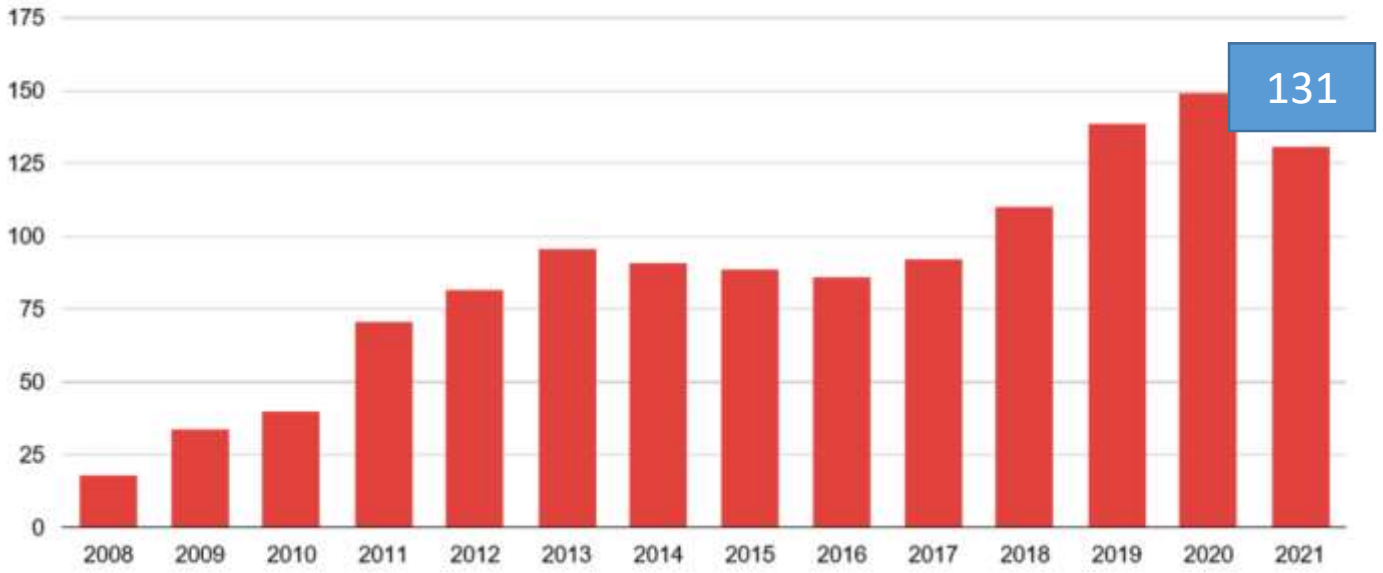
Data Quality determined by thoughtful reporting

Incidence (Bloody Easy 4, 2020)

Risk of Event	Event
1 in 13	Red cell sensitization, increasing risk of hemolytic transfusion reaction and hemolytic disease of fetus and newborn
1 in 20	Febrile non-hemolytic transfusion reaction (FNHTR) per pool of platelets
1 in 100	Transfusion-associated circulatory overload (TACO)
1 in 100	Minor allergic reaction
1 in 300	Febrile non-hemolytic transfusion reaction per unit of RBC
1 in 7,000	Delayed hemolytic transfusion reaction
1 in 10,000	Transfusion-related acute lung injury (TRALI)
< 1 in 1,000,000	Transmission of West Nile Virus
1 in 4,000,000	Transmission of Chagas disease per unit of component
1 in 7,500,000	Transmission of Hepatitis B virus per unit of component
1 in 7,600,000	Transm
1 in 13,000,000	Transm ent
1 in 21,000,000	Transm

Are we more vigilant in some populations than others?

TACO as per SHOT UK (Serious Hazards of Transfusion)



Transfusion reaction	Risk of transfusion reaction based on SHOT data 2012-2021
Febrile, allergic or hypotensive reactions	1 in 8,138
Transfusion-associated circulatory overload	1 in 23,175

(denominator is based on number of products issued)

LH 2021 (4500 component transfusions): 3 TACO in 49 reactions (1 in 15 reactions, 1 in 1500 transfusions)

TACO Summary

Transfusion Associated Circulatory Overload (TACO): pulmonary edema, caused by fluid overload

- Risk factors
- Identification criteria
- Crossover between different types?
- Volume infused?
- Product type?

Transfusion Related Acute Lung Injury (TRALI): pulmonary edema, caused by immune-mediated response to factors within the transfused product

Transfusion Associated Dyspnea (TAD): a rule-out, catch-all for “other” respiratory reactions

Question 1: Post-Knowledge

Which transfused volume is most likely to cause a TACO reaction?

a. 300 mL (1 unit RBC)

b. More than 300 mL (more than 1 unit RBC)

c. 50 mL (less than 1/3 of a unit RBC)

d. Any volume can cause a TACO reaction

Question 2: Post-Knowledge

What type of blood product can cause TACO?

a. RBC only
b. RBC, plasma, or platelets (only blood components)
c. IVIg, Albumin or Fibrinogen Concentrate (only plasma derivatives)
d. Any blood product can cause a TACO

Question 3: Post-Knowledge

What causes a TACO reaction?

a. patient-specific factors (e.g. underlying disease)
b. The volume of the transfusion (more products means more likely to have a TACO)
c. Product specific factors (e.g. mediators found within the blood product)
d. A combination of all of these


thank you
@nyledimarco