DAY 2> COMPLICATIONS:
COMPATIBILITY, ACUTE & LONG TERM TRANSFUSION RISKS, & ERRORS -

Acute (Non-Infectious) Reactions

Friday November 19th 2021, 10:15 – 11:00

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@margitangyal

Disclosure

- **Relevant relationships with commercial entities:**
  - None

- **Potential for conflicts within this presentation:**
  - Funding from Canadian Blood Services in transfusion reaction research

- **Steps taken to review and mitigate potential bias:**
  - Peer-reviewed content
  - Non-proprietary titles
  - Declaration of use-context (EBM vs off-label)

- **Blood transfusion is the most commonly performed hospital procedure, occurring in >10% of hospital stays.**

H·CUP Agency for Healthcare Research and Quality HEALTHCARE COST AND UTILIZATION PROJECT

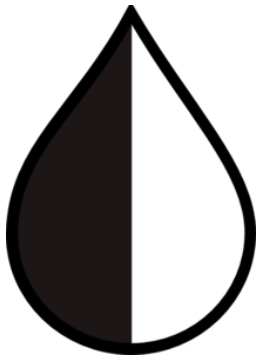
Roubinian et al. BMC Health Serv Res. **2014**; 14:213

https://healthtalk.unchealthcare.org/transfusion/

Reaction rates: 1-10% per encounter

Kaufman et al. Transfusion. **2015**; 55: 144-53.

Hendrickson et al. Transfusion **2016**; 56:2587-2596.



~Half of transfusions may be unnecessary

Jenkins et al. Jt Comm J Qual Patient Saf **2017**; 43: 389-95

"… safety will never be an absolute;

it is only as good

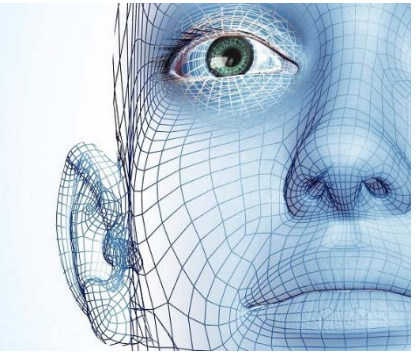
as the human beings on the frontline

and the guidance

under which the system is regulated"

Dubin & Francis. Transfusion. **2013**; 53(10 Pt 2): 2359-2364.

Objectives – Hemovigilance **Philosophies**



- ***Recognition matters:*** I will consider transfusion reactions on my differential diagnosis if relevant disturbances occur after product exposure

- ***Reporting matters:*** I will report these suspicions to my blood bank, as I appreciate the impact that feedback has on informing risks, and identifying (& neutralizing) dangers

- ***Collaboration matters:*** As a witness, I will share my observations & impressions

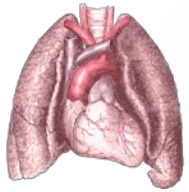
Objectives – *Entities to Know*

- Describe presentation, frequency, and management of the **3 most commonly encountered but minor** adverse transfusion events

- State the **3 most important causes of transfusion-related mortality and severe morbidity, ie- potentially life-threatening acute transfusion reactions** and how we mitigate the risks for these events

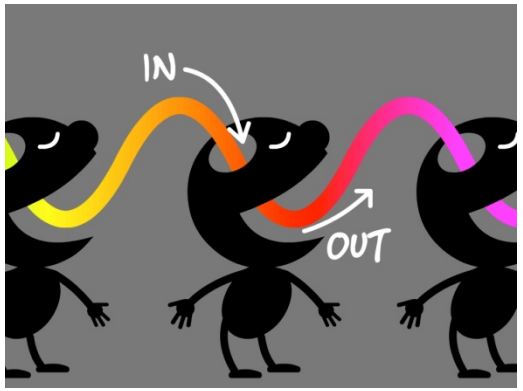
febriles

*deep-stuff: cardiorespiratory (**dyspnea**, shock)*



surface-stuff: skin (rash)

How Can We Inform Patients of the Risks of Transfusion?



- By the extent to which we participate in **HEMOVIGILANCE**

- WHAT should be reported? :
  - **all** transfusion **reactions [adverse events]** and transfusion-related **errors [incidents]**

- TO WHOM are these reports meant to be directed?:
  - the Hospital Transfusion Service ("blood bank")
    - for internal committees
    - for external stakeholders

http://www.transfusionmedicine.ca/sites/transfusionmedicine/files/PDF/GuideToReportingAdverseTransfusionEvents

Reporting Rules: External Stakeholders

TRACKERS – Public Health Agency of Canada (PHAC) via Transfusion Transmitted Injuries Surveillance System (TTISS)

MAKERS – Canadian Blood Services (CBS) or Derivative Manufacturers

REGULATORS – Canada Vigilance Program

ISTARE - International Surveillance of Transfusion-Associated Reactions and Events

25 countries

2006 – 2012

133 million components

AFFSSaPS - France
Biovigilance Network - US
SHOT - UK
TTISS - Canada
TRIP- Netherlands

Politis et al. Vox Sang. **2016**; 111(4):409-417.

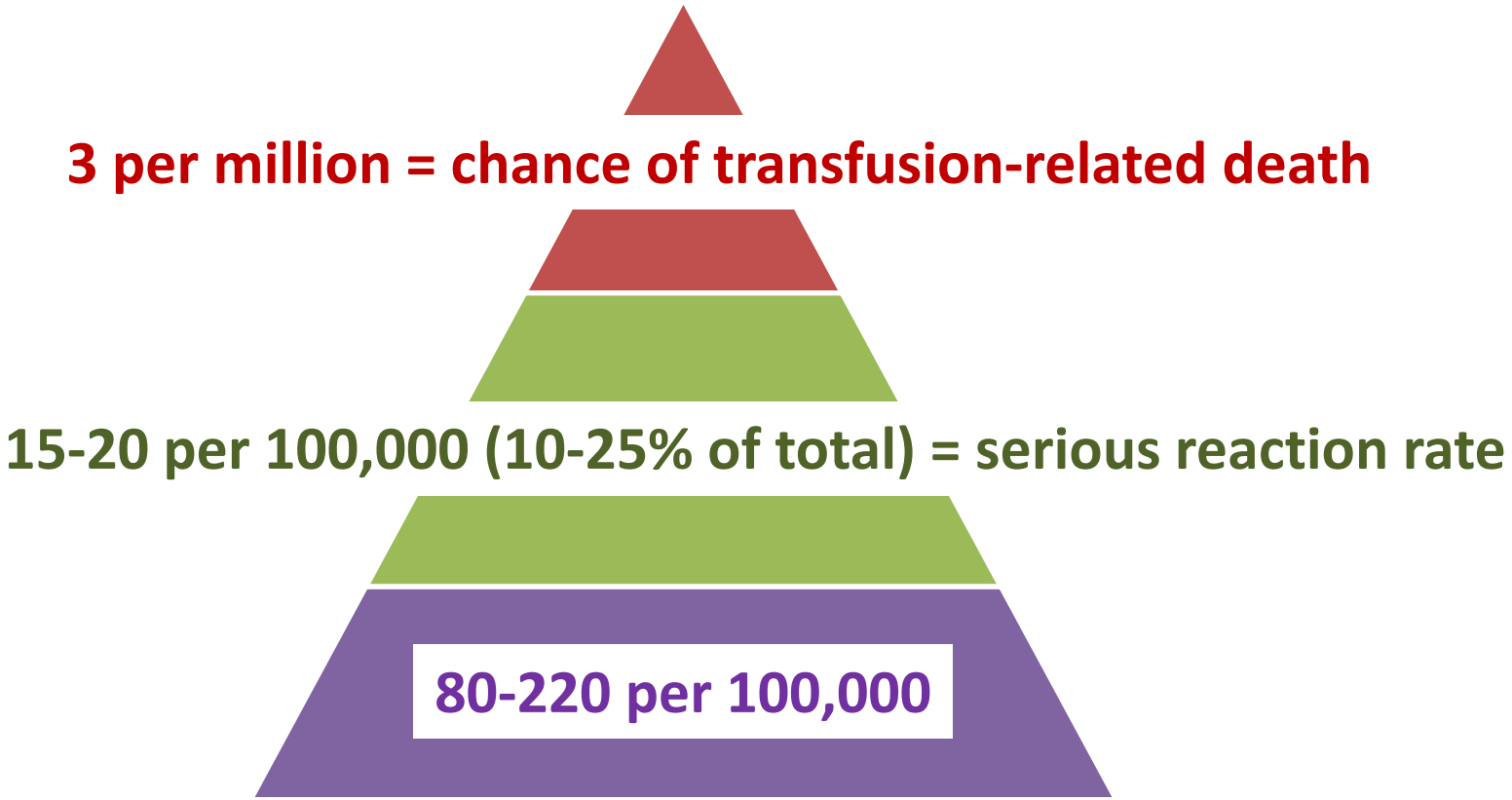
NHSN - National Healthcare Safety Network Hemovigilance Module of the CDC USA

2013 – 2015

8 million components

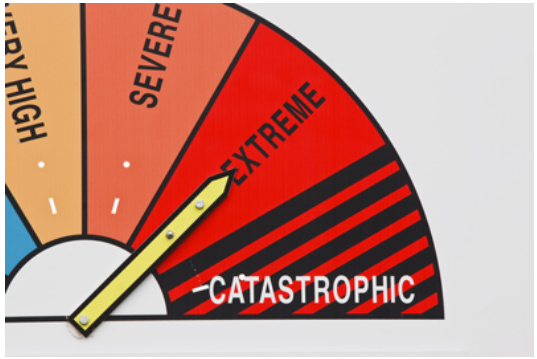
Kracalik et al. Transfusion **2021**; 61: 1424-34.

"Frequencies"



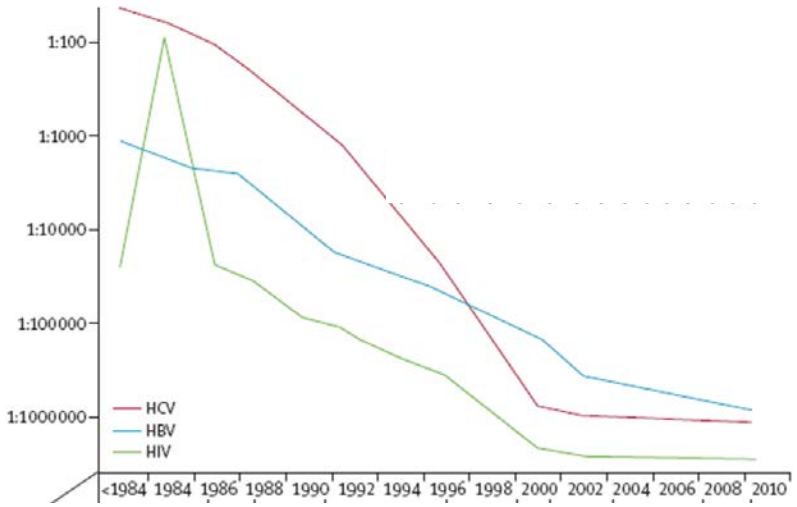
Qualifying the Event: Provisional Adjectives

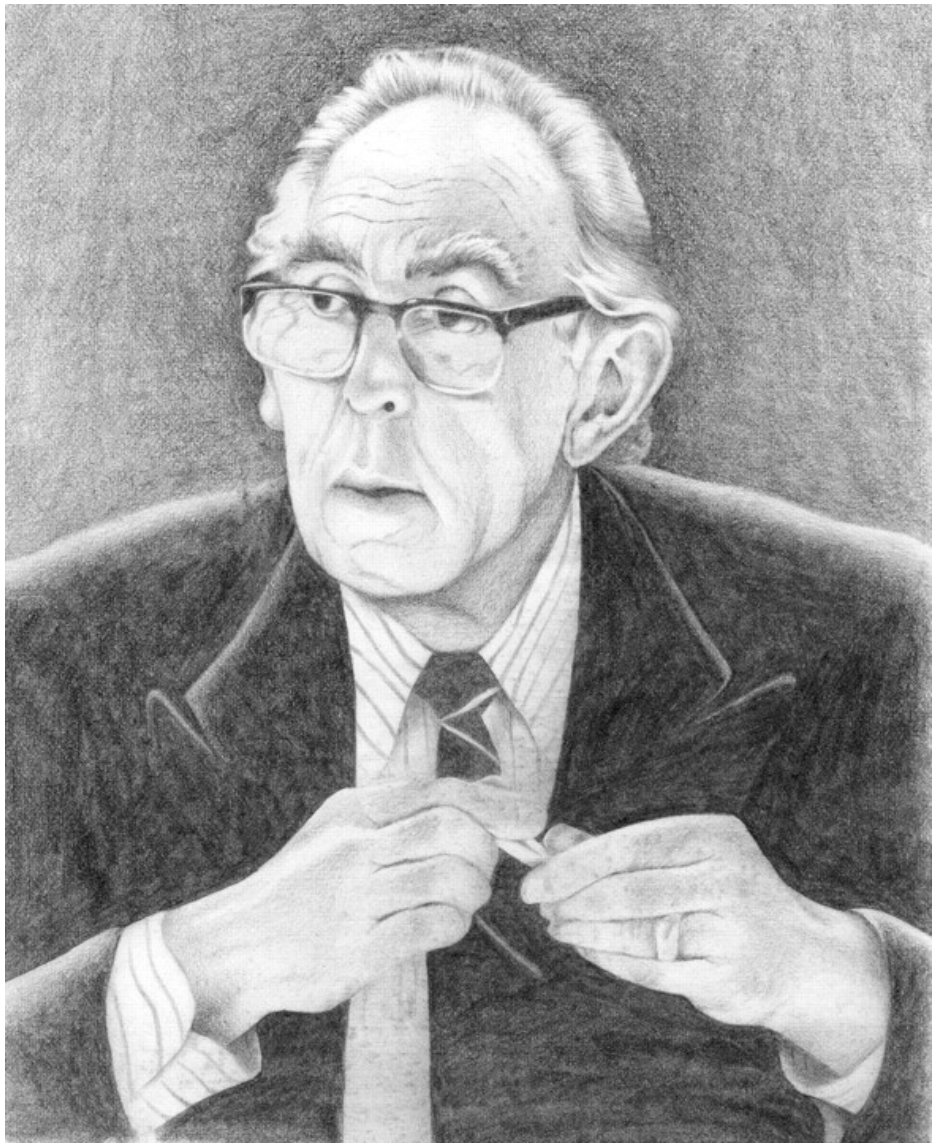
- SEVERITY
  - Grade 1 (non-severe)
    - Mild
    - Moderate
  - Grade 2 (severe)
  - Grade 3 (life-threatening)
  - Grade 4 (death)



- IMPUTABILITY
  - Definite (certain)
  - Probable (likely)
  - Possible
  - Unlikely (doubtful)
  - Excluded

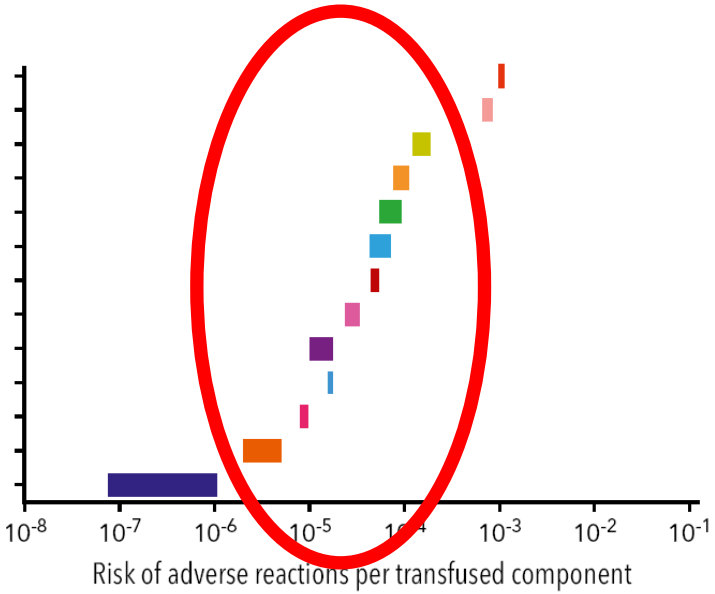
Aggregate Transfusion Transmitted Viral Infection (TTVI) hazards:
< $1/10^5$





Justice Horace Krever

Aggregate non-TTVI hazards:
>$1/10^5$

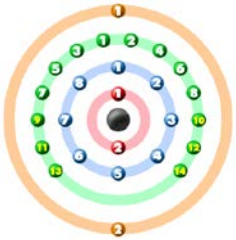


Andrzejewski Jr et al. Int J Clin Transfus Med. **2014**; 2: 45-57.

Goel et al. Blood **2019**; 133: 1831-9

Minimum Disclosure Framework

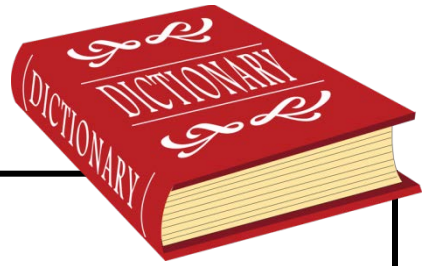
in Layman's Terms & Logscale Frequencies



logscale 1 2 3 4 5 6

Common, minor events (1 / 10^1-10^2)	non-serious **fever** non-serious **hives** make **antibodies** to donor antigens (RBC, HLA)
Serious, potentially fatal events (1 / 10^3-10^5)	**breathing trouble**: –volume-driven fluid excess –immune injury-driven fluid leaks –anaphylaxis / severe bronchospasm **bacterial contamination** of unit **botched process** (wrong sample or bag)
Extremely rare events (1 / 10^6 or less)	viral contamination of unit (**hepatitis, HIV**) **new** or **rare** (not tested-for) **bugs** fatal immune "take-over" by product

Your Acronymic Glossary (What to Learn)



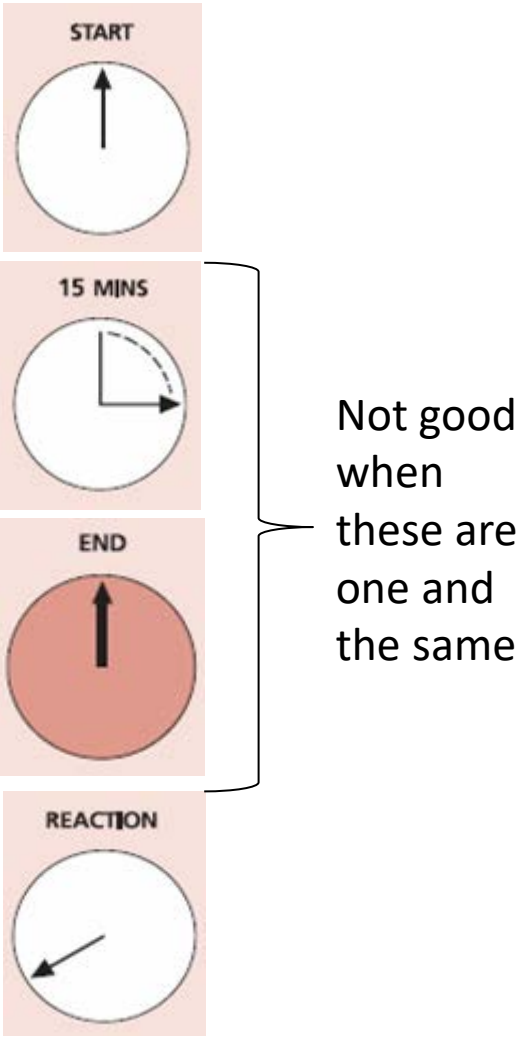
FNHTR	-non-serious fever
ATR	-non-serious hives
STR	-trigger new antibodies to red cells
TAD	-breathing trouble:
TACO	–volume-driven fluid excess
TRALI	–immune injury-driven fluid leaks
Anaphylaxis	–anaphylaxis / severe bronchospasm
TAS (“BaCon”)	-bacterial contamination of unit
AHTR / IBCT / WBIT	-botched process (wrong sample or bag)
TTVI	-viral contamination of unit
Emerging infections	-new, unexpected bugs
TA-GVHD, PTP	-fatal immune “take-over” by product

Secret Decoder Slide

FNHTR	febrile non-hemolytic transfusion reaction
ATR	allergic transfusion reaction
STR	sensitization (serologic transfusion reaction)
TAD	transfusion-associated dyspnea
TACO	transfusion-associated circulatory overload
TRALI	transfusion related acute lung injury
Anaphylaxis	anaphylaxis (allergic bronchospasm)
TAS (“BaCon”)	transfusion-associated sepsis/bacterial contamination
AHTR / IBCT / WBIT	acute hemolytic transfusion reaction/incorrect blood component transfused/wrong blood in tube
TTVI	transfusion transmitted viral infection
Emerging infection	new, unexpected bugs
TA-GVHD, PTP	transfusion-associated graft-vs-host disease, post-transfusion purpura

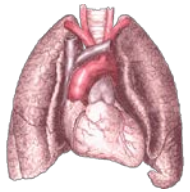
Our First Defense: Vital Signs: HR, BP, T, RR, SpO2

- time 0: vital signs
- 1st 15 minutes: SLOW infusion (50cc/h)
- **at 15 minutes:** vital signs re-check
- end: must be within 4 h; re-check vital signs
- reaction: vital signs



deadliest outcomes show up fast… & dose-dependent

Febrile



Cardiorespiratory

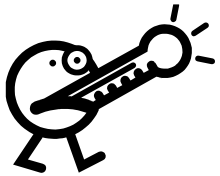
Allergic

Adapted from Ontario's Transfusion Transmitted Injuries Surveillance System (TTISS) Transfusion Reaction Chart

https://ttiss.mcmaster.ca/wp-content/uploads/2017/08/Transfusion-Reaction-Chart-V_2.2-Pocket-and-Poster.pdf

When Is It A Fever (Pyrexia) ?

- T > 38ºC AND ↑ by Δ1ºC



OR

- the cytokine-provoked equivalent of chills or rigors

Shih et al. Transfusion **2019**; 59: 2292-300.

Fever's Differential Diagnosis

danger gradient

HIGH RISK FEVER

LOW RISK FEVER

acute hemolytic transfusion reaction (AHTR)

bacterial contamination (BaCon)/
transfusion-associated sepsis (TAS)

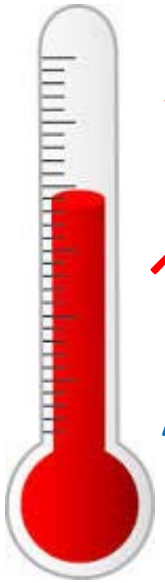
fever due to underlying disease

febrile non-hemolytic transfusion reaction (FNHTR)

frequency gradient

Cohen R et al. Transfusion. **2017**; 57(7):1674-1683.

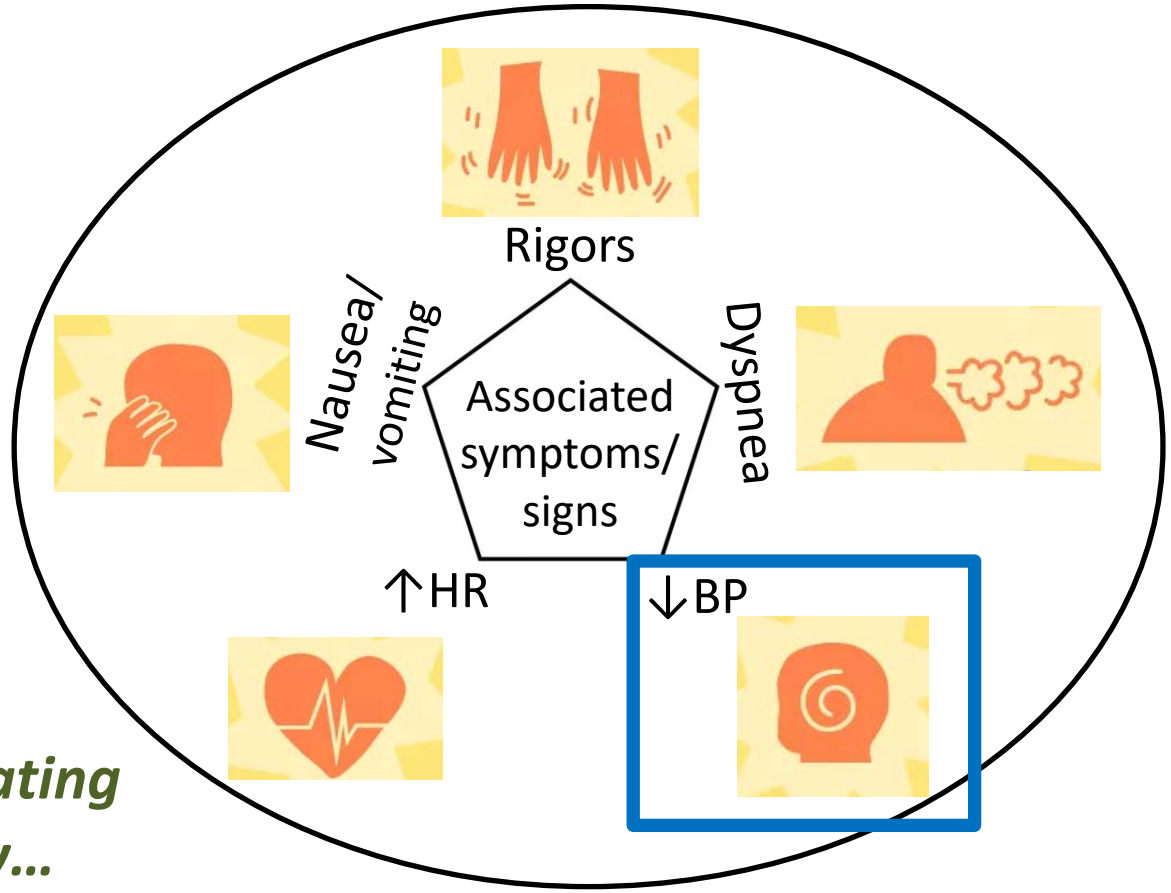
The “High Risk” Fever:
?BacOn ?Bad Match



↑Δ1°C to ≥39°C

↑Δ1°C to ≥38°C + any…

Antipyretic + any…



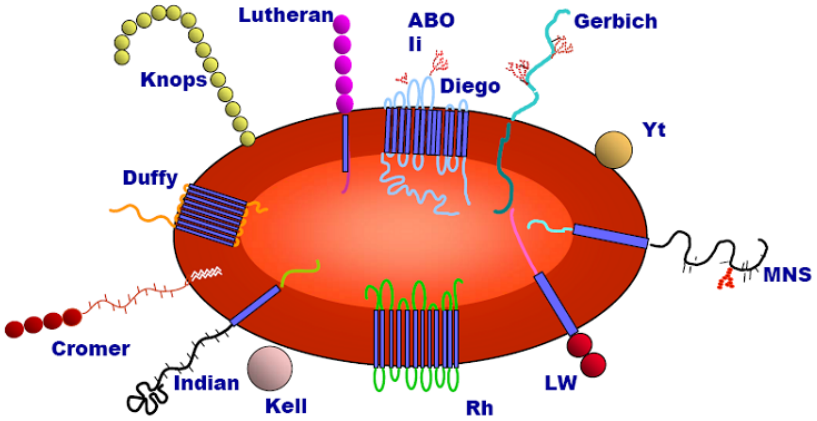
Early interim volume associating with ↑Δ1°C to ≥38°C, or any…

Shih et al. Transfusion **2019**; 59: 2292-300.

As of 2020:

39 blood group antigen **systems**

(ABO, Rh, …) containing structures that are naturally “polymorphic”



- © Jill Storry

ERYTHROGENE

43 RBC blood group related genes

210412 RBC blood group genetic alleles

1241 RBC blood group coding region variants

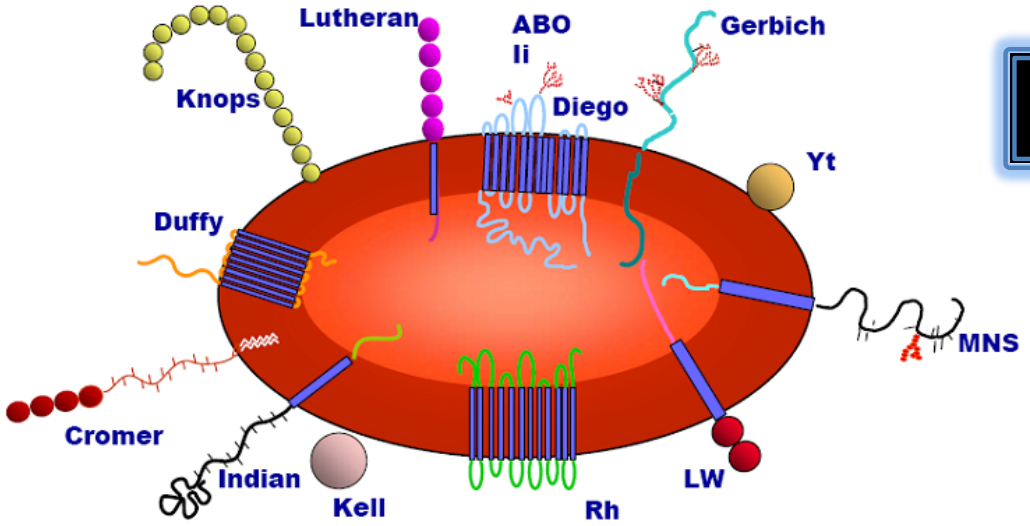
365 RBC antigens (known to provoke antibodies)

- Storry et al. Vox Sang **2019**; 114: 95-102. http://www.isbtweb.org/working-parties/red-cell-immunogenetics-and-blood-group-terminology/
- Möller et al. Blood Advances, **2016**; 1(3):240-249. http://www.erythrogene.com/

As of 2021: 43

blood group antigen **systems**

(ABO, Rh, …) containing structures that are naturally “polymorphic”



- © Jill Storry

47 RBC blood group related genes

210412 RBC blood group genetic alleles

1241 RBC blood group coding region variants

381 RBC antigens (known to provoke antibodies)

http://www.isbtweb.org/working-parties/red-cell-immunogenetics-and-blood-group-terminology/

Möller et al. Blood Advances, **2016**; 1(3):240-249.

ERYTHROGENE

Acute Hemolytic Transfusion Reaction (AHTR)

- **immune**
  - active/major (recipient antibodies)
  - passive/minor (donor antibodies)

- **non-immune**
  - devices damaging RBCs: heat or pressure infusers
  - biochemical:
    - potentiators of pre-existing hemolytic condition
      - C3/C4: PNH, CAS
    - donor RBC hemolysis
      - G6PD deficiency

IBCT –

Incorrect Blood Component Transfused

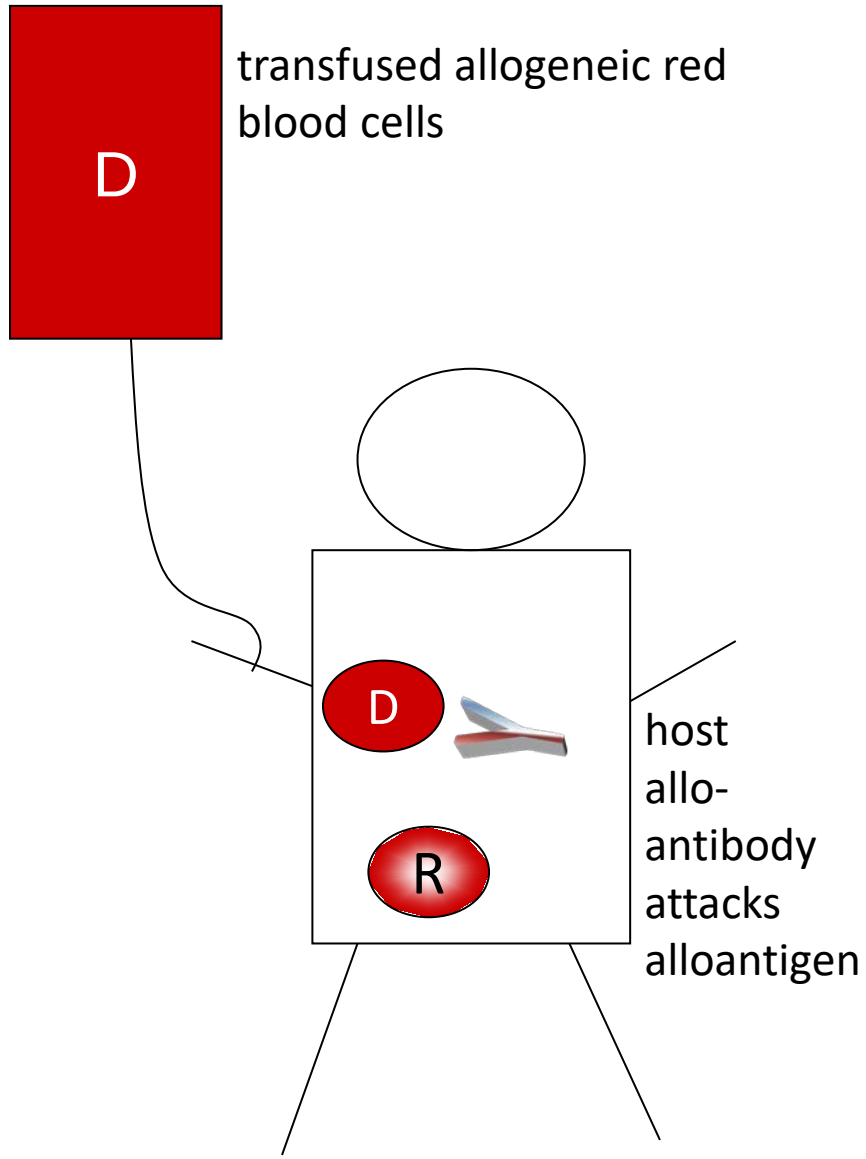
Acute (or Delayed) Hemolytic Transfusion Reaction

- **active** AHTR =

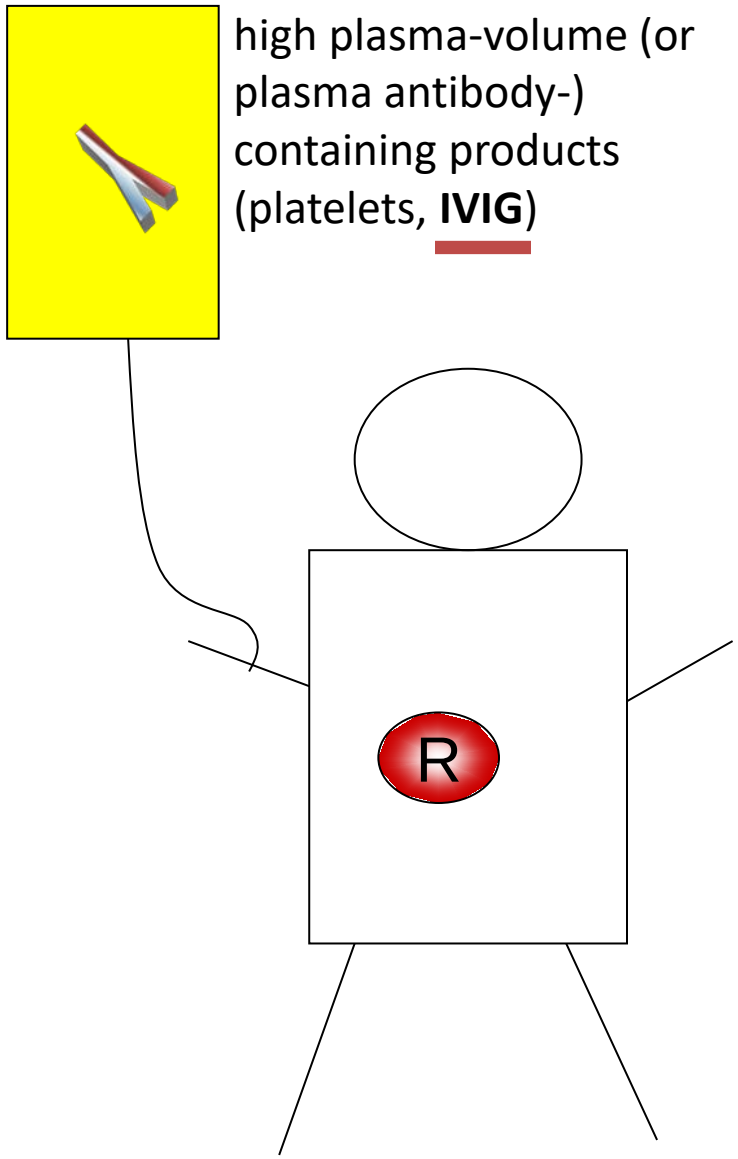
MAJOR INCOMPATIBILITY

  - recipient makes antibodies that destroy foreign RBC

eg. RBC incompatible for (ABO or non-ABO-blood) antigens



Acute (or Delayed) Hemolytic Transfusion Reaction



high plasma-volume (or plasma antibody-) containing products (platelets, **IVIG**)

- **passive** AHTR =

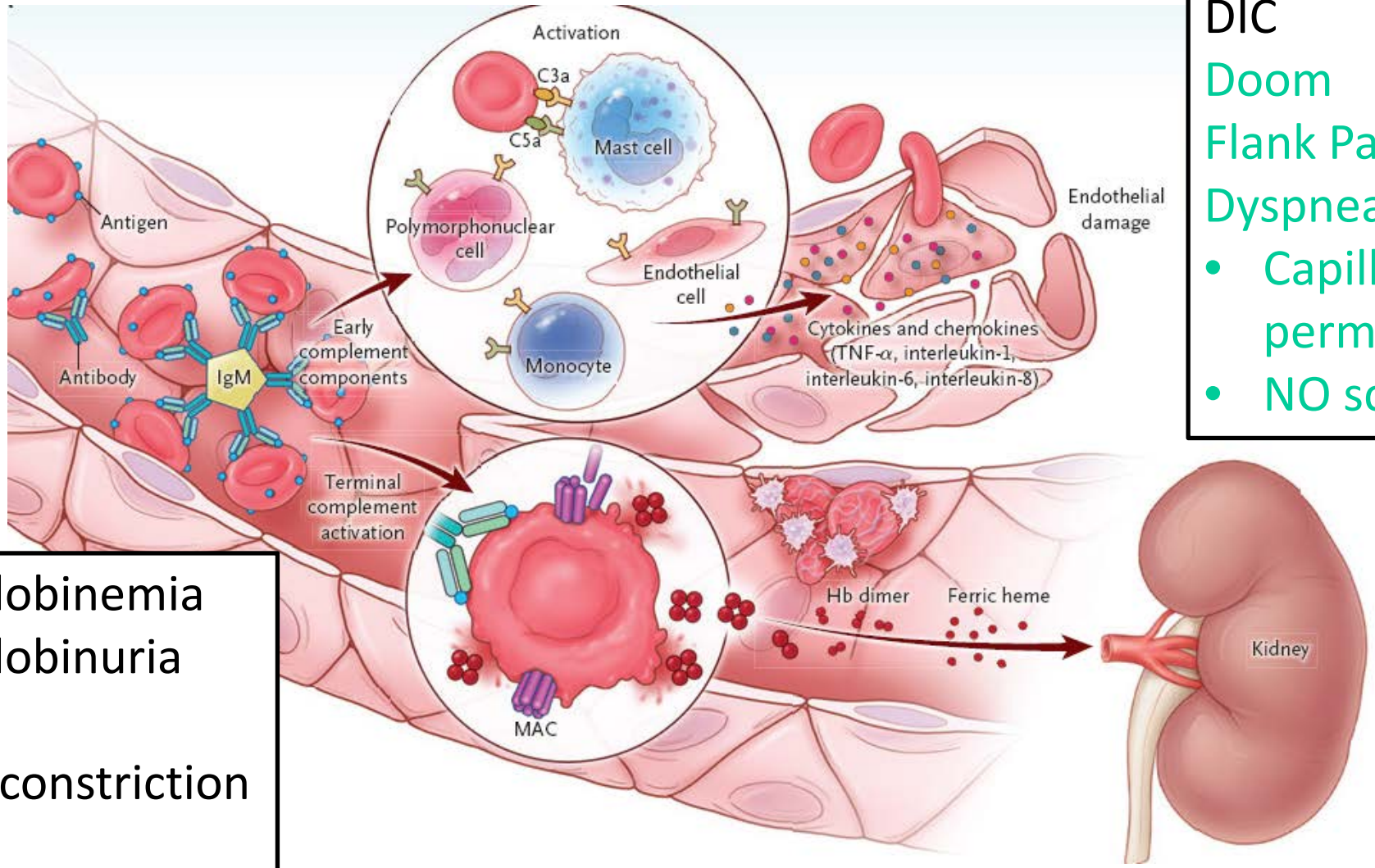
MINOR INCOMPATIBILITY

  - product contains antibodies that destroy host RBC

eg. ABO antibodies ("isohemagglutinins") targeting recipient

(A)HTR

Shock
Fever
DIC
Doom
Flank Pain
Dyspnea
- Capillary permeability
- NO scavenging

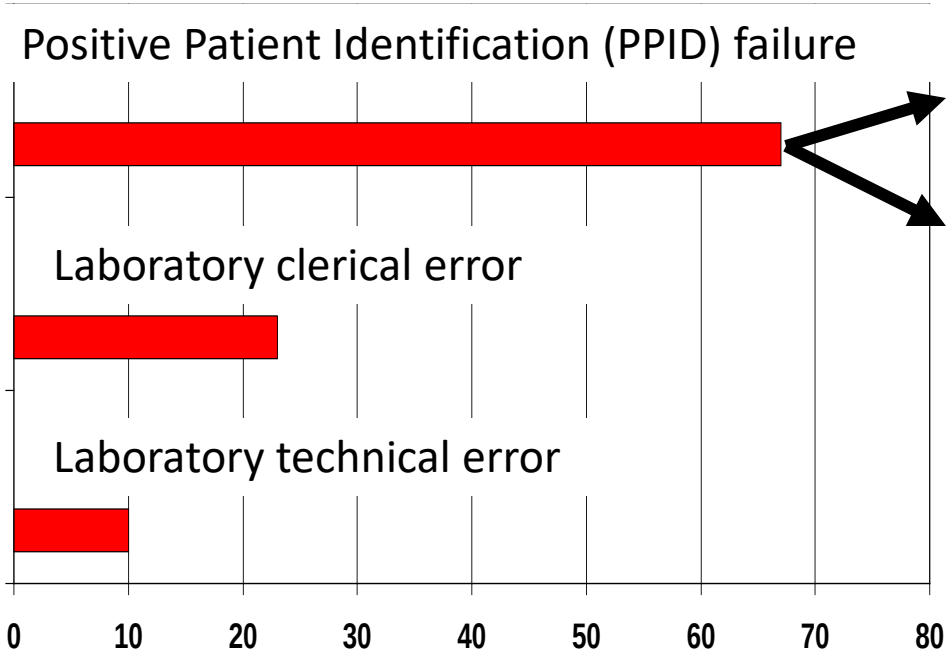


Hemoglobinemia
Hemoglobinuria
AKI:
- Vasoconstriction
- ATN

Panch et al. N Engl J Med **2019**; 381: 150-62
Janatpour et al. Am J Clin Pathol **2008**; 129: 276-81.

Why/How Does The Mistake of Hanging ABO-Incompatible Blood Happen?

1 in 14,000 chance for incorrect blood component transfused (IBCT)



% of Major ABO Incompatible Transfusion Errors

1 in 3000 samples labelled with another patient's name!
(Wrong Blood In Tube [WBIT])

1. Errors in specimen collection (15%)

2. Errors in blood administration (majority)

hanging in haste without Positive Patient Identification (PPId)

Linden et al. Transfusion **1992**; 32: 601-6.

Human Errors Perspective – Sample Rules *and Calls for Higher Technology*

- risk of ABO-incompatible transfusion: 1/40,000 >

  aggregate risk of all TTVI (1/50,000)

- if sample labeled incorrectly: 1:28 chance of WBIT

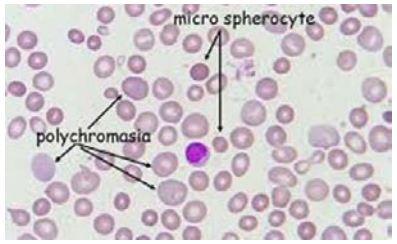
- machine-readable systems ↑ safety by >5-fold beyond manual/human processes

Forest et al. Am J Clin Pathol **2017**; 147: 105-9
Kaufman et al. Transfusion **2019**; 59: 972-80.

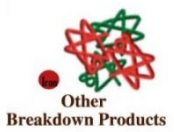
How Do You Prove It?

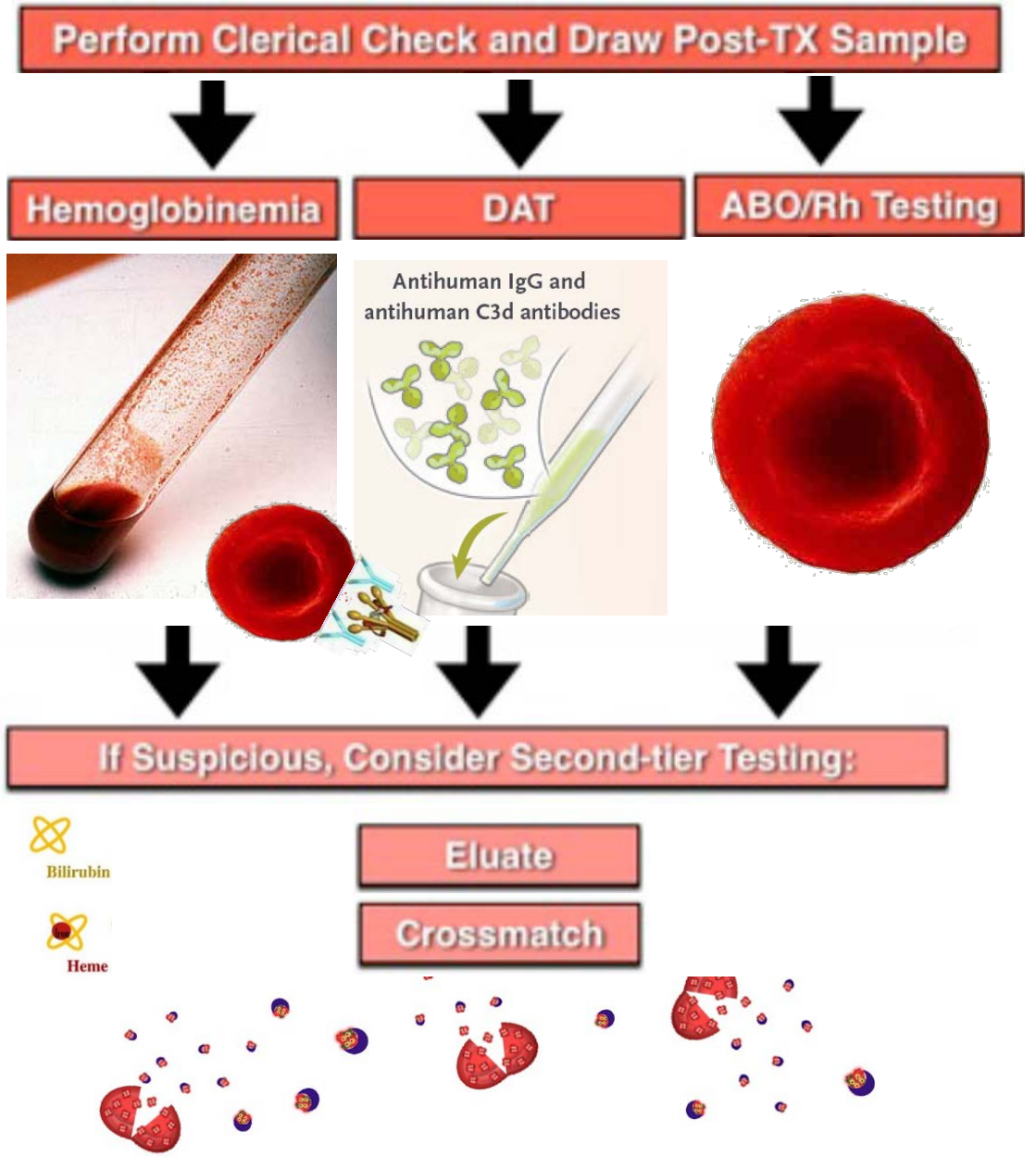
look at labels

look for ‘lysis



- ↑ reticulocytes (± spherocytes)
- ↑ LDH (& AST > ALT)
- ↑ bilirubin (unconjugated-predominant)
- ↓ haptoglobin
- hemoglobinuria/hemosiderinuria, ATN
- DIC
- C3/C4, ferritin

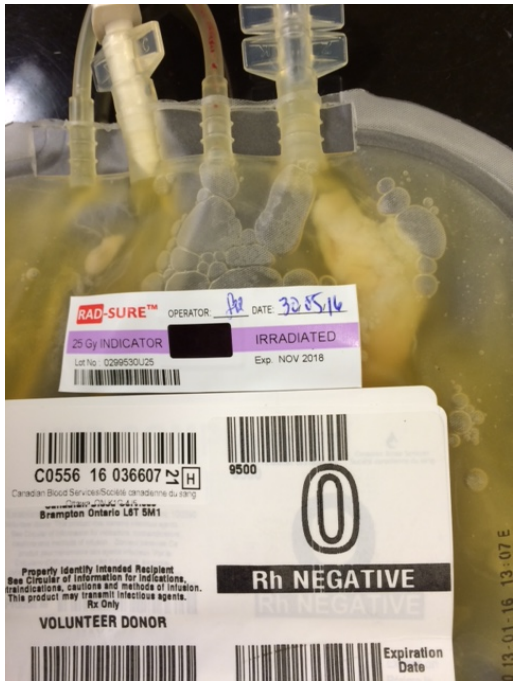




Canadian Blood Services Customer Letter **2011**; #2011-34: 1-5
Elliott et al. Transfusion **2003**; 43: 297.

Bacterial Contamination (BaCon) / Transfusion-Associated Sepsis (TAS)

irradiation is not a decontamination measure



The most BaCon-ific product of all… 1 / 1000?

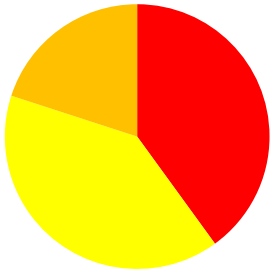
Walker et al.: Transfusion **2020**; 60: 2029-37.

Culture / Investigation Pathway

PRE	POST		CONCLUSIONS
	PATIENT	PRODUCT	
			Pre-existing sepsis
			Definite BaCon
			Probable BaCon
			Possible BaCon
			Doubtful BaCon

Review of Donation/Donor Information

Lookback data



RBC

Plasma

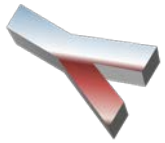
Plt

Co-component quarantine

Febrile Non-Hemolytic Transfusion Reaction (FNHTR): Diagnosis of Exclusion

- common: **1/20** platelet transfusions, **1/300** RBC transfusions

- **<u>recipient</u> has anti-leukocyte antibodies** (because of previous exposure to blood)
  - WBC in product complexed on transfusion



- **product has "pyrogens"**
  - cytokines / inflammatory mediators accumulate,

    inducing fever on transfusion

Blood Product Given → Respiratory Distress

Most "important" of all transfusion hazards

High case morbidity & mortality rates, at high frequency

Accounting for 60% of transfusion-related deaths

deep-stuff:
cardiorespiratory (dyspnea)

Dyspnea

cardiogenic

transfusion-associated circulatory overload (TACO)

non-cardiogenic

transfusion-related acute lung injury (TRALI)

allergic reaction (bronchospasm)

bacterial contamination or incompatibility reaction (off-target)

underlying disease process

transfusion-associated dyspnea (TAD)

STOP ASAP

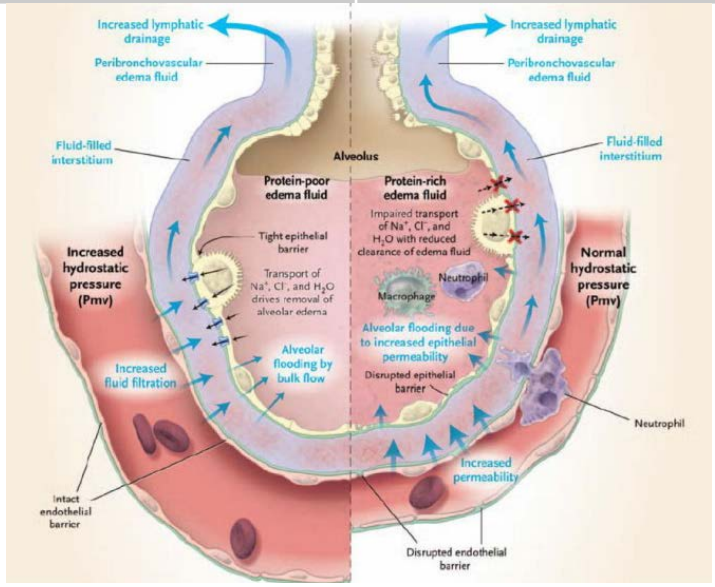
REPORT DISTRESS EVENTS WITHIN 6-12H OF PRODUCT

1 Volume Status as the Discriminant (exam)

2 Structure: Infiltrates?

3 Function: Hypoxia?

Fluid driver:	transfusion-associated circulatory overload (TACO) hydrostatic	transfusion-related acute lung injury (TRALI) permeability/leak
Immunology:	-	+
Agent:	dangerous doctor	dangerous donor
Biomarker:	cardiac stress	leukoagglutinins

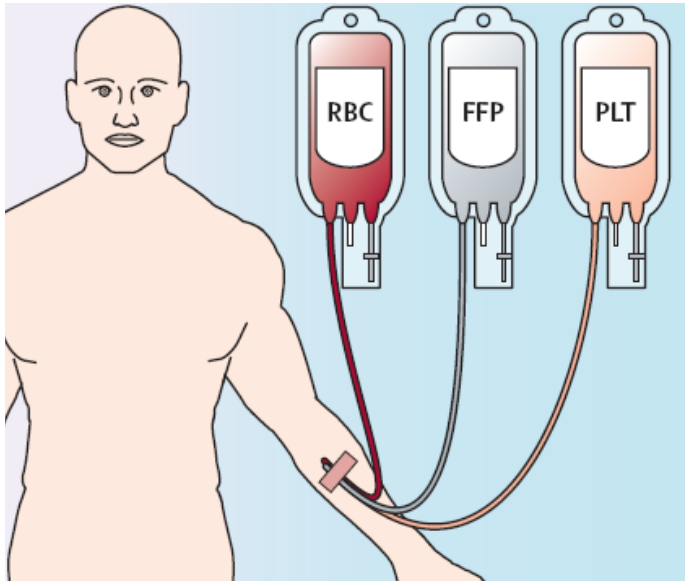


Ware & Matthay. N Engl J Med **2005**; 353:2788-96.

Shared: 2-hit model

more congestive

more humoral



Vlaar & Juffermans. Lancet **2013**; 382:984-94.

Transfusion Associated Circulatory Overload (TACO):

≥ 1 REQUIRED:

OCCURRING WITHIN ≤ **12H** AFTER TRANSFUSION

Respiratory Distress

eg-

- *tachypnea*
- *dyspnea*
- *cyanosis*
- *↓spO_2 % without other causes*
- *bronchospasm/wheezing*

AND/ OR

Pulmonary Edema

Physical

L heart findings *without other causes, eg-*

- *crackles*
- *orthopnea*
- *cough*
- *S3*
- *frothing/pink sputum*

Radiography:

new/worsening changes, eg-

- *effusions*
- *widened vascular pedicle*
- *lobar vessel enlargement*
- *peribronchial cuffing*
- *Kerley lines*
- *alveolar edema*
- *cardiac silhouette enlargement*

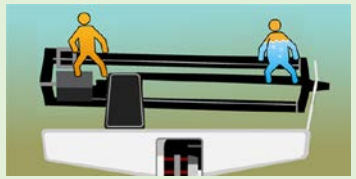
AND: 1 OR MORE OF:

Cardiovascular system changes

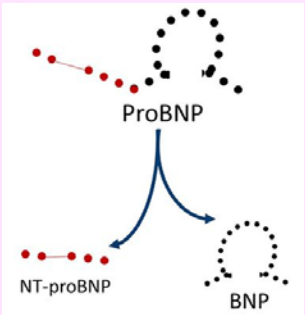
not from underlying condition

- *tachycardia*
- *↑BP, PP (or ↓ if cardiogenic shock)*
- *JVP distension/↑ CVP/↑cardiac silhouette*
- *peripheral edema*

Fluid overload



- *+ fluid balance or weight gain*
- *diuretic or dialytic response*



Natriuretic peptide (BNP)

↑ > ULN and 1.5x pre-transfusion value

for a MINIMUM OF **3** CRITERIA

ISBT Working Party on Haemovigilance, IHN, & aaBB: TACO Definition 2018 https://www.isbtweb.org/fileadmin/user_upload/TACO_2018_definition_March_2019.pdf
Wiersum-Osselton et al. The LANCET Haematology **2019**; 6(7): e350-e358.

TACO Landscape


overstuffed patient

- Common – **1-10%** of encounters

Hendrickson JE et al, Transfusion **2016**; 56: 2587

- Assumed to be **reversible with diuretics**

Roubinian N & Murphy EL, IJCTM **2015**; 17

- Rising in rank as **commonest** reaction entity among **transfusion-related deaths**

TTISS (Ontario)	2014-2018:	13/35 (37%)	**37%**
SHOT (UK)	2010-2020:	104/212 (49%)	(95% CI:
FDA (USA)	2014-2019:	72/262 (27%)	**33-41%**)

- Often serious (**1/5 to ICU**) …

LOS effects…

CFR: **1-10%**

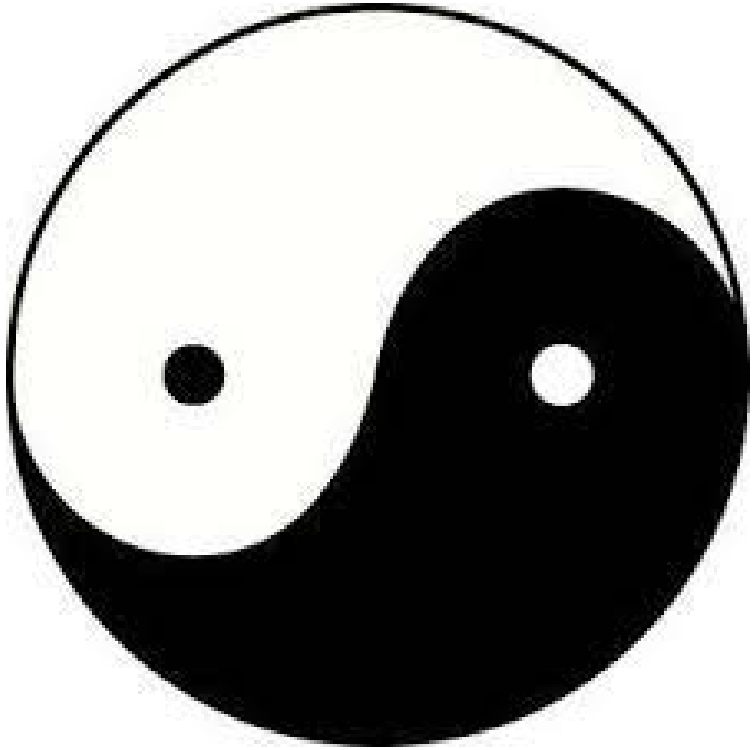
Lieberman L et al, Transfus Med Rev **2013**; 206

Roubinian NH et al, Crit Care Med **2018**; 577

Murphy EL et al, Am J Med **2013**; e29

TACO: Accreditation Standards Expect Lab-to-Bedside Prevention Efforts

IDENTIFYING WHO IS AT RISK



MODIFYNG THE ORDER

New aaBB Standard 5.19.7 Transfusion-Associated Circulatory Overload (TACO) (30th edition, 2016): *"The BB/TS shall have a policy for responding to requests for products for patients identified by the ordering physician or other authorized health professional as being at increased risk for TACO."*

TACO: Risk Factors (Finding Who Needs Mitigation)

- **c**ardiorespiratory 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]
- **r**enal dysfunction
- **a**ge
  - youngest
  - oldest (>60-70 years)
- **p**ositive fluid balance
  - weights, ins/outs, physical signs

- small receiver: low body weight
- anemic hyperdynamism
- heavy-handed giver:
  - unwritten orders (verbal)
  - unassessed patient
  - big order
  - too fast
  - preceding crystalloids: “STACO”

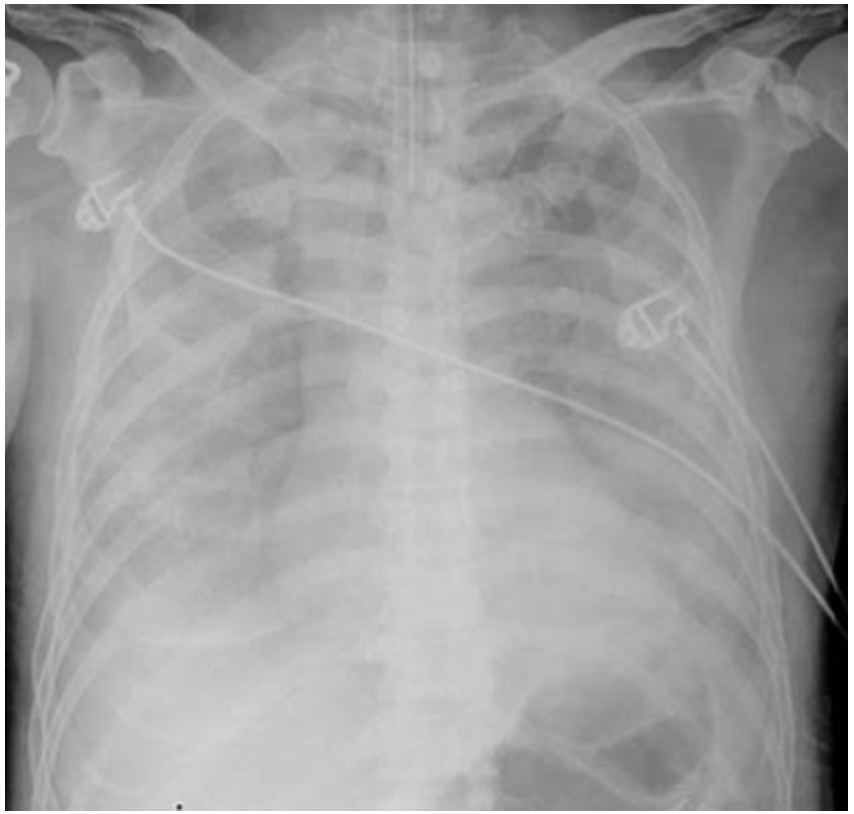
- Li et al. Transfusion **2011**; 51:338-43.
- Lieberman et al. Transfus Med Rev **2013**; 27:206-12.
- Andrzejewski Jr et al. Transfusion **2013**; 53:3037-47.
- Alam et al. Transfus Med Rev **2013**; 27:105-12.
- Clifford et al. Anesthesiology **2015**; 122:21-8.
- Roubinian et al. Crit Care Med **2018**; 46:577-85.

TACO: How to Change the Order to Mitigate Risk

- lower the trigger
- cancel
  - alternatives?
- reduce order size/volume
  - 1 instead of 2u RBC
  - concentrates instead of components
- slow the infusion rate
- (advance) volume decanting
  - diuretics, more UF on dialysis

New aaBB Standard 5.19.7 Transfusion-Associated Circulatory Overload (TACO) (30th edition, 2016): *"The BB/TS shall have a policy for responding to requests for products for patients identified by the ordering physician or other authorized health professional as being at increased risk for TACO."*

Flash Non-Cardiogenic Pulmonary Edema:



?Transfusion Related Acute Lung Injury (TRALI)

Wong et al. Transfusion **2017**; 57:2076.

Transfusion Related Acute Lung Injury (TRALI):

A + B + C:

A.

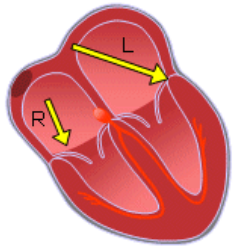
Acute Onset

Hypoxemia

- *paO2/FiO2 ≤ 300*
- *spO2 <90% on room air*
- *Other clinical evidence*

Bilateral Infiltrates

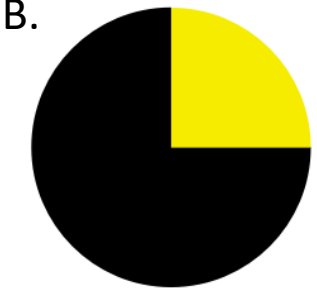
CXR, CT, US



Left Atrial Hypertension: absent, or (if present), not the main contributor to hypoxemia

Echo, PCWP

B.



Onset during or within **6h** of transfusion

(Pulmonary edema/ LAH studies captured within 24h)

C. No alternative ARDS risk factors

Direct Lung Injury:

- *aspiration*
- *pneumonia*
- *toxic inhalation*
- *lung contusion*
- *vasculitis*
- *near drowning*

Indirect Lung Injury

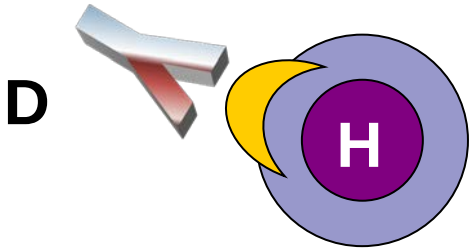
- *non-pulmonary sepsis*
- *multiple trauma*
- *burn injury*
- *acute pancreatitis*
- *non-cardiogenic shock*
- *cardiopulmonary bypass*
- *drug overdose*

** Neither leukoagglutinating (HLA or HNA) antibodies in donors (nor confirmation of cognate antigens in recipient) are required*

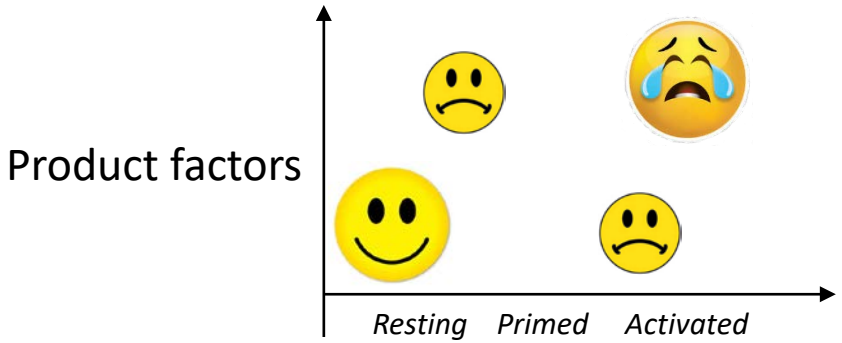
Vlaar et al. Transfusion **2019**; 59: 2465-76

TRALI: How It Happens: 2nd Hit[s] *(in a 1st-Hit Host)*

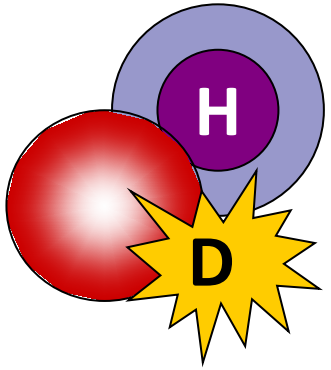
- **<u>donor</u> had incidental anti-leukocyte antibodies (ALA) collected into product**
  - ALA (HLA [**II**>I], H**N**A) delivered IV
  - ALA account(ed) for most cases



cognate Ag binding → activation (TRAIL)*



- **product toxins/biologic response modifiers (BRM)**
  - products release biologically active lipids
    - biologically active lipids, lysoPC, microparticles
    - cytokines, chemokines (HMGB1, solCD40L)
    - NETs, mtDNA



donor cells release harmful humours

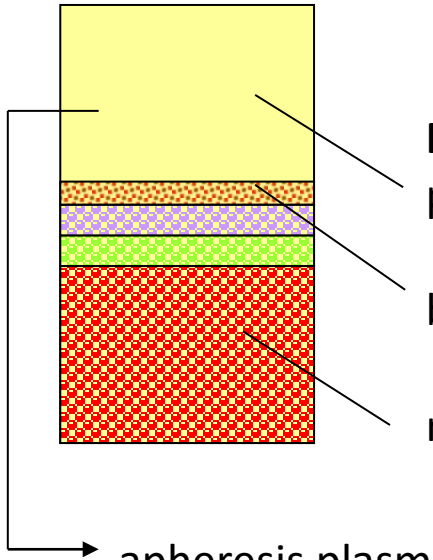
Sachs. <u>Curr Opin Hematol</u> **2011**; 18: 436-42.

Kopko et al. <u>Transfusion</u> **2019**; 59: 1147-51.

Mitigating Femme Fatale:
Fewer TRALI Cases Expected (Seen) Now

- commonest way for (healthy) donors to (RBC/WBC)-sensitize is PREGNANCY
- production methods account for this potentially harmful “immune knowledge”

OR ~0.5



FEMALE WHOLE BLOOD (irrespective of gravidity):
plasma diverted for “recovery”/fractionation (pooling = dilution)

buffy coat platelets now pooled in male plasma

red cells still used for direct component therapy

apheresis plasma or platelets: **MEN or NULLIPARAS**

- Muller et al. Transfusion. **2015**; 55(1):164-75.
- Schmickl et al. Crit Care Med. **2015**; 43(1):205-25.

Culpability/Certainty Spectrum:

TRALI Type I	TRALI Type II
TRALI	possible TRALI (pTRALI)

Disturbance within 6h

No risk factors/features prior

Disturbance within 6h

+ Risk factors/features

BUT *stable in the last 12h*

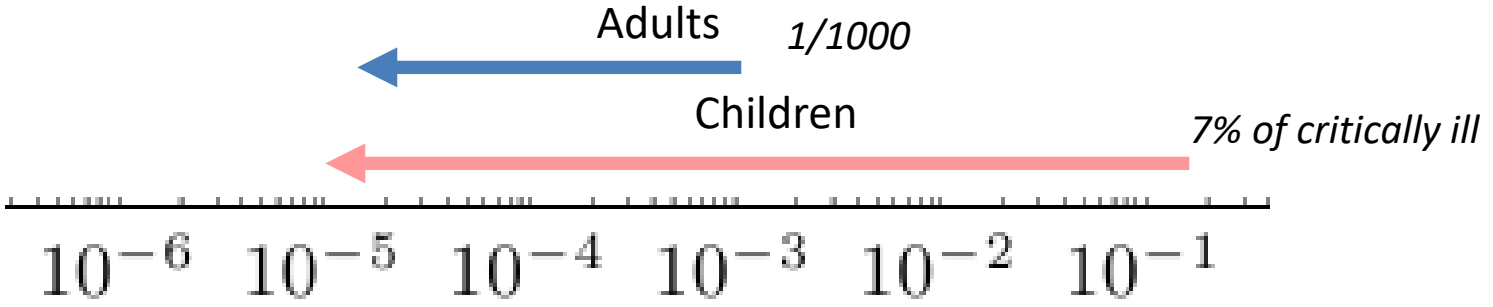
Disturbance within 6h

+ Risk factors/features

& worsening in the last 12h

TARDS

TRALI Epidemiology



Vossoughi et al. Transfusion **2019**; 59: 2567-74

- Transfusion-attributable fatalities:

TTISS (Ontario) 2014-2018:	9/35 (26%)	**16%**
SHOT (UK) 2010-2020:	7/212 (3%)	(95% CI:
FDA (USA) 2014-2019:	59/225 (26%)	**13-19%**)

- IHM: up to 50%
- CFR: 5-25%

McVey et al. Anesthesiology **2019**; 131: 693-715.

Why is dyspneic/hypoxic reaction reporting so important?

A. Billings bring revenue

B. Quality signal on dangerous doctors/facilities

C. Reporting improves real-time care

D. Co-component quarantine, donor investigation (deferral)

E. Enables legal actions

Allergic Reactions

surface-stuff:
skin (rash)

The Allergic Spectrum

frequency gradient

1% incidence

90% of ATR cases

- cutaneous eruption (= urticaria, pruritis, erythema, flushing)
- angioedema (=subcutaneous rather than cutaneous)
- respiratory:
  - bronchospasm
    - wheezing, stridor, hoarseness, dyspnea, hypoxia, feeling of asphyxia/doom
- gastrointestinal instability:
  - nausea/vomiting/abdominal cramping/diarrhea
- cardiovascular instability:
  - hypotension, chest pain, tachycardia
- anaphylactoid / anaphylactic reaction ± death

danger gradient

fatal anaphylaxis: 1 in 2-10 million

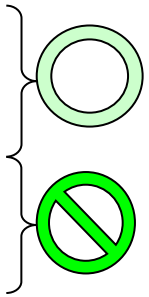
Why Allergic Reactions Happen

CLASSIC ALLERGIC IgE

- **Recipient IgE to incoming donor allergens**
  - eg. drug & food allergens transfused to patient

- **Donor IgE to recipient allergens**
  - eg. donor's peanut allergy passed into recipient

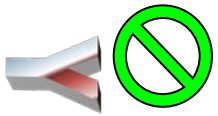
RECIPIENT HAS MISSING OR VARIANT PROTEIN AND REACTS TO WILD-TYPE PROTEIN



<5% of cases

- eg **IgA**, haptoglobin, complement, albumin, α1anti-trypsin, transferrin

- anti-protein IgG develops



Hypotension

acute hemolytic transfusion reaction (AHTR)

bacterial contamination (BaCon)

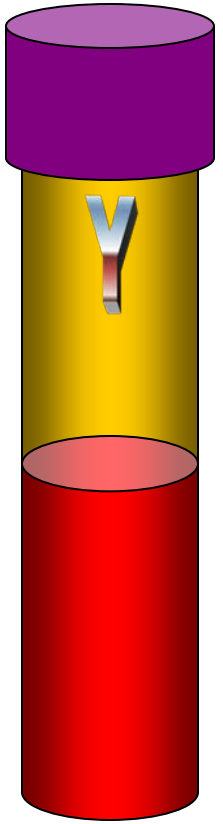
severe allergic transfusion reaction / anaphylaxis

bradykinin shock?

Testing Approach

- We investigate with the following panels for:
  - Febriles: hemolysis, microbiology
  - Dyspneics: hemolysis, microbiology, CBS (donor ALA)
  - Hypotensives: hemolysis, microbiology
  - Anaphylactics: hemolysis, ?IgA/anti-IgA IgG

    (?other protein deficiencies)



Blood bank sample:
BIAS = exploration for immune hemolytic incompatibility

Major Take-Home Messages

- most common killers: TRALI & TACO, AHTR-IBCT, TAS

- what COULD go wrong (3 tiers: common, serious, rare)

ATR / ETR / STR/ TACO

Respiratory / BaCon / mix-up: AHTR

TTVI / rare bug / GVHD

10^1-10^2 10^3-10^4 10^5-10^6

- you report to us, & we report within and to outside channels

- the only measure that has the power to mitigate EVERY single transfusion reaction type, is AVOIDANCE of the order itself…

Happy Transfusion Endings…