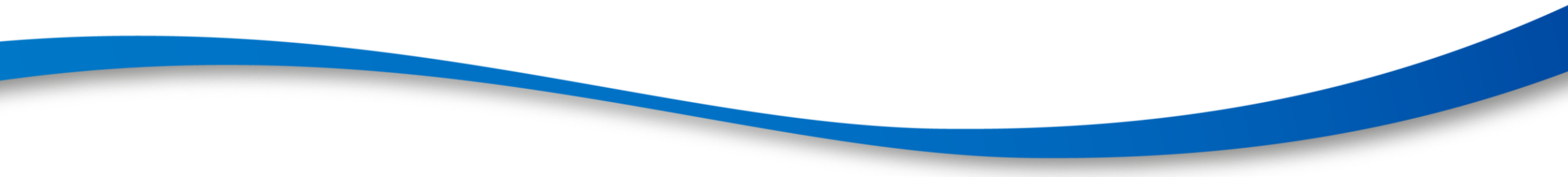


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Transfusion Associated Circulatory Overload: Where are we now?

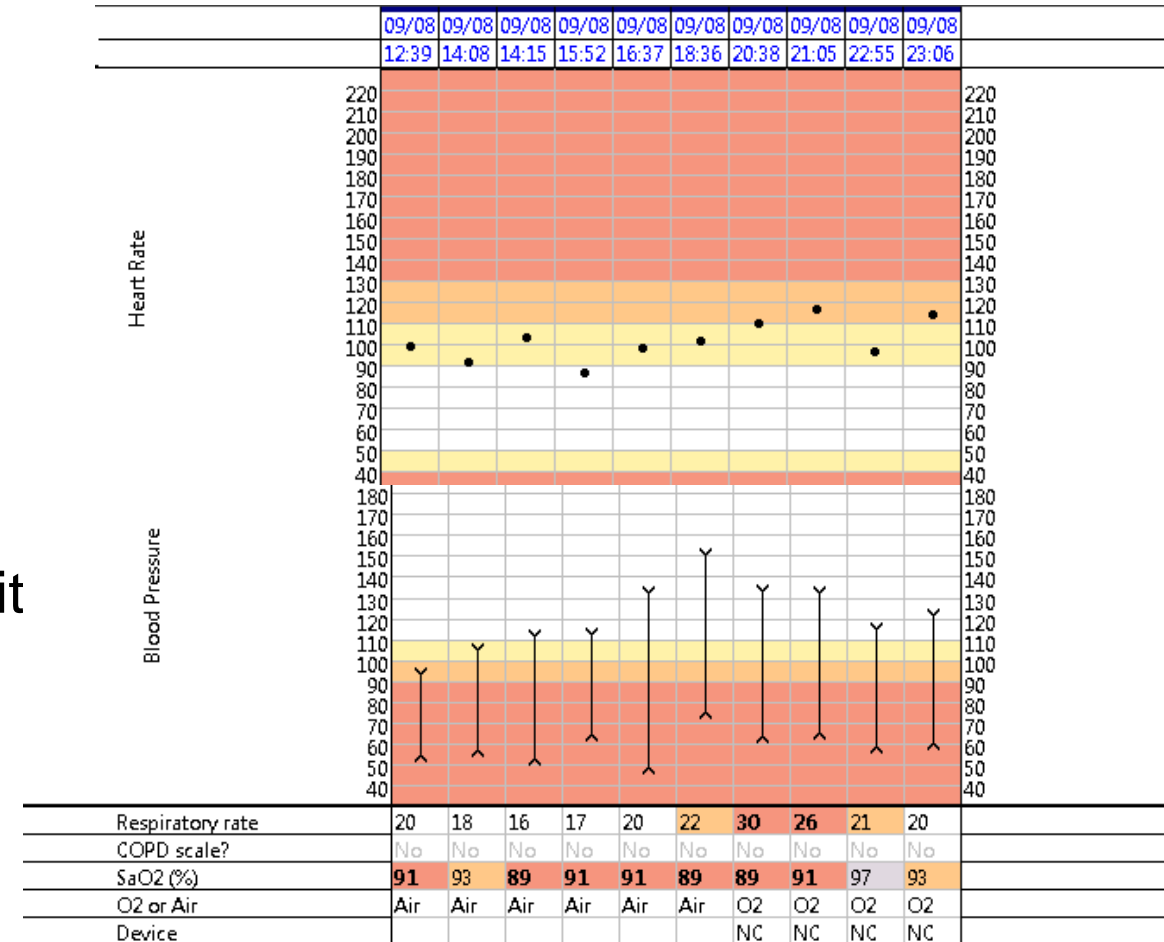
Dr Suzy Morton
Haematology consultant
NHSBT and UHB

Overview

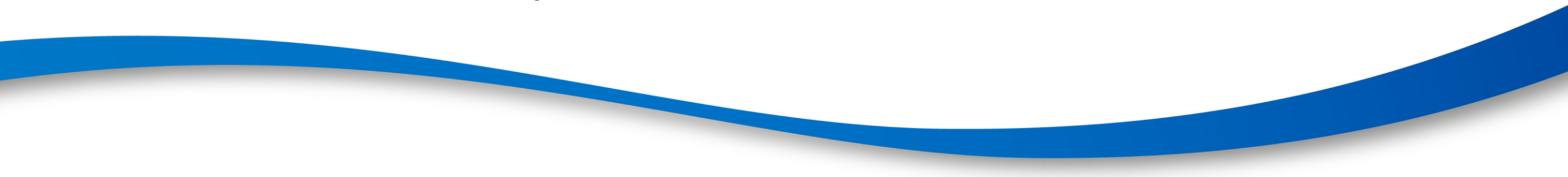
- What is TACO?
 - NCA results
 - Recent data
 - Moving forward
- 
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Case 1

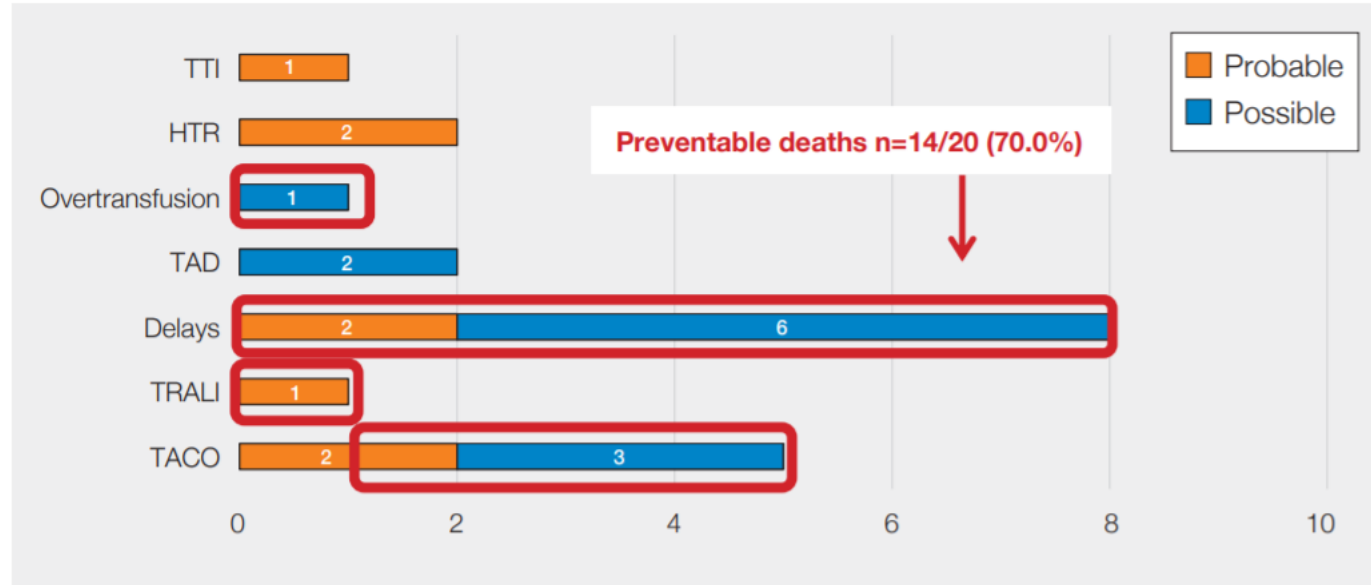
- 81 year old man, recent diagnosis MDS-EB2
- PMH COPD, AF, T2DM, hypertension
- Allergy to darbepoietin
- Hb 78g/L, dyspnoeic, tired
 - Second transfusion on haematology day unit
 - 2 units of red cells each over 2h
- Became hypertensive, tachycardic, hypoxic
- CXR shows pulmonary oedema
- Admitted through ED and treated with GTN infusion and furosemide



Surveillance criteria (ISBT 2019, SHOT 2018)

- Onset during or up to 12 hours after transfusion (SHOT up to 24 hours)
 - ≥ 1 required criterion AND ≥ 3 criteria i.e. A and/or B, and total of at least 3 of A to E
 - **Required criteria**
 - A. Acute or worsening respiratory compromise
 - B. Evidence of acute or worsening pulmonary oedema (clinically or radiologically)
 - **Additional criteria**
 - C. Cardiovascular system changes (htn, tachycardia, hypertension, pulm oedema)
 - D. Fluid overload (+ve fluid balance; clinical improvement following diuresis)
 - E. Positive biomarker (e.g. BNP or NT-pro BNP)
- 

Mortality



HTR=haemolytic transfusion reaction; TAD=transfusion-associated dyspnoea; TRALI=transfusion-related acute lung injury; TACO=transfusion-associated circulatory overload; TTI=transfusion-transmitted infection

Major morbidity: 36 cases

Leading cause of transfusion-related mortality and major morbidity




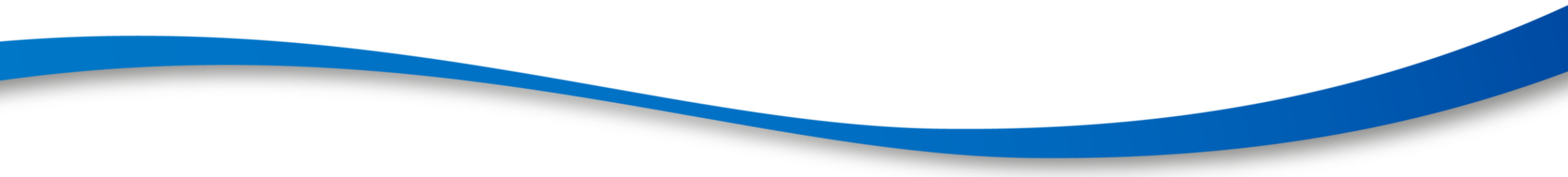
TACO Checklist Red cell transfusion for non-bleeding patients		If 'yes' to any of these questions	
	Does the patient have a diagnosis of 'heart failure' congestive cardiac failure (CCF), severe aortic stenosis, or moderate to severe left ventricular dysfunction? Is the patient on a regular diuretic?	<div>1</div>	<ul style="list-style-type: none"> Review the need for transfusion (do the benefits outweigh the risks)?
	Does the patient have severe anaemia?		<ul style="list-style-type: none"> Can the transfusion be safely deferred until the issue can be investigated, treated or resolved?
	Is the patient known to have pulmonary oedema? Does the patient have respiratory symptoms of undiagnosed cause?	<div>2</div>	<ul style="list-style-type: none"> Consider body weight dosing for red cells (especially if low body weight) Transfuse one unit (red cells) and review symptoms of anaemia
	Is the fluid balance clinically significantly positive? Is the patient on concomitant fluids (or has been in the past 24 hours)? Is there any peripheral oedema? Does the patient have hypoalbuminaemia? Does the patient have significant renal impairment?	<div>3</div>	<ul style="list-style-type: none"> Measure the fluid balance Consider giving a prophylactic diuretic Monitor the vital signs closely, including oxygen saturation

Figure 17b.1:
Updated TACO
pre-transfusion
checklist

When does 282ml = a litre?

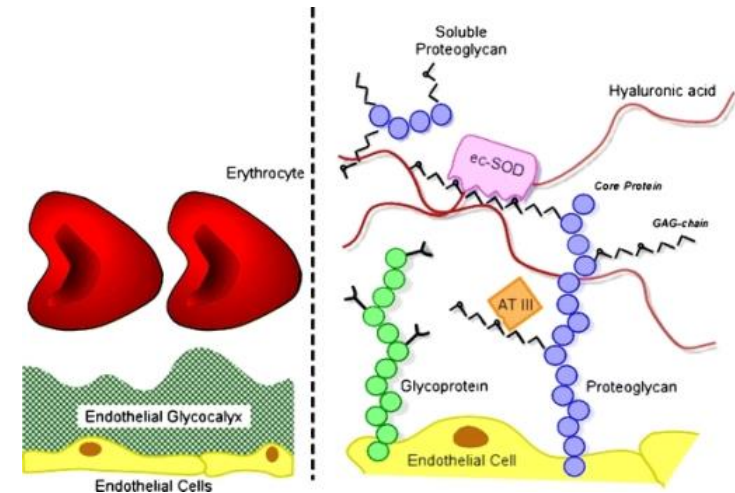
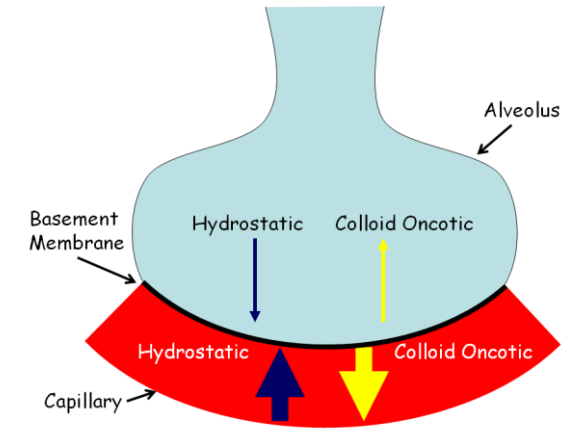


Pathophysiology of TACO

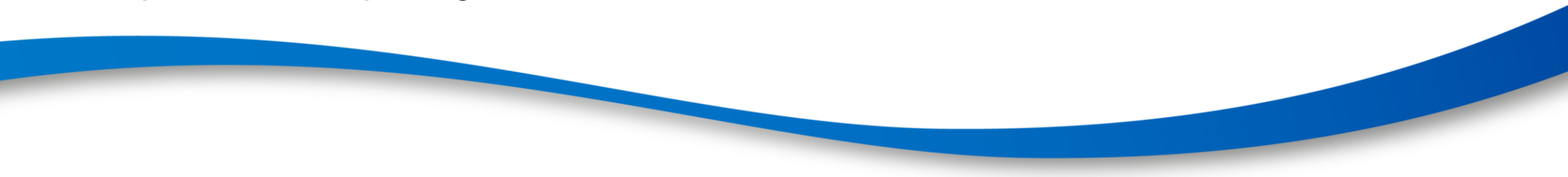
- Hydrostatic and oncotic pressures balanced in health

The glycocalyx

- Protects endothelial cells
 - Keeps inflammatory cells away
 - Role in coagulation
- Reduced surface area in illness (e.g. trauma)
- Damage or reduction in glycocalyx → increased permeability to fluid AND protein
- Damage can be due to
 - Physical pressure e.g. mechanotransduction
 - Illness/inflammation



TACO may not be as straightforward as we thought

- 30% patients with TACO will have fever
 - TACO may have reduced (by 50% in US) with leucocyte reduction
 - Susceptibility may be independent of fluid-handling ability
 - Trauma coagulopathy
 - Chronic disease
 - Alveolar fluid is exudate NOT transudate
 - Blurred lines with TRALI
 - Importance of reporting TACO, TRALI and TAD
- 

Assessing risk of TACO

1. The indication for transfusion is documented in the notes

JPAC, BCSH

2. All patients

SHOT, BCSH

Pre-emptive

3. Restrictive

NICE

4. Use single

NICE, BCSH

5. Perform an

NICE, BCSH

Diagnosis a

6. If risk factor

SHOT, BCSH

7. Monitor the

NICE, BCSH

8. TACO should be suspected when there is respiratory distress with features of fluid overload

SHOT

9. Patients developing features of TACO are treated with a trial of diuretics, morphine or nitrates

SHOT, BCSH

Reporting

10. All patients with TACO are reported to SHOT

SHOT, NICE

NICE Blood transfusion guidelines, NG24, 2015

NICE Quality Standards, QS138, 2016

BCSH guidelines for the administration of blood components, 2009

BCSH amendment 2012

SHOT report 2015, 2016

JPAC 'red book' Guidelines for the blood transfusion services in the UK, 8th Edition

Spring 2017; red cell transfusions in the over 60s

	Inpatients	Outpatients
National	2461	2119
Regional	251	217
Burton Hospitals NHS Foundation Trust	20	20
George Eliot Hospital NHS Trust	1	0
Heart of England NHS Foundation Trust	19	0
Sandwell and West Birmingham Hospitals NHS Trust	13	10
South Warwickshire NHS Foundation Trust	16	18
The Dudley Group NHS Foundation Trust	20	18
The Royal Orthopaedic Hospital NHS Foundation Trust	20	0
The Royal Wolverhampton NHS Trust	20	20
The Shrewsbury and Telford Hospital NHS Trust	16	20
University Hospitals Birmingham NHS Foundation Trust	6	11
University Hospitals Coventry and Warwickshire NHS Trust	20	20
University Hospitals of North Midlands NHS Trust	20	20
Walsall Healthcare NHS Trust	20	20
Worcestershire Acute Hospitals NHS Trust	20	20
Wye Valley NHS Trust	20	20

- 157/171 (92%) sites contributed data

Standard 1: Document the indication for transfusion in the notes

	Inpatients	Outpatients
National	1799 (74%)	1502 (71%)
Regional	209/251 (83%)	157/217 (72%)

Standard 2: Risk assess all patients for TACO and document this in the notes

2a: Benefits & risks of transfusion – Inpatients

	Inpatients
National	502 (20.5%)
Regional	99/251 (39%)

Inpatients

Assessing risk of TACO



89%
(2195/2461)

of inpatients had at least one additional risk factor for TACO, apart from age

3 most common risk factors

Hypoalbuminaemia	52%	(1283/2461)
Concomitant IV fluids	39%	(949/2461)
Positive fluid balance	35%	(286/808)

Risk Factors

- 1.Age >50 years
- 2.CCF, LVF, AS
- 3.CKD
- 4.Liver dysfunction
- 5.Peripheral oedema
- 6.Concomitant IV fluids
- 7.Pulmonary oedema
- 8.Undiagnosed respiratory symptoms
- 9.Use of diuretics
- 10.Weight <50kg

Prescribing

43%

(915/2119)

of outpatients were seen by the person 'prescribing' the blood in the week before transfusion

**9%**

(203/2298)

of inpatients were transferred between teams between the decision to transfuse and completion of transfusion



Only

61%

(1513/2461)

of inpatients were weighed within a week prior to transfusion

10%

(151/1513)

of inpatients weighed, weighed less than 50kg

Only

23%

(490/2119)

of outpatients were weighed within a week prior to transfusion

Recommendations: assessing risk

- Include a formal pre-transfusion risk assessment (e.g. SHOT) for TACO in transfusion policies
- Include risk of TACO in consent
- **Weigh all patients** within 7 days prior to transfusion and document on the prescription
 - If the patient cannot be weighed, document **estimated weight**
- The person authorising/prescribing the blood **must review the patient**
 - Within 24h (inpatient) or 7 days (outpatient)

Standard 3: Use restrictive red cell transfusion thresholds



28% inpatients and **20%** outpatients with **asymptomatic anaemia** had pre-transfusion **hb $\leq 70\text{g/L}$**

71% inpatients and **53%** outpatients with **cardiovascular disease** had pre-transfusion **hb $\leq 80\text{g/L}$**

Top clinical areas transfusing above recommended thresholds




Blood and Transplant

Inpatients

1. Gastrointestinal surgery
2. Oncology
3. Orthopaedic surgery

Outpatients

1. Trauma and orthopaedics
 2. Obstetrics and gynaecology
 3. Haematology
- 
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Standard 4: Use single unit red cell transfusions for patients who do not have active bleeding

	Inpatients	Outpatients
National	659/1788 (37%)	231/1090 (21%)
Regional	55/158 (35%)	18/106 (17%)
Burton Hospitals NHS Foundation Trust	1/9 (11%)	0/6 (0%)
George Eliot Hospital NHS Trust	0/1 (0%)	-
Heart of England NHS Foundation Trust	3/10 (30%)	-
Sandwell and West Birmingham Hospitals NHS Trust	2/8 (25%)	1/3 (33%)
South Warwickshire NHS Foundation Trust	3/9 (33%)	3/7 (43%)
The Dudley Group NHS Foundation Trust	2/13 (15%)	0/2 (0%)
The Royal Orthopaedic Hospital NHS Foundation Trust	11/19 (58%)	-
The Royal Wolverhampton NHS Trust	2/10 (20%)	5/15 (33%)
The Shrewsbury and Telford Hospital NHS Trust	5/8 (63%)	1/18 (6%)
University Hospitals Birmingham NHS Foundation Trust	2/3 (67%)	0/8 (0%)
University Hospitals Coventry and Warwickshire NHS Trust	9/13 (69%)	2/10 (20%)
University Hospitals of North Midlands NHS Trust	4/14 (29%)	3/10 (30%)
Walsall Healthcare NHS Trust	5/11 (45%)	3/8 (38%)
Worcestershire Acute Hospitals NHS Trust	4/13 (31%)	0/10 (0%)
Wye Valley NHS Trust	2/17 (12%)	0/9 (0%)

Standard 5: Perform a clinical assessment of the patient after each unit

14% inpatients and **11%** outpatients had a **clinical review** after the first unit

12% inpatients had a **haemoglobin checked** after the first unit

In the instances where there was a clinical review of following the first unit, subsequent management was altered as a result in **13%**

Over-transfusion to **hb >110g/L** occurred in **5.8%** inpatients



Standard 6: If risk factors are present

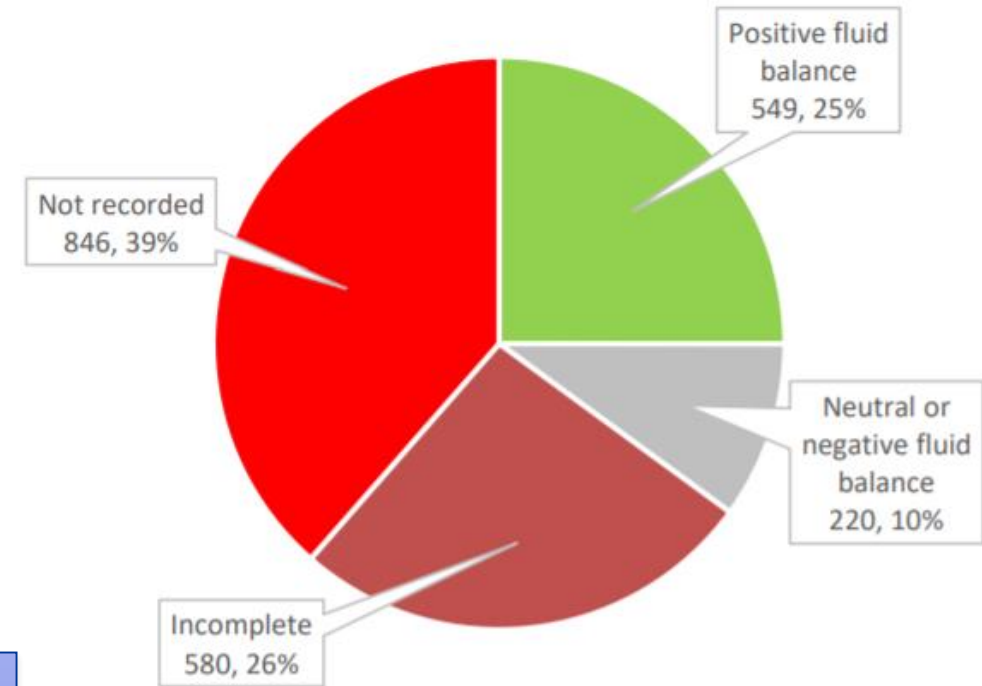
- measure fluid balance
- consider prophylactic diuretics

Of inpatients with 1+ additional risk factor:

57% had a **completed fluid balance** in the 24h prior to transfusion

11% received **pre-emptive diuretics** prior to the transfusion

Prescribers were **twice as likely** to have prescribed a pre-emptive diuretic had they seen the patient within a week prior to the transfusion 9.0% vs. 4.2% ($p < 0.05$)




Fluid balance for inpatients with at least 1 additional risk factor

Inpatients with at least 1 additional risk factor who pre-emptive diuretics prescribed

	Inpatients
National	236/2175 (11%)
Regional	34/225 (15%)
Burton Hospitals NHS Foundation Trust	2/16 (13%)
George Eliot Hospital NHS Trust	0/1 (0%)
Heart of England NHS Foundation Trust	2/19 (11%)
Sandwell and West Birmingham Hospitals NHS Trust	0/11 (0%)
South Warwickshire NHS Foundation Trust	0/15 (0%)
The Dudley Group NHS Foundation Trust	1/19 (5%)
The Royal Orthopaedic Hospital NHS Foundation Trust	1/18 (6%)
The Royal Wolverhampton NHS Trust	4/19 (21%)
The Shrewsbury and Telford Hospital NHS Trust	3/14 (21%)
University Hospitals Birmingham NHS Foundation Trust	3/6 (50%)
University Hospitals Coventry and Warwickshire NHS Trust	1/15 (7%)
University Hospitals of North Midlands NHS Trust	2/20 (10%)
Walsall Healthcare NHS Trust	9/16 (56%)
Worcestershire Acute Hospitals NHS Trust	1/18 (6%)
Wye Valley NHS Trust	5/18 (28%)

Recommendations: Pre-emptive measures

- For patients at risk of TACO
 1. **Monitor fluid balance**
 2. **Prescribe one unit at a time and prescribe according to body weight**
 3. **Transfuse at a slower rate**
 4. **Consider prophylactic diuretics**
 5. **Monitor observations, including oxygen saturations**
 - **Review inpatients after every unit** to assess
 - Whether further transfusion is required
 - Whether features of TACO are developing
- 

Standard 7: monitor the patient before, during and after the transfusion

Inpatients: complete set of observations at 15 minutes	39%
Inpatients: sats done at 15 minutes	41%
Outpatients: complete set of observations within 15 minutes	60%
Outpatients: sats done at 15 minutes	68%

Clinical review after each unit transfused

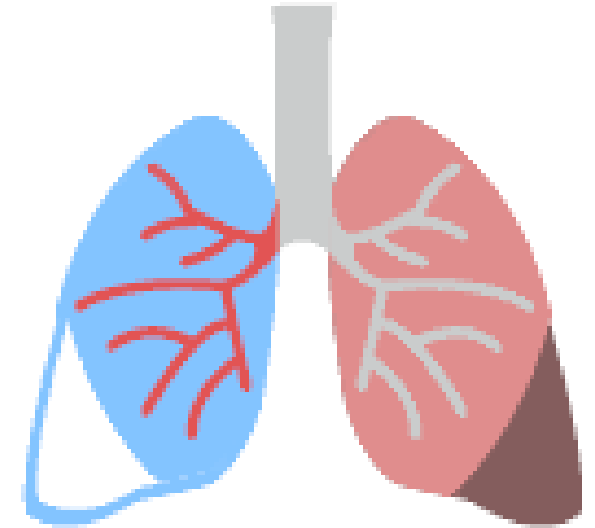
	Inpatients	Outpatients
National	173/1204 (14%)	180/1669 (11%)
Regional	17/121 (14%)	22/181 (12%)
Burton Hospitals NHS Foundation Trust	4/12 (33%)	0/17 (0%)
George Eliot Hospital NHS Trust	0/1 (0%)	-
Heart of England NHS Foundation Trust	3/11 (27%)	-
Sandwell and West Birmingham Hospitals NHS Trust	1/8 (13%)	0/9 (0%)
South Warwickshire NHS Foundation Trust	0/6 (0%)	1/11 (9%)
The Dudley Group NHS Foundation Trust	0/12 (0%)	0/17 (0%)
The Royal Orthopaedic Hospital NHS Foundation Trust	2/8 (25%)	-
The Royal Wolverhampton NHS Trust	1/8 (13%)	1/13 (8%)
The Shrewsbury and Telford Hospital NHS Trust	1/4 (25%)	19/19 (100%)
University Hospitals Birmingham NHS Foundation Trust	1/1 (100%)	0/9 (0%)
University Hospitals Coventry and Warwickshire NHS Trust	1/5 (20%)	0/17 (0%)
University Hospitals of North Midlands NHS Trust	0/11 (0%)	1/16 (6%)
Walsall Healthcare NHS Trust	1/6 (17%)	0/15 (0%)
Worcestershire Acute Hospitals NHS Trust	0/13 (0%)	0/18 (0%)
Wye Valley NHS Trust	2/15 (13%)	0/20 (0%)

Standard 8: Suspect TACO when there is respiratory distress with features of fluid overload

69/2461 (2.8%) patients developed respiratory distress within 24h of transfusion

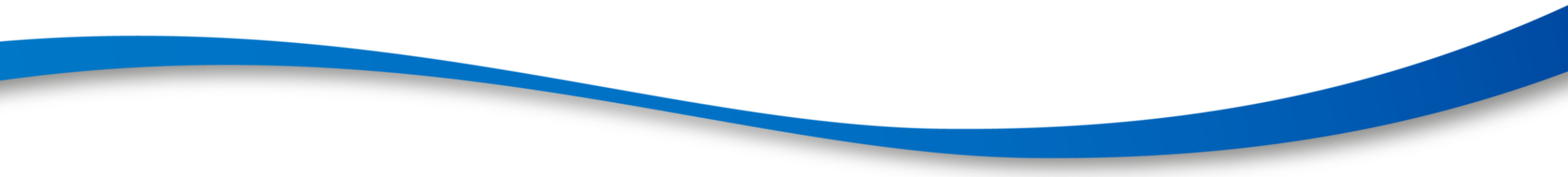
64% inpatients who developed acute or worsening respiratory distress had a CXR

100% outpatients admitted with worsening respiratory symptoms had a CXR




Standard 9: Treat patients developing features of TACO with a trial of diuretics, morphine or nitrates

51% inpatients who developed acute or worsening respiratory distress and **50% outpatients** admitted with acute or worsening respiratory distress with worsening chest x-ray changes **had a trial of diuresis**

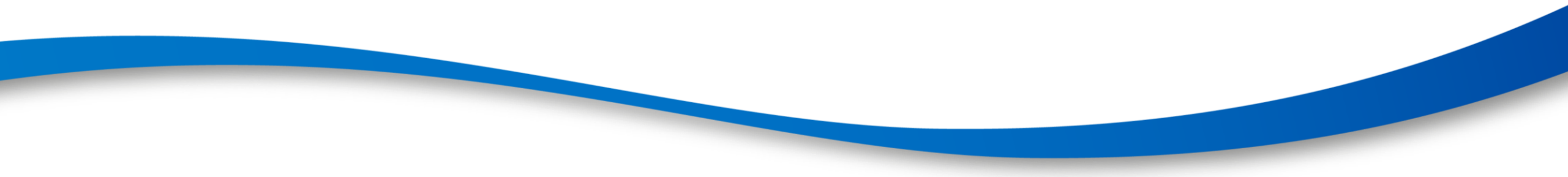


Recommendations: Diagnosis and treatment

- Educate on TACO, highlighting that **respiratory distress, hypoxia and increased respiratory rate** within 24h transfusion may be signs of TACO
 - Inform patients they should seek medical attention if they experience **breathlessness within 24 hours** of having a blood transfusion.
 - For patients developing respiratory distress within 24 hours of transfusion:
 - Stop or slow the transfusion
 - Perform a CXR
 - Consider a trial of diuresis
 - Involve intensive care or outreach team early
- 

Standard 10: Report all patients with TACO to SHOT

27.3% inpatients identified by the treating team as having TACO were reported to SHOT



Clinical evidence of TACO (SHOT 2016 definition)

- Any three of the following clinical features occurring within 24 hours of the transfusion
 - Acute respiratory distress (in the absence of other specific causes)
 - Acute or worsening pulmonary oedema on imaging
 - Evidence of a positive fluid balance
 - Evidence of volume intolerance (response to treatment for circulatory overload or evidence of pulmonary oedema on clinical examination)

9 inpatients (0.37%) met 3 out of 4 criteria, but lots of missing data



Outpatient outcomes

1.7% outpatients were admitted within 24 hours admission

Timing of admission	
Admitted immediately from the day unit	71%
Admitted within 24h of transfusion after being discharged from day unit	29%
Location of readmission	
Admitted to same hospital	94%
Admitted to other hospital	6%
Admitted due to worsening respiratory symptoms	20%
Respiratory symptoms thought to be due to the transfusion	28.6%



Summary of findings

Despite NICE guidelines, low numbers of patients are being transfused with restrictive thresholds and with single units

Almost all patients aged >60 have additional risk factors

Few pre-emptive measures taken – be it with enhanced monitoring or additional treatment

Many basic assessments not done e.g. weighing patient, fluid balance

Transfers of care, increasing use of electronic prescribing, weekend OP transfusions mean authorisers may prescribe medication/blood without ever seeing the patient

Awareness is lacking and although patients may be being treated appropriately, documentation and reporting rates to SHOT are low



Case study

Woman in her 80s

Under multiple teams; under elderly care when transfused

No documented weight, eGFR 56, low albumin

2 units for 'no apparent indication' authorised by consultant (pre transfusion hb 71 g/L)

No risk assessment documented

Each unit prescribed over 4 hours

Fluid balance >1500ml positive in 24h prior to transfusion (concomitant fluids of 2000ml)

No pre-emptive diuretics

No clinical review between units, no observations done

No post transfusion haemoglobin

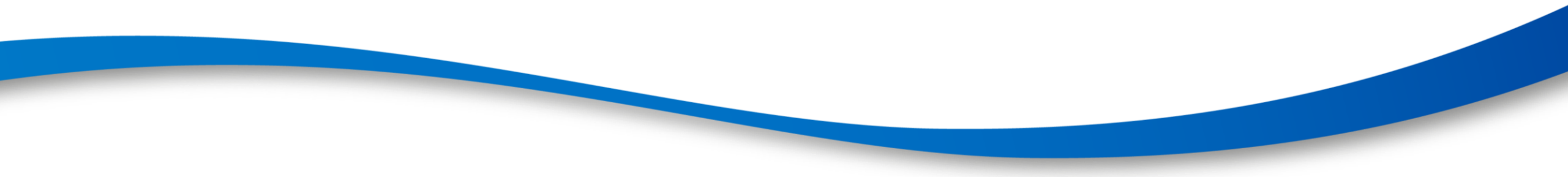
Developed worsening SOB during transfusion; no imaging undertaken (unsure if diuretic given or response)

Suggested improvements to care...

1. Documentation of the **indication** for transfusion and the **risks and benefit** including as **discussed** with patient
2. **One unit** transfused at a time
3. **Weight** performed and documented
4. Reduction in concomitant IV fluids to allow for the transfusion volume
5. Consideration of **pre-emptive diuretics**
6. **Observations** performed as a minimum at baseline, 15 minutes and completion of the transfusion
7. Transfusion administered **during working hours**
8. Transfusion over **3 hours** (4 hours not recommended due to cold chain regulations)
9. **Clinical review** following the first unit
10. Clinical review with **CXR and diuretics** at the onset of breathlessness

Example of good practice

*A lady in her 70s under elderly care and on a general medical ward was transfused for **symptomatic anaemia** with a haemoglobin of 74 g/L. She had **pre-existing respiratory symptoms** and **hypoalbuminaemia**. She weighed 47 kg. **Both the indication for the transfusion and a risk assessment** were documented. **Fluid balance** was documented. **One unit** was prescribed by a CMT/SHO level doctor. The unit was **commenced at 11:45 over 3 hours**. She **was reviewed** following the single unit transfusion. Post transfusion Haemoglobin was 95 g/L.*



TACO MATTERS!

Transfusion-associated circulatory overload (TACO) is the most commonly reported cause of transfusion-related mortality and major morbidity¹

377 reported cases - Deaths = 33, Major morbidity = 108 (2015-2018)¹

PERFORM a pre-transfusion risk assessment for TACO

TACO Checklist Red cell transfusion for non-bleeding patients



- Does the patient have a diagnosis of 'heart failure', congestive cardiac failure, severe aortic stenosis, or moderate to severe left ventricular dysfunction?
- Is the patient on a regular diuretic?
- Does the patient have severe anaemia?



- Is the patient known to have pulmonary oedema?
- Does the patient have respiratory symptoms of undiagnosed cause?



- Is the fluid balance clinically significantly positive?
- Is the patient on concomitant fluids (or has been in the past 24 hours)?
- Is there any peripheral oedema?
- Does the patient have hypoalbuminaemia?
- Does the patient have significant renal impairment?

If 'YES' to any of these questions:



- 1. Review the need for transfusion (do the benefits outweigh the risks?)
- 2. Can the transfusion be safely deferred until the issue can be investigated, treated or resolved?
- 3. Consider body weight dosing for red cells (especially if low body weight)
 - Transfuse one unit (red cells) and review symptoms of anaemia
 - Measure the fluid balance
 - Consider giving a prophylactic diuretic
 - Monitor the vital signs closely, including oxygen saturation

Developing respiratory distress² during or up to 24 hours after transfusion may be a sign of TACO

STOP or slow the transfusion

PROMPT clinical assessment is required

PERFORM a chest x-ray

CONSIDER a trial of diuretics

CONTACT intensive care early if the patient does not respond to initial measures

ALL cases of suspected TACO must be reported to Serious Hazards of Transfusion (SHOT) via your local Hospital Transfusion Team

Due to the differences in adult and neonatal physiology, babies may have a different risk for TACO. Calculate the dose by weight and observe the notes above.

1. www.shotuk.org

2. <http://hospital.blood.co.uk/audits/national-comparative-audit/medical-audits/>

Thank you

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