20a Transfusion-Associated Circulatory Overload (TACO) n=188

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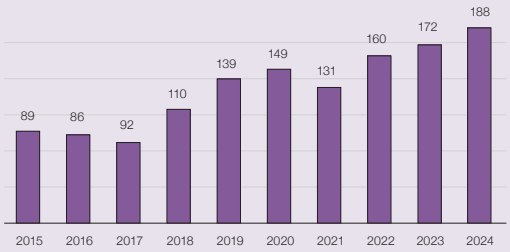
Headline data 2024

Number of reports n=188
Deaths n=31
Major morbidity n=32

TACO reports by year



Demographic data

Male n=91
Female n=97
Adults n=184
Paediatric n=4

Blood component data

Red cells n=162
Platelets n=4
Plasma n=3
Granulocytes n=1
Cryoprecipitate n=2
Multiple components n=16

Key findings:

- TACO-related mortality has doubled for the second consecutive year
- TACO-related major morbidity has increased by more than 50% compared to 2023
- Unnecessary/avoidable and overtransfusion is a factor in around 25% of reported TACO cases in 2024
- The release of the TACO National Patient Safety Alert (NatPSA) may have contributed to the increase in the numbers reported

Gaps identified:

- The cause of anaemia not identified and hence unable to establish the indication for transfusion which informs the appropriate dose of red cells
- Cases continue to be reported where the TACO pre-transfusion risk assessment was not used, or risk mitigation measures were not instituted appropriately despite the identification of risks

Good practice:

- Evidence of structured investigation following TACO
- Continued implementation of the TACO pre-transfusion risk assessment into paper and electronic systems

Next steps:

- Promotion of the updated TACO pre-transfusion risk assessment (Figure 20a.1) and associated supporting tools (Figures 20a.3)
- Addressing unnecessary/avoidable and overtransfusion is a key element of TACO risk reduction and has been added to the TACO pre-transfusion risk assessment as a mitigation measure

For all abbreviations and references used, please see the **Glossary** and **Reference list** at the end of the full Annual SHOT Report. Please see the supplementary information on the SHOT website (https://www.shotuk.org/shot-reports/annual-shot-report-2024/).

Definition:

TACO is defined as acute or worsening respiratory compromise and/or acute or worsening pulmonary oedema during or up to 12 hours† after transfusion, with additional features including cardiovascular system changes not explained by the patient's underlying medical condition; evidence of fluid overload and a relevant biomarker¥.

† SHOT accepts cases up to 24 hours

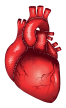
¥ see Table 20a.1 for details of required and additional criteria for the surveillance definition

Introduction

The TACO pre-transfusion risk assessment infographic (Figure 20a.1) was updated in the 2020 Annual SHOT Report to make it suitable for incorporation into clinical documents (Narayan, et al., 2021). Following feedback from reporters, a clarification has been added regarding the use of a prophylactic diuretic. The word 'checklist' has also been standardised to 'risk assessment'. Overtransfusion and unnecessary/avoidable transfusion remain significant avoidable causes of TACO. The TACO pre-transfusion risk assessment has been further updated this year to ensure the appropriate indication and volume of red cell transfusion is a key consideration as a mitigation for TACO. It reflects the recently updated National Blood Transfusion Committee (NBTC) indication codes which includes code R7 (transfusion for severe chronic anaemia) which emphasises a minimal/single unit transfusion strategy for those patients who are at additional risk of TACO (NBTC, 2024). Other changes include inclusion of all heart valve disease, and simplification of 'hypoalbuminaemia' to 'a low serum albumin level'.

SHOT recognise that, following the release of the National Patient Safety Alert (MHRA and SHOT, 2024) in April 2024 to reduce the risks of TACO, staff have invested time and resources in aligning processes with the earlier version of the TACO risk assessment. SHOT acknowledge that the new update may mean additional work for hospital teams to reflect the new version. The new version incorporates the changes described above with the aim of improving clarity, consistency, and effectiveness of application. Specifically, the 2024 data provide a clear signal that inappropriate and excessive volume of transfusion are significant risks in cases of TACO, which was the main driver for this update. It is also important to note that this risk assessment is based on real-life haemovigilance data and not traditional research studies. TACO reports are received from a wide range of clinical contexts and patients. These signals offer powerful insights to risk patterns and patient vulnerabilities. Acting on haemovigilance data allows us to adapt our practice, refine risk assessments and implement preventive strategies to improve patient safety. It is a key part of learning from experience and making transfusion practice safer for everyone.

Figure 20a.1: Updated TACO pre-transfusion risk assessment

TACO Risk Assessment		YES	NO
	Does the patient have any of the following?: diagnosis of 'heart failure', congestive cardiac failure (CCF), left ventricular dysfunction, aortic stenosis, or any other heart valve disease		
	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 receiving intravenous fluids (or received them in the previous 24 hours)?		
	Is there any peripheral oedema?		
	Does the patient have a low serum albumin level?		
	Does the patient have significant renal impairment?		

If risks identified	YES	NO
Review the need for transfusion (do the benefits outweigh the risks)?		
Can the transfusion be safely deferred until the issue is investigated, treated or resolved?		

If proceeding with red cell transfusion: ensure appropriate indication and volume is prescribed (adults)

Indication code for transfusion	Target Hb	Dosing advice
Acute anaemia (R2)	Post-transfusion target Hb 70 - 90g/L	Body weight dosing (max 2 units)
Acute anaemia (R3: with acute MI/ACS)	Post-transfusion target Hb 80 - 100g/L	Body weight dosing (max 2 units)
Severe symptomatic chronic anaemia (R7)	No target Hb - minimum transfusion	Usually single unit only
Regular transfusion programme (R4)	Individualised target Hb	Body weight dosing (max 2 units)

Other measures to mitigate TACO: ASSIGN ACTION AS APPROPRIATE	TICK
Review patient after each unit (red cells) and review symptoms of anaemia. Is further transfusion necessary?	
Measure the fluid balance	
Consider a prophylactic diuretic (where appropriate/not contraindicated)	
Monitor the vital signs closely, including oxygen saturation	

Name (PRINT):	**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.**
Role:	
Date: **Time (24hr):**	
Signature:	

TACO=transfusion-associated circulatory overload; MI=myocardial infarction; ACS=acute coronary syndrome; Hb=haemoglobin

Table 20a.1: TACO surveillance definition (adapted from Wiersum-Osselton, et al., 2019)

TACO surveillance definition
Patients classified with TACO (surveillance diagnosis) should exhibit at least one required criterion* with onset during or up to 12 hours after transfusion (SHOT continues to accept cases up to 24 hours), and a total of 3 or more criteria i.e., *A and/or B, and total of at least 3 (A to E)
*** Required criteria (A and/or B)**
A. Acute or worsening respiratory compromise and/or
B. Evidence of acute or worsening pulmonary oedema based on: • clinical physical examination, and/or • radiographic chest imaging and/or other non-invasive assessment of cardiac function
Additional criteria
C. Evidence for cardiovascular system changes not explained by the patient's underlying medical condition, including development of tachycardia, hypertension, jugular venous distension, enlarged cardiac silhouette and/or peripheral oedema
D. Evidence of fluid overload including any of the following: a positive fluid balance; clinical improvement following diuresis
E. Supportive result of a relevant biomarker, e.g., an increase of BNP levels or NT-pro BNP to greater than 1.5 times the pre-transfusion value

The number of cases reported in 2024 (n=188) is the highest to date and is an increase of 16 cases from 2023 (n=172). Although the pathophysiology of the pulmonary complications of transfusion is not fully understood, the evolving understanding of risk factors for TACO and the development of tools to mitigate risks has advanced significantly in recent years. This chapter describes the demographics of patients reported to have TACO, the adoption of risk-reduction strategies, and highlights areas for further focus based on signals from the data and ongoing trends.

Deaths related to transfusion n=31

Figure 20a.2 shows peaks in TACO deaths in 2016 and 2020, with the latter possibly related to COVID-19. There were 15 deaths related to TACO in 2023 which was almost double the number in 2022 (n=8), and this was a concerning signal in the data that was highlighted in the 2023 Annual SHOT Report (Narayan, et al., 2024). The trend led to the TACO NatPSA which was issued in April 2024 (MHRA and SHOT, 2024). This has again doubled in 2024 with 31 deaths where TACO was implicated (imputability 1 and 2). The cause of this is not clear and is likely multifactorial. Analysis of the 2024 data shows that 6/31 (19.4%) deaths, and 46/188 (24.5%) of all reported TACO cases had evidence of unnecessary/avoidable, or excessive volume of transfusion, suggesting some cases may have been mitigated or avoidable.

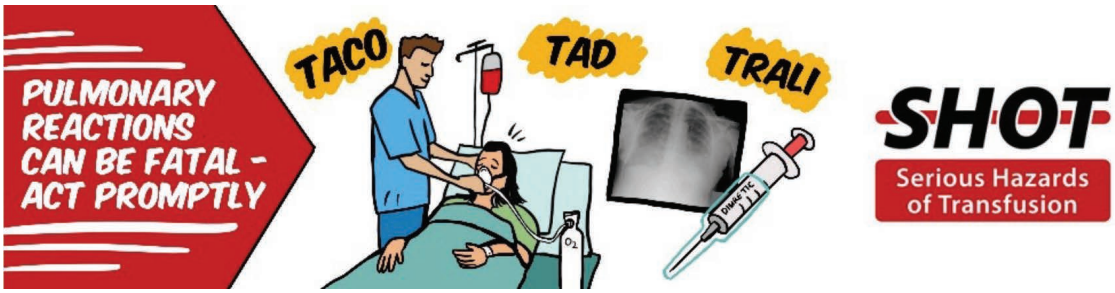
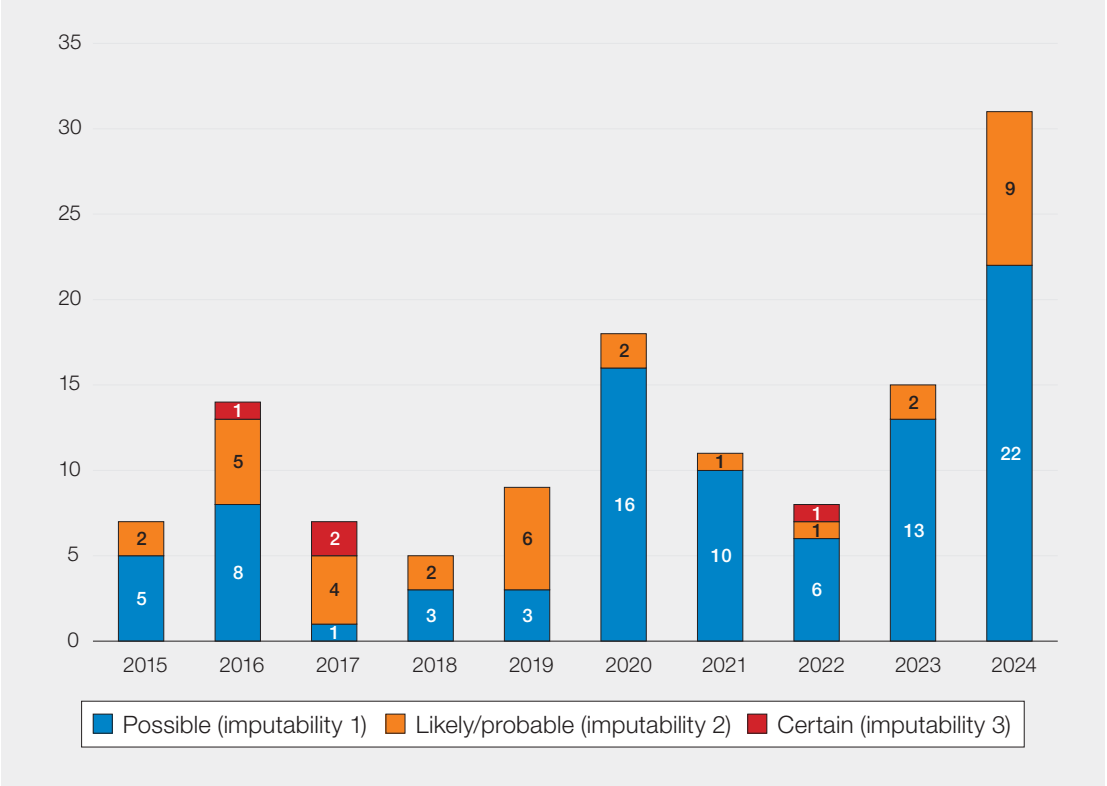


Figure 20a.2: TACO-related deaths with imputability, 2015 to 2024 (n=125)



Major morbidity n=32

There was a significant increase in major morbidity in the 2024 data (n=32) which was more than a 50% increase compared to 2023 (n=20).

Table 20a.2: Demographic overview of TACO cases in 2024

Demographic	Number of reports
Deaths (imputability 3)	0
Deaths (imputability 2)	9
Deaths (imputability 1)	22
Major morbidity	32
Age	Range: 2 months – 97 years (4 paediatric patients < 18 years) Median: 75 years
Sex	Female=97, male=91
Body weight (adults)*	Female (n=73): mean 69.5kg (range 42-125kg) Male (n=72): mean 78.1kg (range 39-130kg)
Top 4 medical specialties*	1st Haematology (n=36); 2nd acute medicine (n=26); 3rd general medicine (n=22); 4th emergency medicine (n=16)
Intensive care or high dependency units	12
Day case including community transfusion	13
Bleeding patients (NBTC indication code R1 or 'massive bleeding' indicated) * (NBTC, 2024)	34
Non-bleeding patients (other NBTC indication codes or 'not stated')	154

** Where data was provided - small numbers do not imply infrequent events*

Unnecessary transfusion and excessive volume of transfusion: a major contributory factor for TACO

Analysis of the 2024 data shows that 46/188 (24.5%) of TACO cases had evidence of unnecessary/

avoidable, or excessive volume of transfusion. It should be noted that the volume of transfusion, body weight, and pre- and post-transfusion haemoglobin levels are not universally reported and therefore these figures can be regarded as an under-estimate of TACO cases where unnecessary and excessive transfusion is a significant contributory factor.

- Unnecessary/avoidable transfusions = 10/188 (5.3%)
- Evidence of excessive volume (red cells) = 34/188 (18.1%)
- Evidence of excessive volume (red cells) and possibly unnecessary/avoidable = 2/188 (1.1%)

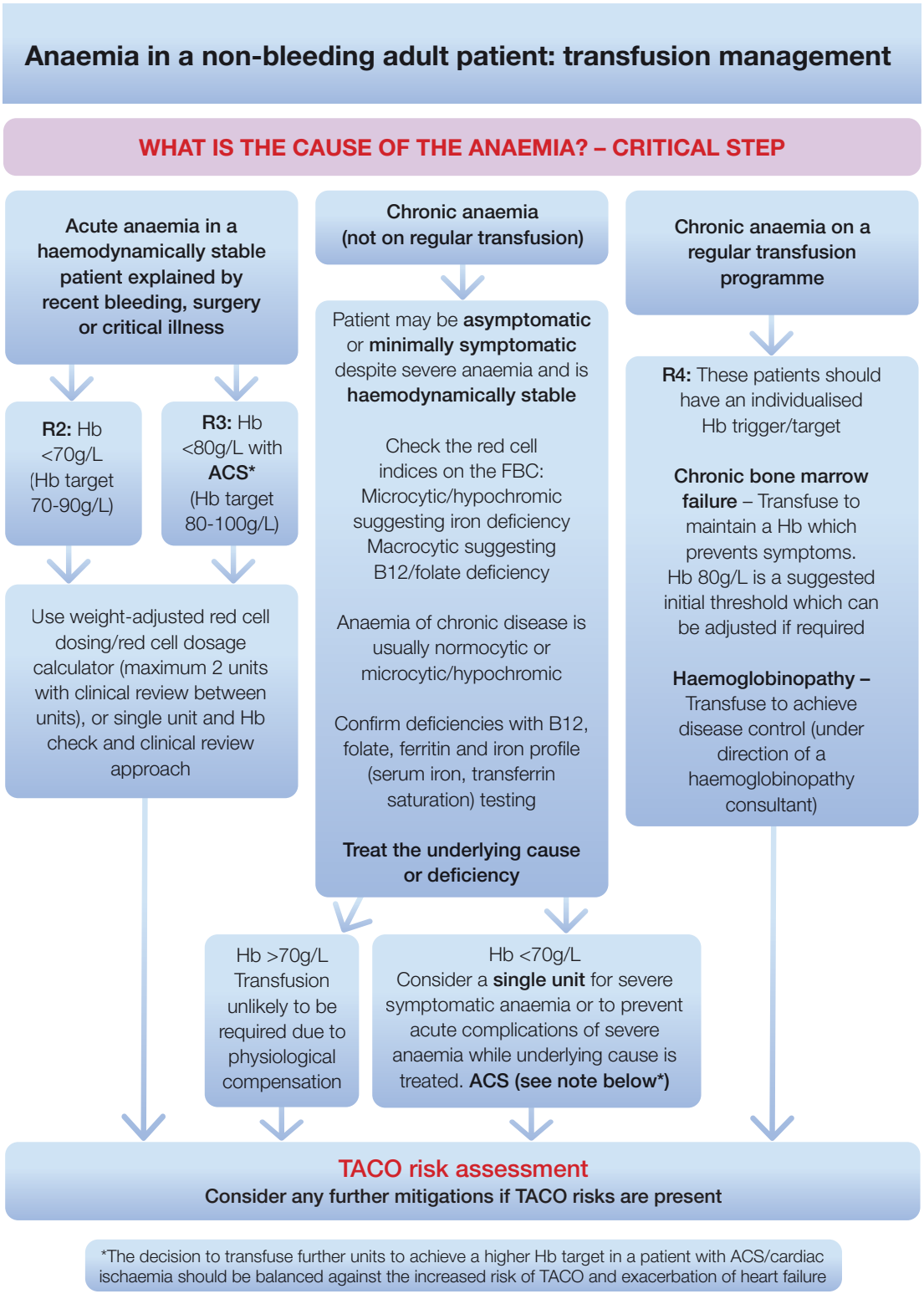
Case 20a.1: Excessive transfusion for chronic anaemia contributed to a patient's death (imputability 1 – possible)

A patient on palliative care for colorectal carcinoma with heart failure, renal impairment and other comorbidities was admitted with a 2-week history of shortness of breath. They were transfused two units of red cells for chronic anaemia (haemoglobin (Hb)68g/L, mean corpuscular volume (MCV)81fl). They had a relatively low body weight (59kg). The clinician decided to aim for a target Hb of >90g/L due to 'cardiac disease'. Acute coronary syndrome was not cited in the report, and it is likely this was chronic cardiac disease. The patient was on a regular diuretic, and they also had a low serum albumin level. There was no current fluid balance recorded, and the patient had peripheral oedema. The pre-transfusion chest X-ray showed a small pleural effusion and atelectasis in the base of the right lung. A TACO pre-transfusion risk assessment was not performed and therefore the multiple risks for TACO were not identified, and mitigations were not implemented. The patient developed a worsening respiratory status with tachypnoea (26 breaths per minute), oxygen desaturation to 87%, and an increased oxygen requirement (3L oxygen to maintain an oxygen saturation of 96%). The heart rate increased to 101 beats per minute, and the blood pressure had also increased from the baseline to 144/78mmHg. The post-transfusion Hb was 95g/L. The post-transfusion chest X-ray showed progression of the pleural effusion and new interstitial oedema. The patient was treated with a steroid, bronchodilator, and multiple doses of diuretic, however the patient deteriorated and died.

TACO was thought to have contributed to the patient's death but was not entirely causal. An internal investigation took place which recognised that administering a second unit of red cells was the cause of the TACO and therefore could have been avoided. The organisational transfusion authorisation card was reviewed and updated. The TACO pre-transfusion risk assessment was also made more detailed and prominent to include TACO mitigation measures. Additionally, TACO education was incorporated into the transfusion face-to-face training. Nurses administering blood components were empowered to challenge prescribers if the TACO pre-transfusion risk assessment was not correctly completed. Single unit transfusions were also promoted.

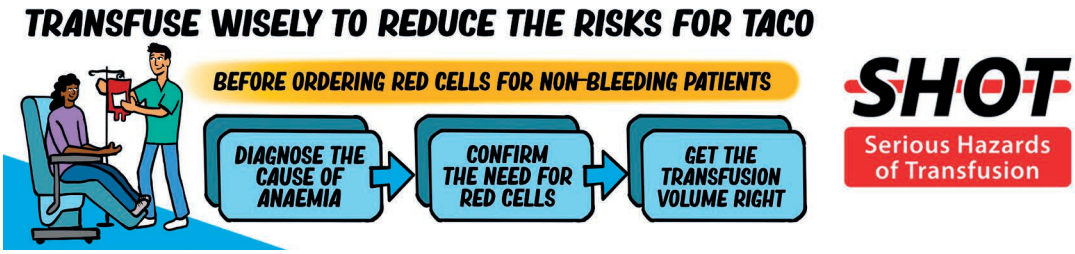
Overtransfusion and unnecessary transfusion remain major contributory factors in TACO and TACO-related deaths. This case highlights the risk of excessive transfusion in a patient with severe chronic anaemia where a minimal transfusion strategy could have been more appropriately adopted. Decision-making regarding the Hb target and volume to transfuse in the context of acute coronary syndrome is complex. The risk of ongoing cardiac ischaemia must be balanced by the risk of exacerbating heart failure and overload due to transfusion. However, in this case there was no evidence of acute coronary syndrome and the Hb target appeared to be based upon the patient having chronic cardiac disease. There is no specific Hb target for patients with severe chronic anaemia. Transfusion is not usually required if the Hb is >70g/L. Below this level a single unit of red cells with appropriate pharmacological treatment (e.g., intravenous iron) is usually indicated to relieve any severe symptoms of anaemia. The TACO pre-transfusion risk assessment has been updated to reflect this and the updated NBTC indication codes (NBTC, 2024). The 2023 Annual SHOT Report also highlighted the critical step of identifying the cause of anaemia as this is fundamental in informing appropriate transfusion strategy (Figure 20a.3) (Narayan, et al., 2024).

Figure 20a.3: Transfusion management of a non-bleeding adult patient – identification of the cause of anaemia



ACS=acute coronary syndrome; FBC=full blood count; Hb=haemoglobin; TACO=transfusion-associated circulatory overload

Unnecessary and excessive transfusion are significant contributors to TACO. Determining the correct dose of red cells in a non-bleeding adult patient is a key mitigation for TACO. This is important for all causes of anaemia. The cause of anaemia should be identified to establish the indication for transfusion which then informs the appropriate dose of red cells. A systematic approach should be taken.



Learning points

- Severe chronic anaemia (asymptomatic or minimally symptomatic) requires only minimal transfusion (usually a single unit) followed by pharmacological treatment where appropriate. Non-bleeding adult patients with severe chronic anaemia are particularly vulnerable to TACO even in the absence of comorbidities that predispose to TACO
- In all cases there should be a systematic approach to the decision to transfuse. The **cause** of anaemia should be identified to establish the **indication** for transfusion which then informs the appropriate **dose** of red cells. These are key factors in mitigating the risk of TACO

Conclusion

The most concerning signal from the 2024 data is the continued increase in mortality and major morbidity in reported cases of TACO. Unnecessary, avoidable and overtransfusion, particularly of red cells persist along with suboptimal management of severe chronic anaemia. This prompted the TACO NatPSA alert in 2024 which was intended to support organisations in implementing best practice to minimise the risk of TACO. The pathophysiology and aetiology of pulmonary complications of transfusion is complex and incompletely understood which limits mitigation strategies. However, there are well known risks associated with transfusions which can be mitigated by best practice measures. These include appropriate use of blood, alternatives to transfusion, and correct dose of blood components. The TACO pre-transfusion risk assessment (Figure 20a.1) has been updated to promote a systematic approach to red cell transfusion to address modifiable risks for TACO which include avoidable, inappropriate and excessive volume/dose. Organisations are encouraged to adopt the updated TACO pre-transfusion risk assessment (Figure 20a.1) and associated guidance (Figures 20a.3 and 20a.4) in this chapter.

Recommended resources

Example of weight-adjusted red cell dosing implemented in clinical practice
MHRA and UKCA marked blood transfusion Red Cell Dosage Calculator Web App
www.rcdcalculator.co.uk

TACO Incident Investigation Guidance Tool
https://www.shotuk.org/resources/transfusion-associated-circulatory-overload-taco-cumulative-data-2/

TACO pre-transfusion risk assessment (alternative format for incorporation into clinical documents)
https://www.shotuk.org/resources/taco-pre-administration-risk-assessment-transfusion-associated-circulatory-overload/

SHOT Bite No. 11: Respiratory symptoms during transfusion
https://www.shotuk.org/resources/shot-bite-no-11/

SHOT Video: TACO – Transfusion-Associated Circulatory Overload
https://www.shotuk.org/resources/taco-transfusion-associated-circulatory-overload/