**Yorkshire & The Humber Regional Transfusion Committee** **Document 2**

# THE NON- MEDICAL AUTHORISATION OF BLOOD COMPONENTS

Name of Candidate:

Job Title:

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Job Title:

Date Completed:

| Document Title | The non-medical authorisation of blood components workbook |
|---|---|
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**CONTENTS**

# 1. INTRODUCTION

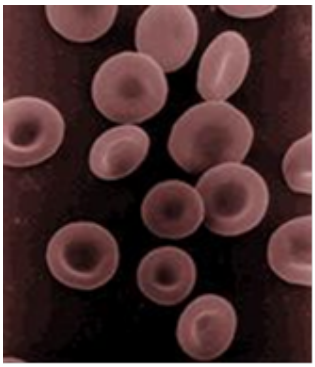
This workbook has been developed with the aim of aiding non-medical practitioners' to become proficient in the authorisation of blood and blood components within the realms of their specialty. It is acknowledged that there is significant variation in the use of transfusions in the medical and surgical arena.
There are two clear advantages of authorising blood components only when they are absolutely necessary:

- Donated blood is a limited resource.
- There are clear and potentially fatal risks to patients receiving transfusions.

Given the complex nature of differences between individual patients and their particular clinical condition, no guidelines can be absolute. This workbook highlights the main aspects and considerations for safely authorising blood components, which are generally applicable. This workbook does not cover specific transfusion requirements or thresholds and triggers for every circumstance; the authors acknowledge that there are specific conditions which require precise management.
For further reading re thresholds and triggers, refer to the individual Trusts policies and procedures.

# 2. RED CELLS

## 2.1. Basic facts



Red cells are also known as erythrocytes and are the most common type of blood cell in the body, they make up a quarter of the cells in the body. They contain Haemoglobin molecules which transport oxygen. See section 7.4
Red cells are made in the bone marrow, 2.4 million are produced per second and they circulate for about 100–120 days in the body before their components are recycled by macrophages. Each circulation takes about 20 seconds.
In humans, mature red blood cells are flexible biconcave disks that lack a cell nucleus. This aids transport of oxygen through the microcirculation and tiny arterioles.

## 2.2. Erythropoiesis

This is the process by which red blood cells are produced. It is stimulated by decreased $O_2$ in circulation, which is detected by the kidneys, which then secrete the hormone erythropoietin. This hormone activates increased erythropoiesis ultimately producing red blood cells. This usually occurs within the bone marrow; however, in humans with certain diseases, erythropoiesis also occurs outside the bone marrow, within the spleen or liver. This is termed extra medullary erythropoiesis.

## 2.3. Why transfuse red cells?

The aim of transfusing red cells is to maintain sufficient oxygen delivery to the tissues - the oxygen delivery must exceed oxygen consumption. Red cells then complete the cycle of respiration by transporting carbon dioxide to the lungs for expiration. Red cells must **never** be used for volume replacement.

## 2.4. How is oxygen ($O_2$) carried in the blood?

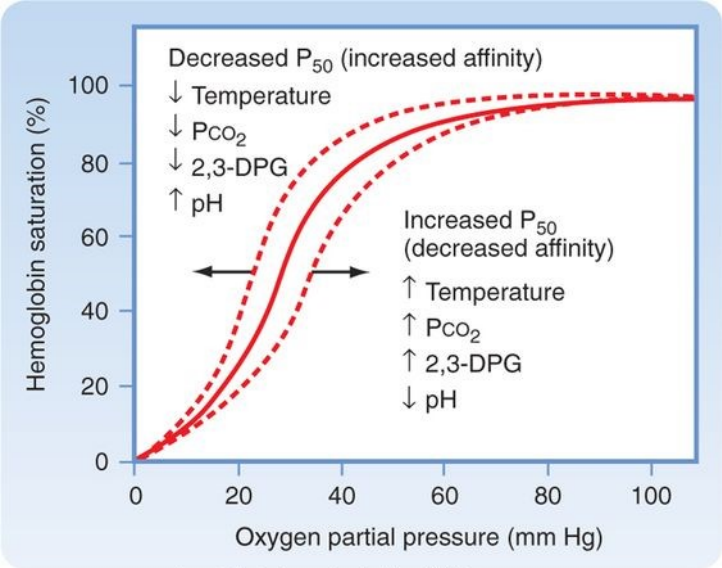
Oxygen is carried in the blood in two forms:

1. Dissolved in plasma in a very small amount which could never sustain tissues and another more effective method of carriage is needed.

2. The Haemoglobin (Hb) molecule found in red cells has 4 binding sites for $O_2$, the Hb is usually 97-98% saturated, hence the vast majority of $O_2$ is transported by this mechanism.

In health there is vast excess in capacity to deliver $O_2$ to tissues.

## 2.5. The oxygen dissociation curve and oxygen delivery




The oxygen dissociation curve shows the saturation of Hb at various partial pressures of oxygen in the body. At high $pO_2$ (i.e. in the lungs), oxygen binds to Hb (to form oxyhaemoglobin). If we follow the curve, when the blood passes through the heart and arteries the $pO_2$ drops but the Hb does not lose much oxygen. However as the blood reaches the deoxygenated tissues there is a large change in the % saturation of Hb, consequently the oxyhaemoglobin releases the oxygen.

When the Hb molecule is fully saturated with $O_2$ it does not easily give it up, however as each $O_2$ molecule breaks free from the Hb molecule binding site the next $O_2$ molecule is released more willingly.

There are several factors that can move the curve to the left or right (denoted by the dashed line in the diagram)
As tissues become more active the rate of respiration increases, more carbon dioxide is released the dissociation curve shifts to the right and Hb becomes more efficient at releasing oxygen.

### 2.6. 2, 3-Diphosphoglycerate (2, 3-DPG)

2, 3-DPG is present in the red blood cell and is an important adaptive mechanism, because the production increases for several conditions in the presence of diminished peripheral tissue $O_2$ availability, such as hypoxaemia, chronic lung disease, anaemia, and congestive heart failure, among others. It will improve oxygen delivery but this takes approximately 50 days to occur.

It is an important adaptation because it means that chronic anaemia can be well tolerated because a 50% decrease in oxygen carrying capacity is accompanied by only a 25% decrease in oxygen availability. And that the reserve of oxygen-carrying capacity is such that cardiac output at rest does not usually increase until the Hb falls below 70 g/L.

High levels of 2, 3-DPG shift the oxygen dissociation curve to the right, while low levels of 2, 3-DPG cause a leftward shift, seen in states such as septic shock.

There are many other mechanisms to compensate for low Hb levels and to maintain oxygen delivery. Tissues may increase blood flow by recruiting more capillaries or vasodilatation. Tissues may also increase oxygen extraction ratios. In acute anaemia clinicians may underestimate the effectiveness of such adaptive mechanisms, leading them to towards over-reliance on Hb levels and transfusions.

The cardiac output is probably a bigger player in the delivery of $O_2$ to the tissues than the $O_2$ content. This is because the cardiac output can almost instantaneously respond to a fall in $PaO_2$ saturation of Hb. Moderate hypoxaemia leads to an increase in the cardiac output. On the other hand, compensation for a fall in cardiac output is slow and weak (it takes time to increase Hb production and the $O_2$ dissociation curve is flat – it can't become anymore saturated). Nevertheless, in the clinical setting, it is often easier to increase the Hb or the fraction of inspired oxygen than to increase the cardiac output.

## 3. COAGULATION

### 3.1. Basic facts

Haemostasis is a process which causes bleeding to stop, meaning to keep blood within a damaged blood vessel. It is the first stage of wound healing. Most of the time this includes blood changing from a liquid to a solid state.

The endothelial cells of intact vessels prevent blood clotting with a heparin-like substance and prevent platelet aggregation with nitric oxide and prostacyclin. When endothelial injury occurs, the endothelial cells stop secretion of coagulation and aggregation inhibitors and instead secrete von Willebrand factor which initiate the maintenance of haemostasis after injury.

Haemostasis has three major steps: 1) vasoconstriction, 2) temporary blockage of a break by a platelet plug, and 3) blood coagulation, or formation of a clot that seals the hole until tissues are repaired.

### 3.2. Coagulation screen

The coagulation status of the patient is measured by performing a coagulation screen;

**PT**
**APPT**
**Clauss Fibrinogen** (measures actual fibrinogen not derived)
**INR** (if the patient is on Warfarin)

Additionally if the patient is on a Direct oral anticoagulation medication (Rivaroxaban or Apixaban) **Factor Xa levels** can be tested on request depending on the hospital site.

When interpreting the results, the co-morbidities of the patient needs to be taken into account. There can be several influences on the coagulation system including:

- hepatic failure,
- anti-platelet drugs (Clopidogrel, Aspirin),
- anti-coagulation therapy (Warfarin, Rivaroxaban, Dabigatran, Apixaban)
- dilutional coagulopathy in massive haemorrhage
- coagulation factor deficiencies.

Please refer to your local policies for the reference ranges and management plans for the results of the tests.

## 4. ESSENTIAL COMMUNICATION

In order to transfuse patients safely, there are a number of key stakeholders with whom the decision to transfuse must be communicated and where an effective working relationship must be nurtured.

### 4.1. The Patient

Following consultation on consent for transfusion by the Advisory Committee on the Safety of Blood, Tissues and Organs (SaBTO), there is a recommendation by the Department of Health (2011) for all NHS Trusts to ensure patients provide their informed consent wherever possible prior to the transfusion of blood components. These DoH recommendations stipulate;

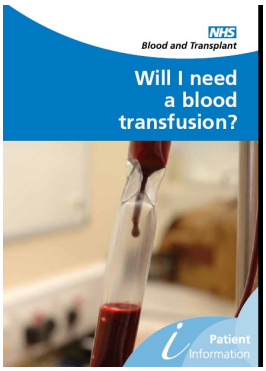
- there must be an unequivocal clinical indication for transfusion,
- that information of sufficient quality must be provided to allow patients to give fully informed consent
- that retrospective information on transfusion must be given to those patients transfused unknowingly (during their current admission).

SaBTO advises that valid consent entails the provision of information on risks, benefits and alternatives available before asking the patient to give consent.
This does not have to include a signature from the patient. It also recommends that consent should be standardised (with a checklist of key points to discuss) and that this is documented. Also particularly pertinent to haematology patients, that transfusion consent is modified and repeated at regular interval (according to local policy) - to cover aspects of increased risks in those multiple transfused patients i.e.

iron overload, increased risk of TTI, platelet refractoriness etc. and to establish if the patient is still willing to receive transfusion.

In March 2015 The Supreme Court ruled (Montgomery v Lanarkshire) on the requirement for risks, benefits and alternatives to be discussed when obtaining consent. Further details are available at; Montgomery (Appellant) v Lanarkshire Health Board (Respondent) (Scotland) - The Supreme Court

(https://www.supremecourt.uk/cases/uksc-2013-0136.html)




Confusion has arisen because written consent is not legally required, but this does not detract from the underlying principle. It is strongly recommended that verbal consent be recorded in the clinical notes (along with the indication) not least because in an increasingly litigious society, how can you prove two years or more down the line that you fulfilled your responsibilities
Gaining informed consent is of course a skill in itself, which requires practice, reflection on past experience, and a balance should be struck.
The process can be aided by the use of patient information leaflets, these are produced free of charge by NHS Blood and Transplant. Patient information leaflets - Hospitals and Science - NHSBT.
In some situations, (e.g. haematology oncology patients), consent should be taken by the consultant reviewing the patient and recorded in the relevant section of the patient assessment tool.
In other situations it is the responsibility of the medical practitioner/nurse authoriser or registered health care professional with the knowledge to do so, to discuss with the patient the need for transfusion and the potential benefits and risks. The patient may not see a medical practitioner during the transfusion episode therefore it is recommended that non-medical authorisers pay particular attention to NMC or other professional body guidance on consent.

### 4.2. The Clinical Team

It is vital that having correctly and appropriately requested/authorised blood transfusion, the clinical team looking after the patient are made aware of the decision, and able to carry through the process in as safe and efficient a manner as possible.
Transfusion Practitioners strive to train nursing/midwifery staff to question the indication for a transfusion, not least because they will have to address subsequent anxiety in patients (and/or their relatives) long after the authoriser has left the arena. It is also vital that there is a sensible prioritisation of the transfusion along with other essential care, in particular effective communication should avoid unnecessary overnight transfusions which audit has shown are all too common and SHOT data has proved are inherently less safe.

### 4.3. Non-Medical Authoriser

The Registered Practitioner must understand that by agreeing to act as an approved authoriser of blood transfusion under the framework documents they are extending their role and job description. They must perform this role in accordance with guidance from their professional body e.g. NMC and/or their own Code of Conduct, performance and ethics standards. The protocol must be followed to ensure

vicarious liability from their employing Trust. See appendix 4 of the 'Non-Medical Authorisation' framework document.

### 4.4. Transfusion Laboratory

Although less visible, the transfusion laboratory Biomedical Scientists (BMS) are integral to safe transfusions and have expert knowledge that is an invaluable resource available to you. For less clear cut cases speaking to a BMS over the phone is essential so that the true clinical picture can be understood by the laboratory. The National Blood Transfusion Committee Patient Blood Management guidelines (2014) has stated that blood transfusion laboratory staff should be empowered to question apparently inappropriate requests for blood components; the indicative parameters for transfusion should be clear on the request form.

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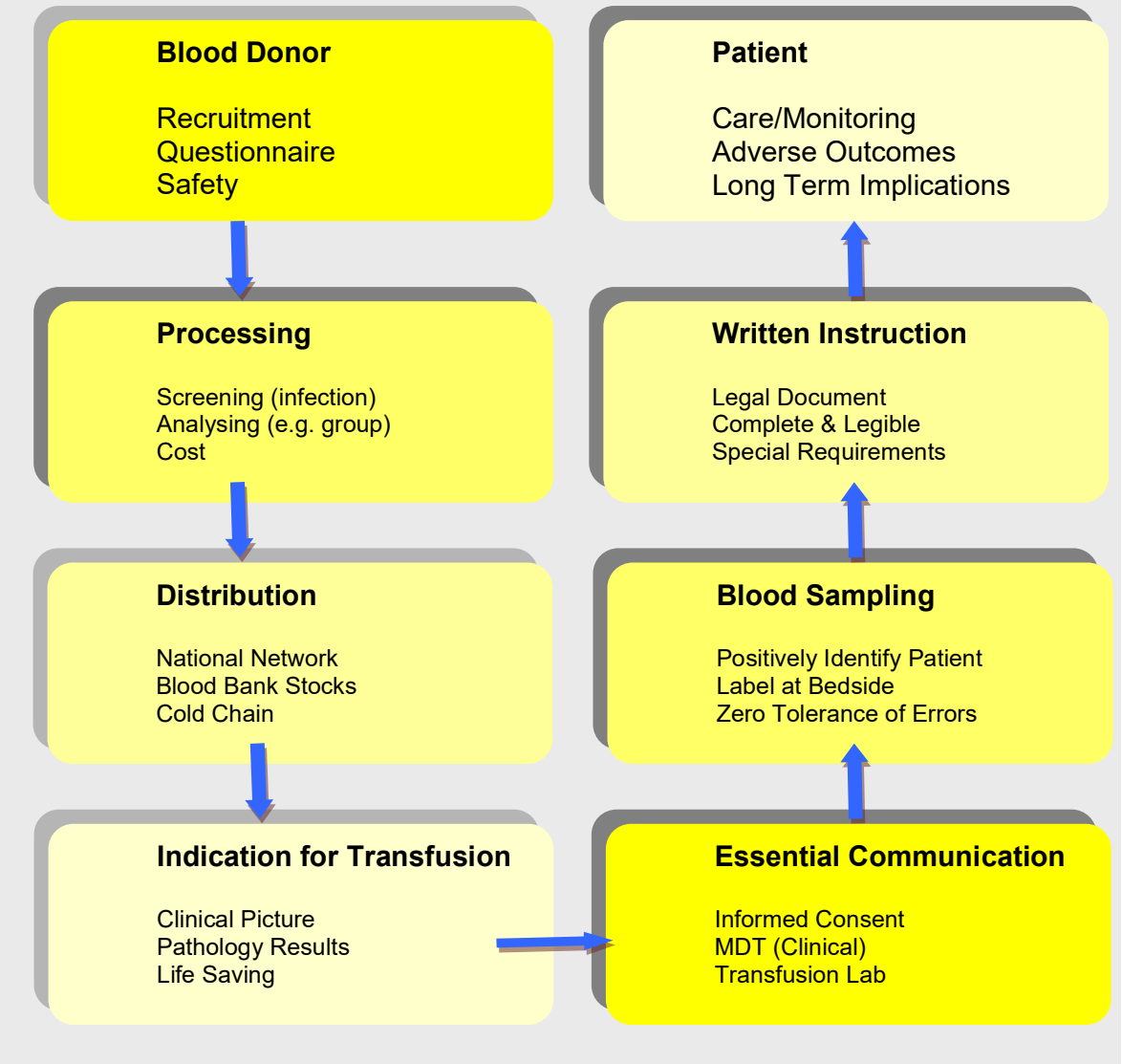
You have a responsibility to inform the laboratory on every request form of:

- Special requirements e.g. CMV Negative or Irradiated
- Previous transfusions
- Previous transfusion reactions
- Previous pregnancies
- Any known antibodies

The BMS can in turn advise you when to repeat blood samples for compatibility testing because recent transfusions can produce new antibodies which if undetected could lead to a haemolytic transfusion reaction.

In summary, safe transfusion is a collaborative process between all of these key stakeholders.

## 5. OVERVIEW OF ENTIRE TRANSFUSION PROCESS: SALIENT POINTS




## ROLES AND RESPONSIBILITIES

## 6. PATIENT BLOOD MANAGEMENT (PBM)

PBM is a multidisciplinary, evidence-based approach to optimising the care of patients who might need blood transfusion. PBM puts the patient at the heart of decisions made about blood transfusion to ensure they receive the best treatment and avoidable, inappropriate use of blood and blood components is reduced.

PBM represents an international initiative in best practice for transfusion medicine. NHS Blood and Transplant (NHSBT) is working together with the Department of Health and the National Blood Transfusion Committee to support NHS Trusts to manage their blood use effectively. Evidence shows that there is inappropriate use that can be reduced and that the current trend of annual increases in use is not sustainable.

There are 3 principles involved in PBM:

1) **Optimising red cells before treatment**
- Active management of anaemia
- Be aware of drug interactions that can increase risk of anaemia
- Accurate patient history, travel, previous abnormal bleeding

**2) Minimising blood loss throughout treatment and control bleeding –**
- Reduce iatrogenic blood loss (i.e. take smaller volumes and less samples from patients)
- Active management of abnormal haemostasis
- Surgical techniques

**3) Avoid unnecessary transfusion**
- Use restrictive threshold values
- In non-bleeding patients transfuse one dose of blood component, then reassess
- Use alternatives to transfusion where appropriate

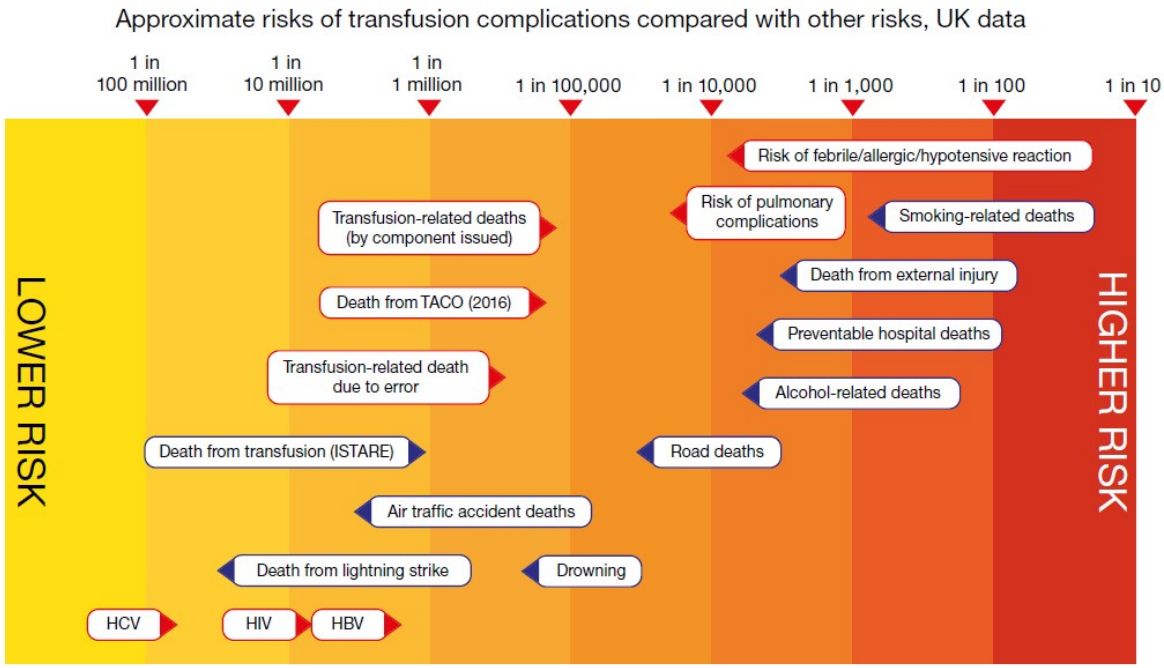
## 7. RISKS OF TRANSFUSION

Since 1996 evidence for the risks of transfusion have been illustrated by the data from Serious Hazards of Transfusion (SHOT) scheme. SHOT is highly respected and valued in transfusion medicine worldwide and is recognized as one of the first haemovigilance schemes. Consistently the data has demonstrated by some considerable margin that human error is the biggest risk in transfusion.

The overview of the transfusion process (section 5) highlights just how many steps there are between blood donor and recipient and that many disciplines are involved. A chain is only as strong as its weakest link, errors can occur at any point. The Blood Safety and Quality Regulations 2005 (SI/50/2005) have strictly addressed the matter of the production and distribution of blood components along the principles of “Good Manufacturing Practice”, which are effectively quality assurance mechanisms.

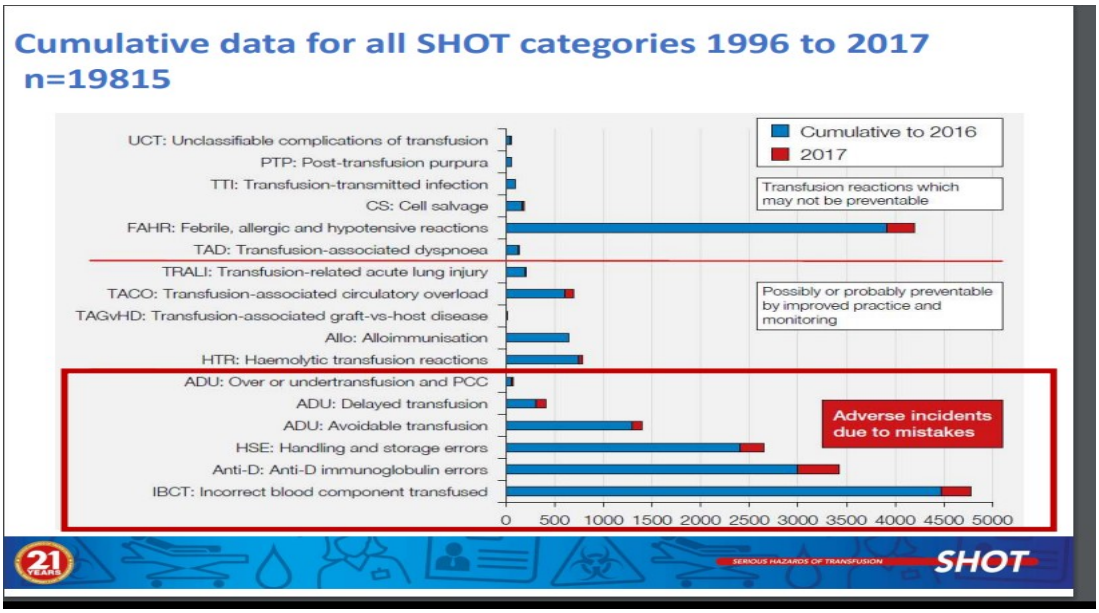
It is now a statutory requirement to investigate and report all errors occurring within the blood transfusion services and hospital laboratories, including “Corrective and Preventative Actions (CAPA)” taken. Although there has been a steep learning curve for both national transfusion services and hospital laboratories, these must be seen as positive steps to improve patient safety.

Currently the practice in clinical areas is less controlled and both national audits, and clinical incidents, demonstrate areas of weakness. The biggest risk to patients is healthcare professionals' complacency. A good example of this is patient identification and labeling of blood samples. The task itself is not complicated and as a result, dare we say, practitioners do not perform this process with the necessary respect for safe protocol. Simple mislabeling of blood samples has led to patients being transfused the wrong ABO blood group with devastating consequences.




*Sources of data: Many of these are found online in the UK office for national statistics. Red outline indicates SHOT data, blue outline indicates data from other sources. ISTARE is the International Haemovigilance Network database for the surveillance of adverse reactions and events in donor and recipients. Viral transmissions denote risk of infection, not deaths. HCV=hepatitis C virus; HIV=human immunodeficiency virus; HBV=hepatitis B virus. A full list of sources is available in supplementary information on the SHOT website www.shotuk.org.*

## 8. SHOT CASES




In broad figures over 99% of all blood components transfused occurred without incident although we cannot be sure that every event has been reported. The overall numbers of adverse events are low, and so the chances of these types of reactions equally are low however, we can never know which patients will suffer these outcomes. There is additionally the unknown element of undiscovered pathogens for which transfusion can be the medium of entry. These arguments combine to form the principle that patients should only be transfused when it is absolutely necessary. Furthermore, during and after a transfusion, patients should be closely monitored.

## 9. PRE - TRANSFUSION TESTING

The patient's pre-transfusion blood sample is tested to determine the ABO and RhD groups and the plasma is screened for the presence of red cell alloantibodies capable of causing transfusion reactions. Antibody screening is performed using a panel of red cells that contains examples of the clinically important blood groups most often seen in practice. Blood units of a compatible ABO and Rh group, negative for any blood group alloantibodies detected, can then be selected from the blood bank, taking into account any special requirements on the transfusion request such as irradiated or cytomegalovirus (CMV) negative components.

Almost all hospital laboratories carry out blood grouping and antibody screening using automated analysers with computer control of specimen identification and result allocation. This is much safer than traditional manual techniques and eliminates most transcription and interpretation errors. ABO grouping is the single most important test performed on pre-transfusion samples and the sensitivity and security of testing systems must never be compromised.

9.1.1. Electronic issue

This is sometimes known as computer cross matching. Most hospitals now issue the majority of blood by this safe and rapid technique. It relies on the fact that if the patient's ABO and RhD groups are reliably established, and a sensitive antibody screen is negative, the possibility of issuing incompatible blood is negligible. The laboratory computer can identify all compatible units in the blood bank inventory without the need for further testing. There are exceptions to Electronic issue in some patients so ensure you are aware of local guidance

# 10. TRANSFUSION ALTERNATIVES

When justifying a transfusion to a patient in order to gain their informed consent, it is vitally important to explore any potential alternatives to transfusion with them. Patients may have objections to blood transfusion, e.g. Jehovah's Witnesses (JW) on religious grounds (predominantly cellular components of blood), or for other reasons, they do not want to be given donor blood.

Patients who are anaemic due to a deficiency in their haematinic profile (iron, B12, Folate) respond very well to replacing the missing ingredient for the production of healthy red cells. In particular this treatment highlights the importance of good surgical pre-assessment; where there is time to correct anaemias in this way prior to surgery.

Anaemias caused by impairment of erythropoietin, typically secondary to chronic renal failure, can be treated with recombinant erythropoietin (EPO) again with good effect. EPO has been shown to reduce the need for transfusion with cancer patients who have myelosuppression secondary to their cytotoxic treatment.[i] However there are question marks over the effect on quality of life and of greater concern some trials indicate that EPO may encourage tumour growth firstly by stimulating tumour blood vessel formation and secondly that some cancer cells express EPO receptors. Although not licensed for this purpose, EPO is occasionally given to JW patients who are severely anaemic post-surgical or other traumatic incident in an attempt to raise their haemoglobin in as short a time as possible.

## 10.1. Autologous Transfusion

10.1.1. Acute Normovolaemic Haemodilution (ANH)

This practice is permitted under the Blood Safety and Quality Regulations 2005 with the strict proviso that the blood is returned to the patient within a very short time and never leaves the patient's side. This is practiced rarely by anaesthetists immediately prior to surgery, where approximately 500ml of whole blood is venesected, the volume replaced with colloid and crystalloid. Any blood loss during surgery is diluted blood, the anaesthetist then returns the Autologous blood with the net loss being less than without the ANH.

### 10.1.2. Intra-Operative Cell Salvage

There are several devices that enable intra-operative cell salvage, some mechanised using centrifugation and some use filtration. Essentially any blood loss during surgery is taken from the surgical field under suction, mixed with anti-coagulant, processed and returned. The Centrifugation devices will separate the red cells providing a red cell rich product, it must be noted that the other major components of whole blood are not returned, especially clotting factors and platelets, vital ingredients to replace for a patient who has suffered major blood loss including major obstetric haemorrhages.

Some centres have successfully used cell salvage for trauma cases, such as reclaiming blood loss into chest drains, which has significantly reduced the need for donor blood. In experienced hands, cell salvage can reduce the time period for which the patient is severely compromised due to red cell loss.

### 10.1.3. Post-Operative Cell Salvage

There are different devices on the market that are designed to draw blood from wounds, e.g. knee and hip replacement, which can then simply be returned to the patient's bloodstream. Timing is very important with these devices to minimise the risk of bacterial growth, the maximum time to collect and return the blood is six hours.

It is the responsibility for each practitioner to determine which cell salvage process is used in their Trust.

## 10.2. IV/oral Iron

Oral iron is the preferred, and safest, first-line therapy for most patients with iron deficiency anaemia but many users experience gastrointestinal side effects and compliance with treatment is poor.

Parenteral iron produces more rapid responses and better repletion of iron stores in several clinical settings but, until recently, its use was limited by a significant risk of severe, occasionally fatal, allergic reactions with the available preparations (especially high molecular weight iron dextran). The currently available preparations have a very low incidence of serious reactions and have brought parenteral iron back into mainstream practice. Common indications for the use of intravenous iron include:

- Iron deficiency anaemia with intolerance of oral iron, especially in inflammatory bowel disease, or where oral iron is ineffective.
- To support the use of erythropoiesis stimulating agents (including patients on renal dialysis).
- As an alternative to blood transfusion when a rapid increase in Hb is required (e.g. perioperative anaemia, severe anaemia in late pregnancy or postpartum anaemia).

The availability of individual parenteral iron preparations varies between hospitals and they should be used according to local guidelines and policies.

### 10.3. Tranexamic acid

Tranexamic acid inhibits fibrinolysis (the breakdown of blood clots) by reducing the conversion of plasmin to plasminogen. It is low cost and can be used by the oral or intravenous route. A recent systematic review of trials in many forms of surgery confirms that tranexamic acid reduces both the risk of receiving a blood transfusion (by around 30%) and the need for further surgery due to re-bleeding. A small increase in the risk of thromboembolic events could not be excluded but there was no increase in mortality in patients receiving tranexamic acid. Many different dosages were used in surgical trials, but low-dose protocols appeared equally effective.

## 11. TRANSFUSION CHART

There is wide variation between different healthcare organisations as to where blood components are authorised, for example:

- Integrated care pathways
- Separate blood prescription charts
- Medicines prescription chart / fluid chart (paper or electronic)

There are essential factors required in all of these approaches including:

- Patient minimum dataset (which has been verified)
- Clear legible handwriting
- Type and quantity of components required
- Duration
- Special Requirements
- Additional medications e.g. diuretics / antihistamines
- Sign and PRINT your name, to provide a clear audit trail

NB. Red cell transfusion must be completed within 4 hours of leaving the blood fridge. If it takes 30 minutes for the collection and bedside checking, that only leaves 3½ hours for transfusion time. Patients who have a compromised cardio-vascular system can be prescribed diuretics, e.g. 20mg Furosemide P.O. given with the second unit of a two unit transfusion, dose and route can vary depending on the indication. Patients who have previously had mild allergic reactions (more common with platelets) may be prescribed an antihistamine prior to transfusion.

Blood transfusion can be described as a “liquid transplant” it is a human tissue transplant that must be treated in practice with the appropriate gravitas.

## 12. CHRONIC ANAEMIA

There are a number of differences between acute and chronic anaemia and it is worth considering these when deciding whether or not to transfuse a patient.

### 12.1. Hypovolaemia

Hypovolaemia is at least initially the major problem in acute blood loss; however the patient with chronic anaemia is normovolaemic or even hypervolaemic.

### 12.2. Rate of change and ability to compensate

In cases of chronic anaemia, the fact that the changes have happened more slowly brings two advantages; firstly there is time to consider the risks and benefits and involve the patient in the decision to transfuse; secondly, an increase in red cell 2, 3-DPG leads to a shift in the oxygen dissociation curve and improved delivery of oxygen to tissues. Consider transfusing one unit at a time with assessment after each unit to avoid unnecessary transfusion and donor exposure.

### 12.3. The alternatives (dependent on the reason for anaemia)

Management will differ depending on the cause. Transfusions should not be given where there are effective alternatives, e.g. treatment of iron, folate or B12 deficiency, unless the anaemia is life threatening. This will have been considered by the senior medical staff managing the patients care. If there is evidence that the patient would benefit from alternative treatments please refer to the patient's medical team prior to authorising a transfusion.

## 13. NICE GUIDELINES ON BLOOD TRANSFUSION (NG24)

NICE guidelines on blood transfusion (NG24) highlights the requirement for a restrictive transfusion practice in patients who do not;

- have major haemorrhage or
- have acute coronary syndrome or
- need regular blood transfusions for chronic anaemia.

When using a restrictive red blood cell transfusion threshold, consider a threshold of 70 g/litre and a haemoglobin concentration target of 70–90 g/litre after transfusion. Consider a red blood cell transfusion threshold of 80 g/litre and a haemoglobin concentration target of 80–100 g/litre after transfusion for patients with acute coronary syndrome.
Consider setting individual thresholds and haemoglobin concentration targets for each patient who needs regular blood transfusions for chronic anaemia.

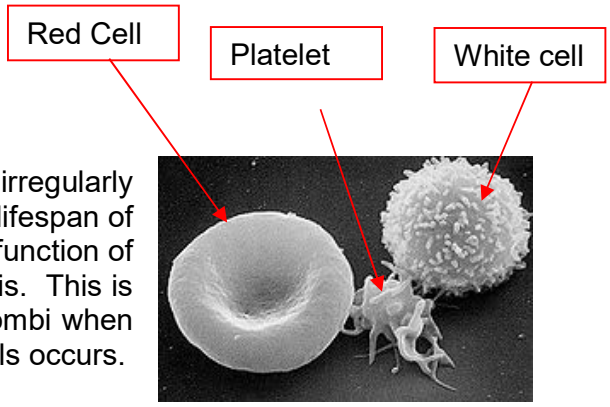
Consider single-unit red blood cell transfusions for adults (or equivalent volumes calculated based on body weight for children or adults with low body weight) who do not have active bleeding.
After each single-unit red blood cell transfusion (or equivalent volumes calculated based on body weight for children or adults with low body weight), clinically reassess and check haemoglobin levels, and give further transfusions if needed.

Transfusion indication codes can be found on;
https://www.transfusionguidelines.org/document-library/documents/nbtc-indication-codes-june-2016v2.

# 14. MAJOR HAEMORRHAGE TRANSFUSION

The management of a patient with major haemorrhage has three elements: assessment and resuscitation following Advanced Life Support principles; local control of bleeding (surgical, radiological and endoscopic techniques); and haemostatic, including transfusion support.
Ensure you are aware of local protocols regarding the management of major haemorrhages including major trauma. The British Standards in Haematology national guidelines on major haemorrhage can be found on;
https://b-s-h.org.uk/guidelines/guidelines/haematological-management-of-major-haemorrhage/.

# 15. PLATELETS




## 15.1. Basic facts

Platelets, or thrombocytes, are small, irregularly shaped clear cell fragments. The average lifespan of a platelet is normally just 5 to 9 days. The function of platelets is the maintenance of haemostasis. This is achieved primarily by the formation of thrombi when damage to the endothelium of blood vessels occurs.

## 15.2. Maintenance of haemostasis

When the endothelial layer is injured, collagen, von Willebrand Factor and tissue factor from the sub-endothelium is exposed to the bloodstream. When the platelets contact these, they are activated to become aggregated (e.g. to clump together).
The blood clot is only a temporary solution to stop bleeding; vessel repair is therefore needed. The aggregated platelets help this process by secreting chemicals that promote the invasion of fibroblasts from surrounding connective tissue into the wounded area to completely heal the wound or form a scar. The obstructing clot is slowly dissolved by the fibrinolytic enzyme, plasmin, and the platelets are cleared by phagocytosis.

## 15.3. Indications for platelet transfusion

Platelet transfusions are indicated for the prevention and treatment of haemorrhage in patients with thrombocytopenia or platelet function defects. Platelets are not indicated in all causes of thrombocytopenia and may indeed be contraindicated in certain conditions (BCSH 2016).
It is therefore important that the cause of the thrombocytopenia is known before transfusion. As with all transfusions the decision to transfuse must involve assessment of the risks versus expected benefits.

# 16. PLASMA COMPONENTS /PRODUCTS

## 16.1. Basic Facts

Fresh Frozen Plasma (FFP) contains all coagulation factors in normal concentrations. Plasma is free of red blood cells, leucocytes and platelets. One unit

is approximately 250mL and must be ABO compatible. Rh factor need not be considered.
UK FFP is from predominantly male donors.
Those patients born after 1st January 1996 should receive plasma sourced from countries with a low risk of vCJD i.e. pathogen reduced FFP (MBFFP) or Octaplas.

### 16.2. Indications

- Replacement of single coagulation factor deficiencies where no concentrate is available
- The treatment of acute disseminated intravascular coagulation (DIC) with associated bleeding and abnormal coagulation results
- Plasma exchange; specific guidance on which component/product should be used is available at; http://www.b-s-h.org.uk/guidelines/guidelines/clinical-use-of-apheresis-procedures/.
- The management of massive haemorrhage

There is no evidence for use in non-bleeding patients with liver disease

FFP should not be used for the reversal of warfarin, it only has a partial effect and the optimal treatment is the use of a prothrombin complex concentrate and/or Vitamin K ,
The prescription of FFP should be guided by the clinical situation and coagulation results.

### 16.3. Dosage

The recommended therapeutic dose is 15ml/kg in adults which is equivalent to 4 units of FFP in a 65 to 80Kg patient. It is important that the patient receives enough plasma to be clinically effective but not too much to increase the risk of overload and other reactions. The patient may require more or less plasma due to their weight and indication for treatment.

## 17. CRYOPRECIPITATE

Used as a source of concentrated FVIII and von Willebrand factor, fibrinogen, Factor XIII and fibronectin. It is most commonly used in major haemorrhage if after FFP; fibrinogen levels remain <1.5gL or <2g/L in obstetric haemorrhage.

## 18. TRANSFUSION REACTIONS

### 18.1. Acute Haemolytic Transfusion Reaction (AHTR)

AHTRs can be immune-mediated or non-immune-mediated. Immune-mediated haemolytic transfusion reactions happen when transfused red cells of the incorrect ABO group react with the patient's anti-A or anti-B immunoglobulin M (IgM) causing an acute severe clinical reaction (symptoms may occur after just a few mls of blood have been transfused).

AHTR symptoms are produced due to destruction of red cells within the bloodstream (intravascular haemolysis). This occurs because the antigen antibody reaction activates the entire complement cascade, which results in holes punched in the red cells causing them to rupture.
Transfusion of a small volume of ABO-incompatible plasma is unlikely to cause haemolysis in the recipient. However, infusing a unit of plasma (or cryoprecipitate or

platelet concentrate) containing a potent anti A or anti B antibody may haemolyse the recipient's red cells. Group O plasma and platelet components should only be given to group O recipients (Transfusion Medicine 2013).
Administration of ABO incompatible blood may start with the patient feeling anxious commonly referred to as a "sense of impending doom".

N.B. You must be aware that an AHTR can present very subtly with little more than a fever. Refer to your trust guidelines in treating transfusion reactions.

These reactions are frequently due to human error at some point in the transfusion process. It is therefore imperative to take steps immediately to protect any patients that may be involved in the error.

### 18.2. Bacterial Contamination

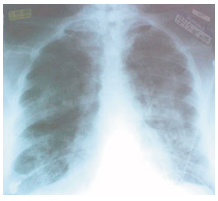
Common signs and symptoms of a bacterial contamination are fever, chills, rigors, vomiting tachycardia and hyper or hypotension, and collapse, usually during the transfusion but can occur a few hours later. The shock that occurs is likely to be due to bacterial toxins, although immune reactions that take place between naturally occurring antibodies and the bacteria are also a factor. The signs and symptoms may be similar to acute haemolytic transfusion reactions or severe acute allergic reactions.

These patients should be managed initially as for an acute haemolytic reaction, but also take blood cultures and seek expert microbiology advice and give combination of antibiotics that will be active against the range of bacteria that may be involved. . It is also essential that NHSBT is informed (via your transfusion laboratory) of a suspected contamination so that other components from the donor can be recalled.

### 18.3. Transfusion Related Acute Lung Injury (TRALI)

The mechanism by which TRALI occurs is not yet fully understood. In most cases leucocyte antibodies have been found in the plasma of the donor that are thought to act against antigens on the recipient's leucocytes. It is thought that these antibodies activate the leucocytes, which are then sequestered in the lungs where they cause pulmonary capillary endothelial cell damage that allows fluid to leak into the alveoli (Dry 1999). However, in some cases, no antibody is found in the donor so TRALI may occur as part of a "two-hit" process. The first hit is a serious illness in the patient. The second hit is the transfusion of a blood component containing either:

- Leucocyte antibody directed against the patient's leucocytes
- Biologically active lipids that develop in stored blood, capable of causing the release of inflammatory mediators that damage the pulmonary vascular endothelium
- Or both leucocyte antibody and biologically active lipids



Symptoms include fever and chills, hypotension, breathlessness and non-productive cough, usually occurring within a few hours of the transfusion. The chest X-ray characteristically shows bilateral nodular infiltrates in a batwing pattern, typical of acute respiratory distress syndrome.

The management will involve seeking urgent critical care and haematology advice. Treatment is the same as adult respiratory distress syndrome from any cause. Diuretics should be avoided.

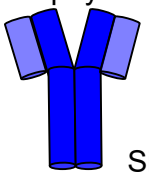
All cases of TRALI must be reported to MHRA and SHOT. NHSBT should also be informed so that the donor, if appropriate, can be removed from the donor panel.

### 18.4. Transfusion Associated Circulatory Overload (TACO)

TACO is a condition that is probably under diagnosed, which may cause acute left ventricular failure (LVF) with dyspnoea, tachypnoea, raised JVP, basal lung crackles, frothy pink sputum, hypertension and tachycardia. Patients are at risk if over-transfused or transfused too quickly.
SHOT have produced a TACO checklist which is available at;
http://www.shotuk.org/wp-content/uploads/SHOT-Summary-Infographic_Final.pdf

### 18.5. Allergic reactions

Anaphylactic reactions are IgE mediated. They are likely to occur in IgA deficient patients with anti-IgA. These patients can have severe anaphylaxis when exposed to donor plasma containing IgA.



Signs and symptoms include hypotension, bronchospasm, periorbital and laryngeal oedema, vomiting, erythema, urticaria and conjunctivitis, dyspnoea, chest pain, abdominal pain and nausea.

#### 18.5.1. Less severe allergic reactions

These reactions involving urticaria or itching within minutes of starting a transfusion are quite common.

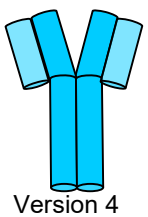
If a patient has suffered an allergic reaction in the past an antihistamine may be given before starting the transfusion. If a reaction occurs in spite of this precaution saline-washed blood components should be considered.

### 18.6. Febrile, Allergic or Hypotensive Reactions (FAHR)

These reactions are often caused by cytokines from leucocytes in the transfusion. The patient has a fever (> 1.5°C above baseline) usually with shivering and general discomfort during the transfusion or up to two hours after.
N.B. care must be taken in diagnosing a FNHTR as haemolytic and septic reactions can present similarly.

### 18.7. Delayed complications of transfusion

#### 18.7.1. Delayed Haemolytic Transfusion Reaction (DHTR)



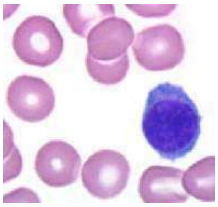
Immune-mediated haemolytic reactions involving IgG typically cause extravascular haemolysis (in this context extravascular means outside the main blood vessels) for example:

- Rh antibodies (anti-D, anti-C, anti-c, anti-E, anti-e)
- Anti-Kell (anti-K, anti-k, anti-Kp$^a$, anti-Js$^a$ etc.)
    - Anti-Kidd (anti-Jk$^a$ and anti-Jk$^b$)
    - Anti-Duffy (anti -Fy$^a$ and anti-Fy$^b$)
    - Anti-S

Antibodies attach to antigens on the red cell, which are then phagocytosed by macrophages, and also lysed within the hepatic and splenic sinusoids.

The reaction usually occurs within 14 days of transfusion, and may include falling Hb levels, a lower rise in Hb than expected, jaundice, fever and rarely haemoglobinuria or renal failure. The laboratory should be informed immediately and must investigate. Renal function should be closely monitored although specific treatment is rarely required.

### 18.8. Transfusion Associated Graft-versus Host Disease (TA-GvHD)

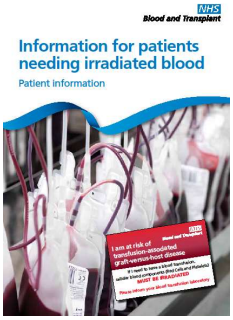


TA-GvHD is a life threatening complication of transfusion that is in most cases preventable. Usually a recipient of a transfusion will recognise any foreign lymphocytes and destroy them; however there are 2 conditions that prevent the recipients from protecting themselves in this way:

1. If the recipient shares the HLA haplotype of the donor
2. Defective cell-mediated immunity in the recipient.

In these patients the donor lymphocytes engraft and proliferate, they then recognise the recipient's cells as foreign and attack them causing inflammation and tissue damage.

Clinical features include fever, skin rash, diarrhoea, hepatic dysfunction, and bone marrow failure typically 1-2 weeks after the transfusion (Handbook of Transfusion Medicine 2014).




Although all blood components are leucodepleted by filtration, lymphocytes are a similar size to red cells, and some are still present after filtration. Cellular blood components can be made safe by gamma or X-ray radiation that stops lymphocyte proliferation. These components have a label applied to the bag, which turns black on successful irradiation. Patients who require irradiated blood should be given an information leaflet and card, which are available from the local blood centre.

### 18.9. Post Transfusion Purpura (PTP)

PTP is an extremely rare but serious complication of transfusion; there is a sudden drop in platelet count usually 5-10 days after transfusion. The thrombocytopenia is so severe that haemorrhage occurs and could be fatal. In a patient who has already been sensitised either by pregnancy or a previous transfusion the thrombocytopenia is caused by an antibody-mediated reaction that destroys both donor and (for reasons not completely understood) the patient's own platelets (2011). PTP must be reported to both the MHRA and SHOT. Treatment of choice is IV IgG (85% response rate). Platelet transfusions (random or antigen negative) are ineffective and should be given for life threatening haemorrhage only.

## 19. COMPLICATIONS OF CHRONIC TRANSFUSION

Some patients require long-term red cell transfusion programmes, e.g. Haemoglobinopathies or marrow failure due to disease. These patients require sensitive care to deal with problems including poor venous access, reduced quality of life and frequent visits to hospital. Additionally, the more donor blood a patient is exposed to the more difficult it can become to find them suitable blood (excepting thalassaemia) and the higher the chances of a transfusion reaction.

Another complication of long-term transfusion therapy is the build-up of iron, which is deposited in major organs (heart, liver and endocrine system). Often when this problem presents itself, the patient is extremely unwell and there is little that can be done. Iron chelating therapy to excrete the excess iron initially was limited to sub-cutaneous infusions of desferrioxamine, which had varying levels of patient compliance (pain, oedema, inconvenience) similar to other chronic diseases. More recently oral iron chelators have been introduced which have been shown to be effective and with minimal toxicity (Hershko 2006).

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## Additional Articles related to Patient Blood Management

**Prospective and retrospective adjudication of appropriateness in single versus multiple unit red blood cell transfusions**

**Author(s):** Marleau S.; Roland K.; Shih A.W.Y.; Trudeau J.

**Source:** Transfusion; Oct 2018; vol. 58

**Publication Date:** Oct 2018

**Publication Type(s):** Conference Abstract

Available at Transfusion - from Wiley Online Library Medicine and Nursing Collection 2017

**Impact of a patient blood management program within an Orthogeriatric care service**

**Author(s):** Bielza R.; Arias E.; Neira M.; Mora A.; Zambrana F.; Sanjurjo J.; Sanz-Rosa D.; Thuissard I.J.; Gomez Cerezo J.F.

**Source:** Transfusion and Apheresis Science; Aug 2018; vol. 57 (no. 4); p. 517-523

**Publication Date:** Aug 2018

**Publication Type(s):** Article

Available at Transfusion and Apheresis Science - from ScienceDirect

**Clinical experience with ferric carboxymaltose in the management of anemia in acute gastrointestinal bleeding.**

**Author(s):** Ballester-Clau, Raquel; Torres Vicente, Gisela; Voltà-Pardo, Tania; López-Barroso, Laura; Cucala-Ramos, Mercedes; Reñé-Espinet, Josep M; Planella de Rubinat, Montse

**Source:** European journal of gastroenterology & hepatology; Oct 2018

**Publication Date:** Oct 2018

**Publication Type(s):** Journal Article

**PubMedID:** 30335628

**Clinical trials evaluating red blood cell transfusion thresholds: An updated systematic review and with additional focus on patients with cardiovascular disease.**

**Author(s):** Carson, Jeffrey L; Stanworth, Simon J; Alexander, John H; Roubinian, Nareg; Fergusson, Dean A; Triulzi, Darrell J; Goodman, Shaun G; Rao, Sunil V; Doree, Carolyn; Hebert, Paul C

**Source:** American heart journal; Jun 2018; vol. 200 ; p. 96-101

**Publication Date:** Jun 2018

**Publication Type(s):** Journal Article

**PubMedID:** 29898855

**Introduction of national guidelines for restrictive blood transfusion threshold for hip fracture patients—a consecutive cohort study based on complete follow-up in national databases.**

**Author(s):** Viberg, Bjarke; Gundtoft, Per Hviid; Schønnemann, Jesper; Pedersen, Lasse; Andersen, Lis Røhl; Titlestad, Kjell; Madsen, Carsten Fladmose; Lauritsen, Jens; Overgaard, Søren

**Source:** Journal of Orthopaedic Surgery & Research; May 2018; vol. 13 (no. 1)

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**Five-year trends in perioperative red blood cell transfusion from index cases in five surgical specialties: 2011 to 2015.**

**Author(s):** Mazzeffi, Michael A; See, John M; Williams, Brittney; Richards, Justin; Zimmerman, Darin; Galvagno, Samuel; Fontaine, Magali; Tanaka, Kenichi

**Source:** Transfusion; May 2018; vol. 58 (no. 5); p. 1271-1278

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**Advances in transfusion medicine: gastrointestinal bleeding**

**Author(s):** Oakland K.; Murphy M.F.; Jairath V.

**Source:** Transfusion Medicine; Apr 2018; vol. 28 (no. 2); p. 132-139

Available at Transfusion medicine (Oxford, England) - from Wiley Online Library Medicine and Nursing Collection 2017

**Patient blood management in surgery-results of a repeat UK national comparative audit with improvement in practice**

**Author(s):** Allard S.; Pendry K.; Richards T.; Grant-Casey J.; Lowe D.; Highton D.; Kotze A.

**Source:** British Journal of Haematology; Apr 2018; vol. 181 ; p. 33-34

**Publication Type(s):** Conference Abstract

**Contemporary Risk Factors and Outcomes of Transfusion-Associated Circulatory Overload.**

**Author(s):** Roubinian, Nareg H; Hendrickson, Jeanne E; Triulzi, Darrell J; Gottschall, Jerome L; Michalkiewicz, Michael; Chowdhury, Dhuly; Kor, Daryl J; Looney, Mark R; Matthay, Michael A; Kleinman, Steven H; Brambilla, Donald; Murphy, Edward L; National Heart, Lung, and Blood Institute (NHLBI) Recipient Epidemiology and Donor Evaluation Study-III (REDS-III)

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**Publication Date:** Apr 2018

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**Author(s):** Neoh, Karen; Stanworth, Simon; Bennett, Michael I

**Source:** BMJ supportive & palliative care; Mar 2018

**Publication Date:** Mar 2018

**Publication Type(s):** Journal Article

**A single unit transfusion policy reduces red cell transfusions in general medical in-patients**

**Author(s):** Heyes J.; Dhesi A.; Kelly P.A.; Monaghan K.; Lawn M.; Mijovic A.

**Source:** QJM; Oct 2017; vol. 110 (no. 10); p. 735-739

**Publication Date:** Oct 2017

**Publication Type(s):** Article