

WIDER PERSPECTIVES

Mitigating the impact of blood shortages in England

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Summary

The supply of blood components and products in sufficient quantities is key to any effective health care system. This report describes the challenges faced by the English blood service, NHS Blood and Transplant (NHSBT), towards the end of the COVID-19 pandemic, which in October 2022 led to an Amber Alert being declared to hospitals indicating an impending blood shortage. The impact on the hospital transfusion services and clinical users is explained. The actions taken by NHSBT to mitigate the blood supply challenges and ensure equity of transfusion support for hospitals in England including revisions to the national blood shortage plans are described. This report focuses on the collaboration and communication between NHSBT, NHS England (NHSE), Department of Health and Social Care (DHSC), National Blood Transfusion Committee (NBTC), National Transfusion Laboratory Managers Advisory Group for NBTC (NTLM), National Transfusion Practitioners Network, the medical Royal Colleges and clinical colleagues across the NHS.

KEY WORDS

blood shortages, shortage plans, amber alert, blood service, blood donors, clinical transfusion medicine

INTRODUCTION

The provision of safe blood components in sufficient quantities is key to any effective health care system. This requires a stable base of voluntary donors and robust testing for transfusion-transmitted infections. Sufficiency of blood requires active monitoring of blood collection and usage and efforts to minimise wastage. The maintenance of blood sufficiency is even more challenging during and after disasters,^{1–3} and reports have emphasised the importance of disaster planning.⁴ This report describes the substantial changes implemented in England in 2022 to manage the blood supply challenges faced during and after the COVID-19 pandemic and the importance of collaboration between relevant national groups (Table 1).

INTERNATIONAL PERSPECTIVE

The World Health Organization (WHO) reported that approximately 118.5 million units of blood were collected in

2018, but despite an increase of 10.7 million from 2008,⁵ this was not enough to meet the world's requirements. Klein et al.⁶ described the crisis in the sustainability of the blood system in the United States in 2018.

Causes of blood shortages worldwide include lack of willing blood donors and lack of availability of facilities for testing, processing and delivery.⁷ Galeb et al.⁸ reported the effects of war on the Yemen blood service where shortages of blood bags, reagents and generator fuel were experienced. Natural catastrophes, man-made disasters such as the 9/11 attack,⁴ and the spread of blood-borne infectious agents aided by global climate change (*Aedes*-borne viruses—especially dengue, chikungunya and Zika)^{9,10} have also resulted in blood shortages. Other important causes are pandemic infections such as H1N1 influenza A as reported in Japan in 2010,¹¹ or severe weather conditions such as the 'Beast from the East' in 2018 which caused a shortfall of 7000 red cell units in England.¹²

At the onset of the COVID-19 pandemic in 2020, significant decreases in the number of blood donations^{13–16} were experienced worldwide, provoking widespread fear of blood

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shortages. Blood and blood components are essential medicines,¹⁷ and hence blood donation was classified as an essential service enabling donors to travel to donation centres even during strict lockdown measures.^{13,14} Communications using social media became standard practice globally as the impact of the pandemic on the blood supply chain materialised.^{13,14}

Blood services in high-income countries felt the impact of the pandemic as clinical activity increased to catch up with non-urgent procedures. In January 2022, the American Red Cross¹⁸ declared it was facing the worst blood shortage in over a decade.

IDENTIFICATION OF THE POTENTIAL FOR BLOOD SHORTAGES IN ENGLAND ASSOCIATED WITH THE COVID-19 PANDEMIC AND INITIAL MITIGATING ACTIONS

As the UK media reported the COVID-19 pandemic arising from China early in 2020, NHS Blood and Transplant (NHSBT) sent out a situation update to hospitals that national blood stocks were at good levels. However, by mid-March, blood donations were 15% lower than expected. NHSBT reassured donors that extra safety measures had been implemented and that transmission of the virus through blood donation had not been reported internationally.¹⁹ This reduction in blood collection was mitigated by a rapid decrease in demand for blood (Figure 1). During the first lockdown from March to July 2020, reduction in demand was related to a significant drop in trauma, elective and semi-elective surgery, and delays in performing non-urgent stem cell transplants, similar reductions in demand were also reported by others.^{20–23}

The NHSBT Hospital and Science website (<https://hospital.blood.co.uk/business-continuity/blood-stocks/>) was modified to publish daily blood stock levels in March 2020 in response to concerns from hospitals about the availability of blood. This website became a key route for updating hospital teams. Regular communications were sent to hospitals by NHSBT's customer service and Patient Blood management (PBM) teams in collaboration with the National Blood Transfusion Committee (NBTC) to inform hospital staff about the availability of blood. The PBM team led regular discussions with the National Transfusion Laboratory Managers Advisory Group for NBTC (NTLM), National Transfusion Practitioners Network and Regional Transfusion Committee (RTC) members to support hospitals in their region. Hospitals were advised to consider sharing stock with nearby hospitals. Some hospitals were able to do this across multiple sites in large NHS Trusts and across local and regional networks, but many reported difficulties due to lack of service level agreements (SLAs) for sharing blood between hospitals.

By June 2020, there were difficulties in accurately forecasting demand as hospitals continued to adapt their

services to manage the continuing challenges of the pandemic (Figure 2A), and there were significant changes in demand from week to week (Figure 1).

Maintaining the blood supply became an increasing challenge for several reasons, including:

1. higher levels of staff vacancies, which were occurring even before the pandemic in the NHS and internationally,²⁴ and COVID-19 exacerbated these;^{25,26}
2. short and long-term sickness absences due to the direct and indirect effects of COVID-19;²⁵
3. higher staff turnover, resulting in a higher proportion of inexperienced staff in training and therefore fewer staff able to collect blood donations; and
4. changes in donor behaviour with a reduction in footfall around many city-centre donor centres due to donors working from home. This had not returned to prepandemic levels at large donor centres even by autumn 2022.

From July until September 2021, the stock of B D negative, O D negative and O D positive red cells was reported as low, at Pre-Amber levels, as defined by Table 2 which shows the numbers of days of stock within NHSBT in the different shortage phases. This resulted in NHSBT prompting hospitals to review the NBTC shortage plan and ensure their Emergency Blood Management Arrangements (EBMA) plans were up to date.²⁷ Figure 2B outlines significant changes in the blood supply in 2021, in particular the supply of group O red cells.

By January 2022, NHSBT reported the increased challenges in blood collection caused by the Omicron variant of SARS-CoV-2, this was compounded by increased demand from hospitals as activity increased to catch up with delayed procedures. NHSBT modelling and data from the UK Blood Stock Management Scheme (BSMS) showed demand for blood at this time of year was higher than seen prepandemic despite NHSE reporting the number of hospital procedures being the same. Hospital clinicians reported that patients were sicker, needing more complex procedures and subsequently required more blood components. Group O red cell stock remained low over subsequent months.

The changes in the blood supply during 2022 are shown in Figure 2C. A declaration of a Pre-Amber Alert for group A platelets was issued in June, extending to alerts for multiple blood groups of red cells the following month. Communications were sent to Medical Directors and Chief Executives of hospitals in addition to Hospital Transfusion Teams with recommendations on actions needed by hospital staff.

Supply became more vulnerable with peaks in demand and drops in collections due to ongoing challenges generated by COVID-related sickness in donors and staff, high donor staff turnover, and changes in donor behaviour with lifting of restrictions on air travel. The unprecedented heatwave with temperatures exceeding 40°C, National Rail and Royal Mail strikes in July 2022 intensified these challenges.

TABLE 1 Description of key groups involved in the blood supply challenges facing the blood service in England in 2022.

Name of group	Abbreviation
Blood Stock Management Scheme Established in 2001 to understand and improve blood inventory management across the blood supply chain. BSMS is hosted by NHSBT but funded via the UK Forum.	BSMS (Bronze)
Blood Operation Leadership Team Board of Directors and Executive team in NHSBT.	BOLT (GOLD command)
British Society of Haematology The largest UK haematology organisation and the only society to cover all aspects of the specialty.	BSH
Care Quality Commission Independent regulator of health and social care in England.	CQC
Department of Health and Social Care Department of His Majesty's Government responsible for government policy on health and adult social care matters in England.	DHSC
Haemoglobinopathy Forum A multidisciplinary group of health care professionals interested in all aspects of sickle cell disease, thalassaemia and related conditions.	
Haemoglobinopathy Co-ordinating Centres Responsible for co-ordinating, supporting and promoting a system-wide networked approach to the delivery of haemoglobinopathy services.	HCC
Hospital Transfusion Committee Responsible for promoting safe and appropriate transfusion practice in hospitals. Channel information to their regional RTC to share with local hospitals.	HTT
National Emergency Team Consists of senior management team at NHSBT from all directorates.	NET (Silver command)
NHST Blood and Transplant Blood service for England—the largest blood service in the United Kingdom.	NHSBT
National Blood Transfusion Committee The blood management/transfusion committee responsible for ensuring safe transfusion practice and the implementation of Patient Blood Management initiatives in England.	NBTC (Bronze)
National Institute for Health and Care Excellence Provides national guidance and advice to improve health and social care. NICE is an executive non-departmental public body, sponsored by the DHSC.	NICE
National Transfusion Laboratory Managers Advisory Group for NBTC A working group under the direction of the NBTC assisting the progress of laboratory tasks in the NBTC workplan. The primary purpose is to promote safe and effective transfusion laboratory practice within hospitals.	NTLM (Bronze)
National Transfusion Practitioners Network The primary purpose of the group is to work within NBTC objectives to promote safe, effective and appropriate transfusion practice by facilitating best practice resulting from the Transfusion Practitioner role.	NTPN (Bronze)
NHS England An executive non-departmental public body, sponsored by the DHSC.	NHSE
Medicines and Healthcare products Regulatory Agency Regulates medicines, medical devices and blood components for transfusion in the United Kingdom.	MHRA
Patient Blood Management Team Consists of Haematology Consultants employed jointly by NHS/NHSBT, Scientists, Nursing staff, PBM Practitioners and Analytic staff—whose role is to promote good patient blood management practice through national guidelines and delivery of education and training.	PBM (Bronze)
Regional Transfusion Committee Implement the actions of the NBTC. They oversee the activities of local Hospital Transfusion Committees and provide a link between them and the NBTC.	RTC
Royal College of Anaesthetist The professional body responsible for the specialty throughout the United Kingdom. The College ensures the quality of patient care through the maintenance of standards in anaesthesia, critical care and pain medicine.	RCOA
Royal College of Nursing Professional body for nurses & nursing union.	RCN
Royal College of Pathology Professional membership organisation with charitable status, concerned with all matters relating to the science and practice of pathology.	RCPATH

TABLE 1 (Continued)

Name of group	Abbreviation
Royal College of Physicians British professional membership body dedicated to improving the practice of medicine, chiefly through the accreditation of physicians and physicians' assistants by examination.	RCP
Royal College of Radiology Professional body which leads, educates and supports doctors who are training and working in the specialties of clinical oncology and clinical radiology.	RCR
Royal College of Surgeons Professional body responsible for enabling surgeons to achieve and maintain the highest standards of surgical practice and patient care.	RCS
UNISON United Kingdom's largest union representing staff who provide public services in both the public and private sectors.	
UNITE the UNION United Kingdom's second largest trade union. Offers a range of services to members, from representation in the workplace and free legal advice.	UNITE

Note: Unison and UNITE are the largest unions in England, while they had no role in managing the blood supply, strike actions taken by members, many of who were employed by the national health service influenced the ability to collect, process and delivery blood components. Command structure: GOLD—strategic, SILVER—tactical and BRONZE—operational.

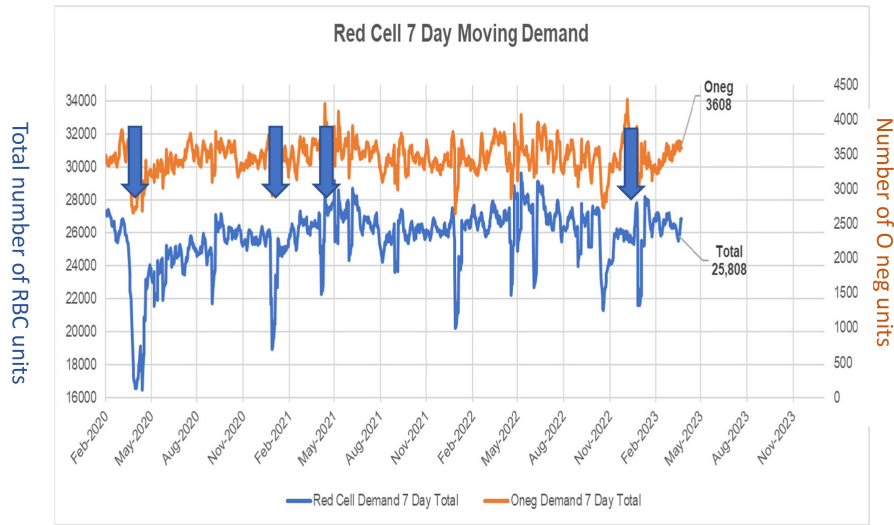


FIGURE 1 Red cell demand from February 2020 to March 2023. At the onset of the COVID-19 pandemic, total red cell demand fell by approximately 35%, increasing to around 5% below expected demand by December with a further dip seen in January 2021 as the country moved into another lockdown period. A smaller drop in demand in April 2021 was seen. Drop in demand is seen in October 2022 during the Amber Alert.

Early in August 2022, concerns around the availability of group AB plasma necessitated several high users to be contacted to confirm the reason for usage and to promote the usage of group A plasma for emergencies. The mourning period for the Queen's funeral and especially the additional day's holiday in September placed further strain on red cell stocks, target collection for the date of the funeral was 5468 units, but only 2634 units were collected.

OPTIMISING STOCK MANAGEMENT IN HOSPITALS

The UK Blood Stocks Management Scheme (BSMS) supplied every hospital with its Issuable Stock Index (ISI), which represents the recommended number of days' worth of stock

held per blood group with the aim of promoting efforts to prevent overstocking of blood and minimisation of wastage of blood in hospitals. The BSMS data enabled hospitals to benchmark their stock levels with comparable hospitals.

The concerns around plasma stock in August 2022 resulted in modifications to the hospital stock reporting system (a software package called VANESA) to enable collection of hospital platelet, FFP and cryoprecipitate stock data as well as red cells. This was implemented at the end of September 2022.

IMPROVING PATIENT BLOOD MANAGEMENT IN HOSPITALS

The National Comparative Audit of Blood Transfusion produced individual summary audit reports for hospitals based

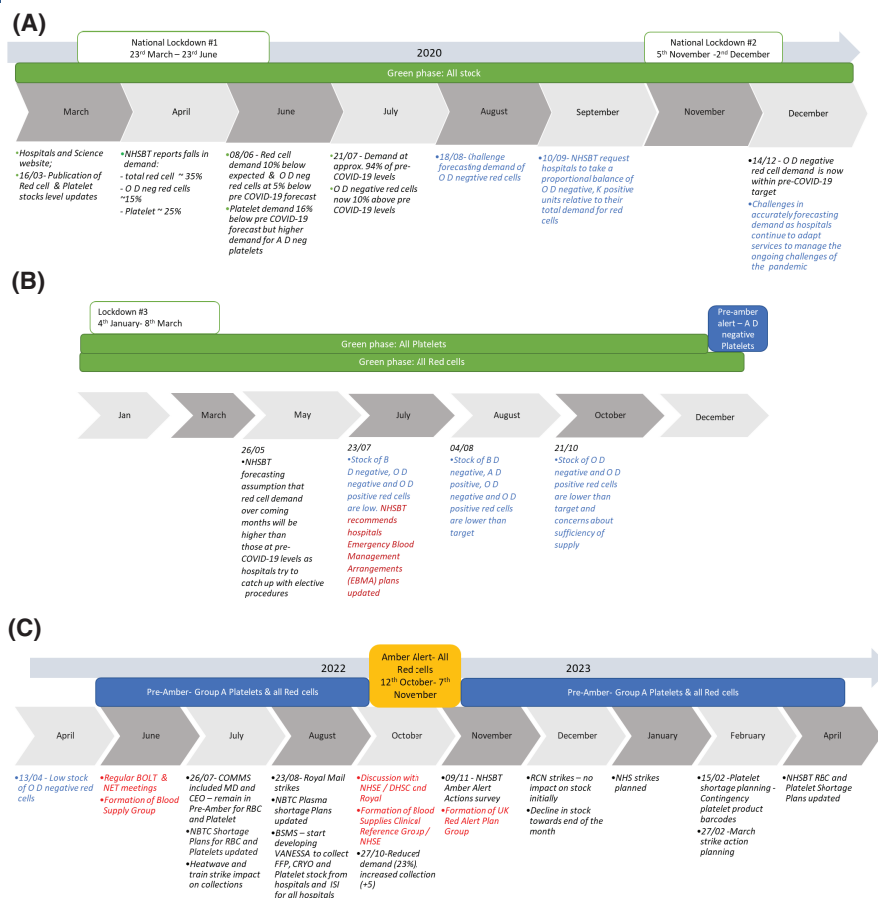


FIGURE 2 (A) Timeline of key changes in the blood supply in 2020. Hospital and Science website became a key route for disseminating information & resources to hospital transfusion teams. August, September and December are always a challenging time for the blood service due to national holidays, in 2020 this was more apparent. (B) Timeline of key changes in the blood supply in 2021. NHSBT sends communications to hospitals in July asking hospitals to review and update EBMA plans for the first time. (C) Timeline of key changes in the blood supply in 2022/2023. Blood collections around Easter time is always more challenging due to bank holidays, but in 2022, concerns relating to low O D negative red cell stock were more pronounced than usual for the time of year. By June, concerns resulted in regular senior management meetings in NHSBT; BOLT (gold—strategic), NET (silver—tactical) and Multidisciplinary teams (bronze—operational). Pre-Ambler Alert was declared early in summer, by the end of September red cell stock continued to decline, resulting in an Amber Alert being declared in October—the first in the history of the blood service.

TABLE 2 Shortage plan phases.

Phase	Situation	Red	Platelet	FFP	Pooled Cryo
Green	Normal circumstances where supply meets demand	5.5–7 days	≥1.15 days	15 days	20 days
Pre-Ambler	Reduced availability of blood for a short or prolonged period without impact on clinical care	3 days	<1 day	7 days	10 days
Amber	Reduced availability for a short or prolonged period with impact on clinical activity	2 days	0.58 days	5 days	5 days
Red	Severe, prolonged shortages with impact on clinical activity	1 day	0.33 days	2 days	2 days

Note: This plan has been categorised into four phases to allow for an actual or potential blood component shortage to be managed progressively. Trigger points (days' supply) have been set for each blood component as a guidance, summarised above. Dynamic assessments of validated stocks, pipeline stocks including predictions of future production determine the level of action required for each trigger level.

on their compliance with the NICE Quality Standards in Blood Transfusion (QS138).²⁸ These reports found a significant level of non-compliance. They were sent to every

Medical Director and Chief Executive of hospitals in England to highlight areas of improvement which would promote good transfusion practice and reduce the blood

requirements for their hospitals. All the Royal Colleges were contacted and were asked to relay the blood shortage messages to their members. For example, infographics endorsed by the Royal Colleges for the use of tranexamic acid in surgery and the management of preoperative iron deficiency anaemia were developed as part of the PBM toolkit to help reduce the use of blood.²⁹

TACKLING LOW BLOOD STOCKS

When it became apparent that there were very significant challenges facing the blood supply chain, decision making by senior NHSBT staff was imperative. Consequently, NHSBT Emergency Preparedness, Resilience and Response mechanisms were implemented utilising a gold-silver-bronze structure. Regular meetings were held by the NHSBT Board of Directors and Executive Team, the Blood Operation Leadership Team—(BOLT; gold), a National Emergency Team (NET; silver) and a multidisciplinary team with representation from all the NHSBT directorates (bronze).

The NHSBT Donor Experience team promoted donations where there was capacity at local blood collection sites. Local media and the NHSBT Blood Donor website were used to direct donors to specific city donation centres with spaces to maximise capacity, specifically focussing on group O donors.

It was clear there was a need for a working group to assist in the modelling of the demand for blood who had transfusion and organisational knowledge of hospital-based transfusion activity, and the ability to gather intelligence quickly from various sources to communicate to senior NHSBT teams including BOLT. This led to the formation of regular

'Blood Supply' meetings, with representation from medical nursing and scientific staff familiar with good transfusion practice and hospital transfusion services. This group met regularly to discuss changing blood supply problems, putting these into context from intelligence obtained from hospitals about the use of blood. This information generated key actions needed by hospital transfusion teams to manage the challenge of low blood stocks and agreement on communications to hospitals. Up-to-date information for hospital teams was made available on the Hospital and Science website. Table 3 summarises the dates these different groups were convened and the shortage phases.

NATIONAL BLOOD TRANSFUSION COMMITTEE (NBTC) SHORTAGE PLANS

The EBMA, and NBTC red cell and platelet shortage plans were updated and published rapidly in July 2022 to incorporate the Pre-Amber recommendations shown in Table 4. The concerns around the availability of group AB plasma in August highlighted the need for a plasma shortage plan, this was written and ratified by the NBTC urgently in August 2022.²⁷

After consultation with the Royal Colleges, it became apparent that the Amber and Red phase actions in the red cell and platelet shortage plans would need further revisions. These included entering regular stock levels and wastage data into VANESA, and amendments to the Indications to Transfuse guidance (Table 5), using the Clinical Guide to Surgical Prioritisation from Federation of Surgical Speciality Association,³⁰ regularly used by anaesthetists and surgeons

TABLE 3 Summary of dates of the different groups formed during 2022 to tackle the blood chain challenges.

Jun 2022	BOLT (Board of Directors and Executive team) NET (senior managers)	Pre-Amber Group A platelets
July 2022	Blood Supply Group—Represented by nursing, medical, scientific and analytical staff supporting PBM nationally Multidisciplinary teams—donor experience, logistic, demand planning, human resources, quality, communications and digital	Pre-Amber Group A platelets & all red cell groups
September 2022	Regular discussion with: National Blood Transfusion Committee (NBTC) National Transfusion Laboratory Managers Advisory Group for NBTC (NTLM) National Transfusion Practitioners Network (NTPN)	
Oct 2022	NHS England (NHSE) Department of Health and Social Care (DHSC) Royal Colleges Blood Supplies Clinical Reference Group/NHSE NHSBT production of infographics for TXA—approved and disseminated by Royal Colleges	Amber Alert for all red cell groups Pre-Amber—Group A platelets
Nov 2022	UK Red Alert Plan Group Representation from all four UK blood services	Pre-Amber Group A negative
Dec 2022	NHSBT production of infographics for Iron—approved and disseminated by Royal Colleges	Platelets & All red cell groups

Note: Command structure: GOLD—Strategic, SILVER—Tactical and BRONZE—Operational. NHSBT: BOLT, Blood Operation Leadership Team—GOLD; NET, National Emergency Team—SILVER; Blood Supply Group—Bronze. Non NHSBT: NBTC, National Blood Transfusion Committee; NHSE, NHS England; NTLM, National Transfusion Laboratory Managers Advisory Group; DHSC, Department of Health and Social Care; NTLN, National Transfusion Practitioners Network.

TABLE 4 Pre-Amber recommendations for hospital clinical teams and transfusion laboratory teams.

Hospitals' clinical teams should take the following actions

- Ensure EBM arrangements are in place and that the EBM group can be convened quickly if needed. This is in anticipation of a potential Amber Alert should the situation not improve.
- Alert the Medical Director as the potential move to Amber and the implications of this.
- Review haemoglobin triggers for red cell transfusions with use of restrictive transfusions as per evidence-based Patient Blood Management guidance.
- Use tools available to support decisions to administer transfusions and consider alternatives to blood including the 'Blood Component App' summarising national clinical indications for transfusions and the Patient Blood Management toolkit.
- If contacted by NHSBT for targeted donation, that is, specific group(s) that maybe low, ensure communication is relayed by advertisement on the local intranet to request for staff who are regular donors to arrange appointment with local donation centre.

All patients

- Minimise iatrogenic anaemia (reduce frequency or volume), take samples from patients only if this will change clinical management.
- Use a restrictive red cell transfusion threshold, haemoglobin of 70 g/L unless patient is bleeding, has acute coronary syndrome or is on a chronic transfusion programme.
- Transfuse one unit of red cells at a time (or equivalent volumes calculated based on body weight for children from 1 year of age or adults with low body weight), in patients who are not bleeding or on a chronic transfusion programme. Reassess the patient clinically and with a further blood count to determine if further transfusion is needed.

Surgical patients

- Ensure patients with anaemia who are due to have elective surgery are properly diagnosed and treated prior to the planned surgery.
- Ensure early preassessment of patients in priority categories P2-3, check haematinic status and treat deficiencies with appropriate supplement. Early screening for anaemia and other significant comorbidities is recommended by other NHSE guidance and can be supported by using HemoCue or similar point of care devices.
- Optimise care of patients in P1 category with iv iron infusions preoperatively or at induction.
- Review preoperative haemoglobin level and expected blood loss. If preoperative haemoglobin low or intraoperative blood loss could be greater than 500 mL (in adults), use tranexamic acid and cell salvage unless contraindicated. Contraindications to either tranexamic acid or cell salvage should be documented.
- Ensure that operating theatres have adequate access to cell salvage equipment and appropriately trained staff to deliver cell salvage when it is indicated.
- Use point-of-care coagulation testing to guide intraoperative blood component management.
- Consider use of postoperative iv and/or oral iron in anaemic patients to avoid need for transfusion.

Patients requiring or who may require a chronic transfusion programme

- Use alternatives to transfusion, where appropriate (MDS guidance, oncology guidance).

TABLE 4 (Continued)

Review local protocols for red blood cell transfusions if they are used to maintain haemoglobin levels above a target level during curative radiotherapy (e.g. in cervical or head and neck cancers). The evidence that transfusion improves cancer outcomes in this situation is of poor quality.

Red cell exchange for haemoglobinopathy patients

- reassess the use of red cells during previous red cell exchanges to ensure optimising red cell component use and
- if available, use the depletion mode in the Apheresis machine if safe to do so and if it results in less blood use.

Transfusion laboratory teams

- Use the Emergency Blood Management Arrangements (EBMA) checklist.
- Use the recommended guidance provided by the Blood Stocks Management Scheme (BSMS) to reduce stock orders.
- Reduce stockholding of red cells where possible.
- Conserve O D negative red cells for O D negative patients in line with guidelines.
- Transfuse group specific red cells wherever possible.
- Remove age requirement for red cells used for red cell exchanges in haemoglobinopathy patients. Age requirements are not in place in other countries that use red cell exchange in sickle cell disease.
- Enter daily red cell stock levels and wastage data into VANESA.
- Accept shorter dated red cells where you are confident that they can be used.
- Start communications with senior clinicians/high users about potential to move to Amber phase and the consequences of this.
- Consider if it is safe to do so
 - reducing reservation periods;
 - reducing levels of stock in remote fridges;
 - reducing levels of irradiated stock and ordering more often; And
 - limiting requests for phenotyped units for stock and order on a named patient basis only.
- Any delays to transfusion or avoidable transfusion should be reported to Serious Hazards of Transfusion (SHOT).

in the UK. These guidelines had been developed in collaboration with the Royal Colleges during the COVID-19 pandemic.

Additional modifications to the shortage plans occurred following the Amber Alert and formally published in April 2023. These included revised actions in the recovery phase as a contingency to preserving blood for the highest priority patients. The Red phase was split into Red A (less than 0.5 days of stock) and Red B (0.5–1 day of stock) with recommendation that transfusion support be available for Priority 1a surgeries, symptomatic transfusion-dependent anaemias and resuscitation of patients with life-threatening and on-going blood loss if the prognosis was felt to be reasonably promising. Haemoglobinopathy patients on regular exchange programmes were recommended to not only continue to follow Amber guidance but also increase the interval between red cell exchanges or consider using top-up transfusion as an interim measure. Additional appendices

TABLE 5 Amber/Red recommendations for hospital clinical teams and transfusion laboratory teams.

All patients
Decision to transfuse should be consultant led in all cases unless it is an emergency.
Where component use is prolonged in major haemorrhage, trauma scenario or prehospital setting, review transfusion support in clinical cases where component use is prolonged or of significant quantity to consider the appropriateness of continued treatment.
The clinical team should liaise with the hospital transfusion laboratory and consider the availability of blood components.
Consideration should be given to reviewing the transfusion trigger for all transfusions particularly in haemato-oncological or critical care unless contraindicated.
Surgical
Continuation of elective surgery will depend on red cell stock levels.
Patients requiring or who may require a chronic transfusion programme
Use alternatives to transfusion, where appropriate, for example, iv iron or erythropoietin (MDS guidance, oncology guidance).
Review local protocols for red blood cell transfusions if they are used to maintain haemoglobin levels above a target level during curative radiotherapy (e.g. in cervical or head and neck cancers). The evidence that transfusion improves cancer outcomes in this situation is of poor quality.
Red cell exchange for haemoglobinopathy patients
Consider where possible, exchanging to a higher post HbS% and then giving a simple top transfusion.
Reconsider bringing HbS% post exchange to below 15%. Achieving this often requires many additional units because at lower HbS% levels, you are removing mostly transfused blood. Other mechanisms of maintaining a sufficiently low HbS% could include aiming at a higher haemoglobin following the exchange.
Reassess use of red cells during previous red cell exchanges to ensure optimising red cell component use.
If available, use the depletion mode in the Apheresis machine if safe to do so and if it results in less blood use.
Transfusion laboratory teams
Decrease stock holding when safe to do so using the recommended guidance provided by the Blood Stocks Management Scheme.
Consider a reduction in the reservation period for blood wherever possible.
Consider the use of temperature loggers in blood boxes to reduce wastage because of uncertainty in cold chain management.
Consider the further reduction or removal of stock in remote issue fridges especially those in locations used for elective surgery.
Any delays to transfusion or any avoidable transfusion incidents should be reported to Serious Hazards of Transfusion (SHOT).
Consider sharing stock between sites/trusts.
Additional actions in the Red Phase
Entry of daily red cell stock levels and wastage data into VANESA is mandatory .
<ul style="list-style-type: none"> NHSBT may request a reduction in stock levels down to a given level on an individual hospital basis. EBM group to review red cell stock levels and the impact of the blood shortage on patient care as frequently as needed.

TABLE 5 (Continued)

- All requests for blood components to be reviewed by the blood transfusion laboratory supported by the consultant in charge of transfusion to minimise inappropriate requests for this Red Phase.
- Consider where possible the removal of all red cell stock from remote issue fridges, except for emergency units, and issue blood components directly from the laboratory.
- Sites with no on-site laboratory will need to ensure transportation is maintained to ensure adequate blood component availability.
- Clinical teams are advised to consider following the NBTC guidance and triage tool for the rationing of blood for massively bleeding patients during a severe national blood shortage which outlines the algorithm for triaging patients in the context of severe national shortage.
- Any delays to transfusion or any avoidable transfusion incidents should be reported to Serious Hazards of Transfusion (SHOT).

were added, including the Emergency Framework for Blood Rationing in the context of severe national shortage³¹ and a Recommended Summary Plan for Emergency Care and Treatment.³²

AMBER ALERT (OCTOBER 2022)

By the end of the first week of October, it was apparent that the stock position was not improving and MHRA and CQC as stakeholders were formally notified. On 12 October after discussion with DHSC, an Amber Alert was officially declared for 4 weeks. Amber actions listed in Table 5 were incorporated into the hospital communications. These needed approval from the senior management teams within NHSBT, NHSE and DHSC. NHSBT staff collaborated with the colleagues in NHSE, DHSC and the Royal Colleges to establish the Blood Supplies Clinical Reference Group within NHSE to ensure alignment across all specialities and hospitals in the promotion of the PBM actions. Many of the Royal Colleges and professional societies provided additional guidance for their members on best practice for their patients during the Amber Alert.

Hospitals were advised to consider transfusion for only those patients in categories 1 and 2 of the NBTC red cell shortage plan and to postpone elective surgery likely to those who require donor blood support, that is, category 3 patients. Hospital laboratories were advised to further reduce stock holding where possible and to have arrangements in place to respond to any potential future red status alert.

Some hospital transfusion teams experienced initial difficulties in getting buy-in from their senior management teams and identifying key members of their Emergency Blood Management (EBM) groups. Most, if not all hospitals have Emergency Preparedness, Resilience and Response mechanisms, typically utilising a gold-silver-bronze structure to manage issues such as shortages of staff (e.g. strikes), fuel and crucial materials (i.e. oxygen or specific drugs). This structure would logically manage a shortage of blood in a similar organisational manner. While there was general support from senior management teams in hospitals, there was a reluctance to postpone surgeries without confirmation

(Continues)

that all hospitals would be doing the same. Many hospitals found that they had few or no surgical procedures which fell in category 3 of the red cell shortage plan, and those who did triaged patients by delaying surgeries in this category.

Before the end of October 2022, NHSBT and BSMS reported a reduction in demand for red cells by 23% and increased collection of blood by 5%. NHSE reported that fewer than 300 operations across England were postponed during the Amber Alert. The reduction in demand for red cells was primarily due to fall in demand for red cells in medical patients.

The Serious Hazards of Transfusion (SHOT), the UK haemovigilance scheme, did not receive any reports of harm as a result of the Amber Alert despite regular communications via the website and letters to hospitals to report them. The revised shortage plans in July 2022 also clearly recommended reporting these events to SHOT. However, the SHOT reporting website still does not have blood shortage as a reporting category, and this may reflect the absence of reliable data to exclude excess deaths and morbidity due to the blood shortages experienced during this period. Amending SHOT reporting to include a category for harm to patients because of blood shortage would enable data collection in any future blood shortages.

Stock levels of all groups of red cells stabilised and improved during the Amber Alert, and NHSBT was able to return to Pre-Amber phase as planned on the 8 November 2022. An Amber Alert actions survey was launched the following day to gather information. Hospitals were advised to either maintain lower stock levels where possible or increase stock levels gradually over the coming weeks to prevent a sudden surge in demand. Figure 3 shows the red cell stock held in hospital locations during different time periods in 2022. By the time the Amber Alert was lifted, hospital stock had reduced from 4.0 to 3.5 days. Despite concerns that hospitals would rapidly return to Pre-Amber levels, blood stock levels in hospitals remained stable over subsequent months.

POST-AMBER ALERT

The Royal College of Nursing (RCN) strike in early December 2022 initially had no impact on blood supply, but as hospitals returned to normal practice later in the month, a fall in blood group O red cells was again noted and vulnerability seen in group A platelets. Adverse

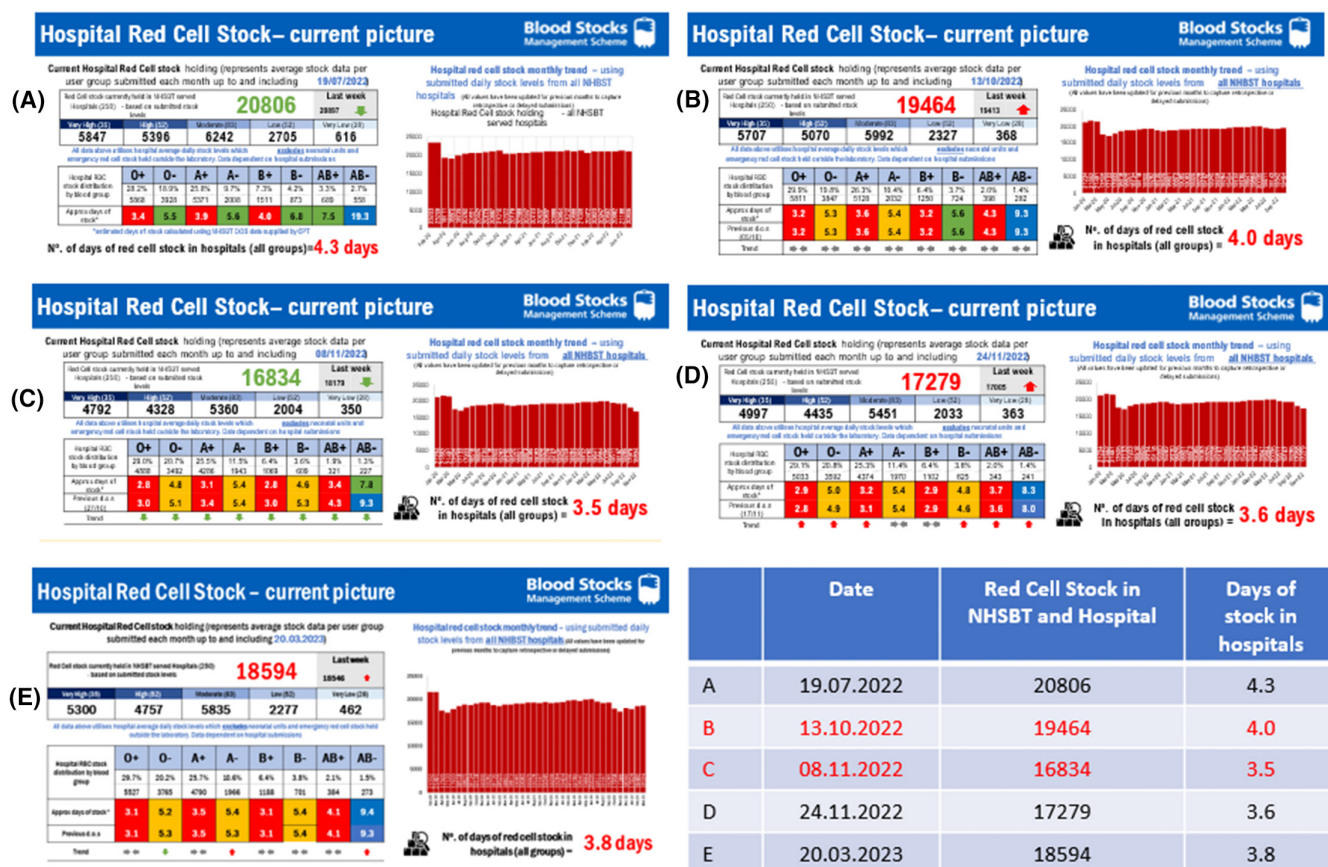


FIGURE 3 Number of days of stock in hospitals. Data from BSMS showing stock in hospitals in July (A), October (B), November (C, D) 2022 and March (E) 2023. In July 2022, when Pre-Amber Alert was declared the number of days of all red cell stock in hospitals was 4.3 days, at the time the Amber Alert was declared in October hospitals had 4.0 days stock of all groups. This fell over the 4 weeks of the alert, and on the day the alert was lifted hospitals had 3.5 days. Concerns that hospitals would restock rapidly were not realised as stock remained stable over subsequent months.

Checklist: Emergency Blood Management Arrangements

This guidance has been developed in conjunction with the National Blood Transfusion Committee (NBTC) red cell, platelet and plasma shortage plans and aims to create a short and concise series of steps to follow in the case of shortage.

Click on the white boxes to tick each step

Checklist for green
This is the business as usual phase of the EBMA

Clinical teams to ensure:

1. your EBMA plan is up to date ☐
2. members of Emergency Blood Management (EBM) Group are aware of the plan ☐
3. PBM strategies (anaemia treatment, cell salvage, adherence to national indication codes) are followed ☐
4. familiarity with trust Emergency Preparedness Resilience and Response (EPRR) plans and command structures ☐
5. communications are drafted for use if a move to amber/red is required ☐
6. stock confirmation of Anti D, Tranexamic acid, Fibrinogen, Albumin, Lyoplas, Octaplas and Desmopressin - ensure process to order additional stocks is established ☐
7. process agreed for the review of appropriateness of blood requests with haematology clinicians as needed ☐
8. daily stock levels and wastage are entered into VANESA ☐

Checklist for amber
NHSBT will inform transfusion team that amber alert declared.

General:

1. Activate EBMA and convene EBM group ☐
2. Prepare to report stock levels and decisions made by EBM group for escalation trust-wide ☐
3. Arrange trust-wide communications (screensavers, emails, newsletters) ☐
4. Review satellite fridge stock ☐
5. Consider pharmaceutical alternatives in appropriate patients with EBM group and disseminate decision ☐
6. Contact areas where transfusions may stop ☐
7. Reprioritise prophylactic transfusions ☐
8. Enter daily stock levels and wastage into VANESA ☐

Red cells:

1. Consider, are all PBM methods being used, review scale up? ☐

Platelets:

1. Use reduced dose platelets (if available) for non bleeding patients ☐
2. Consider D positive platelets for D negative patients (cover with anti-D) ☐

Plasma:

1. Consider conserving AB plasma for group AB patients ☐

Checklist for red
The move to red phase will be communicated to trusts if there are severe shortages of either red cells, plasma or platelets.

Complete all amber actions.

General:

1. Launch rota for senior haematology clinicians to support laboratory in vetting requests ☐
2. Update communications to reflect change to red phase ☐
3. Remove all stock from satellite fridges except emergency group O from acute areas e.g. ED and maternity ☐
4. Contact clinical areas where transfusions will not take place. ☐

Checklist for pre-amber:

1. Ensure EBMA arrangements in place ☐
2. Reduce stockholding (inc. remote fridges) ☐
3. Enter daily stock levels and wastage into VANESA ☐
4. Use the NBTC Blood component APP to ensure supporting PBM measures ☐

[CLICK HERE for more information](#)




FIGURE 4 Revised EBMA checklist.

weather and further sequential strikes by multiple groups (Teachers, RCN, the UNISON and Unite trade unions) through January and February 2023 raised concerns around the supply of short-dated stock, particularly platelets. Pressures on the supply chain due to industrial action raised concerns around the risk of going into Amber Alert phase and subsequently quickly into Red phase for platelets. Contingency planning to mitigate these risks resulted in the development of new platelet components, for example, reduced-dose platelets and 5-day platelets for use in severe shortage situations. Bar codes for these new platelet products were issued to hospitals by mid-February 2023 and usage guidance recommended.³³ The red cell, platelet shortage plan and EBMA checklist (Figure 4) were updated again to incorporate these new components.

THE IMPORTANCE OF COLLABORATION AND COMMUNICATION ACROSS THE SUPPLY CHAIN

From June 2022, demand planning meetings were undertaken by NHSBT teams shown in Table 3, to help forecast what demand would be using different scenarios and

trajectories in an Amber Alert. These meetings highlighted that 30% of demand for red cells came from haematology patients. This prompted the review of transfusion practice in haemato-oncology and haemoglobinopathy patients, the latter group being one of the biggest users of group O blood. It was identified that some reduction in demand would be achieved by reducing the transfusion triggers in all patients to 70 g/L if no clinical contraindications were present, but a greater reduction could be achieved by revising recommendations for red cell exchange in haemoglobinopathy patients. With the approval and support of the Haemoglobinopathy Forum, the recommendations listed in Table 5 were cascaded to clinicians in the Haemoglobinopathy Co-ordinating Centres (HCC) in September 2022.

Concerns around the availability of R₀ (cDe) blood for sickle cell patients resulted in a successful pilot study between two hospitals in North West London to minimise wastage; currently NHSBT is not willing to accept blood units returned from hospitals. Arranging a rapid SLA, with the aid of NHSBT and couriers, 51 units of R₀ red cells over the 8-week trial period were transferred, with 86% of these units subsequently transfused to R₀ patients. Work is ongoing on expanding this trial to other sites across London and further afield.

Discussion with the Royal College of Radiologists resulted in removal of the 120 g/L haemoglobin concentration (Hb) 'trigger' for patients receiving radical radiotherapy for head and neck cancer. Medical oncologists reminded their members to follow restrictive transfusion practice as recommended in the clinical practice guidelines published in 2018³⁴ that red cell transfusions should be reserved for patients with haemoglobin concentrations below 70–80 g/L and for situations when rapid improvement of severely symptomatic anaemia is required.

THE UK RED ALERT GROUP

Arrangements for mutual aid between the UK blood services have been in place for some time, with processes in place for transfer of stock from one service to another to support times of shortage. NHSBT, as the largest UK blood service (84% of the UK supply), provides resilience to the smaller national transfusion services in Scotland, Wales and Northern Ireland. Unfortunately, NHSBT's own supply challenges could not be resolved by support from the relatively small inventories held by the other services.

The UK Red Alert Group was formed with clinical representatives from the four UK blood services. Its aim was to review and update shortage plans and ensure uniformity in guidance for the management of blood shortages across the United Kingdom. There was agreement that all UK nations would adopt the NBTC shortage guidelines.

LEARNING FROM THESE EFFORTS AND FUTURE PLANS

The recent blood supply challenges have emphasised the importance of robust lines of communication across the whole supply chain. Also, the ability to mobilise working groups swiftly to mount a rapid response, and to collaborate with staff in blood establishments, hospitals, national health service management, that is, NHSE, the government, that is, DHSC and professional colleges and societies to manage blood shortages and promote good transfusion practice. The outcome has been a change in clinical practice with reduced transfusion triggers across many different specialities and significant changes in red cell exchange practice for haemoglobinopathy patients. The situation highlighted the deficiencies in NBTC shortage plans and NHSBT standard operating documents which have been updated to incorporate the lessons learnt from the Amber Alert and subsequent staff strike actions. Contingency plans and mitigations have been put into place and are constantly under review. Successful sharing of R₀ (cDe) blood for sickle cell patients between hospitals was shown to be possible. Further plans are in motion to extend this across other hospitals in England. In addition, NHSBT staff are currently assisting the DHSC Operational Response Centre in writing a Standard

Operating Procedure for the national management of blood stocks.

AUTHOR CONTRIBUTIONS

FC wrote the first draft of the manuscript; all authors participated in revising the manuscript and the approval of its final version.

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CONFLICT OF INTEREST STATEMENT

None.

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REFERENCES

- Schmidt PJ. Blood and disaster—supply and demand. *N England Journal Med.* 2002;346(8):617–20. <https://doi.org/10.1056/NEJM2002213460813>
- Klein HG. Earthquake in America. *Transfusion.* 2001;41:1179–80.
- Klein H, Lipton K. Blood and disaster. *N Engl J Med.* 2002;347(1):68–9.
- Gammon RR, Rosenbaum L, Cooke R, Friedman M, Rockwood L, Nichols T, et al. Maintaining adequate donations and a sustainable blood supply: lessons learned. *Transfusion.* 2021;61(1):294–302.
- World Health Organization. Global status report on blood safety and availability 2021. 2022 [cited 2024 Jan 10] Available from: <https://www.who.int/publications/i/item/9789240051683>
- Klein HG, Hrouda CJ, Epstein JS. Crisis in the sustainability of the U.S. blood system. *N Engl J Med.* 2018;378(3):305–6.
- Raykar NP, Makin J, Khajanchi M, Olayo B, Munoz Valencia A, Roy N, et al. Assessing the global burden of hemorrhage: the global blood supply, deficits, and potential solutions. *SAGE Open Med.* 2021;9:20503121211054995.
- Ghaleb YA, Al-Somainy AA, Alamad MA, Al-Serouri AA, Khader YS. Evaluation of blood transfusion Services in Public and Private Blood Bank Centers, Sana'a capital, Yemen. *Inquiry.* 2019;56:46958019870943.

9. Bambrick HJ, Woodruff RE, Hanigan IC. Climate change could threaten blood supply by altering the distribution of vector-borne disease: an Australian case-study. *Glob Health Action*. 2009;2(1):2059.
10. Ryan SJ, Carlson CJ, Mordecai EA, Johnson LR. Global expansion and redistribution of Aedes-borne virus transmission risk with climate change. *PLoS Negl Trop Dis*. 2019;13(3):e0007213.
11. Tsubokura M, Nakada H, Matsumura T, Kodama Y, Narimatsu H, Yamaguchi T, et al. The impact of H1N1 influenza A virus pandemic on the blood donations in Hyogo prefecture, Japan. *Transfusion*. 2010;50(8):1803–5.
12. NHS Blood and Transplant. Beating the Beast from the East - NHS Blood Donation 2018. [cited 2024 Jan 10]. Available from: <https://www.blood.co.uk/news-and-campaigns/the-donor-magazine-summer-2018/beat-the-beast-from-the-east/?bcrFallback=bcrFallback>
13. Choudhury N, Mathur A, Smit Sibinga CT, AATM. COVID-19 pandemic – blood supply challenges and approaches in AATM member countries. *ISBT Sci Ser*. 2020;15(4):353–61.
14. Raghuwanshi B, Behera P, Singh P, Khan R, Munshi R, Patil A, et al. Blood supply management amid COVID 19 pandemic: challenges and strategies. *J Family Med Prim Care*. 2022;11(6):2363–8.
15. Stanworth SJ, New HV, Apolseth TO, Brunskill S, Cardigan R, Doree C, et al. Effects of the COVID-19 pandemic on supply and use of blood for transfusion. *Lancet Haematol*. 2020;7(10):e756–e764.
16. Chiem C, Alghamdi K, Nguyen T, Han JH, Huo H, Jackson D. The impact of COVID-19 on blood transfusion services: a systematic review and meta-analysis. *Transfus Med Hemother*. 2021;30(2):1–12.
17. World Health Organization. WHO model lists of essential medicines. [cited 2021 Aug 24]. Available from: <https://www.who.int/groups/expert-committee-on-selection-and-use-of-essential-medicines/essential-medicines-lists>
18. American Red Cross. Red Cross declares first-ever blood crisis amid omicron surge 2022. [Cited Jan 11 2022]. Available from: <https://www.redcross.org/about-us/news-and-events/press-release/2022/blood-donors-needed-now-as-omicron-intensifies.html>
19. JPAC. Coronavirus infection (COVID-19). Donor Selection Guidelines. 2022. [cited 2024 Jan 10].
20. Nepogodiev D, Abbott TEF, Ademuyiwa AO, AlAmeer E, Bankhead-Kendall BK, Biccard BM, et al. Projecting COVID-19 disruption to elective surgery. *Lancet*. 2022;399(10321):233–4.
21. Glasbey J, Ademuyiwa A, Adisa A, AlAmeer E, Arnaud AP, Ayasra F, et al. Effect of COVID-19 pandemic lockdowns on planned cancer surgery for 15 tumour types in 61 countries: an international, prospective, cohort study. *Lancet Oncol*. 2021;22(11):1507–17.
22. Dass D, Ramhamadany E, Govilkar S, Rhind JH, Ford D, Singh R, et al. How a pandemic changes trauma: epidemiology and Management of Trauma Admissions in the UK during COVID-19 lockdown. *J Emerg Trauma Shock*. 2021;14(2):75–9.
23. EBMT. EBMT COVID-19 guidelines v.4.3. 23 March 2020. [Cited Jan 10, 2024]. Available from: <https://www.ebmt.org/sites/default/files/2020-03/EBMT%20COVID-19%20guidelines%20v.4.3%20282020-03-23%29.pdf>
24. NHS Digital. NHS Vacancy Statistics England April 2015 – September 2022 Experimental Statistics 2022. [Cited Jan 10, 2024]. <https://digital.nhs.uk/data-and-information/publications/statistical/nhs-vacancies-survey/april-2015---september-2022-experimental-statistics>
25. World Economic Forum. Global Health and Healthcare Strategic Outlook: Shaping the Future of Health and Healthcare 2023. [Cited Jan 10, 2024]. Available from: <https://www.weforum.org/reports/global-health-and-healthcare-strategic-outlook-shaping-the-future-of-health-and-healthcare>
26. Buchan J, Gershlick B, Charlesworth A, Seccombe I. Falling short: the NHS workforce challenge: Health Foundation; November 2019. [Cited Jan 10, 2024]. Available from: <https://www.health.org.uk/publications/reports/falling-short-the-nhs-workforce-challenge>
27. National Blood Transfusion Committee. Shortage plans. [Cited Jan 10, 2024]. <https://nationalbloodtransfusion.co.uk/recommendations>
28. 2021 National Comparative Audit of NICE Quality Standard QS138. [Cited Jan 10, 2024]. <https://hospital.blood.co.uk/audits/national-comparative-audit/reports-grouped-by-year/2021-national-comparative-audit-of-nice-quality-standard-qs138/?bcrFallback=bcrFallback>
29. The Patient Blood Management (PBM) toolkit. [Cited Jan 10, 2024]. <https://hospital.blood.co.uk/the-update/the-patient-blood-management-pbm-toolkit-is-now-available/>
30. Clinical Guide to Surgical Prioritisation from Federation of Surgical Speciality Association. [cited 2024 Jan 10]. https://fssa.org.uk/_userfiles/pages/files/covid19/prioritisation_master_28_01_22.pdf
31. Doughty H, Green L, Callum J, Murphy M. Triage tool for the rationing of blood for massively bleeding patients during a severe national blood shortage: guidance from the National Blood Transfusion Committee. *Br J Haematol*. 2020;191(3):340–6.
32. ReSPECT. COVID-19 Resources. [Cited Jan 10, 2024]. https://www.resus.org.uk/sites/default/files/2023-02/ReSPECT_v3-1_Form_Specimen_FINAL.pdf
33. Guidance for reduce-dose platelets. [Cited Jan 10, 2024]. <https://nhs.uk/blogs/core/windows.net/umbraco-assets-corp/28772/inf1657-guidance-notes-for-reduced-dose-apheresis-platelets.pdf>
34. Management of anaemia and iron deficiency in patients with cancer: ESMO clinical practice guidelines. *Ann Oncol*. 2018;29(Supplement 4):iv96–v110. <https://doi.org/10.1093/annonc/mdx758>

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