

We are IntechOpen, the world's leading publisher of Open Access books Built by scientists, for scientists

6,900

Open access books available

186,000

International authors and editors

200M

Downloads

Our authors are among the

154

Countries delivered to

TOP 1%

most cited scientists

12.2%

Contributors from top 500 universities



WEB OF SCIENCE™

Selection of our books indexed in the Book Citation Index
in Web of Science™ Core Collection (BKCI)

Interested in publishing with us?
Contact book.department@intechopen.com

Numbers displayed above are based on latest data collected.
For more information visit www.intechopen.com



Management of Blood Supply and Blood Demand to Ensure International Health Security

Amar Ibrahim Omer Yahia

Abstract

Maintaining international health security requires proactive and reactive activities and actions to minimise the negative impact of any health event that threatens public health. Blood transfusion services are a critical part of healthcare services, and blood and blood products can neither be synthesized nor stored for a long period. So, proper management of blood supply and blood demand is mandatory to preserve adequate safe blood. A failure to manage blood inventory and the resulting blood shortage are considered national and international health security threats because maintaining an adequate supply of safe blood is lifesaving for many patients. Blood shortages lead to the failure of blood transfusion services that ends with the collapse of the health system and health insecurity if health authorities do not take immediate corrective action. An imbalance between blood supply and blood demand is not only a threat to health security, but also poses some of the greatest threats to the national and international economy and security. The perception of health issues as an international health security threat is associated with benefits through attracting political and decision-makers' attention and support. The global health policies and international health regulations concerning the management of blood supply and blood demand should be implemented and updated regularly. The information provided by this chapter addresses the management of blood supply and blood demand as an international health security issue and provides guidance in planning for proper management of blood inventory to avoid a sudden blood shortage and its catastrophic consequences.

Keywords: international health security, management of blood supply, blood demand, adequate safe blood, blood inventory, blood shortage, blood transfusion services failure, health insecurity

1. Introduction

International (global) health security is defined by the World Health Organization (WHO) as the proactive and reactive activities and actions required to minimise the danger and impact of any health event that threatens people's health nationally and internationally. Management of blood supply and blood demand means close monitoring of blood supply and blood demand and appropriate responses to avoid sudden blood shortages, particularly for blood components with a short shelf life, such as platelets. Health problems and the collapse of health systems not only cost lives, but also pose some of the greatest threats to the global economy and security.

Many health issues have affected global health security and necessitated the United Nations Security Council announcing a risk to international security and stability [1–4]. Recently the coronavirus disease-2019 (COVID-19) pandemic has been considered a threat to the global economy, health and security. Maintaining blood supply is important for international health security since blood transfusions are lifesaving in many conditions. A failure to manage blood supply and blood demand and resulting blood shortages are threats that affect national and international health security. This is because maintaining an adequate supply of safe blood is lifesaving for many patients, such as those with blood diseases, cancer, trauma, and those who need emergency surgeries [5]. Blood shortages negatively affect blood transfusion services (BTS) and health services, and can end with the collapse of the health system and health insecurity. The latter starts nationally, but if national and international health authorities and organisations do not work together and manage national health insecurity, it will appear in other countries and become international in time. Furthermore, health insecurity can lead to societal insecurity, political insecurity, and ultimately national and international insecurity. This chapter discusses the management of blood supply and blood demand from the perspective of international health security and why and how it is an international health security threat.

2. Methods

2.1 Literature search strategy

The author has used a method that describes the process of developing a systematic search strategy. Databases were searched to identify relevant articles, policies, and guidelines using a Boolean combination of key terms around the management of blood supply and blood demand and its relations to international health security. To ensure inclusivity, the only search limits were English language and peer-reviewed publications or policies and guidelines approved by the international society up to mid-July 2000. Reference lists of identified articles and published reviews were also examined. A total of 1277 articles were identified (after duplicates were removed) and exported to an Endnote library for eligibility screening. The search terms used for extracting management of blood supply, blood demand, blood shortage, blood transfusion services, national health security, and international health security with Boolean combination of key words for abstract as (blood supply OR blood demand) AND (blood OR blood components) and for full text as (blood supply OR blood demand) AND (blood OR blood components) AND (international OR global OR worldwide OR universal.) AND (Health security OR health guarantee). The databases for search included ProQuest (ProQuest Central, Public Health Database, Social Science Database, ABI/INFORM, ProQuest Dissertations, and Theses Global), EBSCOhost (Academic Source Elite, Business Source Elite, PsycINFO, CINAHL, MEDLINE), and Wiley Online Library (specifying “blood supply and blood demand” in publication title).

3. Management of blood supply and blood demand to ensure international health security

3.1 Why and how improper management of blood supply and blood demand and the resulting blood shortages are an international health security threat

The recent conception of global health presents it as a security issue instead of only a humanitarian or health problem. To achieve national security, we need

to look beyond military dominance and take into account societal matters such as health, education and poverty as security threats [6]. When speaking about health issues related to health security, maintaining an adequate and stable supply of safe blood is the backbone, since blood shortages are a global threat to health security. The availability of an adequate supply of safe blood and blood components is crucial for managing many cases. BTS are an integral part of healthcare services, and blood and blood products can neither be synthesized nor stored for a long period. Platelets' shelf life is 5–7 days, while the shelf life of red blood cells is up to 42 days depending on the type of preservative solution used [7, 8]. Therefore, maintaining an adequate supply of safe blood by appropriately managing blood supply and blood demand is the only solution. To manage the blood inventory properly, the measures and strategies developed by the WHO should be implemented (**Table 1**). A failure to manage blood supply and blood demand and the resulting blood shortage will negatively affect blood transfusion and health services, and as a result, many patients may die or suffer unnecessarily. In addition, blood shortages have negative economic ramifications due to unpleasant consequences such as postponement of surgeries, prolongation of some diseases and increasing hospital stay duration. The subsequent failure and collapse of the health system will lead to health insecurity. The latter, adding to the adverse economic effects, will lead to societal insecurity, which leads to political insecurity and ultimately national and international insecurity. Thus, the improper management of blood supply and blood demand is not only an international health security threat, but can also extend beyond that, causing international insecurity (**Figure 1**). Health insecurity begins as a local problem, but if the problem is not well addressed and corrected, it will appear in other countries and become a global problem. In many countries, the health system's failure is one of the main factors leading to the government's failure. Consequences of the latter, such as violence and the appearance of refugees, will affect neighbouring countries and exacerbate national and international security problems. Therefore, governments should deal with any significant health problems as if they were threats to national security because the health system's stability is reflected in social and political stability. This can be done through regular and effective communication between the health authorities and politicians. The main advantage of considering health issues as international security threats is that countries will work together to develop policies, preventive measures, new vaccines and treatments, and support developing countries financially and scientifically. Thus, health crises will be adequately managed, resulting in a better outcome.

Key actions
• Building a supportive social, economic and political environment to reinforce national blood policies
• Building active cooperation and partnerships with complementary strategies and partners for harmonised actions in countries
• Responding to state requirements to achieve global access to safe blood transfusions
• Strengthening systems for observation and evaluation for better decisions by planners and policymakers
• Fulfilling 100% voluntary non-remunerated donation of blood through innovative methods to improve blood donation programmes
• Ensuring 100% testing of donated blood with high quality
• Fractionating the blood into blood products according to real needs
• Implementing national policies on the proper clinical use of blood and blood components
• Optimising blood usage for patient health

Table 1.
The WHO's global strategic plan for universal access to safe blood transfusions [10].

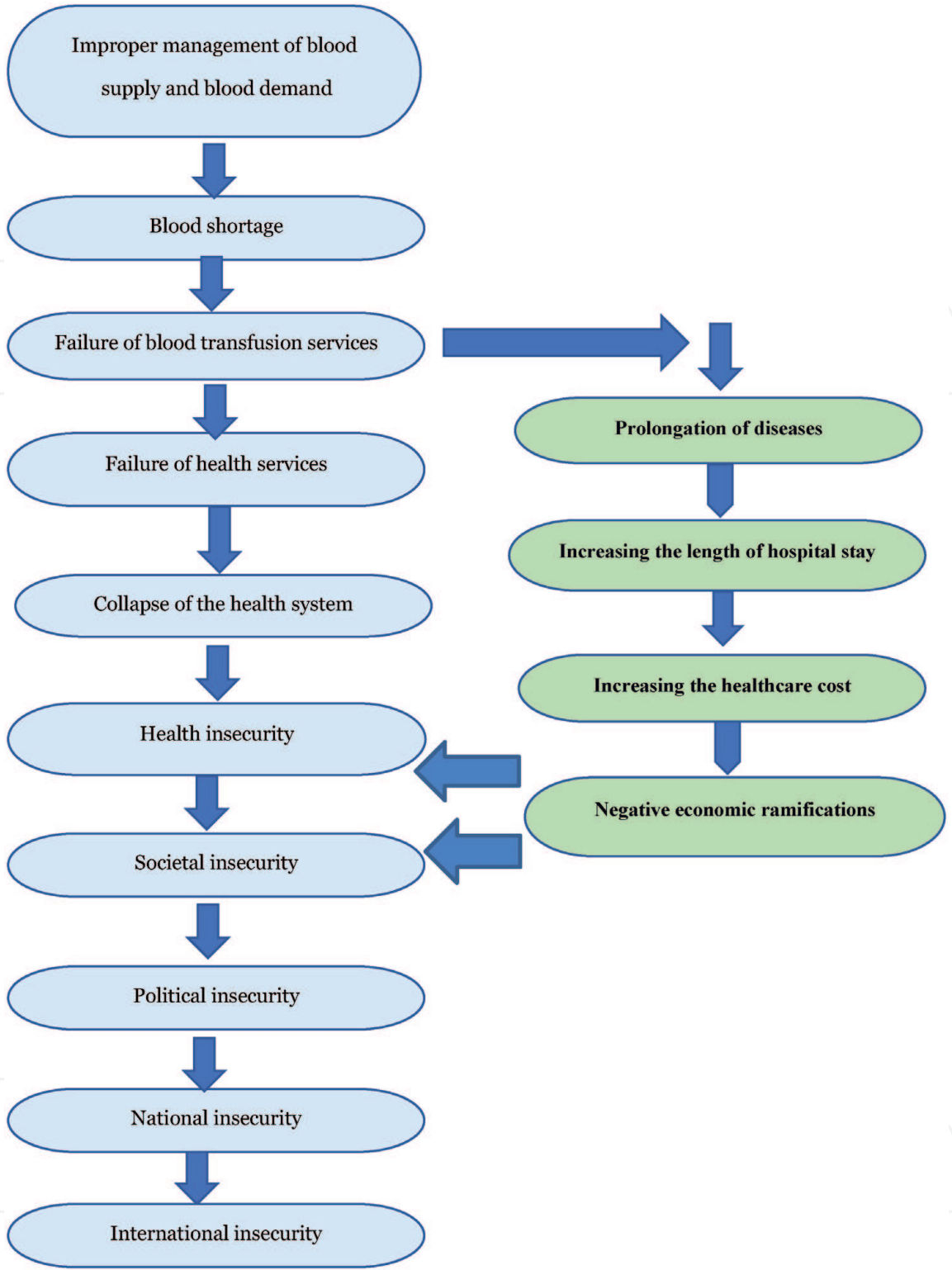


Figure 1.
Consequences of improper management of blood supply and blood demand.

Furthermore, linking health issues with global security is vital because it will bring more political attention and support, thus helping maintain global health security in favourable and stable situations [9]. In addition, this will help countries with poor health systems to benefit from international organizations such as the WHO.

3.2 Access to an adequate supply of safe blood

Globally, there is an increased need for blood and blood components to meet continuous demand. However, many patients requiring transfusion do not have

access to an adequate amount of safe blood at the proper time, and as a consequence, their health outcomes are negatively affected. The WHO recommends that 1–3% of the population should donate blood to meet a country's requirements. According to the WHO, each year, 80 million blood units are donated worldwide, mainly in developed countries. Rural and remote areas of countries have less access to safe blood than urban areas [10]. The prevalence of bloodborne infections has been reported as the lowest among voluntary non-remunerated blood donors; therefore, these blood donations are the safest option [10]. In some countries, a lack of blood supply forces healthcare professionals and patients' relatives to look for paid donors, increasing the risk of unsafe blood. Other factors that lead to an inadequate supply of safe blood include a shortage of trained blood bank staff or test kits, the use of low-quality reagents, a lack of appropriate cold chain facilities, and poor-quality assurance. Unfortunately, these issues are exacerbated by the globally increasing need for blood. To maintain an adequate supply of safe blood globally, the WHO developed evidenced-based strategies (**Table 1**). It is recommended that existing partnerships are maintained and new national and multinational partnerships are built to strengthen the global support for developing countries in terms of increasing access to safe blood. International collaboration in sharing excess supplies continues to grow at a remarkable rate and positively related to the impact on BTS.

3.3 Management of blood supply and blood demand

In response to this potential problem, the WHO and other organisations and societies approved global health policies and international health regulations to deal with all aspects of blood donations and transfusion. Collaboration between developed and developing countries is needed to ensure the transfer of novel technologies and updated scientific materials to implement the international health regulations and improve public health systems, thereby strengthening global public health [11]. This is called health diplomacy. Many measures should be implemented to manage blood supply and blood demand to avoid any sudden blood shortage. These measures may include monitoring blood supplies, using blood only in emergencies during crises, implementing patient blood management (PBM) [12–14] as an effective blood conservation method [15], educating and motivating people regarding blood donation through accessible and comfortable blood donation centres and using all available social media and other forms of advertising (**Table 2**). Among these methods of managing the blood inventory, the most effective one is PBM. The latter is defined as an evidence-based patient care strategy that optimises patients' outcomes using pharmacological medications and patients' blood [16]. In February 2020, the WHO called for the PBM strategy to be implemented after endorsing it in 2010 [17, 18]. PBM is a multidisciplinary approach that involves most healthcare staff, including haematologists, oncologists, surgeons, obstetricians, gynaecologists, anaesthesiologists, general practitioners and other clinical specialists. Many peer-reviewed studies indicated that PBM reduces hospital stay length and the chance of blood transmitted diseases, and improves care quality, morbidity and mortality at a reduced cost [19–22].

3.4 Recommendations to improve blood transfusion services and health security

To ensure proper management of BTS, it is necessary to recognise and fix the current systemic deficiencies affecting BTS in the national health system. These deficiencies include organisational difficulties, insufficient funds, unsafe blood

Key measures
• Raising awareness of the need for blood and blood components
• Increasing the knowledge about the blood donation process
• Optimising the donor experience
• Implementing effective strategies to convert voluntary non-remunerated donors into regular donors
• Organising a mobile blood drive
• Making timely appeals for blood donations before shortages through popular social media
• Regularly educating and training healthcare workers regarding clinical guidelines on transfusion, patient blood management and clinical audits
• Ensuring regular communication between blood bank specialists and clinicians regarding blood transfusion
• Implementing optimum patient blood management
• Creating an electronic blood monitoring system
• Close monitoring of blood inventory and blood demand
• Close monitoring of emergency blood supplies
• Establishing a commission for the responsible use of blood and blood components
• Saving the blood and blood components for the maximum permissible period by increasing blood storage facilities, especially in rural medical centres
• Improving the capacity of blood banks to produce maximum blood products
• Developing an evidence-based emergency plan for blood donations during disasters and crises
• Developing an evidence-based emergency blood management plan
• Adhering to all guidelines and plans regarding blood transfusion services

Table 2.
Specific measures for proper management of blood supply and demand to prevent blood shortages.

donation, outdated equipment, low quality blood test kits and an inadequate number of qualified personnel. Governments should implement strategies to increase their blood inventories and ensure the collection of safe blood. Countries require their governments’ support for their health systems, including BTS, which is a political obligation to guard national health security.

The following are recommendations to help promote public health by ensuring an adequate supply of safe blood.

1. Promote a national blood transfusion services plan and strengthen its management

Current laws, rules and standards that support a statutory structure for blood bank and BTS should be examined and adapted according to the international applications and the WHO’s criteria and rules. Special care needs to be taken to ensure proper execution.

- A blood transfusion service agency coordinated by the state should be established. The agency should have a combined management body and qualified staff. This will call for changes in organisational and management frames and procedures, together with strategies and plans to increase the central blood banks and minimise the hospital blood banks to attain reductions in costs.
- An international system of voluntary non-remunerated blood donation should be established to minimise risky blood transfusion. Critical public health procedures need to be implemented to reduce paid blood donations to

a minimal level. It is also necessary to cooperate with the mass media to carry out targeted educational and promotional activities to encourage voluntary non-remunerated blood donation. Effective plans to foster voluntary non-remunerated blood donation include social recruitment at the national level. There is a need to enter into co-partnerships with communities, domestic institutions, and religious and community leaders.

- There needs to be appropriate use of productive donor screening strategies, containing direct questions for highest-risk attitudes.
- Support should also be delivered to assist each country in establishing a national blood donor register with the support of information technology systems that connect blood bank centres, reference laboratories and hospital users [23].
- Knowledge and awareness needs to be improved on two levels. First, the level of medical expertise must be increased through regular advanced training and continuous medical education. Second, there is a need to raise public awareness of the importance of voluntary non-remunerated blood donation and blood donation safety through appropriate information and publicity activities.

2. Solve the chronic shortage of BTS:

The current budget allocated to the blood banks should be significantly raised to assist the performance of BTS.

3. Improve the quality of BTS and associated medical practices:

- Blood transfusion service sites:
 - After reassigning tasks according to system reform, special attention must be paid to updating the existing BTS. This applies to the functional and safety requirements of donor selection, blood collection, test processing, and storing of the blood and blood components. Sufficient employee expertise is a prerequisite for BTS to function well.
 - Compulsory standard guidelines should be formulated and adopted to inform the purchasing of special requirements (such as blood collection bags, test kits and other consumables). Training support personnel should also be provided for blood transfusion service stations. These measures will assist in standardising collection procedures and ensuring safe service.
 - The blood banks should use high-quality blood collection bags and optimal anti-coagulant additive solution to prolong the product shelf-life.
 - The quality management system should involve the entire blood chain from prospective donor to prospective recipient, including follow-up plans for monitoring and evaluating all relevant blood bank activities, consistent with WHO standards. Critical screening tests and obligatory quality assurance systems are crucial to ensure the safety of blood supply [24].
 - Current working situations and applications of BTS should be evaluated and improved. Special rules and procedures must be reviewed, focusing on blood handling, disinfection/decontamination and waste disposal procedures.

- Hospital sites:

As the entry point for follow-up, assessing and discussing blood transfusion treatment indications, efficiency and associated side effects, the hospital blood transfusion committee is a vital structure of the blood alert system.

- Existing scientific evidence of blood transfusion treatment efficiency should be used, and international recommendations should be adjusted according to local conditions to revise and update outdated guidelines and practices. The standards and clinical guidelines should be formulated following the WHO's advice and applied to the national blood transfusion services.

4. Reinforce public health preventive medicine and primary healthcare plans to minimise blood demand and blood supply gaps:

Develop an effective public health plan, focusing on correcting the causes of diseases that require blood transfusion treatment and strengthening the job of primary healthcare, which will reinforce prevention and early diagnosis.

5. Promote regional exchanges and cooperation arrangements between countries:

Territorial integration and collaboration between countries for economic and social development is becoming increasingly important. Regional exchanges and cooperation arrangements should ease the sharing of information on experiences and best practices and allow for the horizontal spread of expertise and technical assistance.

However, unless these measures are systematically implemented and continue throughout the process, while progress is regularly monitored as a section of quality control, obtaining an adequate supply of safe blood and properly functioning blood transfusion services will remain out of reach.

4. Conclusions

Blood demand has increased worldwide; however, blood supply is insufficient to meet this need. Therefore, the proper management of blood supply and blood demand is crucial to avoid sudden blood shortages. The latter can result in the failure of BTS, national health insecurity and consequently, international health insecurity. Health insecurity ultimately leads to societal and political insecurity, so health security issues remain the priority in terms of national security. The perception of health difficulties through the global health security framework leads to international health securitisation, attracting the attention and support of governments, and pressuring decision-makers to act early. Evidence-based plans for blood safety and availability should be developed, implemented and updated regularly. Global health policies and international health regulations related to BTS should be ready to respond quickly to any challenges in delivering an adequate supply of safe blood, especially during disasters and emergencies. It is essential to implement guidelines and strategies that concern the management of blood supply and blood demand, particularly before any anticipated catastrophe or crisis, to avoid sudden blood shortages. The most essential and efficient method for managing blood inventory is PBM. The implementation of PBM not only reduces the chance of a blood shortage, but is also associated with a low risk

of blood transfusion complications, reduced hospital stays and healthcare costs, and most importantly, lower morbidity and mortality. The information provided by this chapter is linked to the management of blood supply and blood demand as an essential component of global health security. It helps in planning for the proper management of blood inventory and ensuring the availability of safe blood and blood components to avoid sudden blood shortages and the serious consequences of such shortages.

Acknowledgements

The author would like to thank Dr. Maria Satti, Dr. Amin A. Alamin and Prof Partha Nandi for their constant help and input on this project.

Conflict of interest

The author declares that there is no conflict of interest.

Notes/thanks/other declarations

Dr. Amar Ibrahim Omer Yahia is an Assistant Professor of pathology at the College of Medicine, University of Bisha, Bisha, Saudi Arabia, and formerly an Assistant Professor of pathology at the Faculty of Medicine and Health Sciences, University of Kordofan, Elobeid, Sudan. A specialist of Pathology, Haematopathology and Blood Bank at King Abdullah Hospital, Saudi Arabia. He graduated from the Faculty of Medicine and Health Sciences at the University of Kordofan, where he received his MBBS degree. He received his MD degree in Clinical Pathology/Haematopathology and Blood Bank from the University of Khartoum, Sudan. *Amar* has published a number of articles in internationally recognised journals; he is a member of numerous scientific societies and editorial boards. His expertise includes Haematopathology/Blood bank, Student-centered learning, and Supervision of undergraduate and postgraduate research projects.

IntechOpen

Author details

Amar Ibrahim Omer Yahia^{1,2,3}

1 Unit of Pathology, Department of Basic Medical Sciences, College of Medicine, University of Bisha, Bisha, Saudi Arabia

2 Department of Haematology and Blood Bank, King Abdullah Hospital, Bisha, Saudi Arabia

3 Department of Pathology, Faculty of Medicine and Health Sciences, University of Kordofan, Elobeid, Sudan

*Address all correspondence to: amarfigo2@yahoo.com

IntechOpen

© 2021 The Author(s). Licensee IntechOpen. This chapter is distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/3.0>), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited. 

References

- [1] Larson HJ, Bertozzi S, Piot P. Redesigning the AIDS response for long-term impact. *Bulletin of the World Health Organization*. 2011;89:846-851.
- [2] Urbinati S. 11 Some considerations on the role of the Security Council in facing the Ebola outbreak. *The Common Good and Ecological Integrity: Human Rights and the Support of Life*. 2016 May 20:129.
- [3] UN Security Council. Resolution 1308 (2000) on the Responsibility of the Security Council in the Maintenance of International Peace and Security: HIV/AIDS and International Peace-Keeping Operations. In 4172 Meeting 2000. New York: United Nations.
- [4] UN Security Council (2014) Security Council Resolution 2177.
- [5] World Health Organization. Towards 100% voluntary blood donation: a global framework for action [internet]. Melbourne. 2010. http://www.who.int/world_blood_donor_day/Melbourne_Declaration_WBDD09.pdf.
- [6] Redclift MR, Grasso M, editors. *Handbook on climate change and human security*. Cheltenham: Edward Elgar; 2013.
- [7] Cancelas JA, Dumont LJ, Maes LA, Rugg N, Herschel L, Whitley PH, et al. Additive solution-7 reduces the red blood cell cold storage lesion. *Transfusion* 2015;55(3):491-498.
- [8] Kaplan C. Toddy for chilled platelets? *Blood* 2012;119(5):1100-1102.
- [9] Elbe S. Should health professionals play the global health security card? *The Lancet*. 2011 Jul 16;378(9787):220-221.
- [10] World Health Organization. Universal access to safe blood transfusion. World Health Organization; 2008.
- [11] World Health Organization. The world health report 2007: a safer future: global public health security in the 21st century. World Health Organization; 2007.
- [12] Hofmann A, Farmer S, Shander A. Five drivers shifting the paradigm from product focused transfusion practice to patient blood management. *Oncologist* 2011;16(S3):3-11.
- [13] Spahn DR, Munoz M, Klein AA, Levy JH, Zacharowski K. Patient blood management: effectiveness and future potential [published online ahead of print 24 February 2020]. *Anesthesiology* 2020.
- [14] Yahia AI. Management of blood supply and demand during the COVID-19 pandemic in King Abdullah Hospital, Bisha, Saudi Arabia. *Transfusion and Apheresis Science*. 2020 Jun 4:102836.
- [15] Sadana D, Pratzler A, Scher LJ, Saag HS, Adler N, Volpicelli FM, et al. Promoting high-value practice by reducing unnecessary transfusions with a patient blood management program. *JAMA Internal Med* 2018;178(1):116-122.
- [16] Hofmann A, Spahn DR, Holtorf AP. Call to Action–Closing the Gap to Make Patient Blood Management the New Norm (al) as Viewed by Implementors in Diverse Countries.
- [17] World Health Organization. Action framework to advance universal access to safe, effective and quality-assured blood products 2020-2023. (2020).
- [18] World Health Assembly. Availability, safety and quality of blood products [Internet]. Geneva, Switzerland: World Health Assembly; 2010 May p. 4. Report No.: WAH63-11.17. Available from: <https://apps.who>

[int/gb/ebwha/pdf_files/WHA63/A63_R12-en.pdf](https://www.who.int/gb/ebwha/pdf_files/WHA63/A63_R12-en.pdf)

[19] Althoff FC, Neb H, Herrmann E, Trentino KM, Vernich L, Füllenbach C, et al. Multimodal patient blood management program based on a three-pillar strategy: a systematic review and meta-analysis. *Annals of Surgery*. 2019 May 1;269(5):794-804.

[20] Froessler B, Palm P, Weber I, Hodyl NA, Singh R, Murphy EM. The important role for intravenous iron in perioperative patient blood management in major abdominal surgery: a randomized controlled trial. *Ann Surg*. 2016;264(1):41-46.

[21] Khalafallah AA, Yan C, Al-Badri R, Robinson E, Kirkby BE, Ingram E, et al. Intravenous ferric carboxymaltose versus standard care in the management of postoperative anaemia: a prospective, open-label, randomised controlled trial. *Lancet Haematol*. 2016 Sep;3(9):e415–e425.

[22] Leahy MF, Hofmann A, Towler S, Trentino KM, Burrows SA, Swain SG, et al. Improved outcomes and reduced costs associated with a health-system-wide patient blood management program: a retrospective observational study in four major adult tertiary-care hospitals. *Transfusion*. 2017;57(6):1347-1358.

[23] Schmunis G, Cruz J. Safety of the blood supply in Latin America. *Clinical Microbiology Reviews*. 2005;18(1):12-29.

[24] Voak D, Caffrey EA, Barbara JA, Pollock A, Scott M, Contreras MC. Affordable safety for the blood supply in developed and developing countries. *Transfusion Medicine* (Oxford, England). 1998 Jun;8(2):73.