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Foreword

In a continuing effort to reduce the massive global burden of iron deficiency and anaemia, blood loss and coagulopathy with bleeding, the World Health Organization has developed this practical guidance on how to implement patient blood management (PBM). PBM is a concept to address these challenges by comprehensively managing and preserving the patient's own blood.

This document is the result of extensive collaboration among multiprofessional and multidisciplinary international experts dedicated to improving patient outcomes, patient safety and quality of care. Public health experts, chief medical officers, physicians, nurses, pharmacists, hospital adminstrators, implementation experts, medico-legal experts, quality managers, blood bank managers, information technology and clinical data management experts, and patient advocates have all contributed to this document.

Incorporating expertise from peers working in countries where health care faces extreme resource constraints, attention is paid to how PBM processes and structures can be embedded in the system. The aim is to reduce maternal mortality from postpartum haemorrhage, as well as morbidity and mortality from traumatic haemorrhage, and enable more broad-based anaemia management even when resources are limited. Using the collective experience from health care systems where PBM programmes are well established, this guidance shows how the necessary structures and processes can be broadly replicated to improve overall population health. This includes women's health as well as the clinical outcomes for the rapidly growing population segment of elderly patients, particularly in upper-middle and high-income countries.

By looking at blood as an organ that needs to be treated with the same respect as any other organ or organ system, the overarching goal of PBM is to improve and maintain blood health. This document explains how the public health sector, in partnership with patient-level carers, can work to achieve this goal. It not only provides structured guidance on PBM implementation, but also practical tools and recommendations for integrating PBM into existing health care frameworks.

With this implementation guidance, PBM should now become part of the public health agenda for all Member States, ensuring that hundreds of millions of individuals can benefit from this detailed, yet practical approach to improving their blood health status. This initiative is also central to tackling health care inequities by reducing the overall burden of disease and of costly transfusion dependency, which allows the reallocation of limited funds to where they are most needed.

Dr Yukiko Nakatani
Assistant Director-General
Access to Medicine and Health Products (MHP) Division
World Health Organization

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WHO's External Steering Committee for the Implementation of Patient Blood Management, which includes:

Neil Blumberg, University of Rochester Medical Center, Rochester, New York, United States of America (11 February 2022 to 9 December 2024)
Shannon Farmer, Medical School, The University of Western Australia, Perth, Australia
Irwin Gross (Co-Chair), Northern Light Eastern Maine Medical Center, Bangor, Maine, United States of America (11 February 2022 to 9 December 2024)
Jeffrey Hamdorf, Medical School, The University of Western Australia, Perth, Australia
Axel Hofmann (Chair), Medical School, The University of Western Australia, Perth, Australia
James P Isbister, Sydney Medical School, The University of Sydney, Australia
Aryeh Shander, Englewood Health, Englewood, New Jersey, United States of America (11 February 2022 to 9 December 2024)

The experts who contributed to the development of the concept and outline of this document are:

Angel Augusto Pérez Calatayud, Hospital General de México, Ciudad de México, México
Carleen Ellis, Medical School, The University of Western Australia, Perth, Australia
Wendy Erber, Medical School, The University of Western Australia, Perth, Australia
David Faraoni, Harvard Medical School, Boston Children's Hospital, Boston, Massachusetts, United States of America (11 February 2022 to 12 October 2024)
Bernd Froessler, Lyell McEwin Hospital, Adelaide, Australia
Ángel Fernando Galván García, Instituto Nacional de Salud Pública (INSP), Ciudad de México, México
Susan Goobie, Harvard Medical School, Boston Children's Hospital, Boston, Massachusetts, United States of America (11 February 2022 to 12 October 2024)
Thorsten Haas, College of Medicine, University of Florida, Gainesville, Florida, United States of America (11 February 2022 to 12 October 2024)
Pradeep Jayasuriya, Medical School, The University of Western Australia, Perth, Australia
Freddy Kabambi, Nelson Mandela Academic Hospital, Mthatha, South Africa
Vernon Louw, University of Cape Town and Groote Schuur Hospital, Cape Town, South Africa
Nolan McDonnell, Medical School, The University of Western Australia, Perth, Australia
Julie McMorrow, Royal Perth Hospital, Perth, Australia
Claire McNally, Sir Charles Gairdner Hospital, Perth, Australia
Anna Mezzacasa, European Confederation of Pharmaceutical Entrepreneurs (EUCOPE), Brussels, Belgium
Angie Monk, Joondalup Health Campus, Perth, Australia
Lena Napolitano, University of Michigan Health System, Ann Arbor, Michigan, United States of America (11 February 2022 to 12 October 2024)
Sherri Ozawa, Englewood Health, Englewood, New Jersey, United States of America (11 February 2022 to 12 October 2024)

Bronwyn Pearse, The Prince Charles Hospital, Brisbane, Australia
Guilherme Rabello, Instituto do Coração, São Paulo, Brazil
Kylie Symons, Fiona Stanley Fremantle Hospital Group, Murdoch, Perth, Australia
James Savundra, St John of God Health Care, Perth, Australia
Simon Towler, Western Australia Department of Health, Perth, Australia
Kevin Trentino, Medical School, The University of Western Australia, Perth, Australia
Christoph Zenger, Centre for Health Law and Management, University of Bern, Switzerland

The experts who reviewed and commented on the draft of this guidance document are:

Matti Aapro, Genolier Cancer Centre, Genolier, Switzerland
Vanessa Agostini, IRCCS Ospedale Policlinico San Martino, Genoa, Italy
Cesar de Almeida-Neto, Fundaçao Pró-Sangue, Hemocentro de Sao Paulo, Brazil
Justina Kordai Ansah, Ghana College of Physicians and Surgeons, Accra, Ghana
Tarek Al Ansari, Corniche Hospital, Abu Dhabi, United Arab Emirates
Olus Api, Vehbi Koç Foundation American Hospital, Istanbul, Türkiye
Liana Maria Torres de Araujo Azi, Hospital Universitário Professor Edgard Santos, Salvador, Brazil
Fredy Ariza, Fundación Valle del Lili, Universidad ICESI, Cali, Colombia
Claire Armour (Barrett), University of the Free State, Bloemfontein, South Africa
Michael Auerbach, Georgetown University School of Medicine, Washington, DC, United States of America (15 April to 31 May 2024)
Ravishankar Baikady, The Royal Marsden NHS Foundation Trust, London, United Kingdom
Paul Bechtold, FH Campus Vienna – University of Applied Sciences, Vienna, Austria
Ivo Beverina, Azienda Socio Sanitaria Territoriale Santi Paolo e Carlo, Milan, Italy
Elvira Bisbe, Hospital del Mar Medical Research Institute, Barcelona, Spain
Matteo Bolcato, University of Padova, Padua, Italy
Francisco Carmona, Hospital Clínic, Barcelona, Spain
María Cecilia Braxs, Clínica Universitaria Reina Fabiola, Universidad Católica de Córdoba, Argentina
Christian Breymann, Gyn & Perinatal Zürich, Ärztezentrum Hirslanden Seefeld, Zürich, Switzerland
Xavier Capedevila, Lapeyronie University Hospital and Montpellier University, Montpellier, France
Maria Domenica Cappellini, Rare Diseases Centre at the Fondazione IRCCS Policlinico Hospital, Milan, Italy
Pablo Carpintero, Universidad Maimónides, Buenos Aires, Argentina
Isabel Cristina Cespedes, Escola Paulista de Medicina da Universidade Federal de Sao Paulo (UNIFESP), Sao Paulo, Brazil
Nabajyoti Choudhury, Dibrugarh Cancer Centre, Assam, India
Melissa Cushing, Weill Cornell Medical College, New York, New York, United States of America (15 April to 31 May 2024)
Kristina Gemzell-Danielsson, Karolinska Institutet and Karolinska University Hospital, Stockholm, Sweden
Alana Delaforce, Australian e-Health Research Centre, Commonwealth Scientific and Industrial Research Organisation (CSIRO), Australia
Joanna Dewar, Sir Charles Gairdner Hospital, Nedlands, Australia
Mauricio Beltrán Durán, PAHO/WHO Regional Office for the Americas, Washington, DC, United States of America (15 April to 31 May 2024)
Yanet Ventura Enriquez, Centro Médico Naval, Ciudad de México, México
Orlando Cuellar, Hospital San Juan de Dios Santa Cruz, Bolivia
Manuel Quintana Díaz, La Paz University Hospital, Autonomous University of Madrid, Spain
Jochen Erhard, Evangelisches Klinikum Duisburg-Nord, Duisburg, Germany

Tatiana Federova, V. I. Kulakov National Medical Research Center for Obstetrics, Gynecology and Perinatology, Moscow, Russian Federation
Manuel Garay Fernández, El Bosque University Hospital Santa Clara, Bogotá, Colombia
Daniela Filipescu, University of Medicine and Pharmacy Carol Davila, Bucharest, Romania
Vicente Faraon Fonseca, UNISINOS University, Porto Alegre, Brazil
Maria Nieves Garcia-Casal, Food and Nutrition Action in Health System Unit, Nutrition and Food Safety Department, Healthier Population Division, WHO Headquarters, Geneva, Switzerland
José Antonio García-Erce, Blood and Tissue Bank of Navarra, Navarra, Spain
Junbo Ge, Zhongshan Hospital, Fudan University, Shanghai, China
Domenico Girelli, Verona University Hospital, Verona, Italy
Serdar Gunaydin, University of Health Sciences, Ankara City Hospital Campus, Ankara, Türkiye
Hongwen Ji, Fuwai Hospital, CAMS & PUMC, Beijing, China
Poonam Malhotra Kapoor, All India Institute of Medical Sciences (AIIMS), New Delhi, India
Christakis Kassianides, Morningside Mediclinic, Johannesburg, South Africa
Tae-Yop Kim, Konkuk University School of Medicine, Seoul, Republic of Korea
Young-Woo Kim, Graduate School of National Cancer Center, Goyang, Republic of Korea
Ananthi Krishnamoorthy, Malaysian Society of Patient Blood Management, Ampang, Malaysia
Silvina Kuperman, Hospital de Pediatría Garrahan, Buenos Aires, Argentina
Johann Kurz, Austrian Federal Ministry of Health (Emeritus), Vienna, Austria
Milton Larrondo-Lillo, Hospital Clínico Universidad de Chile, Santiago de Chile, Chile
Sigismond Lasocki, Centre Hospitalier Universitaire d'Angers, Angers, France
Michael F Leahy, Medical School, The University of Western Australia, Perth, Australia
Cheuk-Kwong Lee, Hong Kong Red Cross Blood Transfusion Service, China Hong Kong, Special Administrative Region
Jeong Jae Lee, Soonchunhyang University Hospital, Seoul, Republic of Korea
Sarah Lessire, Centre Hospitalier Universitaire UCL Namur, Namur, Belgium
Adam Lloyd, East Metropolitan Health Service, Perth, Australia
Chris Lundgren, Wits Donald Gordon Medical Centre, Johannesburg, South Africa
Hamish Mace, Fiona Stanley Fremantle Hospital Group, Murdoch, Perth, Australia
Tina Tomic Mahecic, University Hospital Centre, Zagreb, Croatia
Yatin Mehta, Medanta Institute of Critical Care and Anesthesia, Gurugram, India
Jens Meier, Kepler University Clinic, Kepler University, Linz, Austria
Patrick Meybohm, University Hospital Würzburg, Würzburg, Germany
Manuel Munoz, School of Medicine, University of Málaga, Málaga, Spain
John K Olynyk, Curtin Medical School, Curtin University, Perth, Western Australia
Ramani Pallemulle, College of Anaesthesiologists and Intensivists of Sri Lanka, Sri Jayawardenepura Kotte, Sri Lanka
Jong Hoon Park, Korea University Anam Hospital, Seoul, Republic of Korea
Diana Castro Paupério, Unidade Local de Saúde Gaia e Espinho (ULSGE), Vila Nova de Gaia, Portugal
Seth Perelman, NYU Health Langone, Grossman School of Medicine, New York, United States of America (15 April to 31 May 2024)
Felice Petraglia, University of Florence, Florence, Italy
Anusha Philips, St John of God Health Care, Perth, Australia
Fausto Pinto, Centro Cardiovascular da Universidade de Lisboa (CCUL), Lisbon, Portugal
Irina Poddubnaya, Russian Medical Academy for Continuous Education, Moscow, Russian Federation
Vanitha Rambiritch, South African National Blood Service, Roodepoord, South Africa
Sandro Rizoli, Hamad General Hospital, Doha, Qatar

Ponlapat Rojnuckarin, Chulalongkorn University, Bangkok, Thailand
Beatrice Rondinelli, Azienda Unita Sanitaria Locale della Bologna (AUSL Bologna), Bologna, Italy
Diego Zuluaga Santamaria, Health Services University of Antioquia, Medellín, Colombia
Jameela Sathar, Ampang Hospital, Selangor, Malaysia
Alberto Martín Díaz Seminario, National Maternal Perinatal Institute of Peru INMP, Lima, Peru
Linda Shore-Lesserson, Zucker School of Medicine at Hofstra Northwell, Manhasset, New York, United States of America (15 April to 31 May 2024)
Ben Slater, St Vincent's Hospital, Melbourne, Australia
Cynthia So-Osman, Sanquin Blood Supply and Erasmus Medical Center-Rotterdam, The Netherlands
Donat Spahn, Institute of Anesthesiology (Emeritus), University Hospital Zurich, Zurich, Switzerland
Daniel Surbek, Inselspital, University Hospital Bern, Bern, Switzerland
Pierre Tibi, Dignity Health, Yavapai Regional Medical Center, Prescott, AZ, United States of America (15 April to 31 May 2024)
Laura Trentino, East Metropolitan Health Service, Perth, Australia
Milena Carlota Chaves Ureña, Hospital de las Mujeres Dr. Adolfo Carit Eva, Caja Costariccense de Seguro Social, San José, Costa Rica
Karin van den Berg, South African National Blood Service, Johannesburg, South Africa
Alicia Beatriz Vilaseca, Clinic San Camilo, Buenos Aires, Argentina
Saleema Wani, Corniche Hospital, Abu Dhabi, United Arab Emirates
Matthew Warner, Mayo Clinic, Rochester, Minnesota, United States of America (15 April to 31 May 2024)
Luca Paolo Weltert, Saint Camillua International University of Health Science, Rome, Italy
Petro-Lize Wessels, South African National Blood Service, Johannesburg, South Africa
Khaled Yassen, College of Medicine, King Faisal University, Hofuf City, Al Ahsa, Saudi Arabia
Kai Zacharowski, University Hospital Frankfurt, Goethe University, Frankfurt am Main, Germany

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This document has been developed to guide health authorities in implementing patient blood management (PBM) as a national standard of care. The aim is to improve the blood health status of the population in general as well as to improve patient outcomes, safety and quality of care, while reducing the overall cost of health care. This guidance document also addresses the specific roles of single health care organizations in conducting pilot projects as models for national PBM implementation and later to serve as national PBM reference centres.

Abbreviations

ACI	anaemia of chronic inflammation
ALGIB	acute lower gastrointestinal bleeding
ASH	American Society of Hematology
AUGIB	acute upper gastrointestinal bleeding
BH	blood health
CHF	chronic heart failure
CHW	community-based health worker
CME	continuing medical education
CMO	chief medical officer
CVD	cardiovascular disease
DOAC	direct-acting oral anticoagulant
DRG	diagnosis-related group
EBL	estimated blood loss
EBM	evidence-based medicine
EML	WHO Model List of Essential Medicines
EMR	electronic medical record
ESA	erythropoiesis-stimulating agents
ESC	European Society of Cardiology
EU	European Union
FIGO	International Federation of Gynecology and Obstetrics
FTE	full-time equivalent
GP	general practitioner
HCO	health care organization
HCP	health care provider
HDI	Human Development Index
HIC	high-income country
HIS	hospital information system
HMB	heavy menstrual bleeding
IBD	Inflammatory bowel disease
ICU	intensive care unit
ID	iron deficiency
IDA	iron deficiency anaemia
IFPBM	International Foundation for Patient Blood Management
IHME	Institute for Health Metrics and Evaluation
IT	information technology
KPI	key performance indicator
LIC	low-income country

LIS	laboratory information system
LHW	lay health worker
LMIC	lower-middle income country
LOS	length of (hospital) stay
MAPBM	Maturity Assessment Model in Patient Blood Management
MDG	Millennium Development Goal
NATA	Network for the Advancement of Patient Blood Management, Haemostasis and Thrombosis
NBA	National Blood Authority (Australia)
NGO	nongovernmental organization
NOAC	novel oral anticoagulant
PAS	patient administration system
PBM	patient blood management
PLTs	platelets (pooled or apheresis)
PoC	point-of-care
PPH	postpartum haemorrhage
PR	public relations
RBCs	red blood cells (packed)
SABM	Society for the Advancement of Patient Blood Management
SCA	Society of Cardiovascular Anesthesiologists
SDG	Sustainable Development Goal
SDH	social determinants of health
SIAPBM	Sociedad Iberoamericana de Patient Blood Management
SLT	standard laboratory testing
SHRAC	State Health Research Advisory Council
STS	Society of Thoracic Surgeons
SU	standard unit
TIS	transfusion information system
TXA	tranexamic acid
UHC	universal health coverage
UMIC	upper-middle income country
VMNIS	Vitamin and Mineral Nutrition Information System
vWD	van Willebrand disease
WHO	World Health Organization
WAPBM	Western Australia Patient Blood Management Group
WRA	women of reproductive age
YLD	years lived with disability

Executive summary

Patient blood management (PBM) is a new paradigm to manage and preserve an individual's own blood in health and illness. The overarching aim is to ensure optimal blood health worldwide, which is the condition in which the individual's blood performs its intended function. Impaired blood health, encompassing conditions such as iron deficiency, anaemia, blood loss and bleeding disorders, affects more than three billion individuals globally and has significant health and economic implications.

PBM has the potential to improve blood health for billions of individuals and to improve safety and outcomes for hundreds of millions of patients. In so doing, it could save billions of health care dollars that could be reallocated where needed. This guidance document underscores the critical importance of blood health and PBM for global public health. It emphasizes the urgent need to prioritize blood health as a global public health goal.

PBM is highlighted as a patient-centred approach aimed at improving patient outcomes by managing and preserving the patient's own blood. It aligns with the principles of health promotion, health protection and disease prevention.

The evidence shows that PBM is associated with reduced morbidity, mortality and length of hospital stay across a broad spectrum of populations. For health care organizations, it therefore offers significant economic benefits. Furthermore, implementing PBM to enhance health care delivery is an ethical obligation.

To facilitate the global implementation of PBM this guidance document uses the "8-model", a structured pathway for complex and comprehensive system implementation in large sectors including national health care systems. This model integrates the "3Ps", namely health promotion, health protection, and prevention of disease and adverse outcomes in relation to blood health and the "3Es", namely clinical evidence, economic benefits and ethical obligation related to PBM. It guides stakeholders through a logical sequence of actions to implement PBM as a national standard of care. The model outlines three phases: preparing the national/jurisdictional health care system for PBM, conducting PBM pilot projects and rolling out PBM nationally/jurisdictionally.

Additionally, the guidance document offers PBM toolkits tailored for different populations and resource levels, enabling customization and implementation of PBM initiatives. These kits provide practical strategies and resources for managing iron deficiency, anaemia, blood loss and coagulopathy, ensuring comprehensive care across diverse health care settings.

Who are the intended audiences for this guidance document?

Awareness and a basic understanding of blood health and PBM across a broad range of stakeholders and constituencies are key to its successful implementation.

Note:

To make best use of this guidance document, readers should first familiarize themselves with the WHO Policy Brief: *The urgent need to implement patient blood management (1)*.

Chapters 1 and **2** are aimed at all leaders, policy-makers, enablers and primary influencers of the public health care system. This includes, but is not limited to, federal and jurisdictional ministers, senior staff of these ministries, departments of health or the analogous governmental agency for the respective country, members of national/jurisdictional health councils, health commissioners, directors of health, chief medical officers, executives of public health payment/insurance systems, heads of regulatory bodies including the centres of disease control, members of parliament or similar legislative bodies, and heads of national and regional academies or similar entities and government-supported and/or recognized health research institutions. Depending on how public health and the national/jurisdictional health system are organized and administered, it might also be advisable to include ministers of finance, justice and defence, and senior representatives of the respective ministries.

The highest-ranking official of the respective health authority is responsible for initiating and authorizing the national/jurisdictional implementation of PBM and should therefore also have an overview of **Chapter 3** of this document.

It is recommended that medical professionals from all levels of care, and particularly all individuals who will later be referred to as members of the **national/jurisdictional PBM implementation task forces** and members of the **health care organization (HCO) implementation task forces**, **study the entire document**. This applies particularly when iron deficiency, anaemia, blood loss and coagulopathy play major roles in their daily practice. An appreciation of the full content of the document is also important for quality and safety managers, chief administrators of HCOs, health economists, epidemiologists, ethicists, patient advocates and medico-legal experts. The guidance also addresses faculty members of medical, nursing, pharmacy, public health and health management schools, and board members of medical and, where appropriate, other professional societies. Editors of medical, public health and medico-legal journals, media professionals specialized in health care and the interested public are also invited to engage with the content.

Manufacturers of pharmaceuticals, medical devices and equipment, biotechnology companies, blood services and laboratory services should also consider how they could contribute to blood health through technological innovation and improved cost-effectiveness of their products and services.

1 Introduction
Improving blood health status is a global public health priority

More than **three billion** individuals are affected by **iron deficiency (ID)**, **anaemia**, **blood loss** and **coagulopathy**, meaning their **blood health** is chronically or acutely **impaired**. This has profound **macro-economic**, public health and patient-level consequences, costing billions of dollars in productivity losses, health care expenditures and diminished quality of life. Impaired blood health has a **disproportionate impact on women's health**, **maternal health**, and **fetal**, **neonatal** and **children's health**. Poor blood health during childhood and adolescence has many underrecognized consequences including impaired cognitive development. Impaired blood health is linked to socioeconomic factors, with the highest prevalence of anaemia in low-income countries (LICs) and lower middle-income countries (LMICs), and in in poorer populations globally. Trauma, including vehicle collisions and interpersonal violence, is the most important cause of death among the young and poor, with haemorrhage playing a central role. Last, impaired blood health **exacerbates morbidities** and comorbidities of **older adults**, a problem that will further increase with the ageing of society. Impaired blood health is highly prevalent in hundreds of millions of medical and surgical inpatients and outpatients. This adds to the impact of their primary diagnosis by **increasing morbidity**, **mortality** and **length of hospital stay**. Patients with severely impaired blood health are also at risk of exposure to transfusion, an added potential hazard and a dose-dependent risk factor for adverse outcomes *(1)*. The WHO Policy Brief: *The urgent need to implement patient blood management*, states that anaemia, blood loss and coagulopathy *represent one of the world's biggest*, ***largely preventable***, *yet* ***greatly underestimated*** *public health and health-economic burdens*.

Box 1

Definitions of patient blood management (PBM) and blood health and how they relate

Patient blood management is a *patient-centred, systematic, evidence-based approach to improve patient outcomes by managing and preserving a patient's own blood, while promoting patient safety and empowerment (2)*.

Blood health[1] *is the optimal function of individual elements of blood, and their associated interactions with all other organs and organ systems (3)*.

Blood is an organ. Although it is often treated or viewed as a connective tissue, a commodity, a medicine or a replacement fluid, circulating human blood fits every criterion that defines an organ of the human body. In fact, no other organ system can survive without properly functioning blood and, uniquely, markers in the blood provide information on the health of every other part of the body. Given this distinctive, or even principal role that blood plays in overall human well-being, striving for blood health through PBM is an ethical and societal imperative in every corner of the globe *(3)*.

PBM is a medical model that manages the patient's own circulating blood with the same consideration as should be given to any other organ or organ system. This includes prevention, diagnosis, treatment and follow-up while aiming for maximal blood health as the therapeutic goal. Health care professionals must understand PBM and integrate it as the standard of care. The public and patients need to understand the concept of blood health, and health authorities must declare blood health a public health priority. Addressing blood health holistically, including its relationship to the heart and the vasculature, will even translate into a significant beneficial impact on cardiovascular health.

[1] With this guidance document WHO introduces the term *blood health* into its vocabulary.

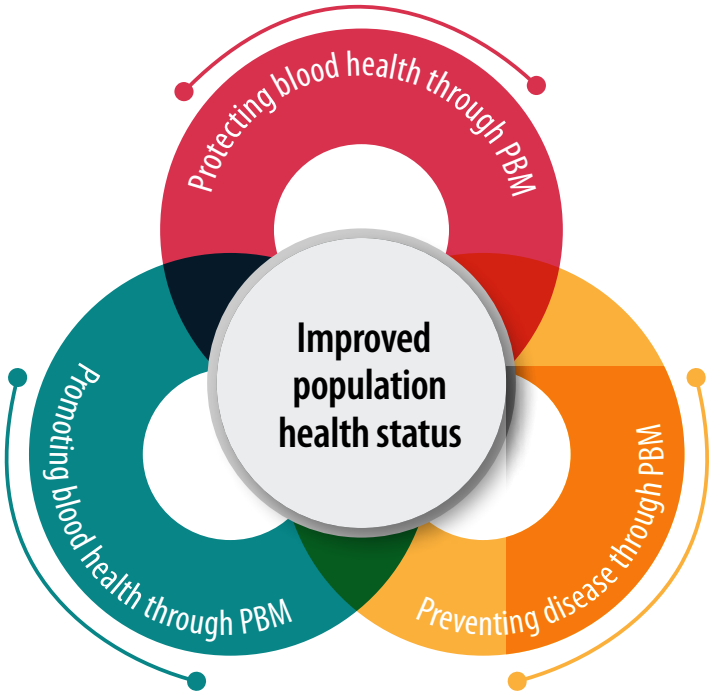
From the epidemiological, safety and clinical viewpoints, the **patients' own circulating blood** is the **most neglected organ** *(3)*. The medical model to rectify this unacceptable situation is PBM. The therapeutic goal of this comprehensive, multidisciplinary model of care is improved blood health.

Improved blood health means improved population health status

From a public health perspective, **PBM greatly improves blood health**. The better blood health is looked after, the more it **improves overall population health status** (Fig. 1). The three main deliverables of public health that directly benefit populations are health promotion, health protection and disease prevention, referred to as the "**3Ps**" in this guidance document.

Preventing disease and adverse outcomes through PBM functions both directly and indirectly. It works directly by establishing structures that allow for early detection and pre-emption of risk for impaired blood health. For instance, screening for ID, including ferritin and anaemia, might be embedded in the care of all women of reproductive age, as part of antenatal care, or in previously designed nutritional programmes for children that can be expanded for early detection of ID. Indirectly, prevention functions through significantly reducing (co)morbidity and mortality in medical and surgical populations when the primary disease or condition is treated in tandem with the management and preservation of the patient's blood. Prevention measures are not always sufficient to maintain blood health. Initiatives to **protect** blood health include the provision of all structural measures that enable and foster PBM as a national standard of care to regain and maximize blood health. Initiatives to **promote** blood health aim to increase awareness within the medical establishment and improve the health literacy of the population as a whole. Educating patients and patient advocates on the importance of blood health as a contributor to overall health status empowers patients and fosters informed choice.

Fig. 1. Improved population health status through PBM



Achievement of blood health through PBM deserves priority

There are many unmet health needs within national health care systems. Implementation of PBM stands out as a priority due to its potential to **improve patient outcomes** for **hundreds of millions of patients while reducing the cost of care** and **freeing up resources by a magnitude of macro-economic dimensions** *(4)*. Public health authorities can then **allocate these billions of health care dollars** saved by PBM to **support universal health coverage (UHC)**, the ultimate Sustainable Development Goal (SDG) in health care. Improved blood health is synergistic with economic improvement and sustainability. Prioritizing the improvement of global blood health status also aligns with **ethical** and **sustainability principles**. In the face of growing challenges, including the ageing of society with the concomitant increase in demand for health services, health care systems worldwide, independent of overall socioeconomic conditions, will benefit from PBM as the **new standard of care**. The unique combination of evidence, economics and ethics, or the "**3Es**" serve as drivers of the PBM implementation process (Fig. 2) as explained below.

- The **evidence** of improved outcomes, safety and quality of care, including big data and "real-world evidence", retrospective and prospective risk-adjusted observational studies *(5-76)*, randomized controlled trials *(77-188)* and meta-analyses *(189-274)* of the diagnostic and therapeutic strategies of PBM.

- The **economic argument** in terms of cost-effectiveness, alleviated cost constraints and immediate returns on investment *(5, 11, 22, 24, 56, 189, 275, 276)*. For inpatients it reduces the mean length of hospital stay and the amount of blood utilized. These reductions alone offset ongoing expenses for medications, medical products and test assays, as well as investment costs for devices that are needed for PBM *(1, 11, 22, 277, 278)*. Reduced rates and costs of complications, and improved patient safety and quality of care, are additional benefits. Recent studies in France and Germany have shown the potential budget impact of PBM for public health insurance systems, where even partial implementation of PBM might result in annual net savings of more than 1 billion euros in these two countries alone *(278-280)*.

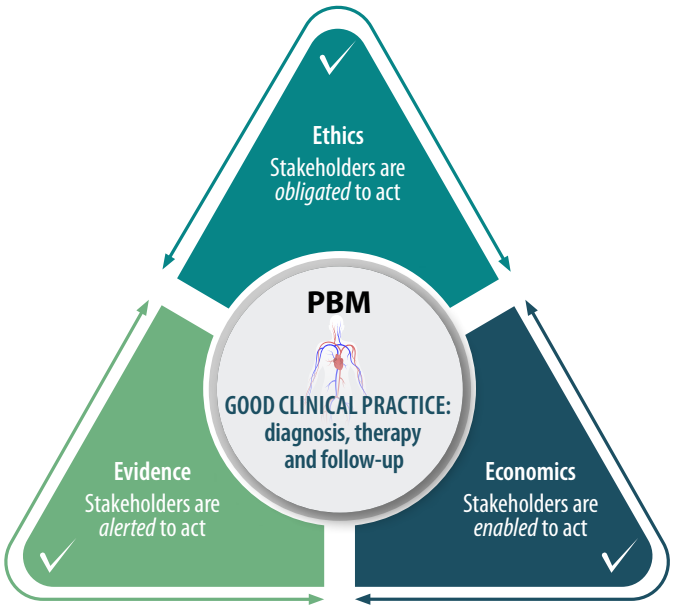
Note:

In many countries, growth in health care spending has outpaced overall economic growth, particularly in those with ageing societies. Health care spending often accounts for the largest or second largest portion of government spending. Demand for health services is likely to increase further and compete with other sectors of public spending. This situation is unsustainable and is prompting efforts to curb public health expenditures while looking for more effective ways to allocate scarce resources *(281-284)*. Therefore, with each PBM budget application, it is crucial to emphasize the urgency and uniqueness of PBM to justify its priority and the fast-tracking of the bureaucratic procedures required for budget approvals. Investment in PBM is part of the solution to public health budgetary pressures.

- There is an **ethical** obligation to quickly implement a medical model that is beneficial for society as a whole, for highly vulnerable populations, for individual patients and also for blood donors *(285)*. Hence, the global health care community is obliged to address this issue without delay. Delaying the implementation of PBM translates into increased morbidity and mortality. The incontrovertible fact is that "our own blood is still the best thing to have in our veins" *(286)*.

  Furthermore, the medico-legal responsibilities of doctors, health care workers and health care organizations must be understood in the context of the implementation of PBM. The legal framework under which medical providers practise mandates that patients be clinically managed in line with evidence-based methods. The importance of PBM as a medical model of care has been substantiated in professional and peer-reviewed publications and textbooks. Therefore, the PBM algorithms and medical model can rightfully be legally defined as the evidence-based standard of care. Medical professionals and health care organizations are legally obliged to adhere to these standards to ensure patient safety and the highest quality of patient care. Failure to implement such evidence-based practices not only violates ethical standards but also exposes health care providers to legal liabilities for not following established protocols that are proven to enhance patient outcomes.

Fig. 2. The "3Es" to drive implementation of patient blood management on the health care organization level



Self-evident ethical obligations:
- Respect patient autonomy
- Manage patients' own blood with with the same respect as any other organ
- Improve equity and access to care
- Respect donors by ensuring their blood donation will be requested and used only when clinically essential to meet the needs of patients

Sufficient peer-reviewed evidence:
- Clinicians should adopt PBM
- Health authorities should mandate PBM

Savings potential of a macroeconomic magnitude:
- Reducing global burden of disease by millions of YLDs
- Reducing transfusion related cost by tens of billions of dollars
- Decreasing significant overall treatment costs
- Costs to enable can be obtained by re-allocating funds from blood acquisition budgets

YLD, years lived with disability.
Source: Hofmann A. et al. (2022) *(4)*.

Taken together, these considerations (3Es) demonstrate the urgent need for the implementation of PBM as a global standard of care, and the coordination of these efforts with existing initiatives to improve patient safety and quality of care. Improving blood health status through PBM implementation, synergistically driven by the 3Ps and 3Es, is an imperative and global public health priority. The WHO Policy Brief: *The urgent need to implement patient blood management* **calls public health authorities around the world to action**:

> *"All Member States should act quickly through their ministry or department of health to adopt their national PBM policy, install the necessary governance, and reallocate resources to improve the population health status and individual patient outcomes while reducing overall health care expenditures"(1).*

However, **system-wide implementation of PBM** is **complex** and **challenging.** Thus, expertise and guidance are essential to successfully manage this process.

2

Overview
How this document helps to overcome the challenges of global PBM implementation

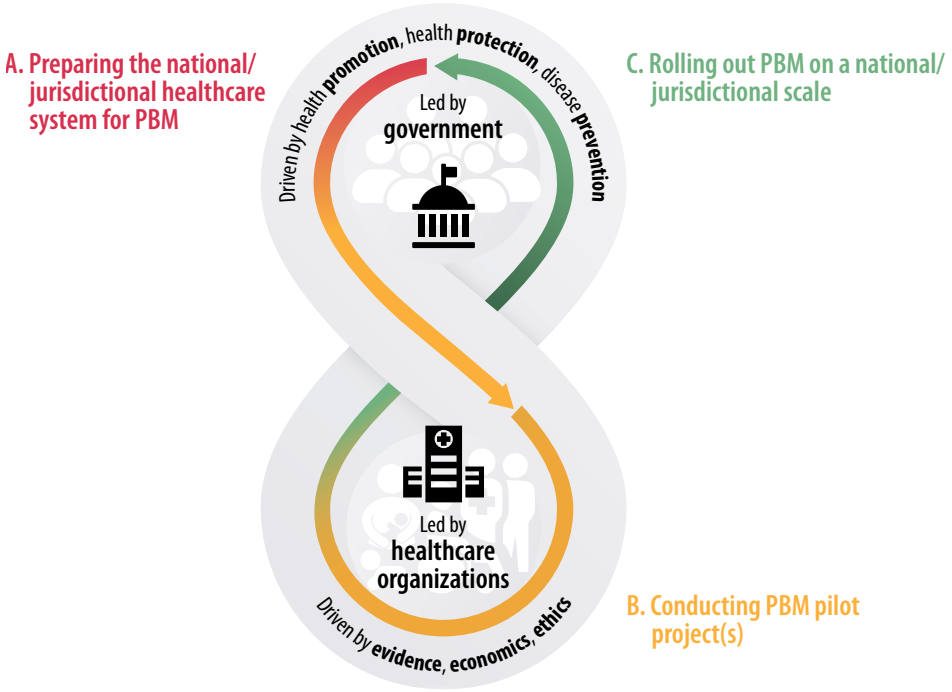
To overcome the challenges of global PBM implementation, this document provides two essential aids:

- a pathway for national/jurisdictional PBM implementation that engages the most relevant stakeholders; and
- PBM toolkits for specific patient populations and diverse resource levels.

Pathway for national/jurisdictional PBM implementation

The **implementation pathway** is based on the "**8-model**", a methodology recently developed for complex and comprehensive system implementations in large sectors, including the national health care system (Hofmann et al., 2024, personal communication). The model's name is derived from the way one usually writes the digit 8. Driven by the 3Ps and 3Es of PBM, the model integrates and leads a range of distinctly different stakeholders through a logical sequence of actions required at the public health, health care organization (HCO) and individual patient care levels. It illustrates how stakeholders relate to each other, explains their roles, and enables them to maintain a structured overview of the entire implementation process and its progress. The pathway comprises three phases (Fig. 3), each including several consecutive implementation steps.

Fig. 3. The 8-model to implement patient blood management



Phase A. Preparing the national/jurisdictional health care system for PBM

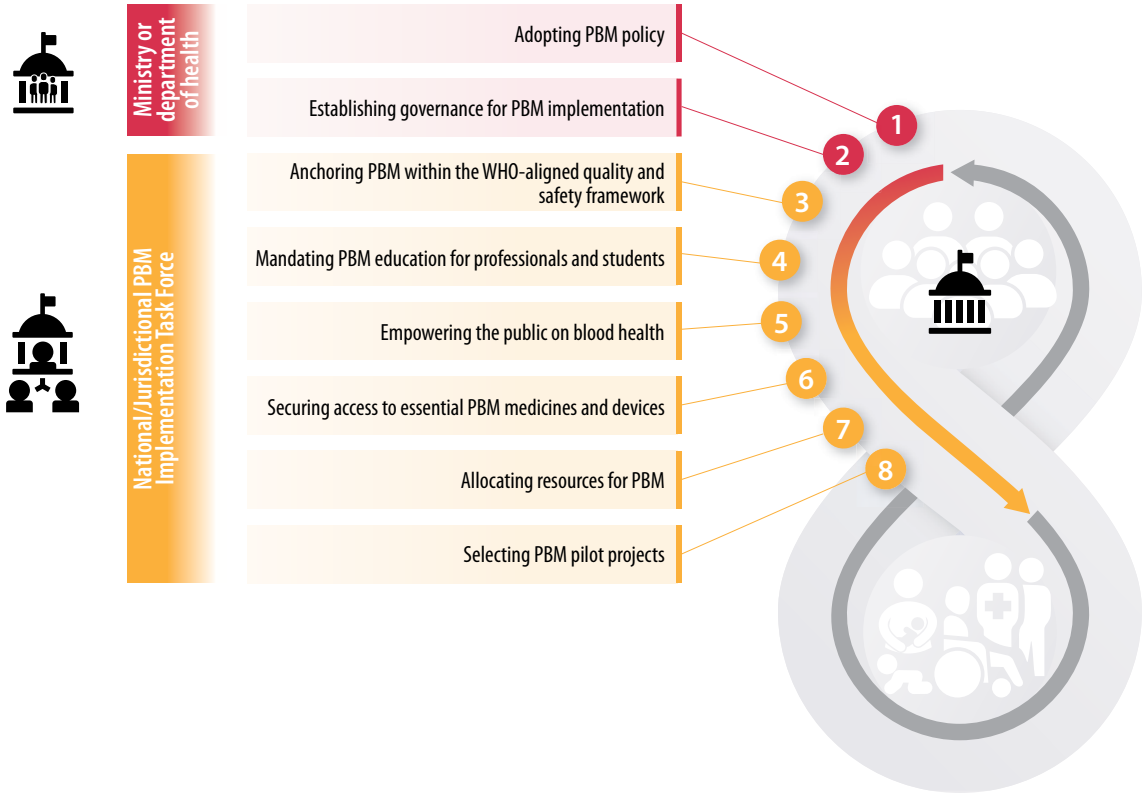
Making PBM a standard of health care requires a firm and formal commitment from the ministry of health, department of health or the analogous governmental agency for the respective country. Based on a primary assessment of the benefits that PBM offers for the national/jurisdictional health care system, it is the responsibility of the minister *(1)* or the highest-ranking official of the respective health authority, to initiate and authorize the national/jurisdictional implementation of PBM and to delegate the oversight of this process to a competent PBM commission referred to in this document as the **PBM Commission** (Fig. 4). Depending on the capacity of the Commission, it may either execute the implementation itself or set up a **PBM implementation task force**, referred to hereafter as the **national/jurisdictional PBM Task Force** that would remain active until the entire process has been completed. With an effective governance framework in place, this Task Force would be given the authority to initiate a series of structural adjustments to enable the smooth implementation of PBM at the clinical level later on. This includes anchoring of PBM within each country's WHO-aligned quality and safety framework, ensuring the provision of professional PBM education, empowering patients and their advocates regarding blood health, and its implications for outcomes and safety. It will also be necessary for the task force to oversee the organization of sufficient access to medicines and devices that are essential to PBM, and adaptation of remuneration and reimbursement schemes for PBM-related services.

Note:

This document consistently refers to national/jurisdictional implementation because in some WHO Member States, the public administration of the health sector falls under national responsibility, whereas in others, it falls under the responsibility of jurisdictions, for example, states, provinces, cantons or other regional authorities. Nevertheless, the overarching goal must be that PBM ultimately becomes a national standard. Thus, jurisdictions within the WHO Member States are expected to collaborate accordingly.

For the last eight steps of the first phase, the national/jurisdictional PBM Task Force would have to appoint HCOs to conduct PBM pilot projects, with a focus on those populations (based on local epidemiological data) that would benefit most from PBM. Eligible HCOs could be general hospitals, specialty hospitals, community health centres, clinics offering outpatient services, or mobile clinics or groups of doctors. A pilot project could also include groups of nurses or community health care workers (CHWs) that are instructed and directed by physicians. These pilot projects would then serve as local proof of concept in accordance with the constraints and challenges unique to each Member State.

Fig. 4. Phase A of the 8-model – Preparing the national/jurisdictional health care system for PBM



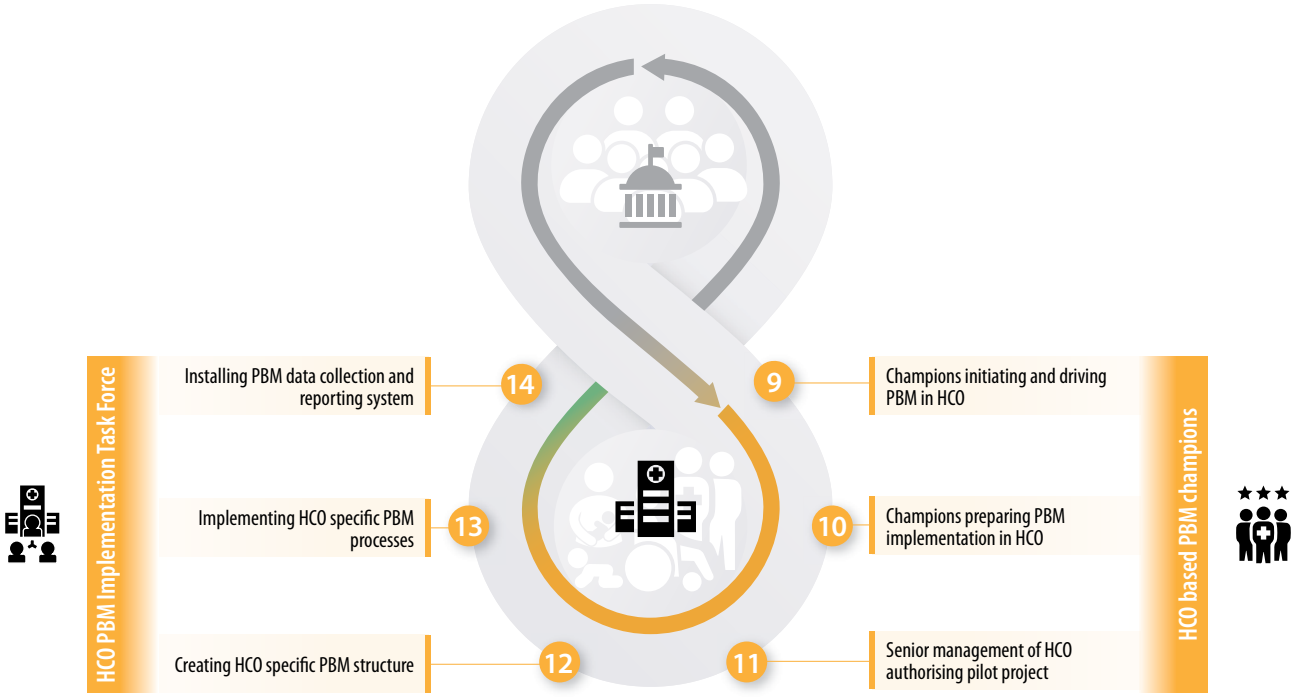
Phase B. Conducting PBM pilot project(s)

The success of Phase B (Fig. 5) depends on the capability and willingness of the appointed HCO(s). Local **PBM champions**, in collaboration with administrative leadership, need to initiate and drive PBM implementation within the HCO. These champions might be identified within the appointed organization or with the help of the country's medical professional societies. In the next step, they are required to diligently prepare for the implementation process by collecting local or institutional baseline data and preparing a business case. Following the approval of the case, the HCO leadership needs to install the necessary local governance. This includes the appointment and authorization of an **HCO PBM Implementation Task Force** referred to hereafter as the **HCO PBM Task Force**. It needs to manage four workstreams:

- development and implementation of PBM data systems;
- development and implementation of PBM education and training courses, alongside staff development;
- blood health communications development; and
- development and implementation of clinical and administrative PBM processes.

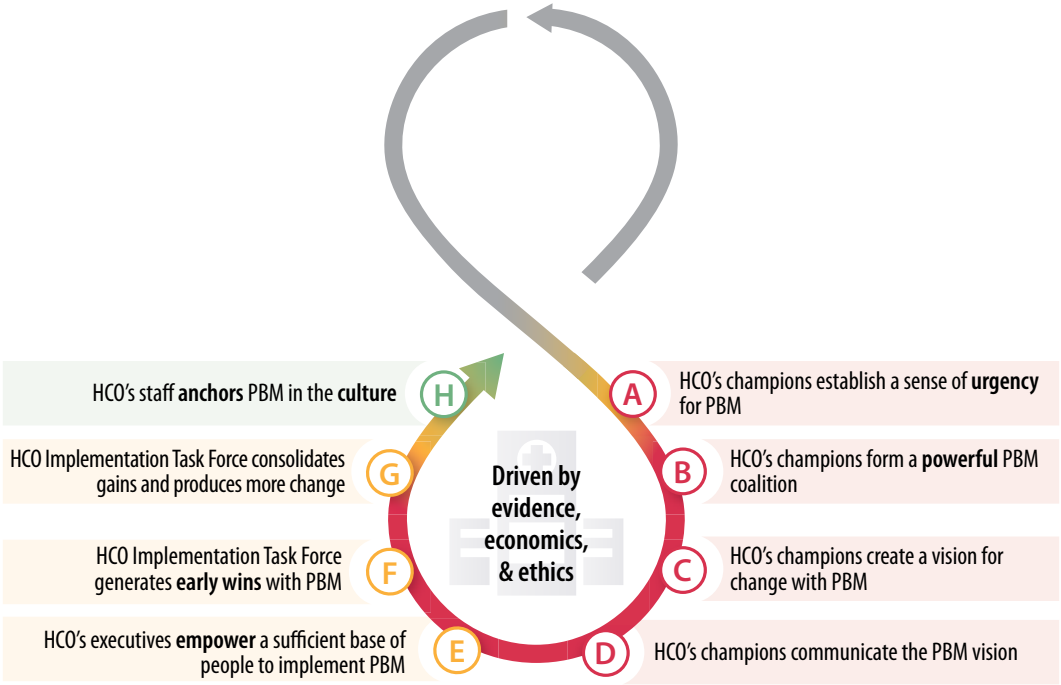
Depending on local circumstances, the HCO PBM Task Force might need to appoint one or more leads to manage these workstreams. The first workstream, which includes data collection, reporting and benchmarking of process, structure and outcome parameters, is pivotal in guiding the ongoing implementation and finally in demonstrating the level of success of the pilot project. This is considered by PBM implementers to be the most challenging of the four workstreams *(287)*. To meet the challenge, the HCO PBM Task Force might choose to establish an **HCO PBM Data Team** with a qualified lead person.

Fig. 5. Phase B of the 8-model – Conducting patient blood management pilot project(s)



An important challenge is that, for most health professionals, PBM means a **new care paradigm**. This requires **culture change**, which has to be managed in tandem with the HCO's structure and process changes *(22)*. To simultaneously manage behavioural and organizational change, the 8-model integrates the Kotter model (Fig. 6). Named after John Kotter, it is a well-established methodology for changing culture and behaviour *(288, 289)*. As a stepwise approach, it begins with "creating a sense of urgency", followed by "forming a powerful coalition" of collaborators and "creating a vision for change". These, and all subsequent steps of the Kotter model, create the climate for a culture change that facilitates the changes in the HCO's structure and process that are necessary to enable PBM. Consistent and repeatedly emphasized use of the 3Es by local PBM champions and the HCO PBM Task Force is crucial for maintaining momentum.

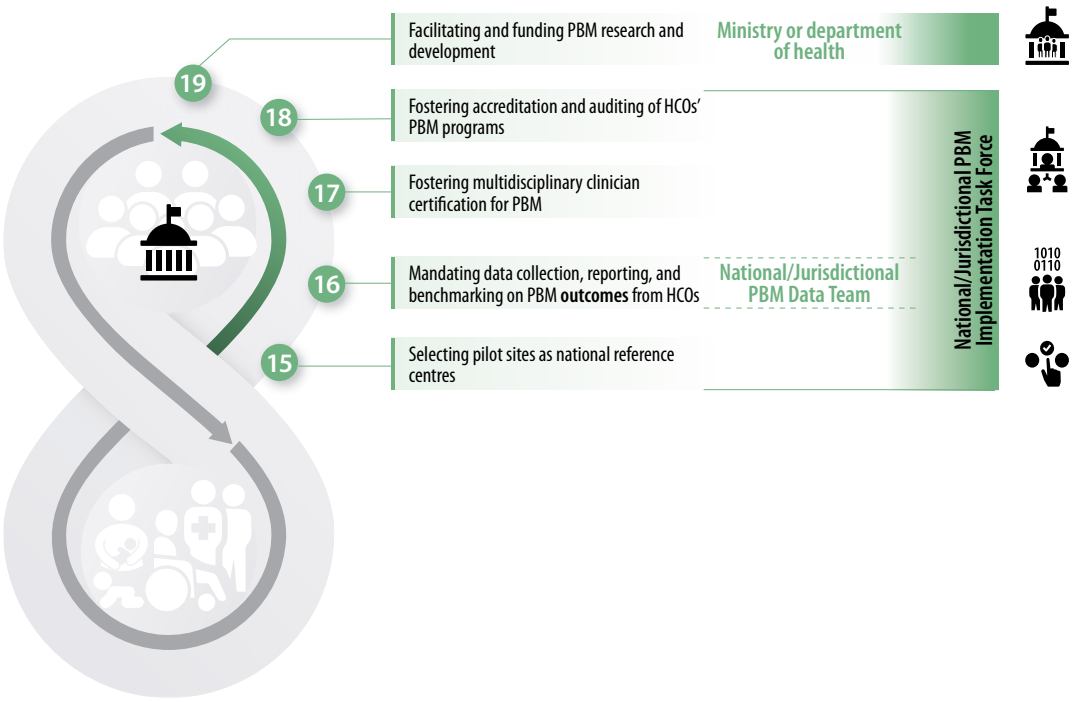
Fig. 6. Integration of the Kotter model into phase B of the 8-model



Phase C. Rolling out PBM on a national/jurisdictional scale

For the final phase of the 8-model, the pathway transitions from the HCO-led pilot projects back to the government-led activities of the national/jurisdictional PBM Task Force (Fig. 7). Before scaling up the national/jurisdictional implementation process, the national/jurisdictional PBM Task Force should evaluate the results from the pilot projects and decide which HCOs were successful enough to qualify as national PBM reference centres. Qualified centres would function as education and training sites for health care professionals from other HCOs. The next step is for the national/jurisdictional PBM Task Force to mandate PBM data collection, benchmarking and reporting to follow the progress and results of the national/jurisdictional roll-out. This mandate should be as comprehensive as possible to include critical data on the prevalence of ID, anaemia and bleeding as well as on clinical outcome. However, depending on the overall sophistication and effectiveness of existing national or jurisdictional health care data collection, analysis and reporting, it may be necessary, at least initially, to rely on a very limited dataset, such as transfusion rates and transfusion ordering practices. In the subsequent stages, it is advisable to create a national or jurisdictional PBM Data Team and leverage the expertise of data professionals to progressively incorporate crucial outcome data, such as rates of ID, anaemia, infection, ischaemia and hospital mortality, and – depending on the populations that would benefit most from achieving blood health – additional parameters *(290)*. The collection of such data underscores the patient-centricity of PBM. The remaining steps to conclude the national/jurisdictional roll-out include developing and establishing clinical PBM standards, followed by certification of health care professionals, certification, accreditation and auditing of HCOs, and mechanisms to foster PBM research and development *(291)*. Drafting specific PBM directives or regulations might be deemed necessary under certain circumstances.

Fig. 7. Phase C of the 8-model – Rolling out patient blood management on a national/jurisdictional scale



In summary, the 8-model pathway with its three phases, as applied to national/jurisdictional PBM implementation, comprises a total of 19 consecutive steps, responsibility for the execution of which is divided among different stakeholders. A detailed description of each step, including more than 50 intermediate steps from initiation to full completion, is provided in **Chapter 3** of this document.

Using PBM toolkits for specific patient populations and diverse resource levels

The other essential aid provided by this guidance document is a set of **six PBM toolkits**. Each includes numerous PBM resources, strategies and tools. They are organized as tables, with the different items categorized according to whether they pertain to the management of ID and anaemia, blood loss or coagulopathy. Three of the toolkits are intended for health care systems with varying levels of resources, stratified by the current World Bank classification (LICs, LMICs and upper-middle-income countries (UMICs) combined, and high-income countries (HICs)). The other three kits are for use in neonatology and paediatrics, obstetrics and trauma departments. All have been compiled giving special consideration to the moderate to severe resource constraints that some Member States are continuously operating under. Special consideration is given to traumatic and obstetric haemorrhage given its frequency, severity and impact, especially in LICs and LMICs. Taken together, these toolkits represent the most comprehensive PBM knowledge and information base published to date. This collection does not include clinical guidelines but refers to such guidelines where appropriate or needed.

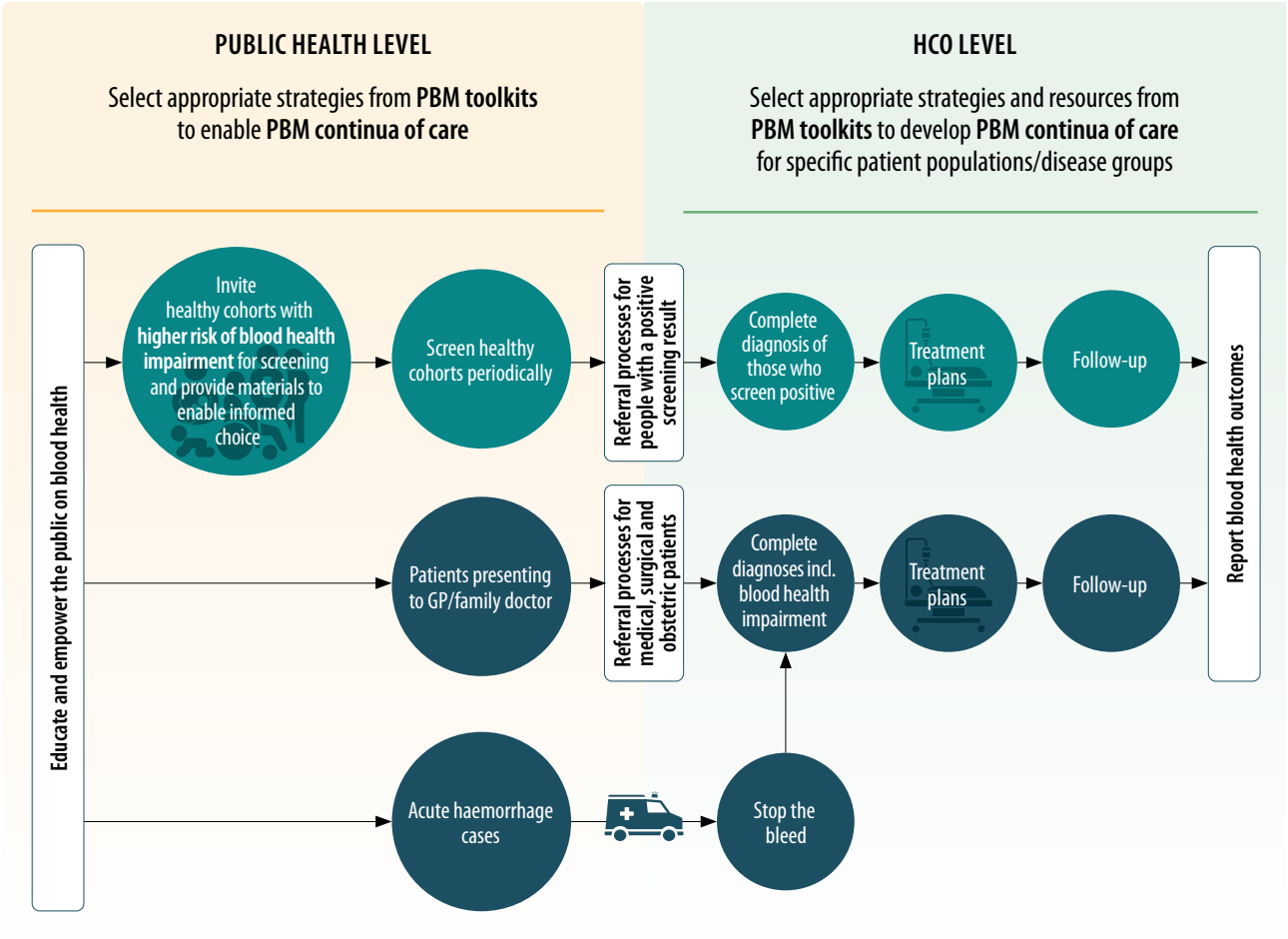
Box 2

Definition of toolkit

In medicine, a "toolkit" refers to a collection of resources, guidelines, strategies and interventions designed to address specific health issues, improve patient care or enhance health care professionals' knowledge and skills. The toolkits in Annexes 6 to 11 cover a wide range of topics and are intended to provide PBM champions and clinicians with practical tools and information to implement PBM as the standard of care. They are designed to reduce the difficulty of PBM implementation, increase the opportunity for understanding and engagement for both patients and health care workers, and improve health outcomes.

The national/jurisdictional PBM Task Force can select and combine various items from these toolkits in a manner appropriate to their national or jurisdictional resources and needs, thus enabling early implementation of PBM for their most vulnerable patient populations. The HCO PBM task forces can adapt the toolkits to their organizational needs. Moreover, they can and should use them to design seamless PBM continua of care for specific vulnerable or at-risk patient populations. This requires participation of all HCO staff members with a role or touchpoint in a specific continuum (see **Chapter 4**). Using the template provided in this guidance document, they would first map the entire patient journey from pre-admission through diagnosis, treatment and follow-up. With guidance from the respective toolkit and the corresponding published literature, they would then integrate all relevant PBM resources, strategies and tools to adjust their current patient care processes (Fig. 8).

Fig. 8. Continuum of care model from public health to individualized patient care to improve national blood health status



Advancing health care in countries with a relatively low human development index (HDI) is always considered difficult and sometimes deemed unviable. However, the PBM toolkits offer opportunities to overcome some of the challenges faced in these countries. Evidence shows that, even under extreme resource constraints, a single or a few PBM clinical strategies, properly and widely implemented, can have a significant positive impact on patient outcomes and population health *(31-33)*. This approach can work both for PBM pilot projects that might be restricted to small village community health initiatives in obstetric care, and for highly developed health care systems, with multiple pilot projects, spanning the spectrum from primary to tertiary health care and across many different specialties.

A detailed explanation of how to use the toolkits and apply them in combination with the template to develop PBM continua of care for different patient populations is provided in **Chapter 3** of this document. Note that the following sections are mainly for use by those responsible for the national/jurisdictional or HCO-level implementation of PBM.

3 The pathway for national/ jurisdictional PBM implementation

Overview

Chapter 3 presents a stepwise model for national/jurisdictional PBM implementation from initiation to completion. Comprising three phases, the pathway follows the 8-model. The name is derived from the way one usually writes the digit 8.

A **Phase A** includes all steps concerning how governments of low- to high-income countries adjust the structure of national or jurisdictional health care systems to enable PBM. The highest-ranking official of the ministry of health or department of health or the analogous governmental agency for the respective country forms a PBM Commission and formally adopts a national or jurisdictional PBM policy, and then establishes the necessary governance to carry out all structural changes. This is best accomplished through a national/jurisdictional PBM Task Force acting on behalf of the Commission.[1] Within the scope of the government's statutory health responsibilities, namely, to protect and promote health and to prevent disease, the Task Force anchors PBM within the WHO-aligned quality and safety framework. This authorizes PBM education for professionals, secures access to medicines and devices essential for PBM, and organizes the necessary (re-)allocation of resources through close interaction with the health insurance system where applicable. With this, the Task Force selects the most appropriate HCOs to run pilot projects.

B **Phase B** includes the steps necessary to conduct PBM pilot projects in diverse settings that may range from village community health initiatives to large state-of-the-art hospital systems. This includes explanations of how champions initiate and drive the local PBM movement, how they formally prepare for implementation, and how they ensure that the HCO's senior management authorizes the pilot projects. An HCO PBM Task Force, which includes clinical champions and is embedded in a governance framework, is empowered to implement the structural changes specific to the HCO's PBM needs. Next, clinical and administrative PBM processes will be introduced. Finally, the functioning and outcomes of the pilot project will be measured and reported to the HCO leadership.

C **Phase C** comprises PBM national/jurisdictional scaling up and roll-out and falls under the direct responsibility of the national/jurisdictional PBM Task Force. HCOs whose pilot projects achieve the intended results will become PBM reference HCOs and serve as models for replicating success on a national or jurisdictional scale. During scaling up, the Task Force will authorize PBM data collection and reporting to measure progress and benchmark achievements. Clinician certification and eventual hospital accreditation for PBM are fostered by the national/jurisdictional PBM Task Force. From this point forward PBM may be regarded as the national standard. However, the government will need to facilitate ongoing PBM monitoring, assessment and development.

[1] Depending on their size, existing structure and resources, some Member States may choose a "flatter" administrative structure with the Commission serving a dual role as the national/jurisdictional PBM Task Force.

Despite examples of PBM programmes being successfully implemented in single HCOs without government support, this approach is insufficient to make PBM the global standard of care that is so urgently needed *(287)*. To effectively respond to the WHO PBM Policy Brief's Call to Action, Member States need guidance on how to successfully implement PBM. It is the expectation of representatives of the world's health authorities that PBM implementation be made a priority.

Due to its complexity, this task will require major structural and process changes in health care at national, jurisdictional and patient levels *(292)*. Chapter 3 applies the 8-model to help stakeholders navigate through the:

- eight steps that governments ranging from LICs to HICs should take to prepare for national/jurisdictional PBM implementation;
- six steps that HCOs – ranging from small village health community initiatives run by CHWs to large institutions – can take to **prepare** and **test PBM implementation strategies** through **PBM demonstration programmes**; and
- **five steps** that **governments** can then take to apply the experiences and lessons learned from demonstration programmes to fully scale up and **roll out** PBM across **their entire health care systems**.

Box 3

The 8-model for national/jurisdictional PBM implementation

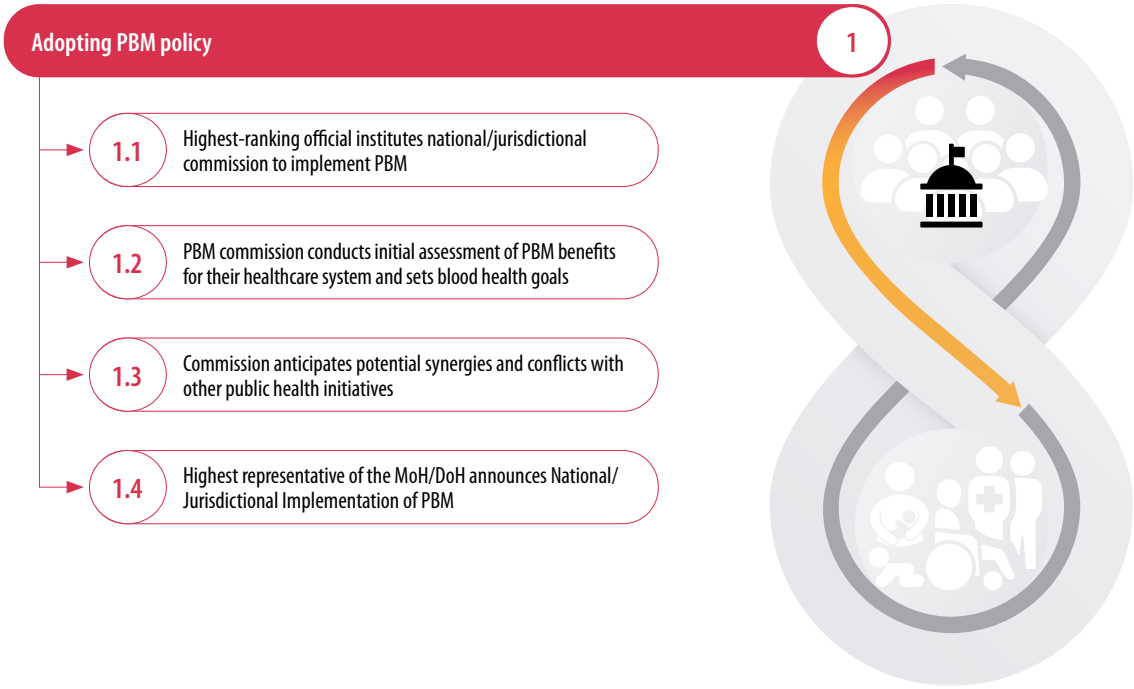
The name 8-model is derived from the way one usually writes the digit 8 (Fig. 3). This illustrates a pathway by means of which health authorities prepare for the implementation of a system along the first semicircle. The pathway then transitions to the level of single health care organizations conducting pilot projects in a full circle from beginning to end. Next, it transitions back to the government level, where the authorities finally scale up the implementation based on the experiences of the pilot projects, until completion of the roll-out along the final semicircle.

In this way, the 8-model guides stakeholders in the macro- and micro-levels of comprehensive system changes and implementation. It harmonizes the tasks of those responsible for the three main public health operations, namely, health promotion, health protection and disease prevention, and the tasks of those responsible for the individual patient-level care that is driven by evidence, economics and ethics. The 8-model integrates the principles of the Donabedian model of quality assessment *(293)*: improved outcomes require improved processes that require improved structure. Additionally, the 8-model embraces the Kotter model for change management.

Phase A
Preparing the national/ jurisdictional health care system for PBM

Phase A of the guidance is a "how-to" manual for the responsible authorities within the public health sector, describing what decisions and steps must be taken to prepare for the full national/jurisdictional implementation of PBM.

Step 1: Ministry of health or department of health adopts national/jurisdictional PBM policy



1.1 Highest-ranking official institutes PBM Commission to implement PBM

The "**Call to action**" in the **WHO PBM Policy Brief states that** "All Member States should act quickly through their ministry or department of health to adopt their national PBM policy [and] install the necessary governance" *(1)*. In direct response, the **health minister**, deputy health minister, chief medical officer or another senior representative of the ministry of health or department of health **institutes** a **PBM Commission**.

The responsibility of the Commission is to **initiate** and **supervise** the **implementation** of PBM. Appointed members should be selected from the following: the operational head of the country's health system and service (for example, chief medical officer (CMO), chief public health officer, director-general of health, director of public health, federal health commissioner, surgeon general), representatives of the national health council (or of a similar body), public health experts, population health experts, epidemiologists, local and international PBM experts, quality and patient safety experts, ethicists, medico-legal experts, patient representatives, representatives of national medical professional societies, health insurance representatives and health economists.

Forming a commission with high-level representatives of the ministry of health or department of health and a broad spectrum of experts underscores the magnitude, importance and urgency of PBM.

1.2 PBM Commission conducts initial assessment of PBM benefits for their health care system and sets blood health goals

Guided by local epidemiological data, and applying its collective expertise, the **Commission** should first estimate or **quantify**, if possible, the **prevalence** of conditions that impair blood health in their country. This information should be organized into three main categories, namely, anaemia and micronutrient deficiency, blood loss and coagulopathy.

Anaemia and micronutrient deficiencies that might lead to anaemia

- ID without anaemia
- anaemia from ID
- anaemia from deficiencies of micronutrients other than iron (for example, vitamin B12, vitamin A, folate)
- anaemia of inflammation
- cancer-related anaemia
- preoperative and preprocedural anaemia and ID
- hospital-acquired anaemia

Blood loss

- chronic blood loss
- acute blood loss
- surgical blood loss
- heavy menstrual bleeding (HMB)

Coagulopathies

- acquired coagulopathies with bleeding risk
- congenital coagulopathies with bleeding risk
- iatrogenic bleeding risk from anticoagulants, antiplatelet medications and herbal supplements, for example, garlic, ginseng, gingko and ginger)
- trauma-induced coagulopathy
- coagulopathy associated with postpartum haemorrhage.

The number of individuals affected by these conditions globally exceeds 3 billion and this has an impact on every Member State. Prevalence data vary depending on age, sex, geography and socioeconomic circumstances. Many of these data can be extracted by country or by region with an interactive tool that is freely available from the Institute for Health Metrics and Evaluation (IHME) (Fig. 9) *(294)*.

This database offers data on national and regional prevalence of anaemia grouped by 15 different causes, sex and patient age (Figs 9–11). Prevalence data on anaemia in subpopulations that are not available from this tool can be estimated from data published in the peer-reviewed literature (Tables 1–3).

Some countries monitor blood utilization through their ministry of health or department of health or other government agencies, stratified by ICD codes, procedure codes and other variables. Blood utilization data could serve as surrogate markers for anaemia and blood loss for specific populations.

Another source of data on anaemia prevalence in women and children is the WHO Global Health Observatory *(295)*. National data on maternal haemorrhage can be retrieved from IHME *(296)*. Additional national prevalence data on blood loss and coagulopathy with bleeding can be estimated from the published literature (Tables 1–3) in combination with national prevalence data from the Global Observatory and IHME on specific diseases or injuries that can impair blood health.

The exceptionally high prevalence of conditions that impair blood health, evident from these data, emphasizes the urgency of PBM implementation and how billions of individuals could benefit from improved blood health. In LICs and LMICs, resource constraints may limit the initial scope of PBM implementation. In that case, the most vulnerable populations should be targeted first. In LICs and LMICs, these are mostly pregnant women, neonates and children. In UMICs and HICs, implementation might be possible across most if not all populations in rapid sequence, once again beginning with the largest and most vulnerable populations.

Fig. 9. Extracting data on blood health with the tool available from the Institute for Health Metrics and Evaluation

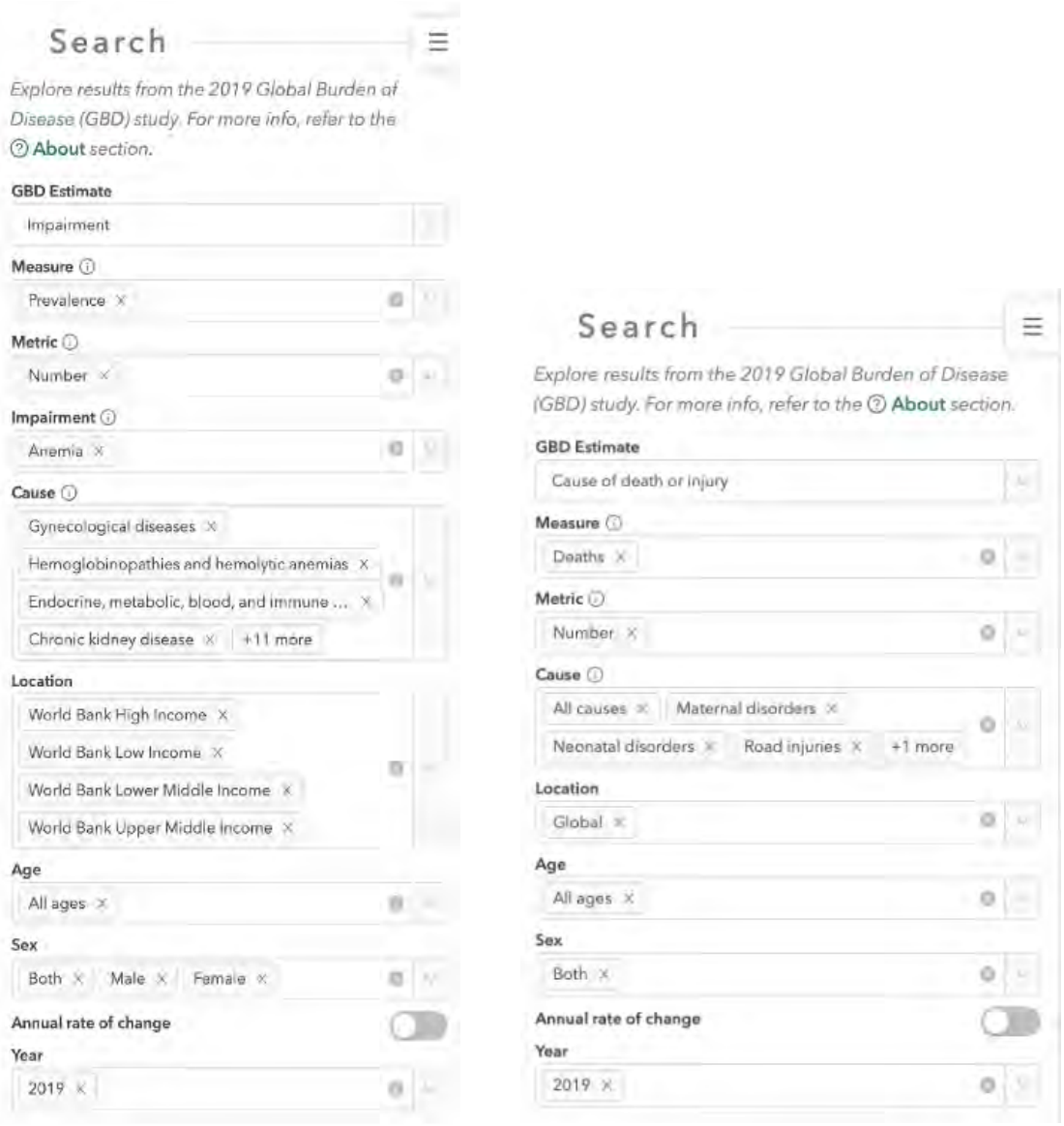
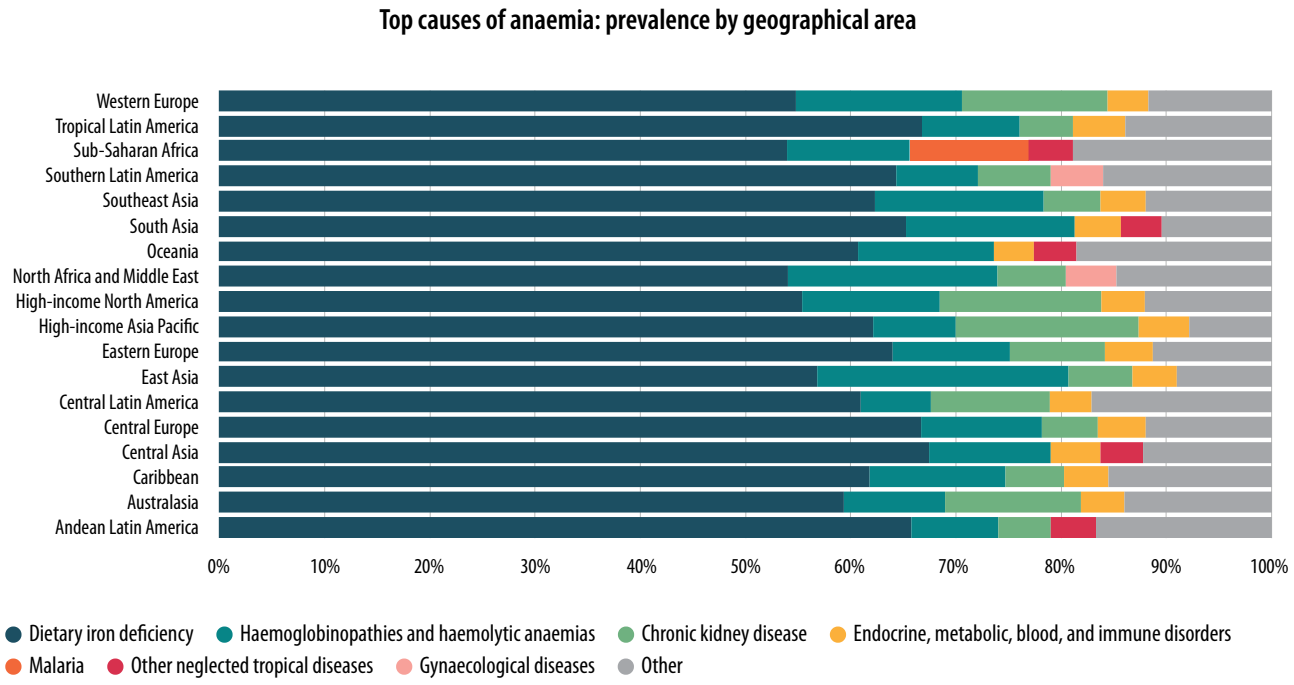
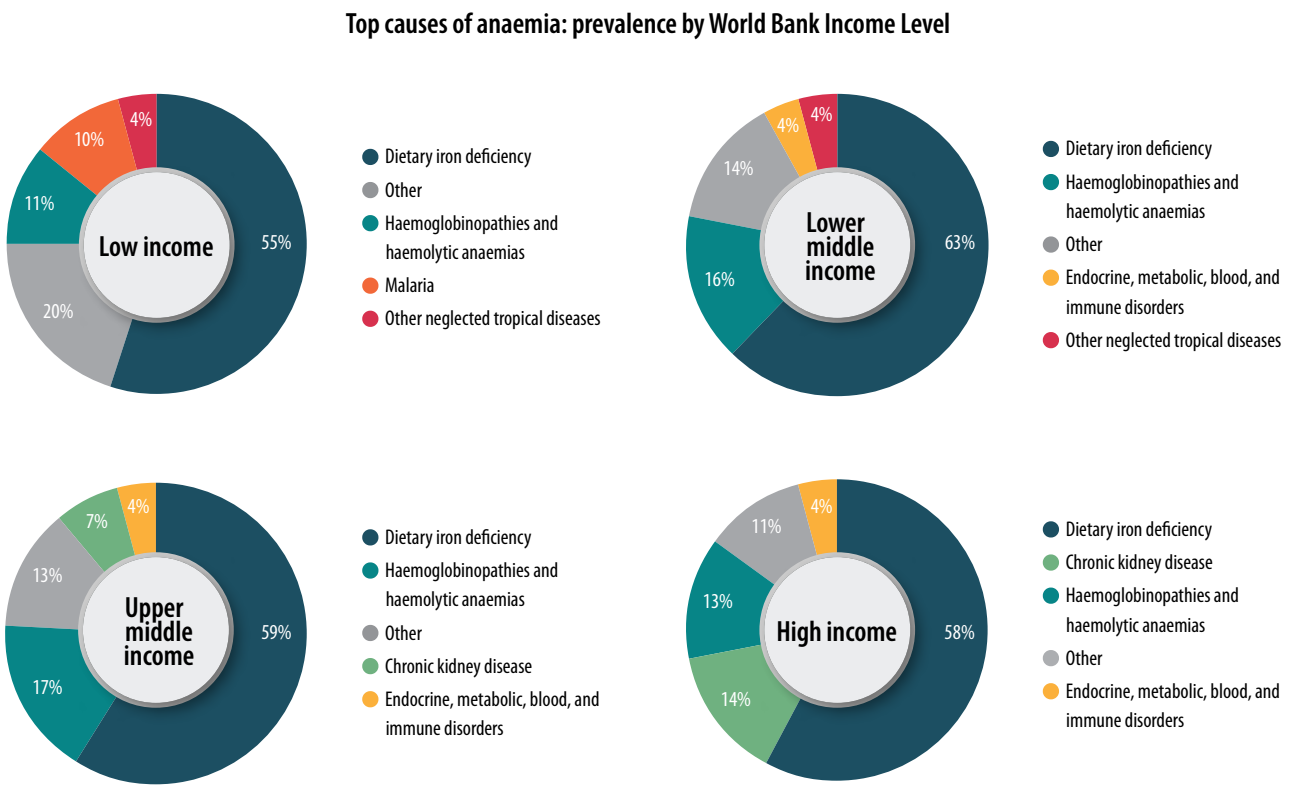


Fig. 10. Causes and prevalence of anaemia





There is significant variation in the prevalence of anaemia by geographical region and specific etiology. Within geographical regions, the most at-risk groups vary by age, sex and socioeconomic circumstances. Dietary iron deficiency is the most common cause of anaemia across all regions and income levels. The graphs provide guidance for those responsible for implementing PBM on the most prevalent causes of anaemia in their jurisdiction.

Source: Produced from the IHME database.

Table 1. Global prevalence of anaemia and the benefits of patient blood management

Anaemia	Global prevalence estimates	Potential and expected benefits for blood health
Anaemia[a]	**1.92 billion people** worldwide, with the highest prevalence in LICs and LMICs *(297, 298)*. In 2019 anaemia was estimated to affect **40% of children** under the age of 5 years and **30% of women** of **reproductive age (WRA)**. In the population aged over 70 years, 25% were estimated to be anaemic *(294)*. The prevalence of preoperative anaemia from all causes varies with the type of surgery, but is estimated to be 30%.	Anaemia is underdiagnosed despite its high prevalence worldwide. This has a negative impact on functional status, quality of life and productivity, and is a major contributor globally to years lived with disability. Increased diagnosis and treatment will improve population health *(299)*. This is particularly important in WRA in LICs and LMICs *(300)*.
Anaemia from **micronutrient deficiencies** • Dietary iron deficiency (ID)[a] - Neonates[a] • Children[a] • WRA[a] • Population over age 70 years[a] • B12 deficiency • Folate deficiency	Iron deficiency **anaemia (IDA) affects an estimated 1.24 to 1.46 billion people** *(298, 299, 301)*.	ID is consistently the top cause of anaemia worldwide *(299)* in both high- and low-income regions. Early recognition of IDA, especially in WRA and in children, will improve women's health and pregnancy outcomes as well as neurocognitive development in neonates and children (302-304).
Anaemia of pregnancy • ID is the most frequent cause • So-called physiological anaemia of pregnancy may contribute to underdiagnosis	Global prevalence is estimated at 37% *(301)*.	To reduce maternal complications caused by ID and IDA and to ensure the safety of fetaldevelopment, especially neurodevelopment duringlate gestation, early screening for anaemia and ID at the beginning of each pregnancy is strongly recommended and is expected to improve neonatal and maternal outcomes *(305)*
Isolated micronutrient deficiencies	Isolated ID is estimated to be **twice as common as IDA** *(306)*. Based on the prevalence of IDA from the 2019 Global Burden of Disease study, this could mean an additional 2.1 billion people have ID without anaemia.	Absolute ID is easy to detect and generally easy to correct. Benefits of treating ID include anaemia prevention, increased productivity, reduced fatigue, enhanced functional status, neurocognitive benefits, improved pregnancy outcomes, mitigation of restless leg syndrome and improved immune function *(306)*.
Anaemia of inflammation (anaemia of chronic disease)	**Anaemia of inflammation** is the **second most common anaemia worldwide** and often coexists with IDA, particularly in people living in LICs and LMICs with a high prevalence of nutritional deficiencies and infectious diseases *(307, 308)*. Anaemia frequently accompanies obesity. Obesity may interfere with iron absorption by increasing hepcidin as a consequence of chronic inflammation *(309)*.	Treatment that targets the underlying inflammatory processes can indirectly improve the anaemia and its symptoms. Anaemia of inflammation can often be mitigated with intravenous iron and/or erythropoiesis-stimulating agents (ESAs). Treatment can lead to decreased health care utilization. It can also improve outcomes and functional status in people with chronic diseases such as kidney disease, bowel disease, heart failure and malignant tumours *(310)*.
• Infectious diseases including - malaria[a] - schistosomiasis[a] - HIV/AIDS[a] - intestinal nematode infections[a]	**Anaemia is highly prevalent in patients with infectious diseases.** The highest prevalence is in the LICs of Asia and sub-Saharan Africa and the lowest in the HICs of Asia, Australia, Europe and North America *(311)*. **Globally, the prevalence of anaemia attributable to infectious diseases, including hookworm, malaria, schistosomiasis, other infectious diseases and neglected tropical diseases, is estimated as 12 000 per 100 000 population** *(312)*. Pregnant and lactating women are at greater risk of anaemia from hookworm infection *(311)*. Of people living with HIV infection, it is estimated that *(313)*.	Coadministration of treatment for infectious disease and anaemia has a greater effect on anaemia. Pregnant and lactating women with hookworm infection and anaemia benefit from coadministration of deworming medicines and iron supplementation *(312)*. Malarial anaemia is multifactorial due to haemolysis, hypersplenism and dyserythropoiesis, sometimes in the setting of glucose-6-phosphate dehydrogenase deficiency or ID. Iron supplementation in individual patients with malarial anaemia, should be administered after the infection is eradicated . A PBM approach reduces the risk of prolonged anaemia, especially in children, as the main risk factor is pre-existing anaemia *(314)*.

Table 1. *continued*

Anaemia	Global prevalence estimates	Potential and expected benefits for blood health
• Chronic kidney disease (CKD)[a]	Of 700 million **patients** with **CKD, 100 million or more are likely to have anaemia** (prevalence estimates for anaemia range between 14% and 64%) *(315-319)*.	Anaemia in people with non-dialysis-dependent CKD remains vastly underrecognized. Less than 20% receive anaemia treatment even though anaemia of CKD is highly responsive to iron, ESAs or both, as well as recently introduced hypoxia-inducible factor prolyl hydroxylase (HIF-PH) inhibitors. PBM would significantly improve blood health, productivity and quality of life in this population as well as reducing transfusion dependency *(320)*.
• Cardiovascular disease (CVD) and diabetes	Among the 420 million patients with CVD *(321)* and the 476 million patients with diabetes *(322)*, anaemia is common. Its prevalence in the subset of CVD patients with chronic heart failure (CHF) is approximately **26 million worldwide** *(323)*. It occurs in approximately 30% of stable and 50% of hospitalized CHF patients *(324)*. In addition, **50% of CHF patients with or without anaemia have ID** *(325)*. The overall prevalence of anaemia in people with type 2 diabetes is estimated at 30% *(326)*. **Anaemia as a comorbidity of CHF and diabetes affects at least 170 million people**.	Anaemia in these populations remains underrecognized and undertreated *(317, 327-329)*. Data from randomized controlled trials show that treatment of ID in CHF patients improves quality of life and exercise capacity, and decreases cardiovascular morbidity and hospitalization *(330)*. Oral sucrosomial iron may provide a less expensive alternative to intravenous (IV) iron therapy *(331)*. However, more studies are needed to demonstrate that oral sucrosomial iron is an effective alternative to IV iron in patients with non-anaemic ID and CHF.
• Upper digestive system diseases[a]	Anaemia and ID in upper gastrointestinal disease is common but prevalence varies widely depending on the population and the specific condition. Thus, regional epidemiological data are needed to obtain accurate estimates. Anaemia and ID results from bleeding, malabsorption and inflammation. Studies suggest that anaemia in people with upper digestive system disease may be more prevalent than in those with lower digestive disease, suggesting it is a significant contributor to overall prevalence of anaemia *(332)*. Bariatric surgery for obesity and major oncological surgery on the upper gastrointestinal tract interferes with iron absorption and is a frequent iatrogenic cause of ID involving the upper digestive system.	Gastrointestinal causes should be considered a possibility in any patient with anaemia. The most common cause is ID. Recognition and treatment will decrease the risk that a transfusion will be administered and mitigate the consequences of ID. A structured approach to diagnosis and management often identifies comorbidities such as peptic ulcer disease (particularly detection and eradication of *Helicobacter pylori* infection), coeliac disease, erosive gastritis, oesophagitis, liver disease, etc., which when identified and treated improve health status beyond blood health alone *(333)*. A structured approach to managing iron absorption after surgery to the upper gastrointestinal system will reduce the incidence of postoperative anaemia in these patients.
• Inflammatory bowel disease (IBD)[a]	**Anaemia and ID is highly prevalent in people with IBD**, but the precise figure remains unknown. Estimates vary widely **from 36–90%** *(334)*.	Iron therapy has been associated with significant benefits in patients with IBD and IDA, in terms of both disease progression and health care resource utilization (335).
Cancer-related anaemia		
• Cytoreductive chemotherapy • Immunotherapy • Inflammation • Bone marrow involvement	The prevalence of **anaemia in patients with oncological or haematological malignancies** is between 26% and 53% and is reported to be as high as 75% in patients with solid tumours who are receiving cytoreductive chemotherapy *(336, 337)*. In patients with haematological malignancy, such as acute leukaemia treated with chemotherapy and immunotherapy, the incidence of anaemia approaches 100%. Of the **more than 19 million new cancer patients every year, 5 to 10 million have concomitant anaemia** *(338)*.	Although guidelines are available to pre-empt or minimize anaemia in these patients *(339)*, clinical adherence is suboptimal. Implementation of PBM in this population will improve quality of life and may reduce mortality *(340-343)*.

Table 1. *continued*

Anaemia	Global prevalence estimates	Potential and expected benefits for blood health
Preoperative and preprocedural anaemia and ID	Preoperative and preprocedural anaemia and ID is more prevalent than anaemia in the general population. Of the estimated 313 million surgeries performed worldwide (2010), **more than 100 million surgeries are likely to be performed on anaemic patients** *(4, 344)*. The prevalence of preoperative anaemia from all causes varies with the type of surgery but is estimated to be 30–40% *(345, 346)*. When anaemia thresholds are redefined at 13 g/dL for both sexes, the prevalence of preoperative anaemia will rise significantly in the overall population and particularly in women *(347)*.	Preoperative anaemia and ID are easy to detect, and the underlying causes are generally readily correctable *(306)*. Diagnosis and management of preoperative anaemia may be expected to reduce postoperative mortality *(345, 346)*.
Hospital-acquired anaemia (HAA)		
• Critical illness (intensive care unit (ICU), paediatric intensive care unit) • Extended hospital stay • Postoperative anaemia	Of an estimated 421 million patients hospitalized annually *(348)*, between 35% and 75% develop anaemia during their stay *(349, 350)*. The prevalence is up to 100% in patients with ICU stays of more than 7 days *(351, 352)*. Of those who are anaemic when discharged from hospital, almost half are still anaemic up to 12 months later *(351)*. The annual blood loss due to phlebotomy is estimated at 25 million litres *(353)*. Global prevalence of postoperative anaemia is estimated at 80–90% *(354)*.	HAA is largely preventable, particularly in surgical and ICU patients *(47, 349, 355-361)*.

LICs, low-income countries; LMICs, lower middle-income countries.

[a] Prevalence data by country can be retrieved from https://vizhub.healthdata.org/gbd-results/

Table 2. Global prevalence of blood loss and the benefits of patient blood management

Blood loss	Global prevalence estimates	Potential and expected benefits for blood health
Acute and chronic blood loss		
• Heavy menstrual bleeding (HMB)[a] • Abnormal uterine bleeding, for example, perimenopausal and dysfunctional uterine bleeding; bleeding due to uterine leiomyomata, adenomyosis, etc. *(362)*	**HMB affects 20-50% of women of reproductive age** *(363, 364)* and is associated with reduced quality of life, lost productivity at work and interruption of girls' education. In a study conducted in low- and middle-income countries, approximately half of the women in a sample of 4828 had HMB. The prevalence ranged from 38% to 78% *(365)*. In another study, the prevalence of HMB in a sample of 4506 women in five European countries was 27% *(366)*. Dysfunctional uterine bleeding and uterine bleeding due to leiomyomata and adenomyosis adds to the burden of iron deficiency (ID) and iron deficiency anaemia (IDA) in women.	The management of IDA and ID is not adequately addressed or adopted in guidelines for management of HMB, dysfunctional uterine bleeding and uterine bleeding due to uterine pathology *(367)*.

Table 2. *continued*

Blood loss	Global prevalence estimates	Potential and expected benefits for blood health
• Gastrointestinal bleeding - Acute upper gastrointestinal bleeding (AUGIB) - Acute lower gastrointestinal bleeding (ALGIB) - Chronic gastrointestinal bleeding	**Major disease-related blood loss affects millions of gastroenterology patients** *(368, 369)*. AUGIB alone represents a significant clinical and economic burden, with a reported incidence of 48–160 cases per 100 000 adults each year *(370, 371)*. ALGIB from such causes as ischaemic colitis, diverticulosis and angiodysplasia may be equally common, with a crude incidence of 87 per 100 000 population *(372)*. Chronic gastrointestinal bleeding, especially from lower gastrointestinal neoplasms, contributes significantly to IDA *(373)*. Acute and chronic gastrointestinal bleeding are frequently exacerbated by the use of anticoagulant and antiplatelet medications, and this is associated with increased mortality and morbidity *(372, 374)* as well as persistent anaemia and ID *(373)*.	AUGIB and ALGIB are often treated with transfusions. PBM will reduce the need for transfusion in patients with acute gastrointestinal haemorrhage and improve clinical outcomes *(374)*. Despite its high incidence in patients with gastrointestinal haemorrhage, ID often goes undiagnosed and undertreated. PBM supports the following recommendations and findings: that IDA be diligently investigated, that effective treatment of ID/IDA improves outcomes such as health-related quality of life and can avoid severe cardiovascular consequences, and that intravenous iron is well tolerated as a treatment in this setting *(375)*.
• **Trauma haemorrhage**[b]	It is estimated that 4.4 million deaths annually can be attributed to trauma-related injuries *(376)*. Trauma-related haemorrhage is thought to be responsible for 1.5 million deaths annually *(377, 378)*. The global burden of severe haemorrhage associated with trauma is difficult to estimate, but road traffic accidents alone account for at least 50 million cases. Those in LMICs in the African Region and South-East Asian Region account for >50% of the total *(378)*. More than 56 million people sustain injuries each year that are severe enough to warrant inpatient care *(379)*.	Although guidelines are available on how to minimize and pre-empt blood loss in these populations, and to manage anaemia and support haemodynamics and oxygenation *(380, 381)*, clinical adherence to these guidelines in direct patient care is suboptimal. This represents a clear opportunity for PBM implementation.
• Postpartum haemorrhage (PPH)[a] • Ectopic pregnancy • Incomplete abortion	**PPH occurs in at least 6%** of births or an estimated **8.4 million** events per annum, and may be increasing *(382)*. Severe PPH occurs in 1.86% of all deliveries, or an estimated **2.5 million** events *(383)*. Numbers of deaths from PPH are several times higher in LICs than in HICs *(384)*. Recent evidence suggests an association between a low antepartum haemoglobin concentration and an increased risk of PPH *(385-387)*.	Active management of the third stage of labour, use of uterotonics and tranexamic acid, and rapid recognition and management of PPH including cell salvage, are all effective PBM strategies used to manage obstetric haemorrhage *(388-391)* and have been shown to reduce transfusions and maternal mortality from PPH *(7, 78, 175)*.
Surgical blood loss		
• Cardiovascular surgery • Transplant surgery • All other major surgery	**80–90% of patients are anaemic following surgery** *(392)*.	Surgical patients present a clear opportunity for both preoperative and postoperative anaemia management. The incidence of transfusion to treat anaemia in surgical patients varies greatly by type of surgery *(393)*, between countries and regions, and even between hospitals within a region *(394, 395)*. Transfusion rates in patients undergoing emergency surgery may be 2–3 times higher than in those undergoing elective surgery *(396)*. Although guidelines are available on how to minimize and pre-empt blood loss in surgical populations *(381, 397)*, clinical application of these guidelines is suboptimal *(398)*. This represents a clear opportunity for PBM implementation.

HICs, high-income countries; LICs, low-income countries; LMICs, lower middle-income countries.

[a] Prevalence data by country can be retrieved from https://www.healthdata.org/research-analysis/health-risks-issues/maternal-health

Table 3. Global prevalence of coagulopathies with bleeding risk and the benefits of patient blood management

Coagulopathies with bleeding risk	Global prevalence estimates	Potential and expected benefits for blood health
• Congenital coagulopathies	The aggregate prevalence of all congenital coagulopathies is unknown. Von Willebrand disease (vWD) is the most common with an estimated prevalence of up to 2.2%. Prevalence of these inherited coagulopathies varies significantly by race and geography. National registries and databases can sometimes be used to estimate prevalence of less common inherited coagulopathies such as haemophilia A and B *(399)*. Patients with coagulopathy experience a high disease burden in terms of bleeding, poor quality of life and high health care resource utilization *(400)*.	Referral-based prevalence studies of vWD suggest the disease (and probably, congenital coagulopathy more broadly) is significantly underdiagnosed *(400, 401)*. There is significant potential to improve overall blood health and quality of life and reduce resource utilization. Guidelines on how to manage affected patients in the perioperative period are available.
• Acquired coagulopathies - Anticoagulants - Antiplatelet therapy - Other medication-induced - Herbal supplement-induced - Vitamin K deficiency - Liver disease - Disseminated intravascular coagulation - Hyperfibrinolysis	Use of anticoagulants, including vitamin K antagonists and direct oral anticoagulants, is increasingly common in ageing societies. Use of platelet inhibitory drugs is also increasing, including dual antiplatelet therapy. The risk of major bleeding is significant: it is estimated to be as high as 2.1 per 100 patient-years *(392)*. Acquired and medication-induced coagulopathies and medication-induced platelet dysfunction are associated with increased mortality, major morbidity including haemorrhagic stroke, and increased admission to the intensive care unit and overall length of hospital stay *(392, 402-404)*.	PBM provides a structured approach to management of anticoagulant and antiplatelet therapy, especially perioperative and periprocedural treatment. Guidelines are available for management of patients with coagulopathies *(393)*. PBM provides for individual decision-making in specific patients for whom generalized recommendations may not be applicable. This should reduce major thromboembolic and bleeding complications *(393, 405)*.
• Trauma-induced coagulopathy	Early trauma-induced coagulopathy is common, occurring in over 15% of patients admitted with trauma. It is also reported in up to 11% of mildly injured patients without physiological derangement or blood component/product administration *(406)*.	Severe trauma and associated haemorrhage represent a major global health burden. PBM strategies will reduce mortality and transfusion dependency by optimizing and standardizing trauma care consistent with evidence-based best practice *(407)*.
• Coagulopathy associated with postpartum haemorrhage (PPH)	Severe PPH occurs in 1.86% of all deliveries, or an estimated 2.5 million events *(383)*. Coagulation abnormalities were recently estimated to occur in 17% of patients with massive PPH *(408)*.	Early recognition and management of coagulopathy in women with massive PPH will reduce maternal mortality.

[a] Prevalence data by country can be retrieved from https://www.healthdata.org/research-analysis/health-risks-issues/maternal-health

1.3 PBM Commission anticipates potential synergies and conflicts with other public health initiatives

The PBM Commission should liaise with project leads or senior officers responsible for current national or regional public health initiatives and activities that might relate to PBM or PBM implementation plans and initiatives. The goal should be to generate synergies and avoid duplication of efforts or conflicts. Examples of potential synergies include programmes to reduce the prevalence of ID and anaemia, improve national nutrition status, improve the management of postpartum haemorrhage, reduce child and maternal mortality *(409-413)*, and improve the efficiency and safety of the national blood-collection network *(414)*.

When done early in the implementation process, this supports the alignment of personnel priorities and resources, improving productivity and increasing the chance of success.

Box 4

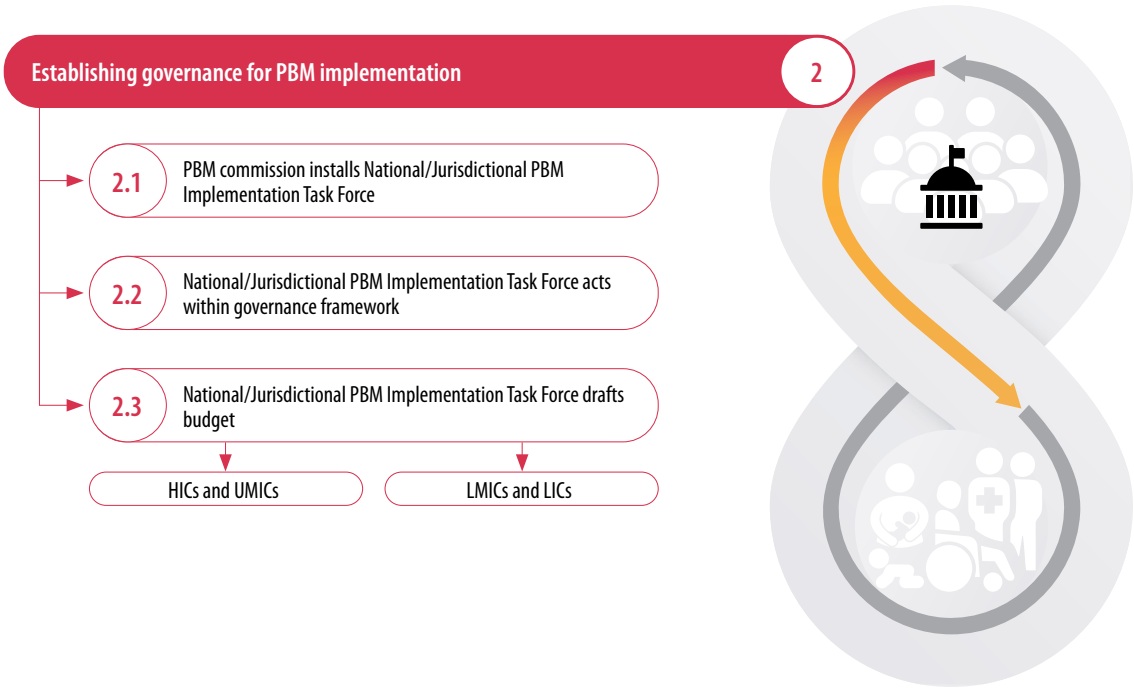
Potential synergies between PBM implementation guidance and other global health initiatives

The 2023 WHO document *Accelerating anaemia reduction: a comprehensive framework for action*, states: "Given that the causes and risk factors for anaemia are complex and diverse, and prevalence appears to have changed little in the past 20 years, accelerating anaemia reduction requires renewed dedication and a coordinated, multipronged approach" *(410)*. This **PBM implementation guidance** is just such a **coordinated**, **multipronged approach** that amplifies the success of any strategy to reduce the burden of anaemia. It is targeted across all sites of care, all causes of anaemia and those populations at highest risk for anaemia. Similarly, it supports the United Nations Children's Fund (UNICEF)'s goals of fighting undernutrition, malnutrition and micronutrient deficiencies and securing a future free of preventable anaemia, since anaemia prevention, recognition, diagnosis and management are core principles of PBM. This also includes the Anaemia Action Alliance brought together by UNICEF and WHO *(415, 416)*.

1.4 Highest-ranking official announces national/jurisdictional implementation of PBM

To increase the chances of success, the ministry of health or department of health should arrange a formal launch of national/jurisdictional PBM implementation. Multiple communication and dissemination strategies should be employed, including media releases distributed through the usual ministry of health or department of health channels (for example, website, social media, press releases). The outreach should address the population as a whole as well as vulnerable patient populations and all health care workers.

Step 2: PBM Commission establishes governance for PBM implementation



2.1 PBM Commission installs national/jurisdictional PBM Task Force

The **Commission** installs a **national/jurisdictional PBM Task Force that holds the central operational role in the national/jurisdictional implementation process**, particularly to execute steps 3–8 and 15–18 of the 8-model. It should be headed by a Chair appointed by the Commission. In coordination with the Chair, the Commission appoints the other members of the Task Force who should have clinical expertise at all levels of patient care. The Task Force might consist of a senior medical officer, one or two senior clinicians with PBM expertise, and an implementation expert (the Task Force might also include some members of the Commission [1]). The Task Force may appoint an executive group or leadership team from within to facilitate decision-making. It can invite individuals with specialized knowledge and skills on an ad hoc basis. Appointing a national/jurisdictional PBM Task Force rather than delegating the PBM implementation task to a ministry of health or department of health department has various advantages. For example, a PBM Task Force has fewer distractions from day-to-day responsibilities. The PBM Task Force should report directly to the PBM Commission.

2.2 National/jurisdictional PBM Task Force acts within the governance framework

Governance is integral to the "call to action" of the WHO PBM Policy Brief *(1)*. Thus, the Task Force should act within a governance framework from which it derives its authority as an officially approved "extension" of the ministry of health or department of health. This will improve coordination with the ministry of health or department of health and the HCOs, promote alignment of all stakeholders, increase effectiveness and efficiency, and ensure transparency and accountability.

The four dimensions of the governance framework are responsibilities and authority, organization, oversight, and policies and procedures. They are summarized in Table 4 with key elements of each of the dimensions. Some of these concepts can and should be extended to all other stakeholders that are actively involved in the implementation process.

2.3.1 National/jurisdictional PBM Task Force drafts budget – HICs and UMICs

The organization of the national/jurisdictional PBM Task Force and their potential supporters require funding. In HICs and UMICs this should not be an obstacle to PBM implementation (the challenge of funding PBM implementation in LICs and LMICs will be discussed in section 2.3.2). As shown in the WHO PBM Policy Brief and in **Chapter 2** of this document, PBM does not require additional (public) funds, but rather the reallocation of already available funds to achieve substantial savings. Compared to the reduction in resource utilization and overall treatment costs, one-time costs to implement PBM over an estimated implementation period of 2–3 years are modest. By reduction of national blood utilization alone, these expenditures are expected to be recouped in the first or second year of the implementation period in HICs and UMICs, and then to result in ongoing savings *(22)*. Additional cost savings are expected from improved clinical outcomes and reductions in complications and adverse events. Moreover, most of the PBM Task Force's workload falls within the scope of the overarching duties and responsibilities of the ministry of health or department of health, namely, the delivery of the three essential public health operations that are strongly supported by PBM.

However, due diligence requires correct budgeting. PBM implementation according to the 8-model, with its phases A, B and C, requires three successive budgets. Budget A relates to Phase A. It includes costs only, because the costs of Phase A are not offset by savings. The first phase of the implementation requires primarily bureaucratic and regulatory work and high-level facilitation. Cost items include:

- ministry of health or department of health personnel (reallocated personnel or additional part- or full-time equivalents) and/or consulting fees for external experts;

[1] Note: Depending on their size, existing structure and resources, some Member States or their jurisdictions may choose a "flatter" administrative structure with the PBM Commission serving a dual role as the national/jurisdictional PBM Task Force.

Table 4. Governance framework for the national/jurisdictional PBM Task Force

Responsibilities and authority What will be required of the Task Force and what is its authority?	Organization How is the Task Force organized and what is its membership?	Oversight Requirements for reporting from the Task Force to the National Commission, and Task Force oversight during phases B and C and post-implementation	Policies and procedures How does the Task Force fulfil its responsibilities and exercise its authority?
• **Executing steps 3–8 and 15–18 of the 8-model to accomplish full implementation of PBM nationally/jurisdictionally** - **Drafting a formal charter that stipulates the Task Force's mission, specific goals and responsibilities** - **Authorized by the ministry of health to play the central operational role in the national/jurisdictional implementation until completion of the process** - **Exhausting all available measures within the ministry of health or department of health's statutory responsibilities that support and accelerate the implementation of PBM, including** - "hard" or regulatory measures - "soft" or persuasive measures	• **Establishing organizational structure that** - defines the role of chair and co-chair - names and describes any additional leadership roles within the Task Force - determines meeting frequency • **Identifying members with specific expertise, e.g. data collection and analytics** • **Hiring external expert consultants as needed**	• **Supervised by the ministry of health or department of health PBM Commission** • **Reporting periodically to ministry of health or department of health PBM Commission during phase A on** - timelines and achievements/progress - unexpected major impediments and process adjustments • **Receiving periodic reports from PBM pilot projects on the progress of the implementation of structure and processes during phase B** (see Annexes **3** and **4**) • **Receiving periodic national summary reports until completion of phase C** (see Annexes **3** and **4**) • **After completion of phase C, the Task Force may mandate the reporting of selected aggregated PBM quality measures/key performance indicators as permanent controls to ensure sustainability, review, assessment and benchmarking for quality in health care**	• **Following written policies and procedures governing its structure and conduct on** - how often it will report to the national commission/ministry of health or department of health - number of members and how long each will serve, or if any members are permanent - policies on ethical conduct in alignment with the "third E" of PBM, professional responsibility and accountability towards patients, blood donors and taxpayers through PBM implementation - policies that cultivate mutual respect and communal participation between diverse stakeholder groups - procedures to foster multiprofessional and multidisciplinary collaboration via team meetings - policies that demonstrate sensitivity to local health care needs and resources and tailor measures accordingly - policies that prioritize patient engagement and empowerment

- travel expenses;
- communication costs;
- costs for initial educational events and materials (kick-off meetings, introductory symposia); and
- fees for webpage design, graphic artists, and ancillary goods and services.

Step 5 (empowering the public through education on blood health) might require additional funding (depending on what communication strategy is developed and what media/communication channels are involved) for:

- public relations fees; and
- advertising/promotion costs.

Budget B for Phase B includes the **costs** of the national/jurisdictional PBM Task Force to **support** HCOs/institutions during the **pilot phase** if needed. **It does not include start-up costs for the HCO to conduct a PBM pilot programme** (see **step 10.2**). Budget B items might include:

- costs for external PBM experts:
  - personnel and/or consulting fees
  - rental fees and operating costs for additional workspace
  - travel expenses
  - communication costs
  - insurance;
- costs for IT/data management/systems engineering experts;
- costs for educational events and materials (kick-off meetings, symposia);
- public relations fees; and
- fees for webpage design, graphic design, and ancillary goods and services.

Note:

The budget for the HCO/institution to conduct a PBM pilot programme will be drawn up by the champions/project leads of the HCO and is integral to the business case discussed under **step 10**.

Budget C for Phase C might include:

- communication costs for issuance of a national/jurisdictional report;
- costs for IT/data management/systems engineering experts; and
- public grants for PBM research (optional).

Analogous to Phase B, the budget for HCOs/institutions to implement PBM by replicating the pilot programmes will be drawn up and managed by the HCOs/institutions themselves, with the effect of reducing overall costs and improving patient outcomes. To enhance the replication of PBM pilot programmes and reduce the costs of the national/jurisdictional roll-out, the ministry of health or department of health might facilitate collaborative networks of HCOs within a region or several regions to share best practices, resources, experiences and data. In some jurisdictions, allocation of funds for start-up costs from the ministry of health or department of health might be considered.

Additional information can be found in How to make budgets work for health? A practical guide to designing, managing and monitoring programme budgets in the health sector, published by WHO *(417)*.

2.3.2 National/jurisdictional PBM Task Force drafts budget – LICs and LMICs

Funding PBM in LICs and many LMICs needs a different approach from that taken by HICs and UMICs: Millennium Development Goal (MDG) cost estimate studies consistently show that the financial gap between the cost of achieving

MDGs and the ability of LICs to allocate the respective financial resources can only be addressed with financing from donors or donor consortia *(418)*. In most of these countries, even the most basic health care infrastructure is missing. The ratios of physicians nurses and midwives per capita are too low *(419, 420)*, and these challenges are exacerbated by ongoing brain-drain *(421)*. Many hospitals experience regular interruptions in their supply of oxygen, running water and electricity, and may even lack basic physical infrastructure *(422, 423)*.

Box 5

Restricted access to care – a global challenge

According to a modelling study, more than half of the world's population has extremely restricted access to surgical care. At least 92.3% of LMIC populations and 97.7% of LIC populations have restricted access due to their inability to reach health care facilities in a timely manner, limited surgical capacity and inadequate safety of surgery, or because they cannot obtain surgery without catastrophic expenditure *(424)*.

Severe resource constraints mean that treatment strategies common in HICs would necessitate resources and physical infrastructure that hardly exist in LICs and LMICs (see Box 6). Thus, even more than in highly developed health care systems, the focus must be on the simplest corrective and relatively affordable preventive and pre-emptive treatment strategies, many of which are foundational PBM strategies.

When a national/jurisdictional PBM Task Force in an LIC or an LMIC approaches donor organizations for support, it must be aware of the fierce competition for funding, not only for health care, but also for other sectors of the economy. It is important to convey that **PBM funding** is an **exceptionally "smart" investment**. Even under extreme resource constraints and with the most basic physical infrastructure, **it can be successfully and sustainably** implemented, resulting in a sustainable and significant return on investment. Simple treatment strategies using small and low-cost bundles of PBM tools, applied with the help of CHWs, nurses and, where available, a few coordinating general practitioners, can produce significantly improved outcomes in highly vulnerable populations (see Box 6).

Box 6

Leading examples of partnering with donor organizations for highly effective nationwide public health initiatives to reduce maternal mortality from postpartum bleeding

The most common reason mothers die during childbirth is late diagnosis of excessive bleeding and inefficient treatment *(296)*. Innovative approaches presented in two studies conducted in sub-Saharan countries demonstrate the considerable life-saving potential from implementation strategies and the use of affordable key components that can be selected from the comprehensive PBM toolkits for managing obstetric haemorrhage under resource constraints (see **Annex 10**).

In Niger, primary postpartum haemorrhage (PPH) was the principal cause of birth-related maternal mortality. With funding through a donor consortium that consisted of the Government of Norway, the Government of Niger, the Kavli Trust (*Kavlifondet*), the InFiL Foundation and individuals from several countries, a nationwide strategy was implemented for prevention, early detection and reduction of primary PPH across all health facilities in which births took place. Three treatment modalities were applied when indicated, beginning with the administration of 800 µg misoprostol. When bleeding persisted after 20 minutes, an intrauterine condom tamponade was applied to stop the bleeding, and in cases where bleeding persisted for another period of 6–12 minutes, the patient was put into a non-inflatable anti-shock garment and referred to a hospital for further treatment. The programme was implemented with a set of public health tools and the organized engagement of champions, referred to in the original paper as "a few people who really care". The programme also involved data managers, programme managers, epidemiologists, resident technical

Box 6 *continued*

advisers and supervisors, with provision of annual training and retraining, course correction mechanisms and other measures. The programme led to a reduction of mortality associated with PPH by at least 50% within 2 years and this was sustained for at least 6 years. Maternal deaths caused by primary PPH in health facilities now stand at 9.53% in Niger, lower than in the United States of America where the figure is 11% *(7, 425, 426)*.

In a second project supported by donor funds, 80 hospitals across Kenya, Nigeria, South Africa and the United Republic of Tanzania implemented a multicomponent intervention to address the high number of avoidable deaths due to PPH. The treatment bundle consisted of criteria for the early detection of bleeding, strategies to reduce blood loss, including uterine massage, oxytocic drugs, tranexamic acid, intravenous fluids and a process for escalating the response to persistent bleeding. To coordinate successful implementation, a multidisciplinary team of public health professionals was needed to design and deliver education (including simulation-based, on-site training), local champions to lead and support change, and data professionals to collect information and report activity. To study the clinical effectiveness of this strategy, researchers from WHO randomly assigned more than 200 000 women undergoing vaginal delivery at 80 hospitals to receive the multicomponent intervention or usual hospital care. The women in the intervention group had a 60% reduction in severe PPH (blood loss ≥1000 mL), laparotomy for bleeding and maternal death from bleeding. As a secondary outcome, the trial also showed a significant reduction of postpartum blood transfusion *(78)*. Women in the intervention group had a higher PPH detection rate, highlighting that PBM awareness can lead to increased detection rates of underdiagnosed conditions such as PPH and anaemia.

Both examples serve as templates for all health care systems under extreme resource constraints. With their affordability and relatively rapid improvements, they demonstrate how to support health-related sustainable development goals, including universal health coverage.

Using the information provided in **Chapter 4** and the PBM toolkits located in Annexes **6** and **9**, and depending on local needs and opportunities, PBM implementation can be gradually expanded. Funding PBM is "smart" because the low-cost nature of these preventive interventions saves funds that might otherwise be spent on corrective interventions that are more costly and potentially less effective. Such savings can be allocated for the expansion of PBM across additional patient populations, or for other health interventions such as immunization programmes.

Box 7

Why PBM needs prioritization over "optimal blood use" programmes under extreme resource constraints

The benefits of implementing PBM are significantly greater than those achieved through expansion of blood collection and distribution. This is particularly the case when health care facilities lack laboratory capacity, cold chain logistics, trained staff and transfusion medicine specialists *(427)*. An increase in blood supply under such conditions is not likely to substantially improve the level of health care, but rather to result in a further increase to the already high rate of wasted blood units in LICs and LMICs *(428)*. The high cost of donor blood makes this situation worse. In Zimbabwe, the overall production cost of one unit of whole blood was equivalent to 12.4% of the country's per capita gross domestic product (GDP) per annum, while the cost of one unit of packed red blood cells was equivalent to 13.7%, of per capita GDP *(429)*. Thus, the expenditures for blood transfusion, let alone the expenditures for surgery, can lead to impoverishment for many patients *(430)*. Significantly higher rates of pathogen contamination in the blood supply add to the safety and economic challenges in these environments. Even in HICs, pathogen reduction in allogeneic blood components remains a problem due to the high cost of use *(431-433)*. In contrast, **low-cost measures to reduce and pre-empt scenarios associated with high blood loss must be highly effective in severely resource-constrained environments** *(78)*.

Examples of low-cost measures are tourniquets *(434-437)*, low technology cell salvage devices *(438)*, pelvic belts utilizing bed sheets, trousers or inner tubes (80), uterine balloons made from condoms or sterile gloves *(439-441)*, traction devices, external fixators *(442, 443)*, anti-shock "trousers" fashioned from bicycle tyre inner tubes *(444)*, topical haemostatics such as local tranexamic acid or sterile compresses with epinephrine *(445)*.

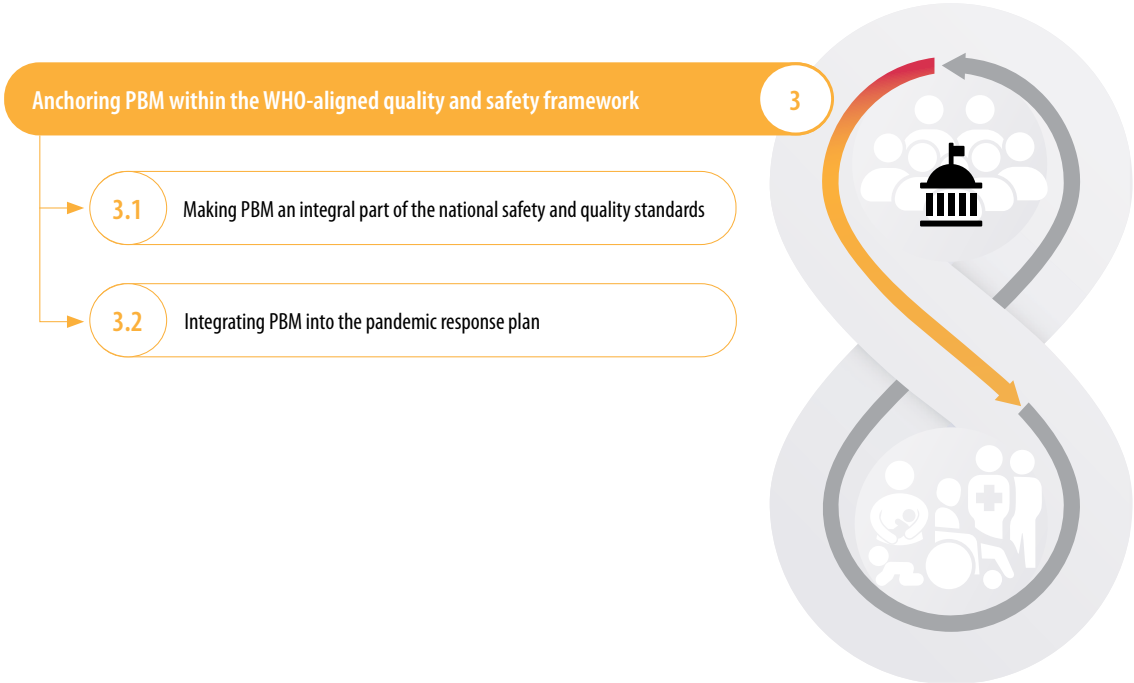
Before seeking funding from financial donors, it is advisable to invite representatives of the respective regional WHO office and from the World Bank, as well as international PBM experts, to discuss PBM health goals, draft the budget and rationale, and to ensure that the content, level of detail and format of the request/application match the expectations of donor organizations.

Once external donors have agreed to support PBM, a legally binding agreement must come into effect between the ministry of health or department of health (or other government entity as needed) and the donor (individual(s), donor consortium or legal entity). Among other things, this should specify when payments are to be made, the achievements or milestones to which the payments are linked, and how the administration of the funds is controlled.

Step 3: National/jurisdictional PBM Task Force anchors PBM within the WHO-aligned quality and safety framework

Introduction: leveraging normative power to implement PBM

Ministries of health and departments of health have limited executive power to direct clinicians on how to practise medicine. However, setting national quality and safety standards lies within their executive power and is arguably one of their key functions. Thus, **integrating PBM into these standards will establish the broad provision of PBM as a requirement within the country**. Step 3 offers one of the few opportunities during PBM implementation where the ministry of health or department of health can apply its executive power in favour of PBM.



3.1 Making PBM an integral part of the national safety and quality standards

Most countries have laws, regulations and/or standards addressing patient safety. PBM, according to its global and broadly endorsed definition, promotes patient safety *(1)*. WHO has recognized that the benefits of PBM for health care institutions and hospitals include "improved patient safety and quality of care" *(1)*. Therefore, it is necessary to integrate PBM into national safety and quality standards, and to identify additional options to support PBM within the regulatory framework for patient safety.

As an example, some of the ministries of health of European Union Member States have issued regulations prohibiting operations on anaemic, elective patients unless the anaemia has been corrected *(446-449)*. The national/jurisdictional PBM Task Force in other countries might follow this example and recommend to the ministry of health or department of health that such PBM modalities be required to better protect vulnerable patient populations. The national/jurisdictional PBM Task Force might also submit relevant draft regulations to the ministry of health or department of health. In turn, the ministry of health or department of health might suggest draft legislation to the legislature.

The global definition of PBM includes the promotion of patient empowerment *(1, 2)*. In many countries it is integral to the patient safety legislation that treating physicians obtain consent from patients before performing any medical procedures or treatments, ensuring that patients are aware of the risks, benefits, alternatives and possible complications. Many physicians have an incomplete understanding of PBM and its potential positive impact on patient outcomes and safety *(4, 287, 450-453)*. There may also be a knowledge gap regarding the challenges of blood supply management and the activity-based cost of transfusion *(454-456)*. There is also limited awareness of the dose-dependent, indirect risks of red blood cell *(1, 457-517)*, platelet *(1, 479, 517-536)* and plasma transfusions *(1, 462, 479, 517-540)*. This deficit results in insufficient patient education, precluding patient empowerment and contributing to avoidable risk and suboptimal treatment. This represents another aspect of the way in which insufficient physician and patient education decreases quality and safety. The national/jurisdictional PBM Task Force should be aware that informed consent carried out pro forma by the HCP or a surrogate, and often developed locally, may not result in true participation of the patient in decisions about transfusion. The national/jurisdictional PBM Task Force might choose to consult with patient advocacy associations to ensure that patient perspectives and needs are fully integrated into PBM programme development.

To mitigate these safety and liability risks, and to ensure full respect of the patients' right to autonomy by empowering them, a legally required and standardized informed consent process, consistent with patient autonomy in the context of PBM and transfusion, is indicated (see **step 5**).

Box 8

PBM and its role in improving global patient safety

WHO's *Global Patient Safety Action Plan 2021–2030: towards eliminating avoidable harm in health care* suggests that safe health care should be viewed as a basic human right. Patient safety is legally protected by specific laws and regulations in many countries. They vary from country to country, but the overarching goal is to ensure the safety and well-being of patients receiving medical care. Common features of patient safety regulations include setting standards for health care facilities and practitioners, establishing protocols for reporting and investigating medical errors and adverse events, and implementing measures to prevent and mitigate patient harm.

The Global Ministerial Summits on Patient Safety helped to sustain the momentum of the global patient safety movement, as evidenced by the adoption of the World Health Assembly resolution (WHA72.6) "Global Action on Patient Safety" in May 2019, which enabled the first-ever World Patient Safety Day in September 2019. One of the key challenges facing patient safety today is to ensure the appropriate and sustainable implementation of suitable concepts and approaches that are crucial to the success of WHA72.6 *(541)*.

Box 8 *continued*

PBM has the exceptional potential to improve patient safety and patient outcomes for hundreds of millions of patients while saving billions of health care dollars that can be reallocated where needed *(1, 4)*. Thus, PBM improves patient safety and supports two essential public health functions, namely, health protection and secondary disease prevention.

However, "there is a persistent lack of awareness about PBM on the part of patients, health authorities including those responsible for universal health coverage, health care professionals such as doctors, nurses and pharmacists, medical professional societies, public health experts, health economists, hospital administrators and others". In addition, "culture and behaviour including existing medical dogma are the main obstacles to the implementation of PBM", and the "long established position of transfusion as 'usual care' for anaemia and bleeding continues to hamper the adoption of PBM" *(1)*. The implementation of PBM represents a paradigm shift through gradual and sufficient accumulation of incremental changes over the past two decades. However, because the accumulated evidence has reached "critical mass", PBM must now be implemented through a more rapid, and possibly more disruptive, departure from still broadly accepted medical practices.

3.2 Integrating PBM into the pandemic response plan

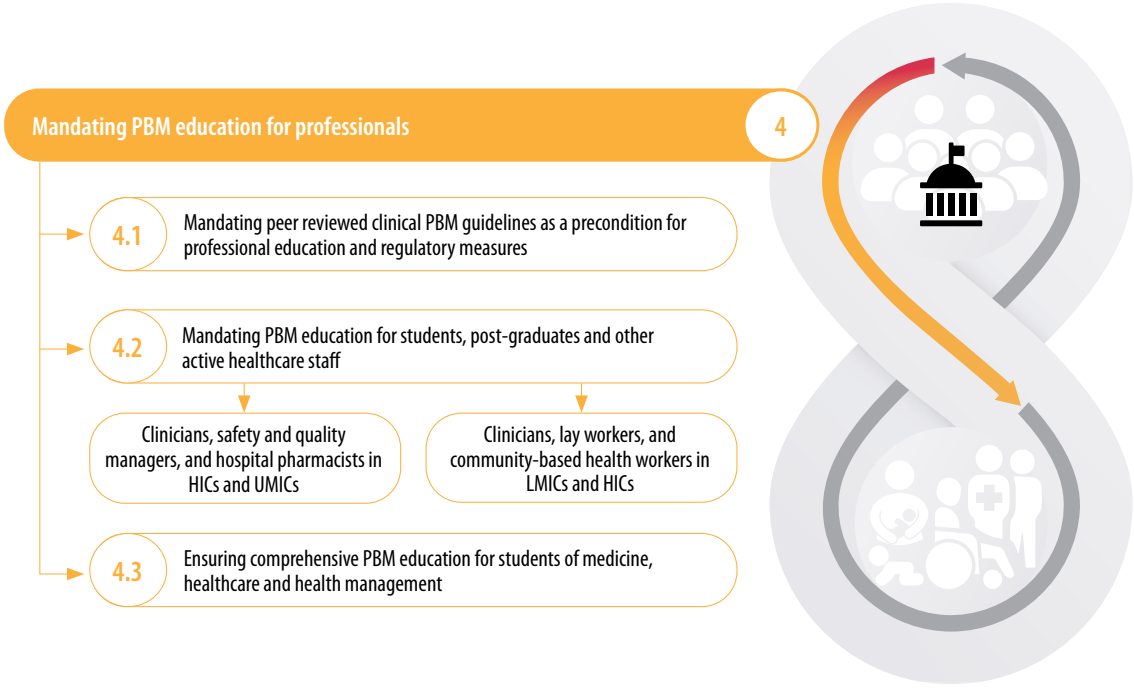
In clinical settings with a high prevalence of moderate to severe anaemia and/or high surgical blood loss, physicians view many of their patients as "at risk" for transfusion, which limits their perceived therapeutic options when caring for these patients. When PBM is implemented as standard practice, there is a significant reduction in transfusion in these vulnerable patient populations *(542-544)*. This reduction increases both perceived and actual therapeutic options in everyday practice. Moreover, in national emergencies, reduced dependency on donated blood products increases the resilience of the national health care system as well as improving basic clinical care, and therefore overall patient safety within the population.

A pandemic is one such emergency. During the COVID-19 pandemic, WHO reminded the global health care community repeatedly, through its Interim Guidance, that PBM takes pressure off the blood supply system *(545, 546)*. PBM "leads to an improved pandemic response when blood shortages occur as a result of emerging or re-emerging infectious diseases in the blood pool, or when there is a reduction in donors or donations due to social distancing, business or school closures" *(1)*. As recommended by experts in pandemic and disaster response, the national/jurisdictional PBM Task Force should advocate for the integration of PBM into pandemic and disaster response plans *(547, 548)*.

Step 4: National/jurisdictional PBM Task Force mandates PBM education for professionals and students

Introduction: ensuring compliance with PBM through broad-based education

Each country has its own laws and regulations governing the registration and conduct of clinicians. These laws are intended to protect patients from advice or treatments that do not correspond to the current state of the art (*lege artis*), ensure the competence and ethics, of medical practitioners and provide a legal framework for the medical profession. Since "[d]elaying the implementation of PBM translates into increased morbidity and mortality" *(1)*, the national or state medical councils are advised to encourage physicians to familiarize themselves with national PBM guidelines in order to comply with the legal or regulatory requirement to provide "state-of-the-art" treatment and minimize the risk of legal liability, not only for physicians but for the public health administration.



4.1 Mandating peer-reviewed clinical PBM guidelines as a precondition for PBM professional education and regulatory measures

Before establishing legal or regulatory measures to implement PBM, the national/jurisdictional PBM Task Force needs to ensure the provision of up-to-date national PBM clinical guidelines that are in line with the global definition of PBM *(1, 2)*. This can be achieved by:

- tasking and sponsoring national medical professional societies to create multidisciplinary peer-reviewed clinical PBM guidelines de novo; or
- requesting national medical professional societies to endorse peer-reviewed clinical PBM guidelines from other countries or from international medical professional societies.

Box 9

Exemplars of clinical PBM guidelines

When medical professional societies invest in a PBM guideline document for their specialty (or when multiple societies develop a consensus around PBM guidelines) it lays the foundation for a widely accepted national clinical guideline and fosters harmonized practice. One example of a society document is the PBM consensus document released in Brazil by their National Haematology, Haemotherapy and Cellular Therapy Society *(549)*. Several national medical professional societies achieved consensus on PBM and made a collaborative effort to expand and promote PBM through joint educational programmes and medical standards. The National Blood Authority (NBA) of Australia funded and managed the development of a series of national evidence-based PBM guidelines, comprising six modules. They were developed through the clinical input and expertise of a clinical reference group made up of representatives from multiple colleges and societies from Australia and New Zealand and an independent consumer advocate. The modules cover critical bleeding (adults), perioperative, medical, critical care, obstetrics and maternity, and neonatal and paediatrics *(550-555)*. These guidelines were used in the development of clinical PBM guidelines for the health authorities in Mexico and can serve as a resource or template for other countries *(556)*. International collaboration on the development and adoption of PBM guidelines and education efforts will help develop a unified and innovative approach to PBM.

4.2 Mandating PBM education for students of medicine, postgraduates and other active health care staff

The urgency of making PBM the standard of care demands that it be immediately integrated into the curricula of students studying medicine and nursing, pharmacy and perfusion. This will have a significant impact on daily clinical practice in the long term. The greatest near-term impact will rely on education and training of postgraduate physicians and nurses, as well as lay health workers (LHWs) and CHWs in LICs and UMICs.

A mandatory requirement for PBM education may be controversial given the demands and time constraints that already exist for both undergraduate and postgraduate medical education. It is recommended that an undergraduate curriculum on PBM be incorporated into medical, nursing and pharmacy schools. This should be taught by a multidisciplinary faculty. A PBM course should be required by HCOs at the beginning of employment of new staff members including physicians, nurses and pharmacists as part of orientation. The course would cover specific aspects of the PBM programme structure at the HCO. PBM education should be required for all existing medical, nursing and pharmacy staff involved in the care of patients managed with PBM, and continuing education should be incorporated into the PBM programme structure.

4.2.1 Clinicians, safety and quality managers and hospital pharmacists in HICs and UMICs

In HICs and UMICs, the clinical responsibilities of general practitioners (GPs), also known as primary care physicians, should include anaemia screening, diagnosis and treatment for otherwise healthy individuals, and for patients prior to surgery. The national/jurisdictional PBM Task Force should facilitate and support a broad-based educational programme for GPs, including advanced practice clinicians such as nurse practitioners and physician assistants. The aim would be for HCPs to treat ID, anaemia and coagulopathy (on the condition that they would be appropriately reimbursed for anaemia screening and management as part of preoperative patient optimization), as well as routine care. PBM nursing expertise in these countries is also needed at the tertiary care level (hospitalized patients). In cooperation with the national nursing society, the national/jurisdictional PBM Task Force, as an example, might support and facilitate the creation of a postgraduate nursing certification for PBM.

The main responsibility for PBM at the tertiary care (hospital) level lies with consultant specialists. The national/jurisdictional PBM Task Force should recommend postgraduate PBM education in accordance with the national PBM guidelines. In some cases, the Task Force could draft evidence-based key points to be considered for legislation by the respective legislative bodies.

Depending on the national rules and regulations, this might require the endorsement of the ministry of education, medical and nursing specialty councils, and other health care professional councils, as well as the leadership of medical schools and teaching hospitals. The Task Force might need to enlist support from medical professional societies, medical and surgical colleges or academies. Collaboration between PBM experts and medical societies is pivotal in fostering a robust platform for continuing medical education (CME). This partnership facilitates the development of targeted and up-to-date PBM training courses.

Proactive support for PBM from safety and quality managers is essential (see steps **15** and **16**), thus, PBM education should be incorporated in their curricula. Postgraduate education and training for hospital pharmacists should also be considered, once again in collaboration with the corresponding professional societies.

4.2.2 Clinicians, LHWs and CHWs in LMICs and LICs

In LICs and many LMICs the main structural problem in health care is a chronic shortage of qualified staff. PBM can mitigate such crises.

At the community level, particularly in LICs and LMICs, GPs handle a broad range of medical conditions and preventive care with limited specialist support and fewer diagnostic tools. They may be involved in community outreach programmes, health education and disease prevention campaigns, as well as in addressing various other public health challenges. In areas with low GP density, nurses, including school nurses, must take on many of the medical tasks.

The national/jurisdictional PBM Task Force will have to determine to what extent GPs and nurses are to be educated on the knowledge and skills required to cover PBM implementation for patient populations in need of it (based on epidemiology data; see **Chapter 3**, **1.2**). They will then need to decide how to facilitate and support the necessary postgraduate education for these HCPs. In the most resource-constrained regions of the world, this education might be provided directly through the ministry of health or department of health.

Large populations in LICs and LMICs, and sometimes even in certain geographical regions of UMICs and HICs, have limited or no access to high-quality health care due to socioeconomic barriers and chronic shortages of HCPs, both physicians and nurses *(424)*. In these regions, the role of LHWs and CHWs is pivotal *(557)*. To bridge this "access gap", tasks assigned to LHWs and CHWs might include health education, disease prevention, screenings for region-specific health conditions, assisting with medication adherence, helping individuals navigate health care systems and promoting healthy behaviours including those related to sanitation and nutrition.

The national/jurisdictional PBM Task Force could consider ways to provide basic PBM training for LHWs and CHWs, supported by materials for the most basic maternal and parental education in blood health. This could build on existing WHO initiatives and training modules *(557)*. WHO and the International Federation of Gynecology and Obstetrics (FIGO) have acknowledged that LHWs and CHWs play a critical role in preventing PPH in regions where skilled birth attendants are not available *(558)*. The unmet need to prevent anaemia, particularly in pregnancy and PPH, represents a potential synergy between implementation of PBM and ongoing efforts to involve LHWs and CHWs in the identification and treatment of ID and anaemia *(559, 560)*.

4.3 Ensuring comprehensive PBM education for students of medicine, health care and health management

In some countries, the ministry of health or department of health and/or the ministry of education is responsible for overseeing medical education and accrediting medical schools. They may also have departments dedicated to assuring the quality of medical education. Some governments delegate accreditation processes to independent national or international organizations so that they can accredit medical schools. In still other cases, medical professional associations may play a role in accrediting medical schools and ensuring that they meet the necessary academic standards.

Regardless of how the structure and arrangements might differ between countries, the role of the national/jurisdictional PBM Task Force would be to identify the respective body or bodies within the medical education system that are to be responsible for, and have authority over, the development of PBM curricula. PBM teaching modules should be a compulsory part of medical education and must be crafted to meet the national PBM need. When reaching out to governmental stakeholders other than the ministry of health or department of health to support this part of the strategy for PBM implementation, the Task Force should refer to the above-described laws and regulations for patient safety as justification to ensure PBM as standard of care. The same principles would apply for education in nursing and pharmacy schools, and schools for health care and health management. Table 5 illustrates the educational materials that will need to be developed and implemented as well as suggesting possible stakeholder groups whose help the Task Force might solicit. The educational materials that are developed might be made accessible through an online document "library". The appropriate stakeholder group will depend on the Member State developing the materials.

Table 5. PBM educational materials to be created and stakeholder groups whose help might be requested

Educational materials to be created	Potential stakeholder groups to be contacted by the national/jurisdictional PBM Task Force
PBM consensus document	Medical professional societies
Peer-reviewed clinical PBM guidelines	Medical professional societies
PBM curricula for medical students	Medical school faculties
PBM curricula for nursing students	Nursing school faculties
PBM curricula for midwifery students	Nursing and midwifery schools
Postgraduate PBM curricula for resident physicians (PBM basics)	Medical councils responsible for postgraduate medical education
Postgraduate PBM curricula for resident nurses	Nursing societies, boards of nursing schools
Postgraduate PBM curricula for birth attendants	International Confederation of Midwives and similar societies
Postgraduate PBM curricula for fellows (medical specialties)	Medical professional societies, specialist societies
Curricula for health care, quality and safety managers	Directors of health care, quality and safety programmes, professional societies
Lectures specific to medico-legal aspects of PBM	Law and/or medical school faculties
Postgraduate PBM curricula for medico-legal professionals	Licensure and recertification boards

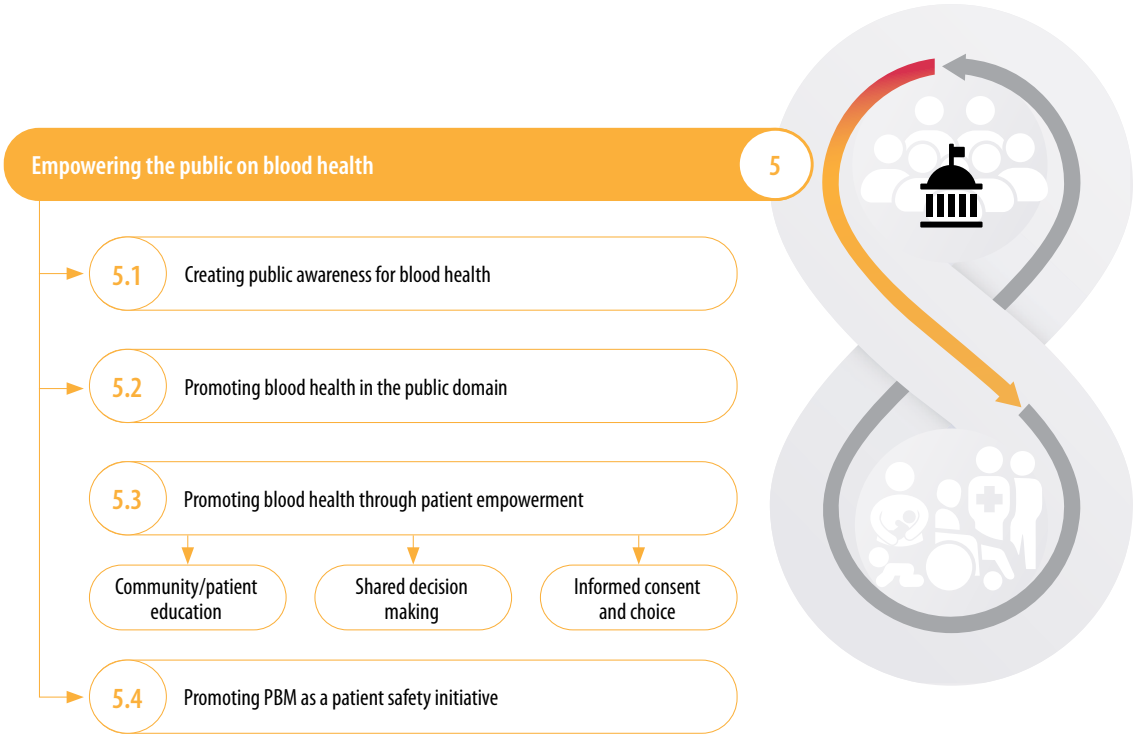
Box 10

Exemplars of clinical PBM guidelines

Education is critical to successfully embedding PBM as the standard of care. Research shows a worldwide lack of training in transfusion medicine *(561, 562)*. Formal undergraduate medical training in PBM is so rare that it has not been surveyed. In Brazil, the largest federal public university (Universidade Federal de São Paulo (UNIFESP)) has faced this challenge and has included PBM in the undergraduate medical course as an optional subject since 2019. As a result, graduating doctors who chose this subject during training will already have incorporated PBM into the way they practise. Assessment of the course's impact showed that on the first day of class, medical students pointed to the use of blood components and donation campaigns as a solution to medical emergencies. On the last day of class, they pointed to PBM as a central strategy (https://pbm.unifesp.br/).

A project jointly sponsored by the European Union and the Turkish ministry of health was developed and implemented from 2019–2023. Titled *Technical assistance for improving blood transfusion management*, this project adopted the six modules of PBM Guidelines and Standards of the Australian National Blood Authority (Agreement No: TREESP3.1IBTMST/P-01-01). Seventy-five physicians participated in a "train the trainer" course. A total of 3130 physicians were trained. PBM-specific software was implemented in 283 hospitals.

Step 5: National/jurisdictional PBM Task Force empowers the public through education on blood health



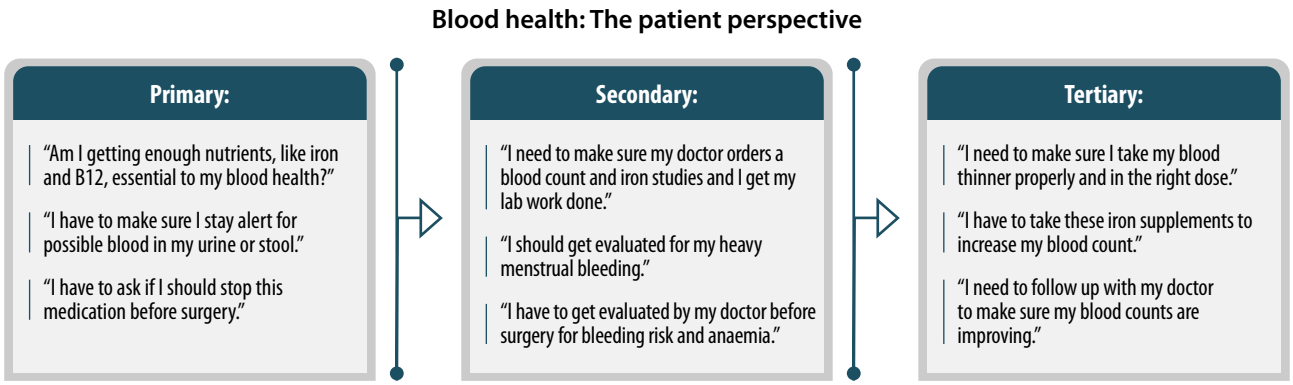
5.1 Creating public awareness about blood health

A public awareness campaign is essential to successful national/jurisdictional implementation of PBM. Considering its potential to improve blood health for billions of individuals and hundreds of millions of patients, education on blood health should be a priority of global health promotion. The national/jurisdictional PBM Task Force should create public awareness through multiple communication channels. In cooperation with the ministry of education, elementary school instruction and materials on human health and nutrition, especially the role of iron and the consequences of ID and anaemia, could introduce blood health at the grass roots level. More detailed information could be taught at high school in electronic and interactive formats. Given the adverse impact of ID and IDA on the cognitive development of children and adolescents, teachers and school health officials could play an important role in blood health education for both students and parents. Similarly, given the potentially negative impact of ID and IDA on work productivity and ability to concentrate, useful information could be made available to both employers and employees/workers. Broad-based education on blood health could also be spread through the regular communication channels of public and private health insurance companies to their customer base.

Further efforts to improve blood health literacy might include the production of flyers or electronic QR-coded materials with infographics or short videos for patients. Some professional societies have already developed materials that might be used as source material (www.ash.org, www.ifpbm.org, www.kpbm.kr, www.mapbm.org, www.nataonline.org, www.patientbloodmanagement.de/en, www.sabm.org, www.siapbm.org, www.wapbm.org.au, www.pbmsia.com, www.nasmkp.ru). This information can be proactively spread by CHWs, LHWs, nurses, GPs and consultant specialists to women of reproductive age (WRA), pregnant women, parents, caregivers and patients facing surgery. The use of lay terms and language that is simple, clear and targeted to the intended audience, is particularly important.

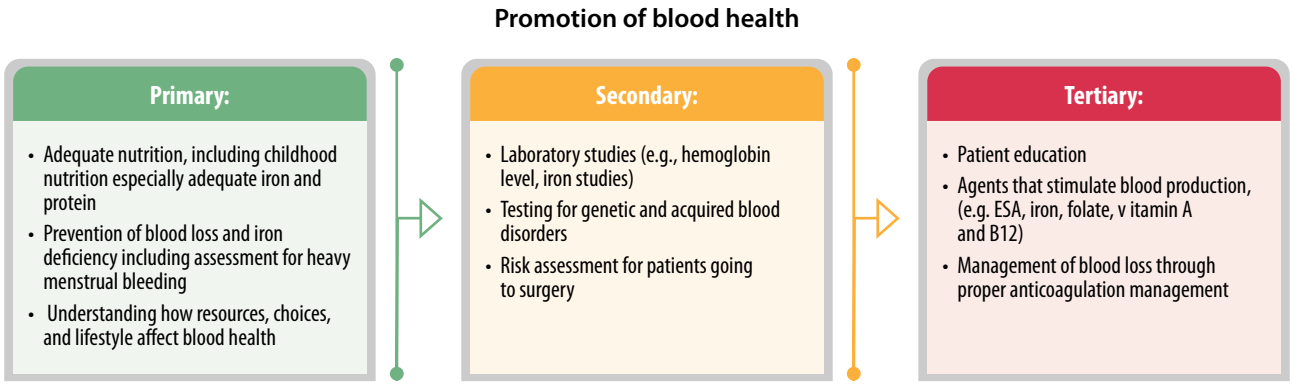
Figs 11 and 12 present examples of content and format for communicating the concept of blood health to patients and the public, as well as primary care providers and other health care workers.

Fig. 11. Blood health: The patient perspective



While blood health can be approached using the prevention model of epidemiology, from a patient's perspective, this focus on the importance of blood as the body's liquid organ and on its health status may be a new concept. Therefore, some basic principles like understanding the importance of access to sound nutrition in support of healthy blood, evaluation of blood health status before any invasive procedure, and medical or pharmaceutical management that optimizes the function of all components of the blood is essential.

Fig. 12. Promotion of blood health



In epidemiological terms, the primary prevention step in blood health is focused on disease prevention. Given the overwhelming prevalence of potentially preventable blood health-related issues (for example, iron deficiency anaemia), attention to adequate nutrition, patient awareness, and education on choices and risk factors for compromised blood health such as bleeding, primary prevention is the first step towards optimal blood health. In secondary prevention, proactive monitoring of relevant laboratory values such as haemoglobin level and evaluating potential risks to blood health before procedures are performed, provide early detection and screening for issues related to blood health. Finally, in tertiary prevention, patients may benefit from haematinic agents, pharmaceutical and mechanical techniques to reduce bleeding and blood loss, and comprehensive education on how to better manage anaemia, bleeding and coagulation to prevent further complications and issues from developing (Fig. 12).

Before commencing awareness campaigns on blood health, coordination with other campaigns and public health activities relating to antenatal and perinatal care, women's health, nutrition or anaemia management is advisable, to avoid conflicts and redundancies, and identify areas for possible synergy.

For most of the educational information on blood health, the Task Force might arrange for a dedicated section of the official ministry of health or department of health website, continuous feeds to social media and periodic news releases for mass media.

Box 11

World Blood Health Day

Professional societies, public health organizations, other nongovernmental organizations and WHO have collaboratively raised awareness about the importance of health maintenance of several body systems. This includes efforts at improving brain health: Brain Health (who.int), heart health (https://www.nhlbi.nih.gov/health/heart-healthy-living) and, more recently, gut health: What doctors wish patients knew about improving gut health: American Medical Association (ama-assn.org), to mention a few examples. Developing awareness through a dedicated "Blood Health Day" designated to recognize the opportunity to improve blood health could be promoted via social media platforms, traditional media and through collaborations with national and local health agencies and organizations. There are several successful examples of such partnership awareness efforts: for example, World Digestive Health Day (worldgastroenterology.org), World Brain Day 2023 (wfneurology.org) with other health optimization initiatives.

5.2 Promoting blood health in the public domain

In tandem with creating public awareness about blood health, the national/jurisdictional PBM Task Force might approach chief representatives of the public and private health insurance systems, where possible, to incentivize the public to engage in behaviours that improve blood health. Incentives could include premium discounts or cash rewards for regular screening, diagnosis and treatment of conditions such as chronic kidney disease, that would pre-empt more serious adverse outcomes and sequelae. Regular screening for ID, IDA, heavy menstrual bleeding due to uterine and other gynaecological causes, and gastrointestinal bleeding, with correction where indicated, could lead to timely interventions, more effective treatment and better outcomes *(563, 564)*.

The promotion of blood health can be supported by promoting community actions to enhance nutritional status, including adequate micronutrients. The Task Force should ask their ministry of health or department of health to coordinate with any ongoing efforts in their country to develop and implement policies and programmes as part of the United Nations' Decade of Action on Nutrition 2016–2025 *(565)*. Nutrition stakeholders must develop and maintain a focus on adequacy of folate and iron intake for ensuring blood health, including new nutrition initiatives, for example, supplementation and food fortification programmes, where necessary.

Social media platforms present unique opportunities for reaching adolescents and young adults. Strategies can be developed and exploited to generate widespread awareness and actionable takeaways for some of the most vulnerable populations, at minimal cost.

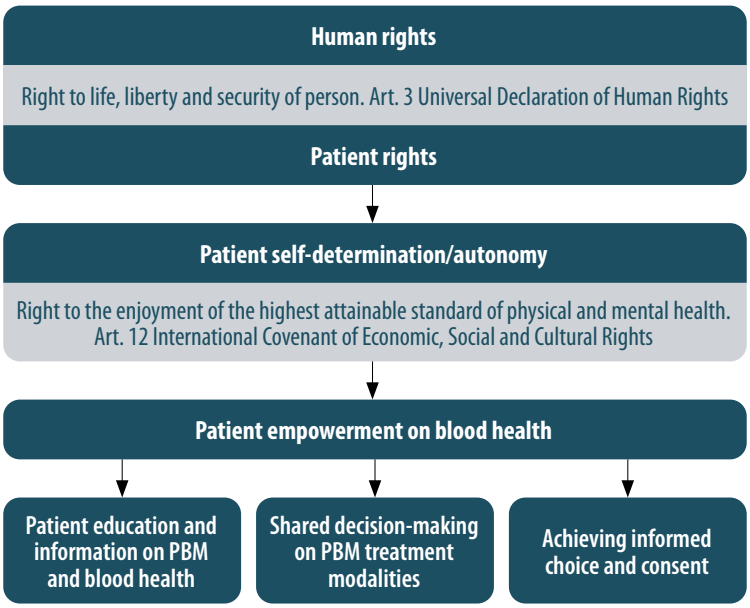
5.3 Promoting blood health through patient empowerment

WHO's *Health promotion glossary of terms 2021* defines empowerment as "a process through which people gain greater control over decisions and actions affecting their health" *(566)*. Patient empowerment is a key component of PBM *(2)*. It is

a principle embedded in a legal and social/ethical framework established by international covenants and conventions, including on human rights, patient rights, patient self-determination/autonomy, and the social right to enjoyment of health (Fig. 13) *(567-569)*. The *Health promotion glossary of terms* makes a distinction between individual and community empowerment. "Individual empowerment refers primarily to the individual's ability to make decisions and have control over their personal health decisions …. Community empowerment involves individuals acting collectively to gain greater influence and control over the factors shaping the determinants of health in their community" *(566)*. These two concepts are synergistic: "Empowered individuals create empowered communities, and vice versa"*(566)*. Both have relevance in PBM. The national/jurisdictional and HCO PBM task forces share the responsibility for facilitating the synergistic empowerment of patients and communities as part of PBM implementation.

Patient empowerment is achieved by a continuous three-step process of providing patient education and information, facilitating shared decision-making, and obtaining informed consent/making an informed choice.

Fig. 13. Legal framework for patient empowerment on blood health



5.3.1 Community and patient education

WHO's *Global Patient Safety Action Plan 2021–2030: towards eliminating avoidable harm in health care* states that "Most importantly, patients need to be given the information that they need to manage their own care and take charge of their safety to the greatest possible extent" *(570)*.

For patients to gain such control requires that both the community (the public) and patients be educated. The individual patient requires relevant information for themself and their medical situation *(450, 571)*. Information involves a dialogue between the HCP(s) and the patient, which includes clear information about the diagnosis, prognosis, all treatment options including their expected benefits, risks, limitations, the clinical treatment pathway, and what to anticipate before and after treatment. They also need to be informed about progress, successes, hurdles and challenges. This information enables patients to share in decision-making and making their treatment choices. Establishing structures and processes for providing individual patient education and information is a joint responsibility of HCOs and HCPs, but broad public education about PBM is a responsibility of the national/jurisdictional PBM Task Force.

Education should include public information campaigns and general educational materials in various forms and formats for patients with different clinical situations, diagnoses, prognoses and procedures. The educational materials should explain the various PBM treatment options together with their benefits, risks, limitations and expected outcomes *(1)*. This might be undertaken within the existing or expanded national framework of legally binding provisions for quality and safety in health care, for example, health care laws or patient safety laws (see **step 3**). National medical professional societies could develop templates of simplified PBM educational materials for patients. These templates could then be adapted to the needs of hospitals and community care centres and made available to all members of their health care teams in electronic and/or printed form *(571)*.

5.3.2 Shared decision-making

WHO's *Global Patient Safety Action Plan 2021–2030: towards eliminating avoidable harm in health care* also states that engaging "patients and families as partners in safe care" through shared decision-making is the first of seven guiding principles used to shape the development and implementation of the WHO Action Plan in relation to patient safety *(570)*. However, it notes that, "[in] many parts of the world, this happens much less than it should". The national/jurisdictional PBM Task Force should proactively promote "patient-centredness" as well as "shared decision-making" as core principles of PBM implementation *(572)*.

The essence of shared decision-making encompasses a patient-centred collaborative relationship of trust between a patient and their HCP. The patient feels that his or her values, goals and preferences are respected while the HCP offers the best available evidence-based treatment options together with explanations of their benefits, risks and uncertainties, when deciding on a course of treatment. As a part of patient empowerment, better informed patients and shared decision-making result in greater patient satisfaction and higher quality decisions *(571, 573)*.

5.3.3 Informed consent and choice

Informed consent is the final step in the three-step process facilitating patient empowerment *(567, 574)*. WHO's *Global health ethics key issues* paper (2015) defines informed consent as "Agreement to a certain course of action, such as treatment or participation in research, on the basis of complete and relevant information by a competent individual without coercion" *(575)*. Informed consent is a legal and ethical concept that serves:

- a legal purpose to protect patient rights;
- an ethical purpose to support self-determination and decision-making;
- an administrative purpose to ensure compliance to promote efficiency in health care; and
- to build the trust necessary to proceed with treatment *(574)*.

Given the continued widespread lack of awareness of PBM coupled with ongoing paternalism *(567)* and a clinical culture that is often unfavourable for adoption of PBM as the standard of care, the WHO Policy Brief on PBM stipulates that "the involvement of key members of parliament or comparable legislative bodies, supported by medico-legal experts, might be advisable to legally ensure patient empowerment and full informed consent and choice related to PBM" *(1)*. The national/jurisdictional PBM Task Force should request legislation to mandate informed consent and choice as it applies to PBM.

5.4 Promoting PBM as a patient safety initiative

The national/jurisdictional PBM Task Force should promote implementation of PBM as a critical patient safety initiative. The WHO Policy Brief on PBM explains that PBM improves patient outcomes by pre-empting risk factors for morbidity and mortality *(1)*. Avoidance and reduction of harm is the essence of patient safety.

WHO's *Global Patient Safety Action Plan 2021–2030: towards eliminating avoidable harm in health care* states that "Safe health care should be seen as a basic human right. As health care is predominantly a service, it is always co-produced with the users. Achieving safe care requires that patients be informed, involved and treated as full partners in their own care" *(570)*. PBM supports Strategic Objective 4 of the plan, which stipulates that HCPs must "Engage and empower patients and families to help and support the journey to safer health care" *(570)*. This is further supported by WHO's Patients for Patient Safety programme, which "aims to emphasize patients' rights, transparency and partnership with health workers to enhance the patient's role in patient safety" *(570)*.

Box 12

Reducing the incidence of legal liability with PBM

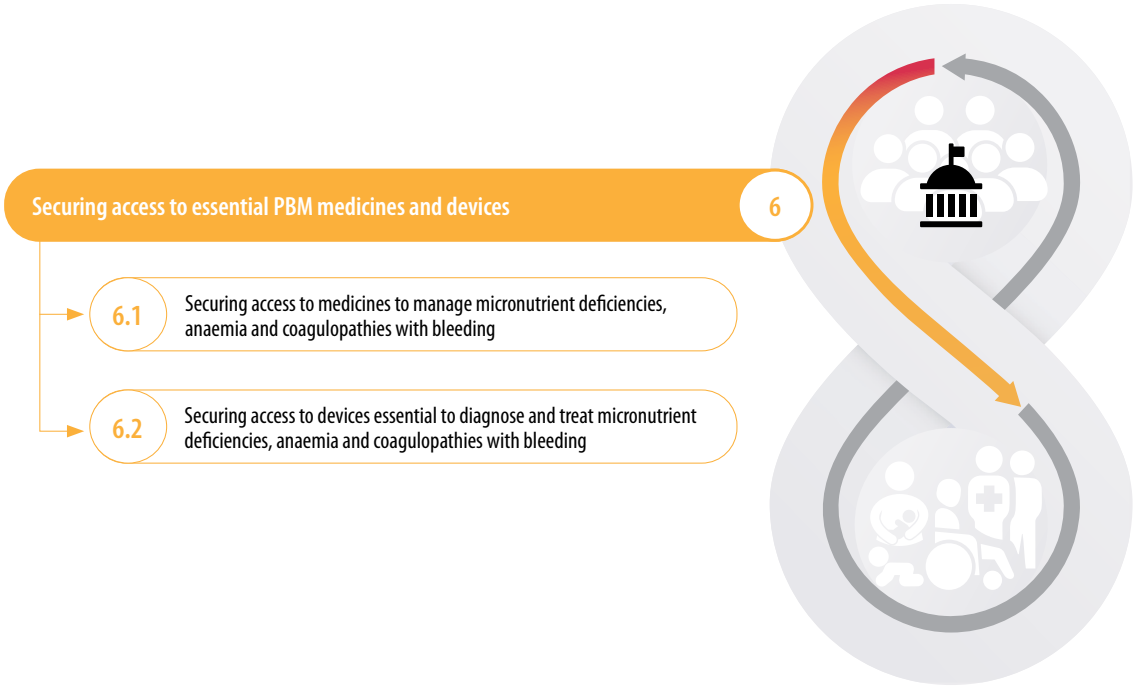
By complying with the WHO guidance in relation to the implementation of PBM and following the core principles of PBM, HCPs and their organizations can minimize their risk of legal liability *(576)*. In accordance with its medico-legal liability environment, the national/jurisdictional PBM Task Force should establish PBM as the standard of care against which medical care delivered by HCPs and HCOs will be evaluated. The national/jurisdictional PBM Task Force should collaborate with medico-legal experts in their jurisdiction to ensure that legal professionals understand PBM and its treatment modalities.

Patients need to be educated on the risks, benefits and limitations of PBM treatment modalities, and the risks (direct and indirect), benefits and limitations of blood components *(1, 576-578)*. Communication about clinical benefits, limitations and risks, and achieving meaningful informed consent, helps to protect HCPs from medical negligence litigation *(285, 571, 576)*. "Increasingly, the medical profession is being put on notice that PBM is now the standard of care and that it can be legally demanded by patients and any failure can lead to medical malpractice litigation" *(571, 579)*.

Step 6: National/jurisdictional PBM Task Force secures access to essential PBM medicines and devices

6.1 Securing access to medicines to manage micronutrient deficiencies, anaemia and coagulopathies with bleeding

WHO defines essential medicines as "those that satisfy the priority health care needs of the population. They can save lives, reduce suffering and improve health. They are selected based on disease prevalence and public health relevance, evidence of clinical efficacy and safety, and comparative costs and cost-effectiveness". Securing availability and access to these medicines is also one of the targets of the SDGs as well as being necessary to achieve UHC *(580)*. National/jurisdictional PBM task forces must decide which medicines and devices are essential to achieve effective PBM, based on their local epidemiology data and population health needs, and prioritize accordingly. These decisions must also



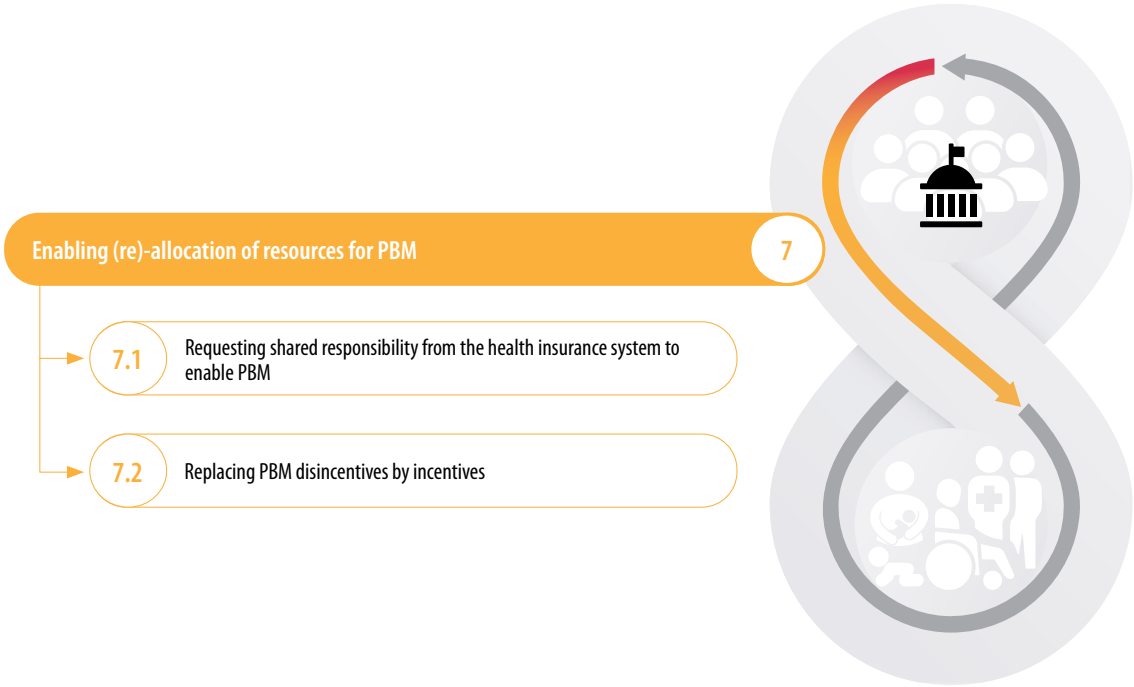
take into account that whereas the prevalence of many conditions and diseases is specific to geographical regions, anaemia and bleeding issues affect the whole of the world's population, even the most economically prosperous.

It is important for the Task Force to know that, except for intravenous iron supplementation and fibrinogen concentrate, most medicines essential to PBM are already included in the *WHO Model List of Essential Medicines* (EML) (see Annexes 6–11). However, having these medicines on WHO's EML does not automatically mean they are registered and available in every country. It must also be kept in mind, that individual WHO Member States have the flexibility to add or remove medicines from their national EML based on their specific circumstances. They may include medicines that are particularly important for treating diseases prevalent in their region or exclude medicines that are not relevant or accessible. Another important aspect is that some countries may face frequent stockouts, particularly at the primary care level. Mechanisms or alert systems to avoid these shortages should be developed. If essential PBM medicines are not registered, the Task Force should facilitate all necessary steps to fast-track registration. As a second step, the Task Force should ensure that the label of each of the various medicines covers all indications that are relevant to the intended PBM programmes. If this is not the case, they should investigate the application of national guidelines, laws and regulations for specific off-label use where appropriate ("compassionate use").

6.2 Securing access to devices essential to diagnose and treat micronutrient deficiencies, anaemia and coagulopathies with bleeding

There is no WHO list of medical devices available akin to the WHO EML. The best alternative for the PBM Task Force might be to identify the devices necessary for their national/jurisdictional PBM programme from the tools and devices listed in **Chapter 3** and Annexes 6–11. As in the case of medicines, the PBM Task Force can facilitate and fast-track market approval as needed. To further support availability of essential medicines and devices, the national/jurisdictional PBM Task Force might consider offering incentives and support to the manufacturers of medicines and pharmaceutical devices to produce some of these items locally and to reduce reliance on imports, possibly with support from the ministry of economic affairs.

Step 7: National/jurisdictional Task Force enables (re)-allocation of resources for PBM



7.1 Requesting shared responsibility from the health insurance system to enable PBM

UHC is the first of the Triple Billion Targets, and it "means that all people have access to the full range of quality health services they need, when and where they need them, without financial hardship. It covers the full continuum of essential health services, from health promotion to prevention, treatment, rehabilitation and palliative care" *(581)*. Although the UHC service coverage index (SDG indicator 3.8.1) has increased significantly over the past 20 years, there are about 2 billion individuals facing catastrophic or impoverishing health spending (SDG indicator 3.8.2) *(582)*. It lies predominantly within the **responsibilities** of social security and **health insurers** to **drive** the **UHC agenda**. As the evidence shows, and the WHO Policy Brief on PBM acknowledges, PBM contributes to the achievement of UHC by improving patient outcomes, reducing average length of hospital stay and preventing secondary health conditions. This is justification for a national/jurisdictional PBM Task Force request for shared responsibility from the national health insurance system, both public and private. Reimbursement schemes should facilitate processes and treatments that support PBM implementation (see 7.2). Policy-makers should enable PBM to become a standard of care by allocating or reallocating resources.

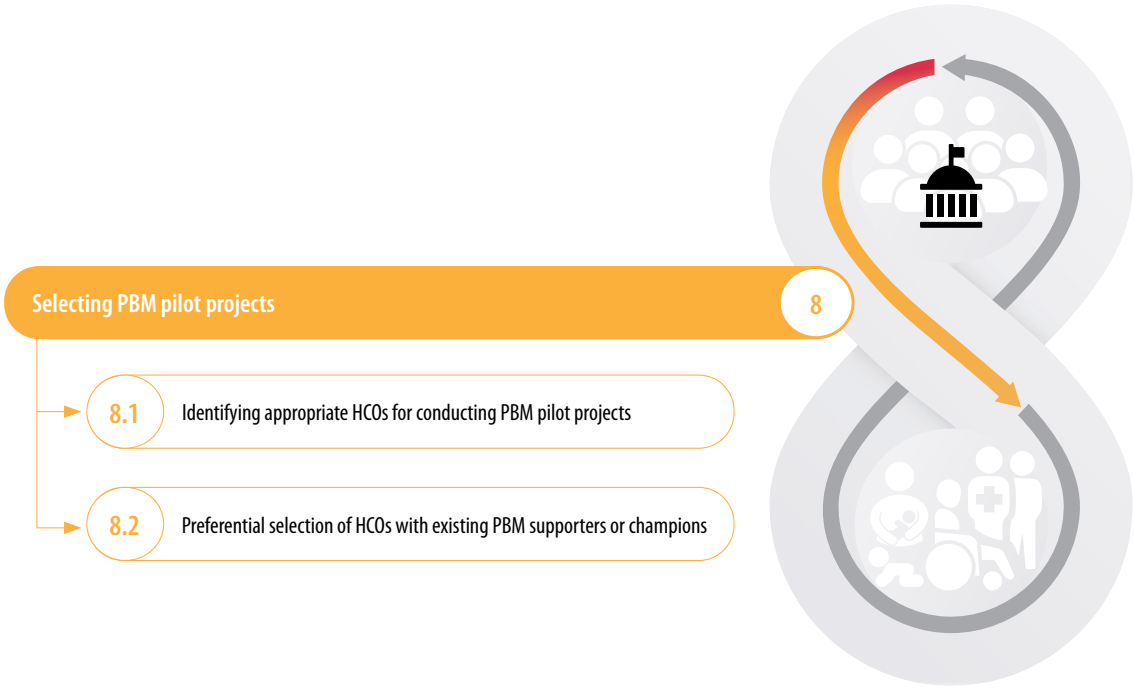
7.2 Replacing PBM disincentives by incentives

The WHO PBM Policy Brief states "Under national governance, and to develop national PBM policies and guidelines that will integrate PBM into health care … key representatives of health insurance systems should optimize incentives, remove disincentives and ensure outcome-based reimbursement schemes. For the public sector, involvement of the 'architects' of universal health care coverage is advisable" *(1)*.

Depending on the structure of the Member States' health insurance systems, it may be challenging to promote and support PBM through insurance incentives, disincentives and reimbursement. Control, oversight and patient eligibility

for public and private insurance will vary from country to country. Regardless of their controlling mechanism, public health insurance systems must adhere to the following economic principles: cost containment, appropriateness and efficient allocation of their limited resources. In the private health insurance sector, profit maximization is the governing principle. The executives of these systems are accountable to the public or to shareholders, and therefore often subject to oversight and regulation to ensure transparency and proper use of funds. Recent budget impact studies in France, Germany and Türkiye have demonstrated that public health insurance systems can save billions of health care dollars with PBM *(278, 279, 583)*. To this end, offering appropriate reimbursement schemes for PBM are not an option but a statutory obligation for public health insurance systems. The Task Force should work with the public and private insurance systems to demonstrate that appropriate reimbursement schemes for PBM are to their economic advantage.

Step 8: National/jurisdictional PBM Task Force selects PBM pilot projects



Introduction: the value of PBM pilot projects

WHO recognizes the value of pilot projects in demonstrating and evaluating the feasibility, safety and effectiveness of new health care interventions, approaches and programmes *(584)*.

PBM pilot projects are likely to reveal country-specific challenges and obstacles *(585)*. Thus, they can be valuable in identifying the corrective measures that will be necessary before national/jurisdictional scaling up. Pilot projects allow for local or regional "proof of concept" and facilitate local and regional acceptance of PBM implementation. Connecting PBM pilot projects nationally and internationally also provides an opportunity to create and expand a community of PBM experts and champions to share their experiences and reinforce one another's efforts during the implementation period and beyond.

8.1 Identifying appropriate HCOs for conducting PBM pilot projects

Preparing for PBM pilot projects requires careful assessment of any potential participating HCOs, including their organizational capacity. In the context of this guidance document, any entity that is organized and delivers health care at a locally acceptable level of quality and safety is considered an HCO. Depending on the specific national/jurisdictional PBM and blood health needs (see step 1.2) of each Member State, the national/jurisdictional PBM Task Force will select from one or more of the following HCO categories to commission PBM pilot project(s):

- community level in LICs and LMICs
  - primary health care centres
  - nongovernmental organizations (NGOs) focused on health care and community development
  - village health committees supported by CHWs
- community level in UMICs and HICs
  - primary health care centres
- tertiary care institutions (hospital or hospital system-based)
- trauma centres
- obstetric and maternal care centres
- paediatric and neonatal centres.

8.2 Preferentially selecting HCOs with existing PBM supporters, champions or programmes

The presence within an HCO of one or more highly respected clinicians who are PBM supporters is a great advantage. In the past, most institutional PBM programmes have developed independently of governmental support or with insignificant governmental support, driven by local champions. These were mostly clinicians, including nurses, but also chief administrators and, in some cases, patient advocates *(287, 586-588)*. Champions are individuals who by their nature, position or both, can influence and guide others to overcome resistance and catalyse action.

The national/jurisdictional PBM Task Force will need to survey the HCOs within their jurisdiction to identify any ongoing PBM initiatives or programmes, liaise with the respective PBM leads, and explore whether these HCOs should be the location for pilot project(s), with the aim of serving as national reference centre(s) after successful completion of the pilot phase (see **step 15**).

In some Member States, nascent PBM programmes can be identified and formalized as pilot projects. Where there are no self-declared local champions or ongoing local clinic- or hospital-based PBM initiatives, the ministry of health or department of health should solicit interest from HCOs in the creation of local pilot projects. Outreach through professional societies, national and local CME meetings, and a formal communication plan including a request for proposals from the ministry of health or department of health, may be needed to identify potential champions and pilot institutions.

Following the identification of HCOs as pilot site(s), the pathway of the 8-model transitions from phase A to phase B, which will be led entirely by the HCOs.

Box 13

Why PBM implementation needs strong government support

Experience shows that PBM champions partner with like-minded peers within their department or institution and attempt to implement PBM by negotiating with their administrators for support for PBM initiatives. If they succeed, they educate, introduce the necessary protocols and treatment algorithms and, with some additional measures and organizational changes, they see incremental gains, recruit additional supporters within their organization, and may see the intended outcome.

Success is often limited. Many, if not most, institutional initiatives yield incomplete or suboptimal results or fail because of complacency, bureaucratic inertia, a culture of deeply embedded clinical practices and the power of eminence-based medicine *(1, 4)*. Other common reasons for failure include lack of resources, reimbursement systems that do not incentivize PBM, and a lack of patient record/documentation systems and integrated data systems. To change any of these conditions is usually beyond the sphere of influence of local champions *(4)*.

PBM programmes have been found to be most successful when efforts led by HCOs and the efforts of government are made concurrently (the 8-model), or when local champions can persuade their ministry of health or department of health to actively support their local HCO-based approach. Only government authorities can change and adapt the allocation of resources *(287)* and adjust reimbursement and incentive systems *(4)*.

WHO's Policy Brief, *The urgent need to implement patient blood management*, together with the present implementation guidance are intended to fundamentally change this dynamic. Local and institutional champions should no longer be the only ones to initiate the implementation of PBM – a disruptive medical model certain to encounter resistance – and then ask their health authorities for structural support and funding. Instead, this support should be offered a priori as part of a national/jurisdictional PBM initiative.

Due to the magnitude and importance of PBM in terms of its potential public health and health-economic impact, ministries of health and departments of health are expected to make the proactive and system-wide "top-down" implementation a national priority by fully exploiting their public health armamentarium. This will further stimulate, incubate, accelerate and revive local and institutional "bottom-up" initiatives.

The government-led deployment of the 8-model offers an exceptionally smart investment opportunity for sustainable population health. It supports several of the SDGs including UHC. This clearly lies within the governance framework of performance, accountability and the 3Es, namely, evidence, economics and ethics.

B

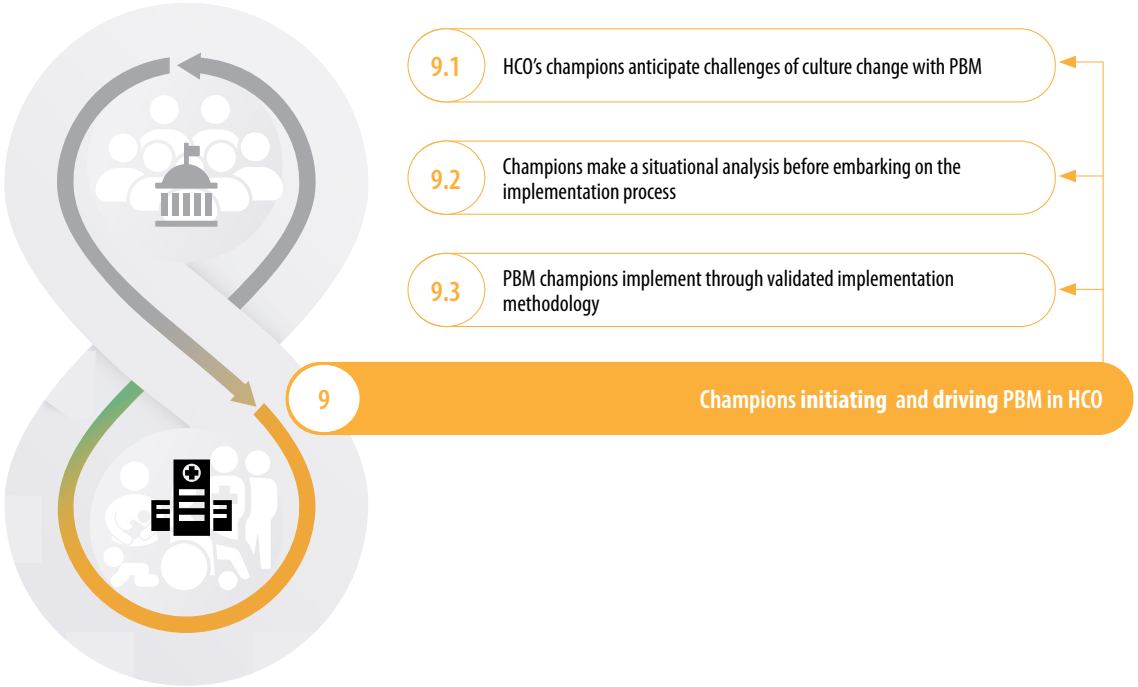
Phase B
Conducting PBM pilot project(s)

Changing HCO's culture methodologically

Phase B of the guidance document is a "how-to" manual for local champions to initiate, prepare and conduct demonstrational PBM projects at an HCO level, and to qualify as national PBM reference centres. These reference centres would then serve as resources to accelerate full national/jurisdictional PBM implementation.

Conducting PBM pilot project(s)

Step 9: Champions initiate and drive PBM in HCOs



Introduction: ensuring compliance with PBM through broad-based education

PBM champions have often "self-identified" by the time a national/jurisdictional PBM initiative is undertaken *(287)*. In other words, in many instances, these champions have already implemented some PBM strategies in their local community, clinic or hospital. Their aim is to improve patient outcomes based on their understanding of PBM as the new standard of care, leveraging whatever local resources they have been able to access *(586, 587)*. The successful local champion is passionate about the need for PBM implementation and is typically an early adopter of clinical or institutional change and a recognized thought leader within their local medical or professional community. If multiple champions have self-identified, administrative and clinical leaders should take steps to ensure that all of them are included in the implementation initiative and work together as part of an organized implementation process.

Box 14

The role of champions

"Clinical champions are individuals who are dedicated to supporting, advocating for, and spearheading an implementation initiative, and who overcome resistance that may occur at the organizational level. They have an intrinsic interest to implement change and use their position to motivate others. . . . [Their] strong communication and mentorship skills include collaborating with others, advocating for change, the ability to negotiate as well as educate and facilitate learning. Strong communication and mentorship skills can facilitate buy-in by conveying their conviction and positive perceptions about the initiative to their peers. Champions can also effectively tailor messages to different audiences to maximize engagement and buy-in" *(589)*.

These attitudes and capabilities could also apply to nonclinical professionals, such as public health representatives, hospital administrators or other health care-related professionals *(287)*.

9.1 Anticipating the challenges of culture change with PBM

PBM champions are aware of the urgent need to implement PBM based on their understanding of the 3Es (see **Chapter 1**). Conducting the pilot projects along the pathway of the 8-model (Phase B) lies within their clinical responsibility and ethical duty of care to replace "good" by better clinical care. However, culture and complacency are major obstacles for PBM implementation. Therefore, a prerequisite for champions to successfully drive PBM implementation is to be aware of these hurdles at each stage of the implementation process *(588)*. The WHO PBM Policy Brief explains that "PBM implementation requires a change in culture and behaviour … that the **challenge lies in changing clinical culture and physician behaviour**, that **physicians and others must unlearn and abandon some old practices** to enable them to adopt the broad, integrated approach of scientifically based PBM and that culture and behaviour, including existing medical dogma, are the main obstacles to the implementation of PBM" *(1)*. Thus, managing PBM implementation as a comprehensive shift in the care paradigm requires a well-structured approach.

9.2 Assessing status quo before the implementation process

The PBM champion(s) should personally assess and discuss the status quo with trusted colleagues before deciding to plant the seed of a local PBM pilot project *(588)*. The following questions are useful in this respect:

- Which patients in our HCO would most benefit from PBM initially?
- Are there PBM case studies or success stories from HCOs like ours?
- Could we leverage respected and influential peers within our HCO to champion the cause and influence more of our colleagues positively?
- What are the clinical and/or administrative departments that would be likely/unlikely to support the pilot project?
- What are the possible reasons for support of, or resistance to, the pilot project? How do these reasons relate to the 3Es of PBM?
- Are we aware of common misconceptions or concerns among our local peers regarding PBM?
- How will we manage the expected initial workload for the intended pilot project?
- How can we incentivize departmental leaders to engage in promoting PBM?
- How can we incentivize physicians and others to practise PBM?
- Who will be responsible for taking the overall leadership role?

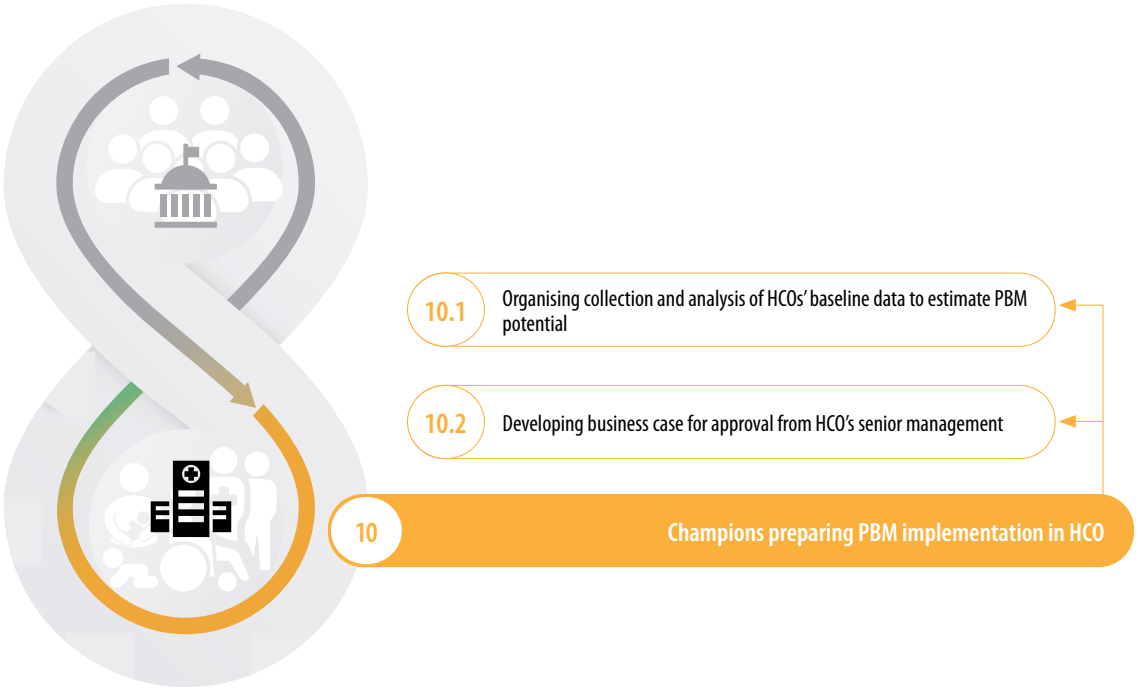
After careful consideration, the potential champions/nucleus of champions must decide whether to request pilot project status.

9.3 Implementing through validated methodology

As highlighted in the WHO PBM Policy Brief, applying a proven implementation methodology is pivotal for successful PBM implementation. **Annex 2** of this guidance document lists and briefly describes several implementation methodologies. In the world's largest PBM implementation programme to date, the Kotter model for change management was applied.

How this model can be used by PBM champions will be also discussed under Phase B Support: changing culture methodologically of this guidance document.

Step 10: Champions prepare for PBM implementation in HCO



10.1 Organizing the collection and analysis of the HCO's baseline data to estimate PBM potential

Collecting baseline data in HCOs can be challenging. This issue is most problematic in LICs where digital data collection and integrated electronic medical records systems are often unavailable. Meaningful data collection and analysis can also be challenging in UMICs and HICs due to competition for hospital information services resources, and sometimes the need to integrate data from multiple information systems. The main sources of baseline digital data relevant to PBM are found in the HCO's electronic medical record (EMR), which will access data from the following core hospital systems:

- transfusion information system (TIS);
- laboratory information system (LIS); and
- hospital information system (HIS) or patient administration system.

Often, the data being collected reflect what is easiest to collect rather than what is useful to collect *(32)*. Champions should work with their local IT resources to develop relevant data collection and analysis methods using **Annex 4** as a guide to what can be done. HCOs might consider seeking partnerships with universities to leverage their expertise in biostatistics, machine learning, IT and public policy. In the absence of digital resources, analogue sources of data can still provide meaningful baseline information.

10.2 Developing a business case for approval from HCO's senior management

Based on the results of their review of baseline data and reference data from peer-reviewed publications, champions estimate the economic (for example, expenditures for blood components, products and pharmaceuticals) and clinical (for example, length of hospital stay, length of stay in ICU and hospital-acquired infection rates) impact of a PBM programme in their institution.

This will be followed by the development of a business case presented to the senior local or institutional administration, represented by the chief financial and chief medical officers or their equivalent. This is to ensure financial and clinical support from senior administration. Depending on the administrative structure of the local institution, other senior administrative leaders can be involved to ensure support for the initiative among what are likely to be competing departmental priorities.

Box 15

PBM kick-off experiences

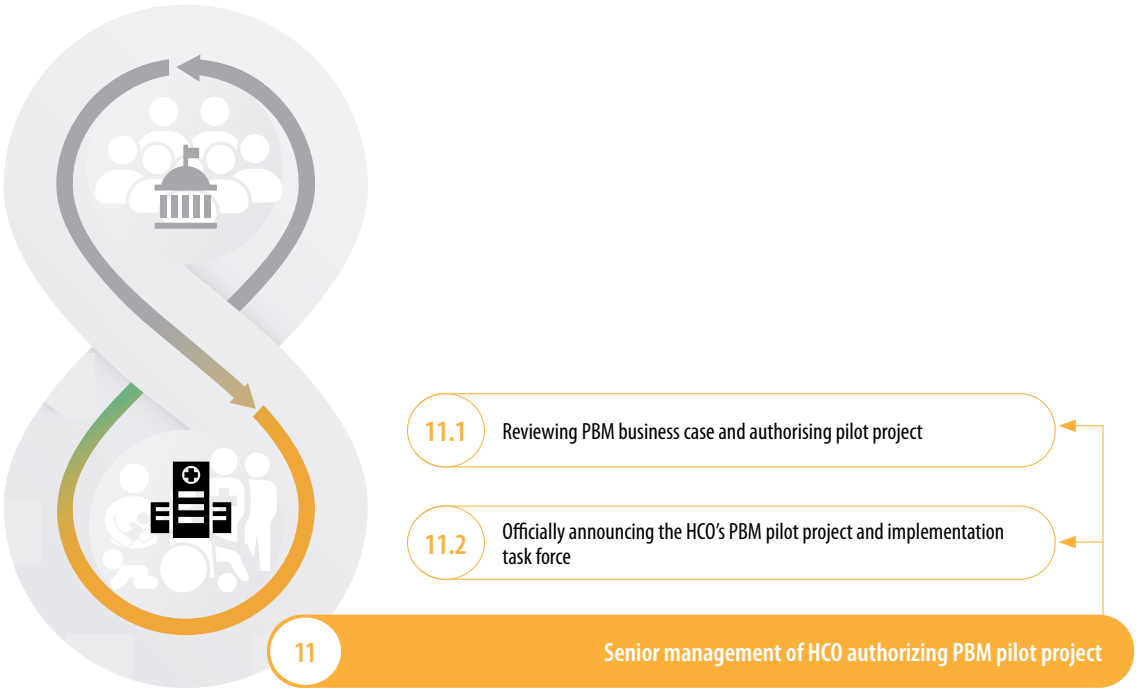
In Mexico City's General Hospital, a PBM programme proposal was presented to the General Director based on the 3Es of PBM. After an official inaugural event, the programme started in the liver transplant service. Administrators authorized an anaemia clinic, the acquisition of new technology (viscoelastic testing and cell salvage technology among others), and training of all personnel in the new technologies and in PBM. A workgroup created a continuum of care between hepatology, anaesthesia, surgery and intensive care teams, as well as treatment algorithms and a full quality and safety structure, and started a simple data collection process. There was an initial increase in overall cost for transplant surgery. However, in the first 6 months of operation, results showed a reduced length of stay in ICU, reduced mortality and overall direct and indirect cost savings. The hospital expanded the budget for the PBM programme to be applied to all hospital services.

In Brazil's Hospital São Paulo (UNIFESP University Hospital), PBM implementation began in 2019 through a workgroup comprising the heads of the cardiac and neurosurgery, anaesthesiology and haematology departments, the director of nursing and representatives of clinical engineering. They assessed team knowledge and infrastructure and raised awareness though education and training. They created an anaemia management protocol and an outpatient anaemia treatment clinic. Bleeding management protocols were drawn up, and an investment made in cell recovery equipment and viscoelastic coagulation testing. The programme now includes intensive care medicine and liver transplantation. Clinical outcomes have improved, with a reduction in overall costs.

Ankara City Hospital established the first PBM centre of excellence in Türkiye. They organized a meeting with broad participation in their centre to establish a consensus for implementation of a specific PBM programme. International and domestic experiences were shared, the importance of coordination and execution of different pillars in PBM were discussed, the problems with the blood transfusion system were investigated and the proposal for solutions discussed *(590)*.

Estimating the direct economic impact might be viewed as one of the most challenging tasks for champions, particularly when they have no educational background in micro- or health economics. However, a simple business case that anticipates resource requirements for steps 12–14 is necessary to move forward. The financial officer of the local institution, which is eligible for a pilot project, may provide the necessary expertise for constructing the business case. Published studies can help make the economic argument in support of PBM *(5, 11, 22, 64, 275, 591-595)*. At a minimum, the business case should include a starting budget for equipment, supplies, medicines, additional personnel (if any) and projected cost savings. The business case should articulate what resources can be reallocated to offset new costs. For example, an increase in cost for haematinics to manage anaemia might be offset by a reduction in length of hospital stay or a reduction in blood acquisition costs. Many institutions perform cost accounting in a "silo" fashion, department by department. Since costs may increase in one department (for example, the pharmacy), while decreasing elsewhere because of PBM implementation, it is important that the business case be structured in a way that looks at the overall cost of caring for the institution's patient population.

Step 11: Senior management of HCO authorizes PBM pilot project



11.1 Reviewing PBM business case and authorizing pilot project

The business case needs to be thoroughly reviewed and approved by the HCO's senior management. Based on cost and revenue projections, the necessary funds for staff, goods (equipment and supplies) and third-party services must either be reallocated within existing budgets or newly allocated in the following year's budget period. Budgets should be set for the whole of the anticipated implementation period (multiyear commitment).

Securing an official commitment and obtaining formal authorization by the board of directors, the chief executive officer or equivalent authority, or any other form of principal of an HCO, is the most important decision point for a pilot project. Once this milestone is reached, the HCO can enter into a formal agreement with the national/jurisdictional PBM Task Force or ministry of health or department of health. This agreement will detail financial support, if any, from the ministry of health or department of health, as well as the reporting obligations of the HCO to the national/jurisdictional PBM Task Force.

11.2 Officially announcing the HCO's PBM pilot project and Implementation Task Force

Once the decision to proceed has been made and the champions/leadership team is authorized to formally establish the HCO PBM Implementation Task Force, the senior management should officially communicate this to all clinical and nonclinical department heads.

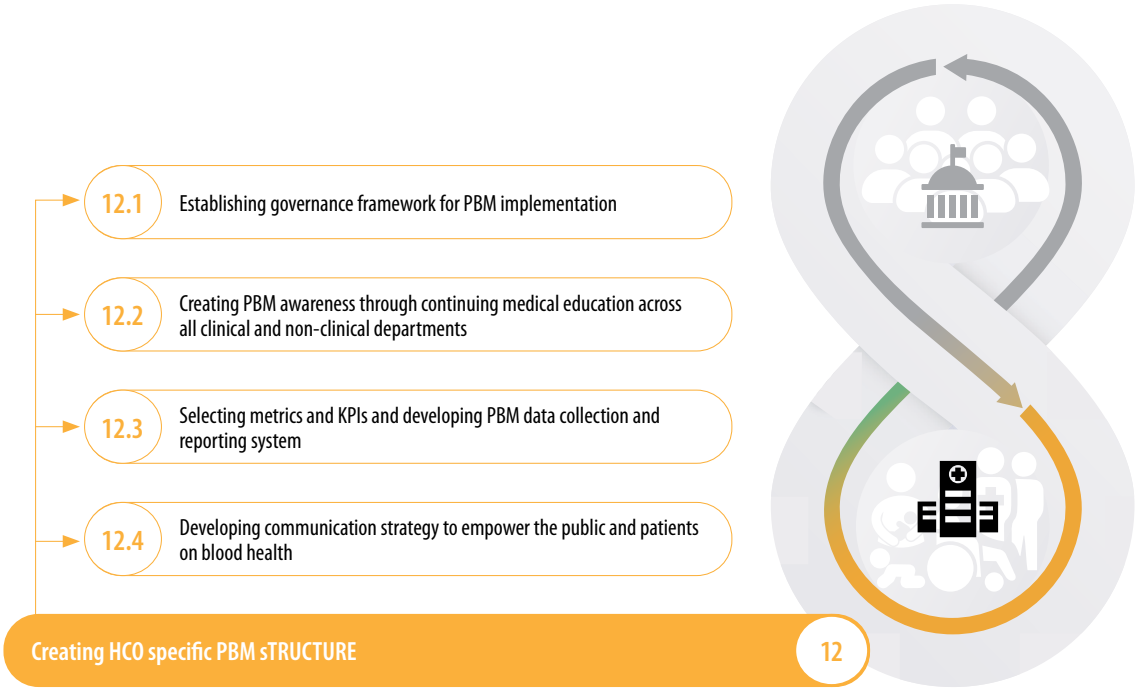
Note:

From this point onwards, the HCO PBM Implementation Task Force will be referred to as the **HCO PBM Task Force**. It should remain in place until full PBM implementation is achieved.

Since PBM is multidisciplinary, virtually every department will be involved in some way. Therefore, all departments should be made aware that PBM has the support of senior leadership as a high-priority, quality, safety and cost savings institutional initiative. This also helps to minimize potential conflicts during the structure and process changes needed to implement PBM.

After an inaugural launch event for a broader audience, supportive materials should be developed and distributed on an ongoing basis, to maintain momentum during the implementation phase.

Step 12: HCO PBM Task Force creates HCO-specific structure for PBM



Introduction: the importance of structural adjustments to enable PBM within HCOs

Similarly to the structural adjustments of the health care system in Phase A, HCOs also need to change structure to enable all the necessary clinical and administrative processes to implement its PBM programme (see **Annex 1**).

12.1 Establishing governance framework for PBM implementation

Analogous to the national/jurisdictional PBM Task Force, the HCO PBM Task Force needs an appropriate governance framework. Key elements of its four dimensions are summarized in Table 6.

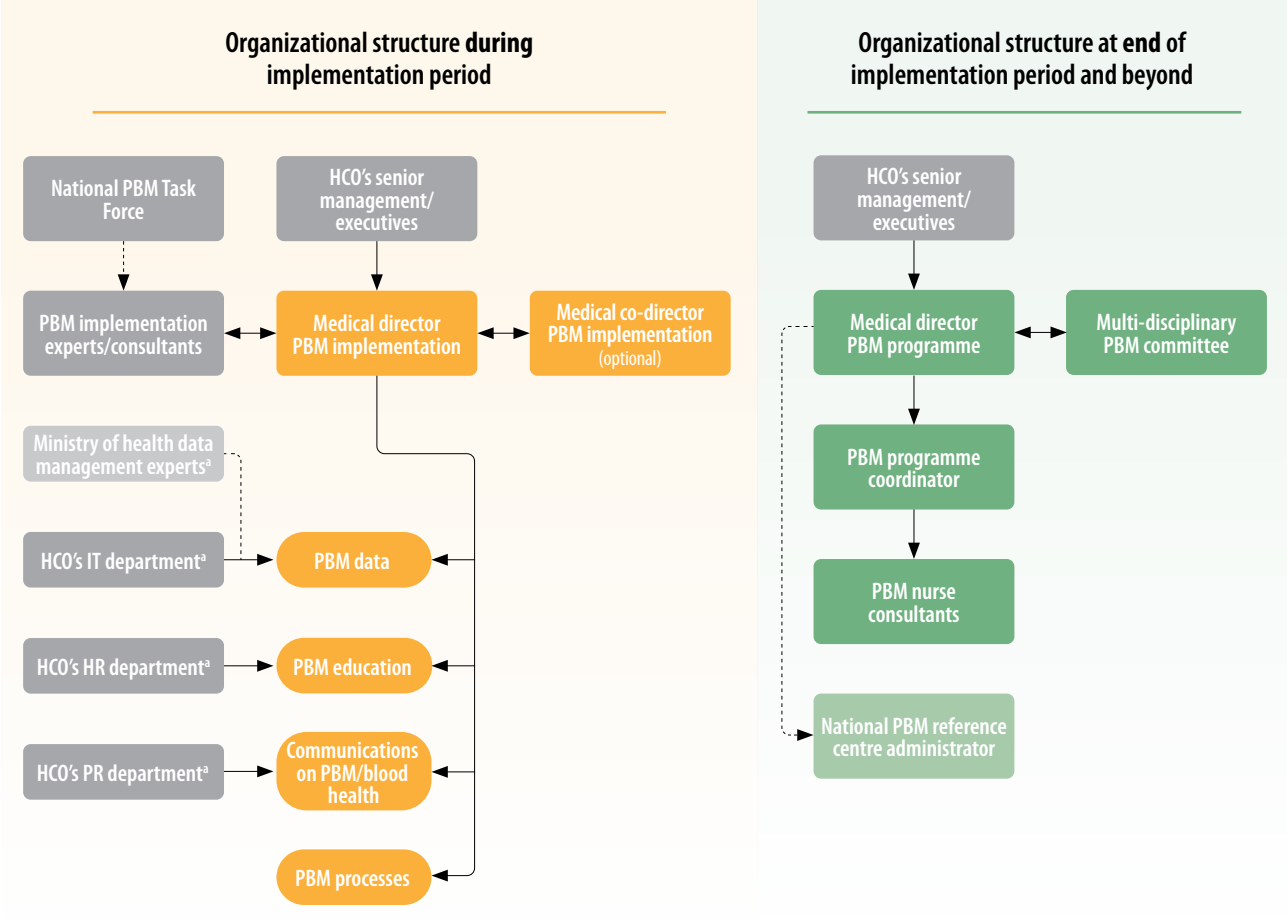
Table 6. Governance framework for the HCO PBM Task Force

Responsibilities and authority What will be required of the Task Force and what is its authority?	**Organization** How is the **Implementation Task Force** organized?	**Oversight** Reporting requirements from the Task Force to the national commission, and Task Force oversight during phases B and C and post-implementation	**Policies and procedures** How does the Task Force fulfil its responsibilities and exercise its authority?
• **Managing/executing steps 12–14 of the 8-model to accomplish full implementation of PBM in the health care organization (HCO)** • **Drafting a formal charter that stipulates the Task Force's mission, specific goals and responsibilities** • **Coordinating necessary workstreams and interaction between all departments/ units** • **Authorized by the HCO's senior management to fully implement PBM as a standard of care, based on the "3Es" of PBM** • **HCO's senior management obliges all clinical and nonclinical departments to support the HCO Task Force where necessary to accomplish PBM implementation** • **Seeking support from the National PBM Task Force when deemed necessary**	• **Establishing organizational structure with individual task assignment, i.e. with defined roles and responsibilities for managing the four workstreams that are required to execute steps 12–14 of the 8-model** - data - education - communication - processes • **Identifying and recruiting members with specific expertise, e.g. data collection and analytics** • **Leading PBM implementation with a methodology (using the Kotter model or another validated model)** • **Post-implementation, HCO Task Force** - **evolves into the HCO PBM department** - coordinates the HCO's activities as a national PBM reference centre	• **Supervised by the HCO's senior leadership, e.g. board of directors, chief executive, operations and finance officers, medical executive committee, or similar committees** • **Reporting periodically to the HCO's senior leadership on** - timelines and achievements/progress - unexpected major impediments and process adjustments - budget reports including planned versus actual costs and savings • **Periodic reporting to the National Task Force on key performance indicators (KPIs) that are specific to the progress of structure and process implementation during phase B (see Annex 4)** • **Periodic reporting to the National Task Force of selected KPIs during phase C of the national/jurisdictional roll-out of PBM (see Annex 4)** • **After implementation of PBM, the newly formed PBM department will continue to report to HCO senior leadership and to report to the National Task Force on selected PBM KPIs** • **The HCO may choose optional reporting of selected KPIs to the community/public**	• **Following written policies and procedures governing its structure and conduct on** - policies on ethical conduct, professional responsibility and accountability towards patients, blood donors and taxpayers through PBM implementation - policies that cultivate mutual respect and communal participation between diverse stakeholder groups - policies that demonstrate sensitivity to local health care needs and resources and tailor measures accordingly - policies and procedures that define where and how frequently the Task Force will meet, how often it will report to leadership, the length of time workstream leaders will serve, etc. - policies that establish a clearly defined quality management system - policies and procedures that will govern clinical protocols, care pathways, patient education and empowerment, informed consent/choice - policies on how to interact with other clinical departments

Fig. 14 shows four workstreams that are essential to create the right structure and implement the necessary processes for PBM in an HCO:

- PBM education, training and staff development, referred to hereafter as *education workstream* (see **step 12.2**);
- development and implementation of PBM data collection and metrics, referred to hereafter as *data workstream* (see **step 12.3**);
- blood health communications development, referred to hereafter as *communications workstream* (see **steps 12.2** and **13.4**);
- development of institutional PBM processes and implementation, referred to hereafter as *processes workstream* (see **step 13**).

Fig. 14. Evolution from HCO Implementation Task Force to an HCO PBM department



[a] if available

Depending on the size and complexity of the HCO, each of these workstreams might be taken on by the **Medical Director PBM Implementation**, with the assistance of a **Medical Co-Director**. Alternatively, workstreams may be assigned to lead individuals, particularly in HCOs with a larger number of departments or units, as shown in Fig. 14. The Medical

Director PBM Implementation might be either a highly respected physician or senior nurse with the requisite training and expertise. Successful PBM programmes appoint a PBM Clinical Nurse Coordinator *(5, 11, 22, 23, 275)*. It is expected that local PBM champions will be assigned this task. Depending on the champions' level of experience, support from external PBM experts might be necessary and should be funded by the national/jurisdictional PBM Task Force.

Once the full implementation is accomplished, the Medical Director PBM Implementation could hold the position of the medical director of the ongoing PBM programme, supported by a PBM programme coordinator and PBM nurse consultants. A multidisciplinary PBM committee will then function as the permanent oversight committee for the HCO's PBM department.

Fig. 14 shows the evolution from the HCO PBM Task Force to an HCO PBM department that will ultimately manage a comprehensive PBM programme and, potentially, the administration duties of a national PBM reference centre.

12.2 Creating PBM awareness through CME across all clinical and nonclinical departments

To create PBM awareness, depending on the type of HCO, the education workstream should accomplish the following tasks:

- Develop and organize specific in-house curricula mandatory for junior staff. These should be embedded in existing training and education programmes in the institution, and created in collaboration with those responsible. The curriculum should include digital and printed education materials that meet or exceed the HCO's educational standards.

- Hold CME-accredited PBM events (including grand rounds and virtual events) for all relevant clinical departments for surgical and medical care, including nursing and, where applicable, pharmacy. If possible, interactive practice workshops should be run (for example, on management of bleeding during surgery, as well as in trauma and obstetric care, coagulopathy management and preoperative management of patients, including anaemia management and nutritional optimization).

- Organize introductory PBM courses for allied health and nonclinical departments including the finance/controlling department (with an emphasis on the economic benefits of PBM – the second E), and the IT department/business intelligence unit to convey the importance and urgent need for these departments to support PBM as a priority relative their other tasks.

Note:

The HCO's PBM education should always accomplish two goals:
- convey how patients and each specific stakeholder group or audience will benefit from PBM; and
- what is expected from each audience to contribute to the success of the pilot project, that is, what will be each one's task and responsibility in PBM.

The PBM Medical Director should liaise with the HCO's human resources department to seek help on development of job descriptions for all positions needed at the end of the pilot project's implementation period. These will include the PBM programme medical director, a programme coordinator or manager, and PBM nurse consultants.

12.3 Selecting metrics and key performance indicators (KPIs) and developing PBM data collection and reporting system

Note:

This section of the guidance document describes the formal aspects of developing an effective PBM data collection and reporting system. What metrics and data are required first to manage the PBM implementation process and, finally, an ongoing PBM programme, are discussed under **step 14**.

Implementing a system to collect and analyse data and report the analysis as a collection of metrics and KPIs is usually a very demanding task, but one that is necessary for successful implementation of PBM *(596)*.

Even under the most resource-constrained conditions, a minimum of data must be collected to measure progress. It has been demonstrated that patient-level data collection can be successfully managed in LICs, as these data are reported in large published observational studies and randomized controlled trials related to PBM or its treatment modalities *(78)*. The data collected and analysed will depend on the size, scope and resources of the pilot project. For example, a village community PBM initiative to reduce the incidence of PPH might require only a very basic data system, with a small group of specifically trained CHWs who collect a data set with a small number of metrics, all manually entered through a simple app on handheld devices.

At the other end of the scale are fully developed PBM data collection and reporting systems in resource-rich HICs, including:

- automated, continuous patient- and physician-level collection of data necessary to monitor
  - the functioning of all major PBM processes (namely, whether they are routinely performed), and
  - PBM patient outcomes;
- automated continuous reporting of KPIs via dashboards, on a physician-, department- and institution-level. For specific in-depth analysis, it is useful to have data analytics tools that allow the user to "drill down" and conduct descriptive analyses including subgroup analysis, for example, by diagnosis-related group (DRG), procedure code, demographic groups or specific comorbidities, which are composited thereafter;
- automated continuous benchmarking against the baseline data, between peers, between departments within institutions and, later, between similar departments in other HCOs (to determine "best in class" and help incentivize efforts to improve) and inter-institutionally in HCOs with multiple sites.

Implementing such systems is complex and faces challenges that include the need for:

- interoperability and connectivity of often diverse technologies and standards;
- data standardization, since clinical data often come in various formats, and use different clinical coding systems and versions;
- standardization of how metrics and KPIs are defined;

- integration with existing systems, since many HCOs have legacy systems that are deeply ingrained in their operations;
- collection of data from written (non-digital) sources and from outpatient and clinic systems not linked to the HCO;
- compliance with security standards and privacy laws;
- regulatory compliance including certification requirements; and
- avoidance of duplicate records, data entry errors and inconsistencies.

Box 16

Data and privacy protection

Health care data are considered sensitive and research entities wishing to analyse data for PBM will need to take sufficient measures to protect personal information. This is often not an impediment as data are generally already collated and stored in accordance with local requirements and can be provided to researchers and analysts by data custodians in a non-identifiable format. By following best practice principles, an HCO PBM Task Force can effectively remove any risk of an inadvertent breach of privacy of patients or their communities. The benefits of accessing and analysing PBM data outweigh the potential risks. These benefits include the potential to improve the health and well-being of vulnerable groups and increase community education and awareness.

Therefore, the individual responsible for this workstream should have a solid understanding and sufficient practical experience of the integration and implementation of a system for data collection, analysis and reporting. This individual should also secure support from:

- data analysts/scientists and/or
- (bio-)statisticians
- data custodians and/or systems administrators.

Identifying all the necessary data sources and databases, and the silos requires profound knowledge of the HCO's systems architecture. Groundwork (see **step 10.1**) that has been done through the local PBM champions when collecting and analysing an HCO's baseline data to estimate the local PBM potential might have identified staff that can help further with developing the PBM information system based on HIS, TIS and LIS (see **step 10.1**).

Having established a system and infrastructure to collect and analyse data and report the analysis, it is necessary to create a framework for evaluating the uptake of PBM as a new model of care. This framework can be divided into three domains: structure, process and outcomes (see **step 16.2**). Structure must be put in place to enable change. In the context of PBM implementation, an example might be whether an HCO PBM Task Force has been approved and appointed and has adopted its governance principles. Assessing these milestones would all be examples of structure metrics. Next, progress can be assessed by measuring the uptake of processes, for example, how many patients within defined populations are treated according to specific PBM protocols and algorithms. Last, outcome metrics measure whether the intended treatment results and clinical outcomes are achieved.

12.4 Developing a communication strategy to empower the public and patients on blood health

In cooperation with the HCO's communication department, legal department, and possibly with the support of health care ethicists, the HCO PBM Task Force needs to develop a communication strategy and plan how to empower patients who face health problems related to anaemia, blood loss or coagulopathy. The communication must include the patient's fundamental right to make a free and voluntary choice about their care (informed consent/choice). Additional essential information to accomplish this task can be found in **step 5** of this guidance document.

The individual responsible for blood health communications could be someone from the corporate communications, patient relations, public relations, or patient advocacy departments or units. If none of these exists, this task could be taken on by one of the local PBM champions. It could also be supported by external professionals in the field. Patient representation to support the team is recommended.

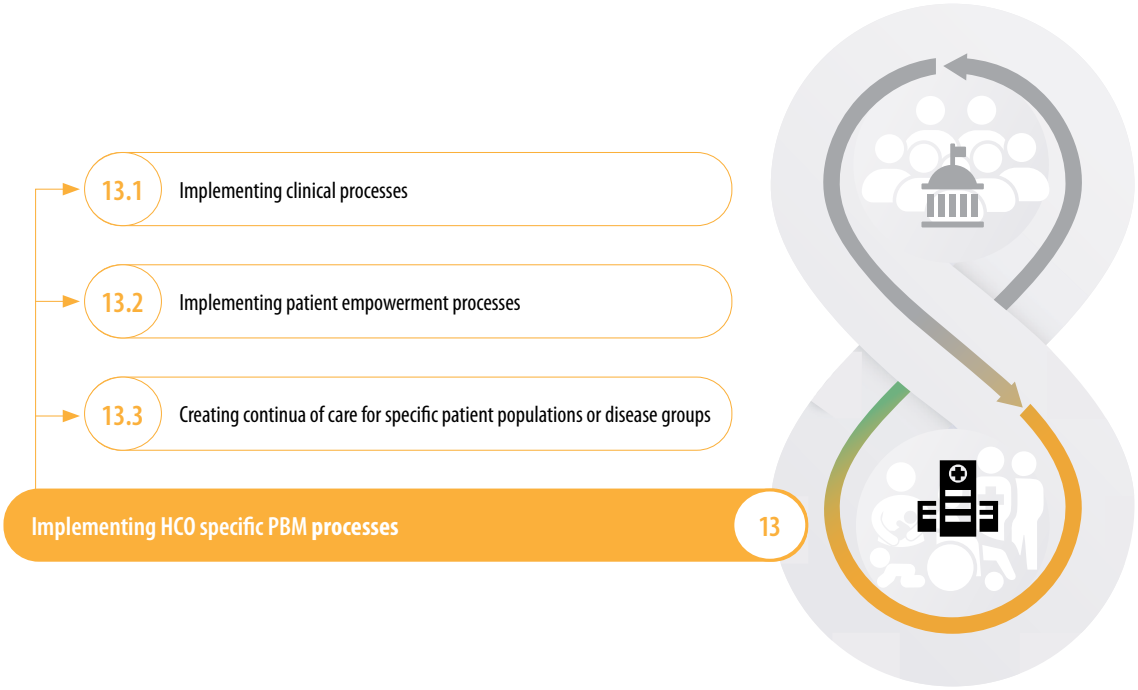
The HCO PBM Task Force needs to develop a communication strategy and roll-out that:

- informs, educates and empowers the public on the multiple benefits of blood health for general quality of life and well-being, as well as for patients with problems related to anaemia, blood loss or coagulopathy with bleeding;
- shows the HCO's firm commitment to improving and maintaining blood health for all patients through a novel, holistic approach called PBM;
- encourages a dialogue between the HCP and the patient to provide clear information about the diagnostic process, their diagnosis, the nature of their disease, the prognosis with or without treatment, and all treatment options including their expected benefits, risks and limitations, as well as:
  - a description of the risks of accepting the treatment and of all the treatment options, and the risks of declining a treatment option(s) or having no treatment at all;
  - an explanation of the clinical pathway and what to anticipate before and after treatment *(571, 574)*;
  - enabling the patient to decide which option(s) they choose or decline through the process of patient empowerment and shared decision-making; and
  - a process for documentation between HCPs and patients.
- encourages a patient-centred collaborative relationship between a patient and their HCP;
- conveys that the HCO is a reliable partner chosen by the country's ministry of health or department of health as the site of a pilot project committed to making the improvement and maintenance of blood health a national health goal for the greater good;
- conveys to all HCPs and professional staff within the HCO the critical importance of developing a robust informed consent/choice structure and a process that avoids any pressure or coercion to accept or decline treatment *(571, 574)*.[1]

The professional and public education and awareness communication plan should encompass face-to-face sessions to build relationships among the professional staff and between professional staff and community leaders, as well as digital and printed education and awareness materials, and outreach through social media and other digital tools.

[1] Consent or refusal should always be documented. Informed consent, however, is not simply getting a patient to sign a form but, rather, a thorough process of communication, starting from the first encounter.

Step 13: HCO PBM Task Force implements PBM processes



Introduction: combining PBM processes into seamless continua of care

PBM requires the implementation of multiple clinical and administrative processes that fall under the PBM process and implementation workstream. This includes the adaptation and/or development and implementation of numerous policies, protocols, algorithms and even single procedures and manoeuvres organized around ID and anaemia, blood loss and bleeding and coagulopathy. It also includes the processes of individual patient empowerment, education/information, and meaningful informed consent, which are split into clinical and medico-legal process elements. However, the goal of PBM lies in tailoring these processes to individual patient needs and delivering them in one seamless continuum of care to achieve that individual's blood health.

13.1 Implementing clinical PBM processes

Before beginning the clinical implementation of PBM, the HCO PBM Task Force member(s) responsible for the processes workstream should estimate and quantify the HCO's main patient populations, namely those with an increased incidence and prevalence of ID, anaemia, blood loss and/or coagulopathy with bleeding. Where resources allow, these data might be stratified by demographic variables, ICD codes, procedure codes and other variables. Data can be made available through:

- empirical data from the pilot site (part of this information might already be available as a result of work done by the champions in step 10.1);
- insight gained under step 1.2 and estimates based on local or international observational data published in the literature;
- the active support and experience of the heads or chairs of clinical departments or units.

The next task is to identify all locally required processes and resources, or "staff, stuff, space and system" for *detection and management of ID and anaemia*. The following questions must therefore be answered by the HCO's clinicians:

- Which are our most vulnerable populations that will need to be screened for ID and anaemia, and what are the inclusion and exclusion criteria for screening?
- Are there any evidence-based guidelines, algorithms or protocols on ID and anaemia screening for our region?
- Who will screen and where? Primary care physicians, nurses, CHWs, central clinical department (anaesthesia, haematology), mixed solution, other?
- How will screening be done?
  - patient education as to the value of screening?
  - screening method(s): blood test, history, survey, symptoms and signs, non-invasive technologies?
- When is the optimal time for the diverse populations to be screened (the ideal time for screening is likely to vary depending on the population being screened)?
- What are the evidence-based guidelines, protocols, diagnostic and therapeutic algorithms for diverse populations with anaemia and micronutrient deficiencies, suboptimal iron stores, isolated ID, IDA, anaemia of chronic disease related to infection, autoimmune diseases, CKD and acute or chronic inflammation?
- Who will diagnose and treat the ID and anaemia, and where?

With a similar set of questions, the HCO PBM Task Force should identify the locally required processes and resources for identification, evaluation and management of:

- postoperative and postprocedural anaemia;
- anaemia in obstetrics and gynaecology patients; and
- anaemia in all other patients, for example, those treated in the gastroenterology, nephrology, neonatology and paediatrics departments, medical ICU, PICU, haematology/oncology, etc.

The processes workstream also includes identifying all locally required processes and resources for *minimization of blood loss and optimization of coagulation*. The relevant questions to be answered by the HCO's clinicians are:

- What are our main populations
  - with chronic blood loss/ongoing bleeding, for example, with HMB, gastrointestinal bleeding or congenital coagulopathies,
  - with acute blood loss, including trauma and PPH,

- at risk of surgical or procedural blood loss,
- at risk of acquired coagulopathies, for example, patients with vitamin K deficiency or liver cirrhosis,
- at an increased risk for medication-related blood loss, for example, those on novel oral anticoagulants (NOACs) or direct-acting oral anticoagulants (DOACs), or antiplatelet therapy,
- with high iatrogenic blood loss, including from phlebotomy for diagnostic laboratory testing?

- Of the populations at risk of bleeding and/or coagulopathies with bleeding, which should be screened?
  - Who will screen and where?
  - When is the optimal time window for these populations to be screened?
  - How will screening be done?
    - Patient education as to the value of screening?
    - Screening method(s): Review of clinical history (symptoms, bleeding history, medications), physical examination, surveys, blood tests and validated tests for occult blood?

13.2 Implementing patient empowerment processes

As part of the PBM processes workstream it is necessary:

- with the help of the head of the legal department or legal experts, to identify the legal requirements and ethical obligations pertaining to full patient empowerment of adult and mature minor patients; and
- with the help of the clinical department heads, to identify the medical information pertaining to their circumstances that needs to be shared with adult and mature minor patients to fully empower them.

13.3 Creating continua of care for specific patient populations or disease groups

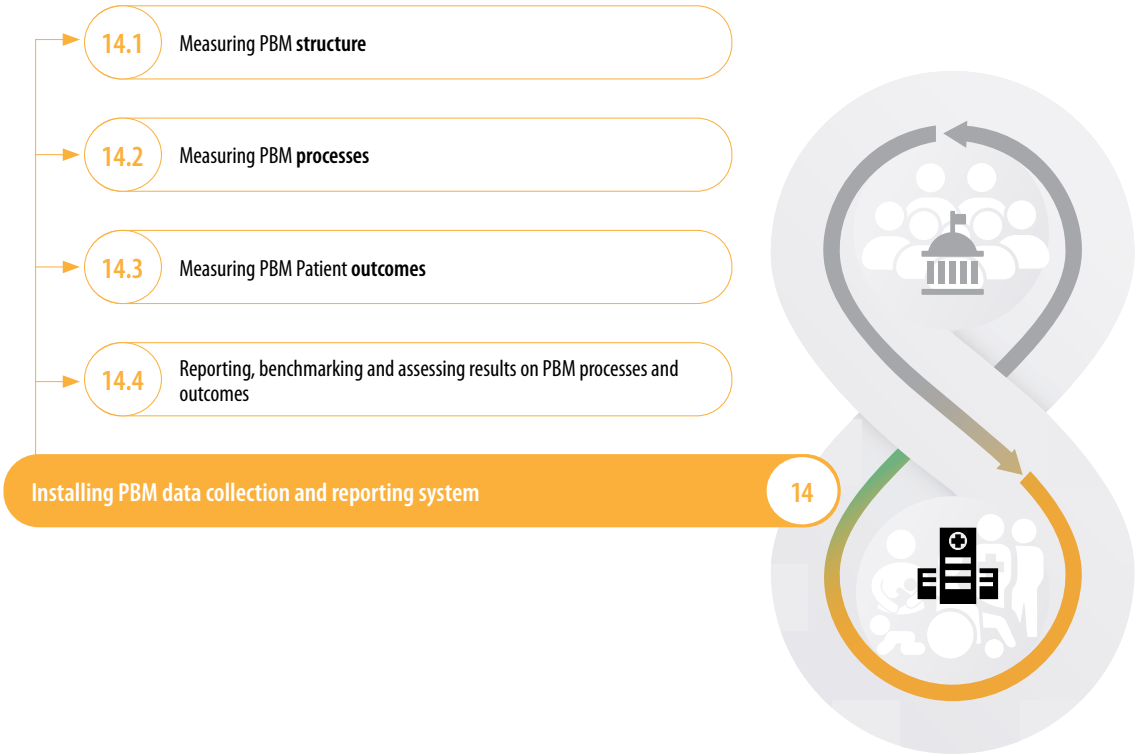
Fully implemented, comprehensive, PBM processes fundamentally change the way patients are served by the health care system across the full continuum of care. The clinical processes briefly outlined in steps 13.1 and 13.2 begin in the outpatient setting and may even be delivered to at-risk populations before they are clearly identified as patients (this is one way in which PBM is integrated into population health interventions). PBM clinical processes continue during hospitalization and extend to post-discharge care. The goal is a seamless, patient-centred continuum of care encompassing the patient's entire health care journey. This is illustrated in Figs 15–16.

Step 14: HCO PBM Task Force installs PBM data collection and reporting system

Introduction: establishing what data to collect and how to collect them

Depending on the HCO's specific needs and the data system's capacity, data can be extracted by subpopulation using demographic variables (age, sex, socioeconomic factors), ICD-classification, procedure codes, DRGs where available (or by means of any similar system used for classifying and determining reimbursement for acute care patients), severity of illness scores (for example, SOFA, APACHE, EuroSCORE), comorbid conditions (for example, Charlson comorbidity index), admission type and health insurance status. In low-resource environments, data might need to be collected manually or by survey. The type of data collected, and the metrics chosen, will be determined by the resources available and the maturity of the implementation journey (See **Chapter 4** and Annexes 6–11). Early data collection and metrics might be replaced by different metrics as progress is made.

The information collected while installing a PBM structure, both within and across HCOs in a jurisdiction, will serve as an indicator of the progress of national/jurisdictional implementation. The HCO teams and the national/jurisdictional PBM Task Force and its data team should collaborate to determine what data to collect and which metrics to report (see **step 16**).



14.1 Measuring PBM structure

Structure metrics are used to determine whether the physical (space and equipment), staff and organizational infrastructures are in place to facilitate an efficiently organized health care environment to deliver PBM as the model of care. Structure is typically assessed with survey questions combined with verification by direct assessment *(291)*. Examples of PBM structure metrics for LICs, MICs and HICs can be found in **Annex 4**.

14.2 Measuring PBM processes

Process metrics are used to evaluate the actions taken to provide care to patients. This includes new processes and procedures that have been developed and implemented, adoption and adherence to clinical guidelines, and the ways that the HCO and its providers interact with patients. These metrics relate directly to the health care provider's and the health care system's performance in delivering PBM. Examples of PBM process metrics for LICs, LMICs and UMICs combined, and for HICs can be found in **Annex 4**.

14.3 Measuring PBM patient outcomes

Outcome metrics are both the most important and the hardest to measure. They measure the impact of PBM on patient health status and outcomes. Many organizations will lack the resources to systematically measure changes in outcomes, but the HCO PBM Task Force should try to include one or more outcome metrics, as they are the ultimate indicators of the effectiveness of PBM implementation. Successfully implemented PBM programmes are associated with improvements in mortality, infection rates, length of hospital stay and patient-reported quality of life, which are all outcomes commonly collected by HCOs. Examples of PBM outcome metrics for LICs, MICs and HICs are provided in **Annex 4**.

Box 17

Correct understanding of the role of transfusion metrics and data for the pilot project and beyond

The goal of PBM is to improve blood health, not to reduce transfusions. However, reductions in transfusions are often a consequence of PBM implementation. Thus, **changes in transfusion rates** and **indices**, namely, the mean number of units per transfused patient (see **Annex 3**) over time, are **surrogate markers** for the **function of PBM processes** but **must be interpreted with caution**. A decrease in transfusions may also reflect stricter adherence to guidelines for more restrictive transfusion thresholds and **single-unit transfusions**. In most HCOs, a reduction in the use of transfusion **reflects both stricter adherence to evidence-based transfusion guidelines and implementation of the clinical processes of comprehensive PBM**. Experience in numerous HCOs shows that the earliest reductions in transfusion are driven primarily by stricter adherence to transfusion guidelines and are therefore early but incomplete measures of PBM implementation. Beyond the early stages, **metrics other than transfusion utilization become the more important ones for evaluation of PBM implementation**.

The practical **advantage** of transfusion metrics is that, in **many HCOs**, they are **more easily available than** most **other PBM metrics** due to regulatory requirements to monitor transfusion hazards (haemovigilance). **Another advantage** is that blood components in most countries have a "**price tag**". **This enables the calculation of total cost savings on blood components** associated **with PBM programmes** from published evidence and estimates of **activity-based transfusion cost**. In countries, where blood components are provided to HCOs at no or reduced cost, both the national/jurisdictional and the HCO PBM task forces must bear in mind that the production costs of blood must be paid by the ministry of health or department of health or another public entity. The HCO PBM Task Force must also consider that the cost of transfusion is a multiple of the cost of blood components, and that this portion is usually paid by HCOs *(454-456, 597)*.

14.4 Reporting, benchmarking and assessing results of PBM processes and outcomes

Benchmarking between physicians, defined as comparing performance on specific metrics when physicians share similar patient populations, is a powerful driver for change in physician behaviour and thus for PBM implementation *(394, 395, 598, 599)*. Whether benchmarking is done with or without open identification of providers depends on local rules and regulations. In most instances, the decision to share physician practice data with physician identifiers within a department or an HCO is based on the organizational culture. Benchmarking between similar departments in larger HCOs that include several institutions is also recommended. For both physician data and departmental data, the association of identifiers with the data can be a powerful driver for change.

Benchmarking results should be reported back to the various stakeholders and discussed/assessed to enable continuous improvements. The HCO PBM Task Force and, towards the end of the implementation period, the HCO's Multidisciplinary PBM Committee, will review all process and outcomes data, and benchmarking results. When comparing specific metrics between hospitals within an HCO (and between HCOs) differences in patient populations and patient acuity must be considered.

Changing HCO's culture methodologically – Phase B support

Using implementation methodology to change culture

To increase the chances of success of local or institutional pilot projects, it is recommended that champions use a validated implementation methodology *(1, 37, 600)*. As stated in the WHO PBM Policy Brief, this is **even more important when the implementation requires culture change**.

The Kotter model for change has been successfully used to implement PBM programmes within HCOs and on a state level *(22)*. The model, with its eight-stage framework, provides a structured approach to facilitate successful organizational change and to overcome complacency, resistance and deeply ingrained culture.

Note:

The **Kotter model for change is not an alternative to the full cycle of implementation** as described in Phase B, **but** an **ancillary model** that focuses on how to win over the "hearts and heads" *(289)* of the HCO's staff in favour of PBM.

Stages of the Kotter model for PBM in HCOs (see Fig. 6)

Stage A: Champions *establish a sense of urgency* for PBM

This stage involves champions proactively creating awareness among peers, colleagues and all stakeholders about the urgent need for a PBM programme, built on the 3Es as the main drivers for change. The urgency can be further supported by emphasizing the impact on patient safety, and quality standards.

Stage B: Champions *create a powerful PBM coalition – leadership*

It is vital that the group of champions form the HCO PBM Task Force and build a guiding coalition together with administrators and support staff. This coalition should be passionate about the PBM programme, possess diverse skills, and have the professional and moral authority to drive change.

Stage C: Champions *develop a vision and strategy* for change with PBM

Champions present a compelling vision of an HCO structurally adapted to provide PBM, which resonates with multiple audiences and inspires them to embrace change. This vision puts the needs and values of patients at the centre by individually managing the patient's blood with the same respect as any other organ system.

Stage D: Champions *communicate* the PBM vision

Champions communicate the vision as broadly as possible through multiple media including newsletters, social media, public education events and press releases on blood health. The aim is to engage the public, and to inspire and motivate peers and colleagues by posting up-to-date evidence and educational case histories as well as offering well-planned educational events on how to optimally care for patients today and in the future.

Stage E: Executives *empower a broad base of people* to implement PBM

At this stage the Kotter model involves introducing the PBM bundle of care that is required for the HCO. This may comprise more than 100 PBM strategies *(601)*. HCO executives need to commit to PBM and to fully authorize the champions to form the HCO PBM Task Force. HCO executives should remove structural barriers by structural innovation, facilitate implementation of new processes and practices, and reallocate resources until broad-based engagement and empowerment is achieved.

Stage F: Task Force *generates short-term wins* with PBM

By means of a PBM data and metrics system and reporting structure, the Task Force will navigate the implementation process towards early "wins". These successes are celebrated with high-level PBM events and official acknowledgements for those spearheading the implementation. Short-term wins build momentum, boost morale and the HCO's own data support trust in the programme's positive impact.

Stage G: Task Force *consolidates gains* and *produces more change*

Broadening the institutional impact of PBM by combining its processes into a continuum of care for an increasing number of subpopulations reinforces this model of care and forms the basis for the national/jurisdictional PBM Task Force to scale up nationally/jurisdictionally. Continuous improvement embeds PBM in the HCO's culture.

Stage H: Staff *institutionalize* PBM in the *culture*

With PBM as the HCO's new standard of care it becomes anchored in the organization's culture. With its newly gained multiprofessional competence, the HCO might act as a national and even an international PBM reference centre, offering training and education. There may also be opportunities for research.

A structured change management approach, such as the Kotter model, results in sustainable improvements within HCOs. Additional information on PBM implementation methodologies is provided in **Annex 1**.

Phase C
Rolling out PBM on a national/jurisdictional scale

Phase C of the Guidance is a "how-to" manual for the responsible authorities within the public health sector explaining what decisions and steps must be taken to fully roll out the national/jurisdictional PBM implementation.

Step 15: National/jurisdictional PBM Task Force selects pilot site(s) as reference centre(s) for national/jurisdictional scaling up

15.1 Evaluating the results of pilot project(s)

The **national/jurisdictional PBM Task Force** must formally **evaluate** the results of the pilot project(s). One approach might be to apply the PBM standards for hospital accreditation as introduced under **step 18** of this guidance document. Alternatively, the Task Force can assess the pilot project(s) against the goals set at the time the pilot HCOs were selected. The evaluation should include an analysis of data, metrics and predetermined KPIs.

Some pilot projects may fail to meet all their goals. The national/jurisdictional PBM Task Force should critically assess the underlying reason(s) why the project fell short and answer the following questions:

- Was the lack of success due to reasons inherent to that specific HCO?
- Did the national/jurisdictional PBM Task Force share responsibility for the lack of success?
- Were sufficient resources and support made available?
- Did the national/jurisdictional PBM Task Force set clear expectations and provide sufficient guidance?
- Should the project be allowed to continue after remedial action has been taken?

In some instances, the final success of one or more pilot projects and, by extension, the success of national/jurisdictional PBM implementation, may be an iterative process whereby HCOs and the national/jurisdictional PBM Task Force learn from mistakes and challenges, make corrections or adaptations and redirect efforts as needed, leading ultimately to successful national/jurisdictional scaling up of PBM.

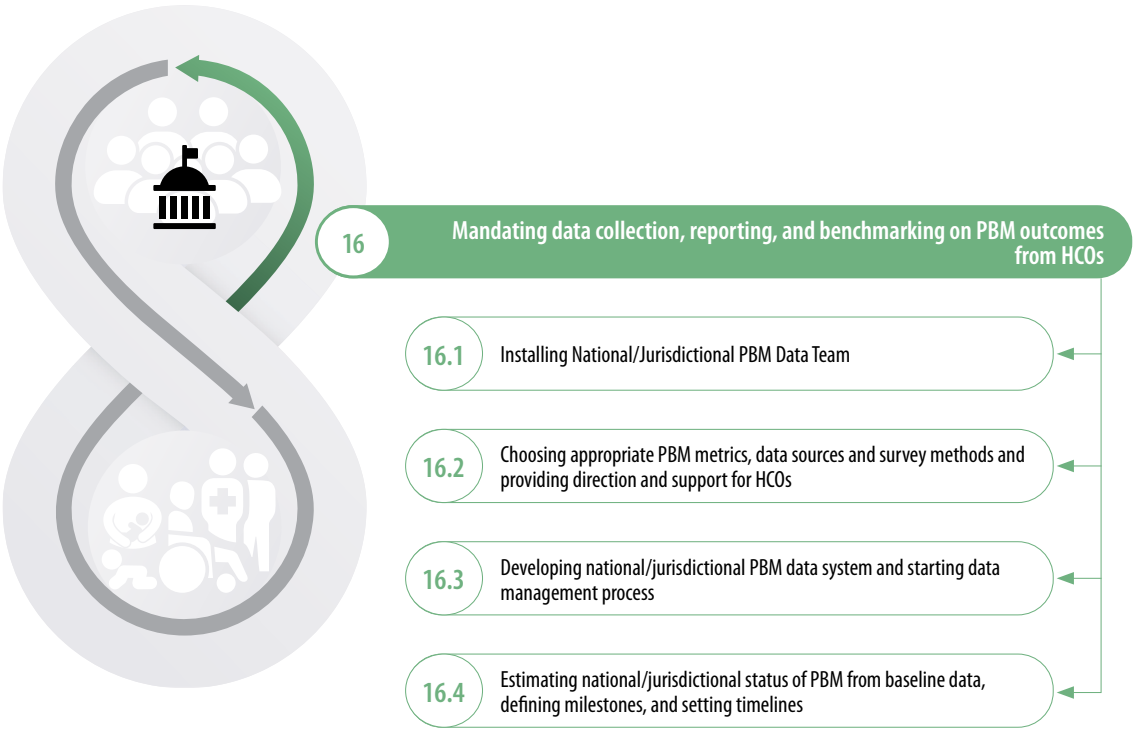
15.2 Choosing pilot sites as national PBM reference centres

Pilot projects that comply with the proposed standards (see **step 18**) and goals established by the national/jurisdictional PBM Task Force qualify as national PBM reference centres. Reference centres can provide:

- education and training programmes for clinicians from other HCOs;
- exchange programmes for medical professionals;
- clinical support for challenging PBM cases;
- consultation services and sharing of implementation know-how and experiences with PBM champions (or potential champions) or designated programme implementers from similar HCOs;
- capacity for data collection on PBM parameters; and
- opportunities for benchmarking with other HCOs.

The champions and leads of the PBM reference centres should keep abreast of the latest developments in the field, promote innovation (see **step 19**), and be available to update and improve national clinical PBM guidelines as needed.

Step 16: National/jurisdictional PBM Task Force mandates data collection, reporting and benchmarking on PBM outcomes from relevant HCOs



Introduction: the need for national/jurisdictional PBM KPIs

Surveillance and monitoring of data critical to support health protection, health promotion and disease prevention are the two operations that constitute the "business intelligence" of health authorities around the world (https://who-sandbox.squiz.cloud/en/health-topics/Health-systems/public-health-services/policy/the-10-essential-public-health-operations). Following **step 3** of this guidance document, the measuring and reporting of PBM implementation as determined by KPIs of structure and process, as well as outcomes on a national/jurisdictional level, are key responsibilities of health authorities.

16.1 Installing a national/jurisdictional PBM Data Team

Different populations and regions have specific PBM needs based on epidemiological factors including disease prevalence and patient demographics. Where resources are available, the national/jurisdictional PBM Task Force should have already appointed experts, or delegated responsibility to existing staff, to operate as a data team (see **step 2**) to identify, generate, access, compile, interpret and report data, metrics and KPIs critical to PBM implementation and practice. In high-resource countries, these might constitute a formal national/jurisdictional PBM Data Team that includes:

- physicians, preferably with PBM knowledge;
- IT specialists that understand system architecture and data sources within the health care system;
- biostatisticians and epidemiologists; and
- data custodians, managers and data analysts.

Where staff and other resources are limited, the national/jurisdictional PBM Task Force must make every effort to ensure that data are collected, analysed and reported to ensure national/jurisdictional progress towards and compliance with PBM as the standard of care.

Ideally these responsibilities would be delegated to a data team. Many Member States will lack the staff and resources for a dedicated PBM Data Team. However, at a minimum, an individual within the ministry of health or department of health should be made responsible for collection and analysis of PBM data and given the authority and resources to carry out the following tasks:

- choosing PBM metrics as KPIs, in cooperation with the national/jurisdictional PBM Task Force, that are most appropriate for the country-specific need to survey and monitor the roll-out process, and where appropriate, the post-implementation period;
- developing a data system to manage PBM data throughout the national/jurisdictional PBM roll-out (Phase C) by identifying and (electronically) interfacing diverse data sources, databases and silos (and if an electronic system is not feasible, for ensuring that there are manual analogue processes in place for collecting data);
- collecting national/jurisdictional PBM data at baseline;
- managing PBM-related data during the national/jurisdictional roll-out phase until completion through:
  - continuously collecting the PBM data;
  - periodically reporting the results on a nationally/jurisdictionally aggregated level to predefined recipients and, where needed, on a regional/provincial level and/or HCO level;

- benchmarking results as needed on a regional/provincial level and/or HCO level and, where possible, by HCO department and individual physician level;
- developing and offering dashboards and other reports that facilitate quick and easy interpretation of data; and
- ensuring compliance with data protection/privacy protection regulations.

Post-implementation, the ministry of health or department of health should continue to collect a set of data that will be instrumental in sustaining PBM as the national standard of care.

Note:

The scope and scale of data collection and analysis will be dependent on resources. LICs and LMICs may be limited to just a few KPIs assessing structure and process. Even UMICs and HICs may have limited IT resources available. It is critical that enough data are collected to effectively evaluate and benchmark progress towards adoption of PBM as a standard of care (see step 16.3).

16.2 Choosing appropriate PBM metrics, data sources and survey methods, and providing direction and support for HCOs

It is incumbent upon the national/jurisdictional PBM Task Force to choose what data they wish HCOs to collect, from which sources to obtain those data and how to analyse them. The Task Force must be certain that it directs HCOs to collect sufficient and appropriate data and report those key metrics that will provide information on the relative success of each HCO's implementation of PBM. With an agreed-upon set of KPIs, the Task Force can track progress towards PBM as the national standard of care.

It is recommended that the Task Force adopts the **Donabedian model** *(293, 602)* to assess progress towards national/jurisdictional PBM implementation as well as quality assessment on an ongoing basis (see **Annex 1**). Early metrics will, of necessity, centre around structure. As processes are put in place and the national/jurisdictional PBM programme expands, key process metrics will provide feedback on whether PBM is having an impact on patient care processes and the cost of care. Outcome metrics are the most difficult to obtain and may be added as the national/jurisdictional roll-out advances and programmes mature. **Annex 1** provides detailed information on the Donabedian model as it applies to PBM, whereas **Annex 4** is a compilation of possible metrics in table format.

Because health care systems differ depending on governmental structures, population needs, epidemiology and resources, the national/jurisdictional PBM Task Force, in collaboration with HCOs, will need to decide which metrics are best suited to their health care system(s). Factors to consider in these decisions are:

- **Temporality of metrics:** Metrics may change over time from those needed to gauge successful start-up or initiation of PBM initiatives to those needed for ongoing monitoring and evaluation as a programme matures.
- **Perspective:** Should metrics apply to the national, regional or HCO level?
- **Economic dimensions:** The feasibility or relevance should be determined based on resources and income level.
- **Type of measure** (structure, process and outcome)**:** Structure and process metrics indicate a national/jurisdictional health system's capacity to provide PBM care. Outcome metrics measure the clinical and financial outcomes of PBM implementation.

- Examples of structure metrics include the percentage of HCOs with a formally designated executive/administrator responsible for implementing PBM or with a clinical director of an existing programme. This and other structure metrics that may be most useful during early implementation can be collected through surveys.

- An example of process metrics is the percentage of individuals screened for ID and anaemia. Such metrics can be used to monitor ongoing progress based on mandatory data from HCOs.

- Examples of outcome metrics are the change in percentage of patients with anaemia presenting for elective surgery or the number of units of red blood cells transfused per admission or per patient-years. These data can be captured through mandatory data from HCOs.

For capturing national/jurisdictional baseline data and for prospective data collection, the data team identifies useful data sources and appropriate survey methods. Health care systems with limited ability to gather data (LICs and LMICs, and sometimes even in UMICs and HICs), may benefit from an initial focus on collecting and reporting structure/process metrics. There is a robust literature supporting improved outcomes with effective implementation of PBM. Thus, demonstrating that PBM has been successfully and comprehensively implemented by means of appropriate structure and process metrics may be both easier and of equal importance to outcome metrics *(23, 277, 603, 604)*.

The following is an abridged list (additional suggestions can be found in **Annex 3**) of possible metrics to capture nationwide baseline data, grouped by data source:

PBM structure data from HCO surveys:

- number and percentage of institutions (stratified by type of HCO) that have implemented a PBM organization including a

  - clinical PBM director

  - PBM coordinator

  - PBM nurses

  - formal multidisciplinary PBM Committee

  - formal PBM education coordinator (physician, nurse, pharmacist, etc.)

  - formal patient education programme on blood health/PBM

  - PBM CME programme;

- number and percentage of institutions with a fully implemented, consistent PBM data collection and reporting system; and

- number of medical schools providing undergraduate PBM education through lectures or courses.

PBM processes data from HCO surveys:

- percentage of vulnerable members of the community screened to detect, diagnose and manage ID and anaemia;

- percentage of HCOs with formal preoperative anaemia management programmes;
- percentage of HCOs with formal postoperative anaemia management programmes;
- percentage of HCOs with a formal anaemia management programme for medical patients;
- percentage of HCOs with formal programmes to limit bleeding and blood loss;
- percentage of HCOs with all essential medicines for implementing PBM policies and procedures available for use (see Annexes 5–9);
- percentage of HCOs with all essential devices for implementing PBM policies and procedures available for use (See Annexes 5–9).

Note:

Data and reports on key hospital conditions (for example, PPH), procedures (for example, hip replacements), and utilization data from pharmaceutical entities may be available from national agencies tasked with collecting and managing health and welfare statistics. Where information is available, the data team may have the opportunity to estimate national levels of use of a wide variety of medicines and devices, and hospital conditions and procedures from these data sources. Note that at the time of publication no national health system has a structured process to gather and analyse data from these disparate sources. Some countries possess data registries for some patient categories (for example, the National Surgical Quality Improvement Program in the United States of America operated by the American College of Surgeons). These might provide a source of valuable data for some Member States. The data team is encouraged to leverage data currently being collected through these sources and repurpose the data for PBM metrics.

PBM outcomes data from WHO databases:

- prevalence of anaemia in women aged 15 to 49 years (%), by pregnancy status;
- prevalence of anaemia in children aged 6 to 59 months (%); and
- prevalence of anaemia in those aged 60 years or over (%) by sex.

Data required for these metrics are already collected from survey reports and manuscripts entered into the WHO Micronutrients Database, part of the Vitamin and Mineral Nutrition Information Systems (VMNIS) *(605)*. **Annex 1** suggests several outcome metrics and data that are regularly and freely retrievable from WHO's Global Health Observatory and other similar databases.

Note:

Patients aged 60 years and over who are undergoing major surgery benefit from PBM since prevalence of anaemia is known to be high in this population *(392) (606)*. The prevalence of preoperative anaemia is not currently captured by the Global Health Observatory *(295)*. However, baseline data on its prevalence might be estimated from national data on admissions for major surgery or discharges following major surgery (possibly by procedure codes or similar information) and from data on anaemia prevalence published in local studies *(607)*. As Phase C of the national/jurisdictional implementation process progresses, tertiary hospitals should be required to share these data.

PBM outcomes data from HCO data systems:

- This includes all outcomes data that are collected in HCOs following **step 14** *and* data that are recommended by the national/jurisdictional PBM Task Force or even required by the ministry of health or department of health.

Member States are encouraged to collect and report the full range of data that is reasonable within the constraints of the local and regional resources available. Additional information on metric rationale, definition and data sources is available in **Annex 3**.

Box 18

National transfusion data as a surrogate marker for the effectiveness of PBM

To comply with haemovigilance regulations, blood services in many countries are mandated to report issuance, and sometimes even transfusion, of blood components (red blood cells, platelets, plasma, cryoprecipitate). These data are often presented as rates per 1000 population. An open source for global transfusion data is the WHO *Global status report on blood safety and availability* (up to now, this report has been updated only at intervals of several years, making it less useful for contemporaneous assessment of PBM implementation initiatives) *(608)*. Issuance data or preferably transfusion data collected in countries of similar socioeconomic status and population age distribution might provide material for a baseline comparison and an ongoing assessment of the impact of PBM.

If transfusion rates were regularly reported per region and hospital type, this would allow for basic observations on transfusion variability within a country. Where available, reporting transfusion rates by product types, and by diagnosis and procedure groups would provide helpful insights. Monitoring changes in national transfusion rates and indices can serve as a surrogate marker for the uptake and function of PBM.

Since haemovigilance structures are already in place in many countries, the national/jurisdictional PBM Task Force should consider requesting, as an immediate measure, a more detailed reporting system for transfusion, while developing a more comprehensive PBM data management system. The Task Force should consider making reporting of adverse events, near misses and incidents an obligatory requirement. This would strengthen the ability to compare international data.

Caveat: In many LICs and LMICs, low transfusion rates are also a reflection of constraints on the availability of blood for transfusion and cannot be considered in isolation as a surrogate measure for PBM implementation. An increase in transfusion, even as PBM is implemented, may reflect increased access to blood.

Prevalence data on patients with medication-induced coagulopathies

In many countries, the number of patients on anticoagulation and antiplatelet therapy is increasing, and it is recommended that these data be monitored in the context of PBM, since these therapies are associated with increased bleeding risk. To pre-empt unintended haemorrhagic events in patients taking these medicines, anticoagulant management algorithms and specific clinical training are required.

16.3 Developing a countrywide PBM data system and starting a data management process

At the HCO level, a PBM data system can be designed to enable efficient reporting of PBM strategies and outcomes for all inpatients, outpatients and emergency department attendees presenting for health care. A comprehensive system would incorporate patient-level demographics, diagnoses, treatments and outcomes. These data would be merged with the results of laboratory testing and transfusion data from the relevant laboratory information systems and transfusion medicine databases. Where possible they would include patient-level pharmacy data such as on use of anticoagulants, antiplatelets, antifibrinolytics, iron supplementation and other relevant therapeutic agents *(290)*.

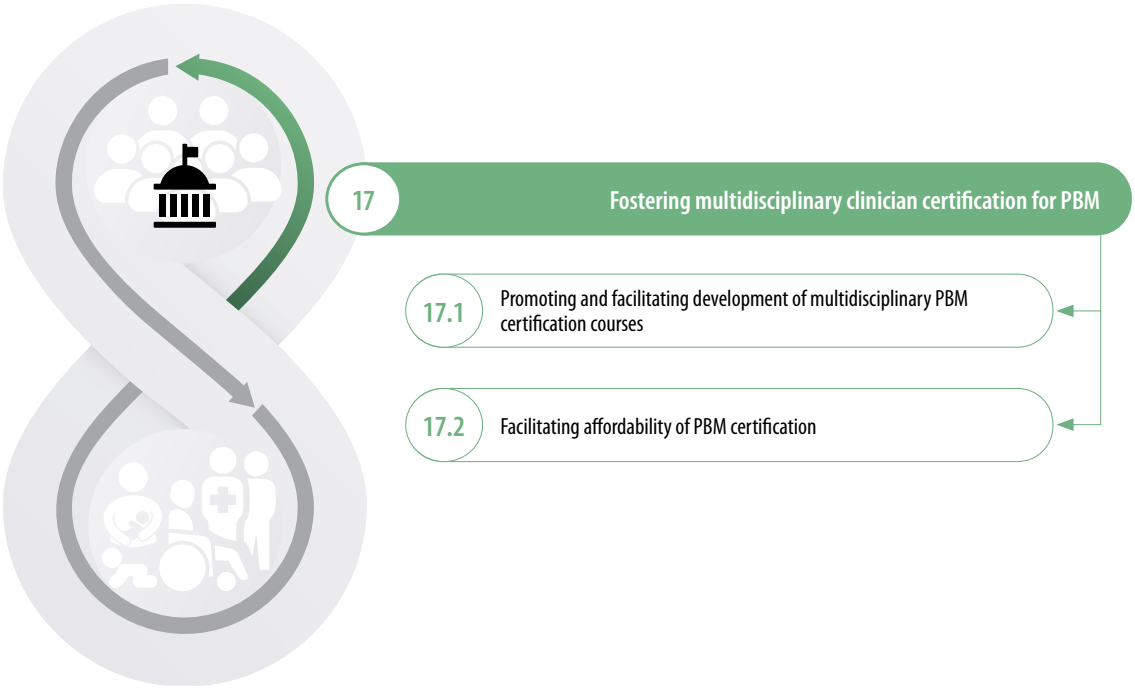
To monitor national/jurisdictional progress, the national/jurisdictional PBM Task Force would benefit from collecting relevant data from the HCO PBM data systems to report progress in KPIs. To that end, the national/jurisdictional PBM Task Force should require HCOs to report specific aggregated KPIs to the national/jurisdictional body for reporting and benchmarking. If a national/jurisdictional data system were to be created, HCOs could submit "row-level data" to the national/jurisdictional data system for collection, merging, analysis and reporting. However, as yet, there are no examples of national/jurisdictional PBM data systems with these capabilities.

16.4 Estimating national/jurisdictional status of PBM from baseline data, defining milestones and setting timelines

With the available baseline data on structure, process and outcomes, the national/jurisdictional PBM Task Force will be able to determine the status of PBM within the national health care system and conduct a gap analysis and needs assessment. This will allow an estimate of the future potential for PBM.

With this information, the Task Force should set realistic PBM/blood health goals with realistic target dates. These goals might be developed for specific at-risk target populations (for example, women of reproductive age), the population as a whole or both.

Step 17: National/jurisdictional PBM Task Force fosters multidisciplinary clinician certification for PBM



17.1 Promoting and facilitating development of multidisciplinary PBM certification courses

At the time of publication of this document, PBM certification courses and clinician certification in PBM are uncommon. Early efforts are being made, however. As an example, the Society for Advancement of Patient Blood Management (SABM) (https://www.sabm.org/) has created a PBM certificate course. Efforts are also being made to set up hospital PBM certification programmes. In Europe, hospitals in the German PBM Network may be certified as having achieved different "levels" of PBM implementation from one star (bronze) up to five stars (diamond). PBM certification in this programme is based on a self-evaluation. As a long-term goal, clinician certification for PBM, based on evidence-based PBM clinical guidelines and national standards for quality and safety (see **step 3**), is viewed as a precondition for institutional accreditation. It helps to establish PBM expertise and treatment in daily clinical practice more firmly. The national/jurisdictional PBM Task Force should therefore promote and facilitate the development of PBM certification courses. Curricula should be aligned with the standards of the national PBM accreditation body (see **step 18**). These curricula should reflect the general standards in all aspects of health care education, including interactive learning with case studies, simulations, discussion opportunities and provision of digital learning materials.

The national/jurisdictional PBM Task Force may seek to create or adopt existing PBM certification programmes *(609, 610)* and recommend that clinicians seek PBM certification and keep up to date through CME. This certification might be linked with overall professional certification through the respective boards, associations, medical schools and colleges. In collaboration with the national medical council (or similar licensure board), the national/jurisdictional PBM Task Force might identify and accredit a professional society or entity to oversee and conduct the national, multiprofessional PBM certification process. Facilitating partnerships between medical schools and between nursing schools, perfusionist schools, pharmacy schools and leading national PBM experts can help to promote education and certification. Clinicians certified in PBM will be better prepared to educate their patients, make shared decisions and achieve meaningful informed consent.

The content of certification courses can be developed by local clinicians in collaboration with international experts. The content must be duly recognized by the relevant national professional boards and have a specified validity period. Upon the course's expiration, recertification will be required to reflect advances in PBM. For efficiency, linking certification and subsequent recertification to specialty and subspecialty recertification could be considered.

Box 19

Effective and consistent PBM protocols across the health care system

During the development of pilot projects in Mexico, the PBM certification course taught health care professionals essential knowledge and fostered a collaborative approach to implementing standardized practices and processes. The success of the certification programme was evident in the significant milestone of certifying more than 4000 health workers within the pilot programme's first year. This accomplishment demonstrates the commitment of health care professionals to enhancing PBM and reflects the course's effectiveness in disseminating crucial information. The collaboration with the University of Western Australia, the International Foundation for Patient Blood Management and the Ibero-American Society of Patient Blood Management has proven instrumental in ensuring the course's quality and relevance. In the future, it is anticipated that the certified workforce will play a key role in seamlessly integrating PBM strategies into routine clinical practices, ultimately improving patient outcomes and reducing the overall burden on health care resources.

In Brazil at the Universidade Federal de São Paulo (UNIFESP), a PBM training course was approved for all medical residencies at the hospital. The course is embedded on the hospital's teaching platform (https://pbm.unifesp.br/), providing access to all physicians and health care professionals.

Certification courses should be open to a broad spectrum of clinical specialties, nurses, pharmacists, laboratory scientists and allied health professionals reflecting the multidisciplinary nature of PBM. The curricula should include not only the basic principles and understanding of PBM but should also address the educational needs specific to medical and surgical specialties. This fosters intra-institutional, interdepartmental and inter-professional communication and coordination of PBM experts, resulting in accelerated dissemination of PBM. PBM-certified clinicians become a local resource for PBM knowledge and are better equipped to educate noncertified clinical colleagues.

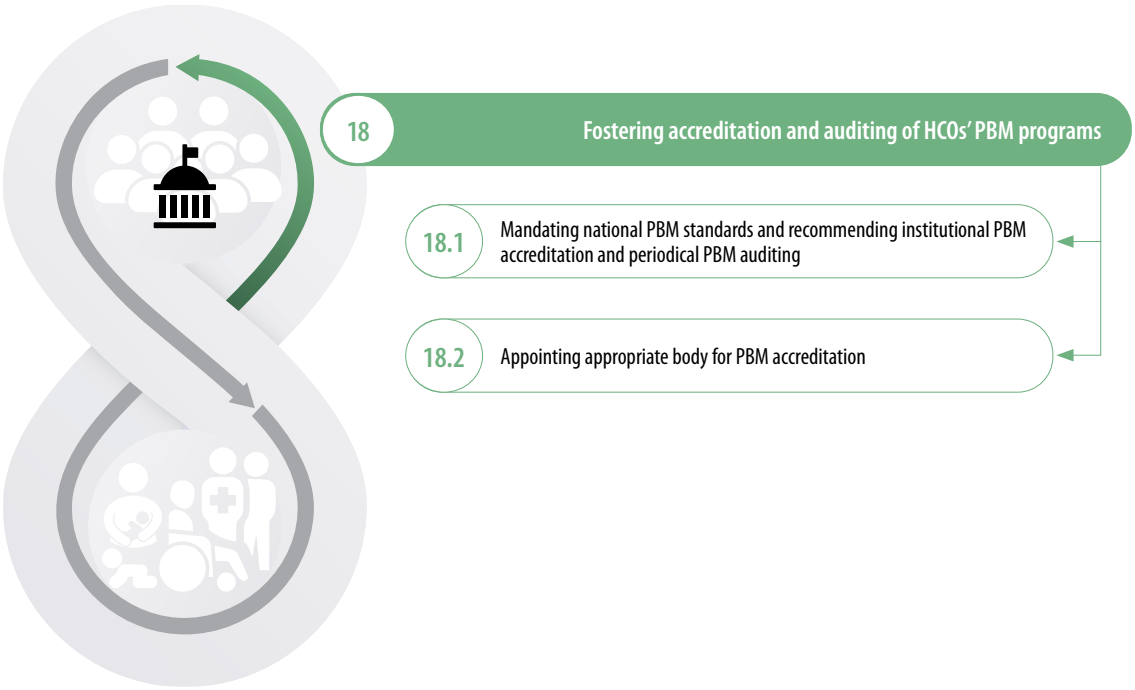
17.2 Facilitating affordability of PBM certification

In LICs and LMICs, PBM certification should be offered for free, or at least at affordable rates. The national/jurisdictional PBM Task Force should find ways to subsidize production costs for curricula, learning materials and the certification itself. The Task Force could also look for opportunities to obtain free licences for curricula that are already used in other countries and use them locally after having made any necessary adjustments.

Note:

At the time of publication, only a few countries have developed formal PBM curricula and certification for physicians. Physician certification should be seen as a long-term goal for most countries.

Step 18: National/jurisdictional PBM Task Force fosters accreditation and auditing of HCO's PBM programmes



18.1 Mandating national PBM standards and recommending institutional PBM accreditation and periodic PBM auditing

Note:

Accreditation for PBM programmes is a realistic and achievable goal for HICs and UMICs. It is viewed as aspirational for all other countries.

Accreditation of an HCO in PBM would indicate that organization's commitment to safety and quality of care. The national/jurisdictional PBM Task Force should recommend that the ministry of health or department of health establish national standards for institutional PBM accreditation together with a programme for institutional PBM accreditation and periodic auditing.

These standards should be based on this guidance document (Table 7), the WHO Policy Brief on *The urgent need to implement patient blood management (1)*, the *WHO Global Safety Action Plan 2021–2030 (570)*, WHO's publication on *Global health ethics: key issues (611)*, national quality and safety norms, government regulations and legislation if applicable. The standards should be updated regularly in accordance with the latest evidence and reflect current clinical guidelines.

The following 16 PBM standards and the respective qualitative and/or quantitative indicators are provided as an example of a possible comprehensive evaluation of PBM structure, processes and outcomes. This entails an assessment of clinical practices, interdisciplinary collaboration and the integration of evidence-based protocols throughout the continuum of care. These proposed standards might serve as the basis for an accreditation process. Any set of accreditation standards should scrutinize the proficiency of health care professionals, the adequacy of resources and the efficacy of data-driven decision-making. These standards might be used in some countries as they are, or they can serve as a template that can be adapted to national, jurisdictional or regional needs.

Table 7. A set of PBM standards and the respective qualitative and/or quantitative indicators as an example of a comprehensive evaluation of PBM structure, processes and outcomes

PBM standards for the accreditation of health care organizations (HCOs)[a]	Qualitative indicators	Quantitative indicators
Structure		
Standard 1: Governance system is in place to ensure optimal and sustainable clinical and administrative PBM in all of the HCO's facilities	Documented through formal commitment to a governance framework	n.a.
Standard 2: PBM is integrated into the **quality** management system and patient **safety**[b] framework	Integration into the quality policy and/or into the patient safety policy is documented	n.a.
Standard 3: PBM is governed by a **multiprofessional/ multidisciplinary** team through strict adherence to evidence-based clinical **PBM guidelines** and their periodic updates	Team members are officially assigned. Selection is based on the size, complexity and disciplines represented in the organization	n.a.
Standard 4: Clinical and administrative **PBM leadership** structure, roles and responsibilities are clearly defined	Documented through organizational chart, appointment of qualified individuals and role descriptions	Number of PBM staff relates to size of the HCO
Standard 5: Continuous and periodically updated PBM staff **education** and **training** is provided	PBM staff education and training follows an education and training plan or programme. The annual curriculum is posted on the Intranet PBM knowledge and competence of staff is checked and kept up to date	Number of PBM-educated health care professionals in the organization
Standard 6: Resource (re-)allocation[c] is ensured to sustain the structure necessary for PBM (staff, stuff, space and systems)	Budget items Periodic evaluation of the necessary resources for PBM	Monetary value (re-)allocated to annual budget

Table 7. *continued*

PBM standards for the accreditation of health care organizations (HCOs)[a]	Qualitative indicators	Quantitative indicators
Processes		
Standard 7: PBM processes are reflected across **all specialties** and within **primary, community, emergency** and **acute health care settings**. These processes are particularly reflected in populations at increased risk for anaemia, blood loss and/or coagulopathy with bleeding, including:	Processes are evidence-based and documented	Process performance indicators are determined
1. age- and weight-appropriate PBM processes for neonates, infants, children and adolescents	PBM process for neonates and children is in place, up to date and quality-assured	Percentage of patients treated according to this process
2. women of reproductive age (WRA)	PBM process for WRA is in place, up to date and quality-assured	Percentage of patients treated according to this process
3. patients 65 years and older	PBM process for patients 65 years and older is in place, up to date and quality-assured	Percentage of patients treated according to this process
Standard 8: Processes are in place to **manage the patient's own blood**, i.e. to	Processes are evidence-based and documented	Process performance indicators are determined
1. identify, evaluate and manage preoperative/ preprocedural iron deficiency (ID) and anaemia	PBM process to identify, evaluate and manage preoperative/preprocedural ID and anaemia is in place, up to date and quality-assured	Percentage of patients treated according to this process Percentage of patients treated with intravenous iron during hospital stay
2. identify, evaluate and manage postoperative/ postprocedural anaemia	PBM process to identify, evaluate and manage postoperative/postprocedural anaemia is in place, up to date and quality-assured	Percentage of patients treated according to this process
3. identify, evaluate and manage anaemia in all other patients	PBM process to identify, evaluate and manage anaemia in all other patients is in place, up to date and quality-assured	Percentage of patients treated according to this process
Standard 9: Processes are in place to **preserve the patient's own blood**, i.e. to	Processes are evidence-based and documented	Process performance indicators are determined
1. reduce iatrogenic blood loss	PBM process to reduce iatrogenic blood loss is in place, up to date and quality-assured	Percentage of patients treated according to this process Percentage of patients with blood recovery systems perioperatively
2. reduce and avoid disease-related bleeding and blood loss	PBM process to reduce and avoid disease-related bleeding and blood loss is in place, up to date and quality-assured	Percentage of patients treated according to this process
3. reduce and avoid surgical and trauma-related bleeding and blood loss	PBM process to reduce and avoid trauma-related bleeding and blood loss is in place, up to date and quality-assured	Percentage of patients treated according to this process
4. reduce and avoid bleeding and blood loss from congenital and acquired coagulopathy or conditions, and manage periprocedural reversal of anticoagulants and antiplatelet medications	PBM process to reduce and avoid bleeding and blood loss from congenital and acquired coagulopathy or conditions, and manage reversal of anticoagulants and antiplatelet medications, is in place, up to date and quality-assured	Percentage of patients treated according to this process
5. reduce postpartum haemorrhage	PBM process to reduce and avoid postpartum haemorrhage is in place, up to date and quality-assured	Percentage of patients treated according to this process
Standard 10: Processes are in place to leverage and optimize the patient-specific physiological tolerance of anaemia,[d] particularly in acute care/intensive care unit, to	Processes are evidence-based and documented	Process performance indicators are determined
1. optimize ventilation/oxygenation while minimizing oxygen demand	PBM process to optimize ventilation/oxygenation while minimizing oxygen demand is in place, up to date and quality-assured	Percentage of patients treated according to this process

Table 7. *continued*

PBM standards for the accreditation of health care organizations (HCOs)[a]	Qualitative indicators	Quantitative indicators
2. optimize fluid management based on patient-specific physiological needs	PBM process to optimize fluid management based on the physiological needs of the individual patient is in place, up to date and quality-assured	Percentage of patients treated according to this process
3. prevent and promptly control infection	PBM process to prevent and promptly control infection is in place, up to date and quality-assured	Percentage of patients treated according to this process
Standard 11: Patients are empowered through proactive education and engagement, and patient choices, values and preferences are reflected in PBM-related clinical decision-making	Information material for patients is available and the content is evidence-based, easy to understand and available; consultation appointments with PBM staff are available	n.a.
Standard 12: Continuous efforts are made to improve community/public understanding of blood health	Continuous external communication of PBM-relevant topics	n.a.
Outcomes reporting		
Standard 13: Function and quality of PBM practice are continuously and regularly evaluated, internally reported and benchmarked	PBM is part of the management review or of performance reports per facility, department and clinician	PBM key indicators are part of the performance report per facility department, and clinician
1. PBM-related quality improvement and patient safety	System to collect and report PBM-related quality and patient safety data is available	Indicators for quality improvement and patient safety with PBM are established
2. PBM-related patient-level outcome data	System to collect and report PBM-related patient-level outcome data is available	Patient-level outcome data are reported per facility, department and clinician
Standard 14: Relevant data/selected indicators are shared with government, regulatory and quality control entities	The relevant data/selected indicators are used for benchmarking	Periodic benchmarking reports are available
Standard 15: Regular auditing processes are in place to ensure high-quality PBM and contribute to benchmarking data	Internal and external audit systems are in place to evaluate PBM and ensure continuous improvement	Hours of PBM-related audits per year
Research and development		
Standard 16: Projects related to PBM activity/ development are fostered and published	Resources for PBM projects are available	Number of research and development projects related to PBM per year

n.a. not applicable.

[a] Organizations may include primary, secondary, tertiary and/or quaternary health care facilities.

[b] According to textbooks, patient safety measures to identify and prevent risks and to mitigate harm to patients are integral to quality management in health care. However, in many health care systems, official documents and regulatory publications, the terms "patient safety" and "quality of care" are used in a complementary sense.

[c] Whereas health care organizations in LICs might need external funding allocated for PBM, LMICs, UMICs and HICs would usually be able to fund PBM through reallocation (see more details under **step 2**).

[d] Standard 10 supports clinicians' adherence to restrictive individualized transfusion thresholds and quantities when PBM modalities are exhausted, and transfusion is considered the only remaining rescue option.

18.2. Appointing an appropriate body for PBM accreditation

A PBM accreditation body, authorized by the ministry of health or department of health or another appropriate body, is needed. This accreditation, and the standards upon which it is based, will be separate **from national transfusion medicine standards and blood bank/transfusion service accreditation**. Accreditation should be non-punitive and geared towards ensuring improvement and maturation of PBM programmes.

Any authorized PBM accreditation body must be PBM-focused and should:

- Develop an evidence-based and ethically guided process for training objective PBM evaluators, grounded in professional principles.

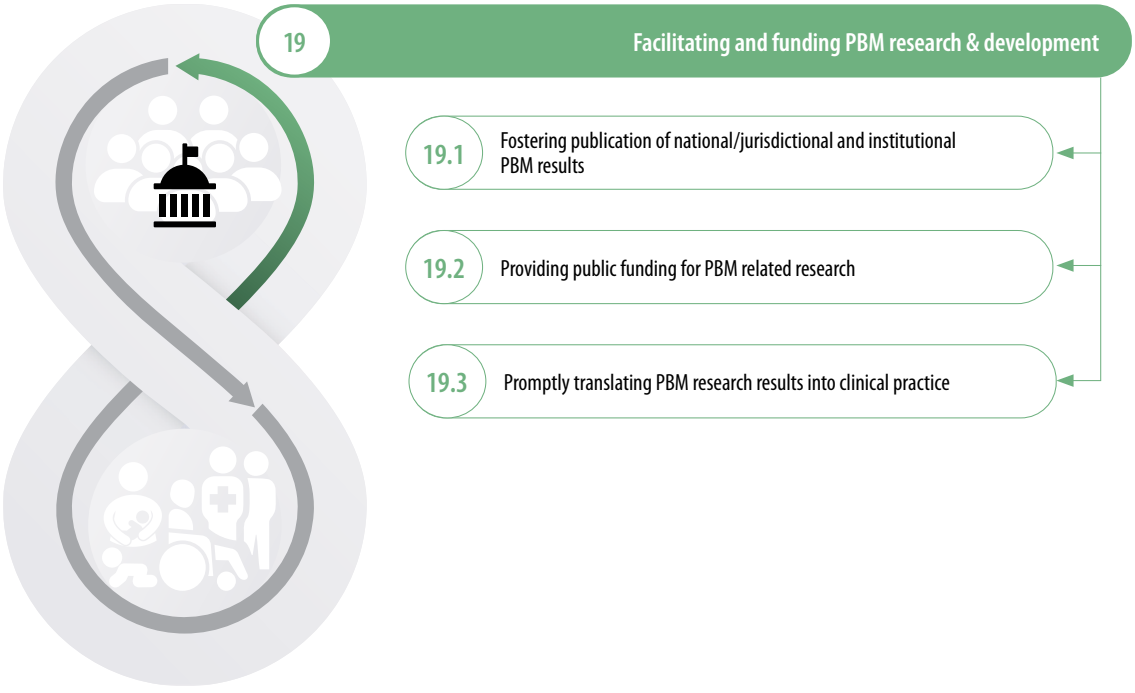
- Ensure independence and objectivity of the evaluation and accreditation process, and transparency in the evaluation process and results.
- Be accountable for all its activities, including:
  - timely evaluation of each HCO when scheduled;
  - ensuring each HCO is following all applicable standards; and
  - utilizing identified non-compliances as opportunities for facilitating the growth and maturation of the PBM programme.

The national/jurisdictional PBM Task Force might identify a competent professional national society or another body of national or international experts to conduct PBM accreditation for HCOs.

Note:

Beyond basic accreditation, HCOs can evolve from a PBM entry level to a comprehensive level, and finally to a centre of PBM excellence. A PBM implementation and assessment tool (PIAT) has recently been developed by PBM implementation experts under the auspices of the Australian National Blood Authority *(291)*.

Step 19: Ministry of health or department of health facilitates and invests in PBM research and development



19.1. Fostering publication of national/jurisdictional and institutional PBM results

Local replication and validation of international PBM research results help to establish broad applicability of the findings and builds the confidence of local stakeholders in PBM. National/local replication also allows for adaptation of PBM strategies to fit local health care practices, policies and infrastructure, as well as taking into account the affordability and availability of specific medicines and devices (see **step 6** and Annexes 6–11). Understanding how international findings can be adapted, can be pivotal for successful integration of PBM into routine clinical care. The results from replicating similar PBM studies in populations or subpopulations that differ in their epidemiological, genetic, demographic and socioeconomic characteristics, or in countries with differences in their cultures and health care systems, allows conclusions to be drawn on the generalizability or limitations of PBM. Taken together, these efforts can help to refine and optimize national clinical PBM guidelines (see **step 4**). Particularly in LICs and LMICs, these findings will help to promote the implementation of PBM modalities when resources are limited (see **step 2**).

19.2. Providing public funding for PBM-related research

To broaden the PBM evidence base across various patient populations and disciplines (for example, trauma, haematology, oncology and transplant surgery, and particularly vulnerable populations including those seen in the departments of obstetrics, neonatology and paediatrics, and geriatrics), governments are encouraged to foster PBM research. Research study design should focus on the impact of comprehensive PBM as an integrated care model rather than evaluating a single therapeutic intervention. This research should focus on real-world observational studies including prospective observational studies, cluster randomized controlled trials, randomized controlled trials and basic research. Areas of research might include:

- investigations of the clinical and cost-effectiveness of PBM programmes across different health systems and clinical settings;
- application of statistical and machine learning prediction models leveraging "big data" for the early detection and treatment of ID, anaemia, blood loss and coagulopathy with bleeding;
- studies of the intersection of PBM with "personalized" medicine, leveraging data on an individual's genetic profile, health literacy and lifestyle, to guide decisions related to blood health – understanding how individual variations impact the response to PBM interventions can lead to more tailored and effective treatment pathways;
- studying real-time non-invasive monitoring and diagnostic technologies with improved specificity and sensitivity and easier to interpret results related to evaluating oxygenation, anaemia and coagulation;
- research from facilities with real-time physiological monitoring in hospital and community settings, for example, Health in a Virtual Environment (HIVE) *(612)*;
- development of novel drugs and treatment interventions;
- the impact of PBM on disaster management and pandemics, particularly for patient populations that are considered transfusion-dependent; and
- short- and long-term effects of PBM-related structural changes on quality of care, patient safety and outcomes, blood utilization and overall costs per patient or treatment episode/case, and overall health care expenditures within the population.

19.3. Promptly translating PBM research results into clinical practice

Advances made in PBM research should be translated into bedside clinical practice as quickly as possible in accordance with **step 3** of this guidance document. These experiences will also ensure that PBM continues to evolve to further improve patient outcomes and reduce overall resource utilization.

4 PBM implementation toolkits for specific patient populations and diverse resource levels

Overview

This section complements government-led implementation steps 3 to 6, but particularly **step 13**, which is HCO-led. It demonstrates a broad range of specific clinical and administrative strategies and resources, which are summarized in the **PBM toolkits**. These are organized as tables to facilitate the care of patients with anaemia/ID, bleeding and blood loss, or coagulation and clotting disorders ("ABC"). Taken together, these kits comprise an armamentarium for effective clinical delivery of PBM as the standard of care.

There are three general toolkits intended for LICs and LMICs, UMICs and HICs and three specific toolkits for neonatology and paediatrics, obstetrics and trauma care. The contents of the toolkits represent suggestions for consideration and are not meant as clinical guidelines.

Those who care for patients should familiarize themselves with the toolkit(s) most relevant to their situation and patient population. These toolkits will enable implementers to create PBM continua of care for specific patient populations and disease groups that need improved blood health.

National/jurisdictional PBM task forces must determine what tools are necessary to meet the needs of PBM

Depending on each Member State's economic situation, the overall structure of its health care system, epidemiological data and on which patient populations need PBM most, PBM standards of care will differ. Thus, only some of a defined set of clinical PBM strategies and resources or tools may be able to be utilized. Some of these tools may need to be acquired, modified and adapted based on the patient-specific clinical setting and local circumstances and resources. For example, not all diagnostic devices or pharmaceuticals will be available, practical or affordable in all jurisdictions and in all circumstances. Processes and protocols, including screening programmes and assessment and treatment plans for both outpatients and inpatients, may be limited in their implementation and practicality by constraints on physical space, communications and IT, time or even basic infrastructure. In many jurisdictions, constraints on patient access may limit implementation. Nevertheless, even a single or a few PBM clinical strategies, properly and widely implemented, can have a significant positive impact on patient outcomes and population health.

A comprehensive collection of the clinical strategies and resources, which, taken together, are critical to the creation of a comprehensive PBM programme is contained in Annexes 6–11 for easy reference. The Annexes contain **six implementation toolkits**: three general kits specifically for HICs, UMICs and LMICs combined, and LICs, and three "specialty" toolkits including neonatology and paediatrics, obstetrics and trauma.

The implementation toolkits are organized as a "pick list", in table format, of the most important things to consider when caring for a patient under the PBM paradigm. This structure provides flexibility, recognizing that a particular jurisdiction, hospital, clinic or community may have more or fewer resources than those described in the three specialty toolkits. An individual provider may choose to utilize or not utilize a particular strategy or tool based on the clinical setting and in consultation with the patient, to accommodate the patient's preferences and values.

Fully mature PBM programmes in HICs are expected to have available all clinical strategies, resources and tools necessary to meet the standard of care in PBM. The PBM toolkits for LICs and middle-income countries (LMICs and UMICs) are combined. Given that their resources are more limited than in HICs, the PBM toolkits for LMICs and UMICs should be seen as an aspirational goal for these Member States. Some LICs and LMICs may be able to implement more tools and strategies than the minimum expected, while others may not initially be able to meet the minimum standard.

How the PBM toolkits are structured

Each toolkit is organized as a matrix of three columns and several layers. The columns refer to management of:

- anaemia and ID
- blood loss and bleeding
- coagulation disorders and abnormal haemostasis.

The three toolkits stratified by national income class include two main layers, one for **strategies** and one for **resources**, each with several subsections.

- **Strategies** include those intended to:
    - Enable **infrastructural changes** and **adaptations** (administrative strategies) and to provide **specific** clinical **knowledge** and **skills** to create continua of care, including standard operating procedures, procedural guidelines

and protocols (for resource-constrained environments, these strategies should also be adaptable to the needs of CHWs and LHWs). In combination with the three columns, clinical strategies cover:

- identification, diagnosis and management of micronutrient deficiency, especially ID, and anaemia;
- early identification of blood loss and bleeding, and use of a variety of strategies to prevent, stop or minimize bleeding; and
- identification of existing coagulation disorders in the patient population (including those due to the use of herbal/vitamin supplements and medications including anticoagulant and antiplatelet drugs), to decrease the risk of bleeding.

Note:

PBM fundamentally shifts the care paradigm from a focus on blood as a product to be replaced if anaemia or bleeding occurs, to a focus on improving the blood health of the population and, with the patient in the centre, protecting and preserving the patient's own unique and precious blood. To be successful this requires significant educational efforts that must target not only physicians but also public health officials, nurses, pharmacists and everyone else that contributes to the care of patients and the community.

- Provide knowledge to foster vigilance regarding nutritional and pharmacological interactions (educational strategies for clinicians and patients). This includes an assessment of nutritional, herbal, vitamin and traditional supplements and remedies that may affect coagulation and bleeding risk, current medications and drug–drug interactions.
- Provide knowledge and develop skills to ensure **patient empowerment** and informed consent (educational strategies for clinicians and patients).

- **Resources** include:
  - **Diagnostic devices** – much can be accomplished with a careful history and physical examination. Although access to diagnostic devices and laboratory studies may be limited by resource constraints, the PBM toolkits list selected diagnostic devices that can play an important role in comprehensive PBM.
  - **Treatment devices** – the PBM toolkits list treatment devices and strategies in a way that recognizes the resource constraints of LICs and LMICs.
  - **Medicines**, including **pharmaceuticals**, **biologics** and other **clotting factors**. The core concept of PBM is the preservation and optimization of the patient's own blood. The PBM toolkits list key pharmaceuticals, biologics and other clotting factors used to manage ID, anaemia, blood loss and bleeding, while recognizing the role of transfusion in the PBM armamentarium when available, safe and clinically indicated and when there are no other options. At the same time, the toolkits guide the provider in those jurisdictions where blood for transfusion may not be a viable option due to cost, or a lack of supply, safety or infrastructure.

Note:

Cross-matched blood, platelets and thawed plasma should not be given simply because it has been prepared. A transfusion that is not clinically indicated simply adds risk for the patient and cost to the health system. In this setting, avoiding a transfusion should be considered a patient safety measure, accepting that there may be "wastage" of blood and blood products in some circumstances.

The toolkits for PBM in obstetrics and trauma care include strategies to enable infrastructural changes and adaptations, and to provide specific clinical knowledge and skills to create PBM continua of care for the patients. These toolkits also include clinical management strategies and strategies to provide knowledge and develop skills to ensure patient empowerment and informed consent in emergency situations.

Creating continua of care for specific patient populations and disease groups as fully integrated PBM processes

The goal of PBM is to combine all processes tailored to individual patient needs and to deliver them in seamless continua of care for specific patient populations or disease groups, a goal shared with successful care delivery in all aspects of health care. To achieve this, the HCO PBM Task Force should keep in mind **three key aspects** and repeatedly communicate them to all stakeholders involved. PBM processes must be:

- **Complete**: Focusing on a single PBM process and its optimization while neglecting other processes will produce suboptimal or even unimproved PBM outcomes.
- **Individualized**: Processes are tailored to the individual needs of the patient, starting with a complete diagnosis, followed by a patient- and disease- or condition-specific PBM treatment plan and individual follow-up.
- **Coordinated**: All processes along the patient's PBM journey should be seamlessly connected and coordinated in a timely manner.

This helps clinicians to understand their respective roles and responsibilities in delivering complete, individualized and coordinated PBM.

Examples of continua of care for a highly developed health care system and an extremely resource-constrained region.

Two examples illustrate how a single seamless PBM continuum of care can be tailored to specific patient populations, demonstrating the breadth and depth of PBM's applicability and its potential to enhance individual patient outcomes and national blood health status, regardless of the health care system's resources.

Example 1 in highly developed health care systems:

This example describes the continuum for cardiac surgery in an HIC. The steps needed to create a workgroup and formulate a continuum of care tailored to the individual needs of the patient are detailed, followed by a simplified graphic representation of the continuum of care (Fig. 15).

1. The HCO PBM Task Force creates a **workgroup** for the **cardiac surgery PBM continuum of care**, and explains the task to its members who might include:
   - quality and safety manager
   - GP or family doctor
   - cardiac surgeon
   - cardiologist
   - cardiac anaesthesiologist
   - haematologist

- intensive care physician
- perfusionist
- operating room/theatre nurse
- intensive care nurse
- ward nurse
- pathologist (central laboratory)
- pharmacist
- immunohaematology and transfusion specialist.

One should keep in mind that the HCO staff should already be aware of the ongoing pilot project. According to the governance framework, staff support is expected, and postgraduate staff education might have already started.

2. The workgroup defines the specific patient population, for example, patients undergoing coronary artery by-pass graft (CABG) and/or valve replacement, etc.

3. A subgroup maps the current patient journey from start to finish, with a description of all processes involved:
   - first contact with the patient and their GP, family doctor or other HCP
   - referrals to consultant specialists
   - pre-admission activities and booking for surgery
   - admission and hospitalization
   - surgery, anaesthesia and perfusion
   - pharmacy
   - post-anaesthesia care unit
   - ICU
   - ward
   - discharge
   - rehabilitation
   - follow-up.

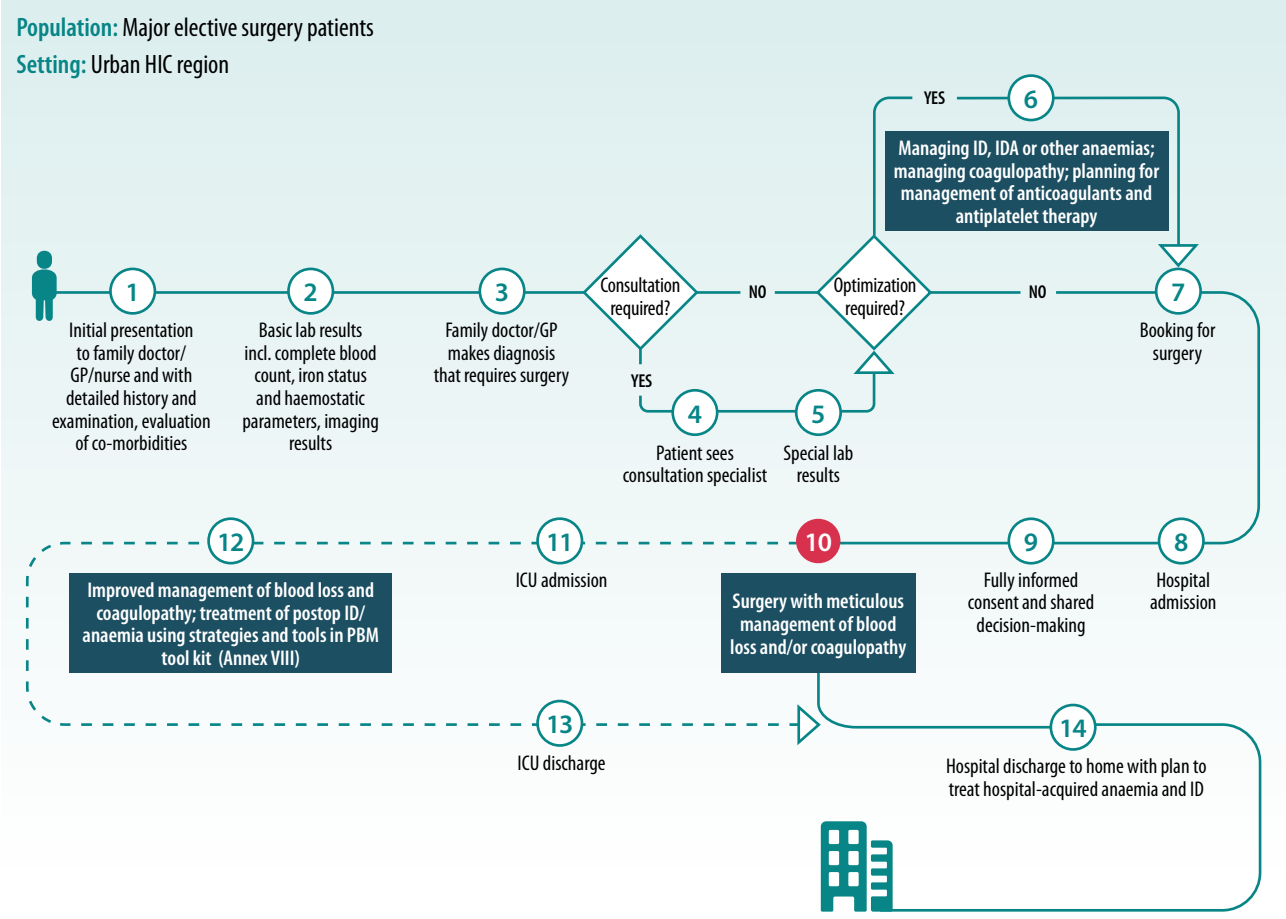
   Permutations of this journey should be allowed for, reflecting for example, the management of unintended but anticipated complications.

4. The workgroup reviews up-to-date PBM guidelines and evidence-based practices in cardiac surgery and:
   - checks this information against the map of current processes;
   - identifies and acknowledges process gaps and deviations with reference to the current evidence;
   - uses the information provided in the "General PBM toolkits including PBM strategies, resources and materials for national, hospital and community implementation – HICs" (**Annex 8**) to determine how to adjust processes and integrate those that are missing; and
   - outlines the proposed **cardiac surgery PBM continuum of care**.

5. The workgroup solicits suggestions and input on adjustments to the proposed cardiac surgery PBM continuum of care for from all of the following:
   - nephrologist
   - pulmonologist
   - dietitian
   - physiotherapist
   - member of PBM Data Management Team
   - patient representation
   - administrator (finance department)
   - administrator (medico-legal).

6. The workgroup reaches consensus on the cardiac surgery PBM continuum of care and presents it to the HCO PBM Task Force. If approved, the Task Force works with all applicable clinical and administrative department heads to establish the new continuum of care. The Task Force might request project management support to ensure effective implementation.

Fig. 15. Continuum of care aiming for improved blood health in major elective surgery



This diagram depicts a simplified continuum of care for major elective surgery patients in an urban setting in an HIC. There is an expectation that all relevant tools and strategies of PBM are utilized in the seamless management of the patient from initial presentation to the family doctor through a post-discharge plan to manage acquired anaemia. **Annexes 5** and **8** serve as resources to further adapt and fine tune the care path for different surgical populations or specialties.

HIC, high-income country; ID, iron deficiency; IDA, iron deficiency anaemia; GP, general practitioner; ICU, intensive care unit.

Example 2 in a rural and resource-constrained region:

This example is for obstetrics in a LIC, where the challenge is to expand and strengthen a weak local HCO or even to build the necessary infrastructure from the ground up and then establish the continuum of care. To facilitate this endeavour, a detailed template for a continuum of care for women at risk for PPH is provided in Fig. 16.

1. Local volunteers, possibly supported by NGOs, form a new HCO to improve maternal health, or staff members and volunteers within an existing local HCO create a PBM Task Force. This includes for example:
   - midwives
   - nurses
   - CHWs/LHWs
   - programme administrator/coordinator
   - patient representative
   - external consultant if available (this could be an obstetrician from an urban medical centre or an NGO to help with the design of the programme and initial staff training).

2. The HCO PBM Task Force analyses the template for a **continuum of care aiming for improved blood health in women at risk for PPH** (Fig. 16).

3. Depending on local circumstances and with the information provided in the *Patient blood management (PBM) toolkit in obstetrics for national/jurisdictional and health care organization PBM task forces and health care professionals* (**Annex 10**) the Task Force determines how to create the necessary infrastructure and to implement and enable the required processes.

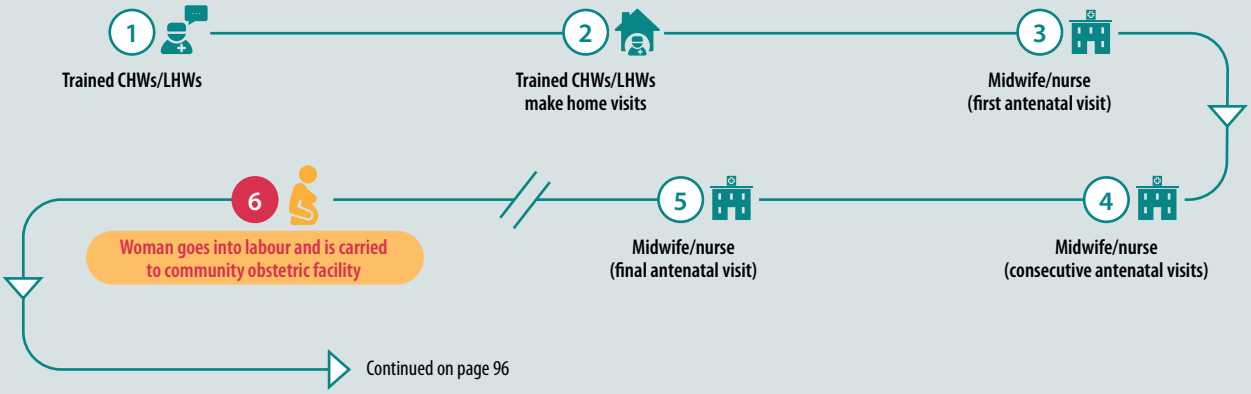
4. The Task Force
   - maps out a draft for the locally adapted continuum of care;
   - reviews up-to-date PBM guidelines and evidence-based practices in obstetric management (see **Annex 5**);
   - checks this information against the map;
   - identifies and acknowledges process gaps and deviations with reference to the current evidence.

5. The workgroup reaches consensus, finalizes the map of the PBM continuum of care and starts implementation.

Fig. 16. Continuum of care aiming for improved blood health in women at risk for postpartum haemorrhage (PPH).

Population: Women at risk of PPH[a]

Setting: Rural LIC region restricted to a community obstetric facility managed by midwives or nurses locally certified in PBM, and supported by CHWs or LHWs

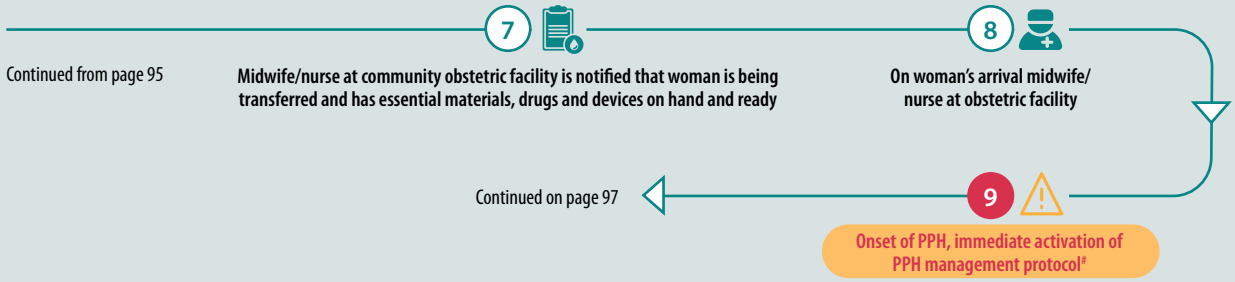


1. Trained CHWs/LHWs	• conduct outreach and education programmes s to promote prenatal and postnatal care • educate on the benefits of facility-based births with experienced obstetric care • educate on necessity for prenatal iron deficiency and anaemia management
2. Trained CHWs/LHWs make home visits	• use questionnaire to collect medical and obstetric history from pregnant women and identify high-risk pregnancies and risk factors for PPH - multiple pregnancies/high parity - women under 18 or over 35 years - previous instances of PPH - polyhydramnios - Instrumented al deliveries[+] - uterine abnormalities, e.g. leiomyomata or adenomyosis - placental issues, e.g. previa, accreta - large-for-gestational-age babies - ID, IDA, hereditary anaemia - pre-eclampsia/eclampsia - gestational diabetes • educate on protein-rich food, e.g. eggs, soybeans, iron-rich and fortified food, and iron supplementation • educate on drugs/vitamins/nutrition/supplements/ beverages that may - impair absorption of iron - Increase bleeding • encourage scheduled antenatal visits at community obstetric facility
3. Midwife/nurse (first antenatal visit)	• provides sufficient patient education on - PPH risks - ID/anaemia risks for mother and baby - risks and benefits of treatment modalities - when to seek additional medical help • establishes informed consent • Involves family members in care and decision-making Trained CHWs/LHWs use mobile technology (mHealth) to send health messages, reminders for appointments, and education about pregnancy and childbirth
4. Midwife/nurse (consecutive antenatal visits)	• screens for anaemia (colorimetric method when haemoglobinometers not available) • screens for helminthic infections contributing to anaemia where endemic, and provides deworming tablets • screens for HIV and treats with antiviral therapy • treats ID/IDA with oral iron • optimizes haematinic status (folate, vitamin B12) • adminsters vitamin K in case of malnutrition • monitors and manages where needed - pre-eclampsia/eclampsia - gestational diabetes • in endemic areas: administers malaria prophylaxis and provides insecticide-treated bed net
5. Midwife/nurse (final antenatal visit)	• educate families on recognizing danger signs and the importance of timely intervention. • provide emergency contact coordinates and transportation plan • allocates CHWs/LHWs to facilitate transportation to community obstetric facility as needed
6. Woman goes into labour and is carried to community obstetric facility	

Fig. 16. *continued*

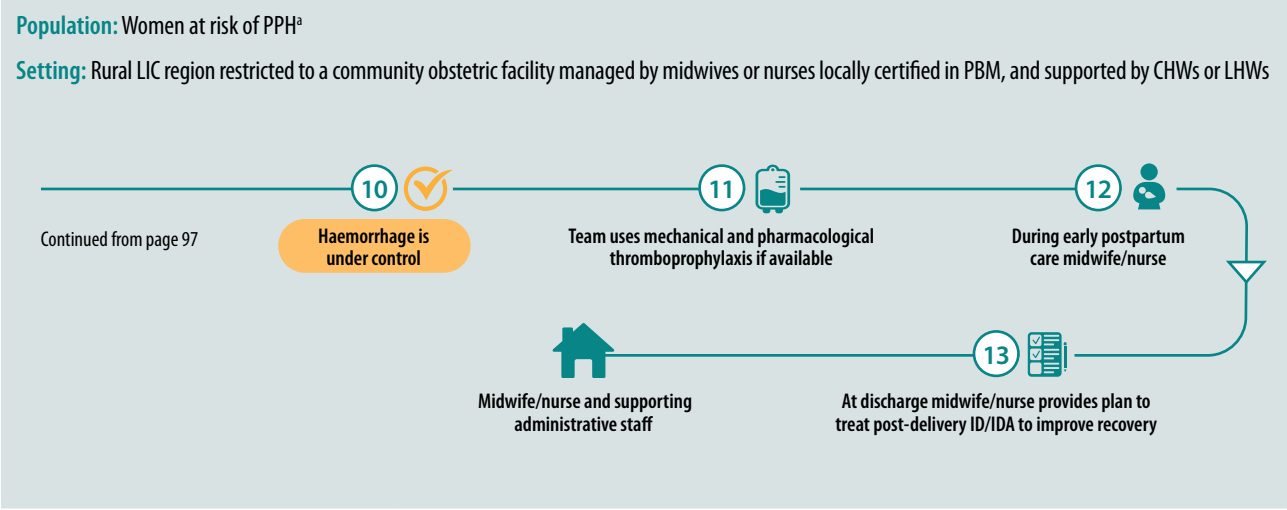
Population: Women at risk of PPH[a]

Setting: Rural LIC region restricted to a community obstetric facility managed by midwives or nurses locally certified in PBM, and supported by CHWs or LHWs



7. Midwife/nurse at community obstetric facility is notified that woman is being transferred and has essential materials, drugs and devices on hand and ready	• blood collection drape • uterotonics (oxytocin, heat-stable sublingual oxytocin, carbetocin, methylergonovine, ergometrine, carboprost, and misoprostol according to local protocol and availability) • tranexamic acid • intravenous fluids • antihypertensives, anticonvulsants (e.g. magnesium sulfate), and antibiotics • haemoglobinometer if available • thermal blankets • Bakri balloon or sterile gauze if available, otherwise condom-catheter balloon • manual vacuum aspirator • blood pressure monitor • low-cost transvaginal uterine artery clamp • low-technology red blood cell collection and reinfusion set • oxygen if available • non-pneumatic anti-shock garment if available, otherwise bicycle tubes and sheets for improvised use
8. On woman's arrival midwife/nurse at obstetric facility	• determines haemoglobin concentration when woman arrives • considers establishing intravenous access • ensures bladder is empty • positions mother for proper access to uterus • controls cord traction to deliver placenta • rapidly identifies atony by manual palpation • massages uterus after delivery of placenta • ensures placenta is complete and intact to avoid undiagnosed tissue retention, and evacuate clots • tracks haemoglobin status with haemoglobinometer • monitors pulse rate, blood pressure, urine output and mental state • monitors amount of blood loss by use of blood collection drape
9. Onset of PPH, immediate activation of PPH management protocol[#]	**Midwife/nurse follows protocol based on published guidelines (see Annex 5). However, guidelines are adapted/expanded in response to local conditions:** • lack of anaesthesia services (skills and/or equipment, pharmaceuticals) • lack of surgical skills, thus caesarean sections cannot be performed • interrupted or no access to electricity, thus limited cold chain (cold storage required for oxytocin) • no or limited access to oxygen • no or limited supply of blood components/products • no escalation/further referral possible • no or limited access to pulse oximetry, ultrasound machines, fetal monitors **The adapted/expanded PPH management protocol relies on** • immediacy of intervention • timing and dosing of uterotonics • timing and dosing of tranexamic acid • patient positioning • trained emergency skills (team-applied bimanual compression, external aortic compression as temporizing measure) • skilled/careful placenta removal with smooth curettage if retained product • umbilical vein injection of oxytocin for the treatment of retained placenta • trained manual dexterity for repairing/suturing of perineal/vaginal/cervical lacerations (task shifting/training in suturing techniques supported online by surgeons/obstetricians) • maintaining normothermia • rehydration/fluid management • skilled use of low-technology uterine tamponade modalities where applicable • skilled use of low-technology red blood cell collection and reinfusion set where applicable • skilled use of low-technology anti-shock devices to where applicable (hypovolaemic shock) • telemedicine support where available

Fig. 16. *continued*



10. Haemorrhage is under control

11. Team uses mechanical and pharmacological thromboprophylaxis if available

12. During early postpartum care midwife/nurse	• promotes early breastfeeding or manual nipple stimulation to encourage uterine contraction • monitoring vital signs and blood loss closely for at least 24 hours post-delivery • provide oral rehydration solutions or intravenous fluids to manage hypovolaemia • avoid infections or treat infections promptly consider prophylactic use of antibiotics (if available) with severe PPH

13. At discharge midwife/nurse provides plan to treat post-delivery ID/IDA to improve recovery

Midwife/nurse and supporting administrative staff	• debrief after each PPH event to evaluate opportunities for improvements • maintain accurate and up-to-date records of all PPH events including identified risk factors • use mobile health applications for efficient data collection to improve continuum of care • report findings to local health authorities to help in planning and resource allocation

This diagram depicts a continuum of care for women at risk for PPH in a rural LIC region where pregnancy management takes place in a community obstetric facility by midwives or nurses locally certified in PBM and supported by community and/or lay health workers. This care path is presented in detail to demonstrate the many modalities that can be implemented even in limited resource situations. **Annexes 5** and **10** provide additional resources to further develop the continuum of care for women at risk of PPH.

CHW, community health worker; ID, iron deficiency; IDA, iron deficiency anaemia; LIC, low-income country; LHW, lay health worker.

Concluding remarks

Implementing a PBM continuum of care for the first time should be done in each HCO for the patient population most likely to benefit. With every additional PBM continuum of care created at the same pilot site, the task will become less challenging. Many processes in the surgical setting might be almost identical, whereas other settings might require additional or different processes. Developing a trauma PBM continuum of care will be different from that needed in the gastroenterology department when treating patients with bleeding ulcers, in burns patients, in paediatric patients, etc. Lessons learned from implementing the first and subsequent PBM continua of care can be applied to each new patient population or department. Prioritization of areas to address first will depend on identifying those patient groups that can benefit most in the context of the readiness and commitment of specific departments within the HCO. A primary goal is to generate early "wins" that will increase enthusiasm and create excitement about broader implementation.

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Annexes

Annex 1. **Donabedian model**

The Donabedian model is a comprehensive framework that is widely used in health care research and management to evaluate and improve the quality of health care delivery. With step-by-step adoption of metrics to assess and analyse the installation of structures to enable patient blood management (PBM), processes to deliver PBM and outcome parameters to show clinical improvement through PBM, the model can be used as an aid for all stakeholder groups involved in the two implementation pathways. The iterative nature of quality improvement means that assessments may cycle through all three components over time as improvements are made and their effects are measured *(1)*. Steps 1–3 of the cycle relate to the assessment and analysis of the current quality of the structure, process and outcome, while steps 4–6 relate to adjustments necessary to achieve the desired quality goals (Fig. A1.1):

1. The assessment of baseline parameters relevant to PBM identifies gaps in the quality of outcomes. Outcome metrics such as complication rates, morbidity and mortality from specific procedures or interventions, linked with prevalence data on anaemia, coagulopathy with bleeding, and postpartum haemorrhage, help to identify gaps in the quality of outcomes. Few or none of these data are currently collected in many institutions, still less at a national level. Data on the quality of outcomes help to determine whether and why certain clinical and/or administrative processes to enable and deliver PBM are currently adequate, missing, underutilized or hampering the efforts.

2. Process metrics can show at what rate diagnostic methods and treatment plans that are specific to PBM are offered to patients, and whether these patients are sufficiently educated and empowered by their HCPs. This information can also be linked to transfusion rates and indices as a surrogate indicator for the effectiveness of PBM. The rate of preventive care measures, such as regular anaemia screening in the population as a whole, or screening for heavy menstrual bleeding, can be measured. One can also measure the extent to which these screenings are free or reimbursed. Particularly in lower-middle-income and low-income countries, hospital-level or national billing and coding data might show whether, and to what extent, HCPs are reimbursed for health care specific to PBM. Data on the number of HCPs certified for PBM and hospitals accredited for PBM offer additional insight into the overall quality of PBM-related processes.

3. Data and information on the quality of PBM processes, as well as direct measures of the quality of existing structures, help to determine whether the structure necessary to organize and support these processes is missing, underutilized or hampering. Reasons might include a lack of awareness of the problems due to insufficient professional education on the evidence supporting PBM's role in patient safety and its outcomes, its economic advantages, the ethical imperative (3Es – evidence, economics and ethics), and the medico-legal implications of PBM. Lack of human resources, physical infrastructure and space might be contributing factors. Other possible factors include a lack of coordination between clinical specialties or between extra- and intramural care, little or no access to medicines and devices essential for PBM, counterproductive budget allocations and departmental protection of financial silos, perverse incentives, reimbursement issues, or simply eminence-based medicine and long-standing culture *(2)*.

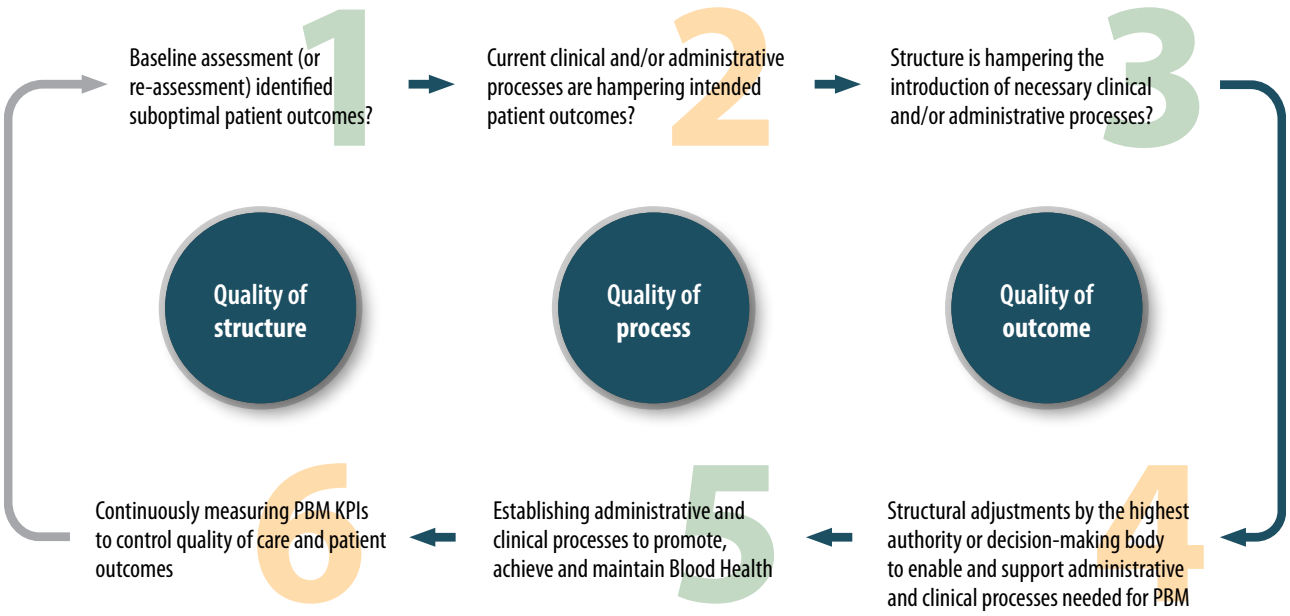
Once all quality gaps have been identified and understood, they should be closed in reverse order, beginning with:

4. Creation of structures or structural adjustments as needed, made by the highest authority or decision-making body of the ministry of health/department of health for the top-down implementation, and by the chief administrator on the community or hospital level for the bottom-up implementation. Assessment and confirmation of these structural adjustments can be seen as an early indicator that top-down implementation has begun. Thus, data collection and analysis of the structural changes needed are metrics of early value.

5. This top-down endorsement will facilitate the establishment of all necessary administrative and clinical processes to deliver PBM and achieve blood health for the public and the individual patient.

6. Continuous measuring of key performance indicators for PBM outcomes closes the loop of the quality framework, with measured outliers potentially indicating the need for further improvements in processes and structure.

Fig. A1.1: Donabedian quality framework in the context of establishing PBM as a standard of care



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Annex 2.
Implementation methodologies

- **Kotter's change management model:** This is an eight-step model for organizational change. The steps are as follows
  - Create a sense of urgency.
  - Build a guiding coalition of committed individuals.
  - Develop a long-term vision for change.
  - Develop a clear communication plan to communicate the vision, to foster and ensure buy-in.
  - Identify and remove obstacles to empower action.
  - Generate short-term wins.
  - Build on short-term successes to create momentum.
  - Embed the changes in the culture.
- **Lewin's change management model:** Simplified, this model is known as unfreeze – change – refreeze.
  - Unfreeze:
    - Recognize the need for change.
    - Determine what needs to be changed.
    - Encourage the replacement of old behaviours and attitudes.
    - Ensure strong support from management.
    - Understand and manage doubts and concerns.
  - Change:
    - Plan and implement the needed changes.
    - Educate and train staff to learn new concepts and points of view.
  - Refreeze:
    - Reinforce and stabilize the changes.
    - Integrate changes as the standard way of doing things.
    - Develop ways to sustain the changes.

- **ADKAR change management model:** ADKAR is an acronym that stands for awareness, desire, knowledge, ability and reinforcement.
  - Awareness:
    - Communicate the change.
    - Explain the reasoning behind the change (for example, three Es – evidence, economics and ethics).
    - Give stakeholders the opportunity to ask questions and make suggestions.
  - Desire:
    - Gauge reaction to the change.
    - Identify collaborators and fellow champions.
    - Address concerns and explain how the changes will benefit those who are resistant.
  - Knowledge:
    - Provide education, training and coaching.
    - Close skill gaps and provide resources.
  - Ability:
    - Monitor performance and provide feedback.
    - Set reasonable goals and metrics.
    - Adjust processes in response to analysis of data and metrics.
  - Reinforcement:
    - Monitor and assess outcomes.
    - Use positive feedback and celebrate successes.

- **Knowledge to action framework** *(1)*.
  - Knowledge cycle
    - knowledge inquiry
    - knowledge synthesis
    - knowledge tools/products (PBM guidelines).
  - Action cycle
    - Identify problem using tools provided within this document.
    - Identify, review and select knowledge (PBM interventions relevant to filling gaps).
    - Adapt knowledge to local context.
    - Assess barriers to knowledge use.
    - Select, tailor and implement interventions (for example, preoperative anaemia nurse).
    - Monitor knowledge use (audits and metrics suggested in **Annex 4**).
    - Evaluate outcomes.
    - Sustain knowledge use – build in sustainability, for example, by avoiding person-dependent interventions.

Specific to PBM, any formal programme implementation strategy that is adopted should:

- Identify and empower a PBM champion.
- Identify local barriers to implementation of PBM.
- Develop implementation strategies that address local barriers *(2, 3)*.
- Recognize that implementation requires culture change across jurisdictions and institutions *(4-6)*.
- Recognize that implementation requires a top-down and bottom-up approach utilizing change management methodology.
- Commit to one or more pilot projects of appropriate scope and scale for the jurisdiction; local pilot projects might be restricted within a single clinical service, as "proof of concept".
- Establish a systematic implementation structure with dedicated PBM leadership positions, especially physician and nurse, as resources permit.
- Establish dedicated multidisciplinary PBM guidance committees.
- Disseminate evidence-based PBM guidelines, pathways and protocols concerning managing and preserving a patient's own blood *(7-15)*.
- Translate evidence-based guidelines/recommendations into clinical practice *(6, 16)*.
- Identify practice areas that need improvement.
- Establish ongoing, up-to-date, comprehensive PBM education and communication programmes for all stakeholders.
- Establish a data collection system and reporting systems for ongoing PBM benchmarking and quality improvement.
- Engage primary care as part of the overall continuum of care for PBM including pre-and post-hospital.

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Annex 3.
Patient blood management (PBM) metrics for national/ jurisdictional implementation and post-implementation periods

Metric name	Rationale	Proposed indicator definition	Primary source	Structure/ process/ outcome	Timing	Collected by the World Health Organization (WHO) and/or Institute for Health Metrics and Evaluation (IHME)
Structure/process metrics						
Implementation of a structure within the national/jurisdictional ministry of health/ department of health (or equivalent) for PBM stewardship	An organizational structure is needed to clearly define national/jurisdictional roles and responsibilities for coordinating and incentivizing PBM efforts	Response to question: Has the national/ jurisdictional ministry of health or department of health leadership produced an organizational structure defining roles and delegation of authority responsible for PBM?	Survey response	Structure/ process	Start-up	–
Implementation of a PBM education and communication strategy within the national/jurisdictional ministry of health or department of health	Mechanisms are implemented to share information on PBM activities and resources (for example, Intranet/Internet pages) at the national/jurisdictional level	Response to question: Are strategies in place to communicate PBM to health care professionals and to the public?	Survey response	Structure/ process	Start-up	–
National/jurisdictional data collection for quality improvement practices	National/jurisdictional ministry of health or department of health participate in collecting data relevant to PBM activities for the purpose of identifying areas for improvement	Response to question: Does your national/ jurisdictional ministry of health or department of health collect data for benchmarking PBM practices?	Survey response	Structure/ process	Start-up	–
Identifying and managing iron deficiency (ID) and anaemia in the community	Vulnerable members of the community are screened to detect, diagnose and manage ID and anaemia	Response to question: Are vulnerable members of the community screened to detect, diagnose and manage ID and anaemia?	Survey response	Structure/ process	Start-up	–
Reporting the units of blood issued/ transfused at the national/jurisdictional level	Allogeneic blood transfusion rates are monitored as a surrogate for successful PBM implementation	Response to question: Does your national/ jurisdictional ministry of health or department of health report on the number of units issued/ transfused?	Survey response	Structure/ process	Start-up	–
Availability of formal PBM education and training courses at the following levels: **(i) undergraduate** **(ii) postgraduate** **(iii) continuing education**	Education and training are essential to ensure clinicians acquire the knowledge and skills to make PBM a standard of care	Response to question: Are there formal PBM education and training courses at the following levels: (i) undergraduate, (ii) postgraduate, (iii) continuing education?	Survey response	Structure/ process	Ongoing	–
Hospital accreditation for PBM standards	Building PBM into hospital accreditation will encourage a minimum level of PBM to be implemented and contribute to high levels of patient safety and quality of care	Response to question: Is PBM currently included in hospital accreditation standards?	Survey response	Structure/ process	Ongoing	–

Annex 3. *continued*

Metric name	Rationale	Proposed indicator definition	Primary source	Structure/ process/ outcome	Timing	Collected by the World Health Organization (WHO) and/or Institute for Health Metrics and Evaluation (IHME)
Health care provider certification for PBM	Helps to establish a standardized level of knowledge and expertise, promoting consistent and high-quality PBM practices	Response to question: Are health care providers certified for PBM knowledge based on evidence-based clinical guidelines and national standards?	Survey response	Structure/ process	Ongoing	–
Strategies for national health promotion and protection measures related to blood health	Increasing awareness of the prevalence of PBM-related topics, such as the burden of anaemia and heavy menstrual bleeding, encourages a focus on early detection and prevention	Response to question: Is the ministry of health or department of health supporting health promotion and health protection campaigns to address PBM-related topics such as anaemia and heavy menstrual bleeding?	Survey response	Structure/ process	Ongoing	–
Availability and access to medicines essential to PBM	Availability of and access to medicines essential to PBM is crucial	Response to question: Are all medicines related to PBM on the Emergency Medicines List available?	Survey response	Structure/ process	Ongoing	–
Outcome metrics						
Number of women aged 15–49 years with anaemia, by pregnancy status (thousands)	Anaemia in women is associated with undesirable outcomes	Number of women aged 15—49 years with a haemoglobin concentration less than 120 g/L for non-pregnant women and lactating women, and less than 110 g/L for pregnant women, adjusted for altitude and smoking	Survey data	Outcome	Ongoing	https://www.who.int/data/gho/data/indicators/indicator-details/GHO/anaemia-in-women-of-reproductive-age-number-(in-thousands)
Prevalence of anaemia in women aged 15–49 years, by pregnancy status (%)	Anaemia in women is associated with undesirable outcomes	Percentage of women aged 15—49 years with a haemoglobin concentration less than 120 g/L for non-pregnant women and lactating women, and less than 110 g/L for pregnant women, adjusted for altitude and smoking	Survey data	Outcome	Ongoing	https://www.who.int/data/gho/data/indicators/indicator-details/GHO/prevalence-of-anaemia-in-women-of-reproductive-age-(-)
Mean haemoglobin level in women aged 15–49 years, by pregnancy status (g/L)	Anaemia in women is associated with undesirable outcomes	Mean haemoglobin concentration in women aged 15–49 years, by pregnancy status	Survey data	Outcome	Ongoing	https://www.who.int/data/gho/data/indicators/indicator-details/GHO/mean-hemoglobin-level-of-women-of-reproductive-age-(aged-15-49-years)
Number of pregnant women aged 15–49 years, with anaemia (thousands)	Anaemia in pregnant women is associated with undesirable outcomes for mother and baby	Number of pregnant women (aged 15–49 years) with anaemia (thousands)	Survey data	Outcome	Ongoing	https://www.who.int/data/gho/data/indicators/indicator-details/GHO/anaemia-in-pregnant-women-number-(in-thousands)

Annex 3. *continued*

Metric name	Rationale	Proposed indicator definition	Primary source	Structure/ process/ outcome	Timing	Collected by the World Health Organization (WHO) and/or Institute for Health Metrics and Evaluation (IHME)
Prevalence of anaemia in pregnant women aged 15–49 years (%)	Anaemia in pregnant women is associated with undesirable outcomes for mother and baby	Percentage of women aged 15—49 years with a haemoglobin concentration less than 120 g/L for non-pregnant women and lactating women, and less than 110 g/L for pregnant women, adjusted for altitude and smoking	Survey data	Outcome	Ongoing	https://www.who.int/data/gho/data/indicators/indicator-details/GHO/prevalence-of-anaemia-in-pregnant-women-(-)
Mean haemoglobin level of pregnant women aged 15–49 years (g/L)	Anaemia in pregnant women is associated with undesirable outcomes for mother and baby	Mean haemoglobin concentration in women aged 15–49 years, by pregnancy status	Survey data	Outcome	Ongoing	https://www.who.int/data/gho/data/indicators/indicator-details/GHO/mean-hemoglobin-level-of-pregnant-women-(aged-15-49-years)
Number of non-pregnant women aged 15–49 years, with anaemia (thousands)	Anaemia in women is associated with undesirable outcomes	Number of non-pregnant women aged 15–49 years with anaemia (thousands)	Survey data	Outcome	Ongoing	https://www.who.int/data/gho/data/indicators/indicator-details/GHO/anaemia-in-non-pregnant-women-number-(in-thousands)
Prevalence of anaemia in non-pregnant women aged 15–49 years (%)	Anaemia in women is associated with undesirable outcomes	Percentage of women aged 15—49 years with a haemoglobin concentration less than 120 g/L for non-pregnant women and lactating women	Survey data	Outcome	Ongoing	https://www.who.int/data/gho/data/indicators/indicator-details/GHO/anaemia-in-non-pregnant-women-prevalence-(-)
Mean haemoglobin level of non-pregnant women aged 15–49 years (g/L)	Anaemia in women is associated with undesirable outcomes	Mean haemoglobin concentration in non-pregnant women aged 15—49 years	Survey data	Outcome	Ongoing	https://www.who.int/data/gho/data/indicators/indicator-details/GHO/mean-hemoglobin-level-of-non-pregnant-women-(aged-15-49-years)
Number of children aged 6–59 months, with anaemia (thousands)	Anaemia in children is associated with undesirable outcomes	Children aged 6—59 months with a haemoglobin concentration less than 110 g/L, adjusted for altitude	Survey data	Outcome	Ongoing	https://www.who.int/data/gho/data/indicators/indicator-details/GHO/anaemia-in-children-under-5-years-number
Prevalence of anaemia in children aged 6–59 months (%)	Anaemia in children is associated with undesirable outcomes	Percentage of children aged 6—59 months with a haemoglobin concentration less than 110 g/L, adjusted for altitude	Survey data	Outcome	Ongoing	https://www.who.int/data/gho/data/indicators/indicator-details/GHO/prevalence-of-anaemia-in-children-under-5-years-(-)

Annex 3. *continued*

Metric name	Rationale	Proposed indicator definition	Primary source	Structure/ process/ outcome	Timing	Collected by the World Health Organization (WHO) and/or Institute for Health Metrics and Evaluation (IHME)
Mean haemoglobin level of children aged 6–59 months (g/L)	Anaemia in children is associated with undesirable outcomes	Mean haemoglobin concentration in children aged 6–59 months	Survey data	Outcome	Ongoing	https://www.who.int/data/gho/data/indicators/indicator-details/GHO/mean-hemoglobin-level-of-children-aged-6-59-months
Prevalence of anaemia in those aged 60 years or over by sex (%)	Anaemia in those aged 60 years or over is associated with undesirable outcomes	Percentage of those aged 60 years or over with a haemoglobin concentration less than 130 g/L	Survey data	Outcome	Ongoing	–
Units of red blood cells issued per population	Great variability exists in the rate or frequency of red blood cell transfusion. Red blood cell transfusions are associated with a range of undesirable patient outcomes	Total number of units issued per 100,000 population	Survey data	Outcome	Ongoing	https://www.who.int/publications/i/item/9789240051683
Mean haemoglobin level (various populations) (g/L)	Anaemia is common and associated with undesirable outcomes	Mean haemoglobin concentration in patients admitted for inpatient surgery	Survey data	Outcome	Ongoing	https://www.who.int/teams/nutrition-and-food-safety/databases/vitamin-and-mineral-nutrition-information-system/data
Median haemoglobin (various populations)	Anaemia is common and associated with undesirable outcomes	Median haemoglobin concentration in patients admitted for inpatient surgery	Survey data	Outcome	Ongoing	https://www.who.int/teams/nutrition-and-food-safety/databases/vitamin-and-mineral-nutrition-information-system/data
Mean ferritin level (various populations) (µg/L)	ID with or without anaemia is common and associated with undesirable outcomes	Mean ferritin level in pregnant women at first prenatal visit	Survey data	Outcome	Ongoing	https://www.who.int/teams/nutrition-and-food-safety/databases/vitamin-and-mineral-nutrition-information-system/data
Median ferritin (various populations) (µg/L)	ID with or without anaemia is common and associated with undesirable outcomes	Median ferritin level in pregnant women at first prenatal visit	Survey data	Outcome	Ongoing	https://www.who.int/teams/nutrition-and-food-safety/databases/vitamin-and-mineral-nutrition-information-system/data

Annex 4.
Patient blood management (PBM) metrics for health care organization implementation and post-implementation periods

Metric name	Rationale	Proposed indicator definition	Primary source	Structure/ process/ outcome	Timing	Notes
Structure/process metrics						
Guidelines to treat iron deficiency anaemia (IDA)	Hospitals or clinics implement guidelines for managing patients with IDA	Response to question: Does your hospital or clinic have guidelines for managing patients with IDA?	Survey response	Structure/ process	Start-up	–
Pre-admission and discharge collaboration with primary health care providers	Hospitals may need to coordinate pre-admission and post-discharge management of anaemia, and ID monitoring with primary health care providers	Response to question: Is there communication and sharing of care plans between the health service organization and primary health care providers, at the pre-admission clinic and/or at hospital discharge, regarding management of ID/anaemia?	Survey response	Structure/ process	Start-up	–
Identify, manage and minimize bleeding and blood loss	Through protocols and guidelines, hospitals will be better equipped to identify, manage and minimize bleeding and blood loss	Response to question: Does your hospital have protocols/guidelines to identify, manage and minimize bleeding and blood loss, and bleeding risks?	Survey response	Structure/ process	Start-up	–
Evidence-based transfusion guidelines	Hospitals should keep abreast of updates to evidence-based transfusion guidelines	Response to question: Does your hospital have evidence-based transfusion guidelines?	Survey response	Structure/ process	Start-up	–
Reporting on outcomes associated with ID or anaemia	ID and anaemia are associated with a range of undesirable patient outcomes	Response to question: Does your hospital report on patient outcomes in relation to ID or anaemia?	Survey response	Structure/ process	Start-up	–
Reporting the blood transfused	Allogeneic blood transfusions are associated with direct and indirect hazards for patients	Response to question: Does your hospital or clinic report on the number of patients transfused and the quantities transfused?	Survey response	Structure/ process	Start-up	–
Percentage of hospitalized patients with iron studies performed prior to discharge	ID is common, presenting in many ways in hospitalized patients, and should be identified and diagnosed	Numerator: sum of patients with iron studies performed. Denominator: total number of patients	Hospital case mix data and laboratory information system	Structure/ process	Start-up	Higher is better
Percentage of patients who were treated for anaemia during hospitalization	Anaemia is common, taking many forms in hospitalized patients, and should be identified and diagnosed	Numerator: sum of patients with anaemia who were treated for it during hospitalization. Denominator: sum of patients with anaemia	Hospital case mix data, laboratory information system, hospital pharmacy database	Structure/ process	Start-up	Higher is better
Percentage of pregnant women screened for ferritin prior to delivery	ID is common following pregnancy and should be identified and managed appropriately	Numerator: sum of pregnant women screened for ferritin prior to delivery. Denominator: sum of deliveries	Hospital case mix data and laboratory information system	Structure/ process	Start-up	Higher is better

Annex 4. *continued*

Metric name	Rationale	Proposed indicator definition	Primary source	Structure/ process/ outcome	Timing	Notes
Maturity assessment model in patient blood management (MAPBM): percentage of patients with a haemoglobin determination 21–90 days before surgery	Pre-admission anaemia is associated with undesirable patient outcomes	Numerator: sum of patients with a haemoglobin test 21–90 days before surgery. Denominator: sum of patients admitted for major surgery. Key elective surgery groups may include: total joint replacement, colorectal surgery, open heart procedures and major gynaecological surgery	Hospital case mix data and laboratory information system	Structure/ process	Start-up	Higher is better
MAPBM: percentage of patients with an iron status determination 21–90 days before surgery	Pre-admission ID is associated with undesirable patient outcomes	Numerator: sum of patients with iron studies 21–90 days before surgery. Denominator: sum of patients admitted for major surgery. Key elective surgery groups may include: total joint replacement, colorectal surgery, open heart procedures	Hospital case mix data and laboratory information system	Structure/ process	Start-up	Higher is better
Outcome metrics						
Percentage of patients transfused with red blood cells in key elective surgery groups	PBM implementation is associated with a reduction in the percentage of patients exposed to red blood cells	Numerator: sum of patients receiving at least one unit of red blood cells. Denominator: sum of patients admitted. Key elective groups may include: total joint replacement, colorectal surgery, open heart procedures, etc.	Hospital case mix data or transfusion database	Outcome	Ongoing	Lower is better
Units of red blood cells transfused per 1000 patient-days	PBM implementation is associated with a reduction in the number of red blood cell units transfused	Numerator: sum of units of red blood cells transfused. Denominator: sum of patient stay days	Hospital case mix data and transfusion database	Outcome	Ongoing	Lower is better
Units of red cells transfused per 1000 admissions	PBM implementation is associated with a reduction in the number of units of red blood cells transfused	Numerator: sum of units of red blood cells transfused. Denominator: sum of patient admissions	Hospital case mix data and transfusion database	Outcome	Ongoing	Lower is better
Percentage of all transfused patients with Hb ≥ 80 g/L at time of transfusion	Evidence-based guidelines recommend restrictive haemoglobin thresholds for red blood cell transfusions	Numerator: sum of transfusion events initiated with a haemoglobin value ≥ 80 g/L. Denominator: sum of all transfusion events	Hospital case mix data and transfusion database	Outcome	Ongoing	Lower is better
Percentage of all transfused patients transfused with Hb ≤ 70 g/L	Evidence-based guidelines recommend restrictive haemoglobin thresholds for red blood cell transfusions	Numerator: sum of transfusion events initiated with a haemoglobin value ≤ 70 g/L. Denominator: sum of all transfusion events	Hospital case mix data and transfusion database	Outcome	Ongoing	Higher is better
Percentage of transfusions ordered as single units	Evidence-based guidelines recommend transfusing one unit of red blood cells in symptomatic non-actively bleeding patients	Numerator: sum of transfusion events with one unit transfused. Denominator: sum of all transfusion events	Hospital case mix data and transfusion database	Outcome	Ongoing	Higher is better

Annex 4. *continued*

Metric name	Rationale	Proposed indicator definition	Primary source	Structure/ process/ outcome	Timing	Notes
Mean pre-platelet transfusion threshold by patient population	Evidence-based guidelines recommend restrictive platelet transfusion thresholds	Mean pre-transfusion platelet count by patient population	Hospital case mix data and transfusion database	Outcome	Ongoing	Lower is better
Percentage of all transfused patients transfused plasma with international normalized ratio (International Normalized Ratios) < 2 (bigger is worse)	Lack of evidence for efficacy of plasma transfusion; association with undesirable outcomes	Numerator: sum of patients transfused plasma with an INR < 2. Denominator: all patients transfused plasma	Hospital case mix data and laboratory information system	Outcome	Ongoing	Lower is better
Percentage of patients with haemoglobin level less than "x" g/L on admission	Pre-admission anaemia is associated with undesirable patient outcomes	Numerator: sum of patients admitted with a haemoglobin level < "x" g/L. Denominator: sum of all admissions. Consider stratifying by elective/emergency admission	Hospital case mix data and laboratory information system	Outcome	Ongoing	Lower is better
Percentage of patients with haemoglobin level less than "x" g/L at discharge	Anaemia on discharge is associated with undesirable patient outcomes	Numerator: sum of patients discharged with a haemoglobin level < "x" g/L. Denominator: sum of all admissions	Hospital case mix data and laboratory information system	Outcome	Ongoing	Lower is better
Average nadir haemoglobin level (without transfusion) for hospitalized patients	If the nadir haemoglobin increases over time, it may represent minimized blood loss, greater tolerance of anaemia or improved management of anaemia	Numerator: sum of nadir haemoglobin levels in patients not transfused. Denominator: sum of all patients not transfused	Hospital case mix data and laboratory information system	Outcome	Ongoing	Higher is better?
Average nadir haemoglobin (without transfusion) in patients with postpartum haemorrhage (PPH)	If the nadir haemoglobin increases over time, it may represent minimized blood loss, greater tolerance of anaemia or improved management of anaemia	Numerator: sum of nadir haemoglobin levels in PPH patients not transfused. Denominator: sum of all PPH patients not transfused	Hospital case mix data and laboratory information system	Outcome	Ongoing	Higher is better?
Percentage of women with PPH treated with some form of iron	ID is common following pregnancy and should be identified and managed appropriately	Numerator: sum of women with PPH treated with some form of iron. Denominator: sum of women with PPH	Hospital case mix data and hospital pharmacy database	Outcome	Ongoing	Higher is better
Percentage of women discharged on iron therapy after delivery	ID is common following pregnancy and should be identified and managed appropriately	Numerator: sum of hospital deliveries following which women are discharged on iron therapy. Denominator: sum of hospital deliveries	Hospital case mix data and hospital pharmacy database	Outcome	Ongoing	Higher is better
Percentage of women receiving some form of iron supplementation prenatally	ID is common following pregnancy and should be identified early during prenatal evaluation and managed appropriately	Numerator: sum of women receiving iron supplementation prenatally. Denominator: sum of pregnant women	Hospital case mix data and hospital pharmacy database	Outcome	Ongoing	Higher is better

Annex 4. *continued*

Metric name	Rationale	Proposed indicator definition	Primary source	Structure/ process/ outcome	Timing	Notes
Percentage of patients with anaemia at discharge	Anaemia at discharge is associated with undesirable patient outcomes	Numerator: sum of patients with anaemia at discharge. Denominator: sum of patients discharged	Hospital case mix data and laboratory information system	Outcome	Ongoing	Lower is better
Metrics from the MAPBM project (https://mapbm.org/home/en)						
Percentage of patients with anaemia prior to surgery	Pre-admission anaemia is associated with undesirable patient outcomes	Numerator: sum of patients with anaemia before surgery. Denominator: sum of patients admitted for major surgery. Key elective surgery groups may include: total joint replacement, colorectal surgery, open heart procedures	Hospital case mix data and laboratory information system	Outcome	Ongoing	Lower is better
Percentage of patients treated with intravenous iron during hospital stay	ID is common in hospitalized patients and should be identified and managed appropriately	Numerator: sum of hospitalized patients treated with intravenous iron. Denominator: sum of hospitalized patients	Hospital case mix data and hospital pharmacy database	Outcome	Ongoing	Higher is better
Percentage of patients given preoperative transfusion	Red blood cell transfusions are associated with a range of undesirable patient outcomes	Numerator: sum of patients receiving a preoperative transfusion. Denominator: sum of surgical patients	Hospital case mix data and transfusion database	Outcome	Ongoing	Lower is better
Percentage of patients under spinal anaesthesia	Spinal anaesthesia for caesarean section is associated with less bleeding than general anaesthesia	Numerator: sum of hospitalized patients who had a caesarean section under spinal anaesthesia. Denominator: sum of hospitalized patients undergoing caesarean section	Hospital case mix data	Outcome	Ongoing	Higher is better
Percentage of patients treated with antifibrinolytics perioperatively	Bleeding and blood loss are associated with a range of undesirable patient outcomes	Numerator: sum of patients receiving peri-operative antifibrinolytics. Denominator: sum of patients admitted for major surgery. Key elective groups may include major orthopaedic surgery such as spine and total joint replacement, major oncological surgery such as colorectal surgery, major craniofacial surgery, open heart procedures and major gynaecological surgery	Hospital case mix data and hospital pharmacy database	Outcome	Ongoing	Higher is better
Percentage of patients with blood recovery systems perioperatively	Bleeding and blood loss are associated with a range of undesirable patient outcomes	Numerator: sum of patients with blood recovery systems perioperatively. Denominator: sum of patients admitted for major surgery. Key elective surgery groups may include: total joint replacement, colorectal surgery, open heart procedures, major gynaecological surgery	Hospital case mix data and operating room database	Outcome	Ongoing	Higher is better
Mean haemoglobin level prior to transfusion for hospitalized patients	Evidence-based guidelines recommend restrictive haemoglobin thresholds for red blood cell transfusions	Numerator: sum of pre-red blood cell transfusion haemoglobin values. Denominator: sum of transfusion orders in hospitalized patients with a haemoglobin value before red blood cell transfusion	Hospital case mix data, transfusion database, laboratory information system	Outcome	Ongoing	Lower is better

Annex 4. *continued*

Metric name	Rationale	Proposed indicator definition	Primary source	Structure/ process/ outcome	Timing	Notes
Mean haemoglobin level post-transfusion for hospitalized patients	Evidence-based guidelines recommend restrictive haemoglobin thresholds for red blood cell transfusions	Numerator: sum of post red blood cell transfusion haemoglobin values. Denominator: sum of transfusion orders in hospitalized patients with a haemoglobin value post-red blood cell transfusion	Hospital case mix data, transfusion database, laboratory information system	Outcome	Ongoing	Lower is better

Annex 5.
Patient blood management (PBM) and PBM-related guidelines, guidance, consensus statements and recommendations by specialty and/or clinical settings

1. Peri-operative	Patient blood management guidelines: module 2 – Perioperative. National Blood Authority, 2012 *(1)* Management of severe perioperative bleeding: Guidelines from the European Society of Anaesthesiology and Intensive Care: Second update, 2023 *(2)* EACTS/EACTA Guidelines on patient blood management for adult cardiac surgery, 2017 *(3)* STS/SCA/AmSECT/SABM Update to the clinical practice guidelines on patient blood management, 2021 (4) 2022 ESC Guidelines on cardiovascular assessment and management of patients undergoing non-cardiac surgery *(5)* Recommendations from the International Consensus Conference on Anemia Management in Surgical Patients (ICCAMS), 2022 *(6)* *(7)* Centre for Perioperative Care, 2022 *(8)* Identification and management of preoperative anaemia in adults: A British Society for Haematology Guideline update, 2024 *(9)* Management of peri-surgical anemia in elective surgery. Conclusions and recommendations according to Delphi-UCLA methodology, 2024 *(10)*
2. Medical	Patient blood management guidelines: module 3 – Medical. National Blood Authority, 2012 *(11)* Management of anaemia and iron deficiency in patients with cancer: ESMO clinical practice guidelines, 2018 *(12)* Guidance for the gastrointestinal evaluation and management of iron deficiency in Sub-Saharan Africa, 2024 *(13)* Practical clinical consensus guidelines for the management of cancer associated anemia in low- and middle-income countries, 2023 *(14)* British Society of Gastroenterology guidelines for the management of iron deficiency anaemia in adults, 2021 *(15)*
3. Intensive care/ critical care	Patient blood management guidelines: module 4 – critical care. National Blood Authority, 2012 *(16)*
4. Obstetrics and gynaecology	Patient blood management guidelines: module 5 – obstetrics. National Blood Authority, 2015 *(17)* A roadmap to combat postpartum haemorrhage between 2023 and 2030. Geneva: World Health Organization, 2023 *(18)* Patient blood management in obstetrics: management of anaemia and haematinic deficiencies in pregnancy and in the postpartum period: NATA consensus statement, 2018 *(19)* Patient blood management in obstetrics: prevention and treatment of postpartum haemorrhage. A NATA consensus statement, 2019 *(20)* UK guidelines on the management of iron deficiency in pregnancy, 2020 *(21)* Accelerating anaemia reduction: a comprehensive framework for action, WHO, 2023 *(22)* SABM administrative and clinical standards for patient blood management programs, 4th edition, 2017 *(23)*

Annex 5. *continued*

5. Neonatology and paediatrics	Patient blood management guidelines: module 6 – neonatal and paediatrics. National Blood Authority, 2017 (24) Patient blood management for neonates and children undergoing cardiac surgery: 2019 NATA Guidelines *(25)* Society for the advancement of blood management administrative and clinical standards for patient blood management programmes (pediatric version), 2019 *(26)* Management of severe peri-operative bleeding: Guidelines from the European Society of Anaesthesiology and Intensive Care: Second update 2022 *(27)* Accelerating anaemia reduction: a comprehensive framework for action, WHO, 2023 *(22)*
6. Massive haemorrhage	The European guideline on management of major bleeding and coagulopathy following trauma: sixth edition 2023 *(28)* Management of severe perioperative bleeding: Guidelines from the European Society of Anaesthesiology and Intensive Care: Second update, 2023 *(2)*
7. Hospital PBM implementation	SABM administrative and clinical standards for patient blood management programs, 4th edition, 2017 *(23)* Supporting patient blood management (PBM) in the EU – A practical implementation guide for hospitals, 2017 *(29)*
8. National/ jurisdictional PBM implementation	Building national programmes of patient blood management (PBM) in the EU – a guide for health authorities, 2017 *(30)* Accelerating anaemia reduction: a comprehensive framework for action, World Health Organization, 2023 *(22)*

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Annex 6.

General patient blood management (PBM) toolkit for national/ jurisdictional and health care organization (HCO) PBM task forces and health care professionals in low-income countries (LICs)[a]

Tools	Anaemia and iron deficiency	Blood loss and bleeding	Coagulopathy
Strategies to enable infrastructure changes and adaptation, and to provide specific clinical knowledge and skills to create continua of care	• Develop and implement public health initiatives to identify, evaluate and manage anaemia, iron deficiency (ID) and nutritional deficiencies so the population is in a better state of blood health *(1-10)* • Involve patients and family members or patients' trusted individuals in care and decision-making as a collaborative effort *(11)* • Use every patient encounter with the health system as an opportunity to screen for and diagnose anaemia and ID • Screen all patients as early as possible for anaemia prior to surgery and initiate investigation and treatment as soon as possible. Include those undergoing minor procedures if resources allow *(3)* • In patients undergoing urgent surgery, begin anaemia treatment as early as possible *(3)* • Educate physicians on the recognition and diagnosis – including interpretation of laboratory tests – of anaemia from all causes, including: - anaemia of inflammation - iron deficiency anaemia (IDA) - ID without anaemia - cancer-related anaemia - anaemia from blood loss - hospital-acquired anaemia (HAA) - haemolytic anaemia - vitamin B12 and folate deficiency - nutritional deficiency including protein deficiency - sickle cell disease, thalassaemia and other haemoglobinopathies - malaria and other infectious diseases • Establish a PBM support system (with available physicians and nurses) who can provide advice for clinicians in the remote field • Evaluate, diagnose and manage anaemia and ID. Identify and manage the underlying cause(s)/disorder(s) and take into consideration the mechanisms of the ID and anaemia *(1-3)* • Be aware of drugs that are associated with red blood cell disorders *(12)*	• Practise meticulous surgical haemostasis - Utilize surgical haemostatic devices such as electrocautery if available - Consider tourniquet, or improvised versions such as a cravat, rope, belt, strap or blood pressure cuff - Utilize staging and packing - Utilize mechanical pressure - Consider local vasoconstrictive agents - Consider topical haemostatic agents • Intervene **early** for bleeding • Position patient appropriately during surgery • Consider autologous cell salvage options (see devices section) • Manage blood pressure and fluid appropriately - Consider controlled intraoperative hypotension, if indicated and resources permit - In bleeding patients, initiate restrictive fluid administration and permissive hypotension, if indicated and resources permit, until bleeding is controlled, then aim to restore normal circulating blood volume (euvolaemia) - Maintain euvolaemia in stable anaemic patients • Prevent/correct hypothermia *(26)*, hypoperfusion, acidosis and hypocalcaemia • Monitor for and promptly manage postoperative bleeding • Respond promptly, including by reoperation when indicated, to arrest active bleeding • Minimize the risk of gastrointestinal bleeding (enteral feeding/food, gastrointestinal acid-lowering agents) • Avoid infections; where they do occur treat them promptly • Minimize iatrogenic blood loss *(27-32)*; minimize number of blood draws and volumes for testing, minimize volume of blood wasted (microtainers/small phlebotomy tubes) • If allogeneic blood is considered clinically indicated see Anaemia and ID column	• Assess for inherited or acquired coagulopathy or platelet dysfunction before surgery and develop a management plan. Address clinically significant coagulopathy early by identifying the source and/or coagulation defect *(33)* • Use a questionnaire to determine bleeding risk • Develop a checklist of drugs, herbs and other supplements that may affect platelet function or coagulation[c]

Annex 6. *continued*

Tools	Anaemia and iron deficiency	Blood loss and bleeding	Coagulopathy
Strategies to enable infrastructure changes and adaptation, and to provide specific clinical knowledge and skills to create continua of care *(continued)*	••Be aware of conditions that interfere with iron absorption, for example, *Helicobacter pylori* and coeliac disease • Focus on patients with comorbidities (diabetes, chronic kidney disease, congestive heart failure) *(13, 14)* and those at high risk for ID and anaemia (neonates, young children and women of reproductive age) • Establish anaemia management programme for prehospital, hospital and post-discharge patients • Open communication pathways between all parties involved in patient care, as they are essential • Understand and leverage the patient-specific physiological tolerance of moderate to severe anaemia in the short term while providing adequate support • Consider high fractional inspired oxygen (FIO_2) (1.0) in patients with life-threatening anaemia, if oxygen is available • Develop algorithms for the management and dosing regimen for locally available oral and intravenous iron, noting clear indications and contraindications, identifying different types of reactions (for example, Fishbane reaction versus anaphylaxis) and appropriate management of these • After optimizing oxygenation and volume status, and if blood is available, safe and clinically indicated, and informed consent has been obtained *(11)* utilize patient-specific and restrictive blood component transfusion strategy *(15-22)*. The decision to transfuse red blood cells should not be dictated solely by haemoglobin concentration; rather by the patient's clinical signs and symptoms, volume status, haemoglobin decline, risk of haemorrhage, availability of other therapies and patient preferences (a single-unit red blood cell transfusion policy should be employed in symptomatic non-actively bleeding patients not responding to volume replacement and other measures) *(23)*[b] • **Note:** Cross-matched blood should not be given simply because it has been prepared. If it is not clinically indicated, it should be disposed of. A transfusion that is not indicated is simply a risk to the patient and a cost to the health system *(24, 25)*		
	• Identify patients and surgical procedures with increased risk for blood loss, anaemia and coagulopathy and develop pathways for appropriate referral, investigation and management • Develop a patient-specific preoperative surgical plan to minimize the extent and duration of surgery, including use of non-invasive techniques when possible • Consider postponing or cancelling elective surgery to allow time to investigate and optimize blood health when anaemia is moderate to severe, or a large volume of blood loss is expected. Consider the risks and benefits of delay and optimization, For patients with mild anaemia in whom low to moderate blood loss is expected, begin treatment for anaemia and proceed with surgery. Ensure that a postoperative and post-discharge anaemia management plan is in place *(34, 35)*		

Annex 6. *continued*

Tools	Anaemia and iron deficiency	Blood loss and bleeding	Coagulopathy
Vigilance regarding nutritional and pharmacological interactions (knowledge required)	Identify and manage drug therapies, nutrition and conditions that: • can contribute to anaemia and haematinic deficiencies (for example, proton pump inhibitors (PPIs), H2-blockers, *H. pylori*, calcium supplements, pancreatin, pancrelipase, etc.) • can increase iron absorption • can impair absorption for example, some vitamin and herbal supplements, beverages containing polyphenolic compounds (tea, coffee, cocoa, soya) or phytic acid (unprocessed cereals, including bran)	Identify and manage medicines, vitamins and herbal supplements that may increase bleeding risk. For example, • some nonsteroidal anti-inflammatory drugs (NSAIDs) (especially aspirin), antidepressants, statins and antiarrhythmics • vitamin and herbal supplements including vitamins C and E, garlic, ginger, *Ginkgo biloba*, ginseng, omega-3 fatty acids, etc.[c]	• List of medicines, herbs and supplements that may increase bleeding risk[c]
Knowledge and skills to ensure patient empowerment	• Recognize gaps in and educate all staff on the principles of patient empowerment, shared decision-making and informed consent *(11)* • Develop materials for patients to inform them on various treatment options, their risks, benefits and expected outcomes • Develop a process for obtaining and documenting informed patient consent or refusal		
Diagnostic devices to be considered (knowledge, equipment and skills required)	• point-of-care haemoglobin analysers if available *(36)* • paper-based analytical devices • point-of-care ferritin analysers (under development) • direct visualization colorimetric method for the estimation of haemoglobin concentration • smaller volume tubes for laboratory sampling	• Where available, routine central laboratory coagulation testing (for example, prothrombin time, partial thromboplastin time, platelet count, fibrinogen), with treatment algorithm for management • If the above is not available, observation of blood clotting in a non-siliconized glass tube placed in the armpit can tell the clinician about clotting function (time, size and excess lysis), or the 20-minute whole blood clotting test *(37)* • Consult with the surgeon on assessment of clot quality	
Treatment devices to be considered (knowledge, equipment and skills required)		• Utilize low-cost intraoperative and postoperative autologous blood salvage options *(38)* - makeshift devices - soup ladle technique - low-cost devices (for example, hemafuse) - acute normovolaemic haemodilution (ANH) *(39, 40)* - haemostatic surgical devices	
Medicines (access to medicines as well as knowledge of their uses and interactions required)	• oral/intravenous iron *(1, 9, 41-43)* • folic acid *(44)* • vitamin B12 *(44, 45)* • high-dose vitamin D *(46)* • diet counselling: protein-rich (for example, eggs, milk, soya beans), iron-rich and fortified foods (for example, meat, fish), vitamin C-rich foods (for example, fruits) • rituximab (haemolytic anaemias) • hydroxyurea (sickle cell disease)	• Consider tranexamic acid (antifibrinolytics) • Locally available topical haemostatic agents, such as muscle welding, autologous glue, compressions with vasoconstrictive agents (epinephrine, etc.), local tranexamic acid flush • local vasoconstrictive agents • calcium gluconate for hypocalcaemia	• vitamin K either orally or intravenously • consider vitamin K pre-emptively in patients with malnutrition • cryoprecipitate depending on availability • desmopressin (DDAVP)
	• Educate physicians on indications and dosage		

[a] All tools may not be available in all countries, hospitals, regions or communities. This toolkit can serve as a picklist or checklist that can be adapted and used to develop local guidance and protocols.
[b] For guidance on clinically indicated blood component therapy see *WHO Educational modules on clinical use of blood* (https://iris.who.int/handle/10665/350246).
[c] For example, see an extensive list at: https://med.stanford.edu/content/dam/sm/ohns/documents/Sinus%20Center/Stanford_Medication_and_Herbs.pdf

Annex 6. *continued*

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Annex 7.

General patient blood management (PBM) toolkit for national/ jurisdictional and health care organization PBM task forces and health care professionals in lower middle-income countries (LMICs) and upper middle- income countries (UMICs)[a]

Tools	Anaemia and iron deficiency	Blood loss and bleeding	Coagulopathy
Strategies to enable infrastructure changes and adaptation, and to provide specific clinical knowledge and skills to create continua of care	• Develop and implement public health initiatives to identify, evaluate and manage anaemia, iron deficiency (ID) and nutritional deficiencies so the population is in a better state of blood health *(1-11)* • Involve patients and family members or patients' trusted individuals in care and decision-making as a collaborative effort *(12)* • Use every patient encounter with the health system as an opportunity to screen for and diagnose anaemia and ID • Screen all patients as early as possible for anaemia prior to surgery and initiate investigation and treatment as soon as possible. Include those undergoing minor procedures if resources allow *(3)* • In patients undergoing urgent surgery, begin anaemia treatment as early as possible *(3)* • Educate physicians on the recognition and diagnosis – including interpretation of laboratory tests – of anaemia from all causes, including: - anaemia of inflammation - iron deficiency anaemia (IDA) - ID without anaemia - cancer-related anaemia - anaemia from blood loss - hospital-acquired anaemia (HAA) - haemolytic anaemia - vitamin B12 and folate deficiency - nutritional deficiency including protein deficiency - sickle cell disease, thalassemia and other haemoglobinopathies - malaria and other infectious diseases	• Practise meticulous surgical haemostasis - Utilize surgical haemostatic devices such as electrocautery if available - Consider a tourniquet, or improvised versions such as a cravat, rope, belt, strap or blood pressure cuff - Staging and packing - Mechanical pressure - Consider local vasoconstrictive agents - Consider topical haemostatic agents • Intervene **early** for bleeding • Position patient appropriately during surgery • Consider autologous cell salvage options (see device section) • Manage blood pressure and fluid appropriately - Consider controlled intraoperative hypotension if indicated - In patients with bleeding, initiate restrictive fluid administration and permissive hypotension until bleeding is controlled then achieve normal circulating blood volume (euvolaemia) - Maintain euvolaemia in stable anaemic patients • Prevent/correct hypothermia *(27)*, hypoperfusion, acidosis and hypocalcaemia • Monitor for and promptly manage postoperative bleeding • Respond promptly, including performing reoperation when indicated, to arrest active bleeding • Monitor closely for thrombosis and/or bleeding when withholding, bridging or recommencing direct oral anticoagulants (DOACs) and antiplatelet agents	• Assess for inherited or acquired coagulopathy or platelet dysfunction before surgery and develop a management plan. Address clinically significant coagulopathy early by identifying the source and/or coagulation defect *(34)* • Use a questionnaire to determine bleeding risk • Develop a checklist of drugs, herbs and other supplements that may affect platelet function or coagulation[b]

Annex 7. *continued*

Tools	Anaemia and iron deficiency	Blood loss and bleeding	Coagulopathy
Strategies to enable infrastructure changes and adaptation, and to provide specific clinical knowledge and skills to create continua of care *(continued)*	• Establish a PBM support system with available physicians (including haematologists, intensivists, anaesthesiologists, surgeons, nurses and pharmacists, if available) who can provide advice on patient management for clinicians in the remote field • Evaluate, diagnose and manage anaemia and ID. Identify and manage the underlying cause(s)/disorder(s) and take into consideration the mechanisms of the ID and anaemia *(1-3)* • Know which drugs are associated with red blood cell disorders *(13)* • Be aware of conditions that interfere with iron absorption, for example, *Helicobacter pylori* and coeliac disease • Focus on patients with comorbidities (diabetes, chronic kidney disease, congestive heart failure) *(14, 15)* and those at high risk for ID and anaemia (neonates, young children and women of reproductive age) • Establish anaemia management programme for prehospital, hospital and post-discharge patients • Open communication pathways between all parties involved in patient care, as they are essential • Understand and leverage the patient-specific physiological tolerance of anaemia in the short term while providing adequate support • Consider high FIO_2 (1.0) in patients with life-threatening anaemia • Develop algorithms for the management and dosing regimens for locally available oral and intravenous iron, noting clear indications, contraindications, identifying different types of reactions (for example, Fishbane reaction versus anaphylaxis) and appropriate management of these • After optimizing oxygenation, cardiac output, tissue perfusion and volume status, and if blood is available, safe and *clinically indicated*, and informed consent has been obtained *(12)*, utilize patient-specific and restrictive blood component transfusion strategy *(16-23)*. The decision to transfuse red blood cells should not be dictated solely by haemoglobin concentration; rather, consider the patient's clinical signs and symptoms, volume status, haemoglobin decline, risk of haemorrhage, availability of other therapies and patient preferences. A single-unit red blood cell transfusion policy should be employed in symptomatic non-actively bleeding patients who are not responding to volume replacement and other measures) *(24)*[b] • **Note**: Cross-matched blood should **not** be given simply because it has been prepared. If it is not clinically indicated, it should **not** be transfused (return it to the blood bank if possible; dispose of it if it is not returnable). A transfusion that is not indicated is simply a risk to the patient and a cost to the health system *(25, 26)*	• Minimize the risk of gastrointestinal (GI) bleeding (enteral feeding/food, GI acid-lowering agents) • Avoid infections and treat them promptly when they do occur • Minimize iatrogenic blood loss *(28-33)*, minimize number of blood draws and volumes for testing, minimize volume of blood wasted (microtainers/small phlebotomy tubes) • If allogeneic blood is considered clinically indicated, see Anaemia and ID column[c]	

Annex 7. *continued*

Tools	Anaemia and iron deficiency	Blood loss and bleeding	Coagulopathy
Strategies to enable infrastructure changes and adaptation, and to provide specific clinical knowledge and skills to create continua of care *(continued)*	• Identify patients and surgical procedures at increased risk for blood loss, anaemia and coagulopathy and develop pathways for appropriate referral, investigation and management • Develop a patient-specific preoperative surgical plan to minimize the extent and duration of surgery, including use of non-invasive techniques when possible • Consider postponing or cancelling elective surgery to allow time to investigate and optimize blood health if the patient has moderate to severe anaemia or large-volume blood loss expected. Consider the risks and benefits of delay and optimization. For a patient with mild anaemia, if low to moderate blood loss is expected, begin treatment for anaemia and proceed with surgery. Ensure that a postoperative and post-discharge anaemia management plan is in place *(35, 36)*		
Vigilance regarding nutritional and pharmacological interactions (knowledge required)	Identify and manage drug therapies, nutrition and conditions that: • can contribute to anaemia and haematinic deficiencies (for example, proton pump inhibitors (PPIs), H2-blockers, *H. pylori*, calcium supplements, pancreatin, pancrelipase, etc.) • can increase iron absorption • can impair absorption, for example, some vitamin and herbal supplements, beverages containing polyphenolic compounds (tea, coffee, cocoa, soya) or phytic acid (unprocessed cereals including bran)	Identify and manage medicines, vitamins and herbal supplements that may increase bleeding risk. For example, • some nonsteroidal anti-inflammatory drugs (NSAIDs) (especially aspirin), antidepressants, statins and antiarrhythmics • vitamin and herbal supplements including vitamins C and E, garlic, ginger, *Ginkgo biloba*, ginseng, omega-3 fatty acids, etc.[c]	• List of medicines, herbs and supplements that may increase bleeding risk[c]
Knowledge and skills to ensure patient empowerment	• Educate all staff on the principles of patient empowerment, shared decision-making and informed consent *(12)* • Develop materials for patients on various treatment options, their risks, benefits and expected outcomes • Develop a process for obtaining and documenting informed patient consent or refusal		
Diagnostic devices to be considered (knowledge, equipment and skills required)	• Point-of-care haemoglobin analysers, if available *(37)* • Paper-based analytical devices • Point-of-care ferritin analysers (under development) • Direct visualization colorimetric method for haemoglobin measurement • Smaller volume tubes for laboratory sampling • Point-of-care-testing for ID, if available	• Where available, routine central laboratory coagulation testing (for example, prothrombin time, partial thromboplastin time (PTT), platelet count, fibrinogen), with treatment algorithm for management • If the above is not available, observation of blood clotting in a non-siliconized glass tube placed in the armpit can tell the clinician about clotting function (time, size, and excess lysis) *(38)* • Consult with surgeon on assessment of clot quality	• Utilize laboratory tests for platelet function, if available • Utilize point-of-care viscoelastic haemostatic assays if available, and create treatment algorithms based on the results
Treatment devices to be considered (knowledge, equipment and skills required)		• Obtain and utilize automated autologous blood collection and reinfusion devices (cell salvage) where indicated and resources permit, for both intraoperative and postoperative cell salvage • If automated autologous cell salvage is not available, utilize low-cost intraoperative and postoperative autologous blood salvage options *(39)* - makeshift devices - soup ladle technique - low-cost devices (for example, Hemafuse) - acute normovolaemic haemodilution (ANH) *(40, 41)* - haemostatic surgical devices • Obtain and utilize ANH equipment (collection bags, scale, etc.) for surgery that leads to high blood loss, in patients with adequate red cell mass *(40, 41)* • Radiological embolization methods, if available • Obtain and utilize haemostatic surgical devices	

Annex 7. *continued*

Tools	Anaemia and iron deficiency	Blood loss and bleeding	Coagulopathy
Medicines (access to medicines as well as knowledge of their uses and interactions required)	• Oral/intravenous iron *(1, 9, 42-44)* • Erythropoiesis-stimulating agents *(1, 43, 44)* • Folic acid *(45)* • Vitamin B12 *(45, 46)* • High-dose vitamin D *(47)* • Diet counselling: protein-rich (for example, eggs, soya beans), iron-rich and fortified foods • Rituximab (haemolytic anaemias) • Hydroxyurea (sickle cell disease, beta thalassemia) *(48)* • Hypoxia-inducible factor prolyl hydroxylase inhibitors (HIF-PHIs) for anaemia in chronic kidney disease • Erythroid maturation agents (for example, luspatercept) for beta thalassemia, myelodysplastic syndromes, etc.) *(49-51)*	• Consider tranexamic acid (antifibrinolytics) • Locally available topical haemostatic agents such as muscle welding, autologous glue, compressions with vasoconstrictive agents (epinephrine, etc.), local tranexamic acid flush • Local vasoconstrictive agents • Calcium gluconate for hypocalcaemia	• Vitamin K either orally or intravenously • Fibrinogen replacement therapy *(52)* (cryoprecipitate, fibrinogen concentrate) • Prothrombin complex concentrate • Other coagulation factor concentrates for congenital and acquired factor deficiency • Desmopressin (DDAVP)
	• Educate physicians on indications and dosage		

[a] All tools may not be available in all countries, hospitals, regions or communities. This toolkit can serve as a picklist or checklist that can be adapted and used to develop local guidance and protocols.
[b] For guidance on clinically indicated blood component therapy see *WHO Educational modules on clinical use of blood* (https://iris.who.int/handle/10665/350246).
[c] For example, see an extensive list at: https://med.stanford.edu/content/dam/sm/ohns/documents/Sinus%20Center/Stanford_Medication_and_Herbs.pdf

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Annex 7. *continued*

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Annex 8.
General patient blood management (PBM) toolkit for national/ jurisdictional and health care organization PBM task forces and health care professionals in high-income countries

Tools	Anaemia and iron deficiency	Blood loss and bleeding	Coagulopathy
Strategies to enable infrastructure changes and adaptation, and to provide specific clinical knowledge and skills to create continua of care	• Develop and implement public health initiatives to identify, evaluate and manage anaemia, iron deficiency (ID) and nutritional deficiencies so the population is in a better state of blood health *(1–11)* • Involve patients and family or patients' trusted individuals in care and decision-making as a collaborative effort *(12)* • Use every patient encounter with the health system as an opportunity to screen for and diagnose anaemia and ID • Open a preoperative anaemia and surgical planning clinic – ideally a multidisciplinary team with inputs from anaesthesiology, surgery, haematology, nursing, pharmacy and others • Screen all patients for anaemia as early as possible prior to surgery and initiate investigation into etiology and treatment as early as possible *(3)* • For patients undergoing urgent surgery, begin anaemia treatment as soon as possible *(3)* • Educate physicians on the recognition and diagnosis – including interpretation of laboratory tests – of anaemia from all causes, including: - anaemia of inflammation - Iron deficiency anaemia (IDA) - ID without anaemia - cancer-related anaemia - anaemia from blood loss - hospital-acquired anaemia (HAA) - haemolytic anaemia - vitamin B12 and folate deficiency - nutritional deficiency including protein deficiency - sickle cell disease, thalassaemia and other haemoglobinopathies - malaria and other infectious diseases	• Practise meticulous surgical haemostasis - Utilize surgical haemostatic devices - Consider tourniquet - Utilize staging and packing - Utilize mechanical pressure - Consider local vasoconstrictive agents - Consider topical haemostatic agents • Utilize minimally invasive surgical techniques • Intervene **early** for bleeding • Position patient appropriately during surgery • Consider autologous cell salvage options (see device section) • Utilize local vasoconstrictive agents • Utilize topical haemostatic agents • Utilize systemic haemostatic agents • Utilize interventional radiological embolization (for example, surgery for hypervascular tumours, liver resection/transplantation, uterine fibroids, postpartum haemorrhage, oesophageal variceal bleeding, haemorrhoids, etc.) • Practise appropriate blood pressure and fluid management • Practise controlled intraoperative hypotension when indicated • In bleeding patients, practise restrictive fluid administration and permissive hypotension until bleeding is controlled, then aim to restore normal circulating blood volume (euvolaemia) • Maintain euvolaemia in stable anaemic patients • Prevent or correct hypothermia *(27)*, hypoperfusion and acidosis • Utilize autologous blood options • Utilize intra- and postoperative cell salvage	• Conduct preoperative assessment of bleeding risk (history, laboratory investigations) *(34)* • Use a questionnaire to determine bleeding risk • Develop a clear plan or algorithm for management of bleeding during or after surgery • Address clinically significant coagulopathy early by identifying the source and/or coagulation defect • Educate physicians and nurses to ensure their knowledge and understanding of the contribution of blood vessels, platelets, coagulation factors, acid–base balance, temperature, degree of anaemia, perfusion and volume to haemostasis and how to address each of these in a bleeding patient • Educate physicians and nurses about procoagulants and their administration • Educate physicians and nurses on anticoagulants, antiplatelet agents, and/or supplements (herbal, etc.), and when to discontinue and restart them in the peri-operative period

Annex 8. *continued*

Tools	Anaemia and iron deficiency	Blood loss and bleeding	Coagulopathy
Strategies to enable infrastructure changes and adaptation, and to provide specific clinical knowledge and skills to create continua of care *(continued)*	• Establish a PBM support system with available physicians (including haematologists, intensivists, anaesthesiologists, surgeons, nurses and pharmacists if available) who can provide advice on patient management for clinicians in the remote field • Evaluate, diagnose and manage anaemia and ID. Identify and manage the underlying cause(s)/disorder(s) and take into consideration the mechanisms of the ID and anaemia *(1-3)* • Be aware of drugs associated with red blood cell disorders (for example, drug-induced haemolysis) *(13)* • Be aware of conditions that interfere with iron absorption, for example, *Helicobacter pylori* and coeliac disease • If there are resource constraints, focus on patients with comorbidities (diabetes, chronic kidney disease, congestive heart failure) *(14, 15)* and those at high risk for ID and anaemia (neonates, young children and women of reproductive age) • Establish an anaemia management programme for prehospital, hospital and post-discharge patients • Open communication pathways between all parties involved in patients' care, as they are essential • Develop algorithms for the management and dosing regimen for locally available oral and intravenous iron required, noting clear indications, contraindications, identifying different types of reactions (for example, Fishbane reaction versus anaphylaxis) and appropriate management of these • Consider high FIO_2 (1.0) in patients with life-threatening anaemia • After optimizing oxygenation, cardiac output, tissue perfusion, and volume status and if blood is available, safe and clinically indicated, and informed consent has been obtained *(12)*, utilize patient-specific and restrictive blood component transfusion strategy *(16-23)*. The decision to transfuse red blood cells should not be dictated solely by haemoglobin concentration; rather by the patient's clinical signs and symptoms, volume status, rate of haemoglobin decline, risk of haemorrhage, availability of other therapies and personal preferences (a single-unit red blood cell transfusion policy should be implemented for symptomatic non-actively bleeding patients who do not respond to volume replacement and other measures) *(24)*[a] • **Note:** Cross-matched blood should not be given simply because it has been prepared. If it is not clinically indicated, it should not be transfused (return it to the blood bank if possible; dispose of it if it is not returnable). A transfusion that is not indicated is simply a risk to the patient and a cost to the health system *(25, 26)*	• Utilize acute normovolaemic haemodilution • Consider additional blood-sparing options in patients undergoing cardiac surgery, including minimally invasive approaches and transcutaneous valve replacement where appropriate: - Utilize miniaturized cardiopulmonary bypass (CPB) circuit and volume - Utilize retrograde autologous priming/venous antegrade priming - Utilize haemofiltration, ultrafiltration or modified ultrafiltration to minimize haemodilution - Return residual blood in the CPB - Reduce time on CPB as much as possible • Monitor for, document and promptly manage postoperative bleeding • Return patient to operating room/theatre promptly to stop active bleeding • Perform meticulous monitoring while withholding, bridging or recommencing direct oral anticoagulants (DOACs) and antiplatelet agents • Minimize the risk of gastrointestinal (GI) bleeding (enteral feeding/food, GI acid-lowering agents) • Give hormonal treatment or surgical intervention for gynaecological bleeding • Avoid infections and treat them promptly when they do occur • Minimize iatrogenic blood loss *(28-32)*, minimize number of blood draws and volumes, minimize volume of blood wasted (microtainers/small phlebotomy tubes) *(16, 17, 33)* • If allogeneic blood is considered clinically indicated see Anaemia and ID column[a]	• Half-life and pharmacology • Reversal agents • Haemoadsorption *(35)* • Correct use of bridging anticoagulation • Know the indications, contraindications, and timing for peri-operative thromboprophylaxis to ensure appropriate use and minimization of bleeding risk while preventing venous thrombo-embolism

Annex 8. *continued*

Tools	Anaemia and iron deficiency	Blood loss and bleeding	Coagulopathy
Strategies to enable infrastructure changes and adaptation, and to provide specific clinical knowledge and skills to create continua of care *(continued)*	• Identify patients and surgical procedures with an increased risk for blood loss, anaemia and coagulopathy and develop pathways for appropriate referral and management • Develop multidisciplinary preoperative surgical plans to minimize extent and duration of surgery. Consider non-invasive techniques and preoperative embolization (for example, surgery for hypervascular tumours, liver resection/transplantation, obstetric procedures) • Consider postponing or cancelling elective surgery to allow time to investigate and optimize blood health when anaemia is moderate to severe or large-volume blood loss is expected. Consider the risks and benefits of delay and optimization. For patients with mild anaemia in whom low to moderate blood loss expected, begin treatment for anaemia and proceed with surgery. Ensure that a postoperative and post-discharge anaemia management plan is in place *(36, 37)*		
Vigilance regarding nutritional and pharmacological interactions (knowledge required)	Identify and manage drug therapies, nutrition and conditions that: • can contribute to anaemia and haematinic deficiencies (for example, proton pump inhibitors (PPIs), calcium supplements, pancreatin, pancrelipase, etc.) • can increase iron absorption • can impair absorption, for example, some vitamin and herbal supplements, beverages containing polyphenolic compounds (tea, coffee, cocoa, soya, red wine) or phytic acid (unprocessed cereals, including bran)	Identify and manage medicines, vitamins and herbal supplements that may increase bleeding risk. For example, • some nonsteroidal anti-inflammatory drugs (NSAIDs), antidepressants, statins, antiarrhythmics • vitamin and herbal supplements including cumin, cayenne, evening primrose oil, feverfew, vitamins C and E, garlic, ginger, *Ginkgo biloba*, ginseng, grapeseed extract, St John's wort, turmeric, omega-3 fatty acids, etc.[b]	• List of medicines, herbs and supplements that may increase bleeding risk[b]
Knowledge and skills to ensure patient empowerment	• Educate all staff on the principles of patient empowerment, shared decision-making and informed consent *(12)* • Develop materials for patients on various treatment options, their risks, benefits and expected outcomes • Develop a process for obtaining and documenting informed patient consent or refusal		
Diagnostic devices to be considered (knowledge, equipment and skills required)	• Validated point-of-care haemoglobin analysers • Point-of-care ferritin analysers (under development) • Smaller-volume tubes and laboratory set-up for laboratory sampling • Protocols for minimizing the frequency of laboratory sampling	• Validated point-of-care coagulation and platelet function testing and goal-directed treatment including treatment algorithms for management *(38-41)* • Rapid diagnostic tests for presence of DOACs if available *(42)* • Viscoelastic coagulation testing equipment, for example, TEG®, ROTEM®, etc. • Central coagulation laboratory which, in addition to routine coagulation testing, conducts factor assays, inhibitor studies, anticoagulant and antiplatelet medication monitoring, and platelet function testing	• Validated point-of-care coagulation and platelet function testing and goal-directed treatment, including treatment algorithms for management *(38-40)* • Rapid diagnostic tests for presence of DOACs, if available *(42)* • Central coagulation laboratory which, in addition to routine coagulation testing, conducts factor assays, inhibitor studies, anticoagulant and antiplatelet medication monitoring, and platelet function testing
Treatment devices to be considered (knowledge, equipment and skills required)	• Emergency trolley with resuscitation equipment, wherever intravenous iron or blood transfusions are given	• Emergency trolley • Pre- and postoperative cell salvage equipment, with procedural guidelines for patient selection, use of equipment and collection and reinfusion *(43)* • Acute normovolaemic haemodilution *(44)* • Haemostatic surgical devices • Haemoadsorptive devices	• Emergency trolley • Guidelines available with dosing charts and algorithms for management of coagulopathy, for anticoagulant reversal and bridging therapy

Annex 8. *continued*

Tools	Anaemia and iron deficiency	Blood loss and bleeding	Coagulopathy
Medicines (access to medicines as well as knowledge of their uses and interactions required)	• Oral/Intravenous iron *(1, 9, 45-47)* • Folic acid *(48)* • Vitamin B12 *(48, 49)* • High-dose vitamin D *(50)* • Diet counselling: protein-rich (for example, eggs, soya beans), iron-rich and fortified foods • Rituximab (haemolytic anaemias) • Hydroxyurea (sickle cell disease) • Erythropoiesis-stimulating agents *(1, 46, 47)* • Hypoxia-inducible factor prolyl hydroxylase inhibitors (HIF-PHIs) for anaemia in chronic kidney disease • Erythroid maturation agents (for example, luspatercept) for beta thalassaemia, myelodysplastic syndromes, etc) *(51-53)*	• Antifibrinolytics (tranexamic acid, aminocaproic acid) *(54-57)* • Topical haemostatic agents (58) • Local vasoconstrictive agents • Consider high FIO_2 (1.0) in patients with life-threatening anaemia • Platelet-stimulating agents where appropriate	• Fibrinogen replacement therapy *(59)* • Prothrombin complex concentrates *(59)* • Other clotting factors • Vitamin K intravenously • Desmopressin (DDAVP®)

[a] For guidance on clinically indicated blood component therapy see *WHO Educational modules on clinical use of blood* (https://iris.who.int/handle/10665/350246).
[b] For example, see an extensive list at: https://med.stanford.edu/content/dam/sm/ohns/documents/Sinus%20Center/Stanford_Medication_and_Herbs.pdf

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Annex 9.
Patient blood management (PBM) toolkit in neonatology and paediatrics for national/jurisdictional and health care organization PBM task forces and health care professionals[a]

Tools	Anaemia and iron deficiency	Blood loss and bleeding	Coagulopathy
Strategies to enable infrastructure changes and adaptation, and to provide specific clinical knowledge and skills to create continua of care	• Develop and implement public health initiatives to identify, evaluate and manage anaemia, iron deficiency (ID) (with and without anaemia), and dietary and nutritional deficiencies so the paediatric population is in a better state of blood health. • Educate frontline providers on how suboptimal blood health can manifest as ID without anaemia, anaemia, coagulopathy bleeding and/or thrombosis besides many other pathologies • Involve paediatricians and neonatologists, who are frontline providers, in early screening, recognition and management of anaemia and ID • Recognize that there are several different definitions of anaemia, which can lead to inaccuracies and an underestimation of the actual incidence in different populations – special considerations apply to age, race and sex. For neonates there is no consistent, universally accepted definition • Publish and then educate providers on age- and weight-based definitions for mild, moderate and severe anaemia, and ID without anaemia. • Teach that, in children and adolescents, anaemia and ID without anaemia are associated with impaired cognition and cognitive development. This is in addition to symptoms commonly seen in adults such as malaise, dizziness, headaches, myalgias, weakness and impaired exercise tolerance • Teach that, in neonates, anaemia is linked to poor feeding, neonatal infection, intensive care unit admission, transfusion, neurocognitive alterations, increased risk of attention deficit and hyperactivity disorder, increased risk of autism spectrum disorder, preterm births, low birthweight and perinatal mortality *(1)* • Teach that, in infants and children, preoperative anaemia is associated with a more than twofold increase in mortality and morbidity, including increased risk of infection, longer hospital stay and an increase in complications *(2)* • Involve patients and family in care and decision-making as a collaborative effort *(3-5)*	• Practise meticulous surgical haemostasis and haemovigilance • Recognize and intervene **early** to manage bleeding. Calculate estimated blood volume (EBL) and allowable blood loss (ABL) and be aware that a small-volume blood loss may represent 10–20% of blood volume and be clinically significant *(31)* • For bleeding due to surgery and/or trauma consider the following temporizing measures: surgical haemostatic devices, tourniquet and/or packing/mechanical pressure • Consider staged surgical procedures if there is a high risk of blood loss • Consider local vasoconstrictive agents to decrease blood loss • Consider topical haemostatic agents to help control surgical blood loss • Consider interventional radiological embolization when appropriate *(32)* • Practise appropriate blood pressure and fluid management with the aim of restoring volume and pressure, maintaining adequate tissue perfusion, and preventing or mitigating end-organ injury *(33)*. Controlled hypotension is contraindicated as it may put end organs at risk for underperfusion and ischaemia • Prevent or correct hypothermia *(34)*, hypovolaemia, hypoperfusion and acidosis • Use antifibrinolytics for prophylaxis and treatment of major bleeding due to surgery or trauma *(35)* • Utilize intra- and postoperative autologous cell salvage (indicated if estimated blood loss >10% total blood volume) *(31)* • Consider acute normovolaemic haemodilution *(31, 36)*	• Conduct preoperative assessment of bleeding risk based on the medical histories of the family and the child, and laboratory investigations when necessary *(47, 48)* • Use the Paediatric Bleeding Questionnaire to determine bleeding risk *(49)* • Develop a plan or algorithm specific to the paediatric population for management of bleeding during or after surgery • Address clinically significant coagulopathy early by identifying the source and/or coagulation defect • Educate physicians and nurses to understand the contribution of blood vessels, platelets, coagulation factors, acid–base balance, temperature, severity of anaemia, perfusion and volume to haemostasis, as well as how to address each of these in a bleeding child • Educate physicians and nurses on procoagulants and their administration

Annex 9. *continued*

Tools	Anaemia and iron deficiency	Blood loss and bleeding	Coagulopathy
Strategies to enable infrastructure changes and adaptation, and to provide specific clinical knowledge and skills to create continua of care *(continued)*	• Use every patient encounter with the health system (including routine paediatric visits) as an opportunity to discuss and advise on the prevention of anaemia and ID • Open a preoperative anaemia and surgical planning clinic – ideally run by a multidisciplinary team with representatives from the departments of anaesthesiology, surgery, neonatology, paediatrics, haematology, nursing, pharmacy and other input • Screen all patients as early as possible for anaemia prior to major surgery (especially children from high-risk populations) and initiate investigation into etiology and treatment using non-transfusion strategies *(6)* • Postpone non-urgent surgery to allow anaemia to be treated first *(7)* • If surgery is urgent, begin anaemia treatment as early as possible *(6)* • Educate physicians on the recognition and diagnosis – including interpretation of laboratory tests – of anaemia from all causes, including: - anaemia of inflammation - IDA - ID without anaemia - cancer-related anaemia - anaemia from blood loss - hospital-acquired anaemia (HAA) - haemolytic anaemia - vitamin B12 and folate deficiency - protein deficiency - sickle cell disease, thalassaemia and other haemoglobinopathies - malaria and other infectious diseases • Establish a PBM support system (including paediatricians, neonatologists, haematologists, intensivists, anaesthesiologists, surgeons, nurses and pharmacists, if available) who can provide advice on patient management for clinicians in the remote field	• Consider additional blood-sparing options for patients undergoing cardiac surgery, including minimally invasive approaches, and where appropriate *(37)*: - Utilize miniaturized cardiopulmonary bypass (CPB) circuit and volume - Utilize retrograde autologous priming/venous antegrade priming - Utilize haemofiltration, ultrafiltration or modified ultrafiltration to minimize haemodilution - Return residual blood in the CPB - Reduce time on CPB as much as possible • Monitor for, document and promptly manage postoperative bleeding • Return the patient to the operating room/theatre or the interventional radiology suite promptly to intervene and stop active bleeding • Minimize iatrogenic blood loss *(38-43)*, minimize number of blood draws and volumes, and minimize volume of blood wasted (microtainers/small phlebotomy tubes) *(13, 14, 44)* • If allogeneic blood is clinically indicated, consider non-transfusion options wherever possible (see Anaemia and ID column) • If allogeneic components are considered, employ optimal blood use which focuses on the "5 rights" of blood component transfusion, namely giving the **right** product, in the **right** dose, to the **right** patient, at the **right** time, for the **right** reason[b] **Massive haemorrhage protocol (MHP)** *(7)* An MHP includes a multidisciplinary approach to haemorrhage control, correction of coagulopathy and normalization of the patient's physiological parameters. All efforts should be made to identify the source and cause of the bleeding, and to control the bleeding as soon as possible *(45, 46)*. • Practise meticulous surgical haemostasis and haemovigilance • Recognize and intervene early to manage bleeding. Calculate estimated blood volume (EBL) and allowable blood loss (ABL) and be aware that a small-volume blood loss may represent 10–20% of blood volume and be clinically significant *(31)*	• Educate physicians and nurses on anticoagulants, antiplatelet agents, and/or supplements (herbal, etc.), and when to discontinue and restart them in the peri-operative period • When known for neonates and children, drug half-life and pharmacology should be taken into account • Consider anticoagulation reversal agents • Although rarely administered in neonates and children, ensure correct use of bridging anticoagulation

Annex 9. *continued*

Tools	Anaemia and iron deficiency	Blood loss and bleeding	Coagulopathy
Strategies to enable infrastructure changes and adaptation, and to provide specific clinical knowledge and skills to create continua of care *(continued)*	• Evaluate, diagnose and manage anaemia and ID. Identify and manage the underlying cause(s)/disorder(s) taking into consideration the mechanisms of the ID and anaemia *(6, 8, 9)* • Be aware of the drugs that are associated with red blood cell disorders (for example, drug-induced haemolysis) *(10)* • Be aware of conditions that interfere with iron absorption, for example, malabsorption syndromes, *Helicobacter pylori* and coeliac disease • Focus on children with comorbidities (diabetes, chronic kidney disease, congestive heart failure) *(11, 12)* and those at high risk for ID and anaemia (neonates and infants), if there are resource constraints • Establish anaemia management programme for prehospital, hospital and post-discharge patients. • Develop algorithms for the management and dosing regimens for locally available oral and intravenous iron, noting clear indications, contraindications, and appropriate management of these • Consider high FIO_2 (1.0) in patients with life-threatening anaemia • After optimizing oxygenation, cardiac output, tissue perfusion and volume status, and if blood components are available, safe and clinically indicated, and informed consent has been obtained *(3)*, utilize patient-specific and restrictive blood component transfusion strategy *(13-27)*. The decision to transfuse red blood cells should not be dictated solely by haemoglobin concentration; rather, by the patient's clinical signs and symptoms, volume status, rate of haemoglobin decline, risk of haemorrhage, availability of other therapies and patient preferences (a weight-based red blood cell transfusion policy should be applied in symptomatic non-actively bleeding patients who do not respond to volume replacement and other measures) (28)[b] • **Note**: Cross-matched blood components should **not** be given simply because they have been prepared. If it is not clinically indicated, it should not be transfused (return to blood bank if possible; dispose of it if it is not returnable). In this setting, avoiding a transfusion should be considered a patient safety measure, accepting that there may be "wastage" of blood and blood components in some circumstances. A transfusion that is not indicated is simply a risk to the patient and a cost to the health system *(29, 30)*	**Massive haemorrhage protocol (MHP)** ***(continued)*** • Key elements of an MHP should be adapted according to local available resources and should include: - clear communication of activation/deactivation criteria, ongoing contact between clinicians, laboratory and blood bank personnel to relay critical laboratory results, changes in patient location, and utilization of standardized patient handover tools during care transfer - guidelines for ongoing physiological monitoring, point-of-care-testing and administration of crystalloids and vasopressors with a strong emphasis on measures to stop bleeding - rapid transition from a ratio-based to goal-directed component/product transfusion strategy - utilization of blood conservation strategies including restrictive transfusion thresholds, antifibrinolytics and red blood cell salvage technology - mitigation or treatment of sequelae of massive haemorrhage and transfusion including metabolic derangements (for example, hyperkalaemia, hypocalcaemia), acidosis, coagulopathy and hypothermia - recurrent practice audit and ongoing quality improvement • HCOs utilizing viscoelastic testing (VET) should administer blood components/products and antifibrinolytic therapy according to a local VET-guided algorithm. Those without VET should consider commencing massive transfusion algorithm starting with fixed ratio red blood cells/plasma – 1:1 or 2:1 – for life-threatening haemorrhage • Consider fibrinogen replacement therapy (fibrinogen concentrate or cryoprecipitate) and platelet transfusion as balanced adjuncts to manage massive transfusion • Aim for individualized goal-directed bleeding management as soon as possible (i.e. laboratory- or VET-guided bleeding management) • Optimize oxygenation, cardiac output, tissue perfusion and metabolic state • Once bleeding is controlled, continue targeted optimization of coagulation, physiological and biochemical parameters, and continuous patient assessment	
	• Identify patient groups and surgical procedures with an increased risk for blood loss, anaemia and coagulopathy and develop pathways for appropriate referral and management • Conduct multidisciplinary, preoperative surgical planning to minimize the extent and duration of surgery including non-invasive techniques and preoperative minimally invasive surgery, staged surgery, and/or preoperative embolization (for example, surgery for hypervascular lesions/tumours, aneurysms, liver resection) • Consider postponing or cancelling elective surgery to allow time to investigate and optimize blood health when anaemia is moderate to severe, or large-volume blood loss is expected. Consider the risks and benefits of delay and optimization. For patients with mild anaemia in whom low to moderate blood loss is expected, begin treatment for anaemia and proceed with surgery. Ensure that a postoperative and post-discharge anaemia management plan is in place *(50, 51)*		

Annex 9. *continued*

Tools	Anaemia and iron deficiency	Blood loss and bleeding	Coagulopathy
Vigilance regarding nutritional and pharmacological interactions (knowledge required)	Identify and manage paediatric-specific drug therapies, and nutrition that: • can contribute to anaemia and haematinic deficiencies • can increase iron absorption • can impair iron absorption, for example, some vitamin and herbal supplements, beverages containing polyphenolic compounds (tea, coffee, cocoa, soya) or phytic acid (unprocessed cereals, including bran)	Identify and manage medicines, vitamins and herbal supplements that may increase bleeding risk. For example, • some nonsteroidal anti-inflammatory drugs (NSAIDs), antidepressants, statins, antiarrhythmics • vitamin and herbal supplements including cumin, cayenne, evening primrose oil, feverfew, vitamins C and E, garlic, ginger, *Ginkgo biloba*, ginseng, grapeseed extract, St John's wort, turmeric, omega-3 fatty acids, etc.[b]	• List of medicines, herbs and supplements that may increase bleeding risk[b]
Knowledge and skills to ensure patient empowerment	• Educate all staff on the principles of patient and family autonomy, empowerment, shared decision-making, professional communication and informed consent *(3)* • Develop materials for paediatric patients describing the various treatment options, their risks, benefits and expected outcomes • Develop a process for obtaining and documenting informed parental/patient consent or refusal		
Diagnostic devices to be considered (knowledge, equipment and skills required)	• Validated non-invasive haemoglobin analysers at the point of care • Smaller-volume tubes and laboratory set-up for laboratory sampling • Protocols for minimizing the frequency of laboratory sampling • Avoid routine blood work especially in the intensive care setting	• Validated coagulation and platelet function testing at the point of care and goal-directed treatment including treatment algorithms for management *(52-58)*. Viscoelastic coagulation testing equipment, for example, TEG®, ROTEM®, etc. *(55)* • Central coagulation laboratory which, in addition to routine coagulation testing, performs factor assays, inhibitor studies, anticoagulant and antiplatelet medication monitoring, and platelet function testing	• Validated coagulation and platelet function testing at the point-of-care and goal-directed treatment including treatment algorithms for management specific to the neonatal and paediatric population *(57, 59-71)* • Rapid diagnostic tests for the presence of direct oral anticoagulants (DOACs) if available *(72)* • Central coagulation laboratory which, in addition to routine coagulation testing, performs factor assays, inhibitor studies, anticoagulant and antiplatelet medication monitoring, and platelet function testing using reference ranges validated for neonatal and paediatric patients
Treatment devices to be considered (knowledge, equipment and skills required)	• Emergency trolley with resuscitation equipment, wherever intravenous iron or blood transfusion is given	• Emergency trolley • Pre- and postoperative cell salvage equipment, with procedural guidelines for patient selection, use of equipment and collection and reinfusion *(73)* • Acute normovolaemic haemodilution (ANH) *(74)* • Haemostatic surgical devices	• Emergency trolley • Guidelines available with dosing charts and algorithms for management of coagulopathy, for anticoagulant reversal and bridging therapy

Annex 9. *continued*

Tools	Anaemia and iron deficiency	Blood loss and bleeding	Coagulopathy
Medicines (access to medicines as well as knowledge of their uses and interactions required)	• Oral/intravenous iron *(8, 75-77)* • Folic acid *(78)* • Vitamin B12 *(78, 79)* • High-dose vitamin D *(80)* • Diet counselling: protein-rich (for example, eggs, soya beans), iron-rich and fortified foods • Rituximab (haemolytic anaemias) • Hydroxyurea (sickle cell disease) • Erythropoiesis-stimulating agents *(8, 76, 77)* • Hypoxia-inducible factor prolyl hydroxylase inhibitors (HIF-PHIs) for anaemia in patients with chronic kidney disease	• Antifibrinolytics (tranexamic acid, aminocaproic acid) *(35, 81-83)* • Topical haemostatic agents *(84)* • Local vasoconstrictive agents • Consider high FIO_2 (1.0) in patients with life-threatening anaemia • Platelet-stimulating agents where appropriate	• Fibrinogen replacement therapy *(85)* • Prothrombin complex concentrates (PCC) *(86)* • Other clotting factors (for example, FEIBA, rFVIIa, FXIII) • Vitamin K intravenously

[a] All tools may not be available in all countries, hospitals, regions or communities. This toolkit can serve as a picklist or checklist that can be adapted and used to develop local guidance and protocols.
[b] For guidance on clinically indicated blood component therapy see *WHO Educational modules on clinical use of blood* (https://iris.who.int/handle/10665/350246).
[c] For example, see an extensive list at: https://med.stanford.edu/content/dam/sm/ohns/documents/Sinus%20Center/Stanford_Medication_and_Herbs.pdf

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Annex 10.
Patient blood management (PBM) toolkit in obstetrics for national/jurisdictional and health care organization PBM task forces and health care professionals[a]

Tools	Anaemia and iron deficiency	Blood loss and bleeding	Coagulopathy
Strategies to enable infrastructure changes and adaptation, and to provide specific clinical knowledge and skills to create a continuum of care for obstetric haemorrhage	• Develop public health initiatives regarding dietary interventions to prevent and treat iron deficiency (ID) and other nutritional deficiencies *(1, 2)* • Develop and implement educational initiatives to identify, evaluate and manage anaemia, ID, heavy menstrual bleeding and pregnancy planning, so women are in a better state of blood health during their first and subsequent pregnancies *(3-7)* • Establish a PBM support system (with available physicians, nurses, midwives and other health care providers) who can provide advice for health care providers in the remote field • Educate physicians on the recognition and diagnosis – including interpretation of laboratory tests – of anaemia from all causes, including: - anaemia of inflammation - ID anaemia - ID without anaemia - cancer-related anaemia - anaemia from blood loss - hospital-acquired anaemia (HAA) - haemolytic anaemia - vitamin B12 and folate deficiency - nutritional deficiency including protein deficiency - sickle cell disease, thalassaemia and other haemoglobinopathies - malaria and other infectious diseases • Where feasible, establish an ID/anaemia management programme for women of childbearing age and for early, mid- and late pregnancy and postpartum *(8)* • Educate health care provider(s) on indications for and dosage of medications as well as nutritional and pharmacological interactions	• Develop and implement public health education and management initiatives for women and families about the risks and management of postpartum haemorrhage (PPH), preventive measures and early recognition *(6, 9-11)* • Develop a standardized education and training package, including protocols, checklists, audits and simulation training, to train and prepare health care professionals and teams at hospitals and health centres in systems improvement, prevention, recognition, readiness and response and the multiple pharmacological, mechanical and surgical techniques to stop bleeding and manage PPH *(3, 12, 13)* • Develop a checklist of risk factors for PPH *(6)* • All health centres should develop multiprofessional integrated multicomponent obstetric haemorrhage protocols (such as E-MOTIVE treatment bundle *(10)*), including a process for informed consent *(14)*. The protocol should take into account local resources, transport, and access to specialist advice, therapies (including blood components and products) and devices *(3, 6, 9, 15)* • Train health care providers to identify, assess and monitor the amount of blood loss and the development and differential diagnosis of haemorrhagic shock, using simple parameters such as pulse rate, blood pressure, urine output, saturation of peripheral oxygen (SpO2) and mental state *(5–7)*	• Educate health care providers and teams at hospitals and health centres on the causes and pathophysiology of obstetric bleeding and coagulopathy *(13, 16, 17)* • Provide multiprofessional training (including development and dissemination of protocols) on identification, avoidance and management of coagulopathy *(13)*

Annex 10. *continued*

Tools	Anaemia and iron deficiency	Blood loss and bleeding	Coagulopathy
Clinical management strategies	**Antepartum** • Collaborate with patients and their families in decisions about the patient's care *(14, 18, 19)* • Screen all patients (serum ferritin and full blood count) as early as possible during pregnancy for anaemia and ID (*3, 5, 20-22)* • Evaluate, diagnose and manage ID and anaemia, based on the cause, as early in pregnancy as possible • Treat ID or iron deficiency anaemia (IDA) with iron therapy (intravenous or oral iron as available and appropriate) *(3, 23-25)* • Identify and manage drug therapies, nutrition and conditions that can: - contribute to anaemia and haematinic deficiencies such as gluten intolerance (for example, coeliac disease), *Helicobacter pylori*, malabsorption, malnutrition, etc. - impair absorption of iron, for example, some vitamin and herbal supplements, beverages containing polyphenolic compounds (tea, coffee, cocoa, soya beans) or phytic acid (unprocessed cereals, including bran), milk, eggs, etc. - impair absorption of iron (for example, proton pump inhibitors, H2-blockers, calcium supplements, etc.) • Provide nutrition counselling: protein-rich (for example, eggs, soya beans), iron-rich and fortified food • Optimize haematinic status *(5)* - folic acid *(26)* - vitamin B12 *(26, 27)* • Screen for maternal alloantibodies that may cause haemolytic disease of the newborn, and carefully follow Rhesus D negative women for the development of anti-D antibodies that may lead to the development of haemolytic disease of the newborn • Consider haemoglobin determination for all women when labour starts **Massive haemorrhage** • Use point-of-care haemoglobin analysers, if available, to measure and track haemoglobin status • Minimize anaemia development and severity: an overarching principle is to view the patient's own blood as a precious and finite resource. The first critical step is to rapidly apply all emergency interventions to identify and stop bleeding and to preserve every drop of the patient's blood • Minimize iatrogenic blood loss *(28-30)*: minimize the volume and frequency of diagnostic blood draws throughout care	**Antepartum** • Screen for PPH risk factors and for potential birth complications *(55, 56)* • Be aware that women with leiomyomata or adenomyosis are at higher risk of PPH • Be aware that women who become pregnant with the help of assisted reproductive technology are at higher risk for PPH *(57, 58)* • Be aware of the limitations of risk prediction models and the fact that every parturient should be considered at risk of PPH • Refer pregnant women who are at a high risk for haemorrhage to a higher level of care, when possible **Peripartum** • Establish a method for accurate and early diagnosis and documentation of PPH (for example, a blood-collection drape) *(10)* • Consider prophylactic intravenous access for mothers in labour, especially those at higher risk of haemorrhage • Position the mother for proper access to the uterus • Practise uterine massage after delivery of the placenta • Consider, and use when appropriate, measures that prevent/minimize bleeding during and after birth including: - uterotonics such as oxytocin, carbetocin, methylergonovine, ergometrine, carboprost and misoprostol according to local protocol *(9, 55, 56, 59-63)* - tranexamic acid (intravenous; intramuscular at trial stage only at the time of publication) for increased bleeding (9, 64-68) **Note**: these measures should be applied only after birth and cord clamping. • Practise routine active management of the third stage of labour with uterotonics (all women giving birth) after cord clamping, and controlled cord traction *(69)* • Ensure bladder is empty • Ensure that the placenta, once delivered, is complete and intact to avoid undiagnosed tissue retention, and evacuate clots *(10, 16)* • Intervene early, with measures described in this toolkit, to manage haemorrhage, based on a preset cumulative volume blood loss, the mother's haemoglobin, and the assessed speed and magnitude of bleeding. Escalate treatment if bleeding does not stop *(9)* • Create and have available an emergency medical kit with all relevant medications and equipment for managing peripartum haemorrhage expeditiously	**Antepartum** • Assess for inherited or acquired coagulopathy, haematological conditions or platelet dysfunction in women of reproductive age or during pregnancy, as well as in the father of the baby *(17)* • Address clinically significant coagulopathy early by identifying the source and/or coagulation defect. - A good bleeding history, i.e. documented abnormal bleeding previously, is one of the best predictors of bleeding during surgery or labour - Optimize health status prior to giving birth, refer the mother for specialist evaluation, and develop a multidisciplinary peripartum management plan *(3)* • In the bleeding parturient, low fibrinogen levels predict progression to PPH *(16)*[b] • Identify and stop/manage medicines, vitamins and herbal supplements that may increase bleeding risk, for example, - some nonsteroidal anti-inflammatory drugs (NSAIDs), antidepressants, statins, antiarrhythmics, some antibiotics - Vitamin and herbal supplements including cumin, cayenne, evening primrose oil, feverfew, vitamins C & E, garlic, ginger, *Ginkgo biloba*, ginseng, grapeseed extract, St John's wort, turmeric, omega-3 fatty acids, etc.[d] • Give vitamin K pre-emptively in malnutrition patients

Annex 10. *continued*

Tools	Anaemia and iron deficiency	Blood loss and bleeding	Coagulopathy
Clinical management strategies *(continued)*	• Understand and leverage the patient-specific physiological tolerance of moderate to severe anaemia in the short term while providing adequate support • Optimize oxygenation, cardiac output, tissue perfusion and metabolic state • Consider high FIO_2 (1.0) in patients with life-threatening anaemia, if oxygen available • After initial bleeding control, optimize the patient's own blood recovery with intravenous iron (preferred) or oral iron (if intravenous iron unavailable) and haematinic therapy ± erythropoiesis-stimulating agents (epoetin alfa, beta, theta, darbepoetin alfa, methoxy polyethylene glycol-epoetin beta, or quality-assured biosimilars based on local availability and cost) *(22, 31-33)* **Note**: Patients with extremely low haemoglobin following blood loss can survive provided the bleeding is arrested and circulating volume appropriately restored with volume expanders. Haemoglobin response can be relatively rapid from extreme anaemia when intravenous iron and haematinics ± erythropoiesis-stimulating agents (ESAs) are administered *(34-36)*. • If, after optimizing oxygenation, cardiac output, tissue perfusion, metabolic state and volume status, transfusion is *clinically indicated*, if blood/red blood cells (RBCs) is/are available, safe, and prior informed consent has been obtained *(14)*, utilize a patient-specific and restrictive blood component transfusion strategy *(3, 37-46)*. The decision to transfuse RBCs should not be dictated solely by haemoglobin concentration; rather also consider patient clinical signs and symptoms, volume status, rate of haemoglobin decline, risk of ongoing haemorrhage, availability of other therapies and patient preferences in the decision *(47)*[b] • Be aware that although RBC transfusion increases the haemoglobin level, there is little evidence that it increases tissue oxygenation, and may be associated with decreased oxygenation and tissue perfusion *(48, 49)* **Caution**! RBC transfusion can be a life-saving therapy in massive obstetric haemorrhage. However, in non-maternity patients, transfusion of RBCs and other blood components is independently associated in a dose-dependent manner with increased morbidity and mortality. Every effort should be made to avoid or minimize exposure *(3, 47, 50-52)* **Postpartum** • Watch for ongoing bleeding • Avoid infections and treat promptly if they do occur. Consider prophylactic use of antibiotics in severe PPH situations • Optimize oxygenation (if oxygen is available) • Manage anaemia and ID postpartum in all patients *(5),(6)* IV iron (oral iron if intravenous not available) sufficient to cover total calculated ID	• If the patient requires a caesarean section, practise meticulous surgical haemostasis: - Utilize surgical haemostatic devices and techniques such as mechanical pressure, muscle welding and electrocautery if available - Consider locally available vasoconstrictive agents and topical haemostatic agents such as, autologous glue, compressions with vasoconstrictive agents (epinephrine, etc.), local tranexamic acid flush • Monitor for PPH • Promote early breastfeeding or manual nipple stimulation postpartum to encourage uterine contraction **If severe peripartum haemorrhage occurs:** • Call for help early; use a team approach, including anaesthesia staff *(6)* • If needed and possible, transfer to a higher level of care *(6)* • **Priority**: Stop the bleeding and keep the vasculature patent • Systematically search for the cause of bleeding using the four Ts (tone, trauma, tissue, thrombin) being aware that multiple causes can exist in the same patient; check for intra-abdominal bleeding (ultrasound or direct visualization) being aware that multiple causes can exist in the same patient *(13)* • Create a local stepwise haemostatic/surgical treatment algorithm. Possible interventions may include: - Identify atony by manual palpation - Make sure uterine cavity is empty. Consider careful placental removal with smooth curettage if there are retained products - Consider umbilical vein injection of oxytocin for the treatment of retained placenta *(70)* - Examine (manually or ultrasound) the genital tract for lacerations, haematoma or uterine rupture. Repair all visible lacerations immediately - Exteriorization of the uterus out of the abdomen to reduce bleeding and facilitate exploration of the abdomen and all parts of the uterus - External aortic compression as a temporizing measure *(71)* - Team-applied bimanual compression *(72)* - Uterine balloon tamponade devices – improvise when necessary: male condom with IV tubing, sterile glove with urinary catheter *(9, 73-76)* - Topical/local vasoconstrictive (for example, adrenaline, noradrenaline, phenylephrine) and haemostatic agents *(77)*	**Severe bleeding:** **Note**: Early coagulopathy is uncommon in PPH *(13)*.[e] • Prevent and correct hypothermia, acidosis, and hypocalcaemia and maintain normal pH *(3)* • Give tranexamic acid (intravenous or intramuscular) early for PPH, repeat dose if bleeding continues *(9, 15, 64-68)* • Point-of-care coagulation testing, if available, to facilitate goal-directed treatment of coagulopathy • If assays available, measure fibrinogen levels early and often • Fibrinogen replacement therapy in presence of hypofibrinogenaemia[f] • To restore fibrinogen levels, administer cryoprecipitate or fibrinogen concentrate, depending on what is available. Plasma should only be used to replace fibrinogen if neither of these products is not available. Plasma contains a relatively low concentration of fibrinogen *(12)* • If available, use point-of-care viscoelastic haemostatic assays for goal-directed haemostatic therapy with blood components/products and antifibrinolytics *(40, 41, 89, 90)* • Alternatively, use standard laboratory tests for platelet count, and coagulation screen including fibrinogen for goal-directed haemostatic therapy *(40, 41, 91)*

Annex 10. *continued*

Tools	Anaemia and iron deficiency	Blood loss and bleeding	Coagulopathy

Clinical management strategies *(continued)*	**Note**: A 1000 mL blood loss represents 20% of a woman's total iron stores. If an ESA is used it should be combined with iron therapy *(3, 5, 31-33)*.
	• Most otherwise healthy maternity patients can tolerate moderate to severe anaemia while medical therapies take effect *(3, 35)*
	• Consider high FIO_2 (1.0) in patients with life-threatening anaemia, if oxygen is available
	• **Be aware**: A meta-analysis of clinical trials has shown that, in bleeding and critically ill patients, a restrictive RBC transfusion strategy (haemoglobin <70 g/L) reduced mortality, rebleeding, acute coronary syndrome, pulmonary oedema and bacterial infections, when compared to a more liberal transfusion strategy *(42)*. A systematic review of observational studies demonstrated that in surgical patients, the critically ill and patients with acute bleeding, haemoglobin levels of 50–60 g/L are well tolerated if supportive measures are given, without evidence of cardiac ischaemia or decrease in oxygen extraction until haemoglobin decreases to <30 to 40 g/L *(42)*. The risk of red blood cell alloimmunization and potential adverse outcomes associated with transfusion should be considered when balancing the risks and benefits of transfusion *(3, 50)*
	• Adopt a single-unit RBC transfusion policy in symptomatic non-actively bleeding patients not responding to volume replacement and other therapies *(3)*
	Note: Cross-matched blood and thawed frozen components should **not** be given simply because they have been prepared. A transfusion that is not indicated is simply a risk to the woman and an additional cost to the health system. In this setting, avoiding a transfusion should be considered a patient safety measure, accepting that there may be "wastage" of blood and blood components in some circumstances *(53, 54)*
		- Consider shock garments if immediate haemostasis cannot be achieved – improvise if necessary: bicycle inner tubes and sheets *(6, 78)*
		- Transvaginal uterine artery clamp and other novel devices if available *(79, 80)*
		- Uterine packing – a reversible form of haemostasis, but may require analgesia/anaesthesia
		- Pelvic tamponade (abdominal packing)
		- Arterial ligations
		- Suture techniques
		- Consider recombinant Factor VIIa in severe bleeding with estimated blood loss greater than 1500 mL *(81)*
		- Surgical compression
		- Interventional radiology (for example, selective pelvic artery embolization if available
		  - Be aware of low-cost options for embolization, such as small pieces of cut nylon sutures – only to be performed by trained operators
		• Hysterectomy (total or subtotal). Do not delay conversion to hysterectomy in life-threatening situations.
		• Prevent/correct hypothermia *(82)*, hypoperfusion, acidosis and hypocalcaemia and maintain normal pH *(3)*
		• Noninvasive cardiovascular monitoring, if available, to check for signs of hypovolemia *(6)*
		• Manage blood pressure and fluid appropriately
		• Restrictive fluid administration and permissive hypotension, if indicated and resources permit, until bleeding is controlled then aim to restore normal circulating blood volume (consider oral fluid administration when IV fluids are not available *(83)*)
		• Maintain euvolemia in stable anaemic patients
		• Utilize low-cost peripartum autologous blood salvage options *(84, 85)* including makeshift devices to return patient's own blood *(86)*
		  - soup ladle autotransfusion technique *(87)*
		  - low-cost devices (for example, Hemafuse) *(88)*
		• If allogeneic blood is considered clinically indicated, see Anaemia and ID column[b]
		• Appropriate use of mechanical and pharmacological thromboprophylaxis in the postpartum period once bleeding is controlled
			• If the above is not available, observation of blood clotting in a non-siliconized glass tube placed in the armpit can tell the clinician about clotting function (time, size and excess lysis) or the 20-minute whole blood clotting test *(92)*
			• Vitamin K either oral or IV (onset of action is faster with intravenous vitamin K)
			• Be aware of patients on antiplatelet agents and anticoagulation therapy and the agents available to reverse them *(93-95)*. Consider:
			  - fibrinogen replacement therapy *(96)*
			  - desmopressin *(97, 98)*
			  - prothrombin complex concentrate (PCC) *(15, 41, 96, 99)*
			  - tranexamic acid *(100, 101)*
			  - other clotting factors
			  - Vitamin K intravenously *(41)* (if patients were on warfarin or known to be vitamin K deficient, for example, malnutrition, antibiotics)

Annex 10. *continued*

Tools	Anaemia and iron deficiency	Blood loss and bleeding	Coagulopathy
Knowledge and skills to ensure patient empowerment	• Educate all staff on the principles of patient empowerment, shared decision-making and informed consent *(14)* • Develop educational materials for patients on various treatment options, their risks, benefits and expected outcomes • Develop a process for obtaining and documenting informed patient consent or refusal		
Other considerations	• For the purposes of this document, PPH is defined as blood loss of more than 500 mL within 24 hours, whatever the mode of delivery and severe PPH as ongoing blood loss greater than 1000 mL within 24 hours, or blood loss accompanied by signs/symptoms of hypovolemia *(6)* • Effective prevention, diagnosis and management of PPH requires a systems-based approach involving multidisciplinary teams *(102)* • Develop a stepwise obstetric emergency haemorrhage management plan • Debrief after each obstetric haemorrhage to evaluate opportunities for improvement • Communication should be open, transparent and empathetic • Timely recognition and treatment of abnormal obstetric bleeding is more important than implementation of complex risk scoring tools • Active monitoring of blood loss as a nurse-/midwife-led activity • Consider a bundle of care that includes a strategy for early detection of haemorrhage and trigger criteria for staged response *(9)* • Consider distribution of a "haemorrhage-prevention" dose (600 mg) of misoprostol in low-resource settings where delivery outside a hospital or health centre is likely *(8)*		

[a] All tools may not be available in all countries, hospitals, regions or communities. This Toolkit can serve as a picklist or checklist that can be adapted according to the local situation and developed into local guidance and protocols.

[b] For guidance on clinically indicated blood component therapy see *WHO Educational modules on clinical use of blood* (https://iris.who.int/handle/10665/350246).

[c] Fibrinogen levels increase during pregnancy to levels 2-fold higher than those of non-pregnant women *(13, 16)*.

[d] For example, see an extensive list at: https://med.stanford.edu/content/dam/sm/ohns/documents/Sinus%20Center/Stanford_Medication_and_Herbs.pdf

[e] Coagulopathy is present in about 3% of PPH, but the incidence increases with late diagnosis of PPH and increasing volume of bleeding *(13)*.

[f] Fibrinogen is the first coagulation factor to decrease to a critical level in massive bleeding and levels decrease proportionately with blood loss.

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Annex 11.
Patient blood management (PBM) toolkit in trauma for national/ jurisdictional and health care organization PBM task forces and health care professionals[a]

Tools	Anaemia and iron deficiency	Blood loss and bleeding	Coagulopathy
Strategies to ensure infrastructure changes and adaptations, and to provide specific clinical knowledge and skills to create a continuum of care for traumatic haemorrhage	• Develop public health initiatives regarding dietary interventions to prevent and treat iron deficiency (ID) and iron deficiency anaemia (IDA) *(1, 2)* • Develop and implement educational initiatives to identify, evaluate and manage anaemia, ID and nutritional deficiencies so the population is in a better state of blood health should they be affected by trauma *(3-5)* • Educate physicians on the recognition and diagnosis – including interpretation of laboratory tests – of anaemia from all causes, including: - anaemia of inflammation - IDA - ID without anaemia - cancer-related anaemia - anaemia from blood loss - hospital-acquired anaemia (HAA) - haemolytic anaemia - vitamin B12 and folate deficiency - nutritional deficiency including protein deficiency - sickle cell disease, thalassaemia and other haemoglobinopathies - malaria and other infectious diseases • Establish a PBM support system (with available physicians and nurses) who can provide advice for clinicians in the remote field	• Develop and implement public health initiatives to teach the public to act as first responders to stop bleeding *(6, 7)* • Train and prepare local health care teams as first responders in techniques to stop bleeding and manage trauma • Train and prepare (including protocols, checklists, audits and simulation training) multidisciplinary teams in health care clinics and hospitals for assessment and early treatment by emergency physician, community doctor, community nurse or community health officer, in conjunction with a clinician with surgical skills and knowledge of anatomy and the pathophysiology of critical bleeding (surgeon, doctor, nurse, health officer) • Train health care providers to identify, assess and monitor the amount of blood loss and the development and differential diagnosis of haemorrhagic shock, using simple parameters such as pulse rate, blood pressure, urine output, oxygen saturation (SpO2) and mental state *(5–7)* • Develop massive haemorrhage protocols focusing on identifying the source of bleeding, controlling and stopping bleeding as soon as possible, appropriate volume replacement, appropriate coagulation management, normalization of physiological abnormalities and maximizing the patient's blood recovery	• Educate health care providers and teams at hospitals and health centres on the pathophysiology of traumatic critical bleeding and coagulopathy *(8)* • Develop and disseminate protocols for identification and management of coagulopathy and fibrinolysis in traumatic critical bleeding *(9)* • Educate physicians on the limitations of standard coagulation testing for identification of trauma-induced coagulopathy and fibrinolysis. • Consider advanced viscoelastic testing (VET) and platelet function testing for improved identification of coagulopathy, fibrinolysis and platelet dysfunction • Educate physicians on what is now being referred to as the "Diamond of Death" associated with increased mortality in trauma: coagulopathy, acidosis, hypothermia and hypocalcaemia. (Hypocalcaemia has recently been added to the "lethal triad" of coagulopathy, acidosis and hypothermia as an association with increased mortality) *(10, 11)*

Annex 11. *continued*

Tools	Anaemia and iron deficiency	Blood loss and bleeding	Coagulopathy
Clinical management strategies	• When possible, involve patients and family members in care and decision-making as a collaborative effort • Minimize anaemia development and severity: an overarching principle is to view the patient's own blood as a precious and finite resource. The first critical step is to rapidly apply all emergency interventions to identify and stop bleeding and to preserve every drop of the patient's blood • Use point-of-care haemoglobin analysers, if available, to measure and track haemoglobin status • Minimize the volume and frequency of diagnostic blood draws throughout care *(12)* • Understand and leverage the patient-specific physiological tolerance of moderate to severe anaemia in the short term while providing adequate support • Optimize oxygenation, cardiac output, tissue perfusion and metabolic state • Consider high FIO_2 (1.0) in patients with life-threatening anaemia, if oxygen is available • After initial trauma management and bleeding control, optimize the patient's own blood recovery with intravenous iron (preferred) or oral iron (if intravenous iron is unavailable) and haematinic therapy with or without erythropoiesis-stimulating agents (epoetin alfa, beta, theta, darbepoetin alfa, methoxy polyethylene glycol-epoetin beta, or quality-assured biosimilars based on local availability and cost) *(5, 13-15)* **Note**: Patients with extremely low haemoglobin following blood loss can survive provided the bleeding is arrested and circulating volume appropriately restored with volume expanders. Haemoglobin response can be relatively rapid from extreme anaemia when intravenous iron, erythropoiesis-stimulating agents and other haematinics are administered *(16-18)* • If, after optimizing oxygenation, cardiac output, tissue perfusion, metabolic state and volume status, allogeneic transfusion is considered clinically indicated, if blood/red blood cells (RBCs) is/are available, safe, and, when possible, informed consent has been obtained *(19)*, utilize a patient-specific and restrictive blood component transfusion strategy *(20-34)*. The decision to transfuse RBCs should not be dictated solely by haemoglobin concentration; rather, one should also consider the patient's clinical signs and symptoms, volume status, rate of haemoglobin decline, risk of ongoing haemorrhage, availability of other therapies and patient preferences in the decision *(35)*[b]	• **Consider the following acute management strategies. The *priority* is to identify and stop the source and cause of the bleeding.** Intervene early. Make every effort to identify the source and cause of the bleeding, and to stop the bleeding immediately – both external blood loss and concealed blood loss - First aid – manual compression/mechanical pressure, pressure bandages, compression bandages impregnated with haemostatic agents or combined with topical haemostatic agents. Pack open wounds with kaolin-based combat gauze products *(45)* or other clean material and apply pressure bandages. A Foley catheter should be inserted into a penetrating wound *(23)* - Tourniquet – improvise torniquet if necessary: fabric with windlass, blood pressure cuff *(46-49)* - Elevate bleeding body part - Create a stepwise haemostatic/surgical treatment algorithm for bleeding control - Consider tranexamic acid early (must be within 3 hours of injury) *(9, 50-53)* - Prevent heat loss and warm hypothermic patient. Maintain normothermia *(54)* - Restrictive volume replacement (in patients without brain injury) until bleeding is controlled *(23)*. Avoid large volume crystalloid infusion. Permissive hypotension until bleeding is controlled, then achieve euvolaemia) *(23)* - Vasopressors if no response to fluids *(23)* - Consider damage control surgery *(23)* - Pelvic binder – improvise if necessary: bed sheet, blanket, pair of trousers or tyre inner tube *(56)* - Stabilize fractured bones – improvise when necessary: plaster of Paris and a stick, body wraps *(57, 58)*, external fixators, pelvic belt *(59, 60)* - Haemostatic surgical devices, such as electrocautery - Packing and oversewing cutaneous injuries	• Identify trauma patients at risk of coagulopathy *(3,15)* - history of bleeding disorder - medication (nonsteroidal anti-inflammatory drugs (NSAIDs), anticoagulants, antiplatelets, glucocorticoids, selective serotonin reuptake inhibitors (SSRIs), some antibiotics) - alcohol - herbal medication and supplements - hypocalcaemia - chronic kidney disease - liver disease and cirrhosis - bone marrow disorders with thrombocytopenia - massive haemorrhage • Correct hypothermia (initiate active warming), acidosis and hypocalcaemia and monitor frequently *(71)* • Address clinically significant coagulopathy early by identifying the source and/or coagulation defect • Consider tranexamic acid as early as possible (must be within 3 hours of injury) *(23)* • Monitor fibrinogen concentration early (if available) and initiate replacement therapy if hypofibrinogenaemia is present[c] (fibrinogen concentrate if available, or cryoprecipitate as an alternative, if available) *(9)* • If coagulopathic bleeding is ongoing **after** correction of thrombocytopenia, hypothermia, acidosis and hypocalcaemia, and fibrinogen testing is not available, consider empirical fibrinogen replacement *(23, 72, 73)* • Treat with fibrinogen concentrate or cryoprecipitate **if major bleeding is accompanied by documented hypofibrinogenemia** (VET of functional fibrinogen or plasma Clauss fibrinogen level less than 1.5 g/L (*74)* • Consider prothrombin complex concentrate (PCC) as an alternative to plasma *(75-77)* • If available, use point-of-care viscoelastic haemostatic assays for early goal-directed haemostatic therapy *(23, 24, 78, 79)*

Annex 11. *continued*

Tools	Anaemia and iron deficiency	Blood loss and bleeding	Coagulopathy

Clinical management strategies *(continued)*	• Adopt a single-unit RBC transfusion policy in symptomatic non-actively bleeding patients not responding to volume replacement and other therapies *(36)*
	• **Be aware**: A meta-analysis of clinical trials has shown that, in bleeding and critically ill patients, a restrictive RBC transfusion strategy (haemoglobin <70 g/L) reduced mortality, rebleeding, acute coronary syndrome, pulmonary oedema and bacterial infections, when compared to a more liberal transfusion strategy *(25)*. A systematic review of observational studies demonstrated that in surgical patients, the critically ill and patients with acute bleeding, haemoglobin levels of 50–60 g/L are well tolerated if supportive measures are given, without evidence of cardiac ischaemia or decrease in oxygen extraction until haemoglobin decreases to <30 to 40 g/L *(25)*
	• **Caution**! While RBC transfusion can be an effective treatment with life-saving potential in massive haemorrhage, in multiple patient populations, including trauma, transfusion of RBCs and other blood components is independently associated in a dose-dependent manner with increased morbidity and mortality *(37, 38)*. Additionally, in bleeding trauma patients, each additional unit of RBCs transfused is associated with an increased risk of mortality, multiorgan failure, and acute respiratory distress syndrome/acute lung injury *(39)*. Every effort should be made to avoid or minimize exposure *(35, 39, 40)*. While RBC transfusion increases the haemoglobin level, there is little evidence that it increases tissue oxygenation, and it may be associated with decreased oxygenation and tissue perfusion *(27, 41)*. A randomized controlled trial investigating prehospital resuscitation in patients with trauma-related haemorrhagic shock demonstrated that RBC and plasma transfusion was not superior to 0.9% sodium chloride for improving tissue perfusion and reducing mortality *(42)*.
	Note: Cross-matched blood and thawed frozen components should not be given simply because they have been prepared. A transfusion that is not indicated is simply a risk to the patient and an additional cost to the health system. In this setting, avoiding a transfusion should be considered a patient safety measure, accepting that there may be "wastage" of blood and blood products in some circumstances *(43, 44)*
		- Surgical ligation of bleeding points
		- Tissue adhesives, glues and topical haemostatic agents *(61, 62)* – improvise when necessary: muscle welding, autologous platelet-rich plasma glue, sterile compress soaked in epinephrine, local tranexamic flush
		- Local vasoconstrictive agents – adrenaline infiltration and topical agents
		- Appropriate patient positioning for surgery *(35)*
		- Interventional radiological embolization, if available
		- Uterine balloons in the case of traumatic uterine bleeding – improvise when necessary: male condom with IV tubing, sterile glove with urinary catheter *(63-66)*
		- Utilize low-cost autologous blood salvage options *(67)* including makeshift devices to return patient's own blood
		  - soup ladle autotransfusion technique *(68)*
		  - low-cost devices (for example, HaemoClear®, Hemafuse®) *(69)*
		- If no noradrenaline or other options are available, consider anti-shock trousers – improvise if necessary: for example, with bicycle inner tubes and sheets *(70)*
		- Monitor for and promptly manage postoperative bleeding
		- Respond promptly, including reoperation when indicated, to arrest active bleeding
		- Minimize the risk of gastrointestinal (GI) bleeding (enteral feeding/food, GI acid-lowering agents)
		- Avoid infections and treat them promptly when they do occur
		- Monitor closely for thrombosis and/or bleeding when withholding, bridging or recommencing direct oral anticoagulants (DOACs) and antiplatelet agents
			• Alternatively, use standard laboratory tests for platelet count (significant thrombocytopenia is a late event in major haemorrhage *(80)*), and coagulation screen (be aware that partial thromboplastin time (PTT) and International Normalized Ratio (INR) do not predict bleeding *(8)*) including fibrinogen for early goal-directed haemostatic therapy (if platelets are available, be aware that the effects of platelet transfusions on haemostasis and clinical outcomes remain uncertain) *(23, 24, 81)*
			• If the above is not available, observation of blood clotting in a non-siliconized glass tube placed in the armpit can tell the clinician about clotting function (time, size and excess lysis) or the 20-minute whole blood clotting test may be useful *(82)*
			• Check with the surgeon for assessment of clot quality
			• If coagulation studies are normal, and abnormal bleeding is observed, confirm that calcium, acid/base balance and core temperature are normal; rule out surgical bleeding
			• Be aware of patients with chronic kidney disease and renal failure, as platelet dysfunction may contribute to coagulopathy and increased bleeding
			• Be aware of patients taking antiplatelet agents and oral anticoagulants and what agents are available to reverse them *(83-85)* Consider:
			  - Emergency reversal of vitamin K-dependent oral anticoagulants with early prothrombin complex concentrate (PCC), 20-50 IU/kg and intravenous vitamin K
			  - Desmopressin *(86, 87)*
			  - PCC *(9, 24, 88, 89)*
			  - If PCC not available, consider plasma *(9,88,89)*
			  - Tranexamic acid *(90, 91)*
			  - Other clotting factors

Annex 11. *continued*

Tools	Anaemia and iron deficiency	Blood loss and bleeding	Coagulopathy
Knowledge and skills to ensure patient empowerment	• Educate all health care providers on the principles of patient empowerment, shared decision-making and informed consent *(19)* • Develop a process for obtaining (when possible, in an emergency) and documenting informed patient consent or refusal		

[a] All tools may not be available in all countries, hospitals, regions or communities. This toolkit can serve as a picklist or checklist that can be adapted and used to develop local guidance and protocols.

[b] For guidance on clinically indicated blood component therapy see *WHO Educational modules on clinical use of blood* (https://iris.who.int/handle/10665/350246).

[c] Fibrinogen is the first coagulation factor to degrade to a critical level in massive bleeding and levels decrease proportionately with blood loss.

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Blood and Other Products of Human Origin
Health Products Policy and Standards Department
Access to Medicine and Health Products Division
World Health Organization
20, Avenue Appia
1211 Geneva 27
Switzerland
Website: www.who.int