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MODELLING GLOBAL TRANSFUSION MEDICINE EDUCATION

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Abstract

This document provides an analysis and oversight of the necessary educational infrastructure at national level needed for successful and sustainable education programs undergraduate and post-graduate and is focused on desired outcomes needed to secure general Transfusion Medicine (TM) competence and basic skills when appointed in a professional TM position. It provides a global model framework for TM education allowing individual countries to tailor the context and contents of the institutional curriculum.

Education in transfusion medicine is a complex set of intimately interrelated and interconnected components that allow student and fellow exposure to knowledge and skills, the ultimate curriculum. The extent to which knowledge and skills, professionalism and leadership principles are offered depends on the expected outcomes needed for the desired roles, tasks and functions.

A model for the development and implementation of an education (teaching and training) curriculum in Transfusion Medicine aimed at medical students and doctors, nurses and midwives,

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None.

and laboratory professionals should ideally include an outcomes-based component, with clear recommendations on the required roles, skills, attitudes, and knowledge of a trainee completing such a curriculum. This should correspond to the environment and scope of practice required from such a vocational or academic professional and should address deficiencies in knowledge, skills and attitudes present before the curriculum is completed, while taking into account fundamental international standards of knowledge and the needs of their working climate and environment. Therefore, it is considered more practical to provide a set of outcomes that would be useful in most contexts and settings, while equipping students, as adult learners, with the tools for advancing their educational, professional and leadership development suited to their availability and socio-economic environment.

The framework or model recognizes that no one set of education or training initiatives will be appropriate in all countries or settings and should be tailored to specific settings based on the assessment of local needs and available environments.

1. Global principles of education

Education, and in particular higher or academic education, was until relatively recently the privilege of clergymen and the upper class of societies. With the 18th Century enlightenment, this privilege slowly came to an end, lasting till the mid-20th Century in the immediate post WWII years when the young and driven United Nations documented the Universal Human Rights (1), which includes the right of education.

1948 – United Nations (UN) Universal Human Rights’ Declaration:

Article 26.

1. Everyone has the right to education. Education shall be free, at least in the elementary and fundamental stages. Elementary education shall be compulsory. Technical and professional education shall be made generally available and higher education shall be equally accessible to all on the basis of merit.
2. Education shall be directed to the full development of the human personality and to the strengthening of respect for human rights and fundamental freedoms. It shall promote understanding, tolerance and friendship among all nations, racial or religious groups, and shall further the activities of the United Nations for the maintenance of peace.

During ensuing decades societies changed, movements towards decolonization started and, in general, public awareness of the principle human rights gained acceptance. Yet there is a major difference between the advanced world, home to around 18% of the global population, and the less to poorly advanced part of the world, home to the larger 82% of the global population. United Nations Development Program (UNDP) (2) as well as the World Bank (3) mapped the world according to a number of development indices and indicators, illustrating the existing socioeconomic gaps and the huge diversity of states of development and its consequences. As a result, the UN introduced and launched a major human development program at the turn of the last Century – Millennium Development Goals 2000–2015 (4) with strong emphasis on education to bridge the existing knowledge

and socioeconomic gaps. In light of the progress achieved this was continued with another 15-year program:

2016 – UN ‘Sustainable Development Goals 2016–2030’ (5):

Goal number 4 focuses on quality education, stating: *‘Ensure inclusive and equitable education and promote lifelong learning opportunity.’*

The sub-goal 4.1 reads: *‘By 2030, ensure that all girls and boys complete free, equitable and quality primary and secondary education leading to relevant and effective learning outcomes’*,

and sub-goal 4.3 reads: *‘By 2030, ensure equal access for all women and men to affordable and quality technical, vocational and tertiary education, including university’.*

To more effectively approach the major threats of poverty, hunger and health, education was given a high priority. Unfortunately, besides protracted gender inequality, poor economics continued to dominate social and economic life, seriously impacting healthcare. In a large part of the world millions of people are forced into poverty due to poor access and unaffordable expenditures. The World Health Organization (WHO) and UN responded with the Model Lists of Essential affordable and available Medicines (6) and *in vitro* Diagnostics (7), and the Universal Health Coverage (UHC) initiative (8,9).

In 2020 WHO launched the Action framework to advance universal access to safe, effective and quality assured blood products, 2020–2023, with 6 strategic objectives (10). Strategic objective 6 on *partnership, collaboration and information exchange to achieve key priorities and jointly address challenges and emerging threats at global, regional and national levels*, presents among others the following two learning and training activities.

Recently the World Health Assembly endorsed a protective patient-oriented safety initiative to enhance awareness of effective hospital care, including blood transfusion:

2019 – World Health Assembly Resolution WHA72.6 ‘Global Action on Patient Safety’ (11):

Article 2 (8) reads: *‘to build sustainable human resource capacity, through multisectoral and interprofessional competency-based education and training, based on WHO patient safety curricula and continuous professional development, to promote a multidisciplinary approach, and to build an appropriate working environment that optimizes the delivery of safe health services.’*

In response to this resolution, the WHO drafted the ‘Global Patient Safety Action Plan 2021–2030 ‘Towards Eliminating Patient Harm in Health Care,’ which is currently under development (12).

Still, the Sustainable Development Goals (SDGs) 2016–2030 (5) require new indicators for assessing the many faces of inequality in e.g., education, the impact of the global

environmental and pandemic crisis on people now and tomorrow, the importance of voice, and the ways in which communities, rather than individuals, are progressing.

These and many other topics should be re-examined through a human development lens, with holistic orientation towards the future.

1.1 Final Responsibility

Ministry of Education, Government to guarantee formal recognition and licence (diploma); policy making and overall supervision and control.

1.2 Implementation

Formal: Vocational and higher education institutes [Medical Laboratory Professionals (MedTech) schools, Nursing schools; Medical Schools, Universities];

Informal: operational supplier and consumer institutes (Blood Establishments/ Banks, hospital blood transfusion services)

2. Education curriculum and contents

Delegated by Government (Ministries of Education) to the professional peer group and based on the local and national needs and opportunities; Government policy, health care system and organization, stages of development, educational approach (outcomes-based, problem-based, blended learning, etc.; principles of adult learning in education, modern methods of teaching), possibilities for implementation of international recommendations e.g., 2010 UN Universal Health Coverage program (9), 2013 WHO Model List of Essential Medicines (6), 2018 WHO Model List of *in vitro* Essential Diagnostics (7).

Utilising the model for the vocational and academic development and implementation of a Certificate or Diploma in Transfusion Medicine (graduate or post-graduate) requires the acknowledgement of the issues listed below –

The Transfusion Medicine vein-to-vein concept follows three levels of processes for which basic knowledge and skills are required:

2.1 Primary processes (core business)

1) Vocational:

- a. Societal/community based: role of voluntary blood donor and community awareness issues.
- b. Technical/procurement based: collection, processing, Quality Control (QC)/ testing, storage and distribution (cold chain), hygiene and asepsis, risk management and waste management.
- c. Blood group check and pre-transfusion compatibility testing, stock control (hospital) and adverse transfusion events

2) Medical (HE/academic):

- a. Medical operations (blood establishment/bank) – donor selection and blood collection (responsibility), component selection and testing, hygiene and asepsis maintenance, risk and waste management control and clinical consultation
- b. Hospital (prescriber) – indication and decision making, informed consent, ordering, bedside practice (Patient Blood Management/PBM), patient care, adverse event handling and hemovigilance.

2.2 Supportive/Secondary processes (Management/infrastructure support)

Leadership, management, implementation strategies (logistics, technical/engineering, domestic), Quality Assurance (QA) and Quality System Management (QSM) – overarching; standards, documentation and assessment; education, hemovigilance, improvement and development (research).

2.3 Steering processes (top management, translation of governmental policies, regulations and standards)

1. Blood Establishment/Bank: Top management and leadership, liaison with community, consumers (hospitals) and politicians (accountability, strategic inputs), managerial and operational responsibility (product liability), environment, education and development strategies, regulatory and contract aspects, Total Quality Management (TQM).
2. Hospital/patient care: transfusion policy (per discipline); consumer rights protection, overall patient care and blood management (PBM) and outcome evaluation (hemovigilance), bridging with blood establishment (supplier), regulatory aspects and QSM.
3. Both: Costing (14), financing and budgeting of vein-to-vein activities in the blood establishment and hospital blood bank.

The importance of knowledge of the principles of costing is grossly underestimated, because most blood establishments and hospital blood banks in low- and middle-income countries do not understand how to develop a costing structure for blood services. Hence, this leads to incapability of appropriate financing and finally leads to failure in budgeting.

All these need to be considered when a model framework is provided as all students from any background should receive training that is relevant to their own particular contexts, while also being made aware of the practice of Transfusion Medicine in other contexts (15) as presented in Table 2.

The recent (September 2020) eLearning Africa/EdTech^{Hub} report on the ‘Effect of COVID-19 on Education in Africa and its Implications for the Use of Technology (ICT)’ (17) – a survey of the experience and opinions of educators and technology specialists from 52 countries in Africa – provides a wealth of information and illustrations regarding the wide differences between countries on just one continent, which we may use when designing a harmonious model framework for Transfusion Medicine education. The results of the two

AABB Global Transfusion Forum (GTF) Education Subcommittee survey findings (18,19) provide valuable insights for the design of such model frameworks (medical, nursing and technical).

3. Modelling aspects

3.1 Background

The WHO conducted a series of informal consultations on education and training in blood transfusion in 1991 and 2004 with a focus on modelling (20–22). In 2008, the Global Collaboration for Blood Safety (GCBS) adopted formal recommendations relating to Education and Training comprised of three sections –

1. Assessment of needs for education and training establishing framework or model;
2. Monitoring and Evaluation of education and training implementing the 2006 WHO strategy on education and training (23);
3. Collaboration in education and training to consider the feasibility of developing a searchable, web-hosted database of training resources and funding support.

The framework or model recognizes that no one set of education or training initiatives will be appropriate in all countries or settings and should be tailored to specific settings based on the assessment of local needs (24).

3.2 Educational Reference

Fundamental and universal standards for operations (25) and management in Transfusion Medicine as key elements of a quality management system to achieve basic safety and efficacy in the blood supply and clinical use.

3.3 Objectives

A contribution through fundamentally well-educated and competent (knowledgeable and skilled) human resources for the:

- a. Implementation and realization of availability and accessibility of safe and efficacious blood and blood components (UN/WHO Universal Health Coverage Program).
- b. Implementation and realization of availability and accessibility of safe and efficacious blood and blood components as elements of the WHO Model List of Essential Medicines (since 2013) and Model List of *in vitro* Essential Diagnostics (since 2018).

3.4 Prerequisites and conditions

- a. Higher Education Institutes – vocational and academic, mixed education systems available and accessible, flexible and competent governance, stewardship and leadership, funding, sustainability (support from management, financial viability of programs, human resources and otherwise are key).

- b.** Sufficient and competent teaching and training of staff (knowledge and skills, professionalism, stewardship and leadership).
- c.** National and updated standards and references based on fundamental and uniform standards.
- d.** National comprehensive Quality System and Quality System Management of education, health care and blood transfusion.
- e.** National Blood Supply and Transfusion organization based on a sound legislative and regulatory framework, and competent authoritative oversight.
- f.** Community demands for the desired level of blood safety which will continue to change in line with the challenges of emerging and re-emerging infections and technological developments.
- g.** Career prospective (structured).

Successfully implementing such a model framework also requires the recognition of role players, including their needs and functions (26). Their contributions and involvement are significant in the development, implementation and monitoring of a Graduate Certificate or Postgraduate Diploma in Transfusion Medicine (medical, nursing or laboratory science). In specific instances, policy and regulatory frameworks require that certain procedures be followed, and conditions met in order to obtain official recognition and accreditation for a (new) program. Role players who are considered relevant to a Graduate Certificate or Postgraduate Diploma in Transfusion Medicine can be divided into *internal* (from within the education institute, including students) and *external role players* (e.g., government, professional associations, blood establishments and hospitals). Having formal agreements, or at least a memorandum of understanding (MoU) between the institute developing the diploma, the blood establishments, and the government is likely to contribute to the success of such a program. Furthermore, existence of government regulation concerning requirements for formal education in Transfusion Medicine for personnel involved in blood services will also contribute to the success of the program especially in low- and middle-income countries.

Advantages of networking and cooperation include the sharing of resources, ideas, innovation, human resources, incorporating both the theoretical and practical aspects of Transfusion Medicine as well as professionalism, stewardship and leadership aspects, improved marketing, workload sharing and subsequent cost savings. Acquiring buy-in and involvement from all stakeholders through consultation would increase the chances of having a single, tailor-made high-quality program, rather than duplication with several small, fragmented and potentially ineffective programs in a single country. Networking may also expand the strength of all stakeholders, both individually and jointly. An effective network is underpinned by relationships/role players, and is key to collaboration towards achieving a common goal and meeting the unmet needs in the field. Furthermore, networks need to be maintained by ensuring robust communication between role players, particularly during periods of change, e.g., pandemics and humanitarian emergencies.

It is therefore critical to identify relevant role players and stakeholders at an early onset and identify areas of mutual interest and potential cooperation. The roles that each party/ stakeholder will play should be discussed, negotiated and documented. In determining these, the major perspectives and needs of both the program provider and stakeholders should be considered and agreed upon. Furthermore, the relationships and the responsibilities of the various role players need to be strategically considered to ensure smooth and effective collaboration, recognizing that roles may change over time.

3.5 Curricular structure

For the design of a global Transfusion Medicine education model framework, an analysis of competencies and operational and managerial skills in the vein-to-vein transfusion chain is needed, based on the identified primary, secondary (supportive), and steering processes of the chain (27).

3.5.1 The **primary processes** consist of the core business functions of the vein-to-vein transfusion chain, divided into:

1) procurement/manufacturing or supply part:

- Community communication/public awareness and education, donor motivation, mobilization and retention, donor selection, donor care, blood collection;
- Processing of collected blood, platelets and plasma (manufacturing);
- Testing (mandatory QC, and product specifications);
- Storage, quarantine release, labelling and distribution (cold chain);

2) consumption or clinical part:

- Clinical use of blood and patient blood management that cover ordering (bedside - diagnosis, indication, alternatives, decision, Informed Consent, request and sampling, documentation);
- Selection (laboratory/transfusion service – reception of request, documentation, Immunohematology (IH)/blood group serology, crossmatching, and adverse event analysis);
- Transfusion (bedside – reception of products, patient and product identification checks, documentation, patient preparation/vital signs, IV connection/administration set/IV fluid, observation/vital signs and outcome, including adverse events).
- Hemovigilance (look-back, investigation, recording and reporting of adverse events in patients and donors)

These functions/positions need personnel with a secondary education background and a vocational (medical technicians, nurses, finance and administration/business) or academic (medical, pharmaceutical, business/MBA) higher or tertiary education.

3.5.2 The **supportive or secondary processes** contain for both the procurement and the clinical aspects:

1. Mid managerial functions – management of teams, divisions and departments.
2. Ancillary operational functions like cleaning and hygiene, transport (runners, drivers), as well as the infrastructural operations e.g., maintenance (mechanics and engineering), human resource management (HRM), finance and administration (FA), domestic services (canteen, laundry, wellness, waste);

These functions/positions require for the ancillary supportive part a minimal primary education background, and for the supportive infrastructure (HRM, FA, engineering) a secondary education background followed by a vocational and/or managerial education at higher education (HE) level.

3.5.3 The **steering processes** relate to senior management (procurement and clinical use) and consist of policy making, strategy design and implementation, guidance, governance, overall education including continuous professional development (CPD), PR and representation, quality management, planning (medium and long term), economics and budget accountability.

These functions/positions need well-developed leadership, stewardship and governance capacities at HE or academic level.

The approach illustrates the need for an existing human resource pool of primary, secondary and HE/tertiary educated potential. The 2018 UNDP Human Development Indices and Indicators (28), and the 2020 eLearning Africa/EdTech^{HUB} (17) reports illustrate the differences in education enrolment ratios from primary into secondary and from secondary into HE/tertiary education between the four UNDP Human Development groups. The Very High, High and Medium Human Development Index (HDI) groups of countries do have a good enrolment ratio from primary into secondary education (100, 96 and 72% respectively). However, the enrolment ratios from secondary into HE/tertiary education of these three groups are respectively 72%, 50% and 24%. The Low HDI group of countries shows an enrolment ratio for primary into secondary of just 43%, and of only 8% from secondary into HE/tertiary education. Eliminating certain key inequalities in education in medium and low HDI countries, such as the ‘gender gap’, tribal obstacles and poor economics in learning outcomes, by no means would be sufficient to ensure adequate learning levels. Eliminating such gaps will not solve the learning crisis. Focusing on ‘systems-related inequality’ and ‘learning poverty’ linked to poor mastery of basic knowledge and skills as a result of poor-quality schooling (primary, secondary or tertiary) is likely to be the most productive approach to improving equity/ This is most clearly understood in terms of minimum level standards, but also in terms of impartiality and redistribution, when appreciating that inequalities in ‘opportunities to learn’ differ significantly not only according to individual student characteristics (29).

These data reflect the paucity and/or capacity limitations of existing vocational and academic education institutes and systems, and their respective number of graduates (medical technicians, nurses and medical/pharmaceutical). As a result, there will be a distinct problem in maintaining quality of education (knowledge and skills), competent and motivated professional education staff and accessibility of these institutes.

On the more specific Transfusion Medicine scale, the availability of expertise and/or training programs in the low and medium HDI countries are much lower compared to the higher HDI countries. Currently, technology allows us to bridge this gap by having blended teaching and learning programs, ideally developed and presented jointly by local and international experts, at relatively low cost with no great need for travel, thanks to online teaching platforms.

The 2020 launched WHO Action Framework to Advance Universal Access to Safe, Effective and Quality-Assured Blood Products 2020–2023, with 6 Strategic Objectives (11). Objective 6 on *partnership, collaboration and information exchange to achieve key priorities and jointly address challenges and emerging threats at global, regional and national levels*, presents among others the following two learning and training activities –

1. Mobilize and convene technical assistance to Member States and other relevant stakeholders on the development and implementation of learning programs on key functions of the national blood system.
2. Identify relevant organizations that can play a role in the development and implementation of training programs and provide training of trainers on key functions of the national blood system or facilitate training of trainers to be provided by other institutions with adequate capacity.

These two activities justify our efforts to design a fundamental, all inclusive, universal Transfusion Medicine curricula model framework that serves as a tailor-made and layered contextual format for education (learning program) focused on the diversity of competencies and outcomes needed in the day-to-day operations and management of the blood supply and clinical transfusion practice. Development of professionalism (ethics), stewardship and leadership in an early stage are of paramount importance.

3.6 Vocational or professional backgrounds

Analysing the needed vocational and professional backgrounds of staff to be employed in any part of the vein-to-vein Transfusion Medicine chain, the following picture develops as shown in Table A2.

This analysis illustrates the need for personnel with, in principle, a secondary education background that had continued education at a higher HE and academic (tertiary) level to graduate as a vocational professional. These vocational professionals then form the pool of (graduate) trainees for a Transfusion Medicine specialisation and operational or managerial position within a blood establishment (procurement institute) or hospital transfusion service (laboratory or bedside). The ultimate goal is improving patient safety and health outcomes (12).

Unfortunately, the pool of these graduates is limited in medium and low HDI countries (enrolment ratios 24% and 8% resp.) and marginal (enrolment ratio 50%) in high HDI countries (28). That brings along a serious competition for a job at that professional level in the blood supply Institutions and hospitals and the risk for a drain of professionals away from the smaller blood supply institutes or Blood Banks to larger establishments and hospitals with a larger and more diverse and occasionally more advanced transfusion programs.

The analysis also illustrates that the educational focus and emphasis points to three groups or categories of health professionals to be educated – doctors, nurses and (bio-)medical laboratory professionals; supported by ancillary personnel who do not need a specific Transfusion Medicine education. Most ancillary personnel require a primary or secondary education background and may receive structured apprentice or work integrated education and training related to the professional behaviour (professionalism), institutional values, hygiene and cleanliness, and basic risk prevention and management, in line with their respective roles and responsibilities. Education on professionalism and stewardship is essential at early stage of entry and training, appropriate to the role and function of the various ancillary personnel (13).

4. Major outcomes of a graduate certificate and a postgraduate diploma in transfusion medicine

A model for the development and implementation of an education (teaching and training) curriculum in Transfusion Medicine aimed at medical students and doctors, nurses and midwives, and laboratory professionals should ideally include an outcomes-based component, with clear recommendations on the required roles, skills, attitudes, and knowledge of a trainee completing such a curriculum. This should correspond to the environment and scope of practice required from such a vocational or academic professional and should address deficiencies in knowledge, skills and attitudes present before the curriculum is completed, while taking into account fundamental international standards of knowledge and the needs of their working climate and environment. Therefore, it is considered more practical to provide a set of outcomes that would be useful in most contexts and settings, while equipping students, as adult learners, with the tools for advancing their educational, professional and leadership development suited to their availability and socio-economic environment (30).

Having a set of baseline outcomes will form a key component of the documents to be submitted, not only to the vocational institutes, higher education and academic institutes, and the education bodies that deal with curriculum development, but also to those required by governmental regulatory authorities. At the same time, these outcomes may be used as a framework around which an undergraduate or postgraduate Transfusion Medicine teaching and training program should be developed and planned.

The major outcomes identified are categorized as outcomes in terms of knowledge of basic sciences and relevant haematology, the principles of blood banking and Transfusion Medicine, clinical medicine, blood conservation, blood safety, social skills and research.

However, one needs to recognize that the elements listed for each of the four groups of professionals within these applicable categories do not form a complete list, and may need to be systematically combined with non-overlapping elements related to roles, tasks, functions, skills, competences, knowledge, professionalism, stewardship and leadership, state of development, scope of practice, challenges, and deficiencies.

Altogether, the education outcomes allow for the development of a comprehensive set of baseline outcomes, one that encompasses all the necessary elements.

A description of the major outcomes deemed *essential, useful, or at least useful* by category of medical students (undergraduate), medical doctors (postgraduate), laboratory professional (under- and postgraduate) and nursing staff (under- and postgraduate) can be found in the Tables A3-6.

4.1 Medical students (undergraduate)

To adequately equip medical students after graduation (young doctors) who intend to be involved in the manufacture of blood components and/or transfusion of patients on a regular basis for the above-mentioned roles, tasks and functions, the following exit-level outcomes can be listed –

Graduate doctors should be able to demonstrate they:

1. Have the required knowledge and skills to fulfil the different roles, tasks and functions described.
2. Are competent to fulfil a resident or trainee function in terms of blood manufacture and transfusion, which includes ensuring that procedures are followed and that there are no clerical or procedural errors, recognizing inappropriate blood processing, prescribing, usage, monitoring and evaluating the clinical use of blood (haemovigilance).
3. Are competent to play their defined roles in scarce resource management, blood safety and patient blood management and care, and research.
4. Are able to fulfil a complex combination of roles, which includes functions in the fields of management, teaching and training, direct patient care, and research.
5. Are competent to communicate effectively with role players in the different fields mentioned earlier.

4.2 Medical doctors (postgraduate)

To adequately equip clinicians who are involved in the manufacture of blood components and transfusion of patients on a regular basis for the above-mentioned roles, tasks and functions, the following exit-level outcomes can be listed (30) –

Transfusion clinicians should be able to demonstrate they:

1. Have the required competencies, knowledge and skills to fulfil the different roles, tasks and functions described.

2. Are competent to fulfil a supervisory function in terms of blood transfusion, which includes ensuring that procedures are followed and that there are no clerical errors, recognizing inappropriate blood usage, monitoring and evaluating the clinical use of blood and adverse consequences of transfusion (hemovigilance).
3. Are competent to play their defined roles in scarce resource management, patient blood management and care, clinical governance, training and research.
4. Are competent to fulfil a complex combination of roles, which includes functions in the fields of management including costing, financing and budgeting, advocacy, teaching and training, direct patient care, and research or clinical auditing.
5. Are competent to communicate effectively with role players in the different fields mentioned earlier.

4.3 Laboratory professionals (under- and postgraduate)

To adequately equip laboratory professionals who are involved in the manufacture of blood components and transfusion of patients on a regular basis for the above-mentioned roles, tasks and functions, the following exit-level outcomes can be listed –

Graduate laboratory professionals should be able to demonstrate they:

1. Have the required knowledge and skills to fulfil the different roles, tasks and functions described.
2. Are competent to fulfil a laboratory function in terms of blood manufacture and transfusion, which includes ensuring that procedures are followed and that there are no clerical or procedural errors, recognizing inappropriate blood processing and adverse events of the clinical use of blood.
3. Are competent to play their defined roles in scarce resource management, blood safety and preservation and patient blood management and haemovigilance.
4. Are competent to fulfil a complex combination of roles, which includes functions in the fields of logistics, manufacture, quality and waste management, and research.
5. Are competent to communicate effectively with role players in the different fields mentioned earlier.

4.4 Nursing staff (under- and postgraduate) and midwives

To adequately equip nursing personnel involved in the collection of blood from donors or transfusion of patients (transfusion nurse) on a regular basis for the above-mentioned roles, tasks and functions, the following exit-level outcomes can be listed to which transfusion nurses (donor and patient care), and where appropriate midwives, should be competent to –

Transfusion nurses should be able to demonstrate they:

1. Have the required competencies, knowledge and skills to fulfil the different roles, tasks and functions described.
2. Are competent to fulfil an operational and supervisory function in terms of blood collection or transfusion, which includes ensuring that procedures are followed and that there are no clerical errors, recognizing donor selection criteria, aseptic blood collection, inappropriate blood usage, adverse events, and monitoring the clinical use of blood at the bedside.
3. Are competent to play their defined roles in scarce resource management, patient blood management, care and hemovigilance, and training.
4. Are competent to fulfil a complex combination of roles, which includes functions in the fields of logistics, management, teaching and training, direct patient care, and clinical auditing.
5. Communicate effectively with blood donors or patients and with role players in the different fields mentioned earlier.

Note: all teaching and learning areas must be underpinned by ethical and professional values, and quality and safety outcomes.

5. Epilogue

Education in transfusion medicine is a complex set of intimately interrelated and interconnected components that allow student and fellow exposure to knowledge and skills, the ultimate curriculum. The extent to which knowledge and skills, professionalism and leadership principles are offered depends on the expected outcomes needed expected roles, tasks and functions (13). This applies to all professions including healthcare and integrated Transfusion Medicine.

Assuring the safety of every clinical process includes blood transfusion practiced at the bedside, for which a quality procurement or manufacture system needs to be developed based on competence and internationally accepted fundamental standards as a reference to guarantee expected health outcomes and patient safety (12); clinical experience along with knowledge is deemed important.

If the government leads on the infrastructure and enabling environment and climate for technology-assisted learning, then educational institutions - universities, colleges, vocational schools, and their staff, can concentrate on providing a stimulating and practical education experience for their students and fellows (17).

Improvement can become standard practice when working toward an agenda of continuous curriculum development and improvement of quality outcomes.

As the 'front-line' in education provision, institutions with their leadership and staff should have the authority to innovate and upgrade methodology and curriculum, where they can demonstrate that it improves educational experience and outcomes. These 'micro-initiatives'

can feed into the national education agenda and allow for peer learning amongst education institutes and their staff.

Although the primary actions will be the responsibility of national governments, there are several areas where a broader multinational approach might be helpful. Governments, local authorities, role players and education institutions, and professional associations or societies should build an appropriate distance/technology enabled component into the model framework curriculum, taking a semi-blended, self-paced element into all learning, without disadvantaging any student or fellow. Teacher/institute expectations need to be addressed directly. Reasons for poor performance might include elitism and over-ambitious curricula (or failure to ‘teach at the right level’) besides poor access to technology and other resources. Additionally, high-stake exams may encourage teachers to ‘teach to the top’, while lower performing students and fellows fall further behind.

However, one needs to be cautious in advocating singular solutions, as the environments and socioeconomic contexts are diverse and different.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Acronyms

COVID-19	Corona Virus Disease 2019
CPD	Continuous Professional Development
FA	Finance and Administration
GTF	Global Transfusion Forum
HDI	Human Development Index
HE	Higher Education
HQ	Head Quarter
HRM	Human Resource Management
ICT	Information and Communication Technology
ID	Identity
IH	Immunohematology
IV	Intravenous

MBA	Master of Business Administration
MoU	Memorandum of Understanding
PBM	Patient Blood Management
PR	Public Relations
QA	Quality Assessment
QC	Quality Control (testing)
QSM	Quality System Management
TQM	Total Quality Management
UN	United Nations
UNDP	United Nations Development Program
WHO	World Health Organization

References

1. United Nations Universal Declaration of Human Rights. 1948. Accessible at www.un.org/en/documents/udhr/nde.shtml
2. UNDP Human Development Index. Accessible at <http://hdr.undp.org/en/content/human-development-index-hdi>
3. New country classifications by income level: 2019–2020. Accessible at <http://blogs.worldbank.org/opendata/new-country-classifications-income-level-2019-2020>
4. UN Millennium Development Goals 2000–2015. Accessible at New country classifications by income level: 2019–2020. Accessible at <http://blogs.worldbank.org/opendata/new-country-classifications-income-level-2019-2020>
5. United Nations. Sustainable Development Goals. New York: United Nations; 2015. Accessible at <https://sustainabledevelopment.un.org/?menu=1300>.
6. WHO Model List of Essential Medicines, 18th edition Geneva, CH. 2013. Accessible at http://www.who.int/medicines/publications/essentialmedicines/18th_EML.pdf
7. WHO Model List on Essential in-vitro Diagnostics, 1st edition, Geneva, CH. 2018. Accessible at http://www.who.int/medical_devices/diagnostics/WHO_EDL_2018.pdf
8. UN Resolution 67/81 Global Health Policy. New York, USA, 2012
9. WHO Universal Health Coverage. Accessible at http://www.who.int/universal_health_coverage/en/
10. Action framework to advance universal access to safe, effective and quality-assured blood products. 2020–2023. WHO Geneva, CH 2020 Licence: CC BY-NC-SA 3.0 IGO
11. WHA Resolution 72.6 Global action on patient safety. Accessible at https://apps.who.int/gb/ebwha/pdf_files/WHA72/A72_R6-en.pdf
12. WHO Global Patient Safety Action Plan 2021–2030 ‘Towards Eliminating Patient Harm in Health Care. Third Draft January 2021. Accessible at https://www.who.int/docs/default-source/patient-safety/global-patient-safety-action-plan-2021-2030_third-draft_january-2021_web.pdf?sfvrsn=948f15d5_17
13. Rambiritch V, Smith-Tolken A. The imperative of teaching professionalism to biomedical technologists. *AJHPE* 2019;11:139–44
14. World Health Organization. Blood Safety Unit. Safe blood and blood products : costing blood transfusion services. 1998, World Health Organization. Accessible at <https://apps.who.int/iris/handle/10665/65533>

15. Louw VJ. A Model for the Academic Development and Implementation of a Postgraduate Diploma in Transfusion Medicine in the School of Medicine at the University of the Free State. PhD HPE academic thesis Division Health Sciences Education, Faculty of Health Sciences, University of the Free State, Bloemfontein, South Africa 2010. Chapter 7.3 Principles and points of departure. Pp174–75.
16. WHO Guidance on centralization of blood donation testing and processing. 2021 (in press)
17. The Effect of Covid-19 on Education in Africa and its Implications for the Use of Technology. A survey of the experience and opinions of educators and technology specialists. EdTechHub and eLearning Africa 2020. DOI 10.5281/zenodo.4019774
18. Al-Riyami AZ, Louw VJ, Indrikovs AJ, Nedelcu E, Bakhtary S, Eichbaum QG, Smit Sibinga CTh. Global survey of transfusion medicine curricula in medical schools: Challenges and opportunities. *Transfusion* 2020; Doi 10.1111/trf.16147 (on line)
19. Rambiritch V, Vermeulen M, Bell H, Knox P, Nedelcu E, Al-Riyami AZ, Callum J, van den Berg K, on behalf of the Education Subcommittee of the AABB Global Transfusion Forum. Transfusion medicine and blood banking education and training for blood establishment and blood bank laboratory staff – A glimpse into Africa. Submitted 2020.
20. WHO Report Informal Consultation on Assessment of Training Needs in Transfusion Medicine 1991. WHO_LBS_92.6, 1992 Geneva, CH
21. WHO Report Informal Consultation on Collaboration in Training in Transfusion Medicine 1991. WHO_LBS_92.7, 1992 Geneva, CH
22. WHO Report Informal Consultation to Develop a Global Strategy on Education and Training in Blood Transfusion. 2004. Geneva, CH
23. Strategy for Education and Training in Blood Transfusion at Global, Regional and National Level. Blood Transfusion Safety. Department of Essential Health Technologies, WHO, Geneva, CH 2006
24. Global Collaboration for Blood Safety: General Meeting Report. 2008 World Health Organization, Geneva, CH
25. Fundamental Standards for Blood Collection and Transfusion. 1st Edition 2018. AABB Bethesda, MD, USA
26. Louw VJ. A Model for the Academic Development and Implementation of a Postgraduate Diploma in Transfusion Medicine in the School of Medicine at the University of the Free State. PhD HPE academic thesis Division Health Sciences Education, Faculty of Health Sciences, University of the Free State, Bloemfontein, South Africa 2010. Chapter 7.4 The role players who may influence the academic development and implementation of a postgraduate diploma in transfusion medicine. Pp177–84.
27. Jansen van Galen JP, Smit Sibinga CTh. Process Management in the Vein-to-Vein Chain. In: Smit Sibinga Cees Th. Editor. Quality Management in Transfusion Medicine, Chapt IV. Nova Science Pubs. Inc, New York, NY, USA. 2013 pp131–85
28. Human Development Indices and Indicators. 2018 Statistical Update. United Nations development Program, New York, NY, USA. 2018
29. Crouch L, Rolleston C, Gustafsson M. Eliminating global learning poverty: The importance of equalities and equity. *Int J Educ Development* 2020; DOI 10.1016/j.ijedudev.2020.102250, on line
30. Louw VJ. Determining the outcomes for clinicians completing a postgraduate diploma in transfusion medicine. *Transfus Apher Sci* 2014; 51:38–43 [PubMed: 25457005]



Figure 1 –.
The 17 Sustainable Development Goals 2016–2030, with nr. 4 Quality Education.

Table 1 –

Issues to be considered for utilising the model for the vocational and academic development in Transfusion Medicine.

- Take into account the legal and policy framework of the country in which it is used.
- Take into account the higher and academic education system in the country.
- Take into account the situation where Transfusion Medicine is not recognised as a specific discipline.
- Take cognisance of, and be aligned with the vision, mission, policies guidelines and needs of the institution in which it is implemented.
- Provide a theoretical and philosophical basis for the development of a graduate certificate or postgraduate diploma in Transfusion Medicine (technical/vocational, academic).
- Be based on the principle of equal opportunity and provide equitable access to students meeting the stated academic prerequisites from all levels of society and health care provision.
- Contain recommendations for what would constitute quality education for a professional undergoing training in such a certificate or diploma, including the principles of professionalism (13), open-mindedness, critical thinking, scholarship and respect for the pluralism of cultures and complexity of societies.
- Take into account the fact that the levels at which Transfusion Medicine is practised (primary, supportive and steering processes) will vary according to the level of healthcare (i.e., primary, secondary or tertiary), the developmental status of a region or country, level of implementation of the Universal Health Coverage and Model List of Essential Medicines, affordability, national and local healthcare policy, cultural and socio-economic factors.

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Table 2 –

Contexts of Transfusion Medicine practice to be considered.

- Consider that ethical issues and challenges related to the education and training in Transfusion Medicine encompass a wide variety of concepts, principles, disciplines and theories and range from the global and more conceptual to the most personal, direct and practical.
- Take into account the principle of blood as a national resource, non-for-profit service and without boundaries of state, religion, nationality, culture, etc.
- Take into account the principle of centralization of blood donation testing and processing to standardize quality and safety of blood (16)
- Follow an outcomes-based approach, with clear recommendations on the required roles, knowledge, skills, attitudes, ethical and professional values of a trainee completing such a program. This should be linked to the scope of practice required from such a professional (medical, nursing, technical) and address the deficiencies that exist before the program is completed. It should take into account international standards of knowledge and practice.
- Take account of adult learning principles and modern methods of teaching and education (e.g., blended, e-learning, self-learning).
- Focus on the clinical practice of transfusion medicine and related issues supported by a theoretical basis of blood banking and laboratory medicine (procurement/manufacturing of blood) rather than the other way around.
- Be fit for purpose, easy to understand, apply and implement.
- Provide clear recommendations for the development and implementation of the model framework, in particular the contents of the curriculum.

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