Modeling global transfusion medicine education

Cees Th. Smit Sibinga | Vernon J. Louw | Elena Nedelcu | Arwa Z. Al-Riyami | Sara Bakhtary | Sue T. Johnson
Vanitha Rambiritch | Varsha Seoraj | Jeannie Callum | Karin van den Berg | Marion Vermeulen | Claire A. Barrett
Quentin G. Eichbaum | on behalf of the Subcommittee on Education of the AABB

Global Transfusion Forum

1IQM Consulting, Zuidhorn and University of Groningen, Groningen, The Netherlands
2Division of Clinical Haematology, Department of Medicine, Groote Schuur Hospital, University of Cape Town, Cape Town, South Africa
3Division of Transfusion Medicine, Department of Laboratory Medicine, University of California, San Francisco, California, USA
4Department of Haematology, Sultan Qaboos University Hospital, Muscat, Oman
5Versiti, Blood Center of Wisconsin, Milwaukee, Wisconsin, USA
6South African National Blood Service, Roodepoort, South Africa
7Department of Pathology and Molecular Medicine, Kingston Health Sciences Centre, Queen’s University, Kingston, Ontario, Canada
8School of Clinical Medicine, Faculty of Health Sciences, University of the Free State, Bloemfontein, South Africa
9Department of Pathology, Microbiology and Immunology, Vanderbilt University Medical Center, Nashville, Tennessee, USA

Correspondence
Cees Th. Smit Sibinga, IQM Consulting, Zuidhorn and University of Groningen, Groningen, The Netherlands.
Email: c.sibinga@planet.nl

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 World War II 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.

During ensuing decades societies changed, movements toward decolonization started and, in general, public awareness of the principle human rights gained

Abbreviations: 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.

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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 of the 17 focuses on quality education, stating: “Ensure inclusive and equitable education and promote lifelong learning opportunity.”

The 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 sex 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 six strategic objectives.\(^10\) Strategic objective six 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 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 being implemented.\(^12\)

Still, the Sustainable Development Goals (SDGs) 2016–2030\(^5\) require new indicators for assessing the many faces of inequality in, for example, 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 toward the future.

1.1 | Final responsibility

Ministry of Education, Government to guarantee formal recognition and license (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 (outcome-based, problem-based, blended learning, and so forth; principles of adult learning in education, modern methods of teaching), possibilities for implementation of international recommendations for example, 2010 UN Universal Health Coverage program,\(^9\) 2013 WHO Model List of Essential Medicines,\(^6\) 2018 WHO Model List of in vitro Essential Diagnostics.\(^7\)

Utilizing 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 in Table 1.

The Transfusion Medicine vein-to-vein concept follows three levels of processes for which basic knowledge and skills are required (Table 2).

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 as presented in Table 3.

The recent (September 2020) eLearning Africa/EdTechHub report on the “Effect of COVID-19 on...
TABLE 3  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, and so forth.
- Take into account the principle of centralization of blood donation testing and processing to standardize quality and safety of blood.
- Follow an outcome-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, and 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, and 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.

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 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).

The model aims to provide a basic structure and infrastructure needed for sustained and tailor-made transfusion medicine education at all levels and irrespective of the developmental stage.

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. 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 toward 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, for example, 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.

The primary processes consist of the core business functions of the vein-to-vein transfusion chain, divided into the supply and consumption part (Table 4A). These functions/positions need personnel with a secondary education background and a vocational (medical technicians/laboratory professionals, nurses, finance and administration/business) or academic (medical, pharmaceutical, business/MBA) higher or tertiary education.

The supportive or secondary processes contain for both the procurement and the clinical aspects (Table 4B). These functions/positions require for the ancillary supportive part a minimal primary education background, and for the supportive infrastructure (Human Resource Management [HRM], Finance & Administration [FA], engineering) a secondary education background followed by a vocational and/or managerial education at higher education (HE) level.

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), Public Relations (PR) and representation, quality management, planning (medium and long term), economics and budget accountancy.

These functions/positions need well-developed leadership, stewardship and governance capacities at HE or academic level; a higher administrative education (e.g., MBA) is certainly an asset.

The approach illustrates the need for an existing human resource pool of primary, secondary and
Diversities of sub-processes. A - primary processes group; B - secondary processes group

(A) Primary processes group

(1) procurement/manufacturing or supply part:
  - Community communication/public awareness and education, donor motivation, mobilization and retention, donor selection, donor care, and blood collection;
  - Processing of collected blood, platelets, and plasma (manufacturing);
  - Testing (mandatory QC, and product specifications);
  - Storage, quarantine release, labeling, 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, and 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)

(B) Secondary processes group

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, for example, maintenance (mechanics and engineering), human resource management (HRM), finance and administration (FA), domestic services (canteen, laundry, wellness, and waste).

HE/tertiary educated potential. The 2018 UNDP Human Development Indices and Indicators, and the 2020 eLearning Africa/EdTech 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.

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 is much lower compared with 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.

In 2020, WHO launched the Action Framework to Advance Universal Access to Safe, Effective and Quality-Assured Blood Products 2020–2023, with six Strategic Objectives. 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
3.6 | Vocational or professional backgrounds

Analyzing 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 S1.

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 specialization 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 behavior (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 outcome-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 hematology, 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 Tables S2–S5.

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 (Table S6).

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\(^30\) (Table S7).

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 (Table S8).

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 the following exit-level outcomes as listed in Table S9.

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 for the 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 among 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.
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CONFLICT OF INTEREST
The authors have disclosed no conflicts of interest.

ORCID
Cees Th. Smit Sibinga 🔗 https://orcid.org/0000-0003-0156-5620
Elena Nedelcu 🔗 https://orcid.org/0000-0001-5981-9633
Arwa Z. Al-Riyami 🔗 https://orcid.org/0000-0001-8649-0650
Sara Bakhtary 🔗 https://orcid.org/0000-0002-7896-2459
Vanitha Rambiritch 🔗 https://orcid.org/0000-0003-3056-0482
Jeannie Callum 🔗 https://orcid.org/0000-0001-6133-0677
Karin van den Berg 🔗 https://orcid.org/0000-0001-9805-8013
Marion Vermeulen 🔗 https://orcid.org/0000-0003-4383-4526

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SUPPORTING INFORMATION
Additional supporting information may be found in the online version of the article at the publisher’s website.

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