EBMT

PERSPECTIVE

Protection of haematopoietic progenitor cell donors: an updated overview of the European landscape

Jacinto Sánchez Ibáñez[1], Arlinke Bokhorst[2], Akila Chandrasekar[3], Beatriz Domínguez-Gil[4], Jorge Gayoso[5], Artur Kaminski[6], Mar Lomero[7], Marta López-Fraga[7] and Nina Worel[8]✉

Haematopoietic progenitor cell donation from bone marrow and mobilised peripheral blood obtained from related and unrelated donors is an established procedure. The donation process in general has proven to be safe, but in rare cases severe and even fatal events have been reported. The present study aimed at providing a description of the current situation of donor protection measures in Council of Europe member States. A specific questionnaire was developed to compile information on donation activities, graft sources, legal frameworks, donor protection measures, collection of donor outcome data, and long-term follow-up of paediatric and adult related and unrelated donors. The outcome of this survey served as a basis for elaborating the Recommendation CM/Rec(2020)6 of the Committee of Ministers to member States on establishing harmonised measures for the protection of haematopoietic progenitor cell donors.

Bone Marrow Transplantation (2023) 58:842–848; https://doi.org/10.1038/s41409-023-01982-w

INTRODUCTION

Haematopoietic cell transplantation (HCT) is an established procedure for the treatment of many inherited or acquired bening or neoplastic disorders of the haematopoietic system, including those of the immune system and metabolic disorders [1–4].

The activity survey of the European Society of Blood and Marrow Transplantation (EBMT), describing the status of HCT in Europe and affiliated countries, has become an instrument to observe trends and to monitor changes in technology [5–7]. During the COVID-19 pandemic transplant numbers declined from over 48 500 to 45,364 comprising of 18,746 allogeneic (41%) and 26,568 autologous (59%) HCT reported in 2020 [3, 4]. The proportion of related donors (RDs) was 50%, including adults, adolescents and children. Worldwide data demonstrate that approximately one-third of children undergoing allogeneic HCT receive haematopoietic progenitor cell (HPC) grafts from siblings under the age of 18 years [8, 9].

Better supportive care and the administration of reduced-intensity conditioning regimens have contributed to an increase in HCT in older patients, whose RDs are usually also older. As a consequence, the median age of related PBPC donors has increased and is approximately 10 years higher than that of unrelated PBPC donors [10], leading to potentially more donors with occult or manifest comorbidities at the time of donation. In addition, advances in HLA-typing and the use of new immunosuppressive protocols enabling safe haploidentical HCT has led to a further increase in the utilisation of preferable younger (i.e., also minor) RDs, with a simultaneous decrease in cord blood transplantation [7]. It is of utmost importance to ensure the safety of related and unrelated stem cell donors and to avoid any risk both for the donor (i.e., stem cell mobilization and donation) and the patient (i.e., transmissible diseases from the donor). However, in contrast to URDs where donor clearance is clearly separated from the clinical team this is normally not the case in RD.

The Committee on Organ Transplantation (CD-P-TO) is the steering committee in charge of organ, tissue and cell donation and transplantation activities at the European Directorate for the Quality of Medicines and HealthCare (EDQM) of the Council of Europe (CoE)[1]. The Council of Europe is based in Strasbourg, founded in 1949, and includes 46 member States. It is an entirely separate body from the European Union, which is composed by currently 27 member States based in Brussels.

In 2018, the CD-P-TO launched a project to analyse protection measures in place to safeguard the health and rights of HPC donors. As of August 2020, the CD-P-TO was composed of representatives of 36 members States and additional participants and observers, such as the European Commission (EC), the World Health Organization (WHO), the Council of Europe Committee on Bioethics (CDBIO), and relevant professional societies in the field,

[1]https://www.edqm.eu/documents/52006/286849/CD-P-TO_EN.pdf/48fdb16c-a8c8-3cc1-d034-b0ea670e86d5?t=1640004791214

[1]Tissue Establishment and Cryobiology Unit, A Coruña University Hospital, A Coruña, Spain. [2]TRIP Foundation, Dutch office for hemo- and biovigilance, Leiden, the Netherlands. [3]National Health Service Blood and Transplant, Liverpool, UK. [4]Organización Nacional de Trasplantes, Madrid, Spain. [5]Hematology Dept, Hospital General Universitario Gregorio Marañón, Madrid, Spain. [6]Department of Transplantology and Central Tissue Bank, Medical University of Warsaw, National Center for Tissue and Cell Banking, Warsaw, Poland. [7]European Directorate for the Quality of Medicines & HealthCare (EDQM), Council of Europe, Strasbourg, France. [8]Dept. for Transfusion Medicine and Cell Therapy, Medical University of Vienna, Vienna, Austria. ✉email: nina.worel@meduniwien.ac.at

Received: 20 July 2022 Revised: 28 March 2023 Accepted: 30 March 2023
Published online: 15 April 2023

including EBMT and WMDA.[2]. In this article we summarise the findings of this project, providing an overview of measures in the CoE member States to protect HPC donors. Based on these findings, the CD-P-TO prepared a recommendation on establishing harmonised measures for the protection of HPC donors, which was adopted by the Committee of Ministers of the CoE at the 1385th meeting of the Ministers' Deputies [11]. This recommendation includes 2 appendices, with guidance for the medical suitability assessment and eligibility criteria of HPC donors and for the collection of a minimum data set on all HPC donors and donations and is therefore a helpful tool for all Health Authorities and facilities involved in HPC donor clearance and clinical follow-up of donors after the HPC donation process.

MATERIAL AND METHODS

A questionnaire to gather information on current practice in HPC donations/donors was designed by a working group of CD-P-TO representatives. A pilot group composed of representatives from five different countries revised the wording and ensured the clarity of the proposed questions. The final questionnaire was approved by the CD-P-TO.

The survey (Supplementary Table 1) included 23 questions about HPC donation activities (including related and unrelated donation), HPC sources (bone marrow, mobilised PBPCs), legal frameworks, donor protection measures (e.g., age restrictions, defined number of maximum donations), collection of donor outcome data, and long-term follow-up of HPC donors.

The questionnaire was sent in electronic format to all CD-P-TO delegates who collected the information from official sources, either the relevant national health authority(ies) or their delegated agency(ies) in the field of transplantation. As it is mandatory for EU member States to report on HPC procurement activity to the relevant national authorities on an annual basis, national data collected in this survey derive from only one official source. All responses were returned to the CD-P-TO Secretariat for subsequent data quality control and descriptive analysis. The participating countries had 6 months to reply. Email reminders for participation in the survey were sent twice to the relevant CD-P-TO representatives. The results of this data collection were presented and discussed in CD-P-TO plenary meetings to understand the practices and ethical implications of the different national approaches. This article summarises the data provided by the respondents and the deliberations of the CD-P-TO on the subject.

RESULTS

The response rate to the questionnaire was 55%. It was completed by 23 out of 42 countries (Armenia, Austria, Bulgaria, Croatia, Czech Republic, Finland, France, Germany, Hungary, Ireland, Israel, Italy, Republic of Moldova, Norway, Poland, Portugal, Russia, Spain, Sweden, Switzerland, Netherlands, Türkiye and the United Kingdom). The participating countries were mostly those that reported a high level of HPC donation activity in their countries. The Republic of Moldova answered the survey buy reporting not to have any HPC transplant activity and was therefore excluded from further analysis. Information was analysed from the remaining 22 countries with activity in the field of HPC transplantation.

[2]The Russian Federation ceased to be a member of the Council of Europe as of 16 March 2022, following a decision of the Committee of Ministers to exclude the Russian Federation from the Council of Europe. Rights of representation of Belarus to participate as observer or in any other capacity in meetings and activities of the Committee of Ministers of the Council of Europe or in any of its subsidiary organs were suspended on 17 March 2022.

All but one country (96%) declared to have a donor registry for URDs, 9 countries (41%) for reported having also an outcome registry for RDs and/or URDs and patients and 3 countries reported having a URD and recipient outcome registry (Fig. 1). The majority of countries confirmed the reporting of recipient outcomes to a scientific organisation (EBMT).

HPC and leukocyte collection activity

Collection centres for related donors. The mean (±SD) number of HPC collection centres for RDs per million population (pmp) is 0.46 (±0.27) for bone marrow (BM) and 0.5 (±0.23) for PBPC. This is slightly more than for URDs, where 0.33 (±0.22) BM and 0.35 (±0.22) PBPC collection centres were reported.

Collection centres for related donors below 18 years of age. Armenia reported no activity. In 3 countries (14%; Austria, Germany, Netherlands) a differentiation between adult and paediatric collection sites was not possible as donor age is not included in the respective annual activity reports. In 2 countries (9%; France, Italy) no PBPC collection centres for minor donors exist as the use of growth factor stimulation in paediatric donors is not permitted in their jurisdictions (Supplementary Table 2).

Collection activity for related (>18 years and < 18 years) and unrelated donors. As not all countries collecting data on the annual activity of cell and tissue procurement centres also record the age of the HPC donors, data on related adult (>18 years) and paediatric donors (<18 years) were incomplete.

PBPC collections. The mean number of PBPC collections from URDs was 4.96 (± 6.6) pmp and 6.9 (±6.2) pmp and from adult RDs (>18 years), respectively. Data on the number of PBPC collections from paediatric donors (<18 years) were reported by only 9 countries (41%).

Bone marrow collections. The mean (±SD) number of unrelated BM collections pmp was 1.8 (± 3.4). For RDs, data was received from 12 countries for donors <18 years and 14 countries for donors >18 years of age. The mean (±SD) number of related adult BM collections from countries that reported information was 2 (±1.4) pmp. In related BM donors <18 years, was 0.9 (±0.96) pmp performed during 2017.

Unstimulated leukapheresis (donor leukocyte infusions). The mean (±SD) number of related donor leukocyte infusions (DLI) collections was 1.5 (± 2.9) pmp in countries responding to this question. For RD, some countries do not distinguish between minors and adults ($n = 3$), or do not collect the number of DLI ($n = 9$). The remaining countries ($n = 10$) reported between 0 and 4.52 DLI collections pmp for adult donors and between 0 and 0.42 pmp for minor donors.

Reporting of severe adverse reactions and events and outcome data

Severe adverse reaction and event reporting. In all countries, severe adverse reaction and event (SARE) data are collected for all types of donations (PBPC, BM, DLI) as well as data on the outcome of SARE in donors.

Different bodies/institutions are responsible for collecting information on SARE in donors: collection centres (Ireland, Norway, Portugal, Russia), health authorities (Austria, France, Germany, Poland, Spain, Sweden, Türkiye, UK), donor registries (Czech Republic, Israel, Switzerland), registries together with donor and collection centres (Italy, Netherlands), quality department of the hospital (Croatia), transplant physicians (Bulgaria, Hungary), medical director (Armenia), and registry together with transplant unit (Finland).

All countries except Armenia report the outcome of donors who experience severe adverse reactions (SAR), an activity which is

Fig. 1 describes the existence of registries in the participating countries. Countries with unrelated registries are depicted in dark blue, countries with unrelated donor registries and patient outcome registries in medium blue, and countries with unrelated donor registries, donor (related and/or unrelated) outcome registries and patient outcome registries in light blue.

mandatory in 19 (86%) countries. Data are entered into a database in 16 (73%) countries. In all but two countries (Germany and Russia), these data are regularly analysed and summarised. In addition, some countries report the data at regular intervals to the EC SARE system ($n = 6$, 30%), to the World Marrow Donor Association (WMDA; $n = 6$, 30%), to both EBMT and Worldwide network for Blood and Marrow Transplantation (WBMT; $n = 2$, 10%), or to the EC SARE system and WBMT ($n = 2$, 10%).

Donor Outcome Data. Eight (36%) countries reported having a centralised donor outcome registry which is used for data from RD and URD (Austria, Bulgaria, Croatia, Finland, Italy, Poland, Portugal, Switzerland) (Fig. 2). In 17 (77%) countries, outcome data on URD are collected, whereas only 10 (45%) indicated they collect data on RD but not all of them collect these data in a registry. Donor follow-up is performed independently of patient follow-up in the majority of countries (17; 77%).

Seventeen (77%) countries collect data on long-term outcome prospectively, including incidence and type of malignancies (15/22 68%), autoimmune disorders (15/22; 68%), cardiovascular and thromboembolic events (17/22; 77%) and other disorders (16/22; 73%) (Table 1). However, these data are usually not collected in the same manner (12/22; 55%) for URDs and RDs.

Long-term outcome data are mandatorily reported in the majority of countries (14/22; 64%) and are collected in a database in 9 (41%). The proposed period for the provision of long-term follow-up data differed between countries, but 10/20 (50%) countries defined long-term as a 10-year period. Nine of 22 (41%) countries reported that long-term clinical follow-up of paediatric donors was the same as for adult donors (Fig. 3).

For URDs outcome data collection was primarily the responsibility of registries ($n = 15$, 68%) and procurement centres alone or in co-operation with registries ($n = 4$, 18%), whereas for RDs it was mainly the clinical facility alone ($n = 9$, 41%) or in co-operation with the procurement centre ($n = 3$, 14%), or unrelated donor registries ($n = 3$, 14%) that were responsible.

For URDs, the majority of countries had some kind of donor insurance ($n = 16$, 73%) which was mandatory in 9/16 (56%) countries, but only 8 (16%) countries had insurance (e.g., in terms of disability after the donation process) in addition to health insurance coverage (Fig. 4).

Legal obligations and recommendations. The majority of countries had legal obligations and recommendations on the upper and lower age limit for URDs (16/22; 73% and 20/22; 91%, respectively); however, for RDs only 6/22; 27% and 9/22; 41%, had upper and lower limits, respectively.

In more detail, legal obligations imposed a lower age limit of at least 18 years for URDs in 14 of 16 (88%) countries, with an upper age limit of 55–60 years. For RDs, 6 countries reported legal obligations with the following age limits: 0–55 years ($n = 1$), >18 years except for minors donating to a sibling ($n = 2$), >18 years ($n = 1$), <65 years ($n = 1$), and one country required donor clearance by Competent Authorities. In addition, 8 countries had recommendations but no legal obligations on age limits for RDs: 18–55 years, except minors donating to a

Fig. 2 describes countries collecting donor outcome data. Countries who collect unrelated and related donor outcome data are depicted in purple, in blue countries who collect unrelated donor outcome data, green indicates countries who do not collect donor outcome data.

Table 1. Type of data collected on long-term complications by countries.

Country	Malignancies	Autoimmune disorders	Cardiovascular or thromboembolic disorders	Others
Armenia, Austria, Czech Republic, Finland, Hungary, Ireland, Israel, Italy, Norway, Portugal, Spain, Switzerland, Netherlands, United Kingdom,	X	X	X	X
Bulgaria, Croatia	**	**	X	X
Republic of Moldova	*	*	*	*
Poland	X	X	X	**
France, Germany, Sweden, Russia, Türkiye	**	**	**	**

* no activity reported ** data not collected

Table 1 shows the countries that collect data on long-term complications in haematopoietic progenitor cell donors and type of data collected.

sibling ($n = 1$), ≤65 years ($n = 3$), ≤55 years ($n = 1$), 0–70 years ($n = 1$), 1–75 years ($n = 1$), >1 year ($n = 1$) (Supplementary Table 3).

Additional responses on mobilisation (e.g., new mobilising agents, dose of haematopoietic growth factors) and collection parameters (e.g., number of donations, volume of donation, upper and lower age limits) are given in Supplementary Table 4 and Supplementary Fig. 1.

All countries have specified donor eligibility criteria for URDs and 18 (82%) have additional eligibility criteria for RDs. However, only 15 countries (68%) have specific criteria for paediatric donors (Fig. 5). In 14 (63%) countries a minor donor can donate HPC to an adult relative, whereas this is not permitted in 5 (23%) and unknown in 3 (14%) countries.

DISCUSSION

Globally, allogeneic HCT from RDs is performed more often than from URDs [12]. In the EBMT registry, the number of haploidentical RDs HCTs is increasing rapidly and RDs (HLA-identical and haploidentical) reached the numbers of URDs in 2020 [13], [4]. Allogeneic HPC donation has been shown to be a safe procedure with very low rates of SAE [10]. New developments in transplant procedures (e.g., reduced-intensity conditioning, haploidentical

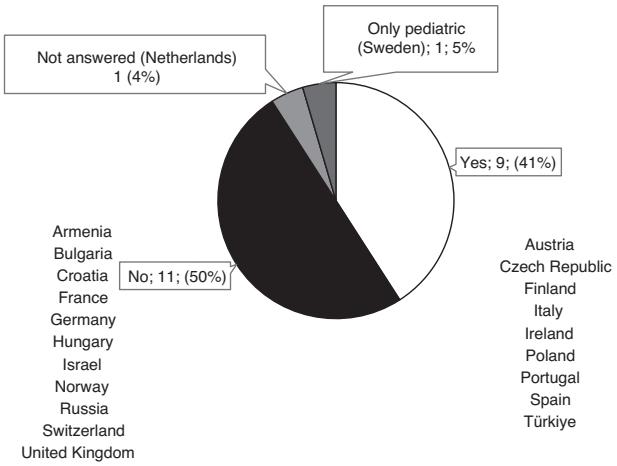

Fig. 3 describes donor long-term follow-up in reporting countries. Coloured in black countries who do not have donor long-term clinical follow-up for adult and paediatric donors, coloured in dark grey countries who only collect donor long-term clinical follow-up for paediatric donors, coloured in grey pale countries who did not answered the question, and coloured in white countries who have donor long-term clinical follow-up for adult and paediatric donors.

transplantation) may lead to changes in acceptance criteria for HPC donors, such as older familial donors – including those with comorbidities – and donors <18 years of age potentially donating to their parents or other adult family members. All this may increase the risk of donor SARE. Of note, donor outcome data are not reported prospectively so far, especially in the related setting.

Organisations responsible for the care of URDs, such as the WMDA, have published detailed recommendations for the assessment of donor health [14], while recommendations for RDs who often would not qualify as URDs are less stringent and less well established [15]. With increasing possibilities for RD to play a role in the treatment of their relatives, further guidelines on RD selection and systems for RD follow-up and SARE reporting are needed. Recently, the WBMT standing committee on donor issues has published updated consensus recommendations on suitability criteria for related and unrelated HPC donors [16]. Most importantly, healthcare providers responsible for related HPC donor clearance must ensure that the risk of harm associated with HPC mobilisation and procurement is kept to a minimum, and should advise alternatives where suitable and available when there is an increased risk of donor complications. The EDQM has published guidance for HPC donor evaluation and biovigilance in the Guide to the quality and safety of tissues and cells for human application [17], which is updated every 3 years. In addition, HCT programmes are seeking quality accreditations, which are

Fig. 4 shows the insurance schemes for related and unrelated donors. Coloured in green countries who have related and unrelated mandatory insurance schemes, coloured in blue countries who have unrelated non-mandatory insurance schemes (e.g., in terms of disability after the donation process), and purple indicates countries who have related and unrelated non-mandatory systems in addition to health insurance coverage. Coloured in yellow countries who have unrelated mandatory insurance schemes, and coloured in red countries who do not have insurance scheme. countries had insurance (e.g., in terms of disability after the donation process) in addition to health insurance coverage.

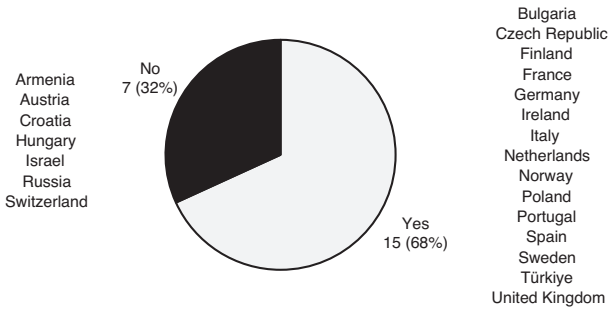

Fig. 5 defines countries with respect to specific eligibility criteria for paediatric donors. Countries with specified donor eligibility criteria for paediatric donors are depicted in white whereas black indicates countries that reported not to have such criteria.

primarily intended to improve patient but also donor safety. The Foundation for the Accreditation of Cellular Therapy (FACT) and the Joint Accreditation Committee of ISCT and EBMT (JACIE) [18], are mainly used in Europe but also in other areas. However, geographical areas might have slight differences in the evaluation of related HPC donors. In North America for example, many of the requirements for donor evaluation are governed by regulations (FDA HCTP rules) and accreditation organization requirements. Those requirements include assessment of donor eligibly and suitability for each day of collection. Similar to the European approach, donor suitability will ensure it is safe for the donor to go through the collection procedure.

The results of our survey show that practices for the follow-up of donors and the registration of data differ significantly between CoE member states. Donor outcome data for both HPC RDs (adults and minors) and URDs, including their health status and short-, medium- and long-term complications (e.g., malignancies, autoimmune disorders, thromboembolic disorders), should be collected, notified to health authorities and managed to help prevent these risks in the future and guarantee an equal level of donor safety and protection. Only through the compilation of harmonised data on the outcome of HPC donors (related and unrelated, adults and minors) by health authorities or officially designated bodies will it be possible to obtain sufficient information to define and secure the proper follow-up of HPC donors, to document prognoses (safety/morbidity) of these donors, as well as to investigate causal relationships between pre-donation comorbidities and the incidence of complications during and after the donation process. On the basis of these data, advice on possible preventive measures can be given, and future HPC donors can be adequately informed about the risks related to the donation process. Most importantly, as a result of our survey, the Committee of Ministers of the CoE adopted Recommendation CM/Rec(2020)6 on establishing harmonised measures for the protection of HPC donors in member states [11]. This legal text provides recommendations for the assessment of donor medical suitability and on eligibility criteria for HPC donation, addresses the consent process, provides guidance for short- and long-term post-donation follow-up, and highlights the need to collect a minimum set of data on all HPC donors (related and unrelated, adults and minors; peripheral blood stem cells (PBSC) and BM), as specified in Appendix 2 of the Recommendation.

To improve our knowledge in the short and long term, prospective follow-up of all donors through data collection and analysis in large registries is absolutely vital in this rapidly evolving field. This will enable vigilance and surveillance of all donations and improve knowledge of the risks of donation in the future [15, 19, 20]. It is fundamental that advancements in the field of HCT should include measures to ensure the protection of donors, from both the medical and psychosocial perspectives.

DATA AVAILABILITY

All data generated or analysed during this study are included in this published article and its supplementary information files.

REFERENCES

1. Copelan EA. Hematopoietic stem-cell transplantation. N. Engl J Med. 2006;354:1813–26.
2. Gratwohl A, Baldomero H, Aljurf M, Pasquini MC, Bouzas LF, Yoshimi A, et al. Hematopoietic stem cell transplantation: a global perspective. JAMA 2010;303:1617–24.
3. Passweg JR, Baldomero H, Chabannon C, Basak GW, de la Camara R, Corbacioglu S, et al. Hematopoietic cell transplantation and cellular therapy survey of the EBMT: monitoring of activities and trends over 30 years. Bone Marrow Transpl. 2021;56:1651–64.
4. Passweg JR, Baldomero H, Chabannon C, Corbacioglu S, de la Cámara R, et al. Impact of the SARS-CoV-2 pandemic on hematopoietic cell transplantation and cellular therapies in Europe 2020: a report from the EBMT activity survey. Bone Marrow Transpl. 2022;57:742–52.
5. Sureda A, Bader P, Cesaro S, Dreger P, Duarte RF, Dufour C, et al. Indications for allo- and auto-SCT for haematological diseases, solid tumours and immune disorders: current practice in Europe, 2015. Bone Marrow Transpl. 2015;50:1037–56.
6. Gratwohl A, Pasquini MC, Aljurf M, Atsuta Y, Baldomero H, Foeken L, et al. One million haemopoietic stem-cell transplants: a retrospective observational study. Lancet Haematol. 2015;2:e91–100.
7. Passweg JR, Baldomero H, Bader P, Bonini C, Cesaro S, Dreger P, et al. Hematopoietic SCT in Europe 2013: recent trends in the use of alternative donors showing more haploidentical donors but fewer cord blood transplants. Bone Marrow Transpl. 2015;50:476–82.
8. Passweg JR, Baldomero H, Peters C, Gaspar HB, Cesaro S, Dreger P, et al. Hematopoietic SCT in Europe: data and trends in 2012 with special consideration of pediatric transplantation. Bone Marrow Transpl. 2014;49:744–50.
9. Shah NN, Wayne AS, Grady C, Fry T, Wendler D. Children as hematopoietic cell donors in research: when is it approvable? Bone Marrow Transpl. 2015;50:15–9.
10. Halter J, Kodera Y, Ispizua AU, Greinix HT, Schmitz N, Favre G, et al. Severe events in donors after allogeneic hematopoietic stem cell donation. Haematologica. 2009;94:94–101.
11. Council of Europe Committee of Ministers, Recommendation CM/Rec 6 of the Committee of Ministers to member States on establishing harmonised measures for the protection of the haematopoietic progenitor cell donors. (2020). https://rm.coe.int/09000016809fdd5b. Accessed 7 Oct 2020.
12. Niederwieser D, Baldomero H, Bazuaye N, Bupp C, Chaudhri N, Corbacioglu S, et al. One and a half million hematopoietic stem cell transplants: continuous and differential improvement in worldwide access with the use of non-identical family donors. Haematologica. 2022;107:1045–53.
13. D'Souza A, Fretham C, Lee SJ, Arora M, Brunner J, Chhabra S, et al. Current use of and trends in hematopoietic cell transplantation in the United States. Biol Blood Marrow Transpl. 2020;26:e177–e82.
14. Sacchi N, Costeas P, Hartwell L, Hurley CK, Raffoux C, Rosenmayr A, et al. Haematopoietic stem cell donor registries: World Marrow Donor Association recommendations for evaluation of donor health. Bone Marrow Transpl. 2008;42:9–14.
15. Worel N, Buser A, Greinix HT, Hagglund H, Navarro W, Pulsipher MA, et al. Suitability criteria for adult related donors: A consensus statement from the Worldwide Network for Blood and Marrow Transplantation Standing Committee on Donor Issues. Biol Blood Marrow Transpl. 2015;21:2052–60.
16. Worel N, Aljurf M, Anthias C, Buser AS, Cody M, et al. Suitability of haematopoietic cell donors: updated consensus recommendations from the WBMT standing committee on donor issues. Lancet Haematol. 2022;9:e605–614.
17. Council of Europe EDQM Guide to the quality and safety of tissues and cells for human application. 4th ed. 2019. https://www.edqm.eu/en/guide-to-the-quality-and-safety-of-tissues-and-cells-for-human-application1.
18. FACT- JACIE International Standars for Hematopoietic Cellular Therapy. Product Collection, Processing and Administration. 8th edition 8.1. Accessed 8 November 2022. Available at: https://www.ebmt.org/sites/default/files/2021-12/STS_5_2_041_FACT-JACIE%20Standards%20Eighth%20Edition_8_1_R2_12142021_ForWeb.pdf
19. Halter JP, van Walraven SM, Worel N, Bengtsson M, Hagglund H, Nicoloso de Faveri G, et al. Allogeneic hematopoietic stem cell donation-standardized assessment of donor outcome data: a consensus statement from the

Worldwide Network for Blood and Marrow Transplantation (WBMT). Bone Marrow Transpl. 2013;48:220–5.
20. van Walraven SM, Nicoloso-de Faveri G, Axdorph-Nygell UA, Douglas KW, Jones DA, Lee SJ, et al. Family donor care management: principles and recommendations. Bone Marrow Transpl. 2010;45:1269–73.

ACKNOWLEDGEMENTS

The authors would like to thank all delegations of the CD-P-TO who contributed in the collection of the data presented in this manuscript and Louise Birrel for copy-editing and proofreading of the manuscript.

AUTHOR CONTRIBUTIONS

JSI was responsible for designing the survey, writing the protocol and report, extracting and analysing data, interpreting results, creating figures and revising the manuscript. AB, AC, BDG, JG, AK, MLF were responsible for designing the survey, and reviewing and revising the report. ML was responsible for designing the survey, reviewing and revising the report and creating the figures. NW was responsible for designing the survey, writing the protocol and report, interpreting results, creating figures, updating reference lists and revising the manuscript.

COMPETING INTERESTS

The authors declare no competing interests.

ADDITIONAL INFORMATION

Supplementary information The online version contains supplementary material available at https://doi.org/10.1038/s41409-023-01982-w.

Correspondence and requests for materials should be addressed to Nina Worel.

Reprints and permission information is available at http://www.nature.com/reprints

Publisher's note Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.