BONE MARROW DONORS WORLDWIDE

Annual Report 2006

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Acknowledgements:
Photographs courtesy of Europdonor and Begum Pillay, South Africa.
Graphic Design Front-page: Buro Blauwbrug, Grafisch Vormgevers, Amsterdam.
Printed by: Drukkerij Groen B.V.

Leiden, 2007.

Preface

Sitting down to write the Preface for the 2006 Annual Report of Bone Marrow Donors Worldwide (BMDW), I suddenly realised that it was almost exactly 20 years ago that the concept of BMDW was discussed for the first time during a meeting in Keystone of what later would become the World Marrow Donor Association (WMDA). It must be confessed that the enthusiasm to start BMDW was at first not overwhelming, but when John Goldman declared that the Anthony Nolan would participate in such an effort, all then existing registries signed up as well. That did not mean that all problems were solved and it took until the next year -1988 - before we had raised sufficient funds to start BMDW and the initiative had been accepted by the Immunology Working Party (renamed the Immunobiology Working Party in 1995) of the European Group of Blood and Marrow Transplantation (EBMT) and approved by the EBMT Board. The first issue appeared in 1989 with about 180,000 donors from eight registries.

As summarised on page 1, from the beginning the main objectives have been to maximise the chance of finding a stem cell donor and to minimise the effort for doing so. The initiative thus came from the ranks of the EBMT or in other words from the transplant centres, which in part financed the start of BMDW. Advocating the BMDW concept in the talks I gave at that time, I always showed a slide of Eliane Gluckman with a “patient” in the outpatient department of the Hôpital St. Louis with a copy of BMDW, at that time still in book form, in front of her. The “patient” was played by Vanderson Rocha! In that historic context it is of interest to note in Figure 20, that in 2006 almost 78% of the online match runs of BMDW are carried out by the transplant centres! That number is flattered because the two largest registries download the BMDW data file and do their match runs on the downloaded data. Nevertheless the interest in and use of BMDW by the transplant centres is substantial. For that reason I would like to hear their voice during the Editorial Board (EB) meetings; an item which I will put on the agenda of the Advisory Committee (AC).

The AC under the chairmanship of Carlheinz Müller has made significant progress in writing the House Rules of BMDW, and we hope to finalise them in 2007. The House Rules have already been circulated and we urge you to have a close look at them and if you have questions, please, let me know (vanrood@europdonor.nl). One of the last items we have to agree upon is the division of the fees and votes. The AC has proposed and the EB has agreed that, as far as efficiency to attain a stem cell graft is concerned, one cord blood equals to about ten stem cell donors. This should be reflected in the votes, but not in the fees. The precise mathematics still has to be worked out.

In the preface of the BMDW Annual Report 2005 I finished by noting that the number of cord blood searches had doubled in the last three years and wondered whether we were ready for a cord blood breakthrough. That seems indeed to be the case. For instance the number of stem cell donors doubled in eight years, while the number of cord blood units in BMDW doubled in four years! The WMDA Annual Report also shows a rapid increase of cord blood donations.

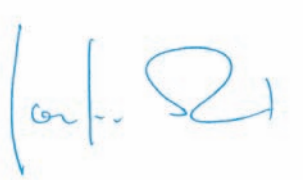
Considering all this, it is really a pity that the attendance during the EB meetings by cord blood bank representatives is really only done by registries with a prime interest in stem cell donors and in general (fortunately there are exceptions) only a secondary interest in cord blood banking. We should try to correct this, because in its present representation the EB does not hear the voice of the largest number of users (the transplant centres), but also misses for a large part the input of the cord blood banks sensu strictu.

One of the recurrent questions in these early BMDW days was, whether I thought that BMDW was a temporary activity or that it might go on for many decades. My answer was that I thought (and hoped!) that it would be temporary, because in one or at most two decades we ought to have one file of all stem cell donors (no cord bloods at that time!) accessible to all and with all the essential information of the donors. In a way we have realised that through European Marrow Donor Information System (EMDIS) (although without a centralised file!) which might in the next few years cover 70 to 80% of the donors with most of the essential information. That sounds good, but there is a caveat! It covers so far only about 11 of the 75 registries and cord blood banks and none of the cord blood banks sensu strictu, thus without an adjoined donor registry. The registries which are left out of the EMDIS effort are to a large extent the smaller ones, in part from developing countries where help is most needed. It is in my opinion clear that we cannot ignore that problem.

Looking back at these 20 years there is one point which has irked me from the beginning: the fact that we have reinvented the IT wheel now 75 times over, i.e. the number of independent registries and cord blood banks. It is understandable, but essential a waste of money. Here BMDW sets an example as it is being used by all these registries and cord blood banks. With very little extra effort and money it could provide an IT starters system for new registries and cord blood banks, which have less easy access to IT support. Perhaps we might be able to get WHO interested in this possibility. As I mentioned before the BMDW file is downloaded by some registries and as the opening page of the BMDW web site states that is fine when the downloading is “for internal use only”. I am less happy if the new IT additions or refinements are not only used internally and are no longer compatible with the original BMDW programs. In that way different “BMDW” applications will be circulating and standardisation might be endangered. We need to sort this out.

The BMDW database is an immunogenetic gold mine and I am happy that the WMDA Genetic Diversity HLA Frequency Calculation Subgroup with Machteld Oudshoorn, Henk van der Zanden, Carlheinz Müller, Steven Marsh, Martin Maiers, Pierre Antoine Gourraud, and others are mining it. The new House Rules include an article how the results may be published.

It is clear that my prediction that BMDW might function for at most two decades was wrong and short-sighted. Thanks to the effort of the BMDW office, the EB, the AC and last but least the contributing registries and cord blood banks, it is after almost two decades alive and well and fulfils an ever growing need. Thank you for your help and input!



Jon J van Rood
May 2007

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I Objectives of Bone Marrow Donors Worldwide (BMDW)

Bone Marrow Donors Worldwide (BMDW) started as an initiative of the Immunobiology Working Party of the European Group for Blood and Marrow Transplantation (EBMT) in 1988. In February 1989 the first edition was distributed, which contained the donor files of eight registries with a total of 180,000 volunteer stem cell donors.

BMDW is a service provided and managed by Europdonor Foundation. It is a voluntary collaborative effort of stem cell donor registries and cord blood banks with the goal to provide centralised information on the HLA phenotypes and other relevant data of unrelated stem cell donors and cord blood units and to make this information easily accessible to search coordinating units and the physicians of patients in need of a hematopoietic stem cell transplant.

The pioneer registries were:

– Anthony Nolan Research Centre (UK)
– France Greffe de Moelle (France)
– National Marrow Donor Program (USA)
– Europdonor Foundation (The Netherlands)
– German Registry of Bone Marrow Donors (Germany)
– Italian Bone Marrow Donor Registry (Italy)
– Austrian Bone Marrow Donors (Austria)
– Marrow Donor Program Belgium (Belgium)

The initiative was well received and supported by workers in the field. At the end of 2006, 58 stem cell donor registries and 38 cord blood banks submitted the phenotypes of almost 11 million volunteer stem cell donors and cord blood units.

The original goals of BMDW are still adhered to, but new initiatives have been added.

The main goals are:

1. To maximise the chance of finding a stem cell donor/cord blood unit by providing access to all donors and cord blood units available in the world.
2. To minimise the effort put into stem cell donor/cord blood unit searches: only registries/banks with potential stem cell donors/cord blood units need to be contacted.
3. To provide an estimate of the chance of finding a stem cell donor/cord blood unit for a given patient.
4. To provide advanced search programs to identify partially matched stem cell donors/cord blood units.
5. To facilitate search request advices via Internet.
6. To provide relevant general information for the benefit of the patient.
7. To provide statistics on the increase of donors of different registries, the number of DNA typed donors etc.

II Participating Stem Cell Donor Registries and Cord Blood Banks

1. Participating stem cell donor registries

At the end of 2006, 58 stem cell donor registries from 43 countries participated in BMDW (Table 1). No new stem cell donor registries joined BMDW in 2006.

Table 1

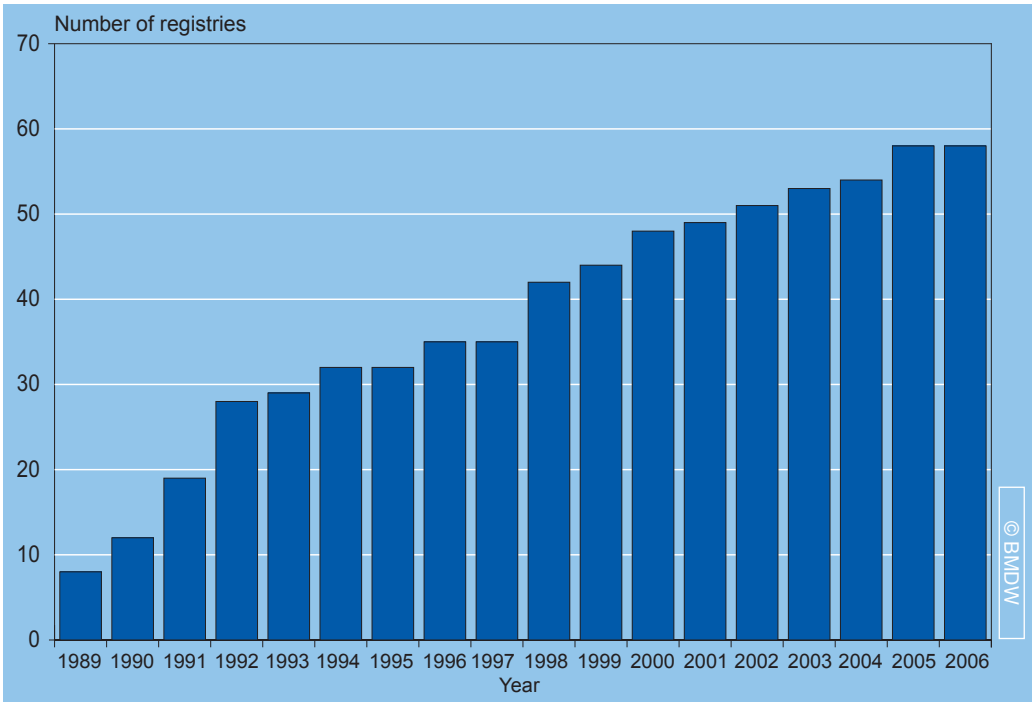
PARTICIPATING STEM CELL DONOR REGISTRIES		
Registry (N = 58)	**City**	**Country (N = 43)**
Argentine CPH Donors Registry	Buenos Aires	Argentina
Armenian Bone Marrow Donor Registry Charitable Trust	Yerevan	Armenia
Australian Bone Marrow Donor Registry including the New Zealand Bone Marrow Donor Registry	Sydney	Australia
Austrian Bone Marrow Donors	Vienna	Austria
Marrow Donor Program Belgium	Mechelen	Belgium
Bulgarian Bone Marrow Donor Registry	Sofia	Bulgaria
Canadian Blood Services Bone Marrow Donor Registry	Ottawa	Canada
Hong Kong Bone Marrow Donor Registry	Hong Kong	China
The Croatian Bone Marrow Donor Registry	Zagreb	Croatia
Cyprus Paraskevaidio Bone Marrow Donor Registry	Nicosia	Cyprus
The Cyprus Bone Marrow Donor Registry	Nicosia	Cyprus
Czech Bone Marrow Donor Registry	Prague	Czech Republic
Czech National Bone Marrow Donor Registry	Plzen	Czech Republic
The Danish Bone Marrow Donor Registry	Aarhus	Denmark
Bone Marrow Donors Copenhagen	Copenhagen	Denmark
Finnish Bone Marrow Donor Registry	Helsinki	Finland
FGM - France Greffe de Moelle	Saint-Denis la Plaine	France
ZKRD - German National Bone Marrow Donor Registry	Ulm	Germany
Unrelated Hematopoietic Stem Cell Donor Registry	Athens	Greece
Hungarian Bone Marrow Donor Registry	Budapest	Hungary
Asian Indian Donor Marrow Registry	New Delhi	India
The Irish Unrelated Bone Marrow Panel	Dublin	Ireland
Hadassah Bone Marrow Donor Registry	Jerusalem	Israel
Ezer Mizion Bone Marrow Donor Registry	Petach Tikvah	Israel

PARTICIPATING STEM CELL DONOR REGISTRIES		
Registry (N = 58)	**City**	**Country (N = 43)**
Sheba Medical Center Donor Registry	Tel-Hashomer	Israel
Italian Bone Marrow Donor Registry	Genova	Italy
Japan Marrow Donor Program	Tokyo	Japan
Lithuanian National Bone Marrow Donor Registry	Vilnius	Lithuania
Mexican Bone Marrow Donor Registry	Mexico City	Mexico
Europdonor Foundation	Leiden	The Netherlands
The Norwegian Bone Marrow Donor Registry	Oslo	Norway
Against Leukemia Foundation Marrow Donor Registry	Warsaw	Poland
National Polish Bone Marrow Registry	Wroclaw	Poland
Polish Central Bone Marrow Donor Registry	Warsaw	Poland
Unrelated Bone Marrow Donor Registry	Warsaw	Poland
Ursula Jaworska Foundation - Bone Marrow Donor Registry	Warsaw	Poland
Portuguese Bone Marrow Donors Registry	Lisbon	Portugal
Russian Bone Marrow Donor Registry	Moscow	Russia
San Marino Bone Marrow Donor Registry	Borgo Maggiore	Republic San Marino
Slovak National Bone Marrow Donor Registry	Bratislava	Slovak Republic
Slovenia - Donor	Ljubljana	Slovenia
South African Bone Marrow Registry	Cape Town	South Africa
REDMO, Jose Carreras International Leukemia Foundation	Barcelona	Spain
Tobias Registry of Swedish Bone Marrow Donors	Stockholm	Sweden
Swiss Blood Stem Cells	Wabern/Bern	Switzerland
Buddhist Tzu Chi Stem Cells Center	Hualien City	Taiwan
Thai Stem Cell Donor Registry	Bangkok	Thailand
TRAN - Ankara University Faculty of Medicine	Ankara	Turkey
Bone Marrow Bank of Istanbul Medical Faculty	Istanbul	Turkey
Emirates Bone Marrow Donor Registry	Sharjah	United Arab Emirates
The Anthony Nolan Trust	London	United Kingdom
British Bone Marrow Registry	Bristol	United Kingdom
Welsh Bone Marrow Donor Registry	Pontyclun	United Kingdom
SINDOME	Montevideo	Uruguay
National Marrow Donor Program	Minneapolis, MN	USA

PARTICIPATING STEM CELL DONOR REGISTRIES		
Registry (N = 58)	**City**	**Country (N = 43)**
American Bone Marrow Donor Registry	Mandeville, LA	USA
Caitlin Raymond International Registry	Worcester, MA	USA
Gift of Life Bone Marrow Foundation	Boca Raton, FL	USA

Number of participating stem cell donor registries are shown in Figure 1.

Figure 1
Participating stem cell donor registries



2. Participating cord blood banks

In 2006, 38 cord blood banks located in 21 countries participated in BMDW (Table 2).
One new cord blood bank from Poland joined BMDW in 2006. The new bank supplied data of 248 units to BMDW. The units of the cord blood bank from the American Red Cross Cord Blood Program, St. Paul, USA have been made available via the NMDP and they are no longer operating as a separate cord blood bank.

Table 2

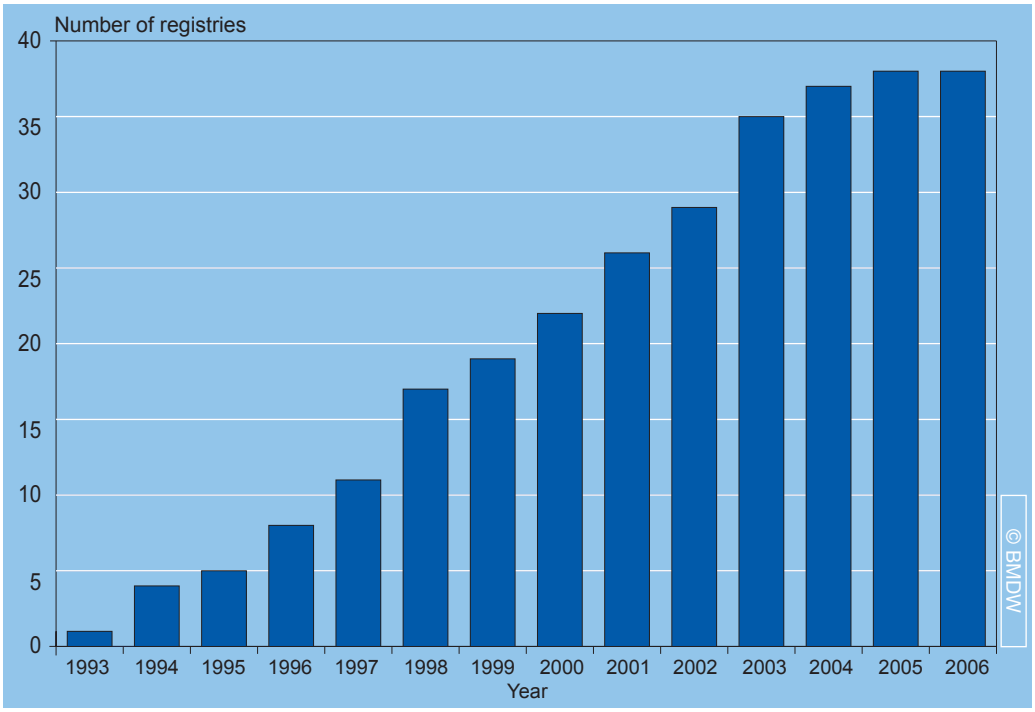
PARTICIPATING CORD BLOOD BANKS		
Registry (N = 38)	**City**	**Country (N = 21)**
BANCEL-Argentina Cord Blood Bank	Buenos Aires	Argentina
Australian Cord Blood Registry *	Sydney	Australia
Austrian Cord Blood Registry	Vienna	Austria

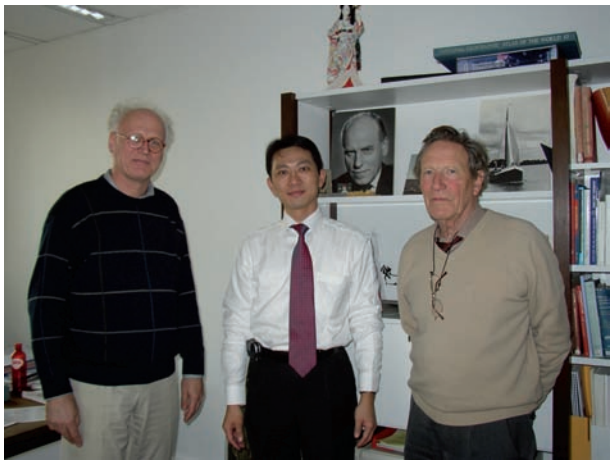
PARTICIPATING CORD BLOOD BANKS		
Registry (N = 38)	**City**	**Country (N = 21)**
Belgium Cord Blood Registry **	Mechelen	Belgium
Leuven Cord Blood Bank *	Leuven	Belgium
Shan Dong Cord Blood Bank	Beijing	China
Czech Cord Blood Registry *	Prague	Czech Republic
Finnish Cord Blood Registry *	Helsinki	Finland
French Cord Blood Registry *	Saint-Denis la Plaine	France
German Branch of the European Cord Blood Bank*	Duesseldorf	Germany
ZKRD - German Cord Blood Bank	Ulm	Germany
Israel Cord Blood Bank *	Jerusalem	Israel
Sheba Medical Centre Cord Blood Registry *	Tel-Hashomer	Israel
Emilia Romagna Cord Blood Bank	Bologna	Italy
Milano Cord Blood Bank *	Milan	Italy
UNICATT Cord Blood Bank	Rome	Italy
Sciacca Cord Blood Bank	Sciacca	Italy
Treviso Cord Blood Bank	Treviso	Italy
Tokyo Cord Blood Bank *	Tokyo	Japan
EuroCord Nederland Foundation *	Leiden	The Netherlands
Polish Central Cord Blood Bank	Warsaw	Poland
Unrelated Cord Blood Registry	Warsaw	Poland
Eurocord Slovakia - Slovak Placental Stem Cell Registry	Bratislava	Slovak Republic
REDMO Spanish Cord Blood Registry *	Barcelona	Spain
Swiss Cord Blood Registry	Wabern/Bern	Switzerland
Buddhist Tzu Chi Stem Cells Center	Hualien City	Taiwan
Bionet Corp./BabyBanks	Jhonghe City, Taipei	Taiwan
StemCyte Inc. Taiwan	LinKou, Taipei	Taiwan
Ankara University Cord Blood Bank	Ankara	Turkey
British Bone Marrow Registry – Cord Blood Bank **	Bristol	UK
Celgene Cord Blood Bank	Cedar Knolls, NJ	USA
StemCyte Inc.	Arcadia, CA	USA
University of Colorado Cord Blood Bank	Aurora, CO	USA
Michigan Community Blood Centers Cord Blood Bank	Grand Rapids, MI	USA
National Marrow Donor Program – Cord Blood Bank	Minneapolis, MN	USA
National Cord Blood Program, New York Blood Center *	New York, NY	USA

PARTICIPATING CORD BLOOD BANKS		
Registry (N = 38)	**City**	**Country (N = 21)**
Elie Katz Umbilical Cord Blood Program	Paramus, NJ	USA
Caitlin Raymond International Registry	Worcester, MA	USA
*) Cord Blood Registries included in NetCord **) Is partly included in NetCord		

Number of participating cord blood banks are shown in Figure 2.

Figure 2
Participating cord blood banks





Chris Tsai from the Bionet Corp./Baby Banks, Taipei, Taiwan, visiting Leiden on January 24, 2006 (Henk v.d. Zanden, Chris Tsai, Jon van Rood).

III Number of Stem Cell Donors and Cord Blood Units

1. Number of stem cell donors

The number of HLA-A, -B and HLA-A, -B, -DR typed stem cell donors per registry is shown in Table 3. In Figure 3 the total number of HLA-A, -B and HLA-A, -B, -DR typed stem cell donors per year is given. The number of stem cell donors increased by 800,635 from 9,937,559 to 10,738,194 on December 26, 2006. The percentage of HLA-DR typed donors has increased by 3%, from 68% in 2005 to 71% in 2006.
In the total group of donors the percentage of HLA class I DNA typed donors is 45% and HLA class II DNA typed donors is 60%. In the group of HLA-A, -B, -DR typed donors the percentage of HLA class I DNA typed donors is 63% and HLA class II typed donors is 84%.

Table 3

THE NUMBER OF HLA-A, -B AND HLA-A, -B, -DR AND DNA TYPED STEM CELL DONORS PER REGISTRY

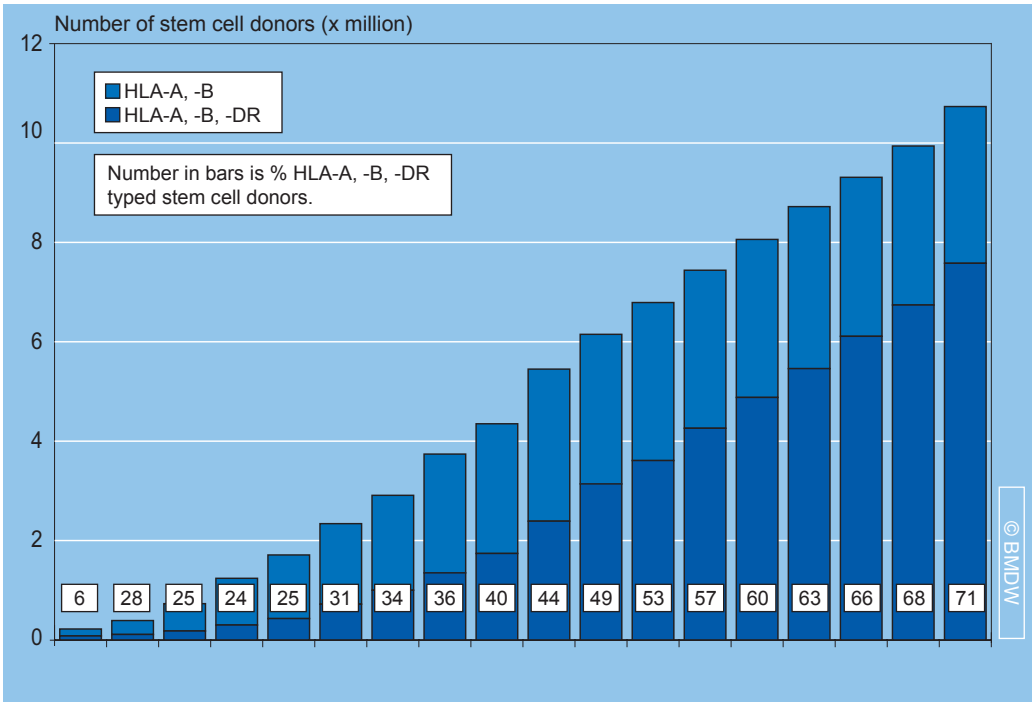
Registry	Total number of donors	Number of HLA-A, -B typed donors	Number of HLA-A, -B, -DR typed donors	Percentage of HLA-A, -B, -DR typed donors	Number of class I DNA typed donors	Number of class II DNA typed donors
Argentina	4,757	1,748	3,009	63	4,757	2,899
Armenia	11,372	2	11,370	>99	11,299	11,371
Australia and New Zealand	161,512	47,737	113,775	70	35,696	96,617
Austria	56,194	34,422	21,772	39	9,407	11,607
Belgium	46,221	8,715	37,506	81	1,536	21,889
Bulgaria	113	0	113	100	55	112
Canada	222,298	84,369	137,929	62	43,250	127,118
China, Hong Kong	56,212	27,171	29,041	52	8,477	8,970
Croatia	83	37	46	55	0	8
Cyprus	4,950	4,275	675	14	2,292	166
Cyprus, BMDR	96,070	39,316	56,754	59	71,824	43,387
Czech Republic, Plzen	30,751	5,956	24,795	81	2,898	24,749
Czech Republic, Prague	19,071	14,289	4,782	25	606	4,713
Denmark, Aarhus	18,421	2,787	15,634	85	6,721	15,633
Denmark, Copenhagen	9,445	808	8,637	91	0	8,401

THE NUMBER OF HLA-A, -B AND HLA-A, -B, -DR AND DNA TYPED STEM CELL DONORS PER REGISTRY

Registry	Total number of donors	Number of HLA-A, -B typed donors	Number of HLA-A, -B, -DR typed donors	Percentage of HLA-A, -B, -DR typed donors	Number of class I DNA typed donors	Number of class II DNA typed donors
Finland	19,443	560	18,883	97	916	2,554
France	141,076	20,635	120,441	85	22,189	104,582
Germany	2,851,705	1,386,011	1,465,694	51	1,258,200	1,365,315
Greece	24,026	15,033	8,993	37	0	1,338
Hungary	4,804	3,016	1,788	37	74	1,523
India	928	928	0	0	0	0
Ireland	17,864	243	17,621	99	7,911	8,786
Israel, Jerusalem	57,284	30,763	26,521	46	41,718	25,786
Israel, Petach Tikvah	262,586	125,968	136,618	52	202,189	136,004
Israel, Tel-Hashomer	1,387	960	427	31	0	339
Italy	318,695	116,876	201,819	63	27,449	84,974
Japan	267,644	380	267,264	>99	0	0
Lithuania	950	92	858	90	320	855
Mexico	5,312	5	5,307	>99	0	5,269
The Netherlands	37,118	1,262	35,856	97	13,299	23,465
Norway	24,904	1,091	23,813	96	4,110	23,226
Poland, Wroclaw	3,797	248	3,549	93	2,726	3,537
Poland-ALF MDR	3,217	1,434	1,783	55	460	1,751
Poland-FUJ	11,085	9,013	2,072	19	563	1,991
Poland-POLTransplant	10,120	52	10,068	99	294	9,644
Poland, Warsaw	6,665	5,977	688	10	101	678
Portugal	56,744	3,366	53,378	94	0	0
Russia	13,926	12,640	1,286	9	0	219
Republic San Marino	803	4	799	>99	0	20
Slovak Republic	285	243	42	15	0	0
Slovenia	4,622	4	4,618	>99	3,983	4,614
South Africa	61,414	57,802	3,612	6	226	2,063

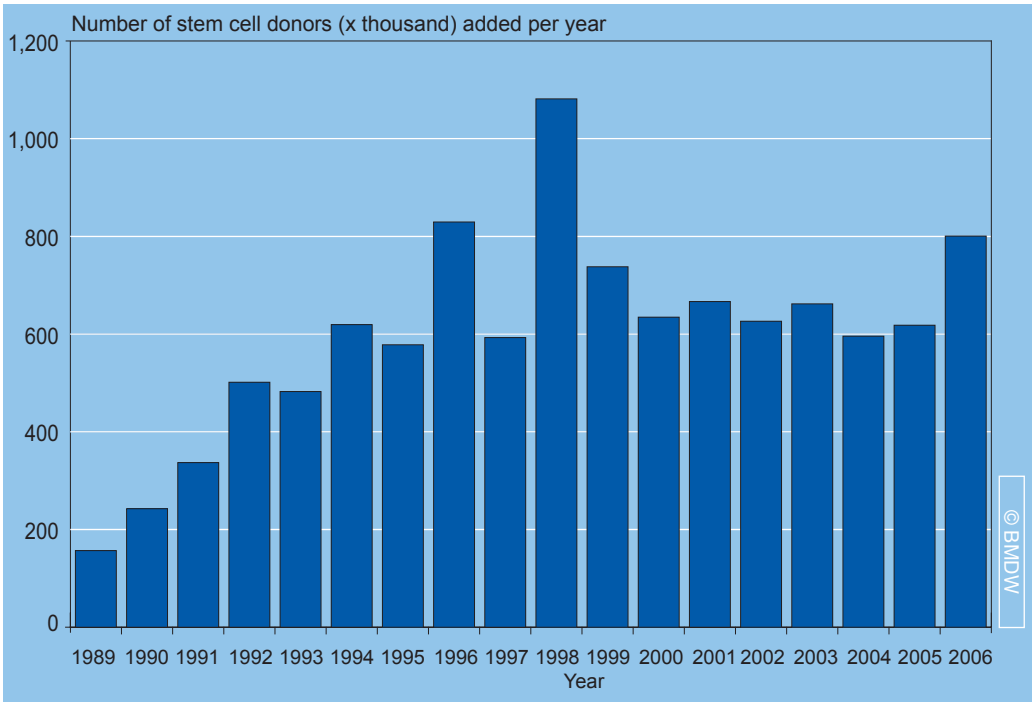
THE NUMBER OF HLA-A, -B AND HLA-A, -B, -DR AND DNA TYPED STEM CELL DONORS PER REGISTRY						
Registry	Total number of donors	Number of HLA-A, -B typed donors	Number of HLA-A, -B, -DR typed donors	Percentage of HLA-A, -B, -DR typed donors	Number of class I DNA typed donors	Number of class II DNA typed donors
Spain	57,911	21,367	36,544	63	8,607	19,022
Sweden	39,859	18,119	21,740	55	1,063	20,375
Switzerland	20,523	167	20,356	99	2,255	20,110
Taiwan	269,374	38,696	230,678	86	121,228	0
Thailand	4,754	2,920	1,834	39	4,183	1,719
Turkey, Ankara	2,473	645	1,828	74	0	0
Turkey, Istanbul	25,436	25,190	246	1	0	0
UK, London	382,336	82,085	300,251	79	137,830	254,158
UK, Bristol	297,333	26,978	270,355	91	215,514	227,547
UK, Pontyclun	46,480	0	46,480	100	42,503	46,479
United Arab Emirates	24	0	24	100	0	0
Uruguay	52	0	52	100	51	52
USA, Mandeville, LA	32,014	28,750	3,264	10	0	1,967
USA, Worcester, MA	64,084	41,057	23,027	36	22,818	21,737
USA, Boca Raton, FL	108,580	21,027	87,553	81	74,399	87,270
USA, Minneapolis, MN	4,441,087	781,170	3,659,917	82	2,379,464	3,520,021
Total	**10,738,194**	**3,154,409**	**7,583,785**	**71**	**4,795,461**	**6,406,630**

Figure 3
Total number of HLA-A, -B and HLA-A, -B, -DR typed stem cell donors



The increase of the number of stem cell donors per year is given in Figure 4. The number of additional donors (800,635) in the database in 2006 is increased compared to 2005 (618,192 donors). On average there was an increase of 482,251 donors per year in the first nine years of the existence of BMDW (1989-1997). This has increased to an average of 624,765 donors per year in the last nine years (1998-2006).

Figure 4
The number of stem cell donors added to the database per year



2. Number of cord blood units

The number of HLA-A, -B and HLA-A, -B, -DR typed cord blood units per cord blood bank is shown in Table 4. The cord blood units are practically all fully typed for HLA-A, -B and -DR, in addition 54% is class I DNA typed and 88% of the units is class II DNA typed. The total nucleated cell count is given for 94% of the units and for 72% of the units the net volume collected is provided. In Table 5 the mean number of total nucleated cells of the cord blood units in the cord blood banks is given.

Table 4

THE NUMBER OF HLA-A, -B AND HLA-A, -B, -DR TYPED CORD BLOOD UNITS PER CORD BLOOD BANK

Registry	Total number of units	Number of HLA-A, -B typed units	Number of HLA-A, -B, -DR typed units	Percentage of HLA-A, -B, -DR typed units	Number of class I DNA typed units	Number of class II DNA typed units
Argentina	70	0	70	100	70	58
Australia	17,239	0	17,239	100	12,168	17,238
Austria	3	0	3	100	0	0
Belgium, Mechelen	5,885	0	5,885	100	3,253	5,826
Belgium, Leuven	5,740	0	5,740	100	5,740	5,740
China	5,794	49	5,745	99	0	0
Czech Republic, Prague	2,454	0	2,454	100	2,326	2,429
Finland	2,643	0	2,643	100	827	2,643
France	5,711	0	5,711	100	1,749	5,086
Germany, Ulm	5,383	0	5,383	100	3,929	5,372
Germany, Duesseldorf	8,441	0	8,441	100	4,107	8,436
Israel, Jerusalem	1,638	2	1,636	>99	1,265	1,634
Israel, Tel-Hashomer	996	5	991	99	0	996
Italy, Bologna	1,571	0	1,571	100	29	62
Italy, Milan	11,640	0	11,640	100	3,231	11,570
Italy, Rome	133	0	133	100	0	133
Italy, Sciacca	4,709	0	4,709	100	0	0
Italy, Treviso	411	0	411	100	0	410
Japan	4,754	0	4,754	100	0	4,754
The Netherlands	3,378	0	3,378	100	2,476	3,374

THE NUMBER OF HLA-A, -B AND HLA-A, -B, -DR TYPED CORD BLOOD UNITS PER CORD BLOOD BANK

Registry	Total number of units	Number of HLA-A, -B typed units	Number of HLA-A, -B, -DR typed units	Percentage of HLA-A, -B, -DR typed units	Number of class I DNA typed units	Number of class II DNA typed units
Poland-POLTransplant	248	0	248	100	248	248
Poland, Warsaw	41	0	41	100	0	41
Slovak Republic	169	0	169	100	0	0
Spain	23,531	0	23,531	100	10,114	19,212
Switzerland	1,498	0	1,498	100	1,492	1,498
Taiwan, Hualien City	1,635	0	1,635	100	1,392	1,373
Taiwan, LinKou,						
Taipei	9,343	0	9,343	100	9,343	9,343
Taiwan, Jhonghe City, Taipei	10,119	0	10,119	100	0	0
Turkey, Ankara	20	0	20	100	0	4
UK, Bristol	8,104	2	8,102	>99	8,022	8,101
USA, Arcadia, CA	10,349	0	10,349	100	10,348	10,349
USA, Aurora, CO	5,552	0	5,552	100	0	5,552
USA, Cedar Knolls, NJ	4,125	0	4,125	100	0	4,125
USA, Grand Rapids, MI	2,021	0	2,021	100	2,021	2,021
USA, Minneapolis, MN	42,490	0	42,490	100	41,657	42,418
USA, New York, NY	31,918	0	31,918	100	0	29,104
USA, Paramus, NJ	2,284	0	2,284	100	0	2,282
USA, CRIR CORD, Worcester, MA	10,069	0	10,069	100	10,034	9,528
Total	**252,109**	**58**	**252,051**	**>99**	**135,841**	**220,960**

The steady increase of cord blood units in BMDW is shown in Figure 5. The total number of cord blood units at the end of 2006 is 252,109.

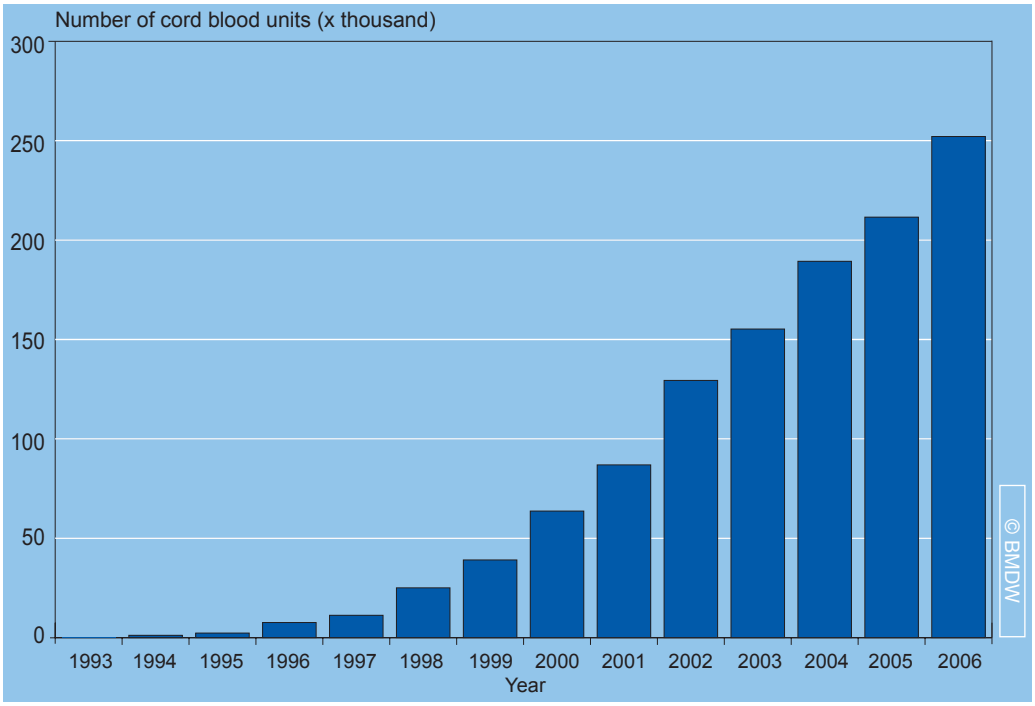


Figure 5
Total number of cord blood units

The increase of the number of cord blood units per year is given in Figure 6. The increase of cord blood units added to the database in 2006 was 40,564 which was more than in the previous year (22,214).

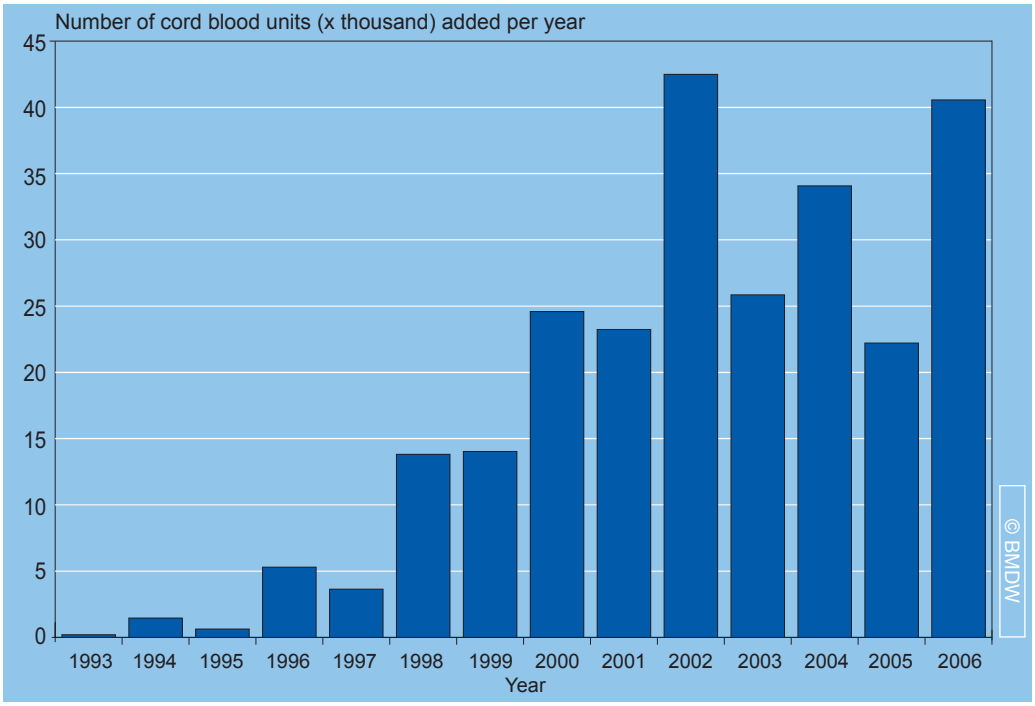


Figure 6
The number of cord blood units added to the database per year

Table 5

THE MEAN NUMBER OF TOTAL NUCLEATED CELLS OF THE CORD BLOOD UNITS IN CORD BLOOD BANKS		
Registry	**Total number of units**	**Mean number of TNC**
Turkey, Ankara	20	149.1
France	5,711	140.9
Italy, Bologna	1,571	134.7
China	5,794	121.6
Argentina	70	121.4
Poland, Warsaw	41	121.3
Israel, Tel-Hashomer	996	121.1
Czech Republic, Prague	2,454	118.7
USA, Arcadia, CA	10,349	115.3
Italy, Milan	11,640	115.3
Italy, Rome	133	111.8
USA, Grand Rapids, MI	2,021	111.6
Italy, Sciacca	4,709	109.5
Germany, Duesseldorf	8,441	106.9
Australia	17,239	104.6
Switzerland	1,498	103.5
Spain	23,221	101.0
USA, Minneapolis, MN	42,490	100.2
The Netherlands	3,378	99.5
Italy, Treviso	411	98.9
Taiwan, LinKou, Taipei	9,343	98.4
Belgium, Leuven	5,740	98.3
USA, New York, NY	31,918	96.2
Belgium, Mechelen	5,885	93.9
UK, Bristol	8,104	92.7
USA, Paramus, NJ	2,284	92.6
USA, Aurora, CO	5,552	88.4
Germany, Ulm	5,383	84.9
Taiwan, Hualien City	1,635	80.0
Finland	2,643	77.3
USA, Cedar Knolls, NJ	4,125	76.0
Poland-POLTransplant	248	67.2
Japan	4,754	64.7
USA, CRIR CORD, Worcester, MA	10,069	64.4

IV Distribution of Stem Cell Donors and Cord Blood Units in the World

1. Distribution of stem cell donors

As shown in Figure 7, almost half of the donors (45%) reside in North America, 43% in Europe and the remaining 12% originate from other countries. The distribution of donors in 2006 was practically identical compared to 2005.

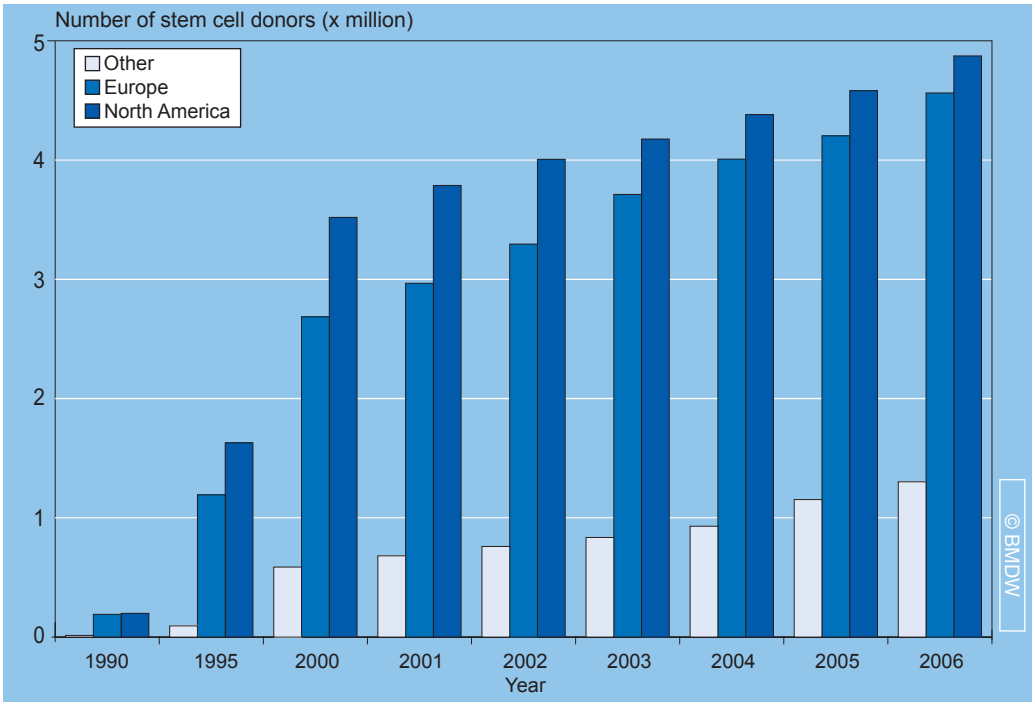


Figure 7
Total number of stem cell donors per continent

In Figure 8a and 8b the distribution of the stem cell donors in the world and in Europe is given.

The number of stem cell donors per 10,000 inhabitants is given in Table 6. The data is sorted by the number of HLA-A, -B, -DR typed donors per 10,000 inhabitants, starting with the highest number. HLA-A, -B, -DR was chosen as criterion because over 98% of patients transplanted received a graft from a donor that had already been typed for HLA-A, -B, -DR. The mean number of HLA-A, -B, -DR typed donors per 10,000 inhabitants in the participating countries is 55.8 and median is 23.1; for HLA-A, -B plus HLA-A, -B, -DR donors the mean is 84.6 and median is 23.2. It is obvious that there are still large differences between the different countries. Of the world population 0.16% is registered as a hematopoietic stem cell donor.

Figure 8a
Distribution of stem cell donors in the world

< 25,000 donors

Argentina, India, Mexico, Thailand, United Arab Emirates, Uruguay

25,000-100,000 donors

China (Hong Kong) South Africa

> 100,000 donors

Australia (including New Zealand), Canada, Israel, Japan, Taiwan, USA

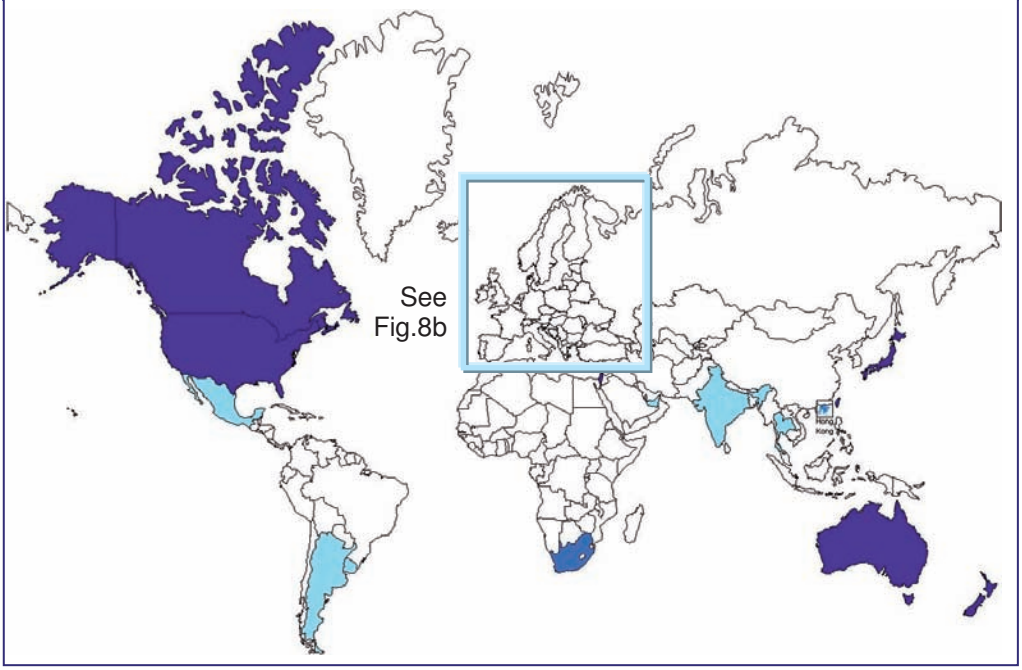


Figure 8b
Distribution of stem cell donors in Europe

< 25,000 donors

Armenia, Bulgaria, Croatia, Finland, Greece, Hungaria Ireland, Lithuania, Norway, Russia, Republic San Marino, Slovak Republic, Slovenia, Switzerland

25,000-100,000 donors

Austria, Belgium, Czech Republic, Denmark, Poland Portugal, Spain, Sweden, The Netherlands, Turkey

> 100,000 donors

Cyprus, France, Germany, Italy, United Kingdom

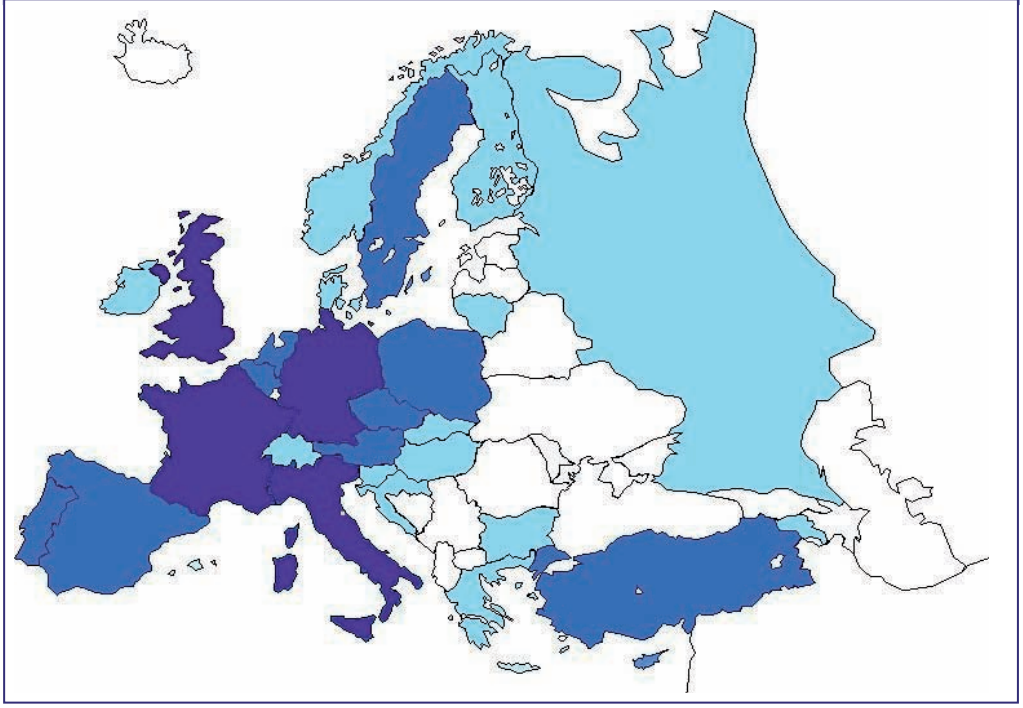


Table 6

THE NUMBER OF STEM CELL DONORS PER 10,000 INHABITANTS (SORTED BY HLA-A, -B, -DR PER 10,000 INHABITANTS)

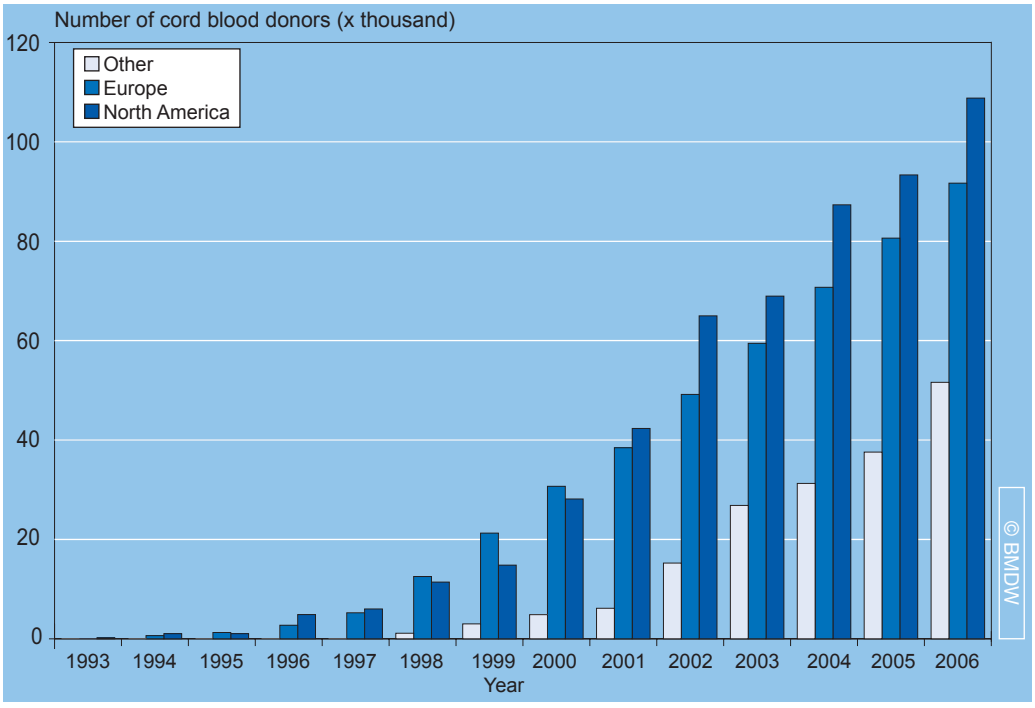
Country	Number of inhabitants x 10^6 (*)	Number of stem cell donors		Number of donors per 10,000 inhabitants	
		ABDR	Total	ABDR	Total
Cyprus	0.8	57,429	101,020	718	1,263
Republic San Marino	0.03	799	803	266	268
Israel	6.4	163,566	321,257	262	502
Germany	82.4	1,465,694	2,851,705	178	346
USA	298.4	3,773,761	4,645,765	126	156
United Kingdom	60.6	617,086	726,149	102	120
Taiwan	23.0	230,678	269,374	100.0	117
Norway	4.6	23,813	24,904	51.8	54.1
Portugal	10.6	53,378	56,744	50.4	53.5
Australia/ New Zealand	24.3	113,775	161,512	46.8	66.5
Denmark	5.5	24,271	27,866	44.1	50.7
Ireland	4.0	17,621	17,864	44.1	44.7
Canada	33.1	132,929	222,298	40.2	67.2
Armenia	3.0	11,370	11,372	37.9	37.9
Finland	5.2	18,883	19,443	36.3	37.4
Belgium	10.4	37,506	46,221	36.1	44.4
Italy	58.1	201,819	318,695	34.7	54.9
Czech Republic	10.2	29,577	49,822	29.0	48.8
Switzerland	7.5	20,356	20,523	27.1	27.4
Austria	8.2	21,772	56,194	26.6	68.5
Sweden	9.0	21,740	39,859	24.2	44.3
Slovenia	2.0	4,618	4,622	23.1	23.1
The Netherlands	16.5	35,856	37,118	21.7	22.5
Japan	127.5	267,264	267,644	21.0	21.0
France	60.9	120,441	141,076	19.8	23.2
Spain	40.4	36,544	57,911	9.0	14.3
Greece	10.7	8,993	24,026	8.4	22.5
Poland	38.5	18,160	34,884	4.7	9.1
Hungary	10.0	1,788	4,804	1.8	4.8
Lithuania	3.6	326	950	0.9	2.6
South Africa	44.2	3,612	61,414	0.8	13.9

THE NUMBER OF STEM CELL DONORS PER 10,000 INHABITANTS (SORTED BY HLA-A, -B, -DR PER 10,000 INHABITANTS)					
Country	Number of inhabitants x 10^6 (*)	Number of stem cell donors		Number of donors per 10,000 inhabitants	
		ABDR	Total	ABDR	Total
Argentina	39.9	3,009	4,757	0.8	1.2
Mexico	107.5	5,307	5,312	0.5	0.5
Turkey	70.4	2,074	27,909	0.3	4.0
Thailand	64.6	1,834	4,754	0.3	0.7
China	1,314.0	29,041	56,212	0.2	0.4
Uruguay	3.4	52	52	0.2	0.2
Bulgaria	7.4	113	113	0.2	0.2
Croatia	4.5	46	83	0.1	0.2
Russia	142.9	1,286	13,926	0.1	1.0
Slovak Republic	5.4	42	285	0.1	0.6
United Arab Emirates	2.6	24	24	0.0	0.1
India	1,096.0	0	928	0.0	0.0
* Data extracted from CIA factbook (July 2006).					

2. Distribution of cord blood units

As shown in Figure 9, the majority of the cord blood units are stored in North American (43%) and European (36%) cord blood banks. The remaining cord blood units are from other continents (20%).

Figure 9 Total number of cord blood units per continent



In Figures 10a and 10b the distribution of unrelated cord blood units in the world and in Europe is given.

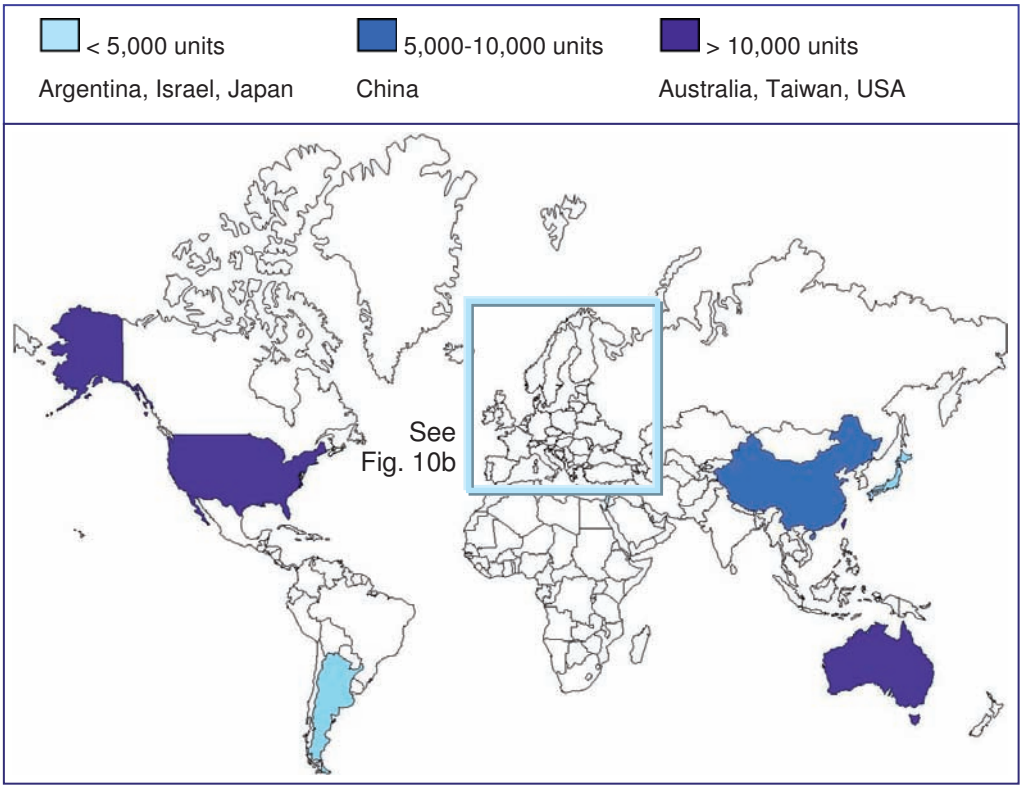


Figure 10a
Distribution of cord blood units in the world

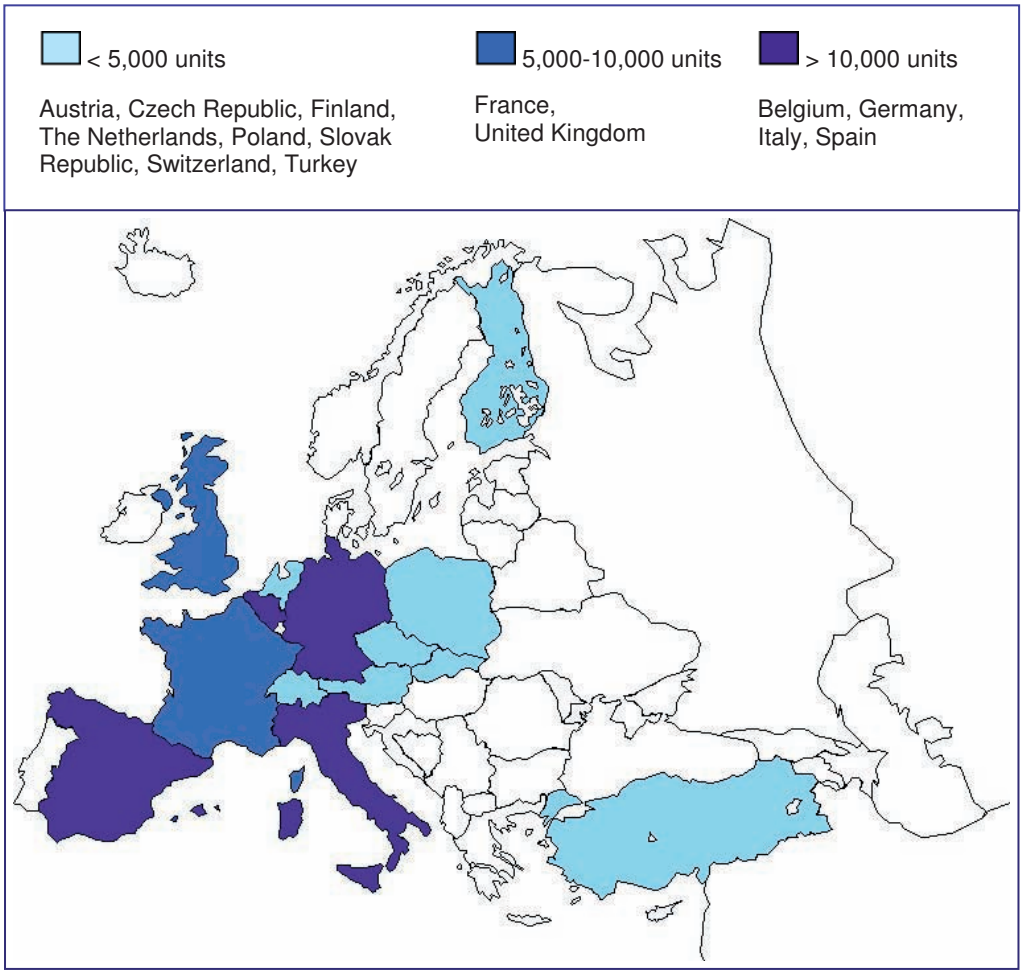


Figure 10b
Distribution of cord blood units in Europe

The number of cord blood units per 10,000 inhabitants is given in Table 7. The data is sorted by the number of cord blood units per 10,000 inhabitants, starting with the highest number.
The mean number of cord blood units per 10,000 inhabitants in the participating countries is 3.3 and the median 2.0.

Table 7

THE NUMBER OF CORD BLOOD UNITS PER 10,000 INHABITANTS			
Country	**Number of inhabitants x 10^6 (*)**	**Number of cord blood units**	**Number of units per 10,000 inhabitants**
USA	298.4	108,808	12.9
Belgium	10.4	11,625	11.1
Taiwan	23.0	21,097	9.2
Australia	24.3	17,239	7.1
Spain	40.4	23,531	5.8
Finland	5.2	2,643	5.1
Israel	6.4	2,634	4.1
Italy	58.1	18,464	3.2
Czech Republic	10.2	2,454	2.4
The Netherlands	16.5	3,378	2.0
Switzerland	7.5	1,498	2.0
Germany	82.4	13,824	1.7
United Kingdom	60.6	8,104	1.3
France	60.9	5,711	0.9
Japan	127.5	4,754	0.4
Slovak Republic	5.4	169	0.3
Poland	38.5	289	0.08
China	1,314.0	5,794	0.04
Argentina	39.9	70	0.02
Austria	8.2	3	0.00
Turkey	70.4	20	0.00
* Data extracted from CIA factbook (July 2006).			

V Number of HLA Phenotypes

In Figure 11 the number of stem cell donors and cord blood units typed for HLA-A, -B, -DR split antigens, the number of different HLA-A, -B, -DR split phenotypes and the number of unique phenotypes are given. Unique phenotypes are defined as occurring only once in the BMDW database. In 2006 there were 5,067,457 HLA-A, -B, -DR split typed stem cell donors and cord blood units representing 853,546 different phenotypes. The latter number is less than 2% of the theoretically possible number of HLA-A, -B, -DR split phenotypes (Nomenclature for the Factors of the HLA System, 2004). Fifty percent of these were unique phenotypes (427,898), i.e. occurring only once in the BMDW database. These donors were mainly typed by serology or low resolution DNA typing, the number of unique phenotypes rises even more if typing is performed on the allele level for the HLA-A, -B, -C, -DR and -DQ loci.

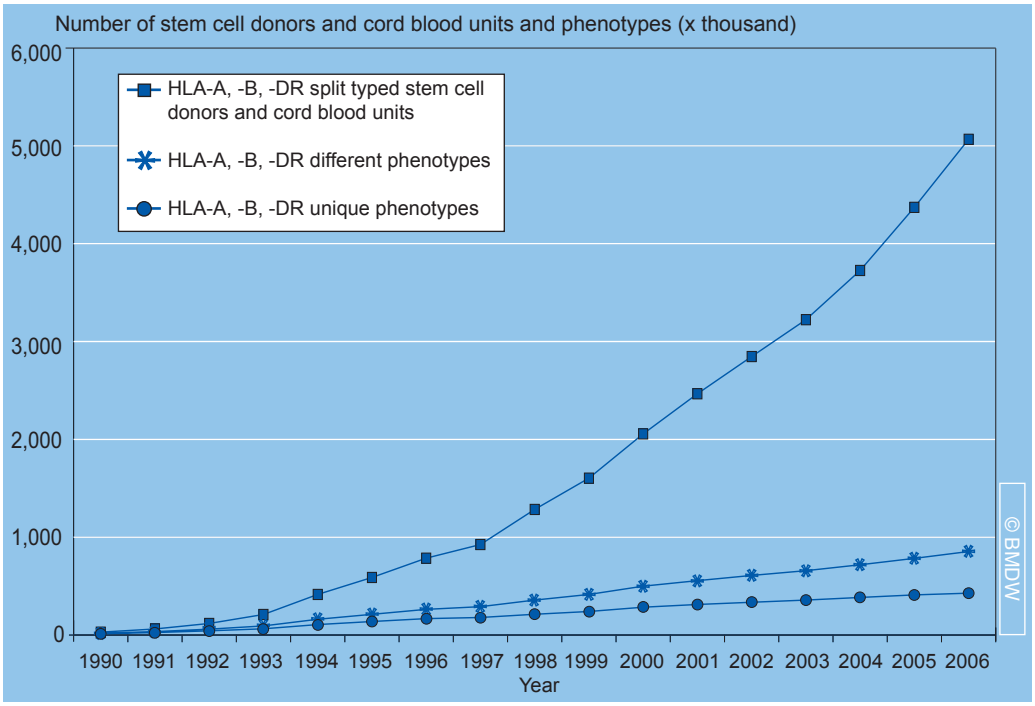


Figure 11
The number of stem cell donors and cord blood units typed for HLA-A, -B, -DR split antigens and the number of different and unique phenotypes

The number of different HLA-A, -B, -DR phenotypes per 1,000 new stem cell donors and cord blood units is given in Figure 12. In 1990 more than half of the new donors and cord blood units had an HLA-A, -B, -DR split phenotype that was not yet present in the BMDW database.
In 2006 one out of ten donors and cord blood units still added a new HLA-A, -B, -DR split phenotype to the database.
Figure 13 shows that new stem cell donors and cord blood units still add new HLA-A, -B, -DR split phenotypes to the BMDW database.

Figure 12
Number of different HLA-A, -B, -DR split phenotypes per thousand new stem cell donors and cord blood units

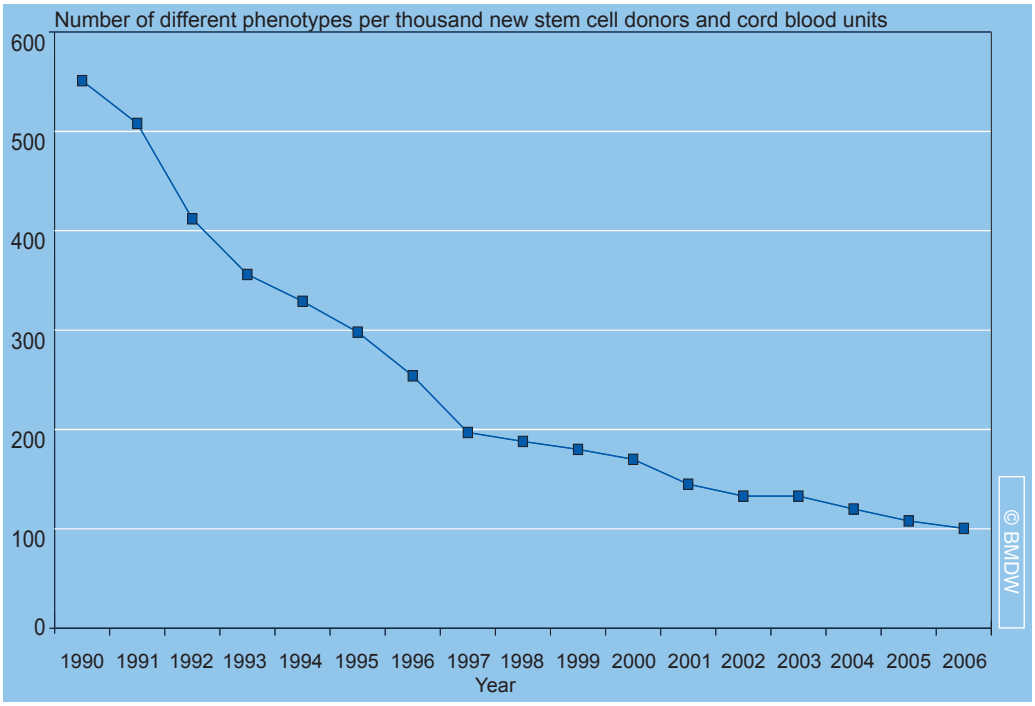
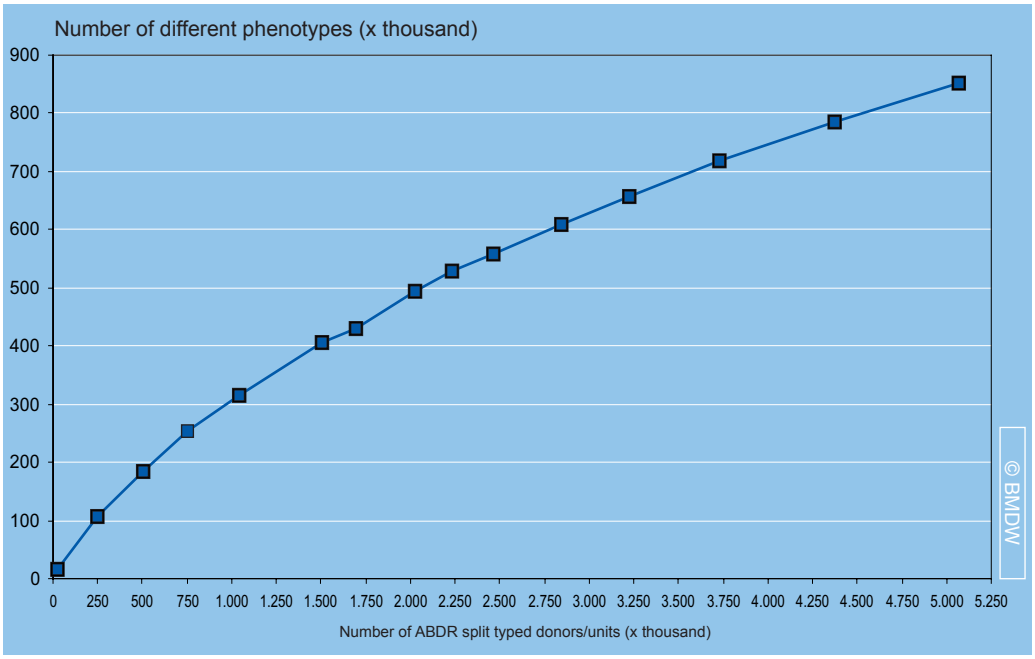


Figure 13
Increase in the number of different phenotypes added to the BMDW database



The relative contribution to BMDW of stem cell donors per country with a new HLA-A, -B, -DR split phenotype is given in Figure 14.
There are large differences between the countries; countries on the left-hand side of the curve such as Uruguay, Mexico, Argentina, Russia, Thailand and Armenia have a high relative contribution of new HLA phenotypes to BMDW, while countries on the right-hand side such as Turkey, Ireland, Norway and Sweden have a relatively low rate of adding new HLA phenotypes to BMDW. The fact that some countries have a relatively low contribution to adding new phenotypes means that many of the phenotypes of those countries are already in BMDW, which is of course good news for the patients in those countries. It is somewhat surprising that Turkey is on the most right-hand side of the curve, this may to a large extent be due to patients' directed HLA-DR typing of donors resulting in selection of common phenotypes.

In Figure 16 the percentage of unique HLA-A, -B, -DR split phenotypes of stem cell donors contributed to the donor BMDW file only (excluding cord blood units) is given. The difference between Figure 14 (entire BMDW database) and Figure 16 (only the stem cell donor data in BMDW) is minimal.
The majority in BMDW are stem cell donors, therefore extracting the data of the cord blood units results in these minimal differences.
Figure 15 depicts the relative contribution of cord blood units with new HLA phenotypes in the entire BMDW database.
In virtually all countries the cord blood units have a much higher relative contribution of adding new HLA phenotypes to BMDW than the stem cell donors of the same country, indicating the success of the cord blood banks in recruiting cord blood units from minority groups.
In Figure 17 the percentage of unique HLA-A, -B, -DR split phenotypes of cord blood units contributed to the cord blood unit data only (excluding donors) is given. The large difference between figures 15 and 17 indicates that the number of phenotypes of the cord blood units within BMDW is still limited.

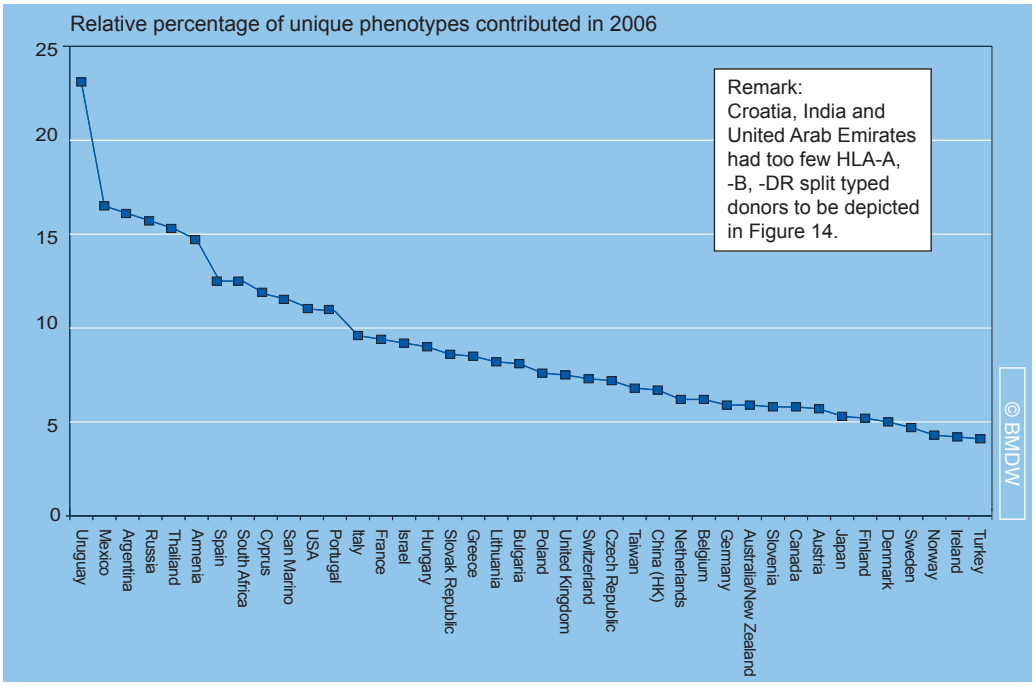


Figure 14
The percentage of unique HLA-A, -B, -DR split phenotypes of stem cell donors per country

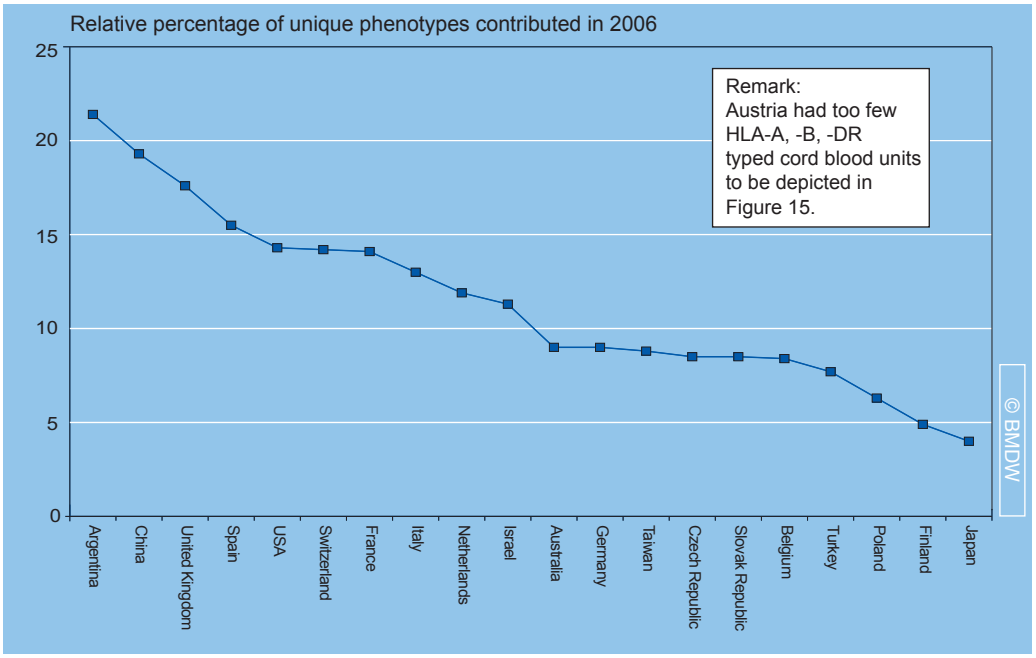


Figure 15
The relative percentage of unique HLA-A, -B, -DR split phenotypes of cord blood units per country

Figure 16
The percentage of unique HLA A, -B, -DR split phenotypes of stem cell donors contributed to the stem cell donor database in BMDW

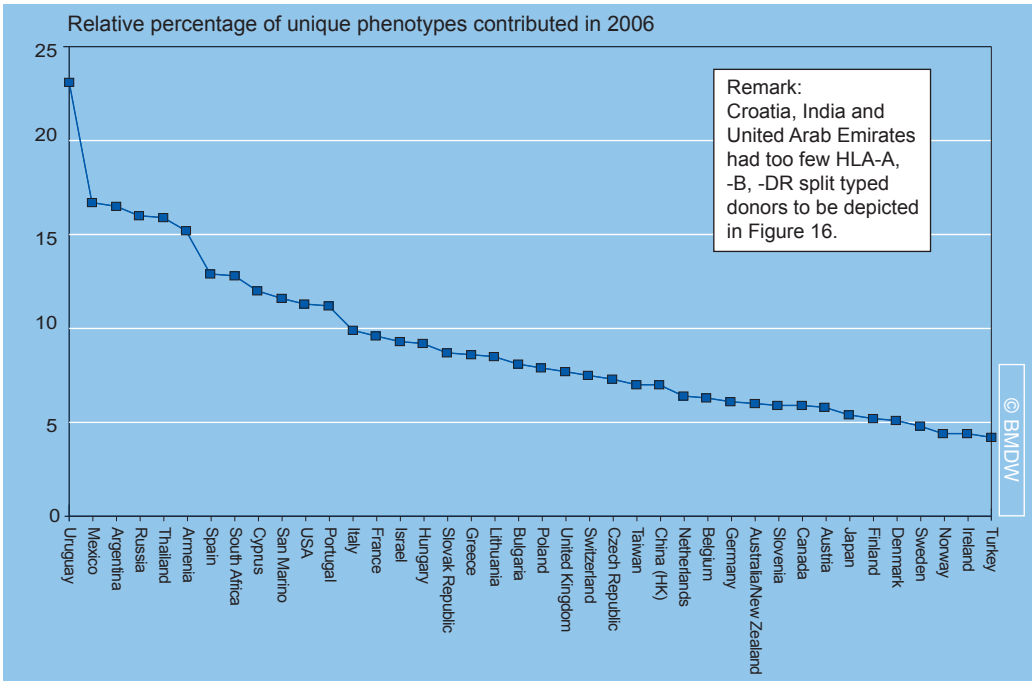
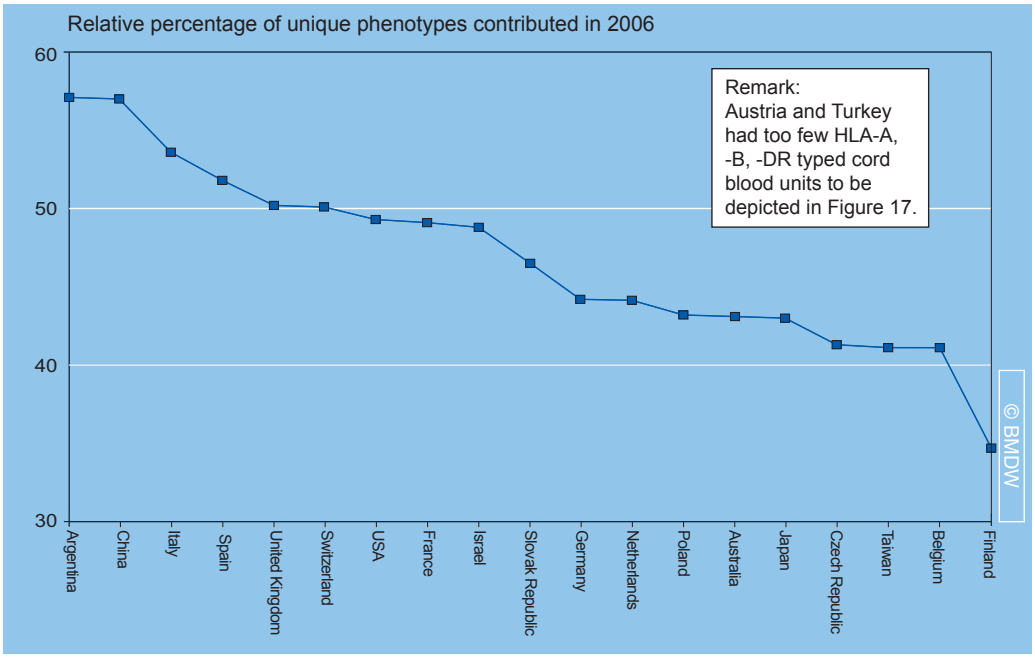


Figure 17
The percentage of unique HLA-A, -B, -DR split phenotypes of cord blood units contributed to the cord blood unit database in BMDW



VI Immunogenetics

Search advice

Sixteen requests for a search advice have been received in 2006. Of the 16 search advices, eight were from Europe and eight were from other continents (Figure 18). The reason for the decrease may be the fact that the online search facility request in the new BMDW system was not yet realized. The number of search advices per continent over the years is given in Figure 19.
The main reason for requesting a search advice remains the presence of rare alleles.
If a patient has a rare haplotype but not necessarily with very rare alleles this may also cause problems in finding a donor.

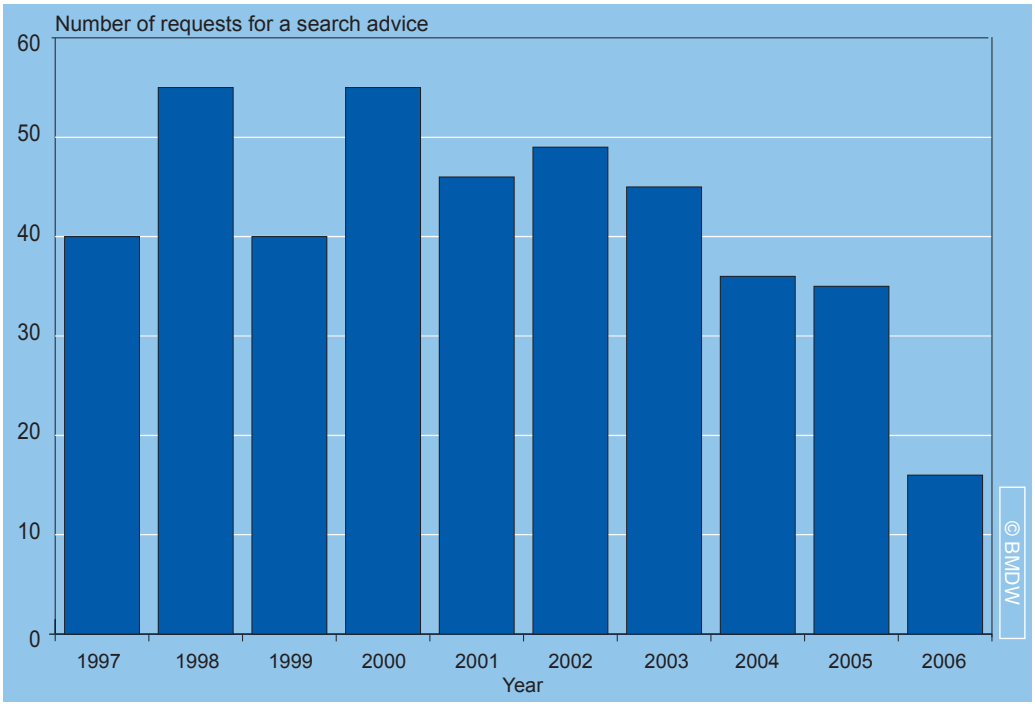


Figure 18
The number of search advices over the last 10 years

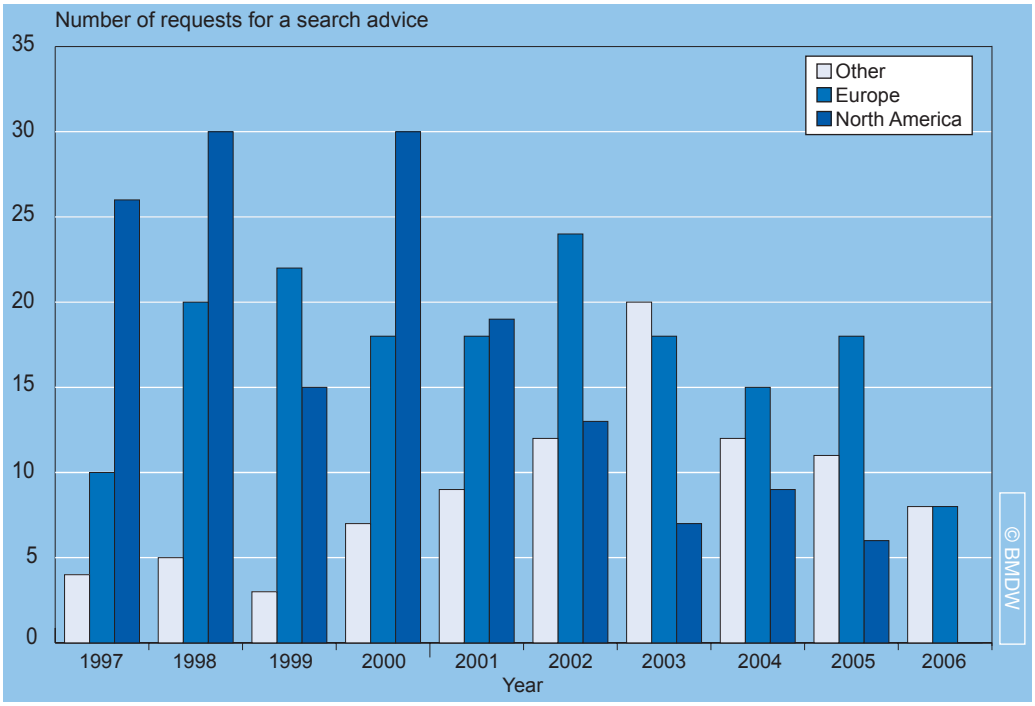


Figure 19
total number of search advices per continent over the last 10 years

VII Automation and Distribution

1. History

Edition 1, 1989: BMDW is a collection of the printouts of the individual registries.
Edition 2 to 5, 1990: BMDW was compiled and sorted on HLA phenotypes with the help of the computer.
From edition 6, 1991: BMDW was distributed on diskettes, together with a match program.
From edition 12, 1993: The paper copy has ceased to exist. Inclusion of DNA class II typing data, with multiple allele codes. BMDW link to the system of a registry is available.
The first cord blood registry is included (New York CB Bank).
From edition 14, 1994: The update and distribution of BMDW was increased from three to six times per year.
From edition 24, 1995: An HLA antigen mismatch program is included.
From edition 28, 1995: BMDW information is available on a World Wide Web Internet server.
From edition 30, 1996: Regular match program was implemented on Internet with 'secure protocol' and password for transplant centres.
From edition 31, 1996: Mismatch programs and prognostic programs are available on Internet.
From edition 33, 1997: Cord blood match program (4 out of 6 HLA antigen match) is available.
From edition 34, 1997: Haplotype frequencies for most registries was implemented on Internet.
From edition 37, 1997: Information on fee structure on Internet for authorised users is available. Edition numbering has ceased.
1998: User interface has been improved.
1999: Update of BMDW was increased to 12 editions a year. The new address (http://www.bmdw.org HYPERLINK http://www.BMDW.org) has been implemented with renewed layout. We celebrated the 10th anniversary of BMDW.
2000: New haplotype frequency program available, bi-annual update of haplotype frequencies.
2001: Registration and presentation of class I DNA typing is in use.
2002: Development of a new match program was started, and a draft report of match output was shown to the users at the Oslo BMDW meeting.
2003: HLA nomenclature for DNA is extended to six digits; multiple allele codes in six characters.
2004: Development of new match programs based on DNA typings.
2005: In May 2005 the new DNA match programs were launched. In November we welcomed the 10,000,000th donor.

2. Developments in 2006

During this year minor improvements have been realised. The improvements were:

- Sorting the results on total nucleated cell counts of the units for each cord blood match category.
- The implementation of a new download of the BMDW data file in comma separated ASCII values.
- Per request of users we have added an option to view (and print) the addresses of all BMDW participants in one action.

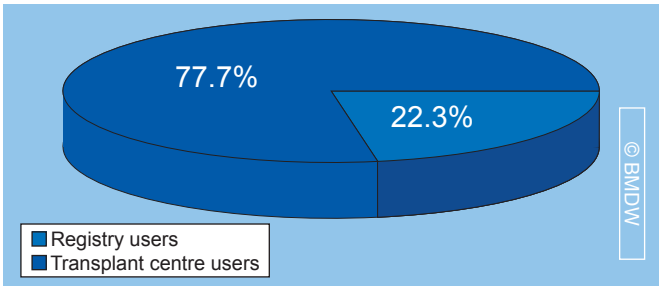


Figure 20
The users of online services in total 591

Users of online service:

- Registry users 132 (22.3 %)
- Transplant Centre users 459 (77.7 %)

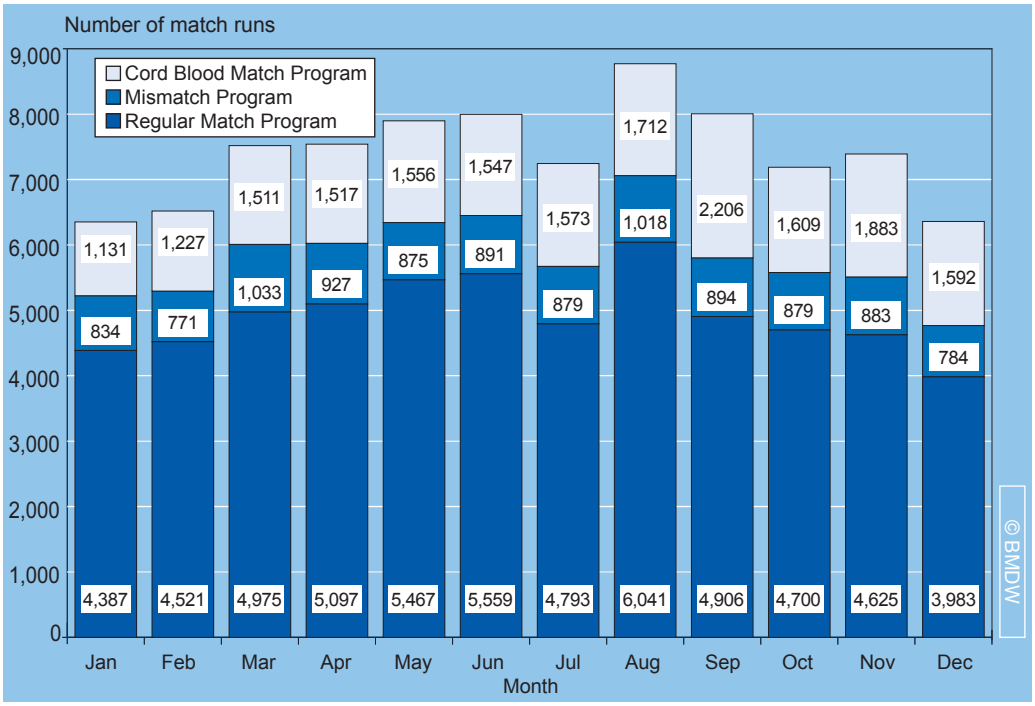


Figure 21
The monthly use of new BMDW online match programs in 2006

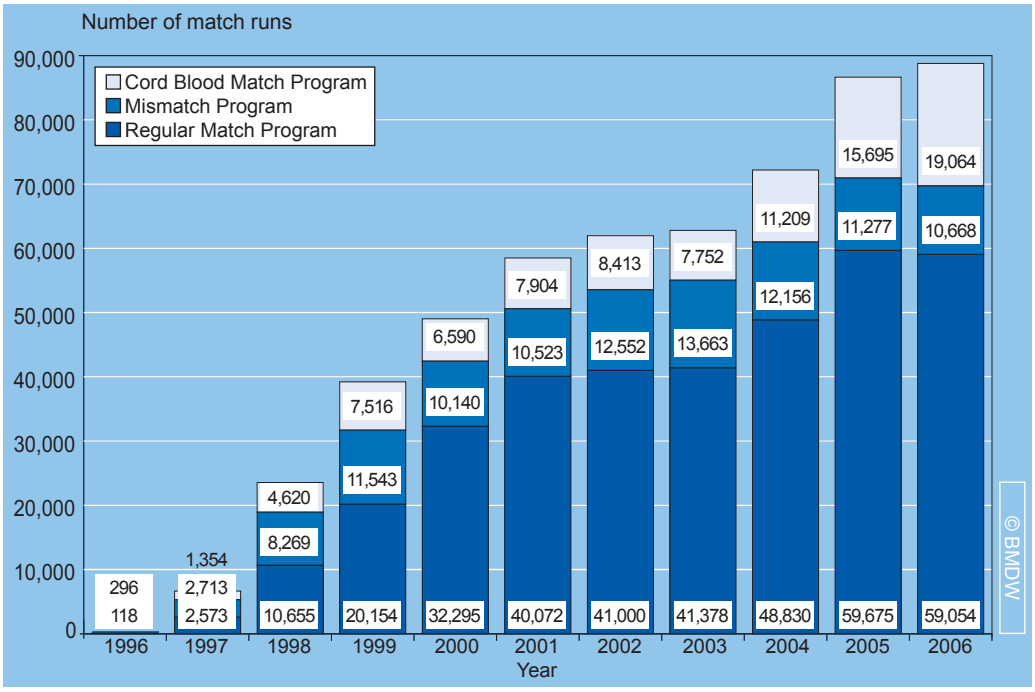


Figure 22
The use of BMDW online match programs per year

VIII Plans for the Future

BMDW will continue to encourage new stem cell donors registries and cord blood banks to join the BMDW program.

Other options will be considered:

- Specification and cost determination of a double cord blood match.
- Match on DRB3/4/5.
- Export to PDF/Excel of search results.
- Allow registries to match on their own donors.
- Further selection on age, gender and CMV status.
- We would like to implement new ways of accessing the match programs. The interface will make use of extended mark-up language (XML) and/or EMDIS.
- The statistics per registry will be extended with the percentage of unique phenotypes in the registry as well as the number of exclusive phenotypes for a centre (i.e. occurring only in a single registry).
- The calculation of the probability of finding an identical donor after HLA-DR typing of HLA-A, -B typed donors will be adjusted, using haplotype frequencies. Use of HapLogic (NMDP).

Machteld Oudshoorn, Carlheinz Müller (ZKRD, Ulm, Germany) and Henk v.d. Zanden discussing genetic diversity in Leiden on July 19, 2006.

Anne-Marie van Walraven, Steven Marsh (from the Anthony Nolan Trust, London, UK, visiting Leiden on June 1, 2006) and Jack Bakker.

IX Board and Staff

Editorial Board:

The 96 participating stem cell donor registries and cord blood banks (see Table 1 and 2)

Chairman Editorial Board:

J.J. van Rood, MD, PhD

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E.E.A. Melis, MSc (programmer)
J. Szymanowski (system assistant)

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Maria Haasnoot-Coëlho during the dinner party organized for her retirement, April 5, 2006.

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S. Okamoto, MD, PhD (till January 1, 2007)

C. Raffoux, MD (till September 30, 2006)

A. Rosenmayr, MD, PhD

XI References

1. Publications

Oudshoorn, M., Bakker, J.N.A., van der Zanden, H.G.M. & van Rood, J.J. (2004-2006) Bone Marrow Donors Worldwide – the presence and perspective in facilitating the donor-recipient matching in hematopoietic stem cell transplantation. In: ***Standardization of Donor-Recipient Matching in Transplantation***, ed. A. Lange. Nova Science Publ., pp. 7-14.

Van der Zanden, H.G.M. (2004-2006) Security and privacy aspects in information systems for unrelated stem cell transplant organisations. In: ***Standardization of Donor-Recipient Matching in Transplantation***, ed. A. Lange. Nova Science Publ., pp. 39-46.

Oudshoorn, M., van Walraven , S.M., Bakker, J.N.A., Lie, J.L.W.Tj., van der Zanden, H.G.M., Heemskerk, M.B.A. & Claas, F.H.J. (2006) Hematopoietic stem cell donor selection: the Europdonor experience. ***Human Immunol. 67***: 405-412.

Van Rood, J.J. (2006) You will never forget your mother! ***Blood 107***, 1: 7-8.

2. Abstracts for Presentations

Oudshoorn, M., Bakker, J.N.A., van der Zanden, H.G.M. & van Rood, J.J. New BMDW match programs. 6th International Donor Registry Conference, Cape Town, South Africa, May 26-27, 2006.

Machteld Oudshoorn presenting her lecture “New BMDW Match Programs”, during the 6th International Donor Registry Conference, Cape Town. (photographer: Begum Pillay, South Africa)

Ernette du Toit and Machteld Oudshoorn, co-chairs of the Scientific Committee of the 6th International Donor Registry Conference, Cape Town. (photographer: Begum Pillay, South Africa)

3. Invited Lectures

Van Rood, J.J.: “Ten Million Donors! What is next?”, 32nd Annual EBMT Meeting, Hamburg, Germany, March 19-22, 2006.

Oudshoorn, M.: “New BMDW Match Programs”, 6th International Donor Registry Conference, Cape Town, South Africa, May 26-27, 2006.

Van Rood, J.J.: “Ten Million Donors! What is next?”, Shirley Nolan Lecture during the 6th International Donor Registry Conference, Cape Town, South Africa, May 26-27, 2006.

Oudshoorn, M.: “The Global Role of the World Marrow Donor Association (WMDA)”, WHO 2nd Global Consultation on Regulatory Requirements for Human Cells & Tissues for Transplantation. Towards Global Harmonization through Graduated Standards, Geneva, Switzerland, June 7-9, 2006.

Van Rood, J.J.: “Ten Million Donors! What is next?, European School of Hematology, Paris, France, July 6, 2006.

Oudshoorn, M.: Participant in a Round Table Discussion at the AlloStem-Anthony Nolan Workshop on Present Practice and Future Promise of Cord Blood Transplantation, London, UK, September 15, 2006.