

The 2016 APBMT Activity Survey Report: Trends in haploidentical and cord blood transplantation in the Asia-Pacific region

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Abstract

This report describes the results of the Asia-Pacific Blood and Marrow Transplantation Group (APBMT) Activity Survey 2016, focusing on the trends of haploidentical and cord blood (CB) transplants in the Asia-Pacific region. Mongolia and Nepal submitted their first activity data in this survey, and the number of countries/regions participating in the activity survey grew to 20. The annual number of transplants exceeded 20,000 for the first time in 2016, and the total number of centers increased to 686. About 87.9% of all hematopoietic stem cell transplantations (HSCTs) were performed in China, Japan, Korea, India, and Australia with China performing the highest number. Beginning with the 2016 survey, APBMT modified the survey forms and initiated the collection of the exact number of haploidentical transplants. The total number of such transplants was 3,871, and 66.0% of those were performed in China. Meanwhile, cord blood transplants in this region remained high (1,612), and 81.8% of them (1,319) were performed in Japan. The number of facilities and transplants, the ratio of haploidentical transplants to related transplants, the ratio of CB transplants to unrelated transplants, and proportions of haploidentical and CB transplants per capita significantly differed among countries/regions in the Asia-Pacific region. Data collection and analysis revealed the transition and diversity of transplants in this region. This report also shows a dramatic increase in haploidentical transplants as seen in other parts of the world, while revealing uniquely that the activity of cord blood transplant remains high in this region.

Key words: Asia-Pacific region, HSCT, haploidentical, cord blood

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Introduction

Hematopoietic stem cell transplantation (HSCT) has actively performed worldwide as a curative treatment for many malignant and nonmalignant hematological diseases, as well as several non-hematological diseases, and its use continue to increase every year¹. The Asia-Pacific Blood and Marrow Transplantation Group (APBMT) commenced a survey of HSCT activities in 2007 tracing back through the activity data in 1986, and has continued with these surveys for 14 years thereafter. The survey was performed using a simple Excel sheet collecting the data of HSCTs performed in the previous year regarding diseases for which HSCT was indicated (or performed), stem cell sources, and donor type. Over the years, some of the disease classifications have been changed, and some collection items were added by the data center to adapt the survey sheets to global standards. Despite such changes, the APBMT Activity Survey continued to be conducted every year with the cooperation of data submission managers in each country/region. The data center regularly analyzed the collected data in detail, and the results were shared with APBMT participating countries/regions. The data was also reported to the Worldwide Network for Blood and Marrow Transplantation (WBMT). APBMT has published the results of the HSCT performed in two different time periods (1986-2006² and 2005-2015³). We herein report the results of HSCT in the Asia-Pacific region in 2016, focusing on the activity regarding haploidentical and cord blood (CB) transplants.

Materials and Methods

Data collection and definitions

This report is based on the data of HSCTs performed in 2016 and collected from 20 out of 22 participating APBMT countries/regions. As previously reported³, depending on the available tools for submitting the data in each country/region, data were sent to the APBMT Data Center 1) through the following national registries: the Australasian Bone Marrow Transplant Recipient Registry (ABMTRR), Chinese Blood and Marrow Transplantation Registry (CBMTR), Indian Society for Blood and Marrow Transplantation Registry (ISBMT), Korean Society of Blood and Marrow Transplantation (KSBMT), Japan Society for Hematopoietic Cell Transplantation (JSHCT)/Japanese Data Center for Hematopoietic Cell Transplantation (JDCHCT), Malaysian Society of Transplantation (MST), and Taiwan Society of Blood and Marrow Transplantation (TBMT) from 8 countries/regions (Australia, New Zealand, China, India, Republic of Korea [referred to as Korea in this paper], Japan, Malaysia, and Taiwan, respectively); 2) by individuals

responsible for data collection in the major transplant centers in each country/region: Bangladesh, Iran, Myanmar, the Philippines, Sri Lanka, and Thailand; and 3) directly from each center in each country/region: Hong Kong, Mongolia, Nepal, Pakistan, Singapore, and Vietnam. At the end of 2018, when the Data Center completed the collection of 2016 Activity Survey data, Indonesia had commenced its HSCT program, and Cambodia had not yet started; hence, their activity was excluded from this report.

The activity survey data were collected for disease for which transplant were indicated, stem cell source, and donor type. The number of transplants was defined as follows: the number of HSCTs was counted as 2 in patients who had received transplants twice separately in the past year. If a patient received one HSCT using more than one donor sources, the case was counted as a mixture transplant which contains cases of bone marrow (BM) plus peripheral blood stem cells (PBSC), BM plus cord blood cells (CB), PBSC plus CB, or BM plus PBSC plus CB transplants. The APBMT Data Center had not previously collected the data under the category "haploidentical" in the activity survey and considered them as "HLA non-identical family". However, in order to assess the trend of haploidentical transplants more precisely, Data Center modified the 2016 survey forms, and we divided the "HLA non-identical family" donor into two categories: 1) "haploidentical" donor, who is a first-degree relative (sibling, parent or child) with 2 or more loci mismatched within the loci HLA-A, -B, -C, -DRB1, and-DQB1 in the GvH and/or HvG direction and 2) "other related" donor, who is any other family member not included in the category of HLA-identical and "haploidentical" siblings. The number of CB transplants in this paper has excluded the ones from related donors.

Transplantation rate

The transplant rates in each country/region were calculated as the number of each type of HSCT per 10 million residents in 2016. The total population for each country was extracted from a United States Census Bureau report⁴.

Statistical analyses and ethical approval

All analyses in this report were conducted at the APBMT Data Center using the basic function of Excel. The present survey was approved by the Institutional Review Board of the Aichi Medical University School of Medicine and the Registry Committee in APBMT.

Results

Number of centers and transplants

In 2016, 20,170 HSCTs were performed at 686 centers

Table 1. The total number of centers and transplants, the average number of transplants per one center, and the number of centers per 10 million population in each country/region in 2016

	Centers	Transplants	Transplant/ Center	Centers/10 million population
Australia	42	1,846	44	17.4
Bangladesh	3	11	4	0.2
China	88	5,904	67	0.6
Hong Kong	2	142	71	2.7
India	67	1,968	29	0.5
Iran	9	410	46	1.1
Japan	373	5,488	15	29.2
Korea	44	2,531	58	8.7
Malaysia	11	360	33	3.5
Mongolia	1	2	2	3.3
Myanmar	2	5	3	0.4
Nepal	1	5	5	0.3
New Zealand	6	305	51	13.0
Pakistan	3	146	49	0.2
Philippines	2	25	13	0.2
Singapore	5	210	42	8.9
Sri Lanka	1	5	5	0.5
Taiwan	18	543	26	7.7
Thailand	7	183	30	1.0
Vietnam	2	81	41	0.2
Total	687	20,170	29	1.8

in 20 countries/regions in the Asia-Pacific (AP) region (**Table 1**). China (5,904) had the highest number of transplants in Asia for the first time, followed by Japan (5,488), Korea (2,531), India (1,968), and Australia (1,846). The total number of transplants per year increased by 2,599 (14.8%) over the previous year. The percent increase in total transplants was highest in China (45.8%), followed by India (20.3%). As opposed to this, the number of annual transplants in Japan decreased by 121 (2.2%). The total number of transplant centers in our region was 686 in 2016, which is 62 more than that in 2015. The number of newly opened centers in 2016 increased significantly in India (N = 26) and China (N = 24). Japan remained as the country with the highest number of centers (373), followed by China (88), India (67), Korea (44), and Australia (42). Comparing the number of centers per 10 million population in each country, 9 countries (Pakistan, Bangladesh, Philippines, Vietnam, Nepal, Myanmar, Sri Lanka, India, China) were less than 1, while New Zealand and Australia exceeded 10 and Japan was 29.2. Transplants in Bangladesh, Sri Lanka, and Myanmar Mongolia, and Nepal in 2016 were approximately 10 and the number of their centers ranged from 1 to 3. The average number of transplants per center in these five countries/regions ranged from 1-10. This figure remained less than the average number of transplants in other countries/regions, such as 10-40 in 6 countries/

regions (30%) (India, Japan, Malaysia, the Philippines, Taiwan, and Thailand), 41-60 in 7 (35%) (Australia, Iran, Korea, New Zealand, Pakistan, Singapore, and Vietnam), and more than 60 in China and Hong Kong.

Stem cell source and donor type

Of the allogeneic transplants, the number of related transplants was consistently higher than that of unrelated ones. The number of unrelated transplants was getting close to those of related transplants from 2004 to 2011, but the number of related transplants has been rapidly increasing compared with unrelated transplants since 2011 (**Figure 1A**). Among the 20,170 HSCTs, 12,806 (63.5%) were allogeneic and 7,364 (36.5%) autologous, and among the allogeneic transplants, 8,033 (62.7%) were related and 4,773 (37.3%) unrelated. Donors for the allogeneic transplants were HLA identical sibling (3,801, 29.7%), haploidentical (3,871, 30.2%), other related (350, 2.7%), and twin (11, 0.1%) (**Table 2**). All allogeneic transplants in Pakistan, the Philippines, and Sri Lanka were performed using related donors. The rate of unrelated transplants exceeded 50% of all allogeneic transplants in Australia and Japan. There were no allogeneic transplants has been performed so far in Bangladesh, Mongolia, Myanmar, or Nepal (**Figure 1B**). Looking at the serial changes in the numbers of haploidentical and CB transplants over the past 30 years, the number of hap-

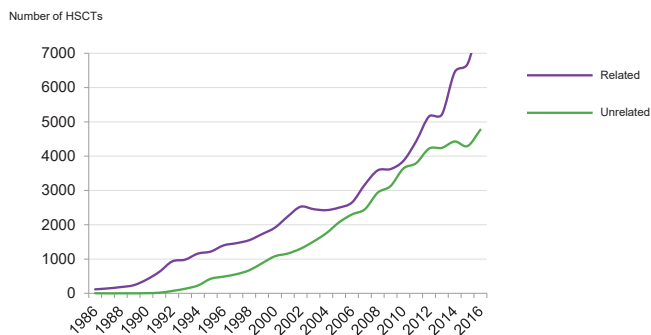


Figure 1A. Trend in the total numbers of related and unrelated HSCTs in Asia-Pacific regions from 1986 to 2016

The number of related HSCTs was consistently higher than unrelated ones. The numbers of unrelated donor transplants got close to those of related donor transplants from 2004 to 2011. However, the difference became larger for the last few years.

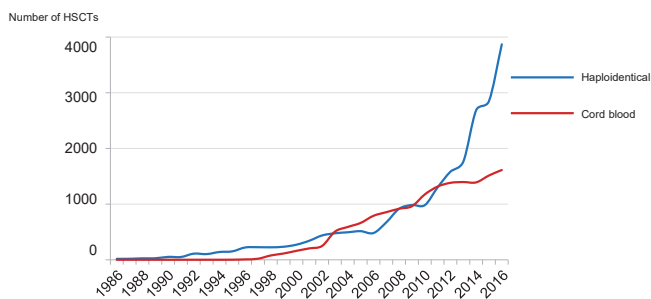


Figure 1C. Trend in the total numbers of haploidentical and cord blood HSCTs in Asia-Pacific regions from 1986 to 2016

The number of haploidentical transplants has increased rapidly since 2011, and it more than doubled the number of CB transplants in 2016. As opposed to haploidentical transplants, CB transplants have been steadily increasing in number.

loidentical transplants has increased rapidly since 2011 and it was more than twice as much as the number of CB transplants in 2016. As opposed to this, the number of CB transplants has also continued to increase constantly during the same period (**Figure 1C**).

The number of haploidentical transplants in 2016 was 2,554 (66.0%) in China, followed by Japan 496 (12.8%), Korea 365 (9.4%), and India 281 (7.3%) (**Table 3**). The stem cell sources used for haploidentical transplants were 100% mixture in China; however, PB was used more than 85% haploidentical transplants in Japan, Korea, and India. Of the 3,871 haploidentical transplants, 2,574 (66.5%) were derived from a mixture of BM and PB, and 99.2% of the mixture haploidentical transplants were performed in China. The majority of CB transplants were performed in Japan (N = 1,319 accounting for 81.8% of all CB transplants) and China (N = 194, accounting for 12.0% of all CB transplants). They were only these two countries that increased in the number of CB transplants in 2016 compared to 2015. In the rest of the countries/regions, the number of CB transplants has ranged less

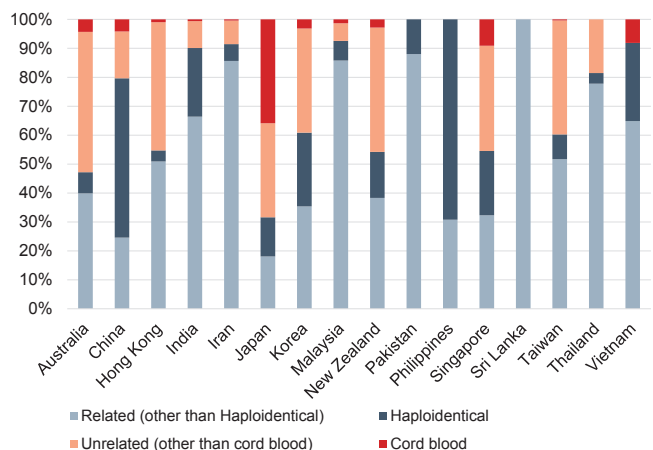


Figure 1B. The distribution of haploidentical and cord blood transplants among allogeneic transplants

Blue portions (dark and pale) indicate related transplants. Red (dark and pale) portions indicate unrelated transplants. All allogeneic transplants in Pakistan, the Philippines, and Sri Lanka were related ones. The rate of unrelated transplants exceeded 50% of all allogeneic transplants in Australia and Japan. The percentage of haploidentical transplants exceeded 50% of related ones in China and the Philippines. The percentage of cord blood transplants exceeded 50% of unrelated ones in Vietnam and Japan. There were no allogeneic transplants in Bangladesh, Mongolia, Myanmar, and Nepal.

than 50 (**Table 3**), and all of them decreased the number of CB transplants in 2016 compared to 2015.

The proportion of haploidentical transplants to related transplants and that of CB transplants to unrelated transplants in each country/region were considerably different, as shown in **Figure 1B**. In China and the Philippines, approximately 70% of related transplants (69.1% and 69.2%, respectively) were haploidentical. In addition, haploidentical transplants in Japan, Korea, and Singapore accounted for a relatively high proportion of related transplants (42.7%, 41.9%, and 40.7%, respectively). On the other hand, the number of CB transplants in Japan was 1,319 accounting for 81.8% of all CB transplants in APBMT, and for 52.5% of all unrelated transplants. In Vietnam, 100% of unrelated transplants were performed using CB.

Disease indication

The main diseases for which transplants were indicated are listed in **Table 2**. The main indications for all HSCTs were as follows: acute myelogenous leukemia (AML) (4,855, 24.1%), plasma cell disorders (PCD) (3,508, 17.4%), non-Hodgkin lymphoma (NHL) (3,289, 16.3%), acute lymphoblastic leukemia (ALL) (2,662, 13.2%), myelodysplastic syndrome (MDS, MDS/MPN) (1,280, 6.3%), and bone marrow failure (BMF) (1,239, 6.1%). Among those, 95.2% of AML, 98.2% of ALL, and 100% of MDS (MDS/MPN) and BMF cases were treated with allogeneic transplants, whereas autologous transplants were preferred for the majority of PCD (95.9%) and NHL

Table 2. The number of transplants by disease indications and stem cell sources in 2016

Disease Indication	Allogeneic (Allo)														Autologous (Auto)		Total						
	Related							Unrelated							Allo	Auto	Total						
	HLA id sibling			Haplo (≥2 loci mismatch)				Other related			Twin												
	BM	PB	CB	Mixture	BM	PB	CB	Mixture	BM	PB	CB	Mixture	BM	PB	CB	Mixture							
Leukemias	Acute myeloid leukemia	102	1,130	0	79	33	493	960	14	76	0	1	0	3	0	370	673	687	0	234	4,621	234	4,855
	Acute lymphoblastic leukemia	80	590	1	32	20	191	730	9	41	1	2	0	0	0	225	406	287	0	47	2,615	47	2,662
	Chronic myeloid leukemia	15	126	3	6	5	35	74	1	12	0	0	0	0	0	30	47	29	0	0	383	0	383
	MDS or MDS/MPN	33	263	0	27	6	114	216	6	24	0	0	1	3	0	199	236	152	0	0	1,280	0	1,280
Lymphoid malignancies	MPN (MPD, MPS)	4	56	0	1	0	16	14	1	5	0	0	0	0	0	12	40	12	0	1	161	1	162
	CLL (including PLL)	0	27	0	0	0	3	0	0	0	0	0	0	1	0	4	5	2	0	0	42	0	42
	Other leukemias	4	41	0	3	1	14	52	1	1	0	0	0	0	0	17	16	23	0	7	173	7	180
	Plasma Cell Disorders- MM	2	50	0	2	1	6	6	0	2	0	0	0	3	0	8	45	6	0	3,154	131	3,154	3,285
Solid tumors	Plasma Cell Disorders-other	0	2	0	0	0	0	5	0	1	0	0	0	0	0	2	1	1	0	211	12	211	223
	Hodgkin lymphoma	1	28	0	1	0	11	4	0	1	0	0	0	0	0	5	13	10	0	497	74	497	571
	Non-Hodgkin Lymphoma	15	173	0	5	6	111	79	6	16	0	0	0	0	0	151	129	213	0	2,385	904	2,385	3,289
	Other lymphoproliferative disorders	1	23	0	0	0	5	0	0	10	0	0	0	0	0	12	0	14	0	93	65	93	158
Non-malignant hematological disorders	Neuroblastoma	0	0	0	0	2	6	0	0	1	0	0	0	0	0	0	0	28	0	315	37	315	352
	Germ cell tumor	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	67	1	67	68
	Breast cancer	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Ewing	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	29	2	29	31
Non-malignant and Non-hematological diseases	Other solid tumors	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	3	0	256	4	256	260
	Bone marrow failure-SAA	91	259	0	102	9	84	340	5	26	0	1	0	0	0	61	197	59	0	1,234	1	1,234	1,235
	Bone marrow failure-other	1	2	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	4	0	4
	Acquired pure red cell anemia	0	3	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	5	0	5
Non-malignant and Non-hematological diseases	PNH	0	4	0	1	0	1	5	0	2	0	0	0	0	0	1	1	1	0	0	16	0	16
	Congenital bone marrow failure	13	11	0	1	3	11	16	3	3	0	0	0	0	0	14	18	10	0	0	103	0	103
	Hemoglobinopathy- Thalassemia	91	137	3	33	2	34	41	12	27	1	1	0	0	0	4	115	12	1	0	514	0	514
	Hemoglobinopathy-other	16	14	0	0	0	13	0	1	0	0	0	0	0	0	1	1	0	0	0	46	0	46
Non-malignant and Non-hematological diseases	Other hematological diseases	0	8	1	1	0	0	0	4	6	0	0	0	0	0	2	1	1	0	0	24	0	24
	Primary immune deficiencies	19	16	0	0	3	33	3	6	9	0	0	0	0	0	30	23	19	0	0	161	0	161
	Inherited metabolic disease	4	7	0	1	0	4	15	2	2	0	0	0	0	0	3	7	16	0	0	61	0	61
	Autoimmune disease	2	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	41	3	41	44
Non-malignant and Non-hematological diseases	EBV related disorders	5	5	0	0	2	8	4	1	1	0	0	0	0	0	7	4	22	0	1	59	1	60
	Hemophagocytic syndrome	2	14	0	1	2	5	10	0	0	0	0	0	0	0	1	4	2	0	15	41	15	56
	Langerhans cell histiocytosis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	1
	Others	4	2	0	0	0	1	0	2	3	0	0	0	0	0	9	6	2	0	10	29	10	39
Total	505	2,992	8	296	95	1,202	2,574	74	269	2	5	1	10	0	1,171	1,989	1,612	1	7,364	12,806	7,364	20,170	

HLA, human leukocyte antigen; BM, bone marrow; PB, peripheral blood; CB, cord blood; MDS, myelodysplastic syndrome; MDS/MPN, myelodysplastic/myeloproliferative neoplasm; MPN, myeloproliferative neoplasm; MPD, myeloproliferative disorder; MPS, myeloproliferative syndrome; CLL, chronic lymphatic leukemia; PLL, prolymphocytic leukemia; MM, multiple myeloma; SAA, severe aplastic anemia; PNH, paroxysmal nocturnal hemoglobinuria; EBV, Epstein-Barr virus.

Table 3. The number of haploidentical transplants by stem cell sources and cord blood transplants in each country/region

Country/Region	Haploidentical			Cord Blood
	Bone Marrow	Peripheral Blood	Mixture	
Australia	4	42	0	27
Bangladesh	0	0	0	0
China	0	0	2,554	194
Hong Kong	0	4	0	1
India	10	269	2	7
Iran	0	15	0	1
Japan	64	428	4	1,319
Korea	8	357	0	45
Malaysia	1	8	1	2
Mongolia	0	0	0	0
Myanmar	0	0	0	0
Nepal	0	0	0	0
New Zealand	1	16	0	3
Pakistan	4	8	3	0
Philippines	0	9	0	0
Singapore	1	21	0	9
Sri Lanka	0	0	0	0
Taiwan	2	13	10	1
Thailand	0	2	0	0
Vietnam	0	10	0	3
Sub total	95	1,202	2,574	1,612
Total		3,871		1,612

(72.5%) (**Figure 2A, B**). Hemoglobinopathy accounted for 2.8% (560 cases) of all HSCTs, and all of them were allogeneic. AML and ALL were major disease indications for haploidentical and CB transplants; however, haploidentical transplants tended to be preferred for BMF, while CB transplants were preferred for hematological malignancies such as AML, ALL and, NHL (**Figure 2C, D**).

Transplant rates

The transplant rates of haploidentical and CB transplants differed significantly among the countries/regions. The number of haploidentical transplants per 10 million people was highest in Korea (71.9), followed by Singapore (39.3), Japan (38.8), and New Zealand (37.0). It was 18.1 in China, where the absolute number of haploidentical transplants was the highest. The rate of CB transplants also differed more widely among countries/regions, from 0.1 in India to 103.3 in Japan (**Figure 3A, B**).

Discussion

This report describes the transition and diversity of transplants in the AP region through the continuous transplant activity data collection and analysis. According to the first APBMT Activity Survey report by Yoshimi *et al.*², the number of countries/regions reported in 2006

was 9 (China, Hong Kong, Iran, Japan, Korea, Malaysia, Singapore, Taiwan, and Vietnam), and the number of transplants was 6,418. The numbers of participating countries/regions and transplants have increased 2.2 and 3.1 times over the last 10 years, respectively, indicating HSCT activity has continued to increase in the AP region. In this report we focused on the activity of haploidentical transplants in our region in comparison of transplant activity using other stem cell sources.

Bone marrow failure was the most frequent disease indication after AML and ALL in haploidentical transplants, reflecting a rapid increase in the number of severe aplastic anemia (SAA) cases in China⁵. Xu *et al.* reported favorable results on performing haploidentical transplants on SAA patients who had no identical sibling or unrelated donors, or those who failed the previous immunosuppressant therapy⁶, and this trend is expected to remain unchanged. In Japan, the proportion of CB transplants to unrelated transplants has also increased and the number of unrelated BM transplants and CB transplants are almost the same⁷. There are many reports of CB transplants for hematological malignancies from Japan and all of which suggest that CB is a favorable alternative stem cell source for patients without a human leukocyte antigen (HLA)-matched related or unrelated donors⁸⁻¹⁰.

With an increased number of participating countries/regions as well as the transplant centers in each country/

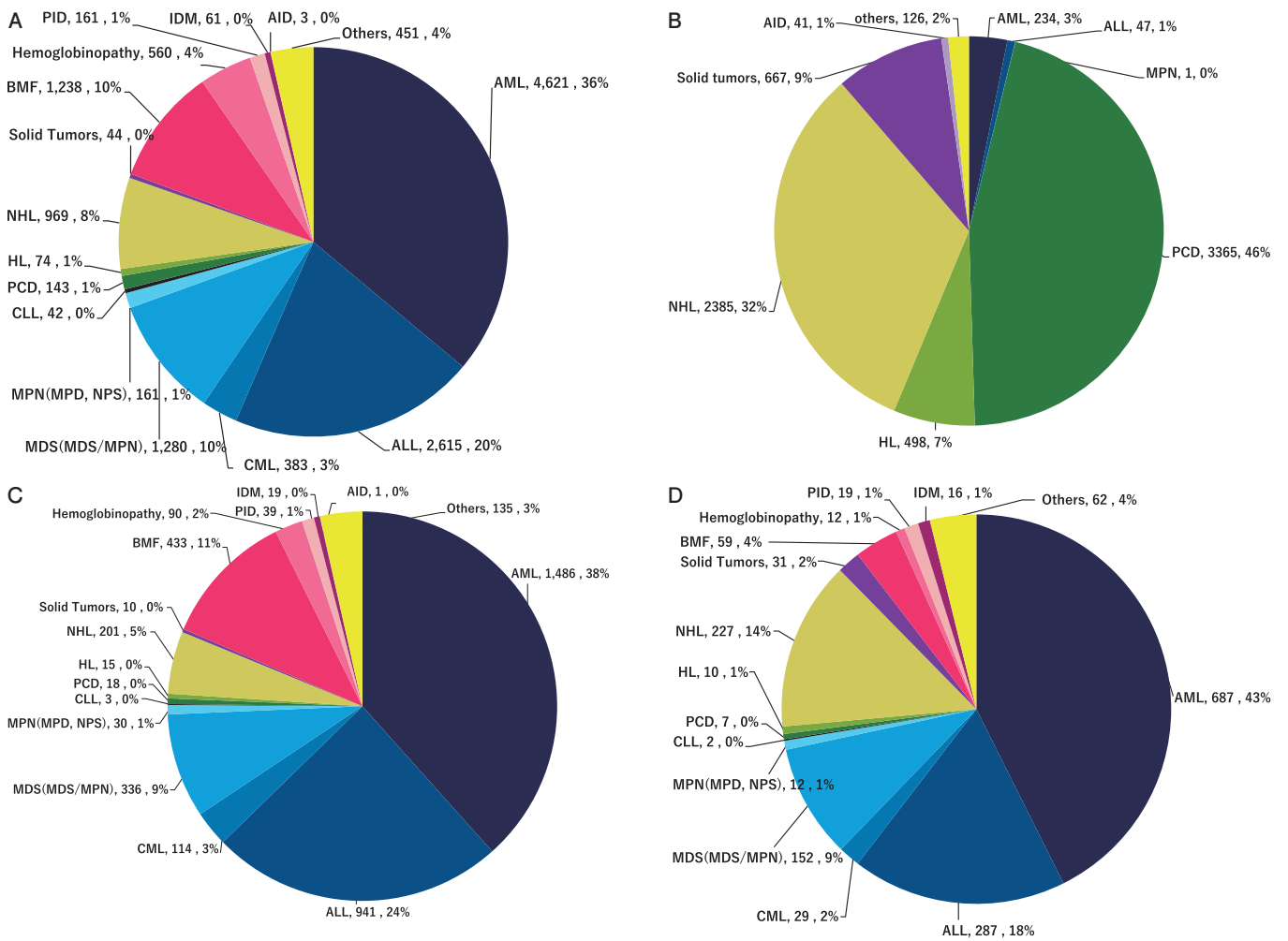


Figure 2. Absolute numbers and percentage of diseases for which transplants were performed in 2016
 (A) Allogeneic transplants, (B) Autologous transplants, (C) Haploidentical transplants, and (D) Cord blood transplants.
 AML, acute myelogenous leukemia; ALL, acute lymphoblastic leukemia; MDS, myelodysplastic syndrome; CML, chronic myeloid leukemia; MDS/MPN, myelodysplastic/myeloproliferative neoplasm; MPN, myeloproliferative neoplasm; MPD, myeloproliferative disorder; MPS, myeloproliferative syndrome; CLL, chronic lymphatic leukemia; PCD, plasma cell disorders; HL, Hodgkin lymphoma; NHL, non-Hodgkin lymphoma; BMF, bone marrow failure; PID, primary immune deficiencies; IDM, inherited disorders of metabolism; AID, autoimmune diseases.

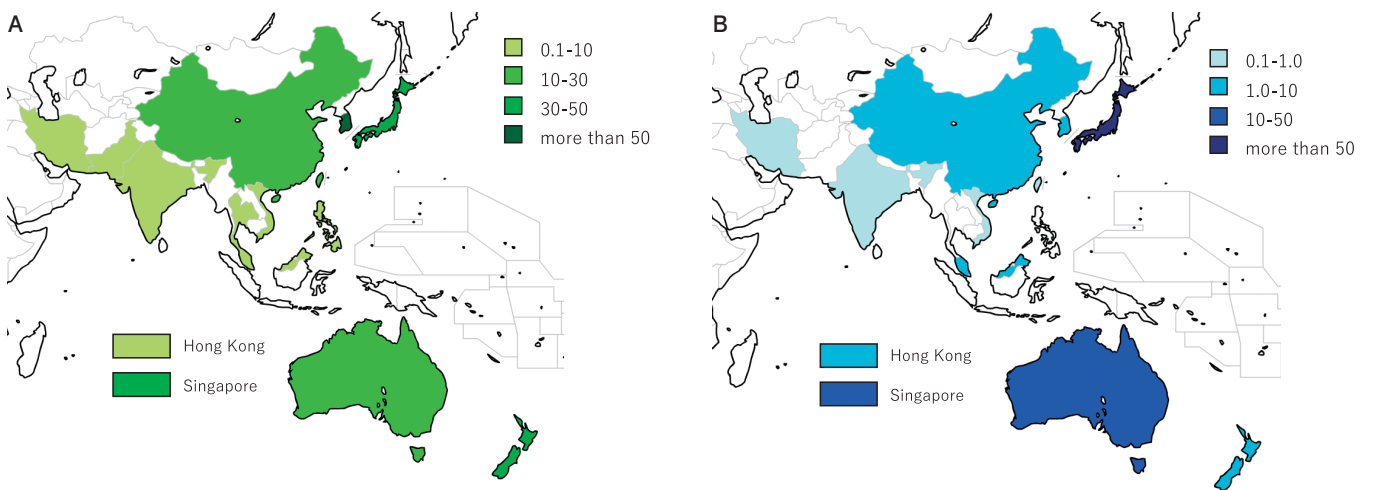


Figure 3. Transplant rates of (A) haploidentical and (B) cord blood in each country/region in 2016
 (A) Global map showing distribution of haploidentical transplant cases using varying shades of green.
 (B) Global map showing distribution of cord blood transplant cases using varying shades of blue.

region, the diversity in transplants among them has been revealed. Not only the annual number of HSCTs and the total number of centers but also the average number of transplants per center, the number of centers, haploidentical and CB transplants per 10 million population showed a great difference among each country/region in this analysis. While there were countries/regions such as China, Japan, Korea, India, and Australia which had very large annual numbers of transplants and centers, those numbers in Bangladesh, Myanmar, and Sri Lanka, Nepal and Mongolia were very small. However, existing centers in these countries/regions are expected to play a central role in promoting transplant activity in each country/region.

A trend of increasing number of haploidentical transplants has recently been reported in Europe¹¹, the United States¹², and the East-Mediterranean/African region¹³. In the Asia-Pacific region, the majority of haploidentical transplants were performed in China using the method reported by Wang *et al.*¹⁴, and their number is still increasing⁵. In addition, based on recent reports on the efficacy and safety of haploidentical PBSC transplants with cyclophosphamide after HSCT^{15,16}, the number of haploidentical transplants is rapidly increasing in Japan, Korea, and India. Compared to CB, the haploidentical transplant has several advantages as an alternative HSCT method: 1) no need for the bank system for hematopoietic stem cells, 2) easy access to sufficient stem cells when a recipient has excess weight, and 3) can expect high engraftment rate. Since emerging countries/regions do not have their own adequate marrow donor bank or CB preservation system, haploidentical transplants in these areas are expected to continue to increase.

A trend of decreasing number of CB transplants has also been reported worldwide^{11-13,17}. On the contrary, there are still many CB transplants in the Asia-Pacific region, especially in Japan. This could be explained by three important factors 1) since the average body weight of Japanese is relatively lighter than that of European and American, it is easier to find a suitable CB donor in Japan¹⁸, 2) the establishment of public CB banks early during the introduction of CB transplants and the cost of CB unit remains much cheaper than those in Western countries. 3) With the development of legislation for the proper implementation of HSCT medicine, the quality of CB units and the system to their supply are well maintained. CB transplants have the advantage of enabling the rapid identification of available donors but at the same time it requires more experience in managing graft failure and relapse is needed by transplant teams. In addition, for the safe preservation and stable supply of CB as well as smooth and proper operation of the marrow donor bank, it is essential for each country/region to create HSCT infrastructure in cooperation with policymakers. Passweg¹¹

and Baldomero¹³ *et al.* pointed out that economics and cost-effectiveness are important in selecting donors in less wealthy countries. The fact that the lack of unrelated-donor registries and public CB banks reflects an increase in haploidentical transplants and stagnation of CB transplants also applies to the Asia-Pacific region. There are 8 countries/regions with national registries and 13 that have CB banks in the Asia-Pacific region³. For HSCT activities to progress in this region, it will be imperative for all countries/regions in APBMT to establish their own HSCT registries and promote not only CB transplants but all HSCT activities on a country-by-country basis in future.

This is limited by the lack of patient outcome data. The APBMT Registry Committee established an outcome data collection system several years ago and the data is accumulating. We will then be able to report more detailed information on HSCT in this region.

We conclude that this report clarified the status of HSCT using alternative donors in this region. We could show a dramatic increase in haploidentical transplants like in other parts of the world while revealing the unique feature in this region that the activity of cord blood transplant remains high. Continuous data collection and analysis by the activity survey will help each country/region clarify the position of HSCT medicine in the Asia-Pacific region as well as in the world and reveal the direction of HSCT medicine in the very near future.

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Author Contributions

MI, AD, MA, JHM, HVM, MRB, AAG, AH, SO, and YA designed the research and wrote the manuscripts. AD, MA, AS, JHM, HVM, MRB, AAG, DJ, KL, BSK, AH, KWH, AH, AU, TF, JS, BP, KB, and YA submitted data and reviewed the results. MI analyzed data.

Conflicts of Interest

The authors declare no conflicts of interest associated

with this article. Disclosure forms provided by the authors are available here.

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