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CURRENT USE AND OUTCOMES OF HEMATOPOIETIC STEM CELL TRANSPLANTATION: BRAZILIAN SUMMARY SLIDES - 2023

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ABSTRACT

The first hematopoietic stem cell transplantation (HSCT) program in Latin America started in 1979 at the federal university hospital in Curitiba, Paraná, Brazil. Over the years, the number of centers performing transplants in our country has increased significantly generating the need to know the results of this treatment modality. Understanding the HSCT scenario in Brazil is still challenging, since not all Brazilian centers report data to the Center for International Blood and Marrow Research (CIBMTR). Despite the improvement in the number of reporting centers over the past few years, infrastructure and trained data managers are still lacking. The partnership between the Brazilian Cellular Therapy and Bone Marrow Transplant Society (SBTMO) and the CIBMTR enabled the establishment of the Hematopoietic Stem Cell Transplantation Brazilian Registry (HSCTBR), using the CIBMTR Data Back to Center (DBtC) tool to retrieve Brazilian HSCT data in a standardized and organized way. Since then, it has been possible to gather country-level data on HSCT demographics and transplant outcomes. Between 2012 and 2022, complete information on 9,868 transplants were reported to the CIBMTR from 40 Brazilian transplant centers. The consolidation of the HSCTBR using CIBMTR infrastructure allowed the development and regular update of the Brazilian Summary Slides. Despite the differences in the number of cases and follow-up time, the results in this study were similar to those presented in the United States (US) Summary Slides. In this paper we present the 2023 SBTMO-CIBMTR Summary Slides prepared by the SBTMO data managers (GD-SBTMO).

Keywords: Data Management. Hematopoietic Stem Cell Transplant. CIBMTR. SBTMO. Brazilian Summary Slides.

INTRODUCTION

Hematopoietic stem cell transplantation (HSCT) is often the only curative option for several malignant and non-malignant hematological diseases, as well as extending the survival of a number of patients[1]. Brazil has a large HSCT program, with 126 teams across 86 transplant centers recognized by the Brazilian Ministry of Health.

The first national results on this treatment modality were published in 1985[2]. In 1997, a Brazilian center took part for the first time in an international multicenter study[3]. Throughout the following years, national multicenter studies were developed. Back then, the first steps for the establishment of the Hematopoietic Stem Cell Transplantation Brazilian Registry (HSCTBR) had already begun[4].

Before the publication of the First Brazilian Summary Slides in 2021[5], the Brazilian Association of Organ Transplants (ABTO), established in 1995, while profiting from a strong collaboration with the SBTMO, was the only data source regarding the number of HSCTs performed each year in the country. In 2022, 3,991 transplants were reported to the ABTO: 1,462 allogeneic and 2,529 autologous HSCTs[6]. The overall survival (OS) of these patients is public and serves as a global benchmark for national HSCT outcomes.

A total of 295,682 autologous and 287,972 related and unrelated allogeneic transplants performed around the world between 1970 and 2021 were reported to the CIBMTR[7]. Despite the existence of our summary slides,[8,9] understanding the HSCT scenario in Brazil is still challenging, since not all Brazilian centers report data to the CIBMTR, besides the fact that there is a lack of infrastructure and of trained data managers (DM). Therefore, over the years, thanks to a working group composed of physicians and DMs, coupled with the collaboration of the CIBMTR and the SBTMO, strategies such as continuing education in data management and direct communication channels were developed to support DM training and HSCT centers in the affiliation process to the CIBMTR. These actions underly the increasing number of Brazilian centers currently reporting to the CIBMTR.[10]

The partnership between the SBTMO and the CIBMTR has allowed access to the tools available in the registry, such as the DBtC, which enables the uniform retrieval of data sent by the Brazilian transplant centers to the CIBMTR. Part of the data inserted can thus return to the registered centers in a standardized, de-identified and codified manner, rendering analyses of the outcomes of transplants performed in the country more effective. The consolidation of the HSCTBR using CIBMTR infrastructure and the

accessibility to these data is essential for our public health administration.

OBJECTIVE

Our objective is to understand the Brazilian HSCT demographics and outcomes using the DBtC tool to retrieve the data reported to the CIBMTR, as well as to regularly update and publish them as the Brazilian HSCT Summary Slides. We also aimed to compare our data to those of the US Summary Slides over a similar period of time.

METHODS

Data from 10,107 transplants performed across 40 Brazilian centers between 2012 and 2022 and reported to the CIBMTR were extracted from their portal using the DBtC tool. Of those, 9,868 transplant records had complete data for analysis (4,454 autologous and 5,414 allogeneic HSCTs). The raw data were imported into the Power BI Desktop (PBI). Functions were updated to count the number of transplants performed and the number of participating centers, to translate columns into Portuguese, to categorize and appropriately classify diseases, to group the variables, and to run the global survival analyses.

Patients were classified as pediatric (0-17 years of age) and adults (≥ 18 years of age). Allogeneic transplants were categorized as matched related donor, mismatched related donor (including haploidentical and related donors with one mismatch), and unrelated donor. Grafts were classified as bone marrow (BM), peripheral blood stem cells (PBSC) and umbilical cord blood (CB). The disease stage for Acute Leukemias was classified as 1st remission, 2nd and further remissions, and active disease. Myelodysplastic Syndrome (MDS) was divided into Early Stage, subdivided into refractory anemia (RA), refractory anemia with ring sideroblasts (RARS), refractory cytopenia with multilineage dysplasia (RCMD), and MDS with del(5q) alone, or Advanced Stage, including refractory anemia with excess blasts (RAEB) and Chronic Myelomonocytic Leukemia (CMML). Patients with Lymphoma were categorized as chemosensitive and chemoresistant disease by the response to treatment prior to the HSCT.

Classification of conditioning therapy was based on the agents and doses used: myeloablative conditioning (MAC) for patients who received total body irradiation (TBI) ≥500 cGy in a single dose or >800 cGy in fractionated doses; busulfan >9 mg/kg oral or ≥7.2 mg/kg IV; or melphalan >150 mg/m^2 as a single agent or in combination with other drugs. Conditioning regimens not fulfilling the criteria for MAC, were classified as reduced intensity/non-myeloablative (RIC/NMA)[11,12].

Causes of death were categorized using the standard classification from the DBtC application. The main causes of death from 2018 to 2022 were separated between deaths from 0-100 days and deaths >100 days up to 3 years after HSCT. For the analysis of OS, only 1st HSCTs were selected, and patients with no follow-up data after HSCT or with errors in survival time were excluded (table 1).

Graphics were generated by PBI and exported to Microsoft PowerPoint for publication. OS was estimated by the Kaplan Meier method, and the log-rank test was used to compare survival between groups. Survival analyses were performed using R Statistical Software (Version 4.2.1).

Ethics approval was obtained from the national Institutional Review Board (IRB) in 2019 (Conep CAAE: 65575317.5.1001.0071, principal investigator Dr. Nelson Hamerschlak).

RESULTS

Between 2012 and 2022, 9,868 HSCTs were reported to the CIBMTR from 40 Brazilian centers (table 2), 21 (52%) of which located in the state of São Paulo; 4 in Paraná, 4 in Minas Gerais, 3 in Rio de Janeiro; 3 in Rio Grande do Sul; and 1 center of which in each of the following states: Ceará, Distrito Federal, Rio Grande do Norte, Pernambuco, and Santa Catarina.

The number of active CIBMTR centers increased over the past years in the country, reaching 34 in 2022 (figure 1), which has contributed to the increase in the total number of Brazilian HSCTss registered with the CIBMTR since 2016. In 2022 1,668 transplants were performed (figure 2).

Between 2012 and 2022, 41% of the allogeneic HSCTs performed in Brazil used a matched related donor, followed by an unrelated donor (30%) and a mismatched related donor (29%). However, during the past 3 years, the main type of allogeneic transplant performed in the country was from mismatched related donors (figure 3).

Regarding the graft source for allogeneic transplants, BM was used in most pediatric transplants, while PBSC comprised the main source in adults from 2018 onwards (table 3).

Mismatched related donors were used to treat acute myelogenous leukemia (AML; 32%), followed by acute lymphoblastic leukemia (ALL; 24%) and non-

-malignant diseases (23%); 52% of them used MAC and 48% used RIC/NMA.

The main indications for HSCT in Brazil in 2022 among all age groups were multiple myeloma (MM; 494; 30%), followed by AML (229; 14%), non-Hodgkin lymphoma (NHL; 205; 12%), ALL (204; 12%), and Hodgkin disease (HD;169; 10%) (figure 4). In pediatric allogeneic HSCT, the main diseases were ALL (37%), other non-malignant disorders (23%), and AML (15%). In adults, the main indications for allogeneic transplants were AML (35%), ALL (23%) and MDS (11%). Acute leukemias continue to be the main indication for allogeneic HSCT, but since 2016, there has been an increase in its use for MDS/MPN and lymphomas. The main indications for autologous HSCT remain stable, with the greatest share being that of multiple myeloma and lymphomas.

Among patients with Acute Leukemias, 51% of those with AML and 47% of those with ALL were in 1st remission. Most HSCTs were performed from matched related donors in both AML (45%) and ALL (37%) (table 4).

Infections were the leading cause of death in the first 100 days after all types of transplants: autologous (71%), matched related donor (54%), unrelated donor (57%), and mismatched related donor (56%) allogeneic HSCTs. The most common cause of death after the first 100 days post-HSCT was relapse of the primary disease in both autologous (66%) and matched related (44%), unrelated (43%), and mismatched related donor (47%) allogeneic transplants.

For survival analyses, the median follow-up was 24 months in allogeneic and 13 months in autologous HSCT. Patients with Acute Leukemia who underwent transplantation with active disease had lower survival rates compared to those at other stages (table 5).

Adults had higher survival rates after HSCT from matched sibling donors when undergoing HSCT for AML (p=0.192; figure 5), ALL (p=0.006; figure 6) and MDS (p=0.013; figure 7), but donor type had no impact in pediatric patients with Acute Leukemias.

The 2-year survival for MDS was similar regardless of disease risk and donor type (figure 8). Patients with Chronic Myeloid Leukemia (CML) had a 2-year OS of 63% with a matched related donor, 51% with a mismatched related donor, and 60% with an unrelated donor (p=0.583) (figure 9). Patients with myelofibrosis had a survival of 63% in 2 years (figure 10). Donor type had no impact in children with aplastic anemia, which differed from adults, who had higher survival after HSCT from matched sibling donors (p=0.001) (figure 11).

Patients undergoing autologous HSCT to treat chemosensitive lymphomas had a significantly better 2-year OS than those with chemoresistant disease: 87% versus 77% in HD (p=0.073) and 76% versus 53% in NHL (p=0.001) (figure 12). The 2-year OS was 83% for patients with multiple myeloma (figure 13), and age at HSCT had no impact on the 2-year OS (figure 14).

DISCUSSION

This was a cross-sectional, register-based study which aimed to understand the Brazilian HSCT demographics and outcomes across 40 Brazilian centers over the past 10 years using the DBtC tool to retrieve the data reported to the CIBMTR from 2012 to 2022. Data from 10,107 transplants, of which 9,868 HSCT records had complete data for analysis, were extracted from the CIBMTR portal using this tool.

Our study, using the DBtC data, included more allogeneic than autologous transplants reported to the CIBMTR, but, according to the ABTO, there is a greater number of autologous HSCTs performed in the country. The reason for this difference is the larger number of affiliated centers in the CIBMTR performing allogeneic transplants. However, as more centers are increasingly affiliated over the years, more autologous rather than allogeneic transplants have already been reported since 2021.

We observed an increase in the number of transplants with mismatched related donors since 2012, along with a decrease in unrelated CB transplants during the same period, most likely due to the use of haploidentical donors with post-transplant cyclophosphamide to prevent graft-versus-host disease.

Comparing our data with those of the US Summary Slides published on the CIBMTR website[13], matched related donor HSCT is the main type of transplant performed in Brazil, while unrelated donor HSCT predominates in the US.

In pediatric patients, the main source was BM in Brazil, following the same trend in the US. In contrast, there has been an increase in PBSC use over the years, and this graft source has now been the choice for adult recipients since 2018 in Brazil - and since 2000 in the US - for all types of allogeneic HSCTs.

The HSCT indications are very similar between both countries: in Brazil, in 2022, the main indications for

HSCT were MM, AML, NHL, ALL, and HD, as compared to MM, AML, NHL, MDS/MPN and ALL in the US in 2020.

Another important comparison was the cause of early death 0 to 100 days after transplantation: in Brazil, the main cause of early mortality was infection for autologous, matched related donor, mismatched related and unrelated donor allogeneic HSCTs, while in the US, it was the primary disease for autologous and unrelated donor transplants and organ failure for matched and mismatched related donor HSCTs.

Comparing the 2-year OS in our study with the 3-year OS in the US Summary Slides, the Brazilian data are similar to the survival rates reported by US centers (table 6), despite the socioeconomic differences between these countries.

The Brazilian Summary Slides and further de-identified data are fully available to active centers in the HSCTBR through the SBTMO data request flow (figure 15).

CONCLUSIONS

The partnership between the SBTMO and the CIBMTR made the HSCTBR possible by use of the DBtC application. Data analysis on HSCTs performed across Brazilian centers, resulting in the Brazilian Summary Slides, contributes to a better understanding of HSCT outcomes, thereby rendering the results available to centers as a national and international benchmark. The Brazilian Summary Slides are updated twice a year and published on the SBTMO website. Despite the differences in the number of cases and follow-up time, the results in this study were similar to those presented in the US Summary Slides.

FUTURE PERSPECTIVES

The consolidation of the HSCTBR over the past few years has shown positive results, such as the increase in the number of Brazilian centers affiliated to the CIBMTR and the progressively higher qualification of DMs. However, there is still a lot to be done. A greater commitment of each HSCT center in the country ought to be made in order to improve transplant activity registry, including the regular reporting of long-term follow-up data, coupled with DM continuing education, thus fostering data quality improvement within our national registry. Government support (through resources, infrastructure, and qualification) is also essential to achieve these goals. Such tireless efforts will enable the consolidation of the HSCTBR, which, in the long run, will result in the provision of better care to our patients.

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TABLE 1. Exclusion criteria for overall survival

Total	**9,868**
Exclusion criteria	**n**
Patients without follow-up update	1,656
Error in survival time	59
≥2nd HSCT	817
Complete data	**7,333**

TABLE 2. HSCT centers

Participants Centers
A.C. Camargo Cancer Center
Albert Einstein Hospital
Associação Hospitalar Moinhos de Vento
Bio Sana's Serviços Médicos
Bio Sana's São Camilo
Centro De Pesquisa Clinica Hospital 9 De Julho
Centro de Pesquisas Oncológicas Dr. Alfredo Daura Jorge (CEPON)
Complexo Hospitalar de Niterói
CTMO-HCFMUSP
Fundação Faculdade Regional de Medicina de São José do Rio Preto (FUNFARME)
Fundação Pio XII - Hospital de Câncer de Barretos
Hospital Amaral Carvalho
Hospital das Clínicas - Faculdade de Medicina de Botucatu, UNESP
Hospital de Clínicas - UFPR
Hospital de Clínicas de Porto Alegre
Hospital Erasto Gaertner
Hospital Leforte Liberdade
Hospital Mãe de Deus
Hospital Monte Sinai
Hospital Nossa Senhora das Graças - IP
Hospital Pequeno Príncipe
Hospital Samaritano
Hospital São Camilo - Mooca
Hospital São Camilo - Pompéia
Hospital São Camilo - Santana
Hospital Sírio Libanês
Hospital Universitário Clementino Fraga Filho, Univ. Fed. RJ
Hospital Universitario da Universidade Federal de Juiz de Fora
Hospital Universitário Walter Cantídio/UFC
Instituto da Criança - Hospital das Clínicas da Faculdade de Medicina da Universidade de São Paulo (ITACI)
Instituto de Cardiologia do Distrito Federal - Unidade de TMO Pietro Albuquerque
Instituto de Oncologia Pediátrica - GRAACC
Instituto Nacional de Câncer
Natal Hospital Center
Real e Benemérita Sociedade de Beneficiência Portuguesa de São Paulo
Real Hospital Português
Santa Casa de Montes Claros
UFMG Hospital das Clínicas Servico de Transplante de Medula Óssea
UNICAMP - Hemocentro
Universidade Federal de São Paulo - Hospital São Paulo

TABLE 3. Source of cells used by donor type, age and year of HSCT

	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Patients <18 Years											
Matched Related Donor (N=417)											
PBSC	2%	4%	2%	3%	9%	5%	6%	8%	3%	14%	15%
BM	93%	88%	96%	94%	91%	93%	88%	90%	97%	86%	82%
CB	5%	8%	2%	3%	0%	2%	6%	2%	0%	0%	3%
Unrelated Donor (N=735)											
PBSC	5%	3%	16%	12%	7%	7%	12%	4%	25%	28%	32%
BM	55%	74%	78%	75%	85%	87%	80%	88%	72%	58%	64%
CB	40%	23%	6%	12%	7%	6%	8%	8%	3%	14%	4%
Mismatch Related Donor (N=602)											
PBSC	24%	10%	27%	14%	25%	21%	34%	25%	24%	24%	24%
BM	76%	90%	73%	86%	75%	79%	66%	75%	76%	76%	76%
Patients ≥18 Years											
Matched Related Donor (N=1,812)											
PBSC	49%	47%	43%	51%	46%	52%	53%	56%	65%	65%	72%
BM	51%	53%	57%	49%	54%	48%	47%	44%	35%	35%	28%
CB	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Unrelated Donor (N=862)											
PBSC	40%	31%	39%	52%	51%	47%	58%	55%	59%	82%	75%
BM	43%	62%	61%	45%	49%	53%	42%	44%	37%	18%	25%
CB	17%	7%	0%	3%	0%	0%	0%	1%	4%	0%	0%
Mismatch Related Donor (N=986)											
PBSC	18%	33%	40%	34%	40%	44%	62%	66%	73%	75%	80%
BM	82%	67%	60%	66%	60%	56%	38%	34%	27%	25%	20%

TABLE 4. Acute Leukemia by disease stage, donor type and HSCT year

	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
AML											
Disease Stage											
1st complete remission	36%	45%	48%	45%	59%	51%	54%	55%	52%	53%	57%
2nd or subsequent complete remission	36%	27%	38%	40%	31%	30%	27%	25%	30%	21%	25%
Relapsed disease/Never in CR	28%	27%	14%	15%	10%	19%	19%	20%	17%	26%	18%
Donor Type											
Matched Related Donor	51%	57%	68%	48%	50%	50%	44%	43%	44%	35%	38%
Mismatch Related Donor	16%	6%	8%	17%	23%	24%	33%	33%	41%	49%	45%
Unrelated Donor (BM/PBSC)	28%	27%	20%	33%	27%	26%	22%	25%	15%	15%	17%
Unrelated Donor (CB)	5%	9%	4%	1%	0%	0%	1%	0%	0%	1%	0%
ALL											
Disease Stage											
1st complete remission	45%	41%	54%	58%	52%	41%	52%	39%	42%	44%	51%
2nd or subsequent complete remission	50%	53%	39%	40%	39%	51%	34%	48%	49%	45%	36%
Relapsed disease/Never in CR	5%	6%	8%	2%	9%	8%	15%	13%	9%	11%	12%
Donor Type											
Matched Related Donor	45%	53%	51%	43%	40%	36%	39%	31%	33%	28%	27%
Mismatch Related Donor	7%	3%	3%	8%	16%	25%	25%	29%	40%	50%	51%
Unrelated Donor (BM/PBSC)	31%	35%	45%	43%	42%	38%	34%	35%	25%	21%	22%
Unrelated Donor (CB)	17%	9%	1%	6%	1%	1%	2%	5%	1%	1%	0%

TABLE 5. Overall survival of AML/ALL patients

	N	OS in 2 years (%)	p
AML			
Patients Age 0-17 Years			
Donor Type			
Matched Related Donor	74	47.9% (35.1-59.6)	
Mismatch Related Donor	73	60.2% (44.8-72.6)	0.269
Unrelated Donor	75	58.3% (45.5.69.0)	
Patients Age ≥18 Years			
Donor Type			
Matched Related Donor	506	54.9% (49.9-59.5)	
Mismatch Related Donor	271	48.4% (41.0-55.4)	0.192
Unrelated Donor	224	54.1% (46.6-61.0	
Matched Related Donor			
Patients Age 0-17 Years			
Disease Stage			
1st complete remission	35	56.5% (37.6-71.7)	
2nd or subsequent complete remission	23	48.7% (26.7-67.6)	0.484
Relapsed disease/Never in CR	16	-	
Patients Age ≥18 Years			
Disease Stage			
1st complete remission	344	63.8% (57.9-69.1)	
2nd or subsequent complete remission	94	38.0% (26.6-49.4)	<0.001
Relapsed disease/Never in CR	68	31.2% (19.4-43.8)	
Mismatched Related Donor			
Patients Age 0-17 Years			
Disease Stage			
1st complete remission	25	77.4% (53.9-90.0)	
2nd or subsequent complete remission	34	64.7% (41.2-80.8)	0.406
Relapsed disease/Never in CR	14	-	
Patients Age ≥18 Years			
Disease Stage			
1st complete remission	155	57.1% (47.1-65.9)	
2nd or subsequent complete remission	70	46.3% (31.9-59.6)	<0.001
Relapsed disease/Never in CR	46	19.7% (7.4-36.2)	
Unrelated Donor			
Patients Age 0-17 Years			
Disease Stage			
1st complete remission	32	78.1% (57.1-89.7)	
2nd or subsequent complete remission	27	57.4% (36.1-73.9)	0.036
Relapsed disease/Never in CR	16	-	
Patients Age ≥18 Years			
Disease Stage			
1st complete remission	92	67.5% (55.3-77.1)	
2nd or subsequent complete remission	87	55.7% (43.8-66.1)	<0.001
Relapsed disease/Never in CR	45	22.6% (10.3-37.8)	

B. ALL

	N	OS in 2 years (%)	p
ALL			
Patients Age 0-17 Years			
Donor Type			
Matched Related Donor	119	57.9% (47.3-67.2)	
Mismatch Related Donor	122	47.9% (35.7-59.1)	0.293
Unrelated Donor	232	60.8% (53.6-67.2)	
Patients Age ≥18 Years			
Donor Type			
Matched Related Donor	260	55.8% (49.3-61.8)	
Mismatch Related Donor	110	50.4% (40.7-59.3)	0.006
Unrelated Donor	143	43.6% (35.1-51.7)	
Matched Related Donor			
Patients Age 0-17 Years			
Disease Stage			
1st complete remission	37	67.7% (48.8-80.9)	
2nd or subsequent complete remission	65	52.4% (38.0-64.9)	0.349
Relapsed disease/Never in CR	17	-	
Patients Age ≥18 Years			
Disease Stage			
1st complete remission	225	63.6% (56.3-70.1)	
2nd or subsequent complete remission	64	32.4% (20.1-45.3)	<0.001
Relapsed disease/Never in CR	13	-	
Mismatched Related Donor			
Patients Age 0-17 Years			
Disease Stage			
1st complete remission	24	76.0% (50.8-89.5)	
2nd or subsequent complete remission	86	45.0% (31.1-57.9)	0.128
Relapsed disease/Never in CR	12	-	
Patients Age ≥18 Years			
Disease Stage			
1st complete remission	97	58.4% (46.2-68.8)	
2nd or subsequent complete remission	50	41.9% (25.8-57.1)	0.074
Relapsed disease/Never in CR	8	-	
Unrelated Donor			
Patients Age 0-17 Years			
Disease Stage			
1st complete remission	68	72.0% (57.8-81.8)	
2nd or subsequent complete remission	141	57.8% (48.7-65.9)	0.033
Relapsed disease/Never in CR	23	41.7% (15.6-66.2)	
Patients Age ≥18 Years			
Disease Stage			
1st complete remission	101	47.3% (35.8-57.9)	
2nd or subsequent complete remission	54	44.1% (29.8-57.4)	0.478
Relapsed disease/Never in CR	14	-	

TABLE 6. Comparison overall survival – Brazil and USA

A. Acute leukemia

	Brazilian Registry (2012-2022)		US Summary Slides (2009-2019)	
	N	OS in 2 years (%)	N	OS in 3 years (%)
AML				
Matched Related Donor				
Patients Age 0-17 Years				
Disease Stage				
1st complete remission	35	56.5% (37.6-71.7)	391	69% (65-74)
2nd or subsequent complete remission	23	48.7% (26.7-67.6)	133	68% (60-77)
Relapsed disease/Never in CR	16	-	75	30% (21-43)
Patients Age ≥18 Years				
Disease Stage				
1st complete remission	344	63.8% (57.9-69.1)	5,317	58% (57-60)
2nd or subsequent complete remission	94	38.0% (26.6-49.4)	1,226	54% (51-57)
Relapsed disease/Never in CR	68	31.2% (19.4-43.8)	1,721	31% (29-33)
Unrelated Donor				
Patients Age 0-17 Years				
Disease Stage				
1st complete remission	32	78.1% (57.1-89.7)	368	66% (61-71)
2nd or subsequent complete remission	27	57.4% (36.1-73.9)	212	64% (57-71)
Relapsed disease/Never in CR	16	-	118	34% (26-44)
Patients Age ≥18 Years				
Disease Stage				
1st complete remission	92	67.5% (55.3-77.1)	7,441	56% (55-57)
2nd or subsequent complete remission	87	55.7% (43.8-66.1)	1,940	54% (52-57)
Relapsed disease/Never in CR	45	22.6% (10.3-37.8)	2,463	31% (30-33)
Mismatched Related Donor				
Patients Age 0-17 Years				
Disease Stage				
1st complete remission	25	77.4% (53.9-90.0)	172	63% (56-72)
2nd or subsequent complete remission	34	64.7% (41.2-80.8)	99	61% (51-73)
Relapsed disease/Never in CR	14	-	71	37% (27-50)
Patients Age ≥18 Years				
Disease Stage				
1st complete remission	155	57.1% (47.1-65.9)	1,977	53% (50-55)
2nd or subsequent complete remission	70	46.3% (31.9-59.6)	572	55% (51-60)
Relapsed disease/Never in CR	46	19.7% (7.4-36.2)	706	28% (25-32)
ALL				
Matched Related Donor				
Patients Age 0-17 Years				
Disease Stage				
1st complete remission	37	67.7% (48.8-80.9)	317	79% (74-84)
2nd or subsequent complete remission	65	52.4% (38.0-64.9)	464	70% (66-74)
Relapsed disease/Never in CR	17	-	38	57% (43-76)
Patients Age ≥18 Years				
Disease Stage				
1st complete remission	225	63.6% (56.3-70.1)	2,302	64% (62-66)
2nd or subsequent complete remission	64	32.4% (20.1-45.3)	640	45% (41-49)
Relapsed disease/Never in CR	13	-	249	37% (31-44)
Unrelated Donor				
Patients Age 0-17 Years				
Disease Stage				
1st complete remission	68	72.0% (57.8-81.8)	312	80% (75-84)
2nd or subsequent complete remission	141	57.8% (48.7-65.9)	421	64% (60-69)
Relapsed disease/Never in CR	23	41.7% (15.6-66.2)	40	68% (54-84)
Patients Age ≥18 Years				
Disease Stage				
1st complete remission	101	47.3% (35.8-57.9)	2,425	64% (62-66)
2nd or subsequent complete remission	54	44.1% (29.8-57.4)	765	46% (43-50)
Relapsed disease/Never in CR	14	-	253	36% (30-42)
Mismatched Related Donor				
Patients Age 0-17 Years				
Disease Stage				
1st complete remission	24	76.0% (50.8-89.5)	137	75% (67-83)
2nd or subsequent complete remission	86	45.0% (31.1-57.9)	233	63% (57-70)
Relapsed disease/Never in CR	12	-	23	28% (14-57)
Patients Age ≥18 Years				
Disease Stage				
1st complete remission	97	58.4% (46.2-68.8)	771	69% (65-73)
2nd or subsequent complete remission	50	41.9% (25.8-57.1)	344	47% (42-54)
Relapsed disease/Never in CR	8	-	99	28% (20-39)

B. MDS and Aplastic Anemia

	Brazilian Registry (2012-2022)		US Summary Slides (2009-2019)	
	N	OS in 2 years (%)	N	OS in 3 years (%)
MDS (Adults)				
Matched Related Donor				
Disease Stage				
Low risk	99	56.4% (45.3-66.1)	677	52% (48-56)
High risk	96	56.7% (45.2-66.7)	1,693	46% (44-49)
Unrelated Donor				
Disease Stage				
Low risk	52	51.8% (35.2-66.1)	1,133	49% (46-52)
High risk	46	43.4% (27.7-58.0)	2,997	46% (44-48)
Aplastic Anemia				
Patients Age 0-17 Years				
Donor type				
Matched Related Donor	59	83.8% (71.1-91.3)	504	98% (96-99)
Mismatched Related Donor	61	73.6% (58.8-83.7)	110	86% (80-93)
Unrelated Donor	70	80.7% (69.0-88.3)	337	90% (95-99)
Patients Age ≥18 Years				
Donor type				
Matched Related Donor	147	83.8% (76.6-88.9)	625	84% (81-87)
Mismatched Related Donor	46	70.8% (55.0-82.0)	177	80% (74-86)
Unrelated Donor	77	56.5% (44.0-67.2)	581	77% (74-81)

FIGURE 1. Brazilian active centers in the CIBMTR by year

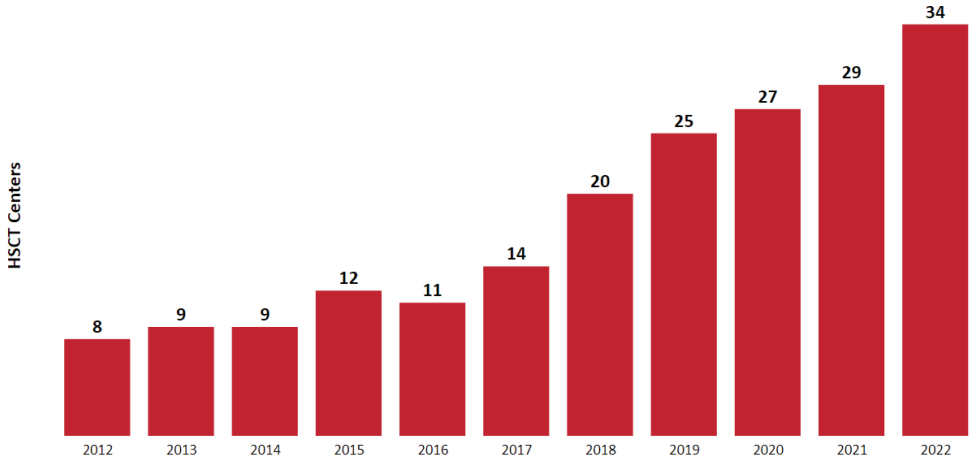


FIGURE 2. Transplants performed in Brazil and reported in the CIBMTR

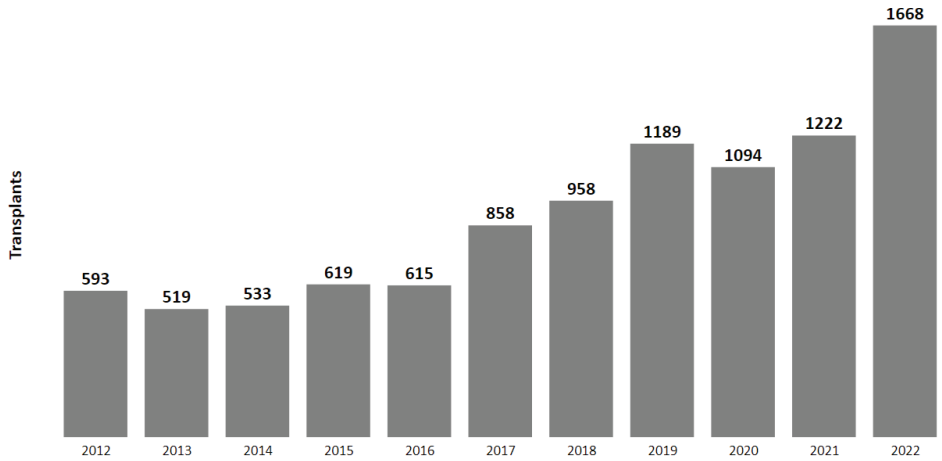


FIGURE 3. Relative proportion of allogeneic HSCT in Brazil by donor type

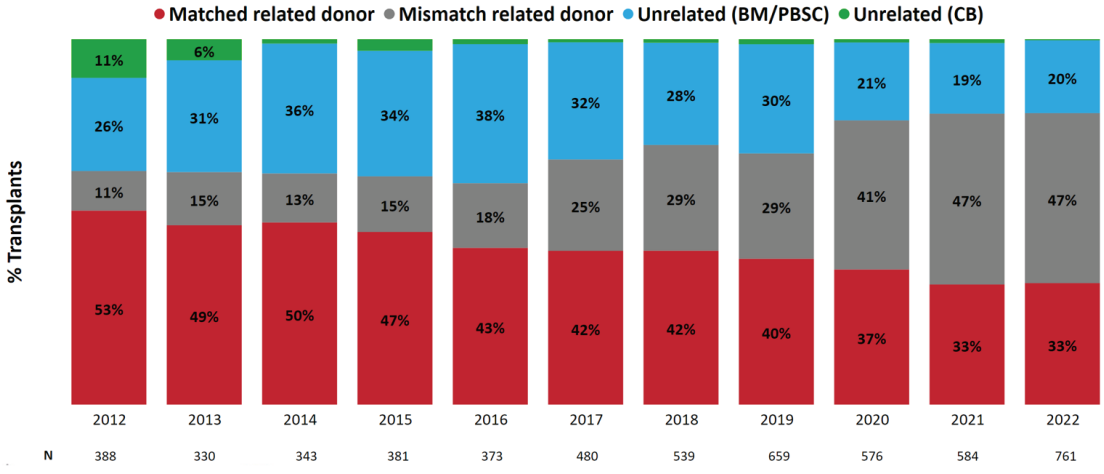


FIGURE 4. **Global indications for HSCT in Brazil, 2022 (n=1,668)**

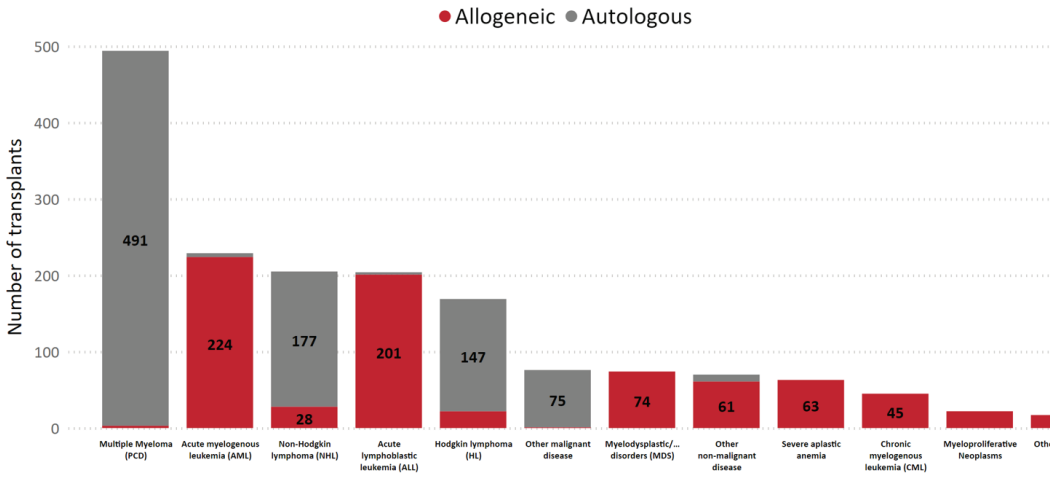


FIGURE 5. **AML, overall survival after 1st allogeneic HSCT by donor type**

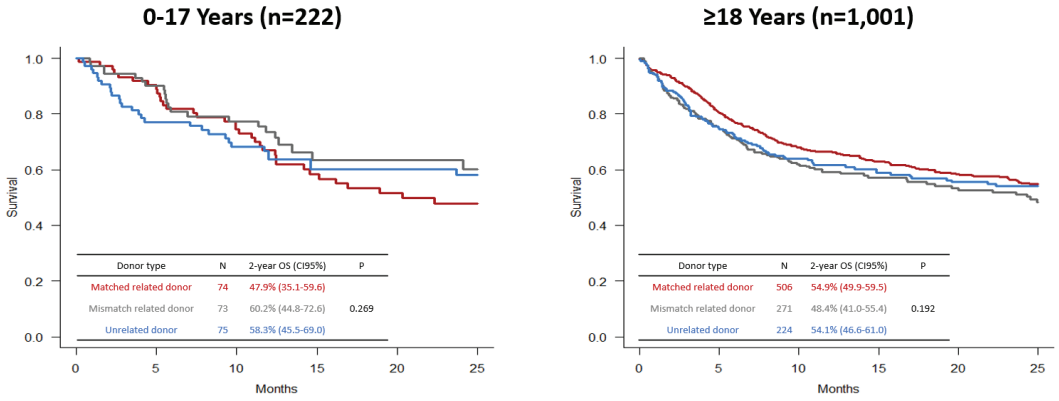


FIGURE 6. **ALL, overall survival after 1st allogeneic HSCT by donor type**

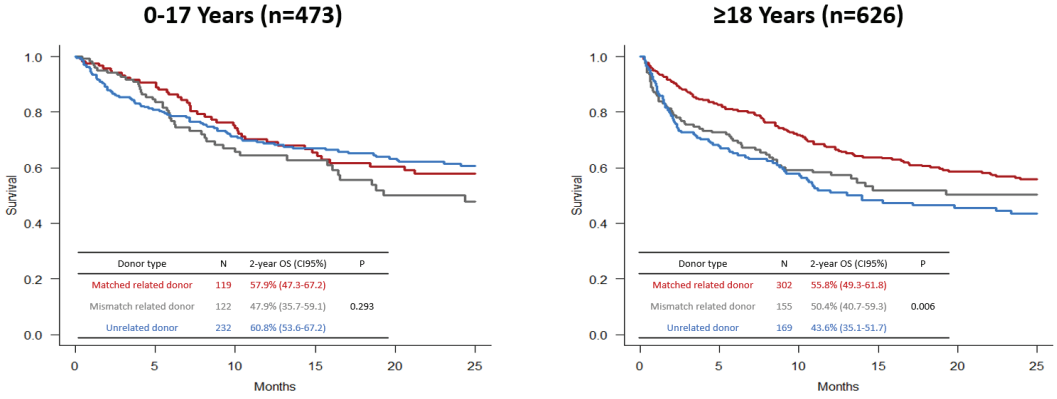


FIGURE 7. **MDS, overall survival after 1st allogeneic HSCT by donor type**

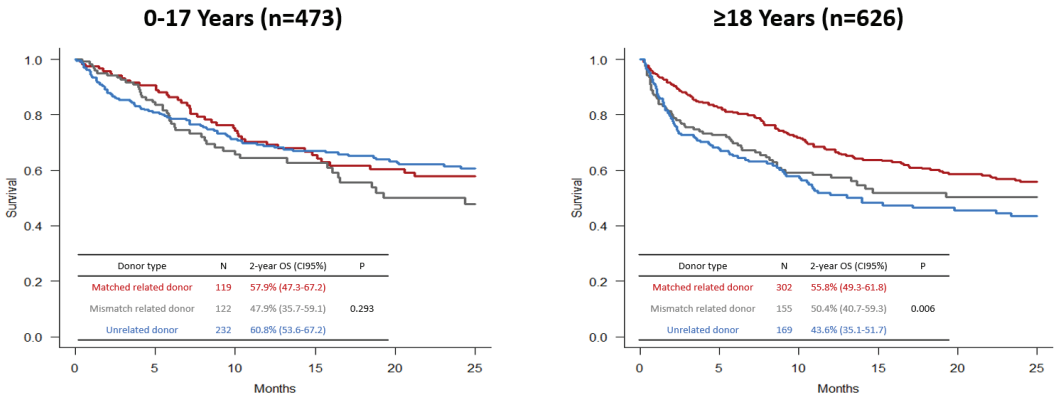


FIGURE 8. **MDS, overall survival after 1st allogeneic HSCT by disease stage**

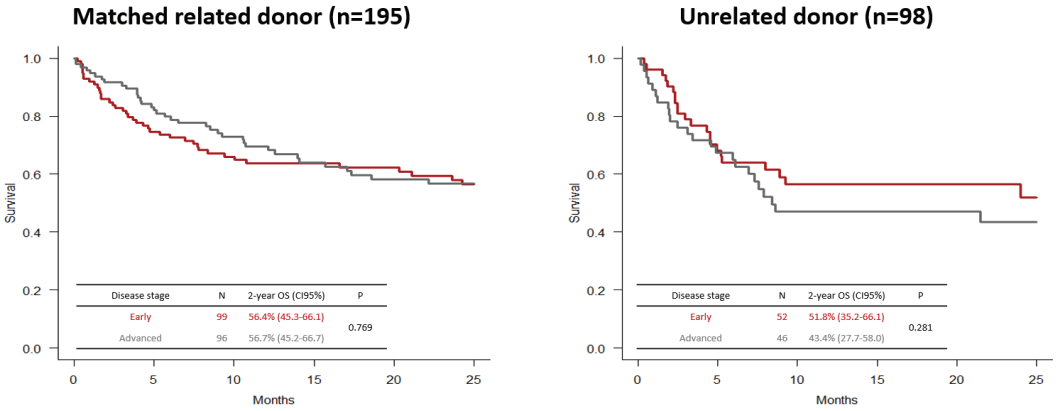


FIGURE 9. **CML, overall survival after 1st allogeneic HSCT by donor type**

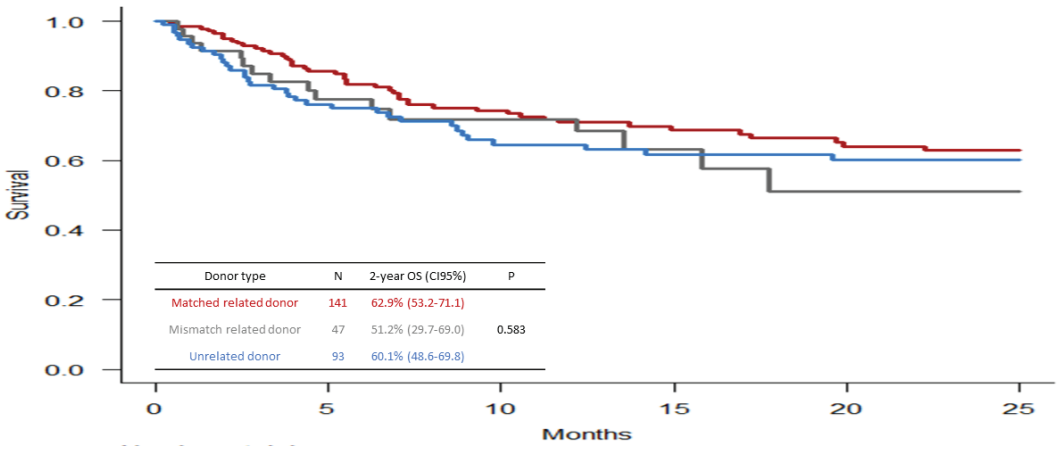


FIGURE 10. **Myelofibrosis, overall survival after 1st allogeneic HSCT**

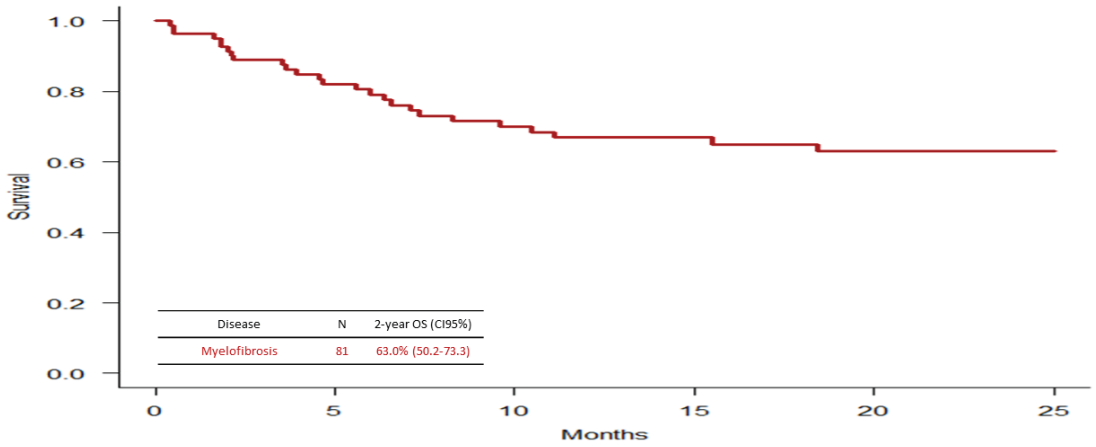


FIGURE 11. **Aplastic Anemia, overall survival after 1st allogeneic HSCT by donor type**

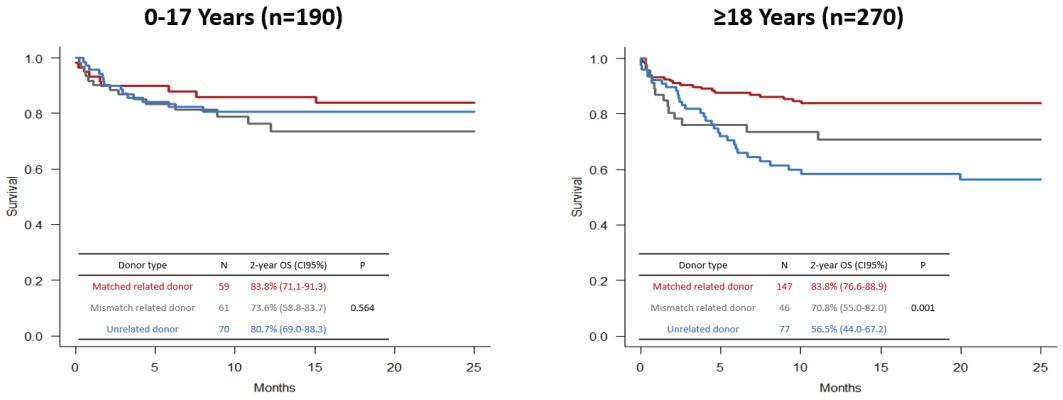


FIGURE 12. **Lymphomas, overall survival after 1st autologous HSCT**

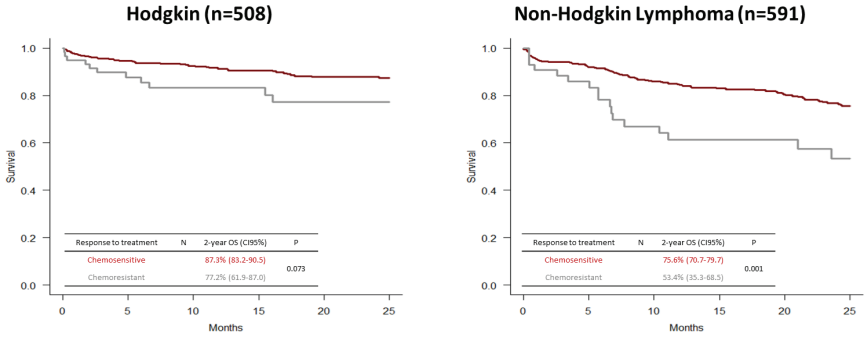


FIGURE 13. **Multiple Myeloma/ Plasma Cell Leukemia, overall survival after 1st autologous HSCT**

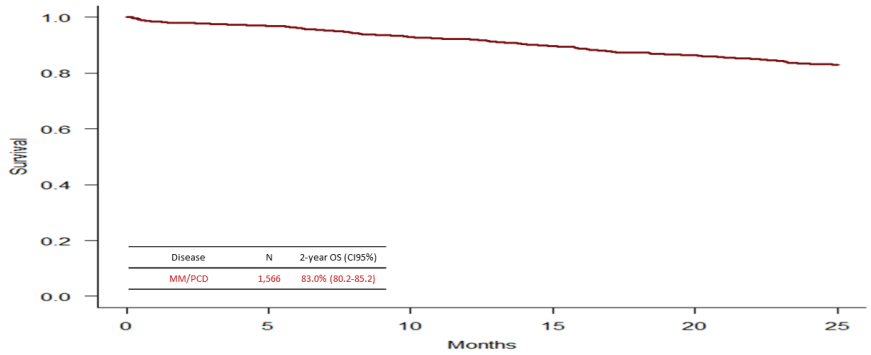


FIGURE 14. **Multiple Myeloma/ Plasma Cell Leukemia, overall survival after 1st autologous HSCT by age at HSCTautologous HSCT**

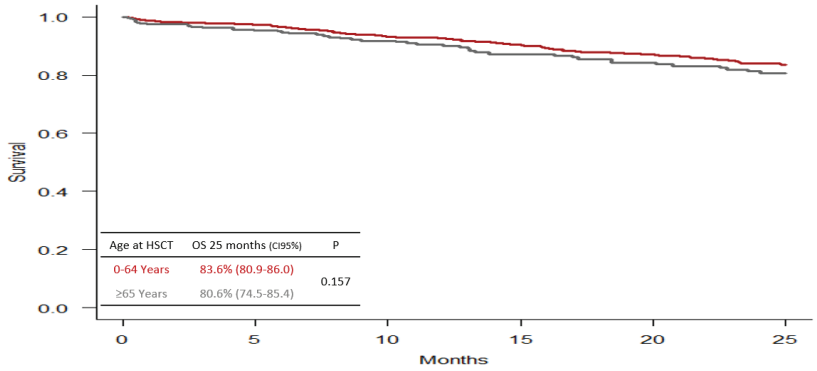
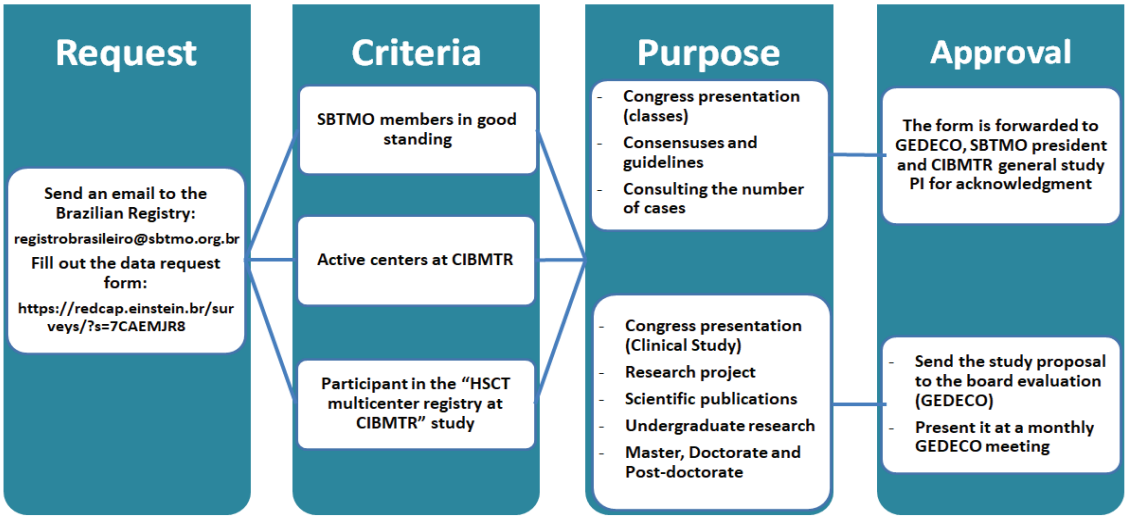


FIGURE 15. **Data request flow**



REFERENCES

1. Kanate AS, Majhail NS, Savani BN, et al. Indications for Hematopoietic Cell Transplantation and Immune Effector Cell Therapy: Guidelines from the American Society for Transplantation and Cellular Therapy. Biol Blood Marrow Transplant. 2020;26(7):1247-56. doi: 10.1016/j.bbmt.2020.03.002.

2. Ferreira E, Dulley FL, Morsoletto F, et al. Bone marrow transplantation in Brazil. R. Hum Immunol. 1985;14(3):324-32. Available from: https://www.sciencedirect.com/science/article/pii/019888598590240X.

3. Gluckman E, Rocha V, Boyer-Chammard A, et al. Outcome of cord-blood transplantation from related and unrelated donors. Eurocord Transplant Group and the European Blood and Marrow Transplantation Group. N Engl J Med. 1997;337(6):373-81. doi: 10.1056/NEJM199708073370602.

4. SBTMO. Reportar é preciso: em webinar, SBTMO apresenta novos dados do Registro Multicêntrico Brasileiro de TCTH [Internet]. Rio de Janeiro; 2022 [cited 2023 May 08]. Available from: https://sbtmo.org.br/reportar-e-preciso-em-webinar-sbtmo-apresenta-novos-dados-do-registro-multicentrico-brasileiro-de-tcth/.

5. Simione AJ, Neves HR, Silva CC, et al. Current use and outcomes of hematopoietic stem cell transplantation: The first Brazilian summary slides. JBMTCT. 2021;2(2):p99.

6. ABTO. Conteúdo [Internet]. São Paulo; 2023 [cited 2023 Apr 11]. Available from: https://site.abto.org.br/publicacao/xxviii-no4/.

7. CIBMTR. 2021 ANNUAL REPORT [Internet]. Milwaukee, WI; 2022 [cited 2022 Jun 26]. Available from: https://cibmtr.org/Files/Administrative-Reports/Annual-Reports/2021-Annual-Report.pdf

8. Simione AJ, Neves HR, Silva CC, et al. Use of a Business Intelligence Tool for Multicentric Analysis in Hematopoietic Stem Cell Transplantation in Brazil with Data Extracted from the Data Back to Center – CIBMTR. Transplant Cell Ther. 2021;27(3):S101–3. Available from: https://www.sciencedirect.com/science/article/pii/S2666636721001317?via%3Dihub.

9 . Simione AJ, Neves HR, Silva CC, et al. Current use and outcomes of hematopoietic stem cell transplantation: Brazilian summary slides. JBMTCT. 2022;3(2):p171. doi: 10.46765/2675-374X.2022v3n2p171.

10. Silva CC, Neves HR, Simione AJ, et al. Challenges and strategies used to increase the report of Brazilian Hematopoietic Stem Cell Transplantation (HSCT) data to the Center for International Blood and Marrow Transplant Research (CIBMTR). JBMTCT. 2020;1(1):46–52. doi: 10.46765/2675-374X.2020v1n1p46-52.

11. Bacigalupo A, Ballen K, Rizzo D, et al. Defining the intensity of conditioning regimens: working definitions. Biol Blood Marrow Transplant. 2009;15(12):1628-33.

12. Giralt S, Ballen K, Rizzo D, et al. Reduced-intensity conditioning regimen workshop: defining the dose spectrum. Report of a workshop convened by the center for international blood and marrow transplant research. Biol Blood Marrow Transplant. 2009;15(3):367-9.

13. CIBMTR. Summary Slides & Reports [Internet]. Milwaukee, WI; 2022 [cited 2023 May 19]. Available from: https://cibmtr.org/CIBMTR/Resources/Summary-Slides-Reports