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ORIGINAL ARTICLE

CURRENT USE AND OUTCOMES OF HEMATOPOIETIC STEM CELL TRANSPLANTATION: BRAZILIAN SUMMARY SLIDES – 2024

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ABSTRACT

The development of the Brazilian Registry of Hematopoietic Cell Transplantation (HCT) in collaboration with the Center for International Blood and Marrow Transplant Research (CIBMTR) allowed for an assessment of the activity and general outcomes of transplants in Brazil. Here, we report an updated activity. Brazilian transplant centers report their data to the CIBMTR, using the FormsNet3 platform. Information returns to Brazilian Cellular Therapy and Bone Marrow Transplant Society (SBTMO) through the Data Back to Centers (DBtC) tool. Data from patients who received an HCT from 2012 to 2023 from Brazilian centers were extracted from CIBMTR. Descriptive analysis was carried out by patient-, disease- and transplant-specific variables and overall survival analysis using Kaplan Meyer. A total of 12,230 patients were eligible for this study (5,573 autologous and 6,657 allogeneic transplants). The number of reporting centers increased from 40 to 44 during the period. The most common HCT indication in Brazil is AML for allogeneic HCT with 152 transplants year and multiple myeloma for autologous HCT with 245 transplants per year. Among allogeneic HCT, in the last 4 years, mismatched related donor was the main source of donors. Regarding the graft source for allogeneic transplants, BM was the most frequent among pediatric transplants, while PBSC was the most used in adults. Infections were the leading cause of death in the first 100 days after all types of transplants. Patients with acute leukemia who underwent HCT with advanced stage disease had lower survival rates compared to those at other stages. 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.

Keywords: Data Management. Hematopoietic Stem Cell Transplantation. Brazil.

INTRODUCTION

Hematopoietic cell transplantation (HCT) is often the only curative option for several malignant and non-malignant hematologic diseases, as well as for prolonging the survival of a number of patients[1]. Brazil has a large number of HCT centers, with 126 transplant programs in 86 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]. Over the following years, a few national multicenter studies were developed. Back then, the process for establishing the Hematopoietic Cell Transplantation Brazilian Registry (HCTBR) had already begun[4].

The Brazilian Association of Organ Transplant (ABTO), created in 1995, quarterly collects and publishes the annual activity of transplants in Brazil without HCT-related complication information. Reporting to ABTO is not mandatory. This activity is carried out voluntarily by those centers that are interested in having their production published. In addition to HCT-related data, also collected and published data on solid organ transplants. According to ABTO, 4,262 transplants were performed in 2023: 1,694 allogeneic and 2,568 autologous[5].

The CIBMTR is a research collaboration between the Medical College of Wisconsin and the NMDP (formerly National Marrow Donor Program), which captures activity and outcomes of transplants in the US. Also, several centers outside the US contribute information to the CIBMTR, and Brazilian centers started to report to then the IBMTR since 1989. The number of Brazilian CIBMTR-reporting centers varied over the years, making it difficult to assess the actual activity of transplants in the region. In 2016 with collaboration between SBTMO and CIBMTR, a program to train professionals for data collection initiated and the number of reporting centers steadily increase[d6]. Also, this collaboration led to the development of the Brazilian Transplant Registry, as data reported from Brazilian centers is combined and returned to the Brazilian Cellular Therapy and Bone Marrow Transplant Society (SBTMO). The HCT activity from Brazilian centers is now published annually in the SBTMO website as a resource to transplant community[7,8,9].

OBJECTIVE

The objective of this report is to report trends in HCT activity from Brazilian transplant centers from the last decade.

METHODS

Data Sources

Brazilian transplant centers report their data to the CIBMTR, using the electronic FormsNet3 platform. That process is protected by double authentication entry requirements for all system users. The compiled, standardized and codified data returns to SBTMO through the Data Back to Centers (DBtC) tool, enabling the analysis of HCT outcomes throughout the country.

Selection

Data from 12,416 transplants performed between 2012 and 2023 were extracted from the CIBMTR portal using the DBtC, gathering information from the 44 Brazilian centers that had sent their HCT data to the CIBMTR. However, only 12,230 transplant records had complete data for analysis (comprising 5,573 autologous and 6,657 allogeneic transplants). For this reason, this was the total number of HCTs considered in the analyses herein.

The analysis of overall survival (OS) included 8,182 patients who underwent a 1st HCT between 2012-2022, and those without follow-up data after transplantation or undergoing a 2nd HCT were excluded (Table 1).

There were considered complete those patients with information about type of transplant, diagnosis and graft source.

The spreadsheet was imported into 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 classify diseases, to group variables, and for performing global survival analyses.

Definitions and Outcomes

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 (UCB).

The disease stage for acute leukemias was classified as 1st remission, 2nd or further remission and patients who underwent HCT with active disease.

Patients with Myelodysplastic Syndrome (MDS) were divided into early disease, comprising refractory anemia (RA); refractory anemia with ring sideroblasts (RARS); refractory cytopenia with multilineage dysplasia (RCMD); and MDS with del(5q) alone, or Advanced disease, 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 HCT.

Classification of conditioning regimens was based on the agents and doses used, as follows: 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. The conditioning regimens that did not fill the criteria for MAC were classified as reduced intensity/non-myeloablative (RIC/NMA)[10,11].

Causes of death were classified using the standard classification from DBtC. The main causes of death between 2018-2022 were separated between deaths 0-100 days and deaths >100 days up to 3 years after HCT.

Statistical analysis

Descriptive statistics were used to describe categorical data with number of cases and percentage, to numerical variables were used median and ranges. Overall survival was estimated by the Kaplan Meier method, and the log-rank test was used to compare survival between groups. Graphics were generated by PBI and exported to Microsoft PowerPoint for publication. Survival analyses were performed using R Statistical Software (Version 4.2.1).

Ethical considerations

Ethics approval for utilization of the CIBMTR platform for the Brazilian Registry for research 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 2023, 12,230 transplants were reported from 44 Brazilian centers (Table 2), of which 21 (48%) were located in the state of São Paulo; 5 in Distrito Federal, 4 in Paraná, 4 in Minas Gerais, 3 in Rio de Janeiro; 3 in Rio Grande do Sul; and 1 in each of the following states: Ceará, Rio Grande do Norte, Pernambuco and Santa Catarina.

The number of active CIBMTR centers increased over the last few years, reaching 36 active centers in 2022 and 35 in 2023 (Figure 1), which has greatly contributed to the increase in the number of Brazilian transplants registered in the CIBMTR since 2016, reaching more than 1,900 transplants per year in the last two years (Figure 2).

Between 2012 and 2023, 39.8% of the allogeneic transplants performed in Brazil used a matched related donor, followed by a mismatched related donor (31.6%) and an unrelated donor (28.7%). In the last 4 years, the main type of allogeneic transplant performed in the country used a mismatched related donor (Figure 3).

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

Mismatched related donors were used to treat Acute Myelogenous Leukemia (AML; 32.8%), followed by Acute Lymphoblastic Leukemia (ALL; 23.9%) and non-malignant diseases (22.8%); 53.3% of them used MAC, and 46.7% used RIC/NMA.

The main global indications for HCT in Brazil in 2023 were Multiple Myeloma (MM; 505; 26%), followed by AML (288; 15%), Non-Hodgkin Lymphoma (NHL; 204; 11%), ALL (201; 10%) and Hodgkin Disease (HD; 173; 9%) (Figure 4). In pediatric allogeneic HCT, the main diseases were other non-malignant (37%), ALL (25%), and Aplastic Anemia (14%). In adults, the main indications for allogeneic transplants were AML (37%), ALL (18%) and MDS (12%).

Even though acute leukemias continue to be the main indication for allogeneic transplantation in the country, an increase was observed, from 2016 on, in transplants performed for non-malignant diseases and MDS/Myeloproliferative Neoplasms (MPN). The main indications for autologous HCT remain MM and lymphomas.

In patients with acute leukemias, 52% of those with AML and 49% with ALL were in 1st remission. Most HCTs were from a matched related donor in both AML (43%) and ALL (36%) (Table 4).

Infections were the leading cause of death in the first 100 days after all types of transplants: autologous (68%), matched related donor (52%), unrelated donor (55%), and mismatched related donor (54%). The most common cause of death for more than 100 days after HCT was the primary disease: autologous (66%), matched related donor (46%),

unrelated donor (45%) and mismatched related donor (45%) (Figure 5).

For survival analyses, the median follow-up was 24 months in allogeneic and 22 months in autologous HCT. Patients with acute leukemia who underwent transplantation with advanced stage disease had lower survival rates compared to those at other stages (Table 5).

Adults had higher survival rates after HCT from matched sibling donors when having HCT for AML (p=0.029; Figure 6), ALL (p=0.007; Figure 7), MDS (p=0.022; Figure 8) and aplastic anemia (p<0.001; Figure 9), but donor type had no impact in pediatric patients with acute leukemias and aplastic anemia.

The 2-year OS for MDS was similar despite disease risk and donor type (Figure 10). Patients with CML had a 2-year OS of 63.6% with a matched related donor, 54.4% with a mismatched related donor, and 57.0% with an unrelated donor (p=0.354; Figure 11). Patients with myelofibrosis had a survival of 59.0% in 2 years (Figure 12).

Patients undergoing autologous HCT to treat chemosensitive lymphomas had a significantly better 2-year OS than those with chemoresistant disease: 87.8% versus 75.7% in HD (p=0.023) and 75.9% versus 57.9% in NHL (p=0.001) (Figure 13). The 2-year OS was 83.2% for patients with MM (Figure 14). Age at HCT had no impact on 2-year OS (p=0.206; Figure 15).

DISCUSSION

The analyses presented herein showed an increase in the number of Brazilian CIBMTR participating centers compared to what was seen in the first publications. Forty-four centers contributed with the information regarding new transplants between 2012 and 2023. In 2023, 35 centers reported new HCT data to the CIBMTR. Despite the lower number of active centers last year, 44 centers were active throughout the whole period analyzed. This shows that, over the years, centers have intermittently started and paused data reporting.

We observed an increase in the number of transplants with a mismatched related donor since 2012 and a decrease in unrelated UCB transplants in the same period, most likely due to the use of haploidentical donors with post-transplantation cyclophosphamide.

Comparing our data with those of the US Summary Slides published in the CIBMTR website[12], matched related donor HCTs are the main type of transplants performed in Brazil, followed by those using a mismatched related donor, while unrelated BM/PBSC transplants predominate in the United States (USA).

Among pediatric patients, the main source was BM in Brazil, following the same trend in the USA; on the other hand, there was an increase in PBSC use over the years, and it has been the main choice of graft source for adult recipients in Brazil since 2018 and, since 2000, in the USA, for all types of allogeneic HCT.

In 2023, the main indications for adult HCTs in Brazil were MM, AML, NHL, HD, and ALL, while in the USA, in 2021, those were MM, AML, NHL, MDS/MPN and ALL. For pediatric patients, the main indications in Brazil were other non-malignant disease, other malignancy, ALL, aplastic anemia and AML, as compared to other non-malignant disease, other malignancy, ALL, AML and aplastic anemia in the USA.

Another important comparison between these countries was the cause of early death, 0 to 100 days after transplantation: in Brazil, infection was the main cause of early mortality for autologous, matched related donor, mismatched related and unrelated donors, while organ failure was the main cause of early death for the same types of transplants in the USA.

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

The Brazilian Summary Slides are fully available to active centers in the HCTBR through the SBTMO data request flow (Figure 16).

CONCLUSION

The partnership between the SBTMO and the CIBMTR has made the HCTBR possible. The Brazilian HCT data analyses shown here have resulted in these updated Brazilian Summary Slides, which contributes to a better understanding of our nationwide HCT outcomes, by making the results available to centers as a both national and international benchmark. The Brazilian Summary Slides are updated once a year and published at 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, as discussed above.

Consolidating the HCTBR has yielded positive results, as witnessed by the increase in the number

of Brazilian centers affiliated to the CIBMTR and the higher qualification of DMs across the country. Nonetheless, there is still a lot to be done. It is necessary to improve the commitment of the HCT centers toward data reporting, in order to optimize the registry of transplants, the accomplishment of long-term follow-up and the continuing education of DMs, thus stimulating good quality data retrieval within the national registry. Government support (through resources, infrastructure and qualification) is also essential to achieve such goals. Continual and tireless efforts in this regard may help in the constant improvement of the HCTBR, and, in the long run, result in the provision of better care to patients.

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TABLE 1. Exclusion criteria for overall survival

Exclusion criteria	n
Patients without follow-up update	1,191
≥2nd HCT	935

TABLE 2. HCT centers

Participating 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
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Hospital Amaral Carvalho
Hospital Brasília
Hospital da Criança de Brasília José Alencar
Hospital das Clínicas - Faculdade de Medicina de Botucatu, UNESP
Hospital de Clínicas - UFPR
Hospital de Clínicas de Porto Alegre
Hospital DF Star
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 Sírio Libanês em Brasília
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Hospital Universitário Walter Cantídio/UFC
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Instituto de Oncologia Pediátrica - GRAACC
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Real Hospital Português
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UFMG Hospital das Clínicas Servico de Transplante de Medula Óssea
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TABLE 3. Source of cells used by donor type, age and year of HCT

	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Patients <18 Years												
Matched Related Donor (N=505)												
PBSC	2%	4%	2%	3%	9%	5%	9%	6%	3%	13%	14%	10%
BM	93%	88%	96%	94%	91%	93%	85%	92%	97%	87%	78%	88%
UCB	5%	8%	2%	3%	0%	2%	6%	2%	0%	0%	8%	2%
Unrelated Donor (N=857)												
PBSC	5%	3%	16%	12%	7%	7%	12%	4%	23%	28%	26%	27%
BM	53%	72%	78%	75%	85%	87%	81%	88%	74%	60%	68%	71%
UCB	42%	25%	6%	12%	7%	6%	7%	8%	3%	13%	6%	2%
Mismatched Related Donor (N=786)												
PBSC	24%	10%	27%	14%	25%	21%	34%	26%	26%	23%	23%	16%
BM	76%	90%	73%	86%	75%	79%	66%	74%	74%	77%	77%	84%
Patients ≥18 Years												
Matched Related Donor (N=2,142)												
PBSC	49%	47%	43%	50%	46%	52%	53%	57%	65%	65%	74%	73%
BM	51%	53%	57%	50%	54%	48%	47%	43%	35%	35%	26%	27%
UCB	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Unrelated Donor (N=1,051)												
PBSC	35%	29%	38%	51%	51%	46%	58%	55%	62%	83%	77%	76%
BM	38%	59%	62%	46%	49%	54%	42%	44%	35%	17%	23%	24%
UCB	27%	12%	0%	3%	0%	0%	0%	1%	4%	0%	0%	0%
Mismatched Related Donor (N=1,316)												
PBSC	18%	33%	43%	34%	40%	44%	63%	65%	72%	76%	78%	81%
BM	82%	67%	57%	66%	60%	56%	37%	35%	28%	24%	22%	19%

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

	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
AML												
Disease Stage												
1st complete remission	35%	43%	47%	44%	59%	51%	53%	55%	52%	54%	54%	55%
2nd or subsequent complete remission	36%	28%	38%	40%	31%	30%	28%	25%	31%	20%	24%	24%
Relapsed disease/Never in CR	29%	28%	15%	16%	10%	19%	19%	20%	17%	26%	22%	21%
Donor Type												
Matched Related Donor	50%	54%	66%	49%	50%	50%	44%	42%	43%	37%	38%	31%
Mismatched Related Donor	16%	6%	10%	17%	23%	23%	33%	33%	42%	47%	45%	49%
Unrelated Donor (BM/PBSC)	28%	26%	20%	33%	27%	27%	22%	25%	15%	15%	17%	20%
Unrelated Donor (UCB)	6%	14%	4%	1%	0%	0%	1%	0%	0%	1%	0%	0%
ALL												
Disease Stage												
1st complete remission	45%	40%	56%	58%	52%	41%	52%	39%	44%	44%	50%	61%
2nd or subsequent complete remission	49%	54%	37%	40%	39%	51%	34%	48%	46%	45%	37%	33%
Relapsed disease/Never in CR	6%	6%	7%	2%	9%	8%	15%	13%	10%	11%	13%	6%
Donor Type												
Matched Related Donor	43%	52%	52%	44%	40%	36%	38%	31%	34%	29%	28%	33%
Mismatched Related Donor	7%	3%	2%	8%	16%	25%	26%	28%	39%	47%	49%	47%
Unrelated Donor (BM/PBSC)	29%	34%	45%	42%	42%	38%	34%	36%	26%	23%	23%	20%
Unrelated Donor (UCB)	21%	11%	1%	6%	1%	1%	2%	5%	1%	1%	0%	0%

TABLE 5. Overall survival of AML/ALL patients

A. AML

	N	OS in 2 years (%)	p
AML			
Patients Age 0-17 Years			
Donor Type			
Matched Related Donor	78	48.9% (37-60)	
Mismatched Related Donor	87	58.7% (46-69)	0.506
Unrelated Donor	80	55.3% (43-66)	
Patients Age ≥18 Years			
Donor Type			
Matched Related Donor	568	55.6% (51-60)	
Mismatched Related Donor	316	47.1% (41-53)	0.029
Unrelated Donor	244	53.2% (46-60)	
Matched Related Donor			
Patients Age 0-17 Years			
Disease Stage			
1st complete remission	36	58.2% (40-73)	
2nd or subsequent complete remission	24	50.3% (28-69)	0.520
Relapsed disease/Never in CR	18	-	
Patients Age ≥18 Years			
Disease Stage			
1st complete remission	387	62.5% (57-68)	
2nd or subsequent complete remission	103	45.7% (35-56)	<0.001
Relapsed disease/Never in CR	78	34.6% (23-46)	
Mismatched Related Donor			
Patients Age 0-17 Years			
Disease Stage			
1st complete remission	30	71.6% (51-85)	
2nd or subsequent complete remission	37	68.3% (48-82)	<0.001
Relapsed disease/Never in CR	20	28.6% (11-49)	
Patients Age ≥18 Years			
Disease Stage			
1st complete remission	173	55.8% (47-64)	
2nd or subsequent complete remission	84	52.9% (40-64)	<0.001
Relapsed disease/Never in CR	59	12.8% (5-25)	
Unrelated Donor			
Patients Age 0-17 Years			
Disease Stage			
1st complete remission	33	76.3% (56-88)	
2nd or subsequent complete remission	28	56.1% (36-72)	0.063
Relapsed disease/Never in CR	19	-	
Patients Age ≥18 Years			
Disease Stage			
1st complete remission	100	67.2% (56-76)	
2nd or subsequent complete remission	94	54.2% (43-64)	<0.001
Relapsed disease/Never in CR	50	23.6% (12-37)	

B. ALL

	N	OS in 2 years (%)	p
ALL			
Patients Age 0-17 Years			
Donor Type			
Matched Related Donor	128	57.2% (47-66)	
Mismatched Related Donor	147	53.0% (43-62)	0.632
Unrelated Donor	250	60.9% (54-67)	
Patients Age ≥18 Years			
Donor Type			
Matched Related Donor	327	56.0% (50-62)	
Mismatched Related Donor	175	48.7% (40-57)	0.007
Unrelated Donor	186	45.1% (37-53)	
Matched Related Donor			
Patients Age 0-17 Years			
Disease Stage			
1st complete remission	38	69.5% (51-82)	
2nd or subsequent complete remission	69	49.7% (36-62)	0.203
Relapsed disease/Never in CR	21	57.1% (27-79)	
Patients Age ≥18 Years			
Disease Stage			
1st complete remission	243	63.2% (56-69)	
2nd or subsequent complete remission	69	36.9% (25-49)	<0.001
Relapsed disease/Never in CR	15	-	
Mismatched Related Donor			
Patients Age 0-17 Years			
Disease Stage			
1st complete remission	33	71.0% (48-85)	
2nd or subsequent complete remission	102	50.8% (39-61)	0.135
Relapsed disease/Never in CR	12	-	
Patients Age ≥18 Years			
Disease Stage			
1st complete remission	111	56.6% (46-66)	
2nd or subsequent complete remission	55	38.5% (25-52)	0.018
Relapsed disease/Never in CR	9	-	
Unrelated Donor			
Patients Age 0-17 Years			
Disease Stage			
1st complete remission	76	73.1% (61-82)	
2nd or subsequent complete remission	147	57.5% (49-65)	0.008
Relapsed disease/Never in CR	27	45.7% (24-65)	
Patients Age ≥18 Years			
Disease Stage			
1st complete remission	112	49.7% (39-59)	
2nd or subsequent complete remission	59	44.5% (31-57)	0.272
Relapsed disease/Never in CR	15	-	

TABLE 6. Comparison of overall survival – Brazil and USA

A. Acute leukemia

	Brazilian Registry (2012-2022)		US Summary Slides (2010-2020)	
	N	OS in 2 years (%)	N	OS in 3 years (%)
AML				
Matched Related Donor				
Patients Age 0-17 Years				
Disease Stage				
1st complete remission	36	58.2% (40-73)	371	69% (64-74)
2nd or subsequent complete remission	24	50.3% (28-69)	141	66% (58-75)
Relapsed disease/Never in CR	18	-	68	28% (18-42)
Patients Age ≥18 Years				
Disease Stage				
1st complete remission	387	62.5% (57-68)	5,340	57% (56-59)
2nd or subsequent complete remission	103	45.7% (35-56)	1,182	53% (50-56)
Relapsed disease/Never in CR	78	34.6% (23-46)	1,594	31% (29-34)
Unrelated Donor				
Patients Age 0-17 Years				
Disease Stage				
1st complete remission	33	76.3% (56-88)	388	64% (59-70)
2nd or subsequent complete remission	28	56.1% (36-72)	210	66% (60-73)
Relapsed disease/Never in CR	19	-	109	37% (29-48)
Patients Age ≥18 Years				
Disease Stage				
1st complete remission	100	67.2% (56-76)	8,066	55% (54-56)
2nd or subsequent complete remission	94	54.2% (43-64)	1,966	53% (51-55)
Relapsed disease/Never in CR	50	23.6% (12-37)	2,417	30% (28-32)
Mismatched Related Donor				
Patients Age 0-17 Years				
Disease Stage				
1st complete remission	30	71.6% (51-85)	176	62% (54-72)
2nd or subsequent complete remission	37	68.3% (48-82)	96	60% (49-73)
Relapsed disease/Never in CR	20	28.6% (11-49)	64	34% (24-49)
Patients Age ≥18 Years				
Disease Stage				
1st complete remission	173	55.8% (47-64)	2,189	50% (48-53)
2nd or subsequent complete remission	84	52.9% (40-64)	595	53% (49-58)
Relapsed disease/Never in CR	59	12.8% (5-25)	629	27% (23-31)
ALL				
Matched Related Donor				
Patients Age 0-17 Years				
Disease Stage				
1st complete remission	38	69.5% (51-82)	296	79% (74-84)
2nd or subsequent complete remission	69	49.7% (36-62)	459	70% (66-75)
Relapsed disease/Never in CR	21	57.1% (27-79)	37	62% (48-80)
Patients Age ≥18 Years				
Disease Stage				
1st complete remission	243	63.2% (56-69)	2,281	64% (62-66)
2nd or subsequent complete remission	69	36.9% (25-49)	629	45% (41-49)
Relapsed disease/Never in CR	15	-	222	37% (31-45)
Unrelated Donor				
Patients Age 0-17 Years				
Disease Stage				
1st complete remission	76	73.1% (61-82)	300	77% (72-82)
2nd or subsequent complete remission	147	57.5% (49-65)	451	65% (61-70)
Relapsed disease/Never in CR	27	45.7% (24-65)	37	69% (55-86)
Patients Age ≥18 Years				
Disease Stage				
1st complete remission	112	49.7% (39-59)	2,652	63% (61-65)
2nd or subsequent complete remission	59	44.5% (31-57)	783	46% (42-50)
Relapsed disease/Never in CR	15	-	248	37% (32-44)
Mismatched Related Donor				
Patients Age 0-17 Years				
Disease Stage				
1st complete remission	33	71.0% (48-85)	124	70% (62-80)
2nd or subsequent complete remission	102	50.8% (39-61)	223	64% (57-71)
Relapsed disease/Never in CR	12	-	20	-
Patients Age ≥18 Years				
Disease Stage				
1st complete remission	111	56.6% (46-66)	771	69% (65-73)
2nd or subsequent complete remission	55	38.5% (25-52)	344	47% (42-54)
Relapsed disease/Never in CR	9	-	99	28% (20-39)

B. MDS and Aplastic Anemia

	Brazilian Registry (2012-2022)		US Summary Slides (2010-2020)	
	N	OS in 2 years (%)	N	OS in 3 years (%)
MDS (Adults)				
Matched Related Donor				
Disease Stage				
Early disease	115	54.1% (44-63)	720	50% (47-54)
Advanced disease	106	54.5% (44-64)	1,611	46% (43-48)
Unrelated Donor				
Disease Stage				
Early disease	54	47.4% (33-61)	1,385	48% (45-51)
Advanced disease	52	47.4% (33-61)	3,044	44% (42-46)
Aplastic Anemia				
Patients Age 0-17 Years				
Donor type				
Matched Related Donor	62	84.9% (73-92)	487	98% (96-99)
Mismatched Related Donor	67	73.8% (60-83)	101	86% (79-93)
Unrelated Donor	70	80.7% (69-88)	358	91% (88-94)
Patients Age ≥18 Years				
Donor type				
Matched Related Donor	154	84.1% (77-89)	603	85% (82-88)
Mismatched Related Donor	52	72.5% (58-83)	200	80% (73-86)
Unrelated Donor	81	57.1% (45-67)	627	76% (73-80)

FIGURE 1. Active Brazilian centers in the CIBMTR by year

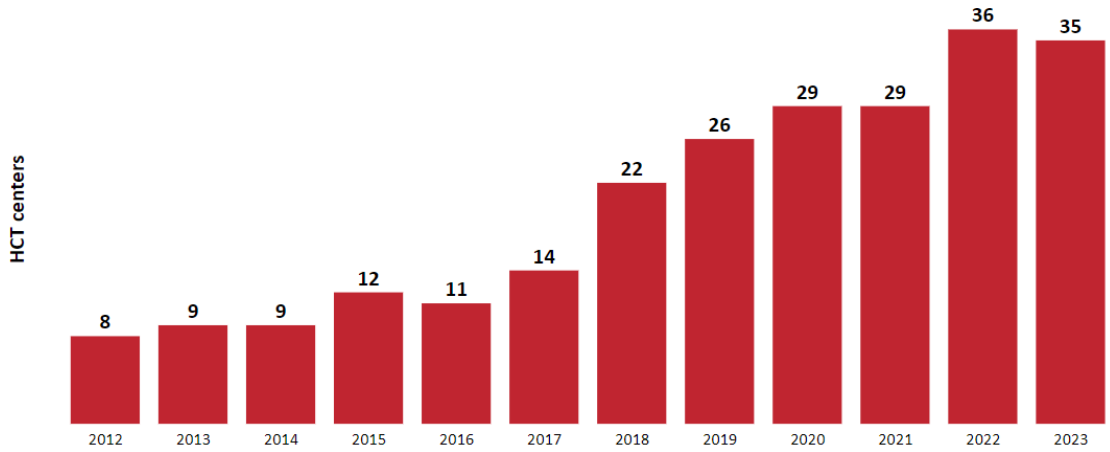


FIGURE 2. Transplants performed in Brazil and reported in the CIBMTR

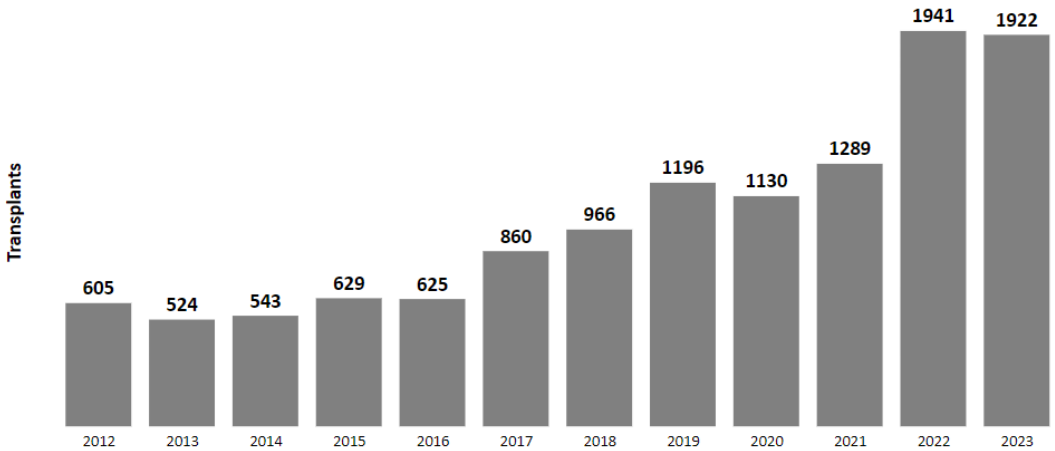


FIGURE 3. Relative proportion of allogeneic HCTs in Brazil by donor type

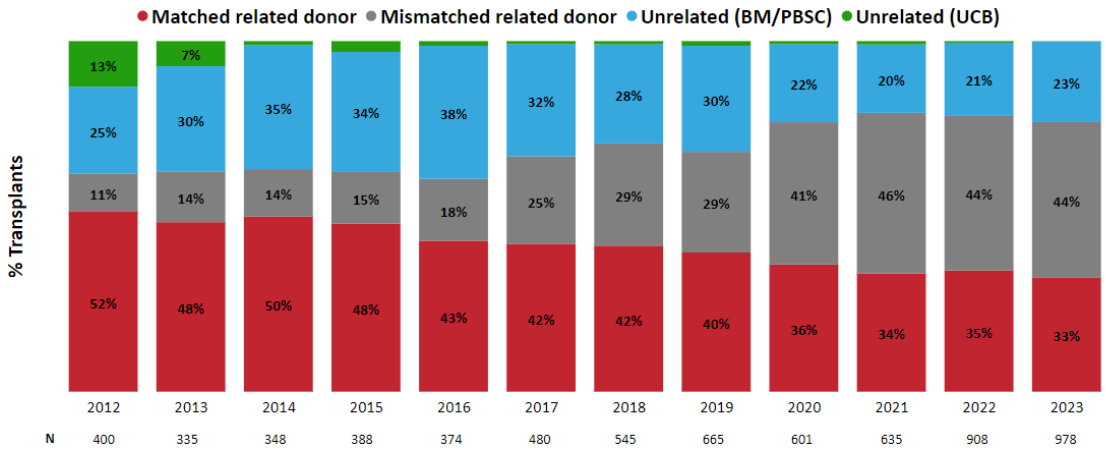


FIGURE 4. Global indications for HCT in Brazil, 2023 (n=1,922)

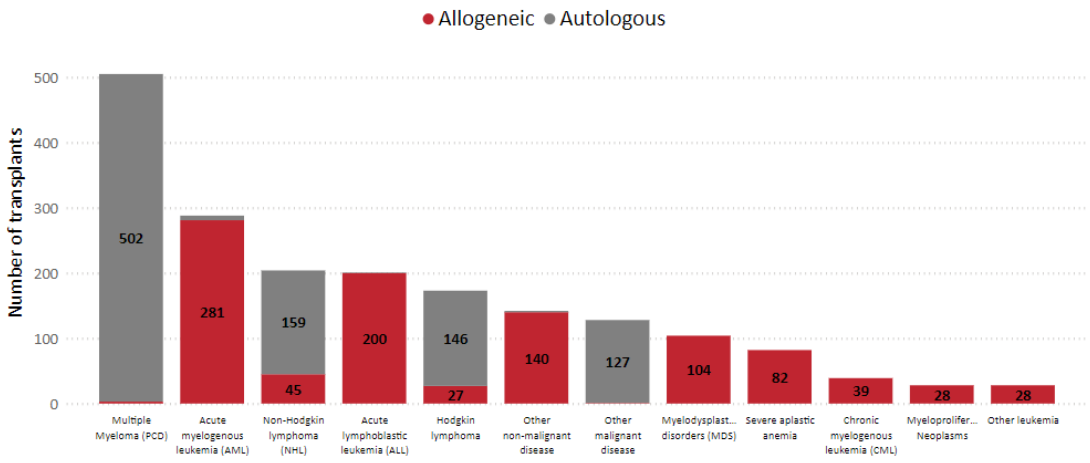
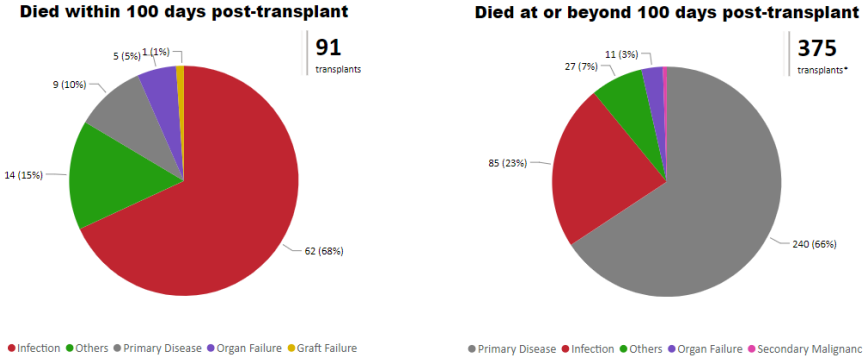
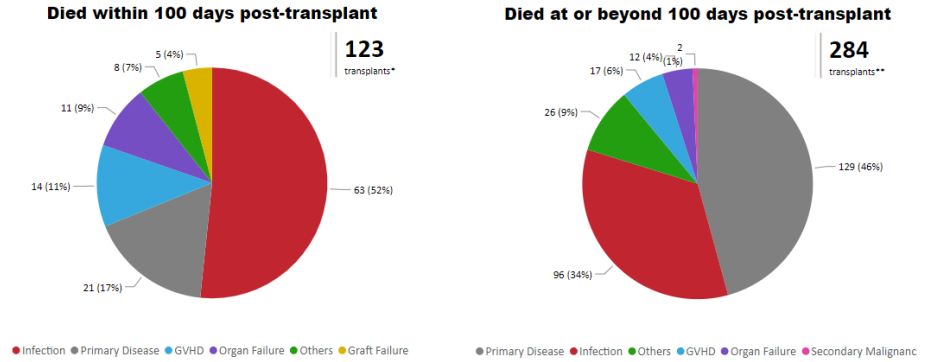


FIGURE 5. Causes of Death after HCT in Brazil, 2018-2022

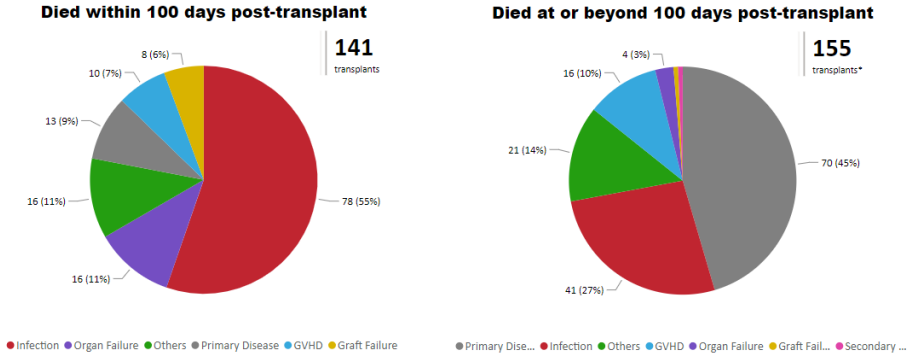
A. Autologous



B. Matched related donor



C. Unrelated donor



D. Mismatched related donor

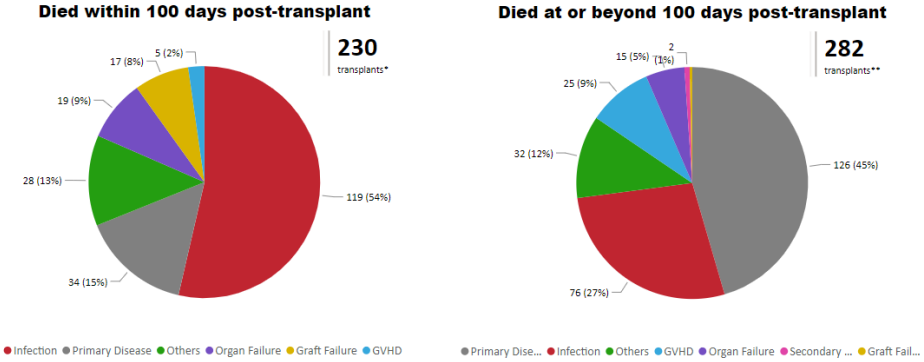


FIGURE 6. AML, overall survival after 1st allogeneic HCT by donor type

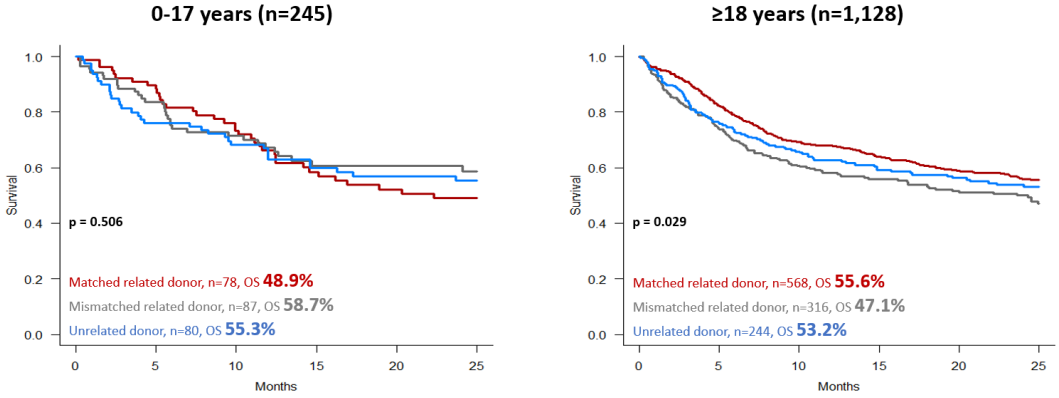


FIGURE 7. **ALL, overall survival after 1st allogeneic HCT by donor type**

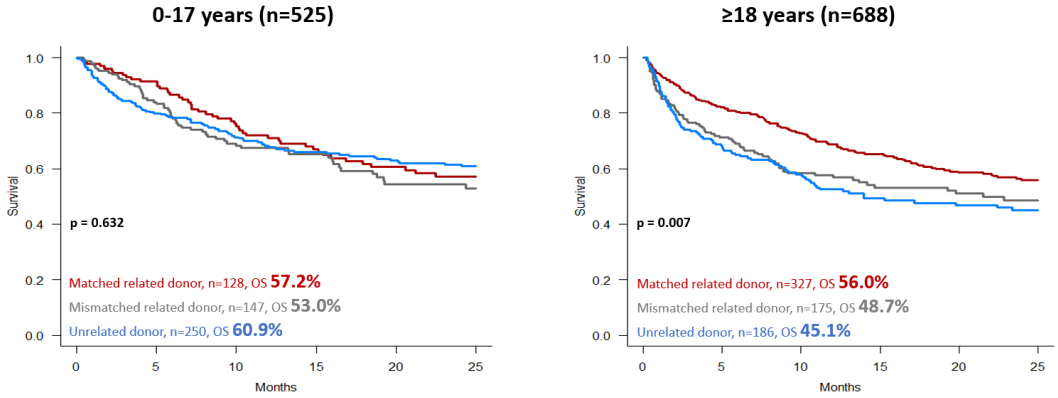


FIGURE 8. **MDS, overall survival after 1st allogeneic HCT by donor type**

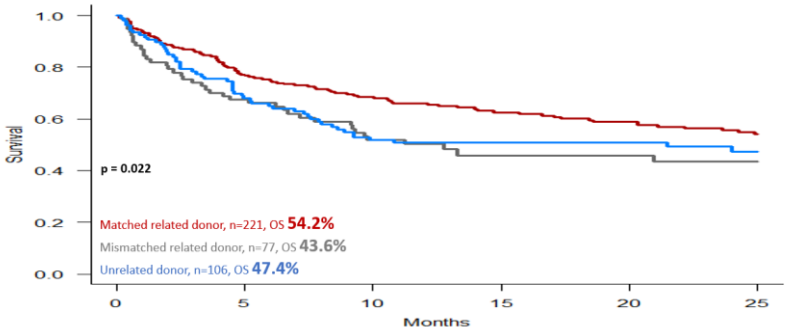


FIGURE 9. **Aplastic Anemia, overall survival after 1st allogeneic HCT by donor type**

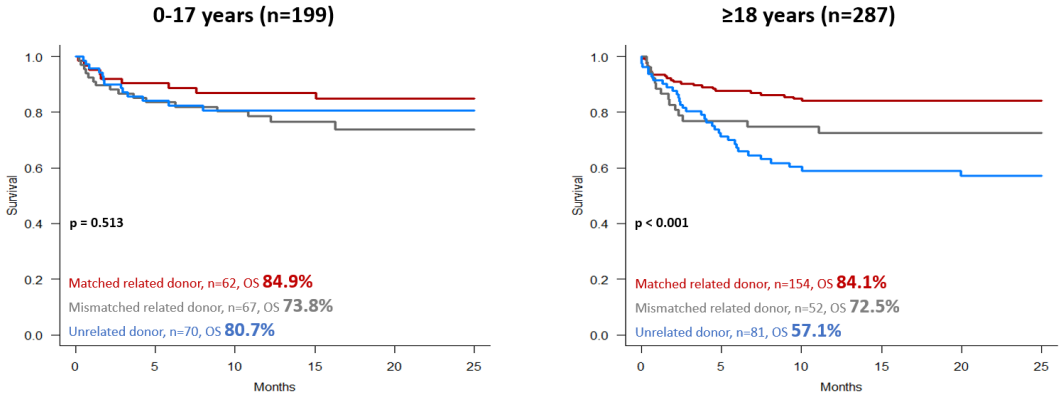


FIGURE 10. **MDS, overall survival after 1st allogeneic HCT by disease stage**

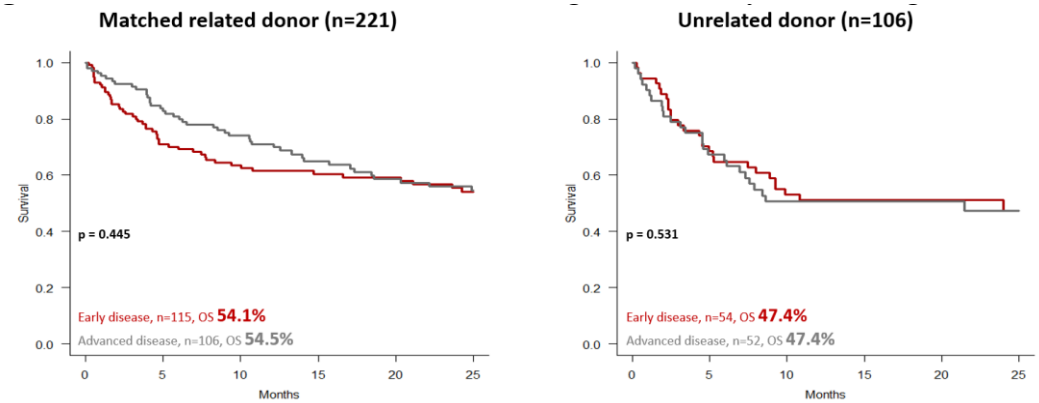


FIGURE 11. **CML, overall survival after 1st allogeneic HCT by donor type**

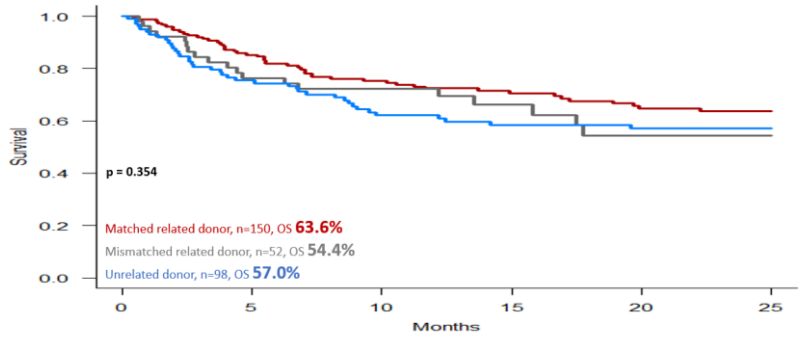


FIGURE 12. **Myelofibrosis, overall survival after 1st allogeneic HCT**

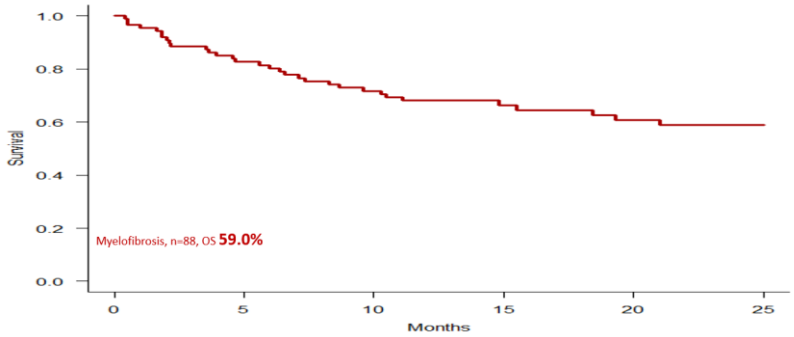


FIGURE 13. **Lymphomas, overall survival after 1st autologous HCT**

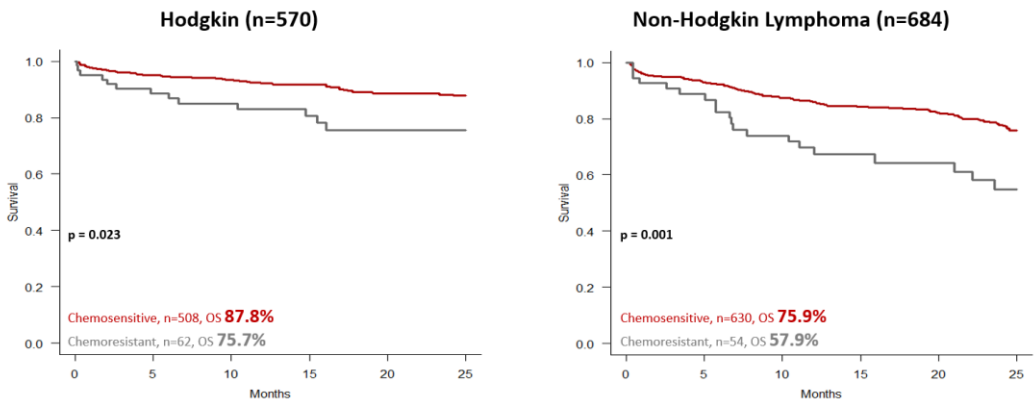


FIGURE 14. **Multiple Myeloma/ Plasma Cell Leukemia, overall survival after 1st autologous HCT**

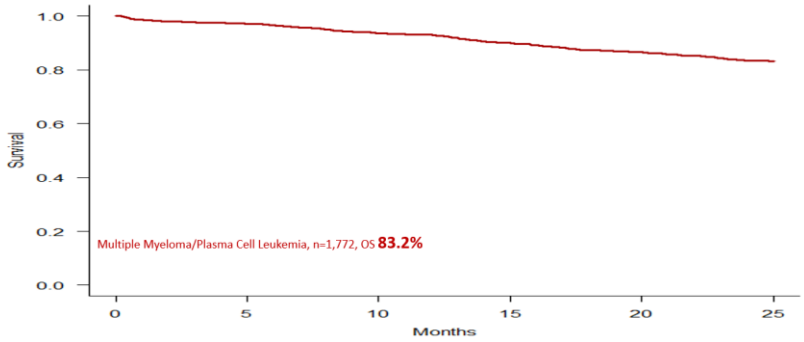


FIGURE 15. **Multiple Myeloma/ Plasma Cell Leukemia, overall survival after 1st autologous HCT by age at HCT**

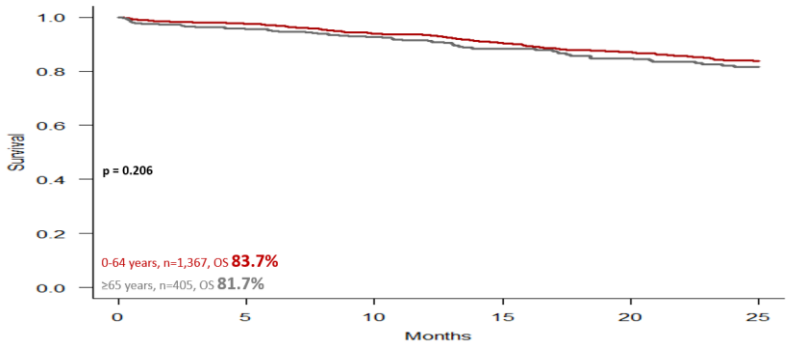
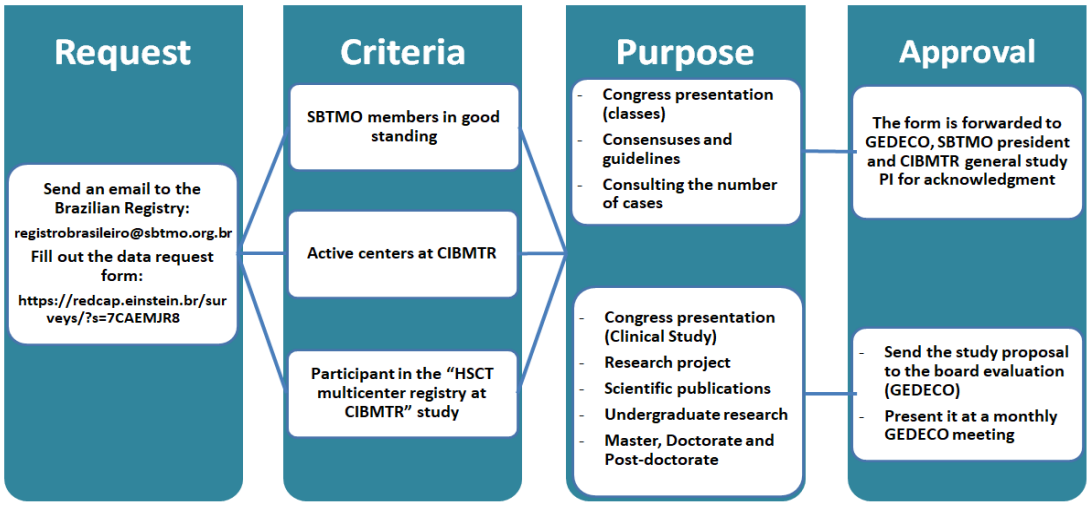


FIGURE 16. **Data request flow**



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. Biology of Blood and Marrow Transplantation. 2020;26(7):1247-56.

2. Ferreira E, Dulley FL, Morsoletto F, et al. Bone marrow transplantation in Brazil. R. Hum Immunol. 1985;14(3):324-32.

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.

4. SBTMO. Reportar é preciso: em webinar, SBTMO apresenta novos dados do Registro Multicêntrico Brasileiro de TCTH [Internet]. Rio de Janeiro; 2022 [cited 2024 Mar 18]. Available from: https://sbtmo.org.br/reportar-e-preciso-em-webinar-sbtmo-apresenta-novos-dados-do-registro-multicentrico-brasileiro-de-tcth/

5. Associação Brasileira de Transplante de Órgãos. Dimensionamento dos Transplantes no Brasil e em cada estado (2016-2023). RBT. 2023;30(4):1-88.

6. 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.

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

8. 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.

9. Simione AJ, Neves HR, Silva CC, et al. Current use and outcomes of Hematopoietic Stem Cell Transplantation: Brazilian Summary Slides – 2023. JBMTCT. 2023;4(2):p200.

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

11. 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.

12. Bolon YT, Atshan R, Allbee-Johnson M, et al. Current use and outcome of hematopoietic stem cell transplantation: CIBMTR summary slides, 2022 [Internet]. CIBMTR: Milwaukee; 2023 [cited 2024 Mar. 18]. Available from: https://cibmtr.org/CIBMTR/Resources/Summary-Slides-Reports