



Advancing Cardiac Care: A Registry of Heart Transplantation in Latin America (1968-2022)

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ABSTRACT

Introduction. Heart transplantation (HTx) has emerged as a pivotal intervention for end-stage heart failure, offering significant improvements in survival and quality of life. This manuscript elucidates the landscape of HTx across Latin America (LATAM) from its advent in 1968 through December 2022, shedding light on its evolution, current practices, and regional disparities.

Methods. We distributed a structured questionnaire to the national coordinators or representatives of the Interamerican Council of Heart Failure and Pulmonary Hypertension, collating responses from 20 LATAM nations. This approach facilitated a comprehensive aggregation of regional HTx data.

Results. A total of 12,374 HTx were performed in 166 centers across 16 LATAM countries, with Brazil, Argentina, and Colombia accounting for the majority of procedures. Pediatric transplants represented 9% of the total caseload, and combined organ transplants were reported in 62.5% of the participating countries, underscoring the complexity and breadth of transplant services in the region.

Conclusion. Despite facing infrastructural and logistical challenges, LATAM has demonstrated a robust capacity to conduct high-complexity transplant procedures. The establishment of a structured, regional HTx registry is imperative to enhance data collection and analysis, which in turn can inform clinical decision-making and policy development, ultimately improving patient outcomes across the continent.

OVER recent decades, heart transplantation (HTx) has solidified its role as a vital therapeutic option for select patients with advanced or refractory heart failure (HF), offering

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significant enhancements in quality of life and life expectancy [1,2]. The initial procedure of HTx was delineated in the early 1960s by Dr. Norman Shumway at Stanford University through animal models [3]. The inaugural successful human HTx was executed by Dr. Christian Barnard and his team on December 3, 1967, in Cape Town, South Africa, marking a pivotal moment in medical history [4].

In Latin America (LATAM), the HTx journey commenced in Brazil in May 1968, spearheaded by Dr. Euryclides de Jesus Zerbini, closely followed by Argentina and Chile within the same year [5-9]. The subsequent years saw the expansion of HTx to other LATAM countries, with the most recent being Panama in 2016. This widespread adoption underscores the regional commitment to advancing cardiac care [10-21].

Notably, several countries globally have established comprehensive national HTx registries, such as France, Spain, Canada, Argentina, Italy, and the United States, alongside regional registries like ANZCOTR and Scandiatransplant [22]. These registries, integral to the International Society of Heart and Lung Transplantation's (ISHLT) global database, provide invaluable data on HTx, facilitating insights into trends, outcomes, and best practices [22].

The 37th report of the ISHLT registry highlights a shift in the geographical distribution of HTx, with an increase in procedures outside of North America and Europe, including LATAM [22]. Despite this progress, LATAM's representation in global HTx data remains limited, with sporadic reporting from only a handful of countries. This gap underscores the critical need for comprehensive regional registries to capture the full spectrum of HTx activity in LATAM, enhancing our understanding and management of this complex patient population.

METHODS

We conducted a descriptive observational study to compile HTx data from Latin American (LATAM) nations spanning from the inception of the region's first HTx on May 28, 1968, through December 31, 2022. A structured questionnaire was disseminated to each national coordinator or delegate of the Interamerican Council of Heart Failure and Pulmonary Hypertension (CIFACAH) under the Interamerican Society of Cardiology (SIAC). The survey solicited detailed information regarding the number of institutions performing HTx, as well as the total number of procedures, including adult, pediatric, and combined organ transplants.

Responses were solicited from CIFACAH delegates or from a designated national expert in the field of HTx—typically a cardiologist or cardiovascular surgeon—with direct knowledge of or access to the required data.

The collation and preliminary analysis of the data were undertaken by the Cardiology Service and Clinical Research Center at Fundación Valle del Lili in Cali, Colombia. The data was meticulously tabulated and assimilated into a comprehensive database, which was subsequently employed for analysis and report generation. The findings are presented through frequency distributions, tables, and illustrative figures.

The results of this study are intended to serve as an inaugural step toward the establishment of a LATAM HTx registry. The envisioned registry would be founded upon a more elaborate and detailed questionnaire, projected to encompass data on active and inactive HTx programs, specific procedural counts, donor and recipient profiles, and post-transplant outcomes.

RESULTS

From May 1968 to December 2022, a total of 12,374 heart transplantations (HTx) were performed in 16 of the 20 Latin American (LATAM) countries, accounting for an 80% participation rate in the procedure. Of these, 11,261 HTx were adult cases (91%) and 1113 were pediatric cases (9%). Argentina, Brazil, and Colombia lead the region in terms of patient volumes undergoing HTx. Four countries, namely El Salvador, Guatemala, Honduras, and Nicaragua, did not report any HTx during this period (refer to Table 1).

The region boasts approximately 166 centers across the 16 countries that have performed at least one HTx since the inaugural procedure in LATAM. Out of these, 98 centers were active in 2022, representing 59% of all centers ever involved in HTx. Brazil (41 institutions), Argentina (19 institutions), Colombia (10 institutions), and Mexico (10 institutions) reported the highest number of active HTx institutions (detailed in Table 2).

Pediatric HTx, although a smaller fraction of the overall procedures, were noted in 10 countries, totaling 1113 operations. The distribution of these pediatric HTx is as follows: Brazil (592), Argentina (293), Colombia (124), Mexico (39), Uruguay (25), Chile (14), Peru (11), Puerto Rico (9), Paraguay (4), and Cuba (2), as indicated in Table 1.

Table 1. Heart Transplantations (HxTx) in Latin America by Country (as of December 2022)

Country	Total HxTx (n)	Adult HxTx (n)	Pediatric HxTx (n)
Argentina	2965	2672	293
Bolivia	1	1	0
Brazil	5931	5339	592
Chile	550	536	14
Colombia	1451	1327	124
Costa Rica	39	39	0
Cuba	151	149	2
Dominican Republic	3	3	0
Ecuador	11	11	0
El Salvador	0	0	0
Guatemala	0	0	0
Honduras	0	0	0
Mexico	680	641	39
Nicaragua	0	0	0
Panama	3	3	0
Paraguay	41	37	4
Peru	138	127	11
Puerto Rico	170	161	9
Uruguay	227	202	25
Venezuela	13	13	0
Total	12,374	11,261	1113

HxTx, heart transplant; (n), number of procedures.

Table 2. Institutional Participation in Heart Transplantations (HxTx) in Latin America by Country (as of December 2022)

Country	Institutions Since 1968 (n)	Active Institutions in 2022 (n)
Argentina	61	19
Bolivia	1	0
Brazil	41	41
Chile	10	6
Colombia	10	10
Costa Rica	2	1
Cuba	2	2
Dominican Republic	1	0
Ecuador	1	1
Mexico	21	10
Panama	1	1
Paraguay	3	3
Peru	5	1
Puerto Rico	1	1
Uruguay	3	3
Venezuela	3	0
Total	166	98

HxTx, heart transplant; (n), number of institutions.

An assessment of combined organ transplants involving HTx reveals that such procedures have been carried out in 10 of the 16 countries (62.5%) engaging in HTx (see Table 3). Kidney-HTx was the most common combined procedure, performed by 56% of these countries, followed by lung-HTx at 44%, and liver-HTx at 19%.

Analyzing the data across the 20 LATAM countries and the cumulative HTx performed since 1968, we find a diverse range of procedural volumes: 11 countries (55%) conducted between 1 and 500 HTx, 2 countries (10%) between 501 and 1000 HTx, one country (5%) between 1001 and 1500 HTx, and 2 countries (10%) exceeded 1500 HTx. It is also noted that 4 countries

Table 3. Combined Heart Transplantations (HxTx) by Organ and Country in Latin America (as of December 2022)

Country	Heart & Kidney	Heart & Liver	Heart & Lung
Argentina	Yes	Yes	Yes
Bolivia	No	No	No
Brazil	Yes	Yes	Yes
Chile	Yes	Yes	Yes
Colombia	Yes	No	Yes
Costa Rica	No	No	Yes
Cuba	Yes	No	Yes
Dominican Republic	No	No	No
Ecuador	No	No	No
Mexico	Yes	No	Yes
Panama	No	No	No
Paraguay	No	No	No
Peru	Yes	No	No
Puerto Rico	Yes	No	No
Uruguay	Yes	No	No
Venezuela	No	No	No

Note: "Yes" indicates that the combined HxTx procedure is performed in the country, "No" indicates that it is not.

(20%) have not performed HTx in the given timeframe (illustrated in Fig 1).

In terms of procedural frequency relative to the duration since the first HTx was performed, Brazil (107 HTx/year), Argentina (53.91 HTx/year), and Colombia (38.18 HTx/year) emerge as the most prolific, indicating an established and active HTx practice (Table 4)

DISCUSSION

More than half a century since the inaugural heart transplantation (HTx) by Dr. Christiaan Barnard's team at the University of Cape Town, South Africa, the global landscape of HTx has evolved substantially [23]. Remarkably, a single center under Barnard's leadership surpassed the collective output of 9 LATAM countries in HTx volume, a discrepancy likely attributable to factors such as economic constraints, limited availability of specialized medical personnel, variations in healthcare coverage, and notably, the fragmented and incomplete HTx data across LATAM.

Comparative analysis with well-established national registries, such as those in Spain and the United States, reveals the potential of collaborative data collection efforts. Spain's national registry, operational since 1984, documented 9664 patients in their 33rd report, while the UNOS database in the United States accounted for 89,749 HTx from 1988 to 2023 [24,25]. These repositories underscore the value of systematic data accumulation and its implications for patient care and research.

In the international sphere, the ISHLT registry predominantly reflects data from North America and Europe, which constitute over 80% of reported HTx, leaving a significant gap in global representation [26]. With our study incorporating data from 166 institutions in LATAM, we potentially represent about 40% of the centers contributing to the ISHLT registry. The ISHLT itself acknowledges a nonreporting rate of nearly one-third, indicating an incomplete global picture.

Under-reporting is not unique to LATAM; in Asia, significant HTx volumes like Taiwan's 1354 and Korea's 1319 transplants have been conducted outside the purview of the global registry [27]. The 12,374 HTx we report for LATAM from 1968 to 2022 further illuminate the extent of under-reporting in the region.

This study documents LATAM's HTx activities over more than 5 decades, with a notable proportion of countries undertaking combined organ transplantation (62%). The most frequent of such combined procedures were kidney-heart, followed by lung-heart and liver-heart transplants.

When examining procedural throughput, Brazil and Argentina emerge as regional leaders, paralleling the high activity seen in international frontrunners like the United States, Germany, France, and Spain [28]. However, there has been a discernible decline in the number of active HTx institutions within LATAM, with 98 centers reported in 2022, and a cessation of HTx activities in Bolivia, the Dominican Republic, and Venezuela during that year.

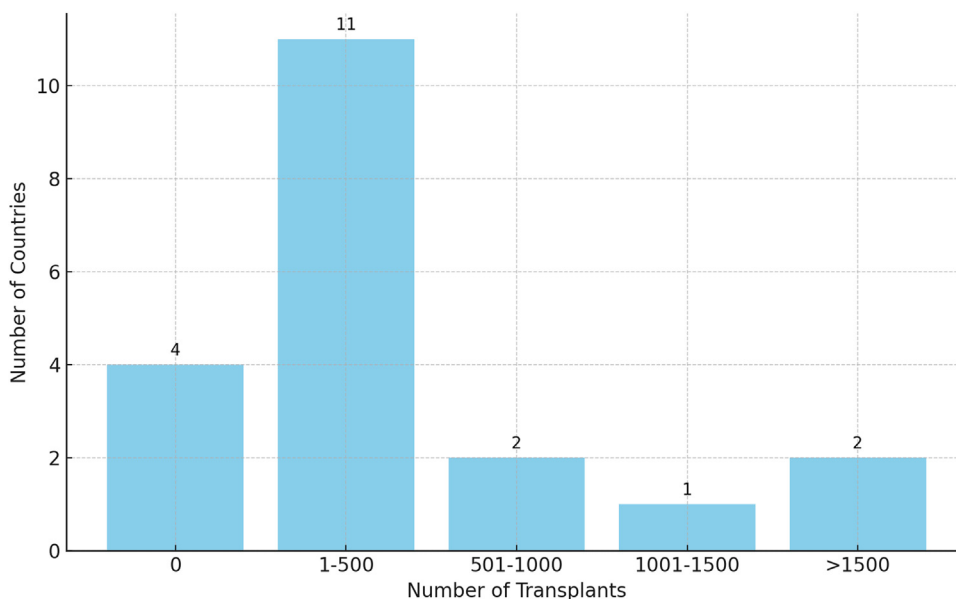


Figure 1. Distribution of heart transplant volumes by countries in Latin America.

Table 4. Number of HxTx Transplants Performed by Country, Since the First HxTx Performed Until 2022 (in Alphabetical Order)

Country	Transplants/Years
Argentina	53.91
Bolivia	0.04
Brazil	107.84
Chile	10.00
Colombia	38.18
Costa Rica	1.22
Cuba	3.97
Ecuador	0.38
México	19.43
Panama	0.43
Paraguay	1.52
Perú	2.71
Puerto Rico	7.08
Dominican Rep.	0.27
Uruguay	8.41
Venezuela	0.36

The absence of a comprehensive regional HTx registry in LATAM hampers the ability to fully understand and improve upon HTx practices. Our preliminary data collection represents a foundational step toward the establishment of such a registry, drawing inspiration from successful national and international models.

CONCLUSION

Our comprehensive review of heart transplantation (HTx) activities across Latin America (LATAM) from 1968 to 2022 reveals a significant body of work, with 12,374 HTx performed in 16

countries. Despite this, LATAM's HTx efforts remain under-represented in the global context, primarily due to the absence of a regional registry. The findings from our study highlight the disparate distribution of HTx capabilities, with Brazil and Argentina demonstrating the highest frequencies of transplantation, indicative of their established infrastructure and expertise in the field.

The persistent challenges—economic limitations, variance in healthcare system coverage, and a shortage of specialized medical teams—underscore the urgent need for a unified HTx registry in LATAM. Such a registry would not only provide a clearer picture of the region's transplantation landscape but also facilitate the sharing of best practices, improve patient outcomes, and support the formulation of effective health policies.

This study serves as a precursor to the development of a LATAM HTx registry, offering a preliminary dataset that emphasizes the need for collaboration and structured data collection. The ultimate goal is to ensure that every HTx conducted within LATAM contributes to the global understanding of heart failure management and the life-saving potential of transplantation.

DATA AVAILABILITY

Data will be made available on request.

DECLARATION OF COMPETING INTEREST

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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