

Deceased donation and organ transplantation in Mexico. Analysis of 12 years and seven strategic proposals

Donación cadavérica y trasplantes de órganos en México. Análisis de 12 años y siete propuestas estratégicas

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Abstract

Background: The evolution of the activity of deceased organ donation and solid organ transplantation in Mexico was analyzed for the period of 2004-2018. **Method:** The information of deceased donation and organ transplantation in Mexico was collected and ordered for said period. When there was no complete information for 2018, the data for 2017 were used instead. **Main sources of information:** The global observatory on donation and transplantation and the National Transplant Center, Centro Nacional de Trasplantes or CENATRA of the Mexican Secretariat of Health (SSA). **Results:** (1) In Mexico, deceased donation rates were: 3.2 donations per million population (pmp) in 2007 and 3.94 in 2017, an increase of 23.1%. The rate in 2017 is quite lower than the average reported for Latin America 9.5 donations pmp. (2) The number of patients awaiting a solid organ transplant increased from 4993 in 2007 to 15,448 in 2018, an increase of 309%. (3) In 2017, Mexico reported having 255 authorized centers for renal transplantation, more than any other country in the world. In the case of other organs: liver, heart, lung, and pancreas, Mexico is the country with the highest number of authorized centers in Latin America. **Conclusion:** The evolution of the figures regarding the activity of deceased donation and solid organ transplantation during the aforementioned study period explains an increasing shortage of organs for transplants in Mexico, despite an apparent large installed capacity. The national organ donation and transplantation system are ineffective and inefficient.

Keywords: Deceased organ donation. Organ transplantation. Problematic.

Resumen

Antecedentes: Se analiza la evolución de la actividad de donación cadavérica de órganos y de la realización de trasplantes de órganos sólidos en México de 2007 a 2018. **Método:** Se recolectó y ordenó la información de donación cadavérica y de trasplante de órganos en México en ese período. Cuando no hubo información completa de 2018, se consideró la de 2017. Las principales fuentes de información fueron The Global Observatory on Donation and Transplantation y el Centro Nacional de Trasplantes de la Secretaría de Salud de México. **Resultados:** 1) La tasa de donación cadavérica de México en 2007 fue de 3.2 donaciones por millón de población (pmp), y en 2017 fue de 3.94 pmp (incremento del 23.1%). La tasa de 2017 está muy por debajo de la media reportada para América Latina (9.5 pmp). 2) El número de pacientes en espera de trasplante de un órgano sólido pasó de 4,993 en 2007 a 15,448 en 2018 (incremento del 309%). 3) En 2017, México reportó tener 255 centros autorizados para trasplante renal, más que cualquier país en el mundo. Para el caso de otros órganos, como hígado,

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corazón, pulmón y páncreas, México es el país que tiene más centros autorizados en América Latina. **Conclusión:** La evolución de las cifras de donación cadavérica y de trasplante de órganos sólidos en el período de estudio explica una escasez cada vez mayor de órganos para trasplante en México, a pesar de una aparente gran capacidad instalada. El sistema nacional de donación y trasplante de órganos es ineficaz e ineficiente.

Palabras clave: Donación cadavérica de órganos. Trasplante de órganos. Problemática.

Introduction

On July 21, 1988, was the first heart transplant performed in Mexico¹. At 31 years of this event, this document analyzes the evolution and current state of deceased organ donation and transplantation activity in Mexico over a 12-year period, from 2007 to 2018.

Methods

Information related to organ donation and transplantation activity in Mexico from 2007 to 2018 was collected and ordered. When all official and pertinent information for 2018 was not available, data were taken until 2017. The main sources of information were:

- The Global Observatory on Donation and Transplantation (GODT; <http://www.transplant-observatory.org/>), which is an international center supported by the World Health Organization with collaboration of the Spanish National Transplant Organization. On its website, donation and transplant data reported by each country's official bodies are compiled and presented organized by region, year, country, organ, etc. This information is publicly accessible.
- The National Transplant Center (CENATRA – *Centro Nacional de Trasplantes*; <https://www.gob.mx/cenatra>) of the Ministry of Health of Mexico, through its website.

In this article, the analysis of deceased tissue donation and the topic of living organ donors will be only marginally addressed.

First, organ donation figures in Mexico and comparisons with other countries that can be made in this subject will be reviewed. Then, figures of the national registry of patients waiting to receive a transplant and changes that have occurred during the study period will be analyzed. Throughout the article, standardized figures per million population (pmp) will be preferably used, through rates referred to the national or institutional population, for example, from the Mexican Institute of Social Security (IMSS – *Instituto Mexicano del Seguro Social*), when necessary, since this it is the

most common form for expressing the figures in this field of medicine all over the world. Subsequently, the figures of solid organ transplants will be analyzed, and kidney transplantation in particular, comparing them with those of other Latin American countries. In addition, the distribution of solid organ transplants in general, and that of kidney transplants in particular, will be analyzed within segments and the entire multi-institutional National Health System (SNS – *Sistema Nacional de Salud*) of Mexico. As extra information, data corresponding to corneal transplants will be added, which, being tissues, are historically the second most frequent transplant in our country. Finally, the figures for installed capacity regarding the number of hospitals authorized to perform solid organ transplants in Mexico will be reviewed and will be compared with those of other countries.

Results

Organ donation from deceased donors diagnosed with brain death

Figure 1 shows the national donation rate evolution between 2007 and 2017. In 2007, this rate was 3.2 donations pmp and in 2017 it increased to 3.94 pmp^{2,3} (an increase of 23.1%). Also in 2017, the deceased donation rates for some other Latin American countries were: Argentina 13.4 pmp, Chile 9.6 pmp, Brazil 16.3 pmp, Colombia 8.9 pmp, Cuba 12.3 pmp, and Uruguay 18.9 pmp^{2,3}. Latin America, as a region, had a mean rate of 9.5 pmp in 2017⁴. That same year, even higher figures were reported in two of the leading countries in this field, such as the United States, with a rate of 31.7 pmp, and Spain, with a rate of 47.0 pmp².

Recorded patients waiting to receive an organ transplant

Figure 2, created based on data published by CENATRA^{5,6}, shows that the number of patients registered in the National Patient Registry Electronic System waiting to receive a solid organ, without

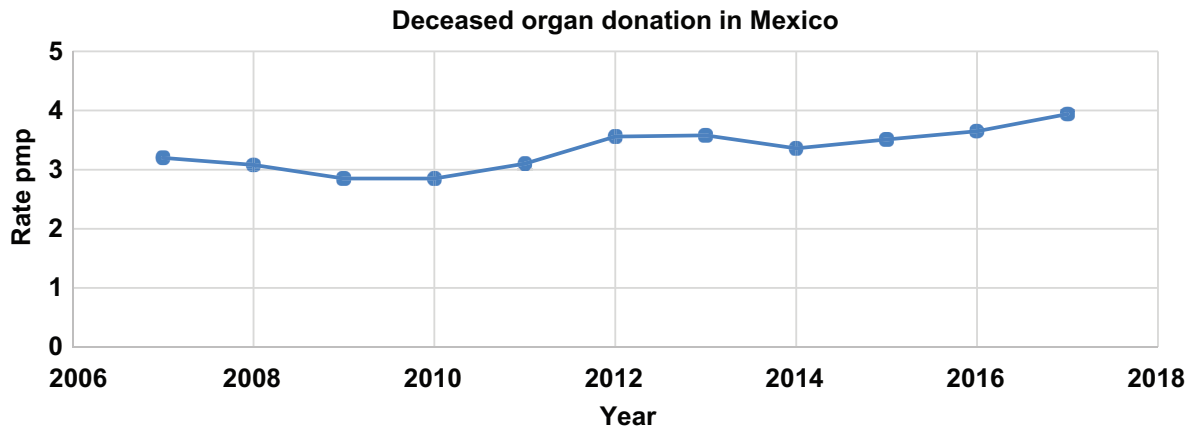


Figure 1. Rate of deceased organ donation per million population (pmp) in Mexico, 2007-2017⁶.

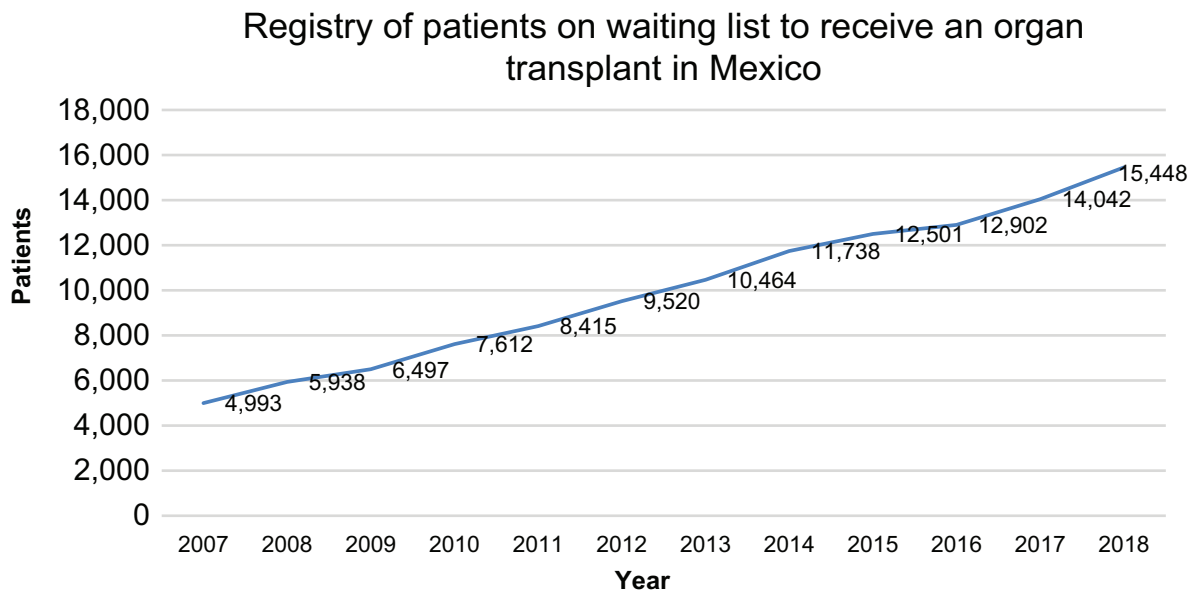


Figure 2. Number of patients on waiting list for a solid organ in Mexico, 2007-2018⁶.

considering tissues such as the cornea, went from 4,993 patients in 2007 to 14,042 in 2017 and 15,448 patients by the end of 2018, which represents an increase of 281% for the 2007-2017 period and 309% for 2007-2018. This increase was mainly driven by patients waiting to receive a kidney transplant. Thus, in 2007, the percentage of patients in the registry waiting for a kidney was 91.8% with regard to total number of registries for all types of solid organs, that is, without counting the list for corneas or other tissues, and for 2018, it reached 97.6%⁶.

Number of solid organ transplants carried out in different countries of Latin America in 2017 expressed as the rate per million population

Table 1 shows the data for the total number of solid organ transplants, the sum of kidney, liver, heart, lung, and pancreas transplants reported that year, carried out in various Latin American countries. Transplanted organs obtained from both living and deceased donors that were recorded in Mexico during 2017 (rate

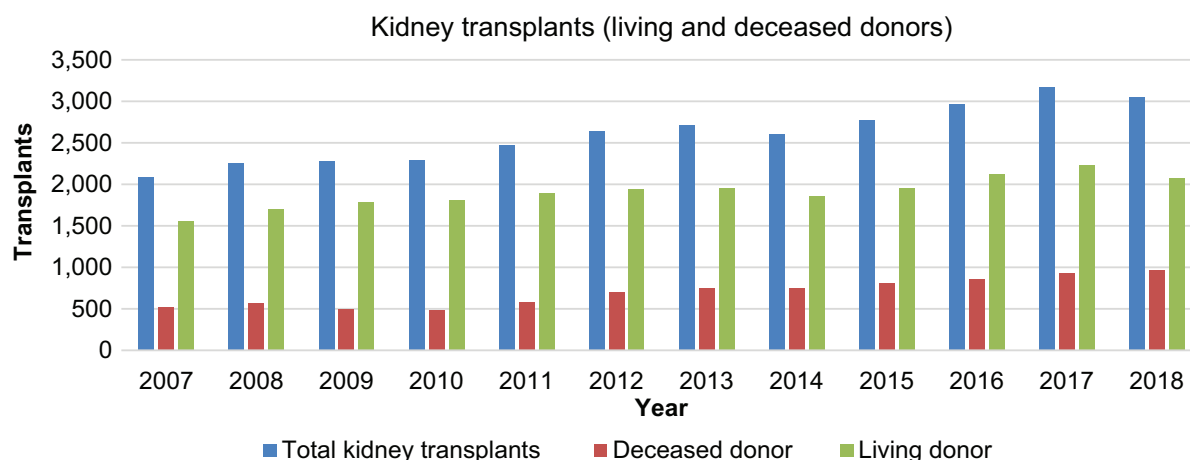


Figure 3. Total annual number of kidney transplants in Mexico and breakdown according to deceased donor and living donor origin, within the 2007-2018 period⁶.

Table 1. Solid organ transplants (kidney, liver, heart, lung, pancreas, intestine) at different countries of Latin America in 2017. Cornea and other tissue transplants are not included³

Country	Total number of solid organ transplants from living and deceased donors in 2017	Rate per million population (%)
Uruguay	184	52.57
Argentina	1999	45.12
Brazil	8668	41.41
Chile	540	28.0
Colombia	1,330	27.09
Mexico	3,386	26.21
Cuba	225	19.57

Table 2. Total number and rate per million population of kidney transplants from deceased donation carried out in 2017 in various countries of Latin America³

Country	Number of kidney transplants from deceased donors in 2017	Rate per million population (%)
Uruguay	128	36.57
Brazil	4807	22.97
Argentina	929	20.97
Colombia	798	16.25
Chile	292	16.13
Cuba	174	15.13
Mexico	932	7.21

of 26.21 pmp) are included and are compared with those recorded in other countries during that same year³.

Kidney transplants

The number of kidney transplants in our country has been increasing over the past 12 years, as observed in figure 3, which shows both total annual figures and transplants from living donors and deceased donors⁶.

Table 2 makes a comparison of 2017 deceased donor kidney transplants productivity between different Latin American countries³. If only absolute figures are considered, Mexico ranked second, below Brazil and had practically the same productivity as Argentina.

However, when the comparison is made using rates pmp, Mexico ranks last among the compared countries.

Kidney transplant distribution in Mexico's SNS

Healthcare in our country is fragmented and is provided by a wide variety of institutions that, in addition, perform organ donation and transplant. Table 3 shows how beneficiaries are distributed between the institutions that make up the SNS, as well as the number of kidney transplants carried out by each institution⁶ and the rate pmp referenced to its population of beneficiaries during 2018.

Table 3. Percentage distribution, in absolute figures and in rates per million population, of total kidney transplants (both from living and deceased donors) in Mexico, among the different institutions of the National Health System in 2018⁶

	IMSS	Private	ISSSTE	PEMEX-Defense-Navy	Seguro Popular or Medical Insurance for a New Generation	National total
Distribution	39.19%	3.27%	7.7%	1.15%	48.69%	100%
Population expressed in millions	48.88	4.08	9.61	1.43	60.74	124.74
Number of performed transplants	1,513	615	108	48	764	3,048
Rate per million population	31.0	150.8	11.2	33.5	12.6	24.4

IMSS: Mexican Institute of Social Security; ISSSTE: Institute for Social Security and Services for State Workers.

Table 4. Corneal transplant distribution among the different institutions of the Mexican Health System in 2018 in absolute figures and in rates per million population⁶

	IMSS	Private	ISSSTE	PEMEX-Defense-Navy	Seguro Popular or Medical Insurance for a New Generation	National
Number of performed corneal transplants	1523	2066	121	49	510	4,269
Rate per million population	31.2	506.4	12.6	34.3	8.4	34.2

IMSS: Mexican Institute of Social Security; ISSSTE: Institute for Social Security and Services for State Workers.

Table 5. International comparison of the number of centers authorized to perform solid organ transplants by country in 2017²

Number of existing authorized transplant centers per organ						
Country	Kidney	Liver	Heart	Lung	Pancreas	Small intestine
Uruguay	3	1	3	1	1	0
Brazil	140	67	44	8	17	2
Argentina	53	29	22	4	17	2
Colombia	22	9	8	4	5	4
Chile	22	9	8	5	3	2
Cuba	9	3	1	0	0	0
Mexico	255	73	51	10	22	3
United States	240	144	138	71	135	40
Spain	40	25	16	8	13	3

Cornea transplant distribution in Mexico's SNS

Although this article is focused on solid organ transplantation, table 4 shows 2018 data for inter-institutional distribution of cornea transplant⁶, which is a tissue. This is the second most frequently performed transplant in our country, and the data associated with this

procedure add relevant information to the panorama of organ and tissue donation and transplant in Mexico.

Installed capacity

In 2017, Mexico reported having the largest number of centers authorized for kidney transplantation, even when compared with the leading countries in this field, such as the United States and Spain², as shown in table 5. In the case of other organs, such as liver, heart, lung, and pancreas, our country has more authorized centers than any other Latin American country.

Discussion

About solid organ transplantation

1) About organ transplant system inefficacy in Mexico

In 2017, Mexico had a solid organ transplant rate (both from living and deceased donors) of 26.21 pmp, only higher, among the Latin American countries compared in this article, than that of Cuba (19.57 pmp). When we compare our installed capacity with that of other Latin American countries, it turns out that Mexico has the largest number of centers authorized for kidney transplantation. Even when compared with countries beyond Latin America, it is surprising that it

is larger and surpasses leading countries in the world, such as the United States and Spain. In the case of other organs, such as heart, liver, lung, and pancreas, Mexico has more authorized centers available than any other Latin American country; despite that, most of them outperform us in productivity. It is more than obvious that in our country we have a serious problem of both efficacy and efficiency in the issue of solid organ transplantation: a supernumerary installed capacity with regard to other countries accompanied by a low productivity measured in rate pmp. Why? This is most likely a multifactorial problem the complete analysis of which is beyond the scope of this article. We will address, just to start, one aspect of the problem: it is notorious that large part of kidney, liver and heart transplantation activity in Mexico is concentrated in at most 5-10 hospitals, as reported by CENATRA. The contribution made by all other authorized hospitals is disproportionately low. Thus, for example, in 2018, CENATRA reported that 969 kidney transplants were from a donor who died from brain death; out of these, 310 (32%) were carried out in five hospitals⁶. Given that, until December 2017, Mexico had 255 centers authorized for kidney transplant²; this means that 250 hospitals performed the remaining 659 kidney transplants (68%) of all deceased donor kidney transplants, an average of 2.6 deceased donor kidney transplants per year, for each one of these 250 hospitals! Obviously, things are not like that, but more serious. An indefinite number of hospitals have nothing to report, while in others, the 659 transplants are distributed in small numbers. It is not difficult imagining that surgical experience and results of these transplants will be compromised when activity is so low and erratic in many authorized centers. For how many years should the operating authorization of a transplant center whose productivity is non-existent or almost non-existent remain in force?

2) Kidney transplant distribution in the Mexican SNS

If we go back to the data presented in table 3 and pay attention to the rate of transplants performed in Mexican SNS different institutions in 2018, the fact that private hospitals achieve the highest rate (150.8 pmp) stands out, against the lowest rates of the system corresponding to *Seguro Popular* (12.6 pmp) and the Institute of Social Security and Services for State Workers (11.2 pmp); the IMSS rate is 31.0 pmp, the pooled rate for PEMEX-Defense-Navy is 33.5 pmp, and mean rate for the entire SNS is 24.4 pmp. Of all these sectors, the most vulnerable due to its beneficiaries' socioeconomic conditions is that which is

covered by *Seguro Popular*, which corresponds to nearly 50% of the national population. The disproportion between the solid organ transplant rate observed in 2018 between the private sector and *Seguro Popular* corresponds to a 4:1 ratio. This disproportion shoots up even further, up to 60:1, when the same comparison is made between private hospitals and *Seguro Popular* in the case of corneal transplants carried out in Mexico in 2018, as shown in table 4.

On deceased organ and tissue donation

Despite the activities carried out in the study period (2007-2017), when the figures of the number of cases of organ donation of deceased persons with a diagnosis of brain death are reviewed, growth is observed to have been extremely low, less than 1 point in the donation rate pmp, to reach the figure of 3.94 pmp in 2017². A Mexican report estimates that no significant increase has been recorded in the rates of deceased donation over the past 40 years⁷.

This minimal growth in the deceased organ and tissue donation rate pmp contrasts with the figures of other Latin American countries during the same time period, in which Argentina, Chile, Brazil and Uruguay have achieved much higher rates than Mexico, with a mean for this region slightly over twice the rate in Mexico.

This stagnation in deceased organ donation rates in Mexico has been accompanied by a 281% increase in the number of patients on waiting list for a solid organ in the 2007-2017 period, which rises up to 309% for the 2007-2018 period on said list. The authors of this article did the exercise of converting the waiting list figures into rates pmp and found that the rate went from 47.2 pmp in 2007 to 108.7 pmp in 2017, with an increase of 230%.

Considering these low deceased organ donation rates in Mexico and the concomitant, increasingly pronounced shortage of organs for transplantation, where should efforts regarding deceased organ donation be directed to? In our country, organ donation has been promoted from three areas: a) as a problem of a cultural nature; b) as a legislation issue; and c) as a training task. Much has been written about these three important areas, which do not appear to be, at least in the usual sense they are approached with, the weakest links in the chain of processes currently linked to organ and tissue donation in Mexico. The constant campaigns for deceased organ and tissue donation, the evolution of Mexican society's attitude,

evolution of the media and evolution of the SNS personnel in Mexico towards this issue, seem reasonably inclined to favoring donation rather than fighting or hindering it. Mexican legislation on the matter, though perfectible, in general protects, legitimizes and organizes donation and transplantation in our country, and some recent concerns about whether we should have a legislation on presumed organ donation do not appear to correspond with current times in Mexico, and neither with the most successful model in the world, which is the Spanish model with its National Transplant Organization, around which most Latin American countries, including Mexico, have aligned, and in which, despite having a legislation on presumed organ donation, in practice, consent of the family⁸ is still preferred for proceeding with deceased organ donation. In addition, training of the personnel that the General Statute of Health in Mexico authorizes and legitimizes to coordinate and execute the essential tasks of the deceased organ donation process, that is, the hospital donation coordinator⁹, is supported by a CENATRA/UNAM professional diploma course for the Training of Hospital Coordinators for Organ and Tissue Donation for Transplantation Purposes¹⁰, which is not only mandatory for completing the profile required by law^{9,11} to access to the hospital donation coordinator position, but has reasonably been established as a highly efficient training and educational tool for the position, renowned for its quality and continuous improvement.

In summary, in the critical situation of stagnant donation rates at a level where they are increasingly insufficient given the scarcity of organs and tissues; in our country, we will allow ourselves making some suggestions in fields where we have wide areas of opportunity that have not been addressed, or at least not as priorities:

Proposal 1: creation of a public entity in charge of financing organ and tissue donation and transplant processes in Mexico, encouraging productivity. This administrative entity would be in charge, among other tasks, of creating, regulating and applying mechanisms for: a) reimbursement of immediate expenses incurred by a hospital during donation and transplantation processes; b) economic compensation, under clear and transparent rules, for overtime, outside working hours, to the personnel that participates in organ donation, procurement and transplantation processes; and c) institutional reimbursement (per hospital) of immunosuppression costs generated by transplant recipients.

Proposal 2: to bring the Declaration of Santiago de Querétaro of the Mexican College of Critical Medicine¹² to reality, and create indicators and processes for improvement and incentives in order for potential deceased organ donors to be admitted with opportunity and as a priority to intensive care units (ICUs) and for the vast majority of them to be cared for within Mexican ICUs. To create a Mexican clinical practice guideline for the management of potential deceased organ and tissue donor patients at emergency departments and ICUs. In summary, to regulate and favor the relevant role of ICUs in the potential donor care process, as it occurs, for example, in Spain, where all the processes ICUs and intensive care physicians participate in are included and subject to specific recommendations of the *Good practice guidelines in the process of organ donation* of the National Transplant Organization⁸.

Proposal 3: to create a Mexican controlled asystole organ and tissue donation program and make it a real and regular modality in Mexico for deceased organ and tissue donation, with significant impact on the donation rate pmp. To illustrate the potential relevance of this program for Mexico in the future, in the 2018 GODT Newsletter², with 2017 final figures, out of 66 analyzed countries, 22 reported controlled asystole donation activity and eight of them had rates higher than 4.0 pmp, ranging from 4.6 pmp in Switzerland to 12.3 pmp in Spain; these figures are entirely independent of those corresponding to deceased donation activity associated with brain death in these countries². In this report, no Latin American country appears with controlled asystole donation activity in 2017. Reports in our country on controlled asystole donation are scarce and occasional; thus, in the 2007-2017 period, in GODT annual reports we only found two cases of this type of donation reported by Mexico in 2012.

Proposal 4: to promote the creation of a Subcommittee for Donation and Transplant of Organs and Tissues within the Health Commission of the Chamber of Deputies, whereby doctors and other professional experts in the field can carry out a formal and short medium- and long-term programmatic agenda that allows making adjustments and legislative reforms as they become necessary for the three previous proposals, and many others that have already been discussed in various forums, but that do not find propitious ground to prosper in legislative or budgetary terms.

We briefly suggest some additional proposals, but underscoring that this list will not be complete without opening to the participation of all those who

professionally experience the reality of organ and tissue donation and transplant in Mexico.

Proposal 4: ensuring that transplant recipients have the immunosuppressive drugs they require.

Proposal 5: to create the legal reforms required to authorize that ambulances of the various health institutions can transport and transfer patients with brain death in the various processes and sub-processes of organ donation and transplant, since, legally, patients with brain death have already lost their lives, and ambulances are not allowed to transport corpses.

Proposal 6: to officially declare, within the entire SNS in Mexico, donation and transplant programs as high priority in all institutions of the system, and create the legal and administrative framework for this purpose and for inter-institutional support (SSA, IMSS, ISSTE, State Transplant Centers, etc.) to be duly regulated in order to ensure that processes are completed at the local or regional level, and thus make resources more efficient and reduce costs and time, and increase organ and tissue donation and transplant productivity.

Conclusions

Solid organ donation and transplantation figures evolution in the 2007-2018 period has been characterized by: (1) a meager growth, with <1 point in the deceased organ donation rate pmp in Mexico; (2) a three-fold increase, in round numbers, of the list of patients waiting for a solid organ transplant; and (3) an installed capacity in the number of centers authorized for kidney transplants that is larger than that of any other country in the world, and a number of centers authorized to transplant liver, heart, lung, and pancreas that is larger than that of any other Latin American country, which, given the low productivity and larger shortage of organs, makes the diagnosis of a national transplant system that is not only ineffective, but also inefficient.

The Mexican organ donation and transplant system is highly active in absolute figures, but insufficient in rates pmp to meet the enormous needs of patients waiting for an organ. There is an urgent need for a comprehensive strategic change in organ donation and transplant in Mexico, which the authors of this article propose should include, among other strategies, a larger budget for donation and transplant and a new way of investing it, as well as the promotion of higher participation of ICUs in the care of the potential donor and, finally, implementation of a national plan for controlled asystole deceased donation. Among all these

proposed issues, each one deserves a broad discussion, national in scope, by experts on the subject.

Conflicts of interest

The authors of this article declare that they have no conflicts of interest in relation with its preparation, for which they did not receive any funds or financial support from institutions of the public, private, or commercial sector, or any NGO.

Ethical disclosures

Protection of human and animal subjects. The authors declare that no experiments were performed on humans or animals for this research.

Confidentiality of data. The authors declare that no patient data appear in this article.

Right to privacy and informed consent. The authors declare that no patient data appear in this article.

References

- Argüero-Sánchez R. Trasplante de corazón. *Rev Invest Clin*. 2005;57:344-9.
- European Directorate for the Quality of Medicines & Health Care of the Council of Europe (EDQM) & Organización Nacional de Trasplantes (ONT). International figures on donation and Transplantation 2017. *Newsletter Transplant EDQM*. 2018;23:1-66.
- Red/Consejo Iberoamericano de Donación y Trasplante. *Newsletter Trasplante Iberoamérica*. 2018;12:1-78.
- Organización Nacional de Trasplantes. Ministerio de Sanidad, Consumo y Bienestar Social. Gobierno de España. Gabinete de Prensa. Nota de Prensa. 2018 08 29 Datos Registro Mundial de Trasplantes. 29 de agosto de 2018. (Consultado el 11 de julio de 2019.) Disponible en: <http://www.ont.es/prensa/NotasDePrensa/2018%2008%2029%20%20DATOS%20REGISTRO%20MUN-DIAL%20DE%20TRASPLANTES.pdf>
- Centro Nacional de Trasplantes. Reporte anual 2017 de donación y trasplantes en México. 2017. (Consultado el 3 de abril de 2019.) Disponible en: https://www.gob.mx/cms/uploads/attachment/file/289636/Presntaci_n_anual_2017.pdf
- Centro Nacional de Trasplantes. Reporte anual 2018 de donación y trasplantes en México. 2018. (Consultado el 3 de abril de 2019.) Disponible en: https://www.gob.mx/cms/uploads/attachment/file/427652/Presntacion_anual_2018.pdf
- Reyes-Acevedo R, Obrador GT, Alberú-Gómez J, Gracida-Juárez C, Madrigal JA, Aburto-Morales S. Current state and challenges for organ donation and transplantation in Mexico. *Transplantation*. 2019;103:648-50.
- Organización Nacional de Trasplantes (ONT). Guía de buenas prácticas en el proceso de la donación de órganos. Madrid: Gobierno de España. Ministerio de Sanidad, Política Social e Igualdad. ONT; 2011. p. 1-65.
- Gobierno de los Estados Unidos Mexicanos. Ley General de Salud. Artículo 316-Bis. *Diario Oficial de la Federación*, 12-Dic-2011.
- Centro Nacional de Trasplantes, CENATRA. Diplomado Universitario para la Formación de Coordinadores Hospitalarios de Donación de Órganos y Tejidos con fines de Trasplante. (Consultado el 16 de julio de 2019.) Disponible en: <https://www.gob.mx/cenatra/acciones-y-programas/diplomado-universitario-para-la-formacion-de-coordinadores-de-donacion>
- Gobierno de los Estados Unidos Mexicanos. Reglamento de la Ley General de Salud en Materia de Trasplantes. Título Segundo, Capítulo II. Del Coordinador Hospitalario. *Diario Oficial de la Federación*, 26-Mar-2014.
- Colegio Mexicano de Medicina Crítica (COMMEC). Declaración de Santiago de Querétaro sobre el proceso de donación y trasplante de órganos y tejidos de origen cadavérico en México. 13 de octubre de 2017. (Consultado el 16 de julio de 2019.) Disponible en: <http://commec.org.mx/images/declaracion-queretaro.pdf>