Impact of Educational and Organizational Initiatives in Organ Donation in a Southern Brazilian State in the Last Decade

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ABSTRACT

Background. The unbalance between the demand and supply of organs for transplant is a universal phenomenon. This study shows Santa Catarina's experience with educational and organizational initiatives in the state's transplant system to describe the result of such actions in increasing donation rates.

Methods. This is a before and after study. Medical data on potential organ donors, listed in the Santa Catarina Transplant Registry between January 2004 and December 2017, were analyzed. This 13-year period was divided into 3 phases. Phase 1, from 2005 to 2007, corresponds to the organization of the program without specific measures. Phase 2, from 2008 to 2011, is associated with theoretical/practical training on family interviews. Phase 3, from 2012 to 2017, is related to the implementation of a protocol for the management of potential deceased donors.

Results. Referrals grew from 35.1 per million population (pmp) (phase 1) to 49.4 pmp (phase 1) and 74.0 pmp (phase 3), translating into a 110.8% ($P < .001$) increase. Lack of family consent dropped from 39.8% to 27.8% in phase 3, a global reduction of 30.1% ($P < .001$). Loss of donors to cardiac arrest were reduced from 51.9% to 23.3% to 12.2%. Effective donors, which varied from 12.0 pmp to 20.0 pmp and 32.7 pmp, increased by 172.5% ($P < .001$).

Conclusions. This study demonstrates the positive association between articulated educational initiatives and improvements in potential donors' identification, which, associated with cardiac arrest loss control and increased family consent, brought about significantly better results in organ donation.

FROM its beginnings to the present, organ transplantation has overcome the main surgical and pharmacological hurdles in its development [1,2]. This successful outcome brought about a worldwide phenomenon that finds the scarcity of organs the main restraining factor for the growth of organ transplant programs in every country where such activities are furthered [3]. On the side of demand, better results, increased referrals, and retransplantation are some of the variables compounding the issue [4,5]. On the other hand, nations perform very differently in regard to converting effective donors relative to their population [6]. Solutions for this problem are being proposed in various forms. In Spain, the National Transplant Organization (ONT) recommends a systematization at referring hospitals of the several stages of the process. With a quality control program and a strong training strategy, the ONT was able to increase the referral rate and family consent while reducing losses owing to cardiac arrest, resulting in a process effectiveness rate of nearly 60% [7].

Brazil holds the second position in the world ranking of organ transplanting countries in absolute numbers. The country's effectiveness in 2015, however, was lower than 30%. Such performance was able to meet only about 40% of the solid organ transplant demand of a waiting list of over 33,000 patients [8] and thus contributed to an important public health issue affecting everyone, especially those on the waiting list [9].

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Losses owing to low efficiency are caused by different factors such brain death nonreferral, lack of family consent, cardiac arrest, misattributed contraindications, and logistic problems [10–12]. Aiming at reducing such large observed losses, some authors have demonstrated the benefits of different actions on the final number of available organs for transplantation. Salim et al, in 2005 and 2006, verified that an aggressive donor management policy increases the referral rate of potential donors and reduces the number of organs lost to cardiovascular collapse [13,14]. The Spanish model for donation and transplantation has shown that quality control of services at referring hospitals carried out by the ONT has effectively reduced the number of brain death nonreferrals. Furthermore, a policy of ostensive training of in-house coordination teams on communication under critical situations has significantly improved family consent rates [5,7,15–17].

The fact that there are no homogeneous results in the comparison between different countries is somehow mirrored in the comparison between the different Brazilian regions. Results vary greatly, but the state of Santa Catarina stands out and surpasses all other regions by showing results that are twice as high as the national average for the last decade [8]. In spite of the basic limitations of a developing country, the reproduction of successful models for the management of transplant systems, specifically regarding family interviews and aggressive management of donor potential, was understood as a concrete possibility to be followed to enhance the performance of Santa Catarina's Transplant System [5,7,13,14,16,18,19]. The modifications, based on the Spanish transplant coordination model, brought about progressively better results. Such measures, initially restricted to training programs and the formation of coordination teams in each hospital, were gradually expanded in terms of coverage and sophistication. Today, detection, brain death diagnosis, maintenance of potential donors, and family interviews are incorporated into the donation/transplantation (D/T) process as standardized procedures. A network of coordinators was built prioritizing neurosurgery reference hospitals and progressively encompassing every hospital with an intensive care unit. Support for the diagnosis of brain death and for the organization of hospital coordination units were among the first measures to be taken. Actions gradually evolved to include education programs on each stage of the donation/transplantation process. In 2008, in order to increase the number of effective donors, 7 essential interventions for improvement were defined based on the Spanish model of transplants coordination (Table 1) [3,20]. In this context, the aim of this paper is to describe the experience of Santa Catarina in implementing multimodal actions to increase organ donation and their respective results.

MATERIALS AND METHODS

Study Design and Definitions

This is a before and after, quasi-experimental study that describes the implementation of concrete measures aimed at improving the quality of the organ donation process within the Santa Catarina Transplant System. Santa Catarina is a Southern Brazilian state occupying 95,346 km^2 (1.12% of the national territory) and had a population of 6.2 million people in 2015. Its Human Development Index (HDI) is 0.84, and life expectancy at birth is 75.2 years. Brain death diagnosis was established in accordance to resolution 1,480/97 of The Federal Medicine Council of Brazil [21].

Table 1. Planned Interventions in the Santa Catarina Transplant System

	Interventions
1	Adapt the number of available ICU beds to the needs of the state
2	Establish a quality assurance program
3	Involve intensive care doctors in transplant coordination
4	Develop transplant coordination teams in all hospital of SC state
5	Develop donation and transplantation process training programs with an emphasis on family interview at SC's hospitals
6	Develop donation and transplantation process training programs with an emphasis on potential donors identification, brain death diagnosis, and maintenance of deceased donors at SC's hospitals
7	Implement a remuneration system for transplant coordinators

Abbreviations: ICU, intensive care unit; SC, Santa Catarina.

Study Phases in Relation to Interventions

The study was divided into 3 phases:

Phase 1 (baseline) covers the period between 2005 and 2007 and corresponds to the initial planning and organization of the quality improvement program with no specific measures being implemented. Initial activities encompassing support to hospitals established a quality assurance program for organ donation to involve intensive care doctors in transplant coordination and to develop transplant coordination teams in all hospitals of Santa Catarina state through general education courses for coordinators [20]. The state health department has also initiated a plan to expand the number of ICU beds over the next few years and, consequently, the next 2 study phases.

Phase 2 started in 2008 and consisted of theoretical and practical training on family interviewing for in-house transplant coordinators. The initial courses were carried out by Spanish and Argentine instructors specialized in communication in critical situations and were assigned to the transplant coordinators of all hospitals with reports of brain death notifications. Among these, participants were selected to receive specific training to be instructors and local replicators to continue the training in subsequent years. Communication courses in critical situations are offered several times a year. The purpose of this activity was to develop the main aspects of breaking bad news under critical situations and included the interpretation of verbal and nonverbal messages of family members. Students' assessment included practical activities with realistic simulations [17].

In phase 3, which took place between 2012 and 2017, we added to the previous actions and measures aimed at maintaining the potential organ donors. The first one was the development of the Brazilian guidelines for potential donor maintenance care, published in 2012 [18]. In early 2012, the guideline's key

Table 2. Data on Organ Donations Over the Years

	Before Interventions			Training for Family Interview				Maintenance Protocol						
	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Brain dead referrals, n	167	249	257	244	277	295	384	386	416	469	498	537	567
Brain dead referrals, pmp	31.2	46.5	43.8	41.6	47.2	47.2	61.5	61.8	66.6	75.1	79.8	78.8	82.0
Actual donations, n (%)	64 (38.3)	75 (30.1)	87 (33.8)	98 (40.2)	120 (43.3)	109 (36.9)	159 (41.4)	165 (42.8)	170 (40.9)	202 (43.1)	203 (40.8)	251 (46.7)	282 (52.5)
Actual donations, pmp	11.9	14.0	14.8	16.7	20.5	17.4	25.4	26.4	27.2	32.3	32.5	36.8	40.8
Family refusals, n (%)	69 (41.3)	95 (38.1)	104 (40.5)	70 (28.7)	94 (33.9)	91 (30.9)	95 (24.7)	111 (28.7)	115 (27.6)	134 (28.6)	150 (30.1)	139 (25.9)	150 (27.9)
Family refusals/interviews, (%)	(61.6)	(69.8)	(66.0)	(59.8)	(56.6)	(45.5)	(37.0)	(40.2)	(38.5)	(37.0)	(40.0)	(37.0)	(33.0)
Contraindications, n (%)	13 (7.8)	36 (14.4)	37 (14.4)	13 (5.3)	8 (2.8)	15 (5.0)	20 (5.2)	32 (8.3)	41 (9.9)	55 (11.7)	69 (13.7)	70 (13.0)	75 (13.9)
Cardiac arrests, n (%)*	Unavailable	Unavailable	Unavailable	52 (21.3)	45 (16.2)	76 (25.8)	107 (27.9)	70 (18.1)	81 (19.4)	60 (13.0)	52 (10.4)	46 (8.5)	43 (8.0)
Others, n (%)	21 (12.6)	43 (17.3)	29 (11.3)	11 (4.5)	10 (3.6)	4 (1.4)	3 (0.8)	8 (2.0)	9 (2.2)	18 (3.8)	24 (4.8)	31 (5.7)	46 (8.5)

*CPR: Donor lost due to cardiopulmonary arrest.

recommendations were outlined in a checklist to guide the main clinical procedures to be followed during the maintenance of potential donors. The detailing of the checklist and its application in daily care were published previously by our group [22,23].

DATA COLLECTION

Medical information of all potential organ donors identified in the Santa Catarina Transplant Registry between January 2005 and December 2017 was analyzed. Information was obtained from the Santa Catarina Transplant Registry, where all potential organ donors are registered by the donor coordinators. The analysis included all potential donors notified between January 2005 and December 2017.

Variables analyzed were: number of brain death referrals, actual donations, family refusals, cardiac arrest, clinical contraindications for donation, and losses from causes that do not fit into the first. In phase 1, cardiac arrests were not counted separately and were included among the "other causes."

STATISTICAL ANALYSIS

Data were analyzed using SPSS 21.0 (IBM, Armonk, NY, United States). Qualitative variables were described through their frequency distributions and quantitative ones by means of their mean and standard deviation, testing normal distribution with Kolmogorov-Smirnov test. Comparisons were performed with Student t test for quantitative variables with normal distribution. For non-normal distribution of variables, the nonparametric Mann-Whitney test was used. Qualitative variables were compared using either χ^2 or Fisher's exact test. Spearman test was used to study the correlation between quantitative variables.

A significance level of 5% was used for the tests.

ETHICAL CONSIDERATIONS

The study was approved by the São José Municipal Hospital Research Ethics Committee, Joinville/Santa Catarina, under registry number 1,536,206.

RESULTS

The results of all donation activities that were studied for 13 years are shown in Table 2. The growth of potential donors' referrals observed on a year-on-year basis followed a constant ratio. When referral rates are analyzed, figures become even more constant. The upward trend is observed throughout the whole period varying from 31.2 pmp (per million population) to 82.0 pmp. Effective donors' pmp rate displayed a constant growth behavior of notifications, and actual donations evolving from 11.9 pmp actual donors in 2005 to 40.8 pmp in 2017 are statistically significant (Fig 1). The annual rate of family nonconsent from the interviews carried out in the period was reduced from 61.6% in the first year to 33.0% in the last year, with some oscillations. Clinical contraindications in the analyzed period varied from 7.8% to 13.9% with some oscillations among the years. Cardiac arrest in the

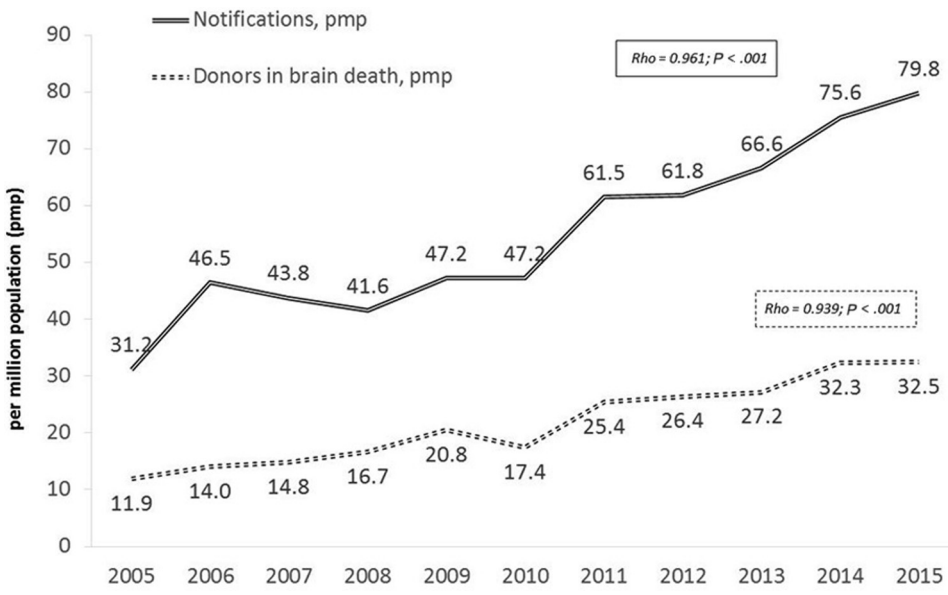

Fig 1. Evolution of notifications and effective multiple organ donation over time. Abbreviations: Pmp, per million population; Rho, Spearman test for correlation between year and notifications or donations.

course of the process declined during the analyzed years, reaching a rate of 8.0% in 2017 (Table 2).

Between phase 1 and phase 3, there was a strong increase in referrals of brain death over time, representing a growth of 110.8% (35.1 pmp to 74.0 pmp, $P < .001$). In parallel, effective donors grew 172.5% (12.0 pmp to 32.7 pmp, $P < .001$) in the period (Table 3).

Figure 2 and Table 3 summarize the 3 studied phases and show the evolution of the variables in each one of them. The accumulated effects of better detection with the reduction in losses to cardiac arrest and family nonconsent implied an increase in actual donations from 33.6% in phase I to more than 40.0% in the subsequent phases. Family nonconsent, initially at 39.8%, dropped to 29.1% and 28.1%, corresponding to a 29.3% ($P < .001$) reduction. Contraindications were initially at 12.8%; they dropped to 5.9% and then increased to 11.9%, resulting in an overall 6.7% reduction ($P = .26$) when compared to the baseline. Data on donor losses owing to cardiac arrest were only available for the 2 last phases. In these phases, a 47.6% ($P < .001$) reduction was observed, with losses having decreased from 23.3% to 12.2%.

DISCUSSION

Our results demonstrate that initiatives in education for family interviews and standardization of maintenance care of brain dead potential donors have translated into a consistent increase in the effectiveness rate of organ donation within the Santa Catarina Transplant System in the last 13 years.

When these data are analyzed under the perspective of the 3 distinct phases, the impact of the interventions carried out in these phases are made clear. The evolution in referral rates, which reflect the capacity of public health professionals in detecting potential donors, suggest that education of coordinators was paramount. It should be stressed that, from the first year and throughout the whole studied period, the education for professionals on the different stages of the donation transplantation process was always present. A network of coordinators was built that focused initially on neurosurgery reference hospitals but eventually encompassed every hospital with an ICU. The usefulness of such measures is well established in the literature [7,15,19]. Programs to support a brain death diagnosis and for establishing hospital coordination teams were offered first and were followed by educational programs on each stage of the D/T process. It should also be noted that, if nonspecific measures were efficient in increasing overall referral rates, the effective improvement of results depends largely on the enhancement of 2 important stages, namely the maintenance of potential donor and family interviews [16,19]. With all these measures being effectively implemented in Santa Catarina's transplantation system, the state has reached the best results in organ donation in Brazil [8].

The 29.3% improvement in family consent, besides being statistically significant, played a key role in the found results. The correlation is made clear with the implementation of the course on breaking bad news under critical conditions developed in partnership with Spain's ONT. These results were reproduced in Spain as well as in other places [17,19,23,24]. This is an activity that was initially conceived for the education of transplant coordinators but was incorporated into the education of all emergency and critical care staff. Today, there are about 150 transplant coordinators in Santa Catarina, and over 750 professionals were trained under these methods. Given that it is a theoretical/practical course, besides educating professionals for the proposed

Table 3. Comparison of Data Before and After Interventions

	Phase 1 Before Interventions (2005–2007)	Phase 2 Training for Family Interview (2008–2011)	Phase 3 Maintenance Protocol (2012–2017)	Change (%) (Phase 1 to Phase 2)	Change (%) (Phase 1 to Phase 3)	Change (%) (Phase 2 to Phase 3)	*P* Value (Comparing Phase 1 to Phase 3)
Brain dead referrals, n	673	1200	2873	-	-	-	-
Brain dead referrals, pmp	35.1	49.4	74.0	+40.7	+110.8	+49.7	<.001
Actual donations, n	226	486	1273	+5.2	+31.8	+9.3	.44
Actual donations, pmp	12.0	20.0	32.7	+66.6	+172.5	+31.7	<.001
Family refusals, n	268	350	799	−27.0	−30.1	−4.4	<.001
Contraindications, n	86	56	342	−64.1	−7.0	+158.7	.26
Cardiac arrests, n	Unavailable	280	352	-	-	−47.6	<.001
Others, n	93	28	136	−26.8	−65.9	+104.3	<.001

Abbreviation: Pmp, per million population.

task, it is a powerful tool in human resource management because it also allows for the assessment of which professionals are better qualified for the job. How successful a family interview will be is directly related to the training and experience of the interviewer; possibly no other variable is as important as the communication capacity and empathy of the health professional [17,25–27]. This information contrasts with the widespread concept that modifications made to the laws or advertising campaigns would play a key role in the results of family interviews.

The 48.4% global reduction in losses owing to cardiac arrest constitute remarkable progress in this scenario. The making of guidelines for the management of potential adult [18] donors and the strategy for their implementation within the state's hospital network has proven very useful [22]. The progressive adherence of the diverse institutions culminated in a sustained reduction in the losses owing to cardiac arrest in the observed results. At the beginning, 27.9% of potential donors were lost to cardiac arrest. In 2017, this rate was 8.0%, corresponding to nearly one-third of the baseline's figures. Salim et al had already demonstrated positive results in a clinical study that assessed the aggressive strategy for the maintenance care of potential donors and resulted in a 87% reduction in losses to cardiac arrest and in an 82% increase in effective donors [13,14]. Such results are reproduced in other similar studies [28–31].

Clinical contraindications fluctuated along the period, varying from 2.8% to 14.4%. Although it is a variable whose predictability is hard to determine, it is worth noting that the rates are always below the standard (26%) established by Spain's ONT in its Quality Control Program [15]. These data suggest that the culture of organ donation has evolved in Santa Catarina, given that excessive contraindications hint at a lack of knowledge of the process [15]. Apparently,

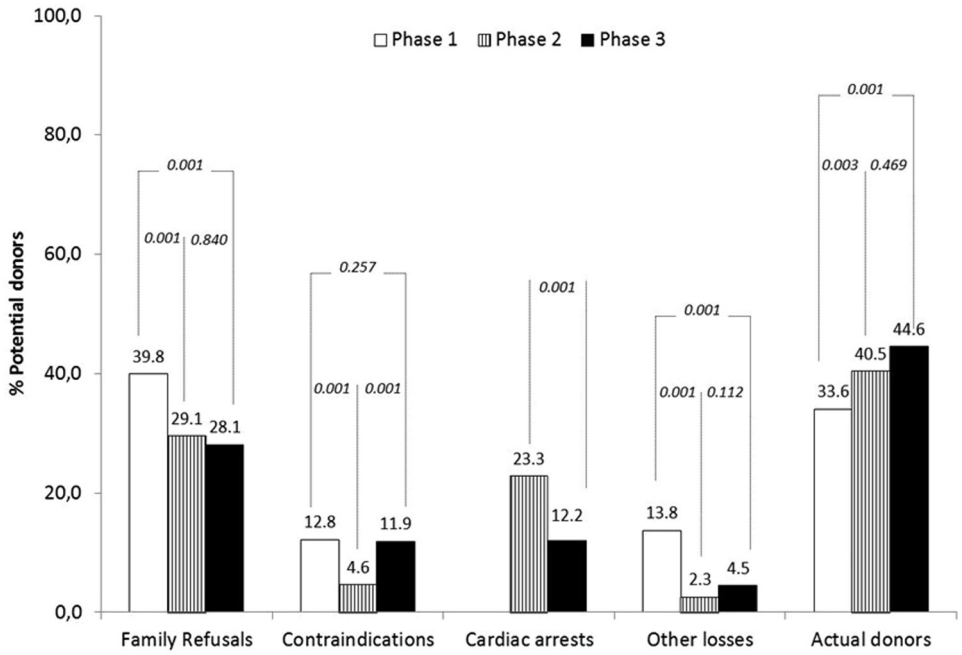

Fig 2. Evolution of potential donors according to study phase. χ^2 test was used for comparisons.

this increase in the third phase is related to the stimulus to the notification of all brain deaths to the state transplant center. The growing number of effective donors, from 12.0 pmp to 32.7 pmp, corresponds to a 172.5% ($P < .001$) increase between the 3 studied phases and may constitute the most indisputable element of the present study. Although the experiences of some Western European countries [6] (such as Portugal, Croatia, and Malta), which presented good results after adopting elements of the Spanish model into their national transplant systems, are known, the results achieved by Santa Catarina are new to Latin America and, according to the Brazilian Organ Transplant Association, allowed the state to claim the "highest rates of donation, comparable to those of developed countries" [8].

The main contribution of the present study is to demonstrate the possibility of implementing a cost-effective and efficient model for the coordination of transplants in a developing country using the organization and education of health professionals as its key elements. These findings open up the possibility of reproducing such results both in developed and developing countries.

Some limitations, however, should be considered: the observational and retrospective nature of this study and the respective impact on data collection; although the temporal relation of interventions and their results are reliable, the diverse interventions may present overlaying effects; and some variables were not available for all the studied years, impairing evolution assessment.

CONCLUSION

This paper presents a positive association between articulated educational initiatives and the evolution in organ donation in the state of Santa Catarina. Support in establishing transplant coordination units and multimodal actions focused on family interviews and maintenance care of potential donors have implied constant and significant improvements in the results of all assessed variables. Advances in the identification of potential donors, cardiac arrest loss control, and increase in family consent form the basis of an efficient process, which can yield the best results.

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