



383

2010

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Versión impresa ISSN: 0716-7334
Versión electrónica ISSN: 0717-7593

PONTIFICIA UNIVERSIDAD CATOLICA DE CHILE
INSTITUTO DE ECONOMIA

Oficina de Publicaciones
Casilla 76, Correo 17, Santiago
www.economia.puc.cl

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Documento de Trabajo N° 383

Santiago, 2010

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Keywords: Kidney transplantation, Economic evaluation, Markov Models.

Abstract word count: 249

Text word count: 2784

Tables and Figure: 1 table and 3 figures.

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List all forms of support received by each author.

This paper was supported by a grant from the Centro de Políticas Públicas. Pontificia Universidad Católica de Chile

Make declaration of conflict of interest.

No conflicts of interest to be declared.

Abbreviations

CT: Corporacion del Trasplante

ICU: Intensive Care Unit.

pmp: per million people.

Abstract

Background

In this paper we present an economic evaluation of policies aimed at increasing deceased organ donation in Chile, a developing country that has low donation rates; 5,4 donors per million people (pmp) in 2010.

Methods

Expert opinion of leading participants in donation and transplantation were analyzed, resulting in a set of local policies aimed at increasing donation rates. Using previous results of reported cost savings of increasing kidney transplant in Chile, we estimate the net benefits of these policies, as a function of additional donors.

Results

The main problem of the Chilean system seems to be the low capability to identify potential donors and a deficit in Intensive Care Unit (ICU) beds. Among considered policies central to increase donation are: an increase in human and capital resources dedicated to identifying potential donors, providing ICU beds from private centres and the development of an online information system that facilitates procurement coordination and the evaluation of performance at each hospital. Our results show that there is a linear relation between cost savings and incremental donors pmp. For example, if these policies are capable of elevating donation rates in Chile by 6 donors pmp net estimated cost savings are approximately US\$ 1.9 million. Likewise, considering the effect in patients' quality of life, savings would amount to around 15.0, million dollars per year.

Conclusions

Our estimates suggest that these policies have a large cost-saving potential. In fact, considering implementation costs, cost reduction is positive after 4 additional donors pmp, and increasing afterwards.

Introduction

Advances in medical technology have made organ transplantation the treatment of choice for several complex diseases such as chronic renal failure, heart, liver, and lung failure, among others. At the same time, it has been proved in other countries that this alternative would significantly reduce treatment costs [1, 2, 3]. However, organ donation is still an underdeveloped activity in many countries, especially in Chile [4, 5]. In 2010 the rate of organ donation from cadaveric origin in Chile, measured as the number of actual donors per million inhabitants (pmp) was 5,4 pmp, approximately 15% of the donation rate in Spain (34 pmp) and 40% of the donation rate in Argentina (14 pmp). Even more relevant is the stagnation and subsequent decline in the rate of donation during the past decade. Indeed, the rate in the year 2000 (10 pmp) nearly doubled the rate in 2010. Meanwhile, the donation rate in Argentina has grown steadily since 2000 (7 pmp), reaching its all-time peak in 2010. In contrast, the stagnation noted in Spain—the country of reference in the donation and transplantation activity— may be because that country probably has already reached its maximum possible level (Fig. 1) [6, 7, 8].

In this paper we perform a brief evaluation of the donation and transplant system in Chile and propose some policies aimed at reverting observed low donation rates. In a previous paper [3], we concluded that for the case of Chile increasing donation rates would result in very important savings as a result of the net benefit of kidney Transplantation over dialysis. These estimated cost-savings should be interpreted, as "investment thresholds" under which any investment in policies that increase organ donation are cost-saving decisions. Thus the cost of the proposed policies is calculated and the cost effectiveness of them is determined.

Materials and Methods

First, we performed an assessment of the organ transplant system in Chile. Information was obtained from the literature, meetings with experts, patients' representatives, ministry of health officials and advisors. When available, statistics from the different actors in the system were used. We focus on the donation of organs from cadaveric origin, not without acknowledging the enormous appeal of the possibility of enhancing living donor transplant. For practical purposes, both

alternatives can be studied independently, starting from the premise that in Chile huge gains in efficiency can still be made through donation of cadaveric origin.

The perspective taken here is that of the main health care provider, which in Chile is the Public Health system. In fact around 80% of the transplants are performed on beneficiaries of the Public Health Care system and more importantly 90% of the donors come from public hospitals. [5]. However, the private health network is also part of the ensemble of relevant players, since dialysis centres that provide this service are primarily private—although it is the public health system that finances dialysis—and patients of private centres are also included in the single national waiting list. Likewise, organs that become available in the private system are considered, in turn, for the entire waiting list.

After the Chilean procurement system was evaluated, different policies were again discussed with all the relevant actors and a consensus on the best policies to be implemented was reached.

We estimated the cost of proposed policies aimed at increasing cadaveric donation rates and, using previous estimates of cost savings from increasing kidney transplant in Chile that use Markov modelling [3], we perform a cost-benefit evaluation. Costs were estimated in different ways, including experts' meetings and information of other parties of the health care system in Chile.

As it is clear that a certain degree of uncertainty exists about some of the costs considered, we assumed distributions for some of these values and performed Montecarlo simulations that gave us a confidence interval for the results. We deem that this enables to represent more realistically the actual decision to be faced by public policy-makers.

Results

Evaluation of the transplant system in Chile

The coordination of organ donation in the last years in Chile has been mainly the responsibility of Corporación del Trasplante (CT), an Non Government Organization that on a good-will basis coordinates physicians and nurses inside hospitals in order to identify potential donors, ensure adequate maintenance of the donor, and coordinate extraction and transportation. This organization receives funding from the public health system for each donor and voluntary cooperation from private institutions, mainly for the transportation of organs and equipment. On the other hand,

Instituto de Salud Pública, a public health-care institution depending on the Ministry of Health manages the only waiting list nationwide and performs the matching between donors and recipients. In 2010, nearly 1600 people were officially in the waiting list for a kidney transplant.

There is a consensus in the transplant community in Chile that low observed donation rates are caused by a low ability to identify potential donors in early stages of the cadaveric donation process [4, 5], a critical point in the success of developed systems like Spain's [6]. In fact in 2010 only 189 potential donors were identified, resulting in a total of 92 effective donors.

The main reasons for this low ability to identify potential donors are; a shortage of dedicated teams inside hospitals to coordinate the transplant activity and a limited availability of ICU beds, where potential cadaveric donors are identified.

The capacity to identify potential donors is mainly determined by infrastructure and organization inside hospitals. Currently acting transplant coordinators are underpaid or not paid at all and usually they are ordered by their local health care authorities to perform other tasks unrelated to Transplantation. As the CT has no authority on hospitals, there is no way to supervise their work, and to establish reasonable goals of potential donor detection. On the other hand coordinators lack adequate incentives.

Studies performed by the Chilean intensive care medicine society have shown that there is a huge deficit in ICU beds. According to this study there were 360 ICU beds and the deficit has been estimated at 116 beds for the entire public health care system in Chile [9]. Theoretically, each ICU bed can generate between 1 and 1.5 brain deaths per bed per year if the unit has neurosurgery, and around 0.5 brain deaths per bed per year otherwise [6]. Thus, given the number of ICU beds observed in 2004 (360) [10], and assuming that 50% have a neurosurgery unit, the theoretical number of potential donors pmp in Chile would be between 20 and 28. In other words, without considering the possible shortcomings associated with the organization of the system and taking into account only the installed capacity of ICU beds the estimated number of potential donors that the Chilean system can identify would be between 20 and 28 donors pmp.

Proposed policies

In this section we outline proposed policies aimed at increasing cadaveric donation rates. Table 1 shows estimated implementation costs. We consider a 6% annual interest rate to discount benefits and costs presented below [11].

First and foremost, each hospital that has an ICU must have a team dedicated to organ donation activities. They should be able to identify potential donors (in ICUs and emergency units), ensure adequate maintenance of these patients and to coordinate organ procurement and subsequent transplantation. Moreover they should promote organ donation within the hospital, educate health-care and non-health-care personnel and get the local community involved in organ donation. We have estimated the need to hire 27 physicians with half-day shifts (22 hours per week) and 41 nurses with full-time working schedule (44 hours per week). We also consider the need for 27 secretaries and a variable payment scheme for the transplantation team for each successful donor in the range between 15% and 20% of the base salary. Thus creating transparent incentives to potential donor detection.

However, even if the potential donor is identified it is necessary to ensure the availability of an ICU bed to properly maintain this patient. In the Chilean public health system, access to ICU beds is granted even if no beds are physically available inside the public sector. If that is the case, the system “buys” the service from private hospitals, which generally have a surplus of ICU beds. This practice should be extended to organ donation to limit the above-mentioned trade-off.

Moreover, in our view, a central element of a good system that permits an appropriate identification of donors is the existence of an institution that, at the same time, manages the system as a whole and has the capacity to intervene in hospitals to enhance their policies. Namely, an institution is required that simultaneously performs the roles of planning, coordinating and controlling at the national level.

- i. Planning. Establishing procurement goals for each hospital (in the form of agreements with hospitals), the structure of incentives, data collection and processing, development of a strategic plan, etc.
- ii. Coordination. Ensuring proper functioning and quality through the procurement chain.

iii. Control. Ensuring compliance with plans with special emphasis on the procurement goals.

To date, Corporación del Transplante is the entity that undertakes the overall coordination of the system, but has no authority to intervene and control in hospitals and dialysis centres

We propose an institution or organization that has a national coordinator, full time physicians, nurses and administrative and technical support for the maintenance of the databases. In order to function properly this institution must be part and depend directly from de Health Care authorities (i.e. the Ministry of Health).

One of the major problems faced by the research team is insufficient information. This task should be implemented by the National Transplant Coordinator. The National System of Procurement and Transplantation (SINTRA) in Argentina is a good example of a centralized system that allows both the administration of the transplant activity and its control. In addition, it operates the online registration of patients on dialysis and allows to coordinate the process of matching donor and recipient [7].

We also consider other costs such as working materials (computers and other) accounting services, and annual meetings and courses.

Cost-benefit estimation of policies

Considering variable costs, total costs as a function of additional donors are presented in **¡Error!No se encuentra el origen de la referencia..** The left axis presents total costs as a function of additional donors (pmp). The right-hand side axis presents total costs per additional donor pmp as a function of additional donors (pmp).

Solid lines represent the mean estimate, while dotted lines refer to the 95% interval for the results.

The figure shows that the total cost for each additional donor is decreasing, showing large economies of scale.

Following previous estimations for the Chilean case [3] we found that an additional kidney transplant has an expected savings value of US\$ 28,000 for the health-care system. If quality of life improvement is also considered, expected savings rise to US\$ 102,000. These results imply that,

increasing donation rate by one donor per million people would turn into an estimated cost saving of US\$ 827,000 per year, or near US\$ 3 million per year if the effect in the quality of life is considered. **¡Error!No se encuentra el origen de la referencia.** shows the estimated total savings for the Chilean health-care system in terms of additional donors obtained considering the cost of the proposals submitted. The results indicate that if all of the proposals that have been presented in this paper materialized, savings for the Chilean health system would be achieved if the donation rate increased by more than 3 donors pmp. If one considers also the gain in quality of life, the benefit is positive from 1 additional donor pmp.

Thus, if with the proposals presented in this paper we could achieve the donation rates of Argentina (14 donors pmp.) and Spain (34 pmp.), the estimated savings would amount to approximately 3.4, and 18.4 million dollars per year, respectively. Furthermore, if we consider the effect on the patients' quality of life [4, 16], the benefit would reach about 20.8 and 79.4 million dollars per year, respectively.

Discussion

The implementation of public policies aimed at promoting organ donation is often hampered by lack of knowledge of the real benefits of transplantation. The use of economic models that can objectively evaluate these benefits can help health authorities to make appropriate decisions.

There are few economic evaluation studies of transplantation in developing countries, where investment in health policies should be geared primarily toward cost-effective policies.

In a previous paper [3], we were able to show that cadaveric Kidney Transplantation has a high cost-saving potential for the health-care system in Chile.

Although there are several publications that suggest what policies to implement in order to increase donation [6, 12], it should be made clear that each country faces problems within its very different health systems, so one-size-fits-all solutions cannot exist. The players in each country should therefore agree on country-specific measures in each case.

In this paper we have presented the main weaknesses of the organ transplantation system in Chile.

While causes of death and demographic characteristics of the population are more or less similar across countries, differences in infrastructure and organization explain the major part of observed

heterogeneity in donation rates [6]. Not surprisingly in Chile, the inability to detect potential donors in the early stages of the procurement chain, appear as the main problem. However other very important factors, such as a chronic deficit in ICU beds in the public health care system, underpaid coordinators, lack of adequate information systems were also identified.

Consequently we propose several measures aimed at resolving these problems. Among the key policies which we believe could help reverse the situation in Chile are: increasing the provision of medical and nursing staff dedicated to organ procurement and coordination, ensuring the availability of ICU beds for maintenance of potential organ donors, establishing an information system that allows on-line monitoring and supervising the activities in each hospital transplant and, finally, transferring the institutionality currently existing in Chile in the field of transplants, to an entity that has the capability to intervene in hospitals.

Several studies in developed countries have evaluated the maximum donor generation capacity. The “magic number” of attainable donors pmp has been around 40 [10,13,14]. According to our study this theoretical maximum in Chile would be around 24, based on the ICU capacity of the Public Health-care system. This emphasizes that, in order to increase organ donation all the aspects involved in the donation chain should be evaluated; furthermore a continuous quality-assuring program should be implemented to detect other areas that need to be improved and the local characteristics of each hospital need to be taken into consideration [12].

The main contribution of this work, however, is the estimation of the potential cost savings of increasing the rate of organ donation, considering the expenses associated with the implementation of these policies. To our knowledge this is the first paper that actually calculates, with a sensitivity analysis, the costs of measures deemed important to increase organ donation. Hence, according to our estimations, these policies have a large cost-saving potential, even considering uncertainty in implementation costs. In fact, cost-savings are positive—with a 95% degree of confidence—for 4 additional donors pmp or more.

As mentioned in previous work [1], estimated cost-savings from deceased donor kidney transplant may underestimate the actual cost savings because increased donation of other organs are not taken into account. This gives additional confidence for our results. Note however that, when other

organs' transplants are considered (like hearts, lungs or livers), cost savings arise exclusively when improvement in quality of life is taken into account [15, 16,17,18].

In addition, the complete set of policies should be regarded as highly aggressive intervention that considers major reforms inside and outside hospitals. In this sense we should expect a large increase in donation rates—more than 4 additional donors pmp—if they are fully implemented.

The experience of countries like Argentina which, by implementing policies similar to those mentioned here managed to double their donation rates, suggests that the same could be replicated in Chile, with the resulting economic benefits and quality of life improvement for the population.

Comparisons with Argentina are relevant for several reasons; we have cultural and geographical similarities, there is a significant centralization of the medical system with most of the top edge technologies such as transplantation being performed in the Capital and very large cities, donation rates in Argentina were as low as in Chile 10 years ago.

In fact as this paper is being submitted these policies are being implemented by the Health care authorities, creating a National Transplant Coordination office, with full powers and funding for online tracking systems and local coordinators is being provided. Hopefully we will soon see a definite and measurable increase in organ donation rates in the near future.

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