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# Global observatory and database on donation and transplantation
## World overview on heart transplantations between 2008 and 2017

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**Heart transplantation is an effective way of improving the quality of life and survival of patients in terminal heart failure. Multiple advances in the management of transplantation over the past few years will improve the survival and quality of life of heart transplant recipients. The shortage of donors limits the number of heart transplants, and the use of mechanical circulatory support devices is increasing. Data from the Global Observatory on Donation and Transplantation (GODT) of the WHO-ONT show that between 2008 and 2017 over 60,000 heart transplants were performed worldwide, ranking third among solid organ transplantation. Since 2008, the median heart transplant volume has been 6,110 procedures per year. Increasing the donor pool and improvement of the quality of life and survival of heart transplant recipients must be the main goals in future years.**

Παγκόσμιο παρατηρητήριο και βάση δεδομένων για τη δωρεά και τη μεταμόσχευση. Παγκόσμια επισκόπηση για τις μεταμοσχεύσεις καρδιάς μεταξύ 2008 και 2017

*Περίληψη στο τέλος του άρθρου*

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### 1. INTRODUCTION

Heart transplantation has been proven the most effective therapy for end stage heart disease.[1] Over 50 years have passed since the first heart transplants were performed by the pioneers Barnard (1967) and Shumway (1968).[2,3] Since then, there have been various tremendous advances in the field, including donor and recipient selection, immunosuppression management and prevention of complications, and, worldwide, the number of heart transplants is growing.[4] According to the most recent data from the Global Observatory on Donation and Transplantation (GODT), the World Health Organization (WHO) estimates that more than 5,000 heart transplants are performed annually, worldwide.[5] Despite the growing number of donors, the availability of this form of treatment continues to be limited.

The field of heart transplantation has made undeniable progress since the first human-to-human heart transplant was performed 53 years ago, and it has now entered a

stage of great growth and innovation. Over 60,000 heart transplants were performed worldwide in the decade 2008–2017, ranking third among solid organ transplantation. Since 2008, the median heart transplant number has been 6,110 cases per year, with a steady uptrend, and in 2017, 7,881 heart transplants were performed (fig. 1). This perhaps reflects increased organ utilization, as the number of donors have remained stable throughout the years.[6] Survival after transplant has improved steadily, with 1-, 5- and 10-year rates in the decade examined at approximately 90%, 80% and 65%, respectively.[7] In addition to the technological and pharmaceutical advances, appropriate patient selection, improved medical management, meticulous operative care, vigilant surveillance and responsive long-term follow-up can all be credited for the continuing success in heart transplantation. From this perspective, we will summarize the contemporary data on heart transplantation.

## 2. GLOBAL HEART TRANSPLANTATIONS

In the present review, we used data from the GODT of WHO-ONT, including all heart transplantations performed between 2008 and 2017, according to the global distribution by WHO areas, and updated data on organ, tissues and cells donation, and transplantation from each country. We included only the data for heart transplantations, and for the statistical analysis, we used descriptive statistics.

According to the WHO-ONT GODT, between 2008 and 2017, the number of heart transplantations increased from 5,327 in 2008 to 7,881 in 2017, which corresponds to an increase of 47.9% worldwide. Specifically, in Africa the increase was 24%, in America 49% and in Europe 21.8%, while in the Eastern Mediterranean there was an increase of 108% up until 2016, but in 2017 there was a decrease of 75%. In South East Asia and Western Pacific, an increase of over 100% was estimated, based on the registered numbers (fig. 2).

The countries where the most transplantations were performed from 2008 to 2017 were South Africa, with 100% of the transplantations in Africa, and America, where 78.89% were in the USA, followed by Brazil (7.95%), Canada (5.44%) and Argentina (3.11%). In the Eastern Mediterranean, the country with the most transplantations was Iran, with 73.66%, and in Europe, France accounted for 17.59% of transplantations, and Germany 13.65%, followed by Spain (11.11%) and Italy (11.08%). In South East Asia, India was the country with the most transplants (84%), and in the Western Pacific 48.62% of the transplants were performed in China, followed by the Republic of Korea (21.84%) and Australia (19.46%) (tab. 1).

The total of actual donors in the period 2008–2017 increased by 67.5%, from 22,350 to 37,447 donors, worldwide (fig. 3). Specifically, in each continent an increase of donors was observed, as follows: Africa 13.8%, America 42.2%, and Europe 36.9%. In the Eastern Mediterranean there was an increase of 200% from 2008 up until 2016, but a decrease of 86.6% the following year. In South East Asia and Western Pacific, an increase of over 100% was estimated, based on the registered numbers. The number of the actual donors over the years studied was 281,639, of which 83.77% were from deceased donors after brain death (DBD), 12.57% from donors after circulatory death (DCD) and 3.66% from donors who died from other causes. The total number of the utilized hearts from deceased donors over the decade was 149,907.

In particular, for the European region, the two countries that shared the first position for the rate of deceased donors were France and Spain with 16% for both countries, followed by Italy and the United Kingdom with 13% and 9%, respectively (fig. 4).

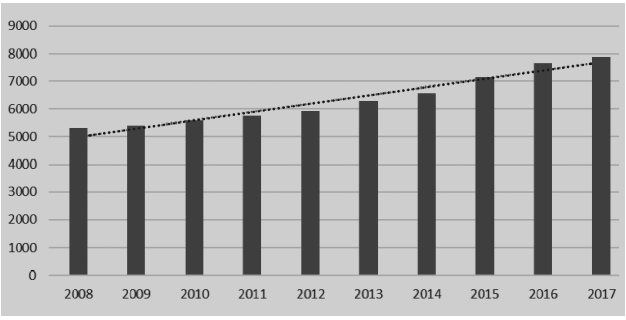


**Figure 1.** Annual heart transplants in the period 2008–2017, worldwide (data of the WHO-ONT Global Observatory on Donation and Transplantation).

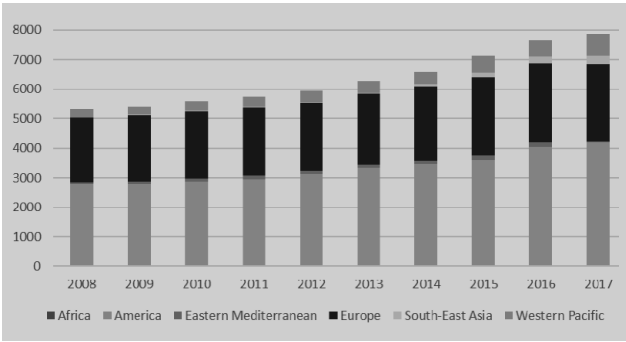


**Figure 2.** Annual heart transplants in the period 2008–2017, by area (data of the WHO-ONT Global Observatory on Donation and Transplantation).

**Table 1.** The countries with the greatest numbers of heart transplants.*

| Region | Country | n | % of total |
|---|---|---|---|
| Africa | South Africa | 254 | 100,00 |
| America | USA | 25,997 | 78,89 |
| | Brazil | 2,620 | 7,95 |
| | Canada | 1,795 | 5,44 |
| | Argentina | 1,029 | 3,11 |
| | Other | 1,509 | 4,57 |
| Eastern Mediterranean | Iran | 733 | 73,66 |
| | Other | 260 | 26,34 |
| Europe | France | 4,260 | 17,59 |
| | Germany | 3,307 | 13,65 |
| | Spain | 2,691 | 11,11 |
| | Italy | 2,685 | 11,08 |
| | United Kingdom | 1,654 | 6,83 |
| | Russian Federation | 1,313 | 5,42 |
| | Other | 8,304 | 34,29 |
| South East Asia | India | 704 | 84,00 |
| | Thailand | 134 | 26,00 |
| Western Pacific | China | 2,088 | 48,62 |
| | Republic of Korea | 938 | 21,84 |
| | Australia | 836 | 19,46 |
| | Other | 432 | 10,00 |

*Data of the WHO-ONT Global Observatory on Donation and Transplantation
USA: United States of America

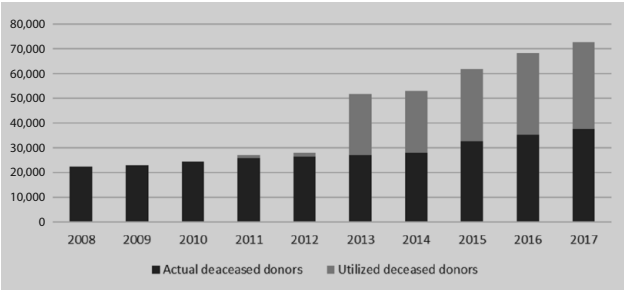


**Figure 3.** Actual and utilized heart donations from 2008–2017, worldwide (data of the WHO-ONT Global Observatory on Donation and Transplantation).

## 3. TYPES OF DONORS AND AVAILABILITY OF ORGANS

Most of the organs come from people who died, who had expressed a wish for their hearts to be used by someone after their death. There are two main types of deceased donors: Brain death donors are assessed as having irreversible and total loss of brain function. The donor's heart continues to beat as long as the donor remains on a ventilator. Circulatory death donors are patients who have sustained catastrophic brain injury from which they will not recover, but are not yet brain dead. When further treatment is not considered to be in their best interests, after discussion with the donor's family, treatment is discontinued by stopping ventilation and terminating stopping their medication.[8]

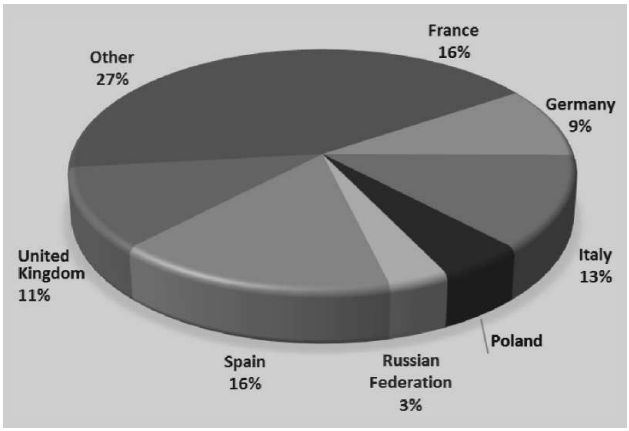


**Figure 4.** Total of deceased donors in Europe for the years 2008–2017 (data of the WHO-ONT Global Observatory on Donation and Transplantation).

The gap between organ demand and organ supply continues, despite progress in the field of transplantations.[4] Ethical medical principles require equal consideration for living persons, regardless of individual differences, such as sex, ethnicity, religion, nationality, age, disabilities and whether they are approaching the end of life; anything else constitutes homicide.[9] The inadequate organ supply from human cadavers has given rise to ethical issues and dilemmas other the years.[10] Many physicians and ethicists believe that these problems can be overcome by application of medically and ethically accepted solutions, including the provision of better care and counseling for the bereaved family, with a view to securing informed consent.[11] The debate about when someone can be declared dead for harvesting of transplant organs is often the major question for many physicians. A single definition of death might be difficult to determine in the case of cardiopulmonary death or brain death. The primary ethical emphasis should be on the ways in which clinicians can and should act to shows respect for dying persons during the end of life transition, even if this sometimes leads to reduced availability of transplantable organs.[12,13]

The "dead donor rule" states that a patient may only become a donor after death, and that the recovery of or-

gans must not cause a donor's death.[14] A possible deceased donor may be a patient with a devastating brain injury or lesion, or a patient with circulatory failure, but who is apparently medically suitable for organ donation.[15] After death, the deceased donors can be described as actual or utilized donors. An actual donor is a donor where an operative incision was made with the intent of organ recovery for the purpose of transplantation, or at least one organ was retrieved for the purpose of transplantation, while a utilized donor is an actual donor from whom at least one solid organ was transplanted.[16]

The combination of an efficient system for organ donor identification, detection and procurement has been identified as one of the keys to increasing deceased donor transplants. In particular, the presence of a key donation person at hospital level (the transplant donor coordinator), whose main responsibility is to develop a proactive donor detection programme, is the most important step towards improvement of donor detection rates and optimization of organ donation. The appointment of transplant donor coordinators in Spain increased donation rates from 14 donors per million population (pmp) in 1989 to 33–35 donors pmp in just a few years.[17,18]

## 4. CONCLUSIONS

Clinical organ transplantation has been recognized worldwide as one of the most enthralling medical events. In recent decades, the numbers of heart transplantations have increased, worldwide, but the availability of human organs is still inadequate, causing a gap between organ supply and demand. This has led to very long waiting periods, with many deaths among potential recipients. This problem could be alleviated by improving public awareness, with media engagement to promote organ donation.

## ΠΕΡΙΛΗΨΗ

**Παγκόσμιο παρατηρητήριο και βάση δεδομένων για τη δωρεά και τη μεταμόσχευση. Παγκόσμια επισκόπηση για τις μεταμοσχεύσεις καρδιάς μεταξύ 2008 και 2017**

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Η μεταμόσχευση καρδιάς είναι ένας αποτελεσματικός τρόπος για τη βελτίωση της ποιότητας ζωής, καθώς και της επιβίωσης σε ασθενείς με τελική καρδιακή ανεπάρκεια. Η πρόοδος η οποία έχει επιτευχθεί τα τελευταία έτη σε επίπεδο μεταμοσχεύσεων αλλά και αποκατάστασης υπολογίζεται ότι θα βελτιώσει το μέσο προσδόκιμο επιβίωσης και την ποιότητα ζωής των αποδεκτών μεταμόσχευσης καρδιάς. Η έλλειψη δοτών περιορίζει την επίτευξη μεγαλύτερου αριθμού μεταμοσχεύσεων καρδιάς και αυξάνεται η χρήση μηχανικών μηχανισμών κυκλοφορικής υποστήριξης. Αντλήθηκαν στοιχεία από το Παγκόσμιο Παρατηρητήριο για τη Δωρεά και τη Μεταμόσχευση Οργάνων του Παγκόσμιου Οργανισμού Υγείας (WHO) μεταξύ 2008 και 2017. Περισσότερες από 60.000 μεταμοσχεύσεις καρδιάς έχουν πραγματοποιηθεί παγκοσμίως στη δεκαετία 2008–2017. Αυτά τα στοιχεία κατατάσσουν τρίτη στη σειρά στην κατηγορία μεταμόσχευσης στερεών οργάνων τις μεταμοσχεύσεις καρδιάς. Από το 2008, ο αριθμός των μεταμοσχεύσεων καρδιάς έχει μέση τιμή 6.110 ετησίως. Η αύξηση της δεξαμενής των δωρητών και η βελτίωση της ποιότητας ζωής και της επιβίωσης για τους αποδέκτες μεταμοσχεύσεων καρδιάς πρέπει να είναι οι στόχοι των μελλοντικών ετών.

**Λέξεις ευρετηρίου:** Ασθενείς με καρδιακή ανεπάρκεια, Δωρεά οργάνων, Μεταμοσχεύσεις καρδιάς

## References


1. TAYLOR DO, EDWARDS LB, BOUCEK MM, TRULOCK EP, WALTZ DA, KECK BM ET AL. Registry of the International Society for Heart and Lung Transplantation: Twenty-third official adult heart transplantation report – 2006. *J Heart Lung Transplant* 2006, 25:869–879
2. SHUMWAY NE, LOWER RR, STOFER RC. Transplantation of the heart. *Adv Surg* 1966, 2:265–284
3. COOPER DKC. Christiaan Barnard, the surgeon who dared: The story of the first human-to-human heart transplant. *Glob Cardiol Sci Pract* 2018, 11; doi: 10.21542/gcsp.2018.11
4. FUCHS M, SCHIBILSKY D, ZEH W, BERCHTOLD-HERZ M, BEYERSDORF F, SIEPE M. Does the heart transplant have a future? *Eur J Cardiothorac Surg* 2019, 55(Suppl 1):i38–i48
5. WORLD HEALTH ORGANIZATION. GKT activity and practices. Available at: https://www.who.int/transplantation/gkt/statistics/en/
6. GLOBAL OBSERVATORY ON DONATION AND TRANSPLANTATION. GODT data, produced by the WHO-ONT collaboration. Available at: http://www.transplant-observatory.org/
7. BALSAM LB, ROBBINS RC. Current trends in heart transplantation. *Scand J Surg* 2007, 96:125–130
8. SADE RM. Brain death, cardiac death, and the dead donor rule. *J S C Med Assoc* 2011, 107:146–149
9. SUHRE W, VAN NORMAN GG. Ethical issues in organ transplantation at end of life: Defining death. *Anesthesiol Clin* 2020, 38:231–246
10. ABOUNA GM. Ethical issues in organ transplantation. *Med Princ Pract* 2003, 12:54–69
11. CAPLAN A, PURVES D. A quiet revolution in organ transplant ethics. *J Med Ethics* 2017, 43:797–800
12. HESTER DM. "Dead donor" versus "respect for donor" rule: Putting the cart before the horse. *Am J Bioeth* 2003, 3:24–26
13. SIMINOFF LA. The dead donor rule: Not dead yet. *Am J Bioeth* 2003, 3:30
14. ROBERTSON JA. The dead donor rule. *Hastings Cent Rep* 1999, 29:6–14
15. EHRLE R. Timely referral of potential organ donors. *Prog Transplant* 2008, 18:17–21
16. DOMÍNGUEZ-GIL B, DELMONICO FL, SHAHEEN FAM, MATESANZ R, O'CONNOR K, MININA M ET AL. The critical pathway for deceased donation: Reportable uniformity in the approach to deceased donation. *Transpl Int* 2011, 24:373–378
17. EUROPEAN COMMISSION. Organ donation and transplantation: Recent facts and figures. Brussels, 2014. Available at: https://ec.europa.eu/health/ sites/health/files/blood_tissues_organs/docs/ev_20141126_factsfigures_en.pdf
18. GONZÁLEZ-VÍLCHEZ F, ALMENAR-BONET L, CRESPO-LEIRO MG, ALONSO-PULPÓN L, GONZÁLEZ-COSTELO J, SOBRINO-MÁRQUEZ JM ET AL. Spanish Heart Transplant Registry. 29th Official Report of the Spanish Society of Cardiology Working Group on heart failure. *Rev Esp Cardiol (Engl Ed)* 2018, 71:952–960



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