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Maximising potential in organ donation and transplantation

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Maximising Potential in Organ Donation and Transplantation: Transferrable Paradigms

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Editorial on the Special Issue

Maximising Potential in Organ Donation and Transplantation: Transferrable Paradigms

Organ donation and transplantation is one of the great success stories of modern medicine, offering the chance of a new life for those with organ failure. The astonishing advancements in medical science, surgical and medical care of the past few decades have taken this treatment option from dream to reality and has transformed the lives of tens of thousands of transplant recipients and their families around the world. However, despite this progress, building an effective and efficient organ donation and transplantation program that meets the needs of a population remains a difficult task, fraught with challenges. Having medical professionals and managers in possession of the requisite knowledge and skills, as well as access to appropriate facilities, are not sufficient to achieve success in this field. Many other factors must be addressed such as gaining continual governmental commitment, investing in adequate infrastructure, implementing carefully designed reimbursement mechanisms and maintaining a highly trained and motivated workforce in sufficient numbers. Moreover, the demand for organs constantly outstrips the supply (1), highlighting the need to focus on the donation end of the process, and the need to gain the support and trust of the public (2). It also underlines the need for investment in public health and primary care programmes which have the potential to reduce the risk of organ failure and therefore reduce the need for transplant (3).

Assessing the performance of national organ donation and transplantation programs, and identifying areas in which there is need for improvement is therefore a complex task requiring attention to many different components. In order to function optimally, many healthcare processes require the collaboration and coordination of a large number of different actors. Organ donation and transplantation is a good example of a such a process which transcends many different scientific disciplines and medical specialities and which cannot function optimally without a high degree of collaboration. Assessing performance in such processes therefore requires careful and thoughtful system-wide analysis in order to gain a full understanding of the challenges and to identify areas in need for improvement. Over recent years, conceptual frameworks have been increasingly used in the assessment of healthcare systems, and they can play an invaluable role in assisting in these analyses (4–6), enabling them to be conducted in a systematic and scientifically sound manner.

In this special issue of Transplant International, we present a conceptual framework which provides a blueprint for the components of successful national organ donation and transplant programs, and can be used for their assessment. Applying this framework, we then present a series of country case studies that highlight the distinctive features that have contributed to the success of the

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organ donation and transplant programs of Croatia, Italy, Portugal, Spain, and the United Kingdom and elaborate on the lessons that can be learned from them. We also apply this framework to analyse the Greek system, a comparatively weaker performer, and make recommendations for its reform and development. Together, the framework and case studies demonstrate the common features of successful organ donation and transplantation systems, and highlight transferrable elements that can be applied elsewhere with the aim of improving performance.

Our case studies highlight a number of important considerations and examples of best practice, from which other countries can learn. It is clear that every organ donation and transplantation programme must be designed with the country's particular cultural context and resource capacity in mind. Organ donation, in particular, is a highly emotive issue which inevitably raises challenging ethical questions (7). Issues such as the diagnosis of death by neurological criteria may challenge prevailing cultural or religious concepts of death and need to be carefully addressed in a transparent, empathetic and culturally sensitive manner. However, our case studies offer good examples of success, some which have achieved this despite relatively modest financial means (Mah et al., Streit et al.). Spain is widely regarded as a leader in the field (Streit et al.), with an organisational structure and strategy which has been effectively adopted by other European countries such as Portugal and Italy (Streit et al., Mah et al.). The three-tier structure of the Spanish program, with highly trained organ donation coordinators as a key component has been an extremely successful approach which many other countries have used as a blueprint for their own program. Meanwhile, in Portugal a series of reforms in the governance of dialysis units have contributed to a reduction in the out-of-pocket payments made by patients, and improvements in quality and outcomes (Streit et al.). Furthermore, in the UK, the successful integration of programmes for research and development with clinical practice have yielded significant insights into means of improving the efficiency of transplantation services (Johnston-Webber et al.), while Italy has pioneered the implementation of innovations in clinical practice and transplant related technologies as well as efficient public awareness campaigns which hold the promise of significantly expanding the available donor base (Mah et al.).

The success of these countries is underpinned by some important common elements: strong support from government; effective public awareness campaigns and relations with the media to build trust and support; an inclusive approach to policy development underpinned by public and expert consultations; and an adequately funded and staffed national transplant organisation which plays a critical role in coordinating activities across the system. As with many other areas of medicine, prevention is better than cure, and successful transplantation systems are best seen as a vital complement to effective public health programmes and universally accessible, well-integrated primary care and specialist services to detect, treat and manage the causes of organ failure, as well as social programmes which address the wider determinants of health (8).

These examples are instructive for countries whose organ donation and transplantation services are at an early stage of development or remain too fragmented to make transplantation a feasible treatment option for all but a lucky few. A case in point is Greece: our study of the Greek system highlights significant shortfalls in funding, public support, staffing, infrastructure, and operational elements necessary for a high-performing organ donation and transplantation system, which are reflected in low transplantation rates and correspondingly high levels of renal replacement therapy, driven by high incidence and prevalence of organ failure among the population. Correspondingly, we propose a set of recommendations, based on an analysis of the Greek system, the lessons learned from our case studies and consultation with a wide array of stakeholders, to enable Greece to attain rates of donation and transplantation in line with those of its European counterparts.

It is our hope that the framework and the case studies will provide a valuable template for the assessment of national organ donation and transplantation systems beyond those included in our sample, to enable the identification and prioritisation of policies to improve their efficiency, responsiveness and availability, with the ultimate goal of improving the health and care of people with organ failure.

AUTHOR CONTRIBUTIONS

All authors listed have made a substantial, direct, and intellectual contribution to the work and approved it for publication.

CONFLICT OF INTEREST

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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REFERENCES

1. Lewis A, Koukoura A, Tsianos GI, Gargavanis AA, Nielsen AA, Vassiliadis E. Organ Donation in the US and Europe: The Supply vs Demand Imbalance. *Transpl Rev* (2021) 35(2):100585. doi:10.1016/j.trre.2020.100585
2. Mossialos E, Costa-Font J, Rudisill C. Does Organ Donation Legislation Affect Individuals' Willingness to Donate Their Own or Their Relative's Organs? Evidence from European Union Survey Data. *BMC Health Serv Res* (2008) 8:48. doi:10.1186/1472-6963-8-48
3. The Madrid Resolution on Organ Donation and Transplantation. *National Responsibility in Meeting the Needs of Patients, Guided by the WHO Principles*. Lippincott Williams & Wilkins (2011).
4. Arah OA, Klazinga NS, Delnoij DMJ, Asbroek AHAT, Custers T. Conceptual Frameworks for Health Systems Performance: a Quest for Effectiveness, Quality, and Improvement. *Int J Qual Health Care* (2003) 15(5):377–98. doi:10.1093/intqhc/mzg049
5. Fazekas M, Ettelt S, Newbould J, Nolte E. *Framework for Assessing, Improving and Enhancing Health Service Planning*. Cambridge, England: RAND Europe (2010). Technical Report.
6. PC Smith, E Mossialos, I Papanicolas, S Leatherman, editors. *Performance Measurement for Health System Improvement: Experiences, Challenges and Prospects*. (Accessed July 28, 2022). (Health Economics, Policy and Management). Cambridge: Cambridge University Press (2010). Available from: https://www.cambridge.org/core/books/performance-measurement-for-health-system-improvement/81C4581EA9DDA3E0F637E9DC8F94BB71.
7. Khetpal V, Mossialos E. An Ethical Appraisal of Living-Anonymous Kidney Donation Using Adam Smith's Theory of Moral Sentiments. *Health Policy* (2018) 122(11):1212–21. doi:10.1016/j.healthpol.2018.08.015
8. Zeng X, Liu J, Tao S, Hong HG, Li Y, Fu P. Associations between Socioeconomic Status and Chronic Kidney Disease: a Meta-Analysis. *J Epidemiol Community Health* (2018) 72(4):270–9. doi:10.1136/jech-2017-209815

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A Conceptual Framework for Evaluating National Organ Donation and Transplantation Programs

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Conceptual frameworks are valuable resources that can be used to guide the planning, evaluation, and development of healthcare services. However, there are currently no comprehensive frameworks focused on organ donation and transplantation that identify the critical factors underlying a successful national program. To address this knowledge gap, we developed a conceptual framework that takes into account all major domains of influence, including political and societal aspects as well as clinical implementation. The framework was initially constructed based on a targeted review of the relevant medical literature. Feedback provided by a panel of international experts was incorporated into the framework *via* an iterative process. The final framework features 16 essential domains that are critical for initiating and maintaining a successful program and improving the health of patients with organ failure. Of particular note, these domains are subject to three overarching health system principles: responsiveness, efficiency, and equity. This framework represents a first attempt to develop a whole-system view of the various factors that contribute to the success of a national program. These findings provide a useful tool that can be adapted to any jurisdiction and used to plan, evaluate, and improve organ donation and transplantation programs.

Keywords: organ donation, organ transplant, comparative analysis, transplantation policy, transplant system

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Point of View

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INTRODUCTION

Conceptual frameworks have important roles in guiding the development of complex processes. These frameworks may be particularly helpful in healthcare systems because they can present a method that can be used to consider the many different factors that influence policy development, implementation, and outcomes. There is a growing interest in the use of frameworks to evaluate healthcare system performance and quality (1) and to assist in their planning and development (2). Solid organ donation and transplantation is a good example of a complex healthcare process, as it involves multiple, frequently time-limited steps and requires high-level coordination and collaboration between distinct stakeholders. Moreover, trust and confidence from the general public must be established and maintained in order to achieve success. The challenges involved in this process extend far beyond those associated with basic clinical practice or a single healthcare

TABLE 1 | Examples of key documents and resources of international importance identified as part of the targeted literature review.

Title/Organization	References
European Directorate for the Quality of Medicines (EDQM):	
Guide to Quality and Safety of Organs for Transplantation; 7th edition	(3)
Transplant newsletters	(4)
ODEQUS[a] Quality Criteria and Quality Indicators in Organ Donation	(5)
Eurotransplant	(6)
KDIGO	(7–9)
American Transplantation Society	
British Transplantation Society	(10–13)
European Society for Organ Transplantation	
UEMS[c] – Division of Transplantation	
NHS Blood and Transplant resources	
ERA-EDTA[d] registry reports	(14)
World Health Organization	(15)
Madrid Resolution on Organ Donation and Transplantation	(16)
The Declaration of Istanbul on Organ Trafficking and Transplant Tourism	(17)

[a]*Organ Donation European Quality System.*
[b]*Kidney Disease Improving Global Outcomes.*
[c]*Union Européenne des Médecins Spécialistes.*
[d]*European Renal Association - European Dialysis and Transplant Association.*

system alone. Many interrelated factors must be addressed to develop and sustain a high-quality program that meets the needs of the population.

Given these inherent complexities, the successful development of an equitable and efficient national organ donation and transplantation program remains challenging for many jurisdictions. A focused conceptual framework will be an essential tool that will help policymakers and healthcare leaders to implement the numerous and intricate features of this discipline. A conceptual framework can be used as a means to evaluate a program, identify gaps in services provided, and formulate targeted plans for reform and development. It can also be used to guide the establishment of structures and processes that facilitate continuous quality improvement and effective and sustainable investment.

The current medical literature includes many academic papers and clinical guidelines that address one or more aspects of organ donation and transplantation. However, to the best of our knowledge, none of these publications provide a framework with a comprehensive system-wide view of the critical components of an organ donation and transplantation program. Thus, the objective of this paper is to provide such a framework. Specifically, our framework was designed to be adaptable to any setting and contains all the components necessary to establish a successful solid organ donation and transplantation program.

MATERIALS AND METHODS

The framework was developed *via* an iterative process in three main stages. In stage one, we performed a targeted narrative review of the relevant literature. We identified several key documents and resources recognized as important internationally in the field of organ donation and transplantation (**Table 1**). These sources helped us to identify the main components or domains of a successful organ donation and transplantation system. The references cited in these publications were also reviewed for more detailed information. Appropriate keywords and phrases relevant to the main domains, such as "organ donation," "transplantation," "deceased donation," "live donation," "post-transplant follow-up" and "national transplant organization" were generated from this full set of publications and used to identify additional sources of information to be included in our review. Additional relevant publications were retrieved from databases including Medline and Web of Science. Internet search engines (e.g., Google Scholar) were also used to retrieve relevant papers from the academic literature. While the searches were not limited by year of publication, non-English language publications were excluded from further consideration. One researcher screened the titles and abstracts and final selections were made based on relevance to the identified domains. Additional hand-searches of references cited by the included studies were also undertaken. These searches also facilitated the retrieval of relevant items from the grey literature, including international reports and reviews. Our searches of the grey literature were not limited by year of publication but were limited to English language publications. This information was used to refine and develop the domains of the framework as well as to identify their interrelationships.

As part of a wider project and parallel to the development of the framework, the research team also created profiles of programs currently in use in six European countries, including Croatia, Greece, Italy, Portugal, Spain, and the United Kingdom (18–23). The findings from these parallel research studies also provided insight into the development of this conceptual framework.

The second stage of the iterative process included an open collaborative discussion between the authors. This process ultimately led to the construction of the first draft of the conceptual framework. A consensus was reached on the 16 key domains to be included.

The third stage included consultation with a panel of international experts in organ donation and transplantation (**Appendix 1**). Due to the restrictions placed on our activities during the COVID-19 pandemic, these discussions were conducted in a series of virtual meetings with single individuals and with all experts. Over the course of two rounds of feedback, the expert panel provided suggestions for additions and modifications to our framework. Their feedback was incorporated *via* an iterative process which led to the final version of the framework.

RESULTS

The first iteration of the framework included 12 domains that were identified based on the results of the literature review and open discussion among the seven authors. Each domain represents an essential component of a successful organ donation and transplantation program. Following the first round of expert feedback and further collaborative discussion, five additional domains were added to this list (**Table 2**). The

TABLE 2 | Domains included after the first and second framework iterations. Additions included after the second iteration are shown in bold.

Government: political support and long-term commitment
Key legislation
Reducing the need for transplant: a whole-system approach
Building and maintaining public support and trust in the system
The National Transplant Organization
Reimbursement mechanisms for staff and facilities
Infrastructure
Deceased donation
Living donation
Transplantation
Post-transplant follow-up
Patient-centered care
Quality standards and quality improvement
Databases and information technology
Teaching, training, and professional development
Research and development
Professional organizations and scientific societies

prevailing opinion was that several of the elements of the original 12 domains were sufficiently important to be included as unique entities.

Following further discussion and expert review, a third and final iteration of the framework was performed. This involved the organization of the domains into a diagram that revealed their relationships with one another (**Figure 1**). As shown, all researchers and expert participants agreed that the overall goal of any program should be the "Improved health of patients with organ failure." The instrumental goals listed below this, those of Responsiveness, Equity, and Efficiency of donation and transplantation services, are goals in and of themselves, and also means by which this final goal is achieved. This methodology is based on the approach proposed by the World Health Organization (WHO) in their report entitled "Strengthening Health Systems to Improve Health Outcomes" (24) and from the concept groupings identified by Klassen et al. (25) in their systematic review of performance measurements and improvement frameworks in health, education, and social services systems. This approach aims to illustrate how the different components of the framework function as part of a dynamic system as well as their impact on both qualitative and quantitative outcomes. Each domain included in the diagram in **Figure 1** makes an important contribution to a successful organ donation and transplantation program.

The 16 domains essential to achieving this overall goal are included in the center of the diagram. The domain count was reduced from 17 to 16 in the final iteration as the domain entitled "Patient-centered care" was subsumed into the instrumental goal of "Responsiveness." Finally, all elements of the framework are underpinned by consistent communication and collaboration between all stakeholders and patients.

Final Goal

Improving Health of Patients With Organ Failure

Improving the health of patients with organ failure should be the main goal of any organ donation and transplantation program. This includes the implementation of robust programs aimed at reducing the incidence of organ failure and thus the need for transplant (Prevention), as well as efforts to increase rates of organ donation and transplantation and optimize follow-up care. It is important to recognize that the strategies used to increase rates of organ donation and transplantation should not compromise quality and must be coupled with efforts to ensure ongoing improvement and patient satisfaction.

Instrumental Goals

Responsiveness

The World Health Report 2000 identified "Responsiveness" as one of the three critical goals of a healthcare system (26). Responsiveness, as defined by the WHO is:

> How well the health system meets the legitimate expectations of the population for the non-health enhancing aspects of the health system. It includes seven elements: dignity, confidentiality, autonomy, prompt attention, social support, basic amenities, and choice of provider (27).

Responsiveness to the General Population, Patients, Caregivers, and Their Loved Ones

Creating a program that is both responsive and patient-centered will be vital to any efforts focused on engendering public support and trust. The needs of patients and their caregivers or representatives need to be at the center of any organ donation and transplantation program and these individuals must be recognized as the most important stakeholders on both sides of this process. Patients and their caregivers or representatives should be involved at every level and their input in planning and developing healthcare interventions must be recognized as invaluable to this process. Patient-centered care has a positive impact on the rates of both living and deceased donations (28,29). Patient-centered care may also help to provide potential recipients with an understanding of the risks and benefits of transplantation and may improve medication compliance and self-management (30). Several core concepts of patient-centered care are listed in **Table 3**.

Many different strategies can be used to achieve patient-centered care including, (a) providing tailor-made, holistic support including shared electronic health records (36), and telemedicine technology for patients in remote locations (37); (b) conducting regular surveys of the patient and caregiver experiences (32, 33); (c) involving patients and caregivers at all levels of the system (38); and (d) ensuring patient and caregiver input to the planning and development of services and educational curricula for healthcare staff (39).

Responsiveness to staff

Recruitment and retention of a well-supported and motivated workforce are crucial aspects of efforts to build a functional and responsive healthcare system (40). The needs of staff must be addressed by optimizing the work environment and providing high-quality training and development opportunities. Workload expectations must be reasonable with adequate staffing to cover the full patient roster as well as time set aside for training and

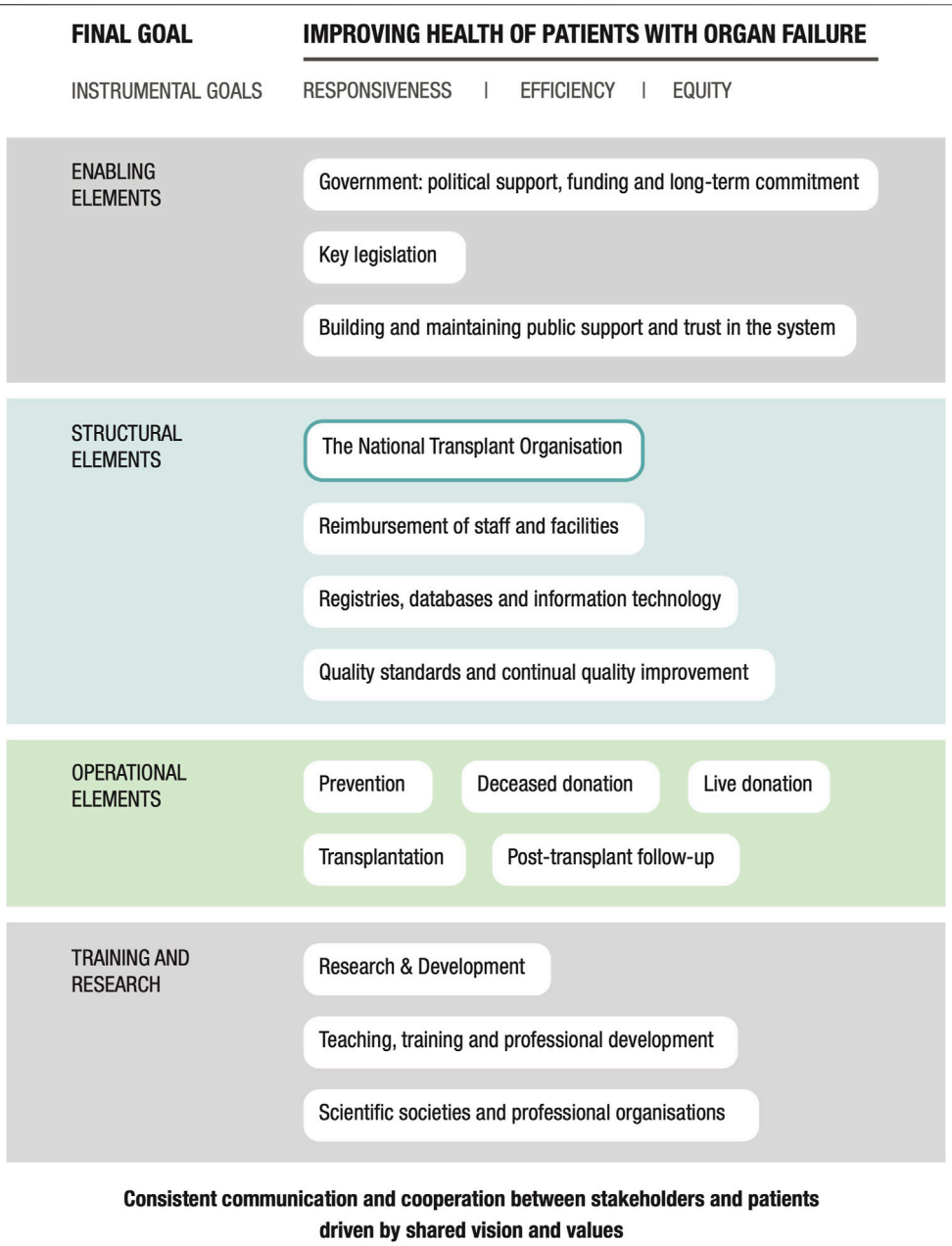

FIGURE 1 | A conceptual framework for a national solid organ donation and transplantation program.

other continued professional development activities. It will also be crucial to provide adequate reimbursement for specific duties and to recognize outstanding contributions and achievements. There should be clear leadership hierarchies and trainees must have access to appropriate supervision and support with structures in place designed to nurture a collegial culture of shared learning and development.

Efficiency and Equity

As in all other areas of healthcare, a national donation and transplantation program must strive to use all resources at its disposal as efficiently as possible and to the maximum benefit of its target patient population (41). Of equal importance, but perhaps posing a greater challenge, a successful program must consider the principle of equity in all organ donation and transplantation activities. The supply of organs available for transplant is outstripped by need; thus, there must be measures in place that ensure that this scarce resource is distributed based on clinical need and in accordance with justified and respected national criteria (9, 18, 37). Access to transplantation must be equitable and not influenced by the ability to pay, personal connections, or other privileged circumstances. There should also be equity in organ

TABLE 3 | Core concepts of patient-centered care (31–35).

- Providing collaborative, personalized, and well-coordinated care
- Treating individuals with dignity, compassion, and respect
- Respecting individual choices, preferences, values, culture, and religious beliefs
- Including family and loved ones in the decision-making process
- Taking into account emotional, social, and practical issues
- Making decisions with patients, not for them, and reaching mutual agreement on goals and expectations
- Ensuring prompt, full, and transparent sharing of information
- Improving health literacy to facilitate shared decision-making

donation; the state can play an important role in ensuring that all segments of the population are well-informed about organ donation and that systematic disparities are minimized (3). For example, there are persistent imbalances in the number of organ donors and the number of patients in need of a transplant among ethnic minorities in both the UK and the United States that remain to be addressed (42, 43).

Equity in organ allocation is of paramount importance and involves complex decision-making processes taking many different factors into account. Due to the shortage of viable organs, this means that some difficult decisions often need to be made and a national waiting list is necessary. The guiding principles of the WHO state that rules for allocation must be "equitable, externally justified and transparent" (15). The task of deciding on national allocation rules should be delegated to committees comprising medical, public health, ethics experts and patient representatives and the national organ allocation system must be objective, transparent and fair. It should be subject to oversight by the National Transplant Organisation (NTO), and there must be processes in place to ensure regular audits of the system and adherence to the rules. It is essential that cultural and community values are taken into account and that there should be no discrimination on the basis of a recipient's race, religion or gender. Tissue type and antibody matching are clearly crucial elements, but other factors such as equity, utility, benefit and fairness are usually taken into account. It Is important that, as far as is possible when taking into account the technical and practical constraints with respect to organ retrieval, preservation and transportation, a patient-based allocation, not a centre-based allocation system is adopted. Different rules will also be required for different types of transplant. For example, in some instances of liver disease patients may die within a few days of organ failure, with transplant being the only effective treatment. Conversely, most cases of kidney failure can be maintained for a period of time on dialysis. Some jurisdictions such as Israel and the USA give priority to those who have been previous living donors, or who have previously given permission for the organs of their loved ones to be donated. However, this kind of priority listing can raise some difficult ethical dilemmas.

Enabling Elements

Government: Political Support, Funding, and Long-Term Commitment

Long-term governmental backing and commitment are essential for the development and maintenance of a successful organ donation and transplantation program. The complex nature of organ donation and transplantation will require high-level collaboration across the healthcare system as well as attention to smaller details at an operational level. All stakeholders must be united in a shared vision of how to achieve the desired goals; this will require clear, decisive, and consistent leadership.

Governmental support must be accompanied by adequate and sustainable sources of funding. Ultimately, an effective donation and transplantation program will deliver profound improvements to the patients' quality of life as well as savings to the healthcare system and financial benefits to the public at large. However, building a comprehensive program requires considerable financial investment to ensure that all the necessary components are suited for their intended purpose and that adequate staffing and resources are provided.

Key Legislation

Legislation should address all the possible modes of organ donation as well as the determination of death by neurological criteria and the national consent policy (9, 18, 38). Protection against organ trafficking or coercion must be in place for those lacking capacity to consent (17). It is also desirable to have key staff roles and responsibilities outlined clearly together with a clear indication of the minimum staffing levels required by participating units based on their size and anticipated level of activity. Legislation should guide and facilitate this process and not present an undue impediment to organ donation or transplantation (44). Changes should be made only after consultation with all stakeholders including the general public (45) to prevent the occurrence of unintended consequences (Example 1).

Example 1. Two contrasting examples of changes to consent legislation: Wales and Greece.

"Opt-out" consent policies have become popular in recent years. Greece enacted this type of legislation in 2013. Wales followed with similar legislation in 2015, albeit with contrasting outcomes. Before the enactment of this legislation, all stakeholders in Wales participated in a comprehensive consultation period that included a survey of opinions from the general public (46). This was followed by a multimodal publicity campaign designed to ensure that the public understood the changes in the law, which included the stipulation that a patient's relatives would continue to have the final say in all decisions. While the impact of this legislation was not immediate, recent findings revealed that consent rates in Wales increased steadily in the years following this legislative change. When compared with consent rates reported in England (which did not enact this type of legislation until 2020), the upward trend in consent rates achieved statistical significance after 33 months (47).

By contrast, in Greece, there was minimal consultation with the public and little publicity regarding the practical impact of the changes in these laws on the general population. The unintended consequence of this approach was a backlash against the new legislation, with many Greek citizens actively registering an objection to organ donation on the donor register (48). Largely as a result of this response, in 2018, Greece returned to the earlier "opt-in" consent system. Greece continues to struggle with low rates of organ donation and family consent.

Building and Maintaining Public Support and Trust in the System

It is imperative to generate strong public support and trust in a national organ donation and transplantation program. This

support can increase over time by strict observance of the highest ethical standards and by adherence to fair, equitable, and transparent processes. Good governance of all aspects of the program is essential. This information can be conveyed *via* regular, publicly available reports of inspections, progress, and activity. Transparency and accountability regarding any untoward events or incidents are also needed to sustain public trust.

Results from previous studies suggest that educational campaigns aimed at the general public have a modest impact in increasing the overall donation rate as well as the number of people who state their willingness to donate their organs (5, 44). These programs should be implemented by the National Transplant Organization (NTO) and might aim to dispel misconceptions and promote principles of social solidarity and altruism. The Madrid Resolution (16) highlighted the need for normative change to support the principles of organ donation and proposed that public education should begin in schools. Evidence suggests that these efforts can change attitudes and boost the number of individuals willing to donate their organs (49). Most religions are supportive of organ donation and transplantation (50–53). However, religious leaders should be consulted before making any changes because some issues, for example, the diagnosis of brain death, remain controversial. Periodic surveys may also help to inform future campaigns and identify issues that need to be addressed.

The press and the media have a powerful influence in shaping public opinion. Media coverage can be utilized to endorse the program by promoting poignant personal stories and highlighting the lives saved by organ transplantation. Positive media coverage is equally or more effective at increasing donation rates than public campaigns aimed at improving knowledge and awareness (54). Example 2 highlights the impact of a media campaign that contributed to a change in consent legislation in England.

Example 2. The powerful influence of media portrayals of organ donation and transplantation: Max and Keira's law.

In 2017, a young girl in the UK named Keira Ball was killed in a car accident. Her donated heart saved the life of Max Johnson, then 9 years of age, who had been diagnosed with dilated cardiomyopathy. This story was featured prominently in the national tabloid press, most notably in the daily news publication, *The Mirror*. With this story, *The Mirror* ran a successful campaign that supported a change to the consent legislation in England from an "opt-in" to an "opt-out" policy. The "opt-out" legislation enacted in 2020 has become known as "Max and Keira's law."

Structural Elements

The National Transplant Organization (NTO)

The NTO plays a crucial role in promoting successful organ donation and transplantation programs. International guidance advises that the NTO must be adequately funded and resourced as a single and independent public body (18, 45). The EDQM Guide to the Quality and Safety of Organs for Transplantation (7th edition) provides a comprehensive list of the essential and supplementary functions of an NTO (3). Various countries have adopted different models of operation according to their national priorities (18–22). Two contrasting models are outlined in Example 3.

Example 3. The NHS Blood and Transplant (UK) and the Croatian National Transplant Organization.

The UK has substantially improved its organ donation and transplantation programs *via* a series of successful reforms and initiatives. All activities are now directed by a single, independent Special Health Authority known as the NHS Blood and Transplant (NHSBT). This authority covers all four jurisdictions of the UK and a population of approximately 66.6 million individuals. The NHSBT oversees 12 regional organ donation teams that serve their designated populations and cover several NHS Trusts and/or Boards. The NHSBT is supported by eight solid organ advisory groups, in which representatives of all relevant organizations collectively review activity and outcomes, discuss policy, and set research priorities (55).

By contrast, Croatia is a country with a small population (~4 million) with a substantially lower healthcare budget. Unlike the other European programs, the Croatian National Transplant Organization (NTO) is directly governed and overseen by the Croatian Ministry of Health and is under the leadership of a single National Transplant Coordinator who was appointed in 2001. The National Transplant Coordinator is supported by a robust team that is responsible for administering a nationwide transplant network. This model is well-suited to this setting and has enabled Croatia to become a world leader in organ donation and transplantation.

Reimbursement of Staff and Facilities

Although transplantation is highly cost-effective over the long term (56), it is expensive and resource-intensive to perform. To generate a successful program, no stage of the process should pose a financial burden to any organization and every step must be adequately reimbursed at nationally agreed-upon rates. To ensure equity of access reimbursement schedules must be carefully devised to account for all eventualities including items such as advanced techniques for organ preservation. While financial or other incentives may be useful, they will need to be carefully designed and consistently implemented. Additionally, the work associated with both donation and transplantation often involves long, intensive shifts involving both night and weekend hours. The remuneration provided must also reflect these factors. Example 4 describes two successful reimbursement mechanisms that have been implemented in Croatia and Spain.

Example 4. Reimbursement mechanisms: Croatia and Spain.

The adoption of a new reimbursement scheme (in 2006) is considered to be a key factor in Croatia's recent success in organ donation and transplantation (22). The costs of organ donation in Croatia are now reimbursed by a special state budget and transplant activities are covered *via* a set of Diagnosis Related Groups (57). This has helped to mitigate the impact of limited financial and other resources and has removed any financial burden that might impede participation in this program. This reimbursement strategy has

(Continued on following page)

(*Continued*)
proven to be especially important for facilitating organ donation in smaller hospitals that would be otherwise unable to sustain a transplant program.

In Spain, some hospitals provide incentive bonuses to medical professionals who facilitate organ donations. This may contribute to Spain's high rate of organ donation (58). However, caution must be used when considering this strategy. Conflicts of interest may arise if the clinicians engaged in initiating family discussions and identifying potential donors are also involved in their direct clinical care. Wherever possible, the two roles should be separate. It will be imperative to maintain full transparency regarding roles and responsibilities in order to maintain trust in the system.

Infrastructure

Infrastructure requirements must be determined based on current and projected future demand. The distribution of the various organizations needs to be considered, particularly given the time-limited nature of many of the processes and the travel times that may be required. All facilities and equipment must be regularly maintained, updated, and replaced when they become obsolete.

Registries, Databases, and Information Technology

The national program must be supported by a sophisticated information technology system that is easily accessed by all staff members. The technology system should be overseen by the NTO under the auspices of a chief digital and information technology (IT) officer. The system should aim to integrate all the data necessary for transplant assessments, including organ matching, allocation, transplantation, and long-term follow-up. In many jurisdictions advanced artificial intelligence algorithms are used to improve the efficiency and accuracy of these processes (59, 60). The data collected should meet the requirements of international organ exchange schemes, for example, the Eurotransplant Network Information System of Eurotransplant (61).

Quality Standards and Continual Quality Improvement

A quality and safety framework that covers all aspects of donation and transplantation will be needed to ensure that a national program maintains the highest standards and strives for ongoing quality improvement. This is a requirement of the European Union (EU) directive 2010/53/EU (62). Similarly, the Organ Donation European Quality System (ODEQUS) manual on quality criteria and quality indicators (5) provides detailed recommendations across different modes of donation. The EDQM Guide to the Quality and Safety of Organs for Transplantation also provides recommendations on quality criteria and indicators for transplantation programs (3). Formal arrangements for authorization, licensing, and regular inspection of all facilities, appropriate equipment and personnel, and nationally agreed-upon procedures must be established that facilitate improvement in cases in which a given party fails to meet expected standards. The quality and safety framework should be devised, updated, and overseen by the NTO with the advice and support of appropriate experts.

Operational Elements

Prevention

Future needs for transplants and strategies that aim to reduce the incidence of organ failure remain a critical priority (16). Diabetic nephropathy accounts for around 20%–30% of the cases accepted for all forms of renal replacement therapy in most European countries; hypertensive nephrosclerosis accounts for another ~10%–20% (63). Cirrhosis and primary liver cancer are the leading causes of liver failure, while alcohol consumption, viral hepatitis B and C, and obesity are also among the main causes of these conditions (64).

Prevention strategies must include both primary and secondary measures. Once tertiary preventative measures are needed, patients have already progressed to terminal organ failure. Efforts to establish effective primary and secondary preventative strategies extend beyond the scope of organ donation and transplantation alone and require a robust public health program that is supported by primary healthcare systems that are fully integrated with both secondary and tertiary care. Careful consideration will be needed to determine how a specific donation and transplantation program fits within the wider healthcare system of a given nation.

Thus, efforts to optimize the health of patients nearing end-stage renal failure and those maintained on dialysis will be essential to the success of the program. It is essential that the responsible physicians are regarded as an integral part of the program and are confident in the assessment and referral process for transplant. As outlined above, pre-emptive transplant, prior to the need for dialysis, and ideally from a living donor, should always be the treatment of choice. Pre-emptive transplant, thus avoiding the risks of dialysis and ensuring the patient is in better health at the point of transplant consistently shows better outcomes (65, 66). The possibility of pre-emptive transplant should be an integral part of the discussions around treatment options prior to the development of end-stage renal failure. Additionally, dialysis centers are operated by private providers in many countries; therefore, measures must be in place to ensure that these providers adhere to the highest standards of quality and safety. Example 5 describes how Portugal has successfully restructured dialysis care.

Example 5. Improving the quality of dialysis care in Portugal.

Largely due to specific demographic and epidemiological issues, Portugal has a high incidence and prevalence of patients with end-stage renal disease. Hemodialysis in Portugal is offered primarily by private providers, and, until 2008, it was reimbursed on a fee-for-service basis. This has since been replaced by a capitation prospective payment system that includes information and monitoring systems that can be used to evaluate process and outcome measures. Providers now receive comprehensive bundled per-patient payments which are based on the submission of a set of quality indicators. A National Dialysis Monitoring Commission was established to assess performance and trends. The Portuguese Ministry of Health has reported that these strategies have been successful both in improving the quality of care and containing costs (67, 68).

Deceased Donation (DD)

Countries with the highest transplantation rates typically have well-developed DD schemes (3). Donation after Brain Death (DBD) and Donation after Circulatory Death (DCD) both present specific ethical challenges which must be addressed by clear national legislation and guidance (as discussed further below). Although DBD remains the main source of organs available by DD in most countries, DCD now represents a significant source in many countries with high donation rates, notably Spain (69) and the UK (70).

Efforts to maximize the number of donors require ongoing identification and referral. Organ Donation Coordinators (ODCs) play an important role in this process. Previous evidence suggests that ODC involvement is one of the most important elements contributing to family consent to donation (71, 72). ODCs must be specifically trained with protected time for their duties and must be available at all times and every day during the year. General staff training is also important in increasing the rate of DD (73, 74). This is particularly important for staff members assigned to areas where there may be a large number of potential donors, for example, the Intensive Care Unit (ICU). Appropriately-trained clinicians must be available to facilitate DD *via* prompt diagnosis of death and communication of this information to families and loved ones. Information concerning the diagnosis of death or withdrawal of life-saving treatment should not be linked to conversations about organ donation unless the topic is raised spontaneously. Among the strategies that might be used to increase the donor pool, the use of expanded criteria donors and/or non-standard risk donors might be considered. For example, Eurotransplant's Senior Program matches older donors to older recipients. Spain has successfully employed both strategies (Example 6).

Example 6. Strategies for expanding the donor pool: Spain.

> Fortunately, Spain has experienced many fewer traffic accidents in recent years. However, this would have led to fewer organ donations had Spain not initiated the use of expanded criteria and non-standard risk donors as part of the "40 Donors pmp Plan" in 2008. This action has successfully increased the donor pool. In 2015, more than 50% of DDs in Spain were from individuals over 60 years of age. The program preferentially matches older DDs to older recipients. In addition, because of concerns that a significant number of potential donors and organs were being rejected for poorly-substantiated medical reasons, the Spanish NTO established a medical team that is available at all times to provide advice to ODCs that may be unsure of the suitability of a potential donor (75).

Several internationally-recognized documents provide guidelines on the management of DDs from patients in ICUs (76, 77). Donor evaluation and management must be performed using protocols that have been approved at the national level. Donor management must be initiated as soon as possible (78) with evaluation undertaken or supervised by trained specialists following internationally-approved criteria (3). The NTO must be available at all times to provide advice and support for any difficult decisions. Organ retrieval, packing, preservation, and storage should also be performed using nationally-approved protocols. Dedicated teams must be available to perform these functions under the supervision of an NTO. Transportation agreements should also be in place, including those that are needed to facilitate air transport as necessary.

The merits of different techniques of organ optimisation and preservation are still to be fully determined, and trials and evaluations comparing various approaches are ongoing (3). However, successful methods promise to deliver improvements in graft survival time, immediate and long-term function. Machine perfusion techniques (normo-thermic machine perfusion with oxygenation or hypothermic machine perfusion with or without oxygenation) are an important strategy to improve transplant outcomes, and these systems aspire to improve the condition of marginal organs and optimise the quality of standard criteria donor organs. Machine perfusion may be continued throughout transport if desired, and specialist equipment is available for this purpose. It may also be used as a method of reconditioning organs prior to transplant which is especially pertinent for organs which have been kept in static cold storage. Different approaches have been used for different organs, and reconditioning using machine perfusion also permits administration of medications which may aid the process. In order to ensure equity of access, it is crucial that these strategies are supported both logistically and financially by the NTO.

Organ sharing between units and regions should be dictated by nationally-approved rules and criteria and coordinated by regional NTO offices under the central supervision of this organization.

Live Donation (LD)

To achieve national self-sufficiency with respect to organ donation and transplantation, DD and LD should be seen as complementary processes (10, 18, 57). A pre-emptive transplant from an LD should be the treatment of choice for patients with renal failure. International evidence has documented excellent short and long-term outcomes after LD with respect to both clinical results and patient quality of life (63, 65, 79).

LD may be from a related (genetically or emotionally) or unrelated donor and may also include exchange programs and altruistic or anonymous donations. Most living donors are related in some way to the recipient; altruistic donation is a largely underutilized mode in most countries (80). A focus on altruistic donation may serve to expand the donor pool and may represent a source of organs for difficult or rare matches, especially when incorporated into a wider organ exchange scheme. In the UK in 2019, more than 100 individuals altruistically donated a kidney; many of these donations were incorporated into the UK Living Kidney Sharing Scheme (81).

The safety and protection of LDs are of paramount importance. The WHO Guiding Principles on Human Cell, Tissue, and Organ Transplantation (15), the Declaration of Istanbul (17), and the Council of Europe Convention against Trafficking in Human Organs (82) all provide standards and guidance on this matter.

Several internationally-recognized documents provide detailed guidance on the assessment of LDs (7, 10, 12) and the provision of follow-up for these individuals (83–85). LD should

be cost-neutral and should not present a financial burden to the donor. There are currently several international examples of useful donor reimbursement schemes from countries with high LD rates including the UK (86), Israel (87), and the Netherlands (88, 89). Example 7 provides additional information on the UK LD reimbursement scheme.

Example 7. Making LD cost-neutral in the UK: the NHSBT living donor reimbursement scheme

The NHSBT living donor reimbursement scheme was carefully designed to account for any direct or indirect financial burden that may be incurred as part of the process of donating an organ. The scheme covers:

- Travel expenses (including any tolls or charges)
- Loss of earnings from employment (including over-time) or self-employment
- Loss of any state benefits
- Accommodations
- Childcare or other dependent care.
- Any medical expenses incurred that were not otherwise covered.
- Costs of temporary staffing for businesses
- Donation-related prescription costs (86)

Dialysis assessments should always include the possibility of identifying an LD. Referring specialists (most notably, nephrologists) play a critical role in providing referrals and assessments for LD (90, 91).

Unfortunately, up to 40% of recipients find they are incompatible with their intended donors (92); thus, the implementation of a kidney exchange scheme may significantly boost the rate of LDs. Spain, the Netherlands, and the UK all provide examples of well-developed kidney exchange schemes (92).

Transplantation

The multidisciplinary nature of transplantation necessitates careful workforce planning to ensure the availability of sufficient and appropriately trained staff from all disciplines that can provide consistent coverage at all times. Multidisciplinary teams must be employed to perform pre-transplant assessments and re-assessments of patients remaining on the waiting list. This can be facilitated *via* the use of sophisticated IT systems (as described above). The NTO should maintain overall responsibility for the coordination of this process, particularly with respect to organ matching and allocation, and must have appropriately-trained staff available at all times to provide support and advice.

Due to the need to act swiftly to preserve organ viability, crucial support must be provided to maintain close collaboration and communication between the many individuals involved in organ transplantation. All aspects of transplantation, including waiting list assessments and decisions, organ matching, allocation, offering, perioperative management, transplant surgery, and post-transplant hospitalization must be addressed using nationally-approved protocols and guidance. Different countries have taken varying approaches to ensure the coordination of the many processes involved in achieving successful transplantation. Example 8 describes the well-established system and the role of Transplant Recipient Coordinators in the UK.

Example 8. The role of the Transplant Recipient Coordinator: the UK.

The role of the Transplant Recipient Coordinator is fully embedded in the UK program. There are currently more than 250 Transplant Recipient Coordinators assigned to the 27 transplant units in the UK. These professionals are typically specialist nurses who provide support and advice to transplant recipients throughout the entire process, from referral through long-term follow-up. An appointed lead nurse is assigned to represent and support the Transplant Recipient Coordinators in all aspects of their work. This individual is expected to maintain close relationships and open channels of communication with key stakeholders, including the NHSBT, solid organ advisory groups, transplant units, and patient groups (93).

Post-Transplant Follow-Up

Long-term follow-up must be provided by multidisciplinary organ-specific teams. Several internationally recognized documents provide guidance on ideal follow-up arrangements for post-transplant patients. These documents provide specific recommendations regarding renal (8, 9, 94, 95), liver (96–98), and heart/heart-lung (99, 100) transplantation procedures. **Table 4** details some of the key principles involved in post-transplant care.

Research and Training

Research and Development

All staff members involved in organ donation and transplantation should be encouraged to participate in research activities. It may be helpful to establish a research division within the NTO similar to the program included in the NHSBT (101) and/or develop collaborations with international research programs (e.g., Eurotransplant) (102). Research funding may be obtained *via* granting mechanisms, partnerships with private organizations, and/or participation in international consortia (e.g., the European Society for Organ Transplantation [ESOT]) (103).

A proposal on the standards of quality and safety of substances of human origin (SoHO) was adopted by the European Commission in July 2022. This proposal repeals the current legislation and aims to update and improve the regulations for the quality and safety of SoHO. This new legislation also intends to support research, innovation, cross-border learning and rapid adoption of evidence-based developments while offering the highest degree of protection and safety to donors and recipients (104).

Teaching, Training, and Professional Development

All staff members must have access to high-quality training and regular updates. This includes staff members who might engage with potential donors as well as physicians caring for patients with organ failure. Training in communication skills is of the utmost importance; simulation training is effective for this purpose (105, 106). Employment plans should incorporate

TABLE 4 | Key principles for follow-up post-transplant.

- National guidelines based on international best practices
- Regular reviews and assessments
- Shared-care arrangements for those living in remote locations that can be facilitated by telemedicine technology
- Immunosuppressive protocols and optimization of immunosuppressive therapy
- Efforts to prevent recurrence of disease (e.g., management of hypertension, diabetes, inflammatory disorders)
- Management and minimization of post-transplant-related complications
- Optimization of psychosocial outcomes
- Recording and disseminating nationally reviewed and approved outcome data

adequate time for training activities. Individually-tailored continuing professional development portfolios with a personal development plan and annual (or more frequent) appraisals should be basic standard requirements. Clear arrangements for supervision should be instituted for all junior staff. The ODEQUS suggests that an annual hospital-wide seminar on organ donation should be organized (5) and that organ donation and transplantation should be included in both medical and nursing school curricula (5). Example 9 outlines some of the internationally-respected training opportunities available to healthcare professionals.

Example 9. Internationally-respected training opportunities.

Internationally-respected training opportunities are available for all professionals involved in organ donation and transplantation. The European Union of Medical Specialists (UEMS) provides comprehensive training and accreditation programs. Similarly, the European Society for Organ Transplantation (ESOT) offers extensive educational portfolios and support, and the Spanish Transplant Procurement Management-Donation & Transplantation Institute (TPM-DTI) foundation provides many highly-regarded training and research opportunities (107).

Scientific Societies and Professional Organizations

These bodies are invaluable sources of expert advice, opinion, and support and they provide opportunities for professionals to meet and exchange experiences and ideas. They also support and fund research and help to disseminate the results and relevant outcomes *via* publications and educational events. They set professional standards and codes of conduct and provide accredited training programs. Their advice should be sought in the development of guidelines and protocols and matters relating to changes in legislation, regulation, and complex ethical issues.

DISCUSSION

The organ donation and transplantation framework described in this paper is a helpful tool that can be adapted by countries seeking to plan a new program or evaluate one that is already in existence. While some elements may seem to be more important than others, they are all interconnected and interdependent. Improvements to a program will only be realized in response to system-wide change and close collaboration between all parties. Moreover, it may not be possible to address specific areas within the framework (for example, prevention) in the absence of wider health-system reform. Gaps between policy plans and policy implementation are frequently observed. Thus, while the application of this framework may help to guide policy development, its overall implementation must be viewed as a long-term and ongoing project.

One strength of this framework is that it was developed with input from a panel of international experts in organ donation and transplantation; these individuals participated actively in the process of validating the components of the framework and provided constructive and insightful feedback. The research team also had the opportunity to apply the framework to six nation-specific case studies performed in parallel with this study that provided further validation of these results (18–23).

However, there are several limitations to consider. First, although we attempted to create domains that could be generalized for a wide variety of circumstances, certain components will certainly need some adaptation when applied in different settings. For example, we recognize that this framework was devised and constructed based on best practice evidence from high-income countries. We understand that significant modifications would be required to adapt this framework for use in low- or middle-income countries. Second, the framework attempts to take a wide view of the theme of organ donation and transplantation by embracing many elements which may influence this process. However, as this topic involves many different disciplines, there may be certain aspects that we have neglected to address.

Despite these limitations, we expect that this framework can be adapted to different settings specifically in high-income countries. Some components may need to be modified to suit individual contexts and needs by taking into account cultural and societal norms as well as political and economic circumstances. This will be especially important when considering ethically challenging areas, for example, consent legislation, diagnosis of death, DCD, and the withdrawal of life-saving treatment. The involvement of specific stakeholders and the nature of educational or publicity campaigns will also be highly dependent on national circumstances and sensibilities. We also recognize that no program exists in isolation and that all countries will be building on and improving some type of existing structure. This concept relates not only to the donation and transplantation program itself but also to the wider capacities of a given healthcare system. For example, the extent to which different jurisdictions can build effective preventative strategies will depend largely on the developmental state of existing public health and primary care systems. Likewise, the speed at which appropriate digital systems can be organized will depend directly on the stage of progress of existing healthcare IT.

Finally, the framework offers countries the opportunity to learn from one another. The use of this framework will not only highlight areas in need of improvement, but also examples of good and innovative practices. Valuable lessons may also be exchanged, including strategies that have not led to success and/or those resulting in unintended negative consequences.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusion of this article will be made available by the authors, without undue reservation.

AUTHOR CONTRIBUTIONS

All authors listed have made a substantial, direct, and intellectual contribution to the work and approved it for publication.

CONFLICT OF INTEREST

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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REFERENCES

1. Arah OA, Klazinga NS, Delnoij DMJ, Asbroek AHAT, Custers T. Conceptual Frameworks for Health Systems Performance: a Quest for Effectiveness, Quality, and Improvement. *Int J Qual Health Care* (2003) 15(5):377–98. doi:10.1093/intqhc/mzg049
2. Fazekas M, Ettelt S, Newbould J, Nolte E. *Framework for Assessing, Improving and Enhancing Health Service Planning*. Technical Report. RAND Eur (2010).
3. EDQM - European Directorate for the Quality of Medicines. *Guide to the Quality and Safety of Organs for Transplantation*. 7th ed. (2018). Available from: https://www.edqm.eu/en/news/new-release-7th-edition-guide-quality-and-safety-organs-transplantation (Accessed February 5, 2020).
4. EDQM - European Directorate for the Quality of Medicines. *Newsletter Transplant - European Directorate for the Quality of Medicines & HealthCare - EDQM*. European Directorate for the Quality of Medicines & HealthCare (2022). Available from: https://www.edqm.eu/en/ (Accessed December 6, 2022).
5. OBEQUS. *ODEQUS - Organ Donation European Quality System* (2021). Available from: http://www.odequs.eu/results.html (Accessed February 9, 2021).
6. Eurotransplant Foundation. *Eurotransplant International Foundation 2018 Annual Report* (2018). Available from: https://www.eurotransplant.org/wp-content/uploads/2019/12/032675-_ET_Jaarverslag_2018_v7-1.pdf (Accessed December 3, 2019).
7. Lentine KL, Kasiske BL, Levey AS, Adams PL, Alberú J, Bakr MA, et al. KDIGO Clinical Practice Guideline on the Evaluation and Care of Living Kidney Donors. *Transplantation* (2017) 101:S109–105. doi:10.1097/TP.0000000000001769
8. Kidney Disease: Improving Global; Outcomes (KDIGO) CKD Work Group; International Society of Nephrology. KDIGO 2012 Clinical Practice Guideline for the Evaluation and Management of Chronic Kidney Disease. *Kidney Inter* (2013) 3(1):1–150. doi:10.1038/kisup.2012.73
9. Kasiske BL, Zeier MG, Chapman JR, Craig JC, Ekberg H, Garvey CA, et al. KDIGO Clinical Practice Guideline for the Care of Kidney Transplant Recipients: a Summary. *Kidney Int* (2010) 77(4):299–311. doi:10.1038/ki.2009.377
10. British Transplantation Society. *Guidelines for Living Donor Kidney Transplantation* (2020). Available from: https://bts.org.uk/wp-content/uploads/2018/07/FINAL_LDKT-guidelines_June-2018.pdf (Accessed October 5, 2020).
11. British Transplantation Society. *Intensive Care Society, Consensus Statement on Donation after Circulatory Death 2010* (2020). Available from: https://nhsbtdbe.blob.core.windows.net/umbraco-assets-corp/1360/donation-after-circulatory-death-dcd_consensus_2010.pdf (Accessed March 11, 2020).
12. British Transplantation Society. *Living Donor Liver Transplantation* (2020). Available from: https://bts.org.uk/wp-content/uploads/2016/09/03_BTS_LivingDonorLiver-1.pdf (Accessed October 5, 2020).
13. British Transplantation Society. *Transplantation from Deceased Donors after Circulatory Death* (2013). Available from: https://bts.org.uk/wp-content/uploads/2016/09/15_BTS_Donors_DCD-1.pdf (Accessed March 11, 2020).
14. ERA-EDTA Registry. *ERA-EDTA Registry Annual Report 2018*. p. 152. Available from: https://www.era-online.org/wp-content/uploads/2022/11/ERA-Registry-Annual-Report-2018.pdf (Accessed March 11, 2020).
15. Sixty-Third World Health Assembly. WHO Guiding Principles on Human Cell, Tissue and Organ Transplantation. *Cell Tissue Bank* (2010) 11(4):413–9. doi:10.1007/s10561-010-9226-0
16. Lippincott Williams & Wilkins. The Madrid Resolution on Organ Donation and Transplantation. National Responsibility in Meeting the Needs of Patients, Guided by the WHO Principles. *Transplantation* (2011) 91:S29–31. doi:10.1097/01.tp.0000399131.74618.a5
17. The Declaration of Istanbul on Organ Trafficking and Transplant Tourism (2018 Edition). The Declaration of Istanbul on Organ Trafficking and Transplant Tourism (2018 Edition): *Transplantation*. 2019;103(2):218–9. doi:10.1097/TP.0000000000002540
18. Mah J, Johnston-Webber C, Prionas A, Romagnoli J, Streit S, Wharton G, et al. How to Structure a Successful Organ Donation and Transplantation System in Eight (Not So Easy) Steps: An Italian Case Study. *Transpl Int* (2023) 36:11010. doi:10.3389/ti.2023.11010
19. Streit S, Johnston-Webber C, Mah J, Prionas A, Wharton G, Cassanova D, et al. Ten Lessons From the Spanish Model of Organ Donation and Transplantation. *Transpl Int* (2023) 36:11009. doi:10.3389/ti.2023.11009
20. Streit S, Johnston-Webber C, Mah J, Prionas A, Wharton G, Paulina J, et al. Lessons From the Portuguese Solid Organ Donation and Transplantation System: Achieving Success Despite Challenging Conditions. *Transpl Int* (2023) 36:11008. doi:10.3389/ti.2023.11008
21. Johnston-Webber C, Mah J, Prionas A, Streit S, Wharton G, Forsythe J, et al. Solid Organ Donation and Transplantation in the United Kingdom: Good Governance is Key to Success. *Transpl Int* (2023) 36:11012. doi:10.3389/ti.2023.11012
22. Mah J, Johnston-Webber C, Prionas A, Bušić M, Streit S, Wharton G, et al. Organ Donation in Croatia: The Importance of a National Champion, a Comprehensive Plan, and International Collaborations. *Transpl Int* (2023) 36:11011. doi:10.3389/ti.2023.11011
23. Johnston-Webber C, Prionas A, Wharton G, Streit S, Mah J, Boletis I, et al. The National Organ Donation and Transplantation Program in Greece: Gap Analysis and Recommendations for Change. *Transpl Int* (2023) 36:11013. doi:10.3389/ti.2023.11013
24. World Health Organization. *Everybody's Business: Strengthening Health Systems to Improve Health Outcomes: WHO's Frmaework for Action*. Geneva: World Health Organization (2007).

25. Klassen A, Miller A, Anderson N, Shen J, Schiariti V, O'Donnell M. Performance Measurement and Improvement Frameworks in Health, Education and Social Services Systems: a Systematic Review. *Int J Qual Health Care* (2010) 22(1):44–69. doi:10.1093/intqhc/mzp057
26. World Health Organization. *The World Health Report 2000: Health Systems: Improving Performance*. Geneva: WHO (2000). p. 215.
27. Darby C, Valentine N, Murray CJ, de Silva A. *World Health Organization (WHO): Strategy on Measuring Responsiveness*. GPE Discuss Pap Ser No 23. 23.
28. Bocci MG, Prestifilippo A, D'Alò C, Barelli A, Antonelli M, Cingolani E, et al. *Family-Centered Care to Improve Family Consent for Organ Donation*. Organ Donation Transplant - Curr Status Future Chall (2018). Available from: https://www.intechopen.com/books/organ-donation-and-transplantation-current-status-and-future-challenges/family-centered-care-to-improve-family-consent-for-organ-donation (Accessed October 7, 2020).
29. NICE. *Organ Donation for Transplantation: Improving Donor Identification and Consent Rates for Deceased Organ Donation*. clinical guideline 135. NICE. p. 101.
30. Silva DD, Health Foundation (Great Britain). *Evidence: Helping People Help Themselves: A Review of the Evidence Considering whether it Is Worthwhile to Support Self-Management*. London: The Health Foundation (2011).
31. Health Foundation. *Person-centred Care Made Simple: What Everyone Should Know about Person-Centred Care*. London: Health Foundation (2014).
32. In: Nolte E, editor. *Achieving Person-Centred Health Systems, Evidence, Strategies and Challenges*. Available from: https://www.euro.who.int/__data/assets/pdf_file/0010/455986/person-centred-health-systems.pdf (Accessed October 6, 2020).
33. Australian Commission on Safety and Quality in Health Care. *Patient-centred Care: Improving Quality and Safety through Partnerships with Patients and Consumers*. Darlinghurst NSW. Australian Commission on Safety and Quality in Health Care (2011).
34. Catalyst N. *What Is Patient-Centered Care? NEJM Catal* (2017). Available from: https://catalyst.nejm.org/doi/abs/10.1056/CAT.17.0559 (Accessed October 6, 2020).
35. NHS ScotlandScottish Government. *Person-centred Care: What Non-executive Members Can Do*. Edinburgh: NHS Scotland (2019).
36. Halim S. *Learning from the Estonian E-Health System*. Health Europa (2019). Available from: https://www.healtheuropa.eu/estonian-e-health-system/89750/ (Accessed October 7, 2020).
37. University of Oxford. *Evaluation of the Attend Anywhere/Near Me Video Consulting Service in Scotland, 2019-20*. Edinburgh: Scottish Government. 91.
38. McNally D, Sharples S, Craig G, Goraya A. Patient Leadership: Taking Patient Experience to the Next Level? *Patient Exp J* (2015) 2(2):7–15. doi:10.35680/2372-0247.1091
39. Dijk SW, Duijzer EJ, Wienold M. Role of Active Patient Involvement in Undergraduate Medical Education: a Systematic Review. *BMJ Open* (2020) 10(7):e037217. doi:10.1136/bmjopen-2020-037217
40. Barriball L, Bremner B, Craveiro D. *Recruitment and Retention of the Health Workforce in Europe: Final*. EUROPEAN COMMISSION Directorate-General for Health and Food Safety (2019).
41. Leatherman S. In: Smith PC, Mossialos E, Papanicolas I, editors. *Performance Measurement for Health System Improvement: Experiences, Challenges and Prospects*. Cambridge: Cambridge University Press (2010). Available from: http://ebooks.cambridge.org/ref/id/CBO9780511711800 (Accessed March 31, 2021).
42. NHS England Statistics. *National Patient and Staff Surveys* (2020). Available from: https://www.england.nhs.uk/statistics/statistical-work-areas/patient-surveys/ (Accessed October 7, 2020).
43. Robb M. *Donor Reported Outcome Measures*. Statistics and Clinical Studies NHS Blood and Transplant (2020). Available from: https://nhsbtdbe.blob.core.windows.net/umbraco-assets-corp/17970/matthew-robb-droms.pdf (Accessed October 19, 2020).
44. Price DPT. Legal Framework Governing Deceased Organ Donation in the UK. *BJA Br J Anaesth* (2012) 108:i68–72. doi:10.1093/bja/aer356
45. Mossialos E, Costa-Font J, Rudisill C. Does Organ Donation Legislation Affect Individuals' Willingness to Donate Their Own or Their Relative's Organs? Evidence from European Union Survey Data. *BMC Health Serv Res* (2008) 8(1):48. doi:10.1186/1472-6963-8-48
46. Palmer M. *Opt-out Systems of Organ Donation: International Evidence Review*. Welsh Government. 91.
47. Madden S, Collett D, Walton P, Empson K, Forsythe J, Ingham A, et al. The Effect on Consent Rates for Deceased Organ Donation in Wales after the Introduction of an Opt-Out System. *Anaesthesia* (2020) 75(9):1146–52. doi:10.1111/anae.15055
48. Sotiropoulos GC, Machairas N. Organ Donation during the Financial Crisis in Greece. *Lancet* (2016) 388(10048):957–8. doi:10.1016/S0140-6736(16)31488-X
49. Byrne M, Stainer B, Symington M, Leighton J, Jackson H, Singhal N, et al. School Education to Increase Organ Donation and Awareness of Issues in Transplantation in the UK. *Pediatr Transpl* (2019) 23(5):e13492. doi:10.1111/petr.13492
50. NHS Organ Donation. *New Fatwa Published to Clarify Islamic Position on Organ Donation*. NHS Organ Donation (2020). Available from:/get-involved/news/new-fatwa-published-to-clarify-islamic-position-on-organ-donation/ (Accessed July 22, 2020).
51. Finger lakes donor recovery network. "Pope Francis: Organ Donation Is a "Testimony of Love for Our Neighbor." In: *Finger Lakes Donor Recovery Network*. (2020). Available from: http://www.donorrecovery.org/2014/10/pope-francis-supports-organ-donation/ (Accessed July 22, 2020).
52. Vatican News. *Pope: Organ Donation Manifestation of Solidarity, No to Commercialisation - Vatican News* (2019). Available from: https://www.vaticannews.va/en/pope/news/2019-04/pope-organ-donation-manifestation-of-solidarity.html (Accessed July 22, 2020).
53. Reform Judaism. *Are Jews Allowed to Donate Organs?* ReformJudaism.org. (2013). Available from: https://reformjudaism.org/practice/ask-rabbi/are-jews-allowed-donate-organs (Accessed July 22, 2020).
54. Symvoulakis EK, Markaki A, Anyfantakis D, Rachiotis G. Organ Donation Awareness: Rethinking Media Campaigns. *Int J Health Pol Manag* (2018) 7(12):1165–6. doi:10.15171/ijhpm.2018.85
55. ODT Clinical. *Advisory Groups - ODT Clinical - NHS Blood and Transplant* (2020). Available from: https://www.odt.nhs.uk/odt-structures-and-standards/clinical-leadership/advisory-groups/ (Accessed March 11, 2020).
56. Axelrod DA, Schnitzler MA, Xiao H, Irish W, Tuttle-Newhall E, Chang SH, et al. An Economic Assessment of Contemporary Kidney Transplant Practice. *Am J Transpl* (2018) 18(5):1168–76. doi:10.1111/ajt.14702
57. Busic M, Lovrencic-Huzj A. Action Taken to Boost Donor Rate in Croatia. In: Randhawa G, editor. *Organ Donation and Transplantation - Public Policy and Clinical Perspectives*. InTech (2012). Available from: http://www.intechopen.com/books/organ-donation-and-transplantation-public-policy-and-clinical-perspectives/action-taken-to-boost-donor-rate-in-croatia (Accessed February 16, 2020).
58. Rodríguez-Arias D, Wright L, Paredes D. Success Factors and Ethical Challenges of the Spanish Model of Organ Donation. *Lancet* (2010) 376(9746):1109–12. doi:10.1016/S0140-6736(10)61342-6
59. UNOS. *UNOS Technology for Transplantation | UNet and DonorNet Applications*. UNOS. Available from: https://unos.org/technology/technology-for-transplantation/ (Accessed December 3, 2020).
60. Manlove DF, O'Malley G, Klasing R. Paired and Altruistic Kidney Donation in the UK: Algorithms and Experimentation. In: Hutchison D, Kanade T, Kittler J, Kleinberg JM, Mattern F, Mitchell JC, editors. *Experimental Algorithms. Lecture Notes in Computer Science*, 7276. Berlin, Heidelberg: Springer Berlin Heidelberg (2012). p. 271–82. Available from: http://link.springer.com/10.1007/978-3-642-30850-5_24 (Accessed April 28, 2021).
61. Eurotransplant. *Eurotransplant ENIS User Manual* (2020). Available from: https://www.immungenetik.de/index.php/vorstand/docman/oeffentlich/dgi-empfehlungen/722-enis-system-user-manual-enis-manual-v5-0/file (Accessed November 4, 2020).
62. Legislation. *Directive 2010/53/EU Quality and Safety of Organs Intended for Transplantation* (2020). Available from: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=LEGISSUM%3Asp0008 (Accessed July 22, 2020).
63. ERA-EDTA Registry. *ERA-EDTA Registry Annual Report 2017*. p. 152.
64. Blachier M, Leleu H, Peck-Radosavljevic M, Valla C, Roudot-Thoraval F. The Burden of Liver Disease in Europe: A Review of Available Epidemiological Data. *J Hepatol* (2013) 58(3):593–608. doi:10.1016/j.jhep.2012.12.005

65. Papalois VE, Moss A, Gillingham KJ, Sutherland DE, Matas AJ, Humar A. Pre-emptive Transplants for Patients with Renal Failure: an Argument against Waiting until Dialysis. *Transplantation* (2000) 70(4):625–31. doi:10.1097/00007890-200008270-00016
66. Abramowicz D, Hazzan M, Maggiore U, Peruzzi L, Cochat P, Oberbauer R, et al. Does Pre-emptive Transplantation versus post Start of Dialysis Transplantation with a Kidney from a Living Donor Improve Outcomes after Transplantation? A Systematic Literature Review and Position Statement by the Descartes Working Group and ERBP. *Nephrol Dial Transpl* (2016) 31(5):691–7. doi:10.1093/ndt/gfv378
67. Coelho AP, Sá HO, Diniz JA, Dussault G. The Integrated Management for Renal Replacement Therapy in Portugal. *Hemodial Int* (2014) 18(1):175–84. doi:10.1111/hdi.12064
68. OECD/European Observatory on Health Systems and Policies. *Portugal: Country Health Profile 2021*. State of Health in the EU (2021). Available from: https://eurohealthobservatory.who.int/publications/m/portugal-country-health-profile-2021 (Accessed February 20, 2022).
69. Miñambres E, Rubio J, Coll E, Domínguez-Gil B. Donation after Circulatory Death and its Expansion in Spain. *Curr Opin Organ Transpl* (2018) 23(1): 120–9. doi:10.1097/MOT.0000000000000480
70. National Kidney Foundation. *Donation after Circulatory Death*. ODT Clinical - NHS Blood and Transplant (2020). Available from:/deceased-donation/best-practice-guidance/donation-after-circulatory-death/ (Accessed February 19, 2020).
71. Hulme W, Allen J, Manara AR, Murphy PG, Gardiner D, Poppitt E. Factors Influencing the Family Consent Rate for Organ Donation in the UK. *Anaesthesia* (2016) 71(9):1053–63. doi:10.1111/anae.13535
72. Morgan J, Hopkinson C, Hudson C, Murphy P, Gardiner D, McGowan O, et al. The Rule of Threes: Three Factors that Triple the Likelihood of Families Overriding First Person Consent for Organ Donation in the UK. *J Intensive Care Soc* (2018) 19(2):101–6. doi:10.1177/1751143717738194
73. Egea-Guerrero JJ, Martín-Villén L, Ruiz de Azúa-López Zaida Z, Bonilla-Quintero Francisco F, Pérez-López Enrique E, Marín-Andrés R, et al. Short-term Results from a Training Program to Improve Organ Donation in Uncontrolled Donation after Circulatory Death. *Transpl Proc* (2018) 50(2):530–2. doi:10.1016/j.transproceed.2017.09.074
74. Paez G, Valero R, Manyalich M. Training of Health Care Students and Professionals: A Pivotal Element in the Process of Optimal Organ Donation Awareness and Professionalization. *Transpl Proc* (2009) 41(6):2025–9. doi:10.1016/j.transproceed.2009.05.020
75. Matesanz R, Domínguez-Gil B, Coll E, Mahíllo B, Marazuela R. How Spain Reached 40 Deceased Organ Donors Per Million Population. *Am J Transpl* (2017) 17(6):1447–54. doi:10.1111/ajt.14104
76. Kotloff RM, Blosser S, Fulda GJ, Malinoski D, Ahya VN, Angel L, et al. Management of the Potential Organ Donor in the ICU: Society of Critical Care Medicine/American College of Chest Physicians/Association of Organ Procurement Organizations Consensus Statement. *Crit Care Med* (2015) 43(6):1291–325. doi:10.1097/CCM.0000000000000958
77. Meyfroidt G, Gunst J, Martin-Loeches I, Smith M, Robba C, Taccone FS, et al. Management of the Brain-Dead Donor in the ICU: General and Specific Therapy to Improve Transplantable Organ Quality. *Intensive Care Med* (2019) 45(3):343–53. doi:10.1007/s00134-019-05551-y
78. Anwar ASMT, Lee JM. Medical Management of Brain-Dead Organ Donors. *Acute Crit Care* (2019) 34(1):14–29. doi:10.4266/acc.2019.00430
79. Organ Procuration and Transplantation Network. *National Data - Organ Procuration and Transplantation Network*. Available from: https://optn.transplant.hrsa.gov/data/view-data-reports/national-data/# (Accessed April 1, 2020).
80. Khetpal V, Mossialos E. An Ethical Appraisal of Living-Anonymous Kidney Donation Using Adam Smith's Theory of Moral Sentiments. *Health Policy* (2018) 122(11):1212–21. doi:10.1016/j.healthpol.2018.08.015
81. NHS Blood and Transplant. *People Donating a Kidney Altruistically Peaks at Five Year High*. NHS Blood and Transplant (2022). Available from: https://www.nhsbt.nhs.uk/news/people-donating-a-kidney-altruistically-peaks-at-five-year-high/ (Accessed March 17, 2022).
82. Council of Europe. *Council of Europe Convention against Trafficking in Human Organs*. Treaty Office (2015). Available from: https://www.coe.int/en/web/conventions/full-list (Accessed February 19, 2020).
83. Ethics Committee of the Transplantation Society. The Consensus Statement of the Amsterdam Forum on the Care of the Live Kidney Donor. *Transplantation* (2004) 78(4):491–2. doi:10.1097/01.tp.0000136654.85459.1e
84. Barr ML, Belghiti J, Villamil FG, Pomfret EA, Sutherland DS, Gruessner RW, et al. A Report of the Vancouver Forum on the Care of the Live Organ Donor: Lung, Liver, Pancreas, and Intestine Data and Medical Guidelines. *Transplantation* (2006) 81(10):1373–85. doi:10.1097/01.tp.0000216825.56841.cd
85. Poltransplant. *LIDOBS Recommendations for High Quality Practices in Living Donation* (2020). Available from: http://www.poltransplant.pl/Download/lidobs.pdf (Accessed July 22, 2020).
86. NHS England. *Commissioning Policy: Reimbursement of Expenses for Living Donors* (2020). Available from: https://www.england.nhs.uk/wp-content/uploads/2018/08/comm-pol-reimbursement-expenses-living-donors-v2.pdf (Accessed October 29, 2020).
87. Live Donors. *State of Israel: Compensating Live Organ Donors* (2020). Available from: https://www.health.gov.il/English/Topics/organ_transplant/live_donors/Pages/compensation_live_donors.aspx (Accessed October 29, 2020).
88. Ministerie van Volkshuisvesting, Ruimtelijke Ordening en Milieu. *Can I Be Reimbursed for the Cost of Living Organ Donation? Government Netherlands*. Ministerie van Algemene Zaken (2015). Available from: topics/organ-tissue-donation/question-and-answer/reimbursed-cost-organ-donation (Accessed October 29, 2020).
89. Netherlands kidney transplant network. *How Do I Choose to Donate?* Niertransplantatie (2020). Available from: https://www.niertransplantatie.info/en/donors/choose-donate (Accessed October 29, 2020).
90. Sharma V, Roy R, Piscoran O, Summers A, Dellen DV, Augustine T. Living Donor Kidney Transplantation: Let's Talk about it. *Clin Med* (2020) 20(3): 346–8. doi:10.7861/clinmed.2020-0047
91. Moore DR, Serur D, Rudow DL, Rodrigue JR, Hays R, Cooper M, et al. Living Donor Kidney Transplantation: Improving Efficiencies in Live Kidney Donor Evaluation–Recommendations from a Consensus Conference. *Clin J Am Soc Nephrol CJASN* (2015) 10(9):1678–86. doi:10.2215/CJN.01040115
92. Biró P, Haase-Kromwijk B, Andersson T, Ásgeirsson EI, Baltesová T, Boletis I, et al. Building Kidney Exchange Programmes in Europe—An Overview of Exchange Practice and Activities. *Transplantation* (2019) 103(7):1514–22. doi:10.1097/TP.0000000000002432
93. NHSBT. *Role of Transplant Recipient Co-ordinator*. ODT Clinical - NHS Blood and Transplant (2020). Available from:/odt-structures-and-standards/organ-donation-retrieval-and-transplantation-teams/role-of-transplant-recipient-co-ordinator/ (Accessed April 9, 2020).
94. Renal Association. *The Renal Association 2017 Clinical Practice Guideline Post-Operative Care in the Kidney Transplant Recipient* (2020). Available from: https://renal.org/wp-content/uploads/2017/06/final-post-operative-care-guideline.pdf (Accessed April 12, 2020).
95. American Society of Transplantation. *Guidelines for Post-Kidney Transplant Management in the Community Setting* (2010). Available from: https://www.myast.org/guidelines-post-kidney-transplant-management-community-setting (Accessed October 5, 2020).
96. EASL Clinical Practice Guidelines. EASL Clinical Practice Guidelines: Liver Transplantation. *J Hepatol* (2016) 64(2):433–85. doi:10.1016/j.jhep.2015.10.006
97. Millson C, Considine A, Cramp ME, Holt A, Hubscher S, Hutchinson J, et al. Adult Liver Transplantation: UK Clinical Guideline - Part 2: Surgery and post-operation. *Frontline Gastroenterol* (2020) 11(5):385–96. doi:10.1136/flgastro-2019-101216
98. Lucey MR, Terrault N, Ojo L, Hay JE, Neuberger J, Blumberg E, et al. Long-term Management of the Successful Adult Liver Transplant: 2012 Practice Guideline by the American Association for the Study of Liver Diseases and the American Society of Transplantation. *Liver Transpl* (2013) 19(1):3–26. doi:10.1002/lt.23566
99. Costanzo MR, Costanzo MR, Dipchand A, Starling R, Anderson A, Chan M, et al. The International Society of Heart and Lung Transplantation Guidelines for the Care of Heart Transplant Recipients. *J Heart Lung Transpl* (2010) 29(8):914–56. doi:10.1016/j.healun.2010.05.034
100. Adegunsoye A, Strek ME, Garrity E, Guzy R, Bag R. Comprehensive Care of the Lung Transplant Patient. *Chest* (2017) 152(1):150–64. doi:10.1016/j.chest.2016.10.001

101. NHSBT. *Research and Development Webpage*. Research and Development - NHS Blood and Transplant (2020). Available from:/research-and-development/ (Accessed October 9, 2020).
102. Eurotransplant. *EU Projects*. Available from: https://www.eurotransplant.org/professionals/eu-projects/ (Accessed October 9, 2020).
103. European Society for Organ Transplantation. *Awards & grants – ESOT* (2020). Available from: https://new.esot.org/awards-grants/ (Accessed October 8, 2020).
104. European Commision. *Proposal for a Regulation on Substances of Human Origin* (2022). Available from: https://health.ec.europa.eu/blood-tissues-cells-and-organs/overview/proposal-regulation-substances-human-origin_en (Accessed December 5, 2022).
105. Douglas P, Goldschmidt C, McCoyd M, Schneck M. Simulation-Based Training in Brain Death Determination Incorporating Family Discussion. *J Grad Med Educ* (2018) 10(5):553–8. doi:10.4300/JGME-D-18-00185.1
106. Marogna N, Bernardi R, Monti M, Costa G, Aguirre Mandau M, de Echave JL. Impact of Clinical Simulation Training in Transplantation. *Transpl Proc* (2018) 50(2):441–3. doi:10.1016/j.transproceed.2017.12.041
107. DTI. *Training | DTI-TPM Foundation* (2020). Available from: https://tpm-dti.com/en-training/ (Accessed April 8, 2020).

APPENDIX

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Lessons From the Portuguese Solid Organ Donation and Transplantation System: Achieving Success Despite Challenging Conditions

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Over the past two decades, Portugal has become one of the world leaders in organ donation and transplantation despite significant financial constraints. This study highlights how Portugal achieved success in organ donation and transplantation and discusses how this information might be used by other countries that are seeking to reform their national programs. To accomplish this goal, we performed a narrative review of relevant academic and grey literature and revised our results after consultation with two national experts. Our findings were then synthesized according to a conceptual framework for organ donation and transplantation programs. Our results revealed several key strategies used by the Portuguese organ donation and transplantation program, including collaboration with Spain and other European nations, a focus on tertiary prevention, and sustained financial commitment. This report also explores how cooperative efforts were facilitated by geographical, governmental, and cultural proximity to Spain, a world leader in organ donation and transplantation. In conclusion, our review of the Portuguese experience provides insight into the development of organ donation and transplantation systems. However, other countries seeking to reform their national transplant systems will need to adapt these policies and practices to align with their unique cultures and contexts.

Keywords: organ donation, organ transplantation, transplantation policy, Portugal, transplant program

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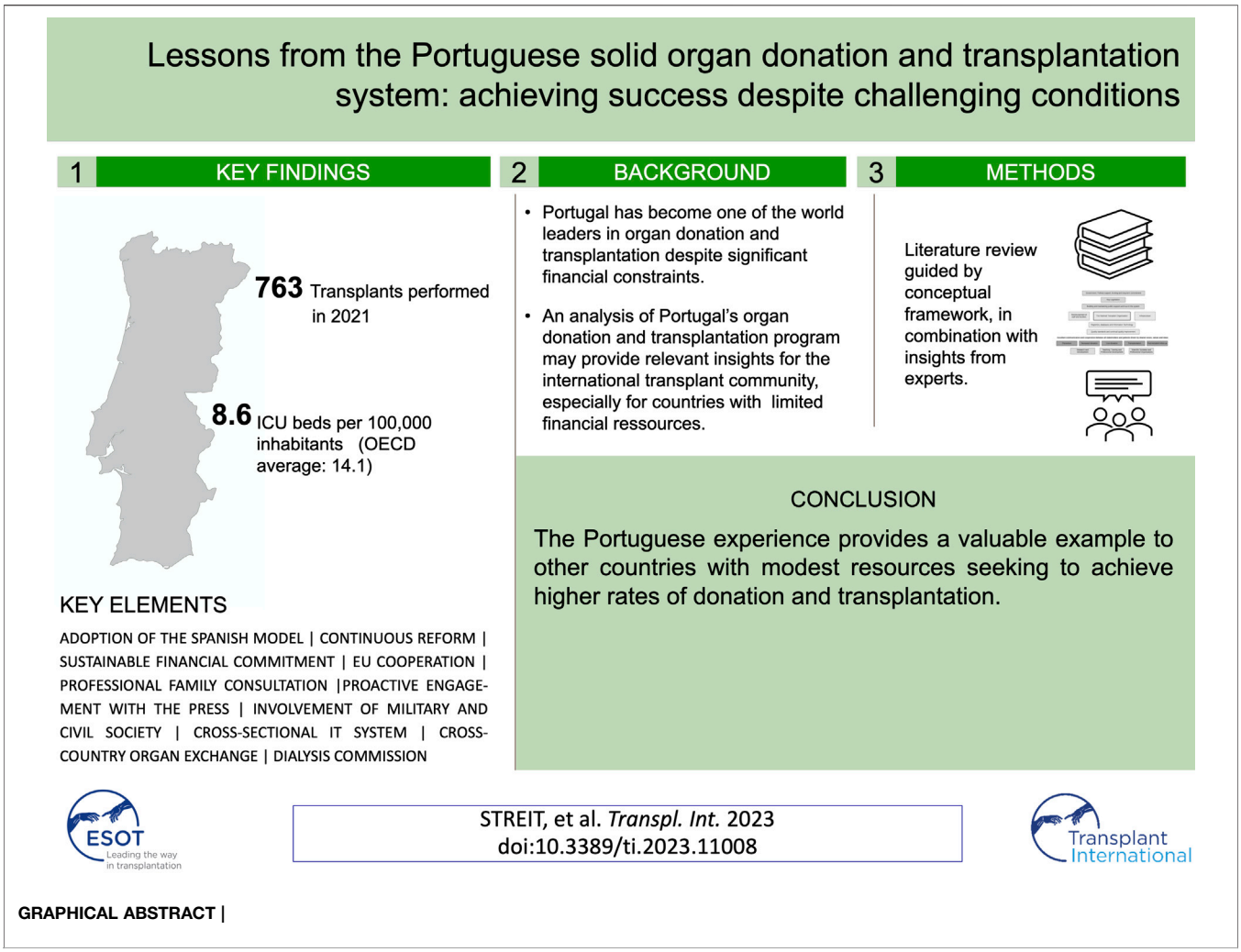
INTRODUCTION

Efforts to develop a high-functioning organ donation and transplantation program require specific investments, including those focused on reimbursement of staff and facilities, infrastructure, robust governing structures, research and development, and digital information technology (IT) (1). However, organ donation and transplantation rates are not always directly related to the financial resources available to a given healthcare system (2). This point is clearly illustrated by the example of Portugal, which as a country spends slightly less of its gross domestic product (GDP) on healthcare and significantly less per inhabitant than the European average (3). Although Portugal, prior to the COVID-19 pandemic, supported fewer



GRAPHICAL ABSTRACT |

critical care beds (an important element of the infrastructure required for a successful organ donation and transplantation program) than any of the other European nations (i.e., only 4.2 beds per 100,000 inhabitants (4), it has substantially increased the rates of organ donation during the last two decades to cope with a significant burden of patients with organ failure including a high number of patients with chronic kidney disease and patients on renal replacement therapy ((5); **Table 1**). Before the disruptions resulting from the COVID-19 pandemic, Portugal reached 33.7 deceased donations per million population (pmp) (6). Thus, Portugal not only outperforms other Southern European countries with similar population sizes, demographics, and economic constraints (e.g. Greece), it has become a world leader in deceased donation, ranking second in Europe and third worldwide in 2018 (6). Therefore, previous reviews of the Portuguese system have been used as a basis for national policy reform and an in-depth study of Portugal's organ donation and transplantation program may provide highly relevant insights for the international transplant community (7).

The paper aims to provide an updated review of the critical features of the Portuguese program that have led to its status as a world leader in organ donation and transplantation The goal is to describe and discuss insights that might be of use to other countries, notably those that share similar demographics and financial constraints.

MATERIALS AND METHODS

Our report on the Portuguese transplant program is based on an in-depth study that was initially designed to provide a comprehensive review of the organ donation and transplantation program in Greece (12). As part of the original report, we identified key features and critical factors that contributed to the success of the Portuguese transplant system, a country with similar demographic and financial resources to Greece. Special emphasis was placed on the question of how this level of success was achieved despite substantial demographic and financial challenges. Here, we present, update, and discuss the major findings from this report.

We began by conducting a narrative literature review of relevant academic and grey literature, including published reviews that discussed the Portuguese organ donor and transplant system. We performed a search of relevant websites including those maintained by the Portuguese government, the Ministry of Health, and the Instituto Portugues do Sangue e da Transplantação; policy reports that focused on donation reform in Portugal were retrieved *via* a Google search. An additional database search was then performed using Medline, Web of Science, and Google Scholar to identify relevant academic literature.

We then reviewed our findings with two experts on the Portuguese organ donation and transplantation program (coauthors Dr Jorge Paulino and Dr Ana Franca). These experts were each invited to present key features of the Portuguese transplant system in an online interview. They also answered questions and provided feedback and additional materials such as national statistics or legislative documents.

In the following sections, we first outline the main advances and achievements of the Portuguese transplant system. We then describe key elements and insights provided by the Portuguese organ donation and transplantation program. These insights are presented according to the domains of a conceptual framework for transplant systems described by Johnston-Webber et al. as shown in **Figure 1** (1). To synthesize key lessons from a well-functioning system, we mainly focus on the time period from initial development of the transplant system in 1993 up to 2019. In addition, we provide an overview of recent developments including adaptations that were made in response to the Coronavirus disease 2019 (COVID-19) pandemic with the latest data available from 2021. Finally, we discuss factors that may have played a role in Portugal's successful adaption of the Spanish organ donation and transplantation model.

According to Johnston-Webber et al. (1), the main goal of an organ donation and transplantation system is to improve the health of patients with organ failure by successful prevention of organ failure, facilitating organ donation, performing safe and effective transplantation, and providing suitable follow-up. Transplant systems must be responsive to the needs of patients, donors, and the general population, and must be capable of using their resources efficiently and providing equitable access to care. The multiple components of this system will need to interact effectively with one another to achieve these goals.

RESULTS

Context and Trends Identified in the Portuguese Transplant System

As has been described for other successful programs, the current Portuguese system is the result of many years of planning, development, and review. An overview of the main advances over the past few decades will be helpful to build an understanding of the structure of the program as it stands today. **Table 2** summarizes the most important steps Portugal has undertaken since 1993 to build a sustainable and effective organ donation and transplantation program. **Figure 2** illustrates the development of transplantation activity in Portugal for the past 20 years.

Key Elements and Policies Leading to Transplant Reform

The following sections provide an overview of the key features of the Portuguese program identified in this study as playing important roles in promoting its success (**Table 3**).

Enabling Elements

Government and Key Legislation

Continuous Reform Efforts Influenced by the Spanish Transplant Model Are a Promising Way to Build a Well-Functioning Transplant System Over Time

The Portuguese program was initiated in 1993 and is broadly based on the Spanish model which has been the source of many of its key features (7).

By law, "all national citizens, stateless persons, and foreigners residing Portugal who have not declared their status as non-donors to the Ministry of Health are potential post-mortem donors." (13–15). Citizens who do not want to be organ donors can declare their will *via* a dedicated registry for non-donors which is maintained by the Ministry of health (16). However, in practice, even where the donor's consent is presumed or explicitly given, families are always consulted, informed and asked for agreement for donation (19, personal correspondence). Thus, consent policy in Portugal can be categorized as "soft opt-out."

In 1993, Portugal implemented the national transplant body which included five regional offices (7). Following several cycles of restructuring (see **Table 2**), the Instituto Português do Sangue e da Transplantação (IPST) was able to provide regulatory oversight and coordination of the donation and transplantation processes, while the regional offices were designated as responsible for the coordination of organ retrieval, allocation, and transportation (7, 13).

The role of hospital-based organ donation coordinators was adapted from the Spanish model and introduced in 2007 (7, 15, 18, 19). Today, all participating hospitals have appointed donor coordinators from their clinical staff who are specially trained in organ donor detection and evaluation. Donation coordinators are typically medical doctors, preferably with a background in intensive care medicine and receive a monthly €500 to €1,000 additional compensation from their local hospitals for their responsibilities. They identify potential organ donors, consult with families, initiate logistics of organ donation in cooperation with the national procurement and transplant coordination network, document the donation process, promote organ donation in their local hospitals and report to hospital management and the national transplant organization (19). These staff members also have access to ongoing training and professional development opportunities *via* national and international schemes that build on existing resources such as the Donation and Transplantation Institute - Transplantation Procurement Management (DTI-TPM) program, Barcelona (7, 20).

TABLE 1 | Health system financing and population health in Portugal: key statistics.

Health system	References
• A universal taxpayer-funded health system that co-exists with special health insurance schemes that apply to particular professionals and private voluntary health insurance	(3)
• Amount spent on healthcare *per capita*, 2,314€; 9.5% of the gross domestic product (GDP)	(3)
• Public spending as a percentage of the total health expenditure: 61%	(3)
• Out-of-pocket payments as a percentage of the total health expenditure: 30.5%	(3)
• Percentage of the population reporting an unmet need for medical care: 2.7%	(3,8)
Health status	
• Percentage >65 years of age: 22.1%; EU average, 20.6%	(3)
• Life expectancy: 81.1 years; EU average, 80.6 years	(3)
• Smoking (% of the population who are daily smokers): 14.2%; OECD average, 16.5%	(9)
• Alcohol (liters consumed *per capita* per year): 10.4 L; EU average, 20.6%	(9)
• Percentage overweight or obese (BMI >25): 67.6%; OECD average, 56.4%	(9)
• Patients maintained on renal replacement therapy: prevalence, 2008.4 per million population (pmp); incidence, 250.7 pmp	(10)
• Age-standardized prevalence of chronic kidney disease: 5.4%; (global 8.7%)	(11)

EUR, Euro; EU, European Union; OECD, Organisation for Economic Co-operation and Development; BMI, body mass index.

Largely due to the changes implemented throughout the 2000s combined with clear legislation and guidance for the diagnosis of brain death (17, 21), Portugal greatly increased its rates of donation and transplantation (7, **Table 2**). The capacity to build on some of the core features of the Spanish system together with a focus on improving rates of donation after brain death facilitated immediate and substantial improvements in the performance of Portugal's transplant system.

Building and Maintaining Public Support and Trust in the System

Professional Family Consultations, Proactive Engagement With the Press and Broad Involvement of Stakeholders From Government and Civil Society Have Helped to Build Trust in the System

In Portugal, the public's willingness to donate their own, or a deceased family member's organs has been shown to be higher than in other European countries (22-24). Additionally, relatively low numbers of people cite mistrust in the transplant system as a reason for their unwillingness to consider organ donation (24). Finally, in 2020, donations from only four of 412 potential donors (only 0.97% of the total potential donor pool) were unsuccessful because of family refusal (personal correspondence). This percentage has remained fairly stable over recent years and represents an outstanding level of success compared to results reported by many other countries worldwide (25).

Together, these findings suggests that there is a generally favorable attitude towards donation, a widespread public acceptance of the current transplant program and the ability to translate these favorable attitudes into consent for organ donation.

Several factors have played a role in achieving this success. First of all, measures that have been crucial in the Spanish context have been adopted in Portugal. This includes collaborations with the press (including training sessions for journalists) and training organ donation coordinators in conducting family consultations (7, 14, 15). The latter is especially important, as experience and training have been directly linked to the decision of families to donate organs (26). Family consultations offer the opportunity to comprehensively inform families about the clinical setting and legal situation. This prevents mistrust in a system in which, from a legal standpoint, donation could be pursued even if there is no documented will of the deceased to donate organs.

Second, The Portuguese authorities have consistently endeavored to include the public and stakeholders from civil society such as religious groups or patient organizations to dispel misconceptions regarding organ donation and win the trust of the public (7, 27). The regional procurement offices collaborate with the Portuguese Air Force (28) and the police (the National Republican Guard, or GNR) to facilitate the transportation of organs. The use of this strategy has increased the visibility and status of organ donation throughout Portugal. The GNR published a statement in conjunction with National Organ Donation Day (July 20th) that highlighted its efforts and beneficial role in this process:

> "The quality and safety of organ transplantation depends on the time required for transport, a factor that is crucial in this mission. Therefore, it is the responsibility of the GNR, and in respect of security conditions, to reach the destination in the shortest time possible, thus contributing to saving yet another life. In this noble mission, this year 2021 alone, the GNR has already carried out 135 transportations of organs, involving 271 soldiers, having covered approximately 37 342 kilometres. In 2020, the GNR transported 240 organs, engaged 478 soldiers and covered 64,133 kilometres" (29).

Together, these measures have helped to gain the trust of the general public in Portugal.

Structural Elements

The National Transplant Organization

International Collaboration can Help With the Process of Acquiring Additional Resources

Portugal has maintained several fruitful international collaborations in the field of organ donation and

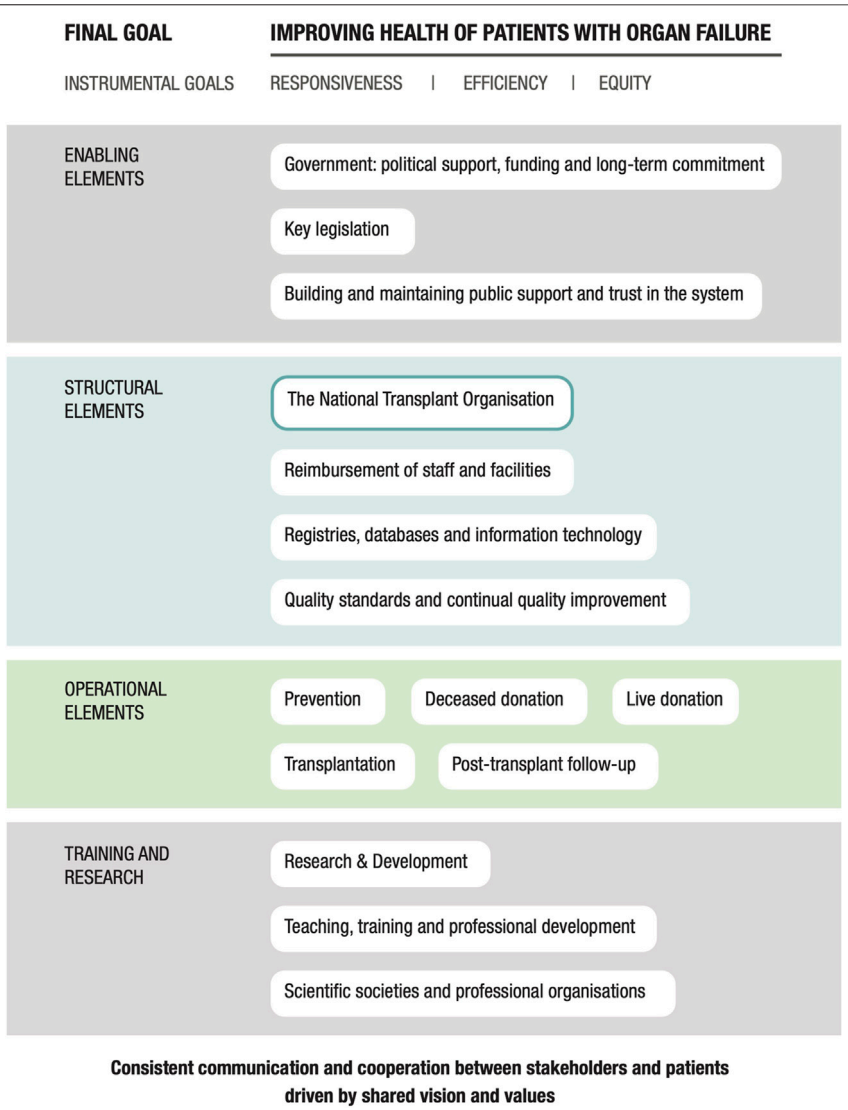


FIGURE 1 | A conceptual framework for understanding a national solid organ donation and transplantation program: the essential building blocks (1).

transplantation. Portugal has participated in multiple EU-funded programs that were included as part of the "EU Action Plan on Organ Donation and Transplantation" (18). Specifically, Portugal has improved its quality assurance system based on a European analysis of end-of-life care practices and an EU-funded indicator-driven quality improvement initiative (30-32). Moreover, the EU-wide "train the trainers" program led by TPM has helped to build local training capacity (20,33). Portugal also participates in a set of cross-organ exchange schemes with Spain and other Southern European countries, including the use of shared lists of those awaiting lung, renal, and liver transplantation (17, 34, 35). Thus, Portugal has successfully managed to compensate for its limited resources by optimizing the advantages associated with membership in the EU as well as its proximity to Spain and other Southern European countries.

Reimbursement of Staff and Facilities

Consistent Financial Commitment is Necessary to Support Structural Reform

In the 2000s, donation rates in Portugal increased steadily along with a set of structural reforms that included general investment in the donation and the transplantation sector, and the introduction of reimbursement for relevant donation activity (7). Unfortunately, this trend was reversed due to the austerity measures that were implemented in Portugal to cope with the 2008 worldwide financial crisis (7). The general impact of these measures on healthcare staff and patients, including reductions in the salaries of hospital staff and the introduction of user charges have been considered in previous publications (36, 37). Funding for donation activities was effectively cut in half (7). Donation activity decreased accordingly, thus illustrating the importance of

TABLE 2 | Main developments in Portugal's organ donation and transplantation program over the past 30 years (7, 13, personal correspondence).

1993	Establishment of a national legal framework for organ donation and transplantation
1993	Establishment of the first national institution (Organização Portuguesa de Transplantação) and five regional authorities dedicated to organ donation and transplantation
1994	Implementation of a national non-donor registry
1996	Implementation of regional transplant coordinators
2007	Introduction of hospital donor coordinators
2008	Implementation of dedicated training programs designed for healthcare professionals in the field of organ donation and transplantation
2008	Restructuring of care for patients with end-stage renal disease
2009–11	Engagement in a set of European Union-wide collaborations to promote organ donation and transplantation
2012	Restructuring and creation of the current national transplant organization (Instituto Portugues do Sangue e da Transplantação [IPST])
2013	Implementing a legal framework for donation after circulatory death (DCD)
2015	Establishment of protocols for the protection of living organ donors (Decree-Law No. 168/2015)
2019	Establishment of July 20th as the National Day of Organ Donation and Transplantation
2019	Introduction of informed consent policy for post-mortem organ and tissue donation by foreign citizens who have not established permanent residence in Portugal
2020	Regulation of the structure and responsibilities of the National Dialysis Commission

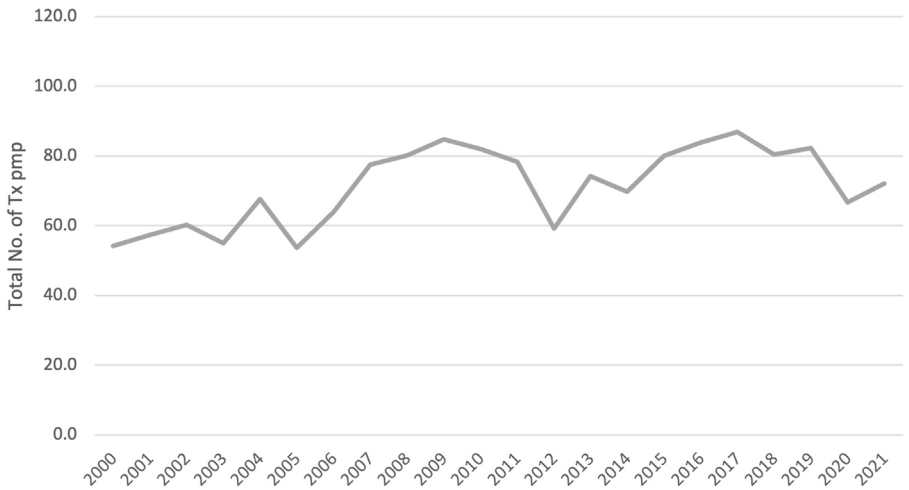


FIGURE 2 | Development of Transplantation Activity in Portugal. *Data of the WHO-ONT Global Observatory on Donation and Transplantation (5). Tx, Transplants; pmp, per million population.

continuous financial commitment to ensure the sustainability of structural reforms.

Registries, Databases, and Information Technology (IT)

A Cross-Sectional IT System can be Used to Manage Complex Clinical Pathways

The Portuguese transplant authorities have successfully implemented a multi-functional IT platform that supports clinical pathways associated with organ donation and transplantation (41; personal correspondence). The IT platform provides access to a consent registry, patient records (clinical information, imaging, and other data), and a real-time clinical workflow system that can be used to document, illustrate, and provide timing for all relevant clinical processes from organ procurement to transplantation. Thus, this IT platform provides critical support for healthcare professionals as it facilitates rapid and safe communication between all clinicians involved in this process. The platform also helps the transplant authorities to track and document critical processes and serves as a tool to support quality improvement and biovigilance. The data collected can also be used for research purposes (41; personal correspondence).

Taken together, the Portuguese system illustrates the advantages of implementing robust IT systems to support organ donation and transplantation. The Portuguese experience suggests that the investment needed to establish a functional digital infrastructure will be worth the costs as it will ultimately facilitate the management of complex clinical protocols.

TABLE 3 | Key features from the Portuguese transplant system that might be adopted by other countries.

Framework domain	Key features	Details
Enabling Elements: Government: Political Support, Funding, Long-Term Commitment, and Key Legislation	A set of basic reforms can have an immediate and substantial impact	Portugal has modeled its program on that of neighboring Spain. Key elements of this program include the establishment of a robust National Transplant Organization (NTO) with regional offices and the employment of specifically-trained organ donor coordinators in hospitals who have ongoing access to high-quality educational programs
Enabling Elements: Building and Maintaining Public Support and Trust in the System	Active inclusion of state institutions and civil society in the process of organ donation reform	Portugal has included a wide range of stakeholders and civil society in ongoing consultations regarding the development of the program. This has helped to raise the profile of organ donation and transplantation, gain the support of the public, and resolve complex ethical issues and religious concerns
Structural Elements: National Transplant Organization	Drawing strength from collaborations	Effective use of European resources has been of great benefit to the Portuguese program. Examples of these collaborations include the creation of an international quality assurance program, training partnerships, and organ exchange schemes
Structural Elements: Reimbursement of Staff and Facilities	Continuous financial support is crucial to ensure consistent donation rates	In 2007, Portugal increased financial support for organ donation with positive results. However, this support was reduced by 50% following the economic crisis which resulted in a parallel reduction in donation rates
Structural Elements: Registries, Databases, and Information Technology (IT)	A national IT system supports complex workflows	Portugal has established an excellent digital donation and transplantation registry which operates in real-time and thus facilitates rapid communication of vital information. This registry supports all aspects of organ donation and transplant and facilitates the smooth and efficient functioning of the program
Operational Elements: Prevention	Preventative policies that address chronic kidney disease will be one way to target demand	As Portugal has very high rates of end-stage renal disease (ESRD), it has established an effective program designed to improve the management of chronic kidney disease (CKD), notably in the field of dialysis care. Prospective capitated reimbursements for dialysis have been introduced that are contingent on regular submission of quality and outcomes findings including patient survey data

Operational Elements

Prevention

Concerted Efforts Toward Tertiary Prevention Pay off

Despite its success in providing kidney transplants, Portugal is currently home to the highest percentage of patients maintained on renal replacement therapy in all of Europe (39). In response to this problem, Portuguese transplant authorities have joined forces with other government agencies, medical, nursing and pharmacists associations, renal patient groups and dialysis centers to implement a dedicated dialysis commission tasked with monitoring and improving this situation (40). Toward this end, a set of reforms direct at patients with end-stage renal disease (ESRD) have been implemented (38). First, the financing of dialysis care has been shifted from a fee-for-service scheme to capitated payments in an effort to reduce costs. Second, a quality improvement initiative has been implemented that requires the collection of a set of clinical quality indicators for dialysis care as part of the prerequisite for reimbursement (38). Additionally, a patient survey focused on the quality of care has been introduced (38). Finally, copayments have been decreased and the rates of referral from general to specialist care have improved (38). Taken together, these measures resulted in an overall reduction of public payments. This was accompanied by improvements in the quality of care as indicated by the results of patient satisfaction surveys and international performance metrics for dialysis care (38, 41).

Our results suggest that countries seeking to reform their national programs might take demand-side measures into account and focus concerted efforts toward improving the care of patients who might otherwise eventually require an organ transplant. As illustrated by the Portuguese example, these efforts not only help to improve patient care but will also result in reduced costs for the healthcare system.

Recent Developments

Recent Progress on Living Donation and Donation After Circulatory Death (DCD)

In recent years, Portugal has aimed to increase the rates of living donation and donation after circulatory death (DCD) as a way to complement its successful deceased donation after brain death program.

All living donation programs will need to prioritize the implementation of measures that safeguard donor rights and psychosocial wellbeing. In Portugal, a protocol was established in 2015 that included a psychiatric evaluation both before and after

live donation (42). This created a unique regimen designed to protect and support the rights of living organ donors. The protocol includes a mandatory living organ donor life insurance guarantee which covers all possible complications that might arise as a result of the donation and procurement process as well as a set of benefits provided to the donor in the event of death, the development of any level of permanent disability, or hospitalization (43). Living donation rates before the COVID-19 pandemic were at 7.28 pmp in 2019, which was slightly below the EU average of 9.85 pmp (44, 45). Accordingly, the number of patients transplanted from living donors accounted only for 9.5% of all patients transplanted (44). However, this program has grown considerably over the past decade and is complemented by an active kidney exchange program that performed its first transplants in 2013 (17, 34, 45, 46).

Similarly, DCD only plays a limited role in the Portuguese transplant system. In 2013, the Ministry of Health implemented DCD in cooperation with the professional societies of intensive care medicine, nursing, and emergency services. However, due to ethical considerations brought forward by the National Council of Ethics in Life Sciences and a strong role of the National Institute for Medical Emergency, it was decided to restrict DCD to uncontrolled DCD (47). Hence, there have only been pioneering uDCD efforts in four University Hospitals that have the infrastructure to perform normothermic regional perfusion and a close connection to the national transplant infrastructure (48, personal correspondence). As a result, Portugal performed 17 uncontrolled donations after circulatory death, accounting for approximately 6% of all donations in 2021 (49). Currently, legislation for controlled donation after circulatory death is under review and the Ministry of Health has started a national consensus process that might permit controlled DCD in the future (personal correspondence).

Taken together, both living donation and DCD only play a minor role in the Portuguese transplant system. However, both areas have been identified as areas of reform and will potentially become more important in the near future.

Response to the COVID-19 Pandemic

The responses of the Portuguese health system to the COVID-19 pandemic included far-reaching containment measures involving two full lockdowns, a mobilization of resources to support the health system, a hierarchical vaccination program, and digital measures to improve contact tracing and telemedicine (3). While the 2021 vaccination rates in Portugal exceeded the European average and telemedicine consultations rose during the pandemic waves, digital contact tracing measures were not as successful largely as a result of the ongoing public debate on data protection (3). Overall, measures taken by the Portuguese health system reduced peak viral transmission, but were not sufficient to prevent over-stretching of intensive care capacity during the second wave of the pandemic (3).

As might be expected, transplantation rates fell sharply following both the first as well as second waves of the pandemic (in early 2020 and late 2020/early 2021, respectively) (50). This resulted in a 19% decrease in the number of transplantations performed per million population compared to 2019 (5, 44, 51). The rate of reduction was higher than that experienced by other European countries even after accounting for the general impact of the pandemic (as indicated by death rates secondary to COVID-19) (50). However, daily transplant activity in Portugal rapidly increased following each of the two pandemic peaks indicating capacity to recover quickly from external shocks (52). Additionally, the increase that followed the second wave began from a higher point and increased more rapidly than after the first wave. These results suggest that a "learning effect" had a significant impact on the rate at which transplant capacity could be re-built.

Collectively, these developments document the notable impact of the COVID-19 pandemic on transplantation rates in Portugal. This was accompanied by a rapid recovery of transplant capacity once peak virus transmission had passed.

DISCUSSION

Consistent with findings presented in previous analyses of the Portuguese organ donation and transplantation program, the results of our study demonstrate the importance of a set of core reforms that were successfully adapted from the Spanish model. In general, an integrated national health system that provides broad coverage, sufficient funding, technical infrastructure, comparatively low labor costs, the potential to provide financial incentives to participating clinical staff, and similar baseline demographics have been suggested to facilitate adoption of the Spanish model (53). These factors may have also influenced the successful adoption of the Spanish model in Portugal.

Most healthcare facilities in Portugal are either part of the national health service or regulated and connected with the Ministry of Health *via* negotiation (54). Although financial coverage for healthcare in Portugal is somewhat lower than that provided in other European countries, virtually the entire population is covered by the Portuguese National Health Service (Serviço Nacional de Saúde; SNS) or insurance schemes that offer an SNS-based broad benefits package (3). The organizational structure of the SNS includes a single central national authority and multiple regional authorities and thus mirrors the general structure of the health system in Spain (54, 55).

Portugal has a relatively large number of physicians who are paid comparatively moderate salaries in relation to the average incomes reported nationwide (3, 56). According to Matesanz et al. (53), this scenario will facilitate the implementation of financial incentives and thus the successful adaption of the Spanish model (53).

Portugal is home to comparatively few intensive care unit (ICU) beds given the size of its population. When donation rates in Portugal peaked in 2010, the number of available ICU beds *per capita* was at the low end of the spectrum in Europe; the number of critical care beds *per capita* was around half that reported to be available in Spain (4). However, the number of ICU beds has increased as part of the strategies to deal with the COVID-19 pandemic. As a result, latest available data shows a total number

of 891 ICU-beds corresponding to approximately 8.6 ICU-beds per 100.000 inhabitants (57, 58). This number is still significantly below the Organization for Economic Co-operation and Development (OECD) average, but only slightly below that reported in Spain (59). Therefore, ICU capacity may have been a limitation for Portugal in the past, but the recent growth in capacity might facilitate organ donation and transplantation in the future.

Age and health status of the general population and the number of fatal accidents are relevant parameters in organ donation and transplantation (53). In Portugal, the fraction of the population over 65 years of age continues to grow and 50% of these individuals have been diagnosed with at least one chronic condition (3, 60). Accordingly, the number of organ donors that died due to medical reasons (most prominently cardiovascular events) has increased over time (61).

At the same time, there has been a significant reduction in the number of fatal traffic accidents in the country over the past 20 years (62). Accordingly, slightly fewer organ donors have died of trauma in the past 10 years, accounting for only 20% of all organ donors in 2021.

In summary, an aging demographic in Portugal may serve to maintain a sufficient pool of potential donors, compensating for a decrease in trauma-related deaths. However, donations from elderly, comorbid donors may lead to challenges regarding the quality of organs in the future.

Finally, largely due to their geographic proximity, Spain and Portugal share numerous cultural features, including a similar history of governmental and economic development in the 19th through the 21st centuries (63) as well as parallel views on end-of-life care that are linked to strong family and community ties and the influence of Catholicism (64). These similar cultural contexts have likely supported the successful adaptation of Spanish policies that are currently in use in the Portuguese program.

Taken together, Portugal fulfills many criteria that have been suggested to facilitate the adoption of the Spanish model. This may provide at least a partial explanation of Portugal's success compared to that experienced by European countries of similar size and with similar financial resources.

The findings presented in this study are based on a comprehensive contemporary review of the Portuguese organ donation and transplantation program. Our results reflect a broad range of evidence, including a thorough search of both the academic and grey literature followed by expert review and synthesis using a multi-dimensional framework approach. The study summarizes key features of the program, including some findings that were described in previous analyses. Our study also highlights several complementary aspects and recent developments in Portugal. However, among the limitations of this study, we were unable to explore the post-transplant follow-up or research and development and focused on the time period prior to the disruption of COVID-19. Future studies of the Portuguese organ donor and transplant system might focus on post-transplant follow-up, and the role of professional societies in Portugal and might cover more recent developments in more detail.

In conclusion, Portugal has become a world leader in organ donation and transplantation largely because of its successful adaptation and adoption of the main components of the highly effective Spanish system. Thus, the Portuguese experience provides a valuable example to other countries with modest resources seeking to achieve higher rates of donation and transplantation. As outlined above, the Portuguese case provides evidence to support the implementation of a specific set of reforms that may also be used in other settings and contexts. However, Portugal has benefitted from several conditions that have facilitated its strong partnership with Spain and the successful implementation of the Spanish model. These advantages include its close cultural and geographical proximity in the Iberian peninsula as well as a similar economy and health system structure. We recognize that this situation is unique and that other countries may not necessarily have the capacity to build on these specific factors. Thus, while countries seeking to reform their national transplant systems should certainly be inspired by the Portuguese example, they also need to accommodate for local context and build on their individual strengths.

DATA AVAILABILITY STATEMENT

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author.

AUTHOR CONTRIBUTIONS

All authors listed have made a substantial, direct, and intellectual contribution to the work and approved it for publication.

CONFLICT OF INTEREST

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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REFERENCES

1. Johnston-Webber C, Mah J, Streit S, Prionas A, Wharton G, Mossialos E, et al. A Conceptual Framework for Analyzing and Comparing National Organ Donation and Solid Organ Transplantation Programmes. *Transpl Int* (2023) 36:11006. doi:10.3389/ti.2023.11006
2. Mah J, Johnston-Webber C, Prionas A, Bušić M, Streit S, Wharton G, et al. Organ Donation in Croatia: The Importance of a National Champion, a Comprehensive Plan, and International Collaborations. *Transpl Int* (2023) 36:11011. doi:10.3389/ti.2023.11011
3. OECD. *Portugal: Country Health Profile 2021*. Paris: Organisation for Economic Co-operation and Development (2021). Available from: https://www.oecd-ilibrary.org/social-issues-migration-health/portugal-country-health-profile-2021_8f3b0171-en (Accessed February 12, 2023).
4. Rhodes A, Ferdinande P, Flaatten H, Guidet B, Metnitz PG, Moreno RP. The Variability of Critical Care Bed Numbers in Europe. *Intensive Care Med* (2012) 38(10):1647–53. doi:10.1007/s00134-012-2627-8
5. World Health OrganizationOrganización Nacional de Trasplantes. *WHO-ONT Global Observatory on Organ Donation and Transplantation*. GODT (2023). Available from: http://www.transplant-observatory.org/ (Accessed February 12, 2023).
6. In: B Dominguez-Gil, editor. Newsletter Transplant. *International Figures on Donation and Transplantation 2018*, 24 (2019). p. 42–4.
7. The Australian Organ and Tissue Donation and Transplantation Authority. *International Approaches to Organ Donation Reform*. (Fact Sheets). The Australian Organ and Tissue Donation and Transplantation Authority (2013).
8. European Commission. *Unmet Health Care Needs Statistics*. Eurostat (2021). Available from: https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Unmet_health_care_needs_statistics (Accessed February 12, 2023).
9. OECD. *Health at a Glance 2021: OECD Indicators*. Paris: OECD Publishing (2021). Available from: https://www.oecd-ilibrary.org/social-issues-migration-health/health-at-a-glance-2021_ae3016b9-en (Accessed February 12, 2023).
10. ERA-EDTA Registry. *ERA-EDTA Registry Annual Report 2019*. Amsterdam, the Netherlands: UMC, Department of Medical Informatics (2021). Available from: https://www.era-online.org/wp-content/uploads/2022/11/ERA-Registry-Annual-Report-2019.pdf (Accessed January 7, 2023).
11. Bikbov B, Purcell CA, Levey AS, Smith M, Abdoli A, Abebe M, et al. Global, Regional, and National burden of Chronic Kidney Disease, 1990–2017: a Systematic Analysis for the Global Burden of Disease Study 2017. *Lancet* (2020) 395(10225):709–33. doi:10.1016/S0140-6736(20)30045-3
12. Johnston-Webber C, Mah J, Prionas A, Streit S, Wharton G, Bušić M, et al. *National Plan for Solid Organ Donation and Transplantation*. Onassis Foundation; Imperial College London; The London School of Economics & Political Science (2021).
13. Instituto Portugues do Sangue e da Transplantacao, IP. IPST. *Legislação; Transplantação* (2023). Available from: https://ipst.pt/index.php/pt/legis-transplanatcao (Accessed February 5, 2023).
14. Domínguez-Gil B, Martín MJ, Valentín MO, Scandroglio B, Coll E, López JS, et al. Decrease in Refusals to Donate in Spain Despite No Substantial Change in the Population's Attitude towards Donation. *Organs Tissues Cells* (2010) 13: 17–24. doi:10.1016/S0140-6736(20)30045-3
15. Matesanz R, Dominguez-Gil B. Strategies to Optimize Deceased Organ Donation. *Transplant Rev* (2007) 21(4):177–88. doi:10.1016/j.trre.2007.07.005
16. Instituto Portugues do Sangue e da Transplantacao, IP. IPST. *Doação e Transplantação; Registo Nacional de Não Dadores (RENNDA)* (2023). Available from: https://www.ipst.pt/index.php/pt/rennda (Accessed February 5, 2023).
17. Deutsche Stiftung Organtransplantation. Report on the General European Situation: Technical, Legal and Socio-Sanitary point of View. Report No.: Deliverable 2.1. In: *DOPKI - Improving the Knowledge and Practices in Organ Donation*. Organización Nacional de Trasplantes (2006). Available from: http://www.ont.es/internacional/Documents/DOPKI.pdf (Accessed February 12, 2023).
18. European Commission. *Action Plan on Organ Donation and Transplantation (2009-2015): Strengthened Cooperation between Member States* (2008). Available from: https://ec.europa.eu/health/ph_threats/human_substance/oc_organs/docs/organs_action_en.pdf (Accessed April 23, 2023).
19. Portuguese Ministry of Health. *Government Ordinance No. 357/2008 of May 9th; Regulations Regarding the National Procurement and Transplantation Coordination Network* (2008). Available from: http://www.ipst.pt/files/IPST/LEGISLACAO/Legislacao_Nacional/Legislacao_Transplantacao/Portaria_357_2008.pdf.
20. DTI. *Training*. DTI-TPM Foundation (2022). Available from: https://tpm-dti.com/en-training/ (Accessed January 7, 2023).
21. Portuguese Medical Association. *DR No. 235. Series I-B* (1994). Available from: http://www.ipst.pt/files/IPST/LEGISLACAO/Legislacao_Nacional/Legislacao_Transplantacao/Declaracao_Ordem_Medicos.pdf (Accessed on April 23, 2023).
22. Directorate General Health and Consumers. *Eurobarometer: Organ Donation and Transplantation*. European Commission (2003). Available from: https://europa.eu/eurobarometer/surveys/browse/all/series/300790 (Accessed January 7, 2023).
23. Directorate General Health and Consumers. *Eurobarometer:Organ Donation and Transplantation*. European Commission (2007). Available from: https://europa.eu/eurobarometer/surveys/browse/all/series/300790 (Accessed January 7, 2023).
24. Directorate General Health and Consumers. *Eurobarometer: Organ Donation and Transplantation*. European Commission (2010). Available from: https://europa.eu/eurobarometer/surveys/browse/all/series/300790 (Accessed January 7, 2023).
25. Global report on organ donation and transplantation. *Activity and Legislative & Organizational Issues*. Global observatory on Donation and Transplantation (2020). Available from: https://www.transplant-observatory.org/wp-content/uploads/2022/07/2020-Global-report-para-web.pdf (Accessed January 7, 2023).
26. Viñuela-Prieto JM, Escarpa Falcón MC, Candel FJ, Mateos Rodríguez A, Torres González JI, del Río Gallegos F. Family Refusal to Consent Donation: Retrospective Quantitative Analysis of its Increasing Tendency and the Associated Factors over the Last Decade at a Spanish Hospital. *Transplant Proc* (2021) 53(7):2112–21. doi:10.1016/j.transproceed.2021.07.026
27. Shrine of Fatima. *30 Nov. a 3 Dez.: XXII Encontro Nacional da Pastoral da Saúde*. Santuário de Fátima (2009). Available from: https://www.fatima.pt/pt/news/30-nov-3-dez-xxii-encontro-nacional-pastoral-saude (Accessed February 18, 2023).
28. Webteam F *Força Aérea Portuguesa* (2020). Available from: https://www.emfa.pt/esquadra-41-esquadra-504-linces (Accessed December 10, 2020).
29. GNR. *Communication - Dia Nacional da Doação de Órgãos* (2021). Available from: https://www.gnr.pt/comunicado.aspx?linha=4569 (Accessed February 18, 2023).
30. European Commission. *Accord Achieving Comprehensive Coordination in Organ Donation*. What is Accord?/Participating Partners (2012). Available from: http://www.accord-ja.eu/landing-partners (Accessed February 18, 2023).
31. Universitat de Barcelona. *ODEQUS - Organ Donation European Quality System*. Partners Directory (2010). Available from: http://www.odequs.eu/partners.html (Accessed February 18, 2023).
32. Manyalich M, Guasch X, Gomez MP, Páez G, Teixeira LODEQUS Consortium. Organ Donation European Quality System: ODEQUS Project Methodology. *Transpl Proc* (2013) 45(10):3462–5. doi:10.1016/j.transproceed.2013.09.009
33. European Commission. *Train the Trainers | EuDonOrgan* (2017). Available from: https://eudonorgan.eu/about-the-project/train-the-trainers/ (Accessed February 18, 2023).
34. Bouwma R, Wiegers T, van Schoten S, Coppen R, Friele R. *Study on the Uptake and Impact of the EU Action Plan on Organ Donation and Transplantation (2009-2015) in the EU Member States*. European Commission (2017). Available from: https://health.ec.europa.eu/system/files/2019-03/2017_euactionplan_2009-2015_impact_exe_en_0.pdf (Accessed January 7, 2023).
35. European Kidney Health Alliance (EKHA). *Italy and Spain Achieve First International Cross-Kidney Transplantation*. EKHA - European Kidney Health Alliance (2018). Available from: http://ekha.eu/blog/italy-and-spain-achieve-first-international-cross-kidney-transplantation/ (Accessed Febuary 18, 2023).

36. Legido-Quigley H, Karanikolos M, Hernandez-Plaza S, de Freitas C, Bernardo L, Padilla B, et al. Effects of the Financial Crisis and Troika Austerity Measures on Health and Health Care Access in Portugal. *Health Policy* (2016) 120(7): 833–9. doi:10.1016/j.healthpol.2016.04.009
37. Sakellarides C, Castelo-Branco L, Barbosa P, Azevedo H. *The Impact of the Financial Crisis on the Health System and Health in Portugal*. European Observatory on Health Systems and Policies (2014). p. 56.
38. Coelho AP, Sá HO, Diniz JA, Dussault G. The Integrated Management for Renal Replacement Therapy in Portugal. *Hemodialysis Int* (2014) 18(1): 175–84. doi:10.1111/hdi.12064
39. ERA Registry. *ERA Registry Annual Report 2020*. Amsterdam, the Netherlands: Amsterdam UMC, Department of Medical Informatics (2022). Available from: https://www.era-online.org/wp-content/uploads/2022/12/ERA-Registry-Annual-Report2020.pdf (Accessed February 18, 2023).
40. Presidência do Conselho de Ministros. *Despacho n.º2289/2020, de 18 de fevereiro* (2020). Available from: http://www.ipst.pt/files/IPST/LEGISLACAO/Legislacao_Nacional/Legislacao_Geral/Despacho_2289_2020_Estabelece_disposicoes_ComissaoNacionalAcompanhamentoDialise.pdf (Accessed April 23, 2023).
41. de Almeida EAF, Raimundo M, Coelho A, Sá H. Incidence, Prevalence and Crude Survival of Patients Starting Dialysis in Portugal (2010–16): Analysis of the National Health System Individual Registry. *Clin Kidney J* (2021) 14(3): 869–75. doi:10.1093/ckj/sfaa023
42. Instituto Portugues do Sangue e da Transplantacao, IP. IPST. *Protocolo de avaliação psicológica e psiquiátrica pré e pós-doação em vida*. Nº 003/INF-IPST, IP/18 (2018). Available from: http://www.ipst.pt/files/TRANSPLANTACAO/transplantacao_Circular_Normativa_03_de_2018.pdf (Accessed April 23, 2023).
43. Portuguese Ministry of Health. *Decreto-Lei n.º 168/2015 de 21 de agosto* (2015). Available from: http://www.ipst.pt/files/IPST/LEGISLACAO/Legislacao_Nacional/Legislacao_Transplantacao/Dec_Lei_168_2015_protecao_dador_vivo_orgaos_dadiva_e_colheita.pdf (Accessed April 23, 2023).
44. In: B Dominguez-Gil, editor. Newsletter Transplant. *International Figures on Donation and Transplantation 2019*, 25 (2020). p. 51–3.
45. Global Observatory on Donation and Transplantation. *Country Summary: Portugal*. GODT (2019). Available from: https://www.transplant-observatory.org/summary/ (Accessed February 18, 2023).
46. Biró P, Haase-Kromwijk B, Andersson T, Ásgeirsson EI, Baltesová T, Boletis I, et al. Building Kidney Exchange Programmes in Europe—An Overview of Exchange Practice and Activities. *Transplantation* (2019) 103(7):1514–22. doi:10.1097/TP.0000000000002432
47. Portuguese Ministry of Health. *Government Order No. 14341/2013 of November 6th* (2013). Available from: https://dre.pt/dre/detalhe/despacho/14341-2013-3313599 (Accessed April 23, 2023).
48. Roncon-Albuquerque R, Gaião S, Figueiredo P, Príncipe N, Basílio C, Mergulhão P, et al. An Integrated Program of Extracorporeal Membrane Oxygenation (ECMO) Assisted Cardiopulmonary Resuscitation and Uncontrolled Donation after Circulatory Determination of Death in Refractory Cardiac Arrest. *Resuscitation* (2018) 133:88–94. doi:10.1016/j.resuscitation.2018.10.016
49. In: B Dominguez-Gil, editor. Newsletter Transplant. *International Figures on Donation and Transplantation 2021*, 27 (2022). p. 46–8.
50. Aubert O, Yoo D, Zielinski D, Cozzi E, Cardillo M, Dürr M, et al. COVID-19 Pandemic and Worldwide Organ Transplantation: a Population-Based Study. *Lancet Public Health* (2021) 6(10):e709–19. doi:10.1016/S2468-2667(21)00200-0
51. In: B Dominguez-Gil, editor. Newsletter Transplant. *International Figures on Donation and Transplantation 2020* (2021). Available from: https://freepub.edqm.eu/publications (Accessed January 7, 2023).
52. IPST. *Doação e Transplantação de Órgãos, Tecidos e Células - Atividade Nacional*. Janeiro de 2020 a Julho 2021. IPST, IP - Dados Estatísticos - Transplantação (2021). Available from: https://www.ipst.pt/index.php/pt/dados-estatisticos-transplantacao (Accessed February 20, 2022).
53. Matesanz R. Factors Influencing the Adaptation of the Spanish Model of Organ Donation. *Transpl Int* (2003) 16(10):736–41. doi:10.1007/s00147-003-0623-1
54. Simões J, Augusto GF, Fronteira I, Hernández-Quevedo C. Portugal: Health System Review. *Health Syst Transit* (2017) 19(2):1–184.
55. Bernal-Delgado E, García-Armesto S, Oliva J, Sánchez Martínez FI, Repullo JR, Peña-, et al. Spain: Health System Review. In: *Health Systems in Transition* (2018). Available from: https://eurohealthobservatory.who.int/publications/i/spain-health-system-review-2018 (Accessed January 7, 2023).
56. OECD Health Statistics 2021OECD Employment Database. Remuneration of Doctors (General Practitioners and Specialists). In: *Health at a Glance 2021: OECD Indicators*. OECD Publishing (2021). Available from: https://www.oecd-ilibrary.org/sites/ae3016b9-en/1/3/8/5/index.html?itemId=/content/publication/ae3016b9-en&_csp_=ca413da5d44587bc56446341952c275e&itemIGO=oecd&itemContentType=book.
57. Statistics Portual. *Estatísticas da Saúde - 2020*. Report No.: Edição 2022. Lisboa, Portugal (2022). Available from: https://www.ine.pt/xportal/xmain?xpid=INE&xpgid=ine_publicacoes&PUBLICACOESpub_boui=436989156&PUBLICACOEStema=55538&PUBLICACOESmodo=2 (Accessed February 11, 2023).
58. The World Bank Group. *Population, Total - Portugal*. Data. 2022 (2022). Available from: https://data.worldbank.org/country/portugal?view=chart (Accessed February 11, 2023).
59. OECD. *Health at a Glance 2021: OECD Indicators. Figure 5.18. Adult Intensive Care Beds, 2029 (Or Nearest Year) and 2020*. Paris: OECD Publishing (2021). Available from: https://www.oecd-ilibrary.org/docserver/ae3016b9-en.pdf?expires=1676720944&id=id&accname=guest&checksum=67E5342059ED2338415DD984F18AAEA9 (Accessed February 18, 2023).
60. Fundação Francisco Manuel dos Santos. *Ageing index 2021*. PORDATA - Statistics about Portugal and Europe (2021). Available from: https://www.pordata.pt/en/europe/ageing+index-1609 (Accessed February 21, 2023).
61. Margarida Ivo da Silva. *Doação e Transplantação de Órgãos, Tecidos e Células Atividade Nacional Anual 2021*. IPST (2021). Available from: https://www.ipst.pt/files/TRANSPLANTACAO/DOACAOETRANSPLANTACAO/Dados_Anuais_Atividade_Doacao_Transplantacao2021_versao_integral_para_publicacao.pdf (Accessed February 21, 2023).
62. European CommissionDirectorate-General for Mobility and Transport (DG MOVE). *Road Traffic Deaths*. Eurostat (2021). Available from: https://ec.europa.eu/eurostat/databrowser/view/SDG_11_40/default/bar?lang=en&category=sdg.sdg_03 (Accessed February 18, 2023).
63. Fishman RM, Lizardo O. How Macro-Historical Change Shapes Cultural Taste: Legacies of Democratization in Spain and Portugal. *Am Sociol Rev* (2013) 78(2):213–39. doi:10.1177/0003122413478816
64. Meñaca A, Evans N, Andrew EVW, Toscani F, Finetti S, Gómez-Batiste X, et al. End-of-life Care across Southern Europe: A Critical Review of Cultural Similarities and Differences between Italy, Spain and Portugal. *Crit Rev Oncol Hematol* (2012) 82(3):387–401. doi:10.1016/j.critrevonc.2011.06.002

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Ten Lessons From the Spanish Model of Organ Donation and Transplantation

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The organ donation and transplantation program in Spain has long been considered the gold standard worldwide. An in-depth understanding of the Spanish program may promote the development and reform of transplant programs in other countries. Here, we present a narrative literature review of the Spanish organ donation and transplantation program supplemented by expert feedback and presented according to a conceptual framework of best practices in the field. Core features of the Spanish program include its three-tiered governing structure, close and collaborative relationships with the media, dedicated professional roles, a comprehensive reimbursement strategy, and intensive tailored training programs for all personnel. Several more sophisticated measures have also been implemented, including those focused on advanced donation after circulatory death (DCD) and expanded criteria for organ donation. The overall program is driven by a culture of research, innovation, and continuous commitment and complemented by successful strategies in prevention of end-stage liver and renal disease. Countries seeking ways to reform their current transplant systems might adopt core features and may ultimately aspire to include the aforementioned sophisticated measures. Countries intent on reforming their transplant system should also introduce programs that support living donation, an area of the Spanish program with potential for further improvement.

Keywords: organ donation, organ transplantation, transplantation policy, transplant program, Spain

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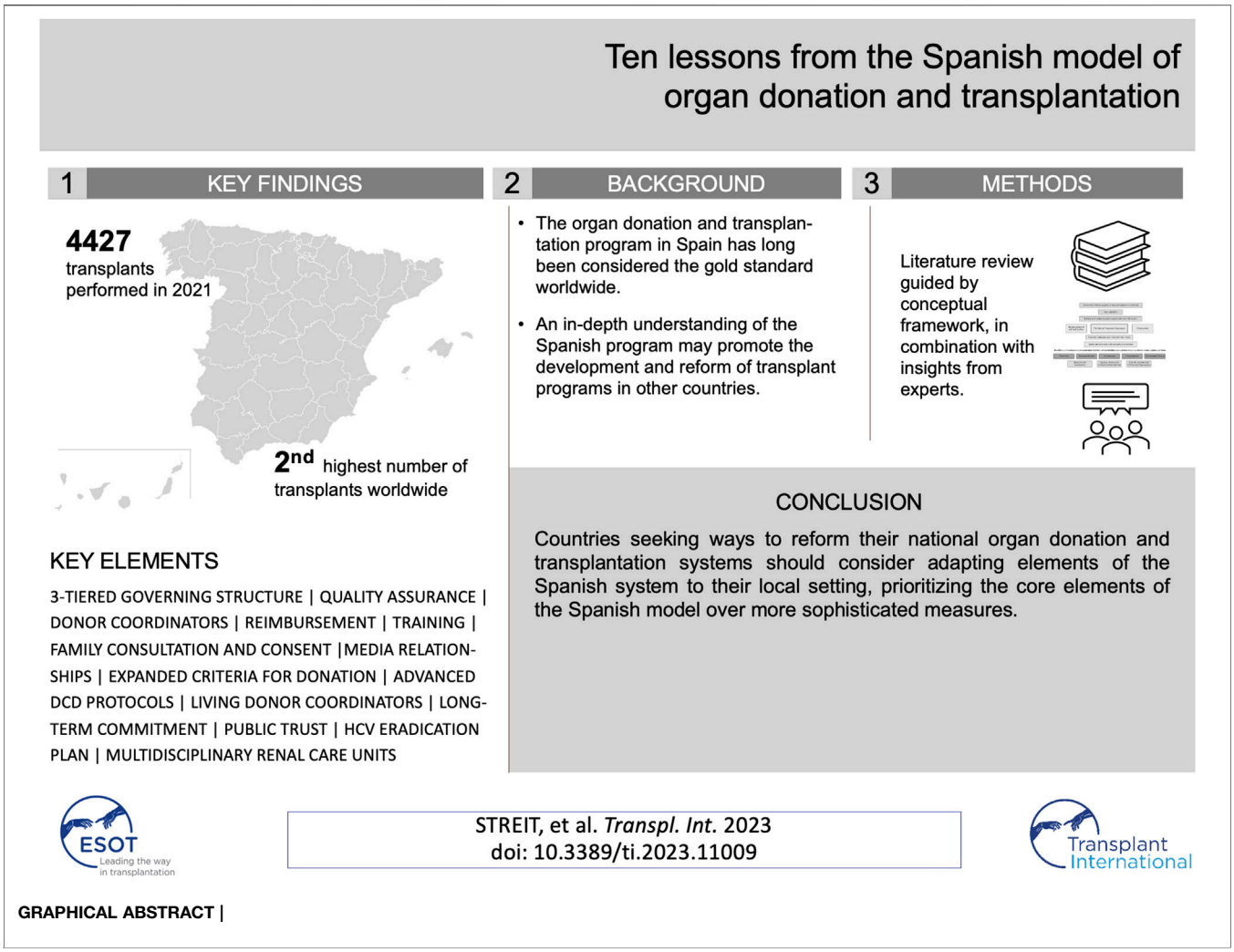
INTRODUCTION

National transplantation rates in Europe vary substantially. Before the global COVID-19 pandemic, the number of patients receiving a transplant in the European Union ranged from 114.8 per million population (pmp) in Spain to only 7.6 pmp in Bulgaria (1). Of note, while these differences do not necessarily correlate with the availability of resources (2, 3), they do highlight the need for countries to learn from one another in order to identify ways to build better organ donation and transplantation programs.

Like other European countries, Spain has an aging demographic potentially at risk of organ failure. Additionally, high smoking rates, obesity, and alcohol consumption contribute to organ failure (**Table 1**). As a result, there is a substantial prevalence of people with chronic kidney disease and patients maintained on renal replacement therapy (**Table 1**).



GRAPHICAL ABSTRACT |

In response, Spain has built a world-leading transplantation program with limited financial resources compared to other European countries (**Table 1**). Thus, a careful evaluation of the Spanish program may provide useful and important lessons for other countries. Donation rates in Spain have been the highest worldwide for many years (1, 4–6). The Spanish organ donation and transplantation organization has also taken a leading role in global efforts to improve transplant programs *via* its participation in projects that include the European Union (EU) Action Plan on Organ Donation and Transplantation and the Global Observatory on Donation and Transplantation (7, 8). Consequently, many academic publications and government reports are available that review the key policies of the Spanish transplant program (9–12). Previous analyses of the Spanish organ donation and transplantation program have highlighted features including its three-tiered system of governance, availability of ample professional teaching opportunities, comprehensive reimbursement scheme, and proactive relationships with the media (10, 12, 13). Recent reviews have also highlighted several advanced clinical protocols, including methods used to identify potential donors in locations other than intensive care units (ICUs) as well as the pursuit of expanded criteria for donation and DCD (11).

This study aims to provide an updated review of the Spanish transplant system and to assemble both existing and complementary findings within a conceptual framework that was recently developed to guide the comprehensive analysis of organ donation and transplantation programs (14). We anticipate that this effort will permit us to identify critical information that may assist other countries in efforts to develop or reform their national programs.

MATERIALS AND METHODS

This paper is based on a report that focused on the Spanish organ donation and transplantation program as part of a comprehensive document that provided information relevant to program reform in Greece (20). The manuscript presents the findings from this report that have been updated and restructured according to the best practices conceptual framework.

As a first step, we performed a narrative review of the literature focused on the Spanish transplant system. Relevant academic

TABLE 1 | Health system financing and population health in Spain: key statistics.

Health system	References
• Mainly tax-funded national health system	(15)
• Health spending *per capita*, EUR 2488; EU average, EUR 3523	(15)
• Health spending as a percentage of the gross domestic product, 9.1%; EU average, 9.9%	(15)
• Public spending as a percentage of the total health expenditure, 70.6%; EU average, 79.7%	(15)
• Out-of-pocket payments as a percentage of the total health expenditure, 21.8%; EU average, 15.4%	(15)
• Percentage of the population reporting an unmet need for medical care, 0.2%; EU average, 1.7%	(15)
Health status	
• Percentage of the population over 65 years of age, 20%; EU average, 20.6%	(16)
• Life expectancy, 84 years; EU average, 80.6 years	(15)
• Percentage of the adult population that smokes daily, 19.8%; OECD average, 16.5%	(17)
• Liters of alcohol consumed *per capita* per year, 10.7L; OECD average 8.7L	(17)
• Percentage of adults that are overweight or obese (BMI >25), 50.2%; OECD average, 56.4%	(17)
• Individuals maintained on renal replacement therapy, incidence 152 pmp	(18)
• Individuals maintained on renal replacement therapy, prevalence 1,368 pmp	(18)
• Age-standardized prevalence of chronic kidney disease, 5%; global, 8.7%	(19)

EUR, Euro; EU, European Union; OECD, Organisation for Economic Co-operation and Development; BMI, body mass index.

literature was identified by searching the PubMed database using the keywords "Spain" and "organ donation and transplantation". Relevant grey literature was also collected from Google search, including key documents obtained from the website of the National Transplant Organization (NTO) in Spain. The literature review was complemented by an expert consultation with author Dr. Daniel Casanova, professor of transplant surgery at the University Hospital Valdecilla in Spain and former president of the transplant division of the European Union of medical specialists. In a first interview, Dr. Casanova presented key features of the Spanish system and answered open questions. In the following correspondence, he provided additional data, including family refusal rates. He also answered questions regarding clinical practices, pre-mortem cannulation, legislation, and reimbursement practices and provided additional literature for review.

The final set of findings was structured according to the organ donation and transplantation program domains described by Johnston-Webber et al. (14) (**Figure 1**). The analysis focused on structures, processes, and distinctive features of the system corresponding to domains of the framework. For each domain, we first present the relevant key features of the Spanish transplant system. We then suggest specific policies from the Spanish system that might be adopted by other countries seeking to develop or improve their national programs.

RESULTS

Context and Trends Identified in the Spanish Transplant System

With €2,488 *per capita* spending on healthcare, the Spanish health system has fewer resources compared to the European average, both in absolute terms and relative to its economic capacity (15). In Spain, 70.6% of healthcare expenditure is based on public revenue, most of which is collected by general taxation (15). At the same time, a significant proportion of healthcare expenditure (21.8%) comes from out-of-pocket spending, mostly on pharmaceuticals (15).

Except for private providers who have been commissioned to reduce waiting lists, most healthcare services are planned and provided by the public sector (15, 21). While strategic planning and regulatory frameworks are developed at a national level, services are organized and provided by 17 regional authorities (15, 21). There is a strong emphasis on primary care with a focus on its role in gatekeeping and directing specialist care (21).

Historically, the basic organizational structure of the Spanish health system was built on the democratic Spanish constitution that was ratified in 1978 (22). The Spanish organ donation and transplantation program was initiated approximately one decade later and was built on a set of concerted reform initiatives. Major milestones in the development of the Spanish program include the implementation of dedicated institutions (1989), the introduction of DCD as part of the 40 donors pmp plan (2007), and the 50 × 22 strategic plan that further developed donation protocols promoting intensive care to facilitate organ donation, expanded donation criteria, and developed pediatric donation strategies (2018) (10–12, 23).

Largely due to these reforms, transplantation rates in Spain increased continuously and peaked at an all-time high of 5,449 transplants performed in 2019 (1). Donation and transplantation rates dropped by about 19% in 2020–4,427 transplants due to the impact of the COVID-19 pandemic (24). In the following year, the transplantation rate in Spain recovered, with 4,781 organs transplanted in 2021 (25).

Internationally, these rates are the second-highest pmp in the world and are surpassed only by transplantation rates reported in the United States of America (25). Also, Spain continues to hold the record for the highest rate of deceased donations worldwide (25).

Key Elements and Policies Leading to Transplant Reform

The following sections present the results of the literature review that highlight ten key features of the Spanish organ donation and transplantation program which have been central to its success

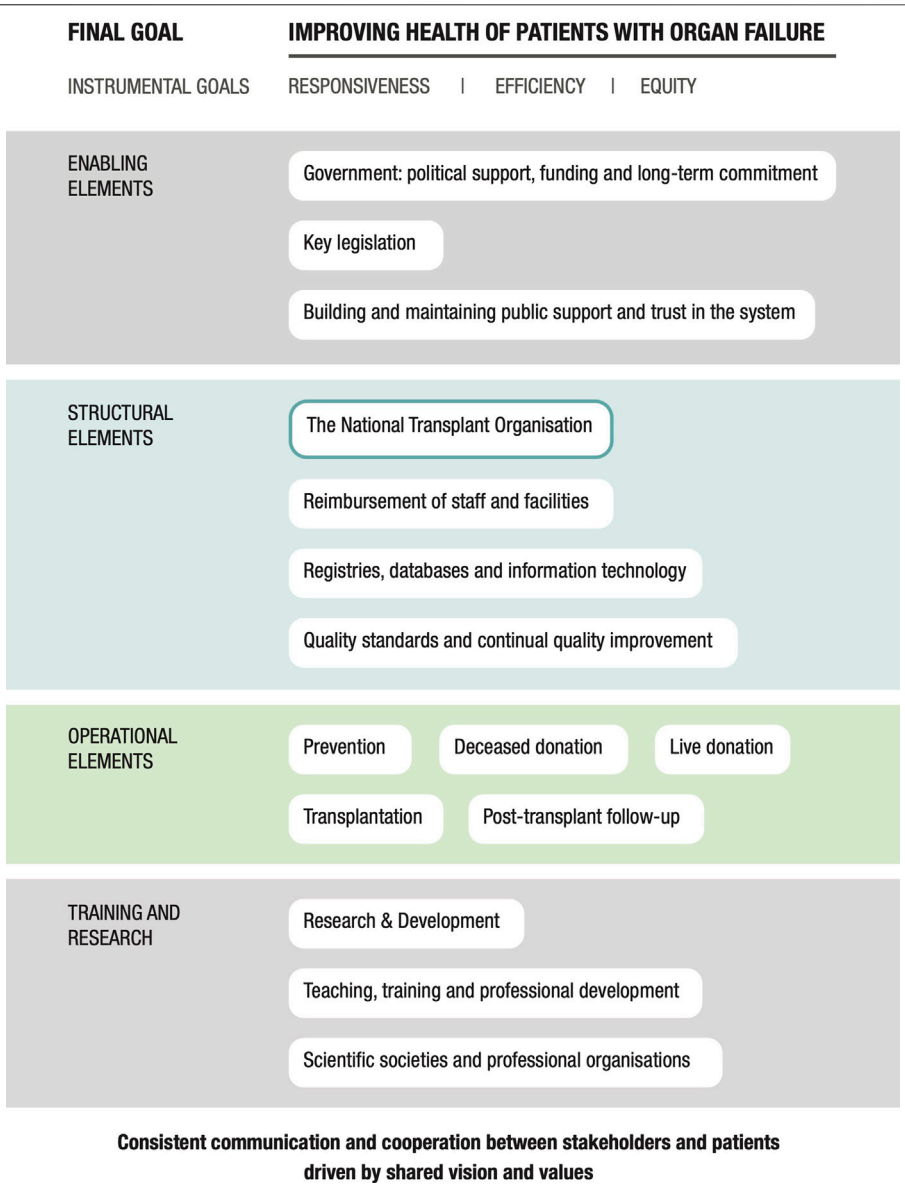


FIGURE 1 | Goals and domains that build a successful transplant system (14).

(**Table 2**). Many of these points may be adopted by other countries that are attempting to develop and/or reform their own national programs. We have also highlighted some areas of weak performance that may need to undergo further improvement.

Enabling Elements

Government: Political Support, Funding, and Long-Term Commitment

Spain Illustrates the Rewards of Long-Term Commitment to Transplantation Policy

The Spanish organ donation and transplantation program has undergone continuous development over the past four decades. While key legislation initially established the program in 1979, core features of the "Spanish model", including the appointment of donor transplant coordinators, development of training opportunities, and the three-tiered governing structure were all established over the 30 years that followed (10–13). Initial reforms focused on deceased donation after brain death (DBD) (10–13). Further reforms focused on several advanced clinical protocols including DCD, efforts to identify possible donors from sources other than ICUs, as well as expanded donation criteria (11). Finally, efforts to increase the rate of deceased donation have been complemented by increased activity in the field of living donation (23, 24).

These developments highlight the continuous commitment of the stakeholders in the Spanish transplant system and their ongoing efforts to improve the system even after achieving world leadership. Countries seeking to reform their transplant systems must be aware of the long-term commitment that is necessary to achieve sustainable success.

TABLE 2 | Ten key features of the Spanish organ donation and transplantation program that may be adopted for use by other countries. These features are displayed according to the domains of the conceptual framework proposed by Johnston-Webber et al. (14).

Framework domain	Key features	Details
Enabling Elements: Government: Political Support, Funding, and Long-term Commitment	Long-term continuous governmental commitment and support for the program	Continuous commitment to ongoing reform and development over several decades has led to sustained success
Enabling Elements: Government: Legislation	A comprehensive legal framework accompanied by acceptable clinical protocols	Spain's well-established legal framework is complemented by clinical protocols that are acceptable to the general public. This is believed to have contributed to the high rate of deceased donations
Enabling Elements: Building and Maintaining Public Trust in the System	Policies in place that nurture a culture of trust and confidence in the organ donation and transplantation program	Extensive training of health professionals in communication skills, an excellent relationship with the media, and a focus on family consent are all factors that have helped to inspire public trust in the national program
Structural Elements: National Transplant Organization	Institutions specifically dedicated to donation and transplantation are developed and maintained on the national, regional, and hospital levels	Spain has implemented a three-tiered governing structure that encompasses the national, regional, and local levels. This may have contributed significantly to the program's success
Structural Elements: Quality Standards and Continual Quality Improvement	Continual quality assurance has been identified as a core strategy of the Spanish program	Standardized evaluation and reporting of donation activity, as well as both internal and external audits, are performed on a rolling basis. Performance metrics from individual hospitals are compared to one another
Structural Elements: Reimbursement of Staff and Facilities	There must be no financial barriers to organ donation or participation in transplantation activities	Spain has recognized the critical link between organ donation and reimbursement. Hospital budgets include specific funding for organ donation based on the previous year's activity
Operational Elements: Prevention	Broad public health measures and specialist policies must be developed to prevent end-stage organ failure	Spain has implemented policies that focus on limiting access to tobacco, improving food labeling, and promoting healthy eating. Multidisciplinary specialty clinics are tasked with providing care for patients with end-stage renal failure and a concerted national strategy was successfully implemented to reduce the prevalence of Hepatitis C. Spain might improve its efforts focused on strengthening secondary preventative measures in renal care
Operational Elements: Donation and Transplantation	Spain is currently applying strategies that facilitated deceased donation to improve rates of living donation	Spain has created a living donor coordinator role with clear and specific responsibilities similar to those of deceased donor coordinators
Training and Research: Teaching, Training, and Professional Development	Tailored training for professionals will provide essential skills, notably those needed for family consultations	Comprehensive, tailored teaching is an integral part of the Spanish program that most likely contributed significantly to its success. Spain offers both public and private training institutions that train all healthcare personnel involved in organ donation and transplantation
Training and Research: Research and Development	Foster a culture of innovation focused on strategy, technology, and the law	Expanding DCD has been identified as an important strategy to increase the donor pool. Advanced DCD protocols have been implemented that are supported by comprehensive legislative reform and clinical guidance

Government: Key Legislation

A Basic Legal Framework Must Be Complemented by Effective Clinical Protocols

As in other European countries, Spain has built a solid legislative framework that supports its institutions and consent policy as well as the regulation of the different modes of donation in a set of laws and royal decrees (25). From a purely legal standpoint, all Spanish citizens who have not specifically stated their unwillingness may be considered for organ donation. However, in clinical practice, donations are only pursued after family consultation and approval (26). This illustrates the fact that, despite the popularity of presumed-consent legislation, its importance should not be overemphasized. Thus, although a legislative framework is an essential component of a successful system, legislation must be complemented by protocols that are acceptable to the general public and professionals at a working level.

Building and Maintaining Public Support and Trust in the System

The Spanish Model Promotes High Donation Rates and a Transplant System That Meets Donor and Family Expectations

In Spain, the transplant system builds on a generally positive attitude towards donation which is more favorable than the European average and has stayed consistent across different

surveys for the past 30 years (26–31). Additionally, results from a recent study revealed a high level of trust specifically in the transplant system; the number of Spaniards who report a lack of trust in the national organ donation and transplantation program as a reason for opting out of organ donation is below the European average (27). Accordingly, the family refusal rate is considerably lower than that reported in other countries (32). These statistics reveal the success of the Spanish program not only in terms of the number of organs transplanted but also in gaining the confidence of donors, families, and the general public.

The success of the Spanish donation and transplantation program can most likely be attributed to policies that focus on trust and transparency. These include policies that support training opportunities for healthcare professionals that are focused on communication skills, family consultation, and consent (9, 28), direct communication with the media, including educational programs for journalists, and round-the-clock availability for consultation (29). Likewise, Spanish policy supports a conservative consent policy and practice that focuses on the needs of donor families (26).

Despite these efforts, some knowledge gaps among the general population regarding organ donation and population remain. For example, a recent survey indicated poor knowledge and consent for donation when individuals were provided with actual clinical scenarios of organ donation (30). Also, surveys revealed a lack of knowledge regarding current consent legislation both recently and in past years (30, 31). However, as indicated by the low rates of family refusal rates, these are issues that are successfully addressed in family consultations.

Taken together, building on a generally favorable attitude towards donation, the Spanish system has focused on preventing misconceptions and mistrust in the system by targeting the media and donor families directly rather than investing in broad awareness and education campaigns (26).

Other countries seeking to develop or reform their national programs might focus on building a similar culture of trust and transparency, as this is clearly essential for gaining the confidence of the general population and supporting high rates of organ donation.

Structural Elements

The National Transplant Organization (NTO)

Institutions Specifically Dedicated to Organ Donation and Transplantation Are Needed at the National, Regional, and Hospital Levels

Spain has implemented a three-tiered governing system that oversees this process (9). On a national level, the NTO is responsible for analyzing national developments in organ donation and transplantation, building a general national strategy in cooperation with relevant stakeholders, and implementing relevant regulations and guidelines (9, 10, 23). The NTO also coordinates transplantation logistics and provides 24-h support for healthcare professionals with information focused on donation protocols and regulations (9, 10). Spain also maintains 17 regional offices that reflect the distribution of autonomous regions as well as the structure of the health system in general (21, 33). The regional offices support strategic reform processes and coordinate organ transport (21). Finally, "donor transplant coordination units" have been implemented in Spanish donation hospitals (9, 10). These units include nurses and physicians, often with a background in intensive care medicine, who have been trained to carry out this responsibility and are accredited for their role in coordinating donation activity at the hospital level (9, 10, 34). These individuals are tasked with training other clinical staff members, identifying possible donors, evaluating medical suitability for donation, documenting donation activity, consulting with relatives, and coordinating the overall clinical pathway of donation (9, 10).

This three-tiered governing structure is currently considered to be a major contributor to the success of the Spanish model; it has been used as a framework for several other successful European organ donation and transplantation programs, for example, those currently in place in the United Kingdom, Portugal, and Italy (2, 3, 35, 36).

Quality Standards and Continual Quality Improvement

Standardized Evaluation and Reporting of Donation Activity as a Strategy to Improve Quality

An integral part of the Spanish organ donation and transplantation program is the national quality and benchmarking system led by the NTO (9). Hospitals are externally audited and donor transplant coordinators periodically collect and report on a set of indicators of donation activity. The data are reported for each autonomous region as a means to encourage accountability (5, 9), and differences in hospital performance are compared in an attempt to identify the potential for improvement at a local level as well as areas in need of strategic national reform (11). Continuous quality assurance is understood to be an essential component of the Spanish organ donation and transplantation program (11). Countries aiming to reform their programs should consider periodic quality evaluations, reporting, and feedback as vital strategies that might be developed to ensure continuous improvement.

Reimbursement of Staff and Facilities

Policymakers Should Review Reimbursements for Donation Activity in Order to Identify Any Financial Barriers to Participation

Similar to other medical procedures, donation and transplantation activities must be appropriately reimbursed and there should be no financial barriers to implementing and participating in these activities (14). Spanish officials have highlighted the critical link between organ donation activity and reimbursement. Hospital budgets in Spain are provided with funds to cover the costs of donation activity based on previous donation rates (13). Accordingly, countries seeking to reform their transplant systems should revisit their national reimbursement practices and identify potential financial barriers to donation.

Operational Elements

Prevention

Broad Public Health Policies and Specialty Care Models Should Be Used to Address End-Stage Renal Failure

As part of a wider public health initiative designed to reduce cardiovascular risk factors, Spain has limited access to tobacco products and improved both labeling and promotion of healthy foods (15). As cardiovascular risk factors are highly relevant to organ failure, most notably, renal disease (37, 38), these initiatives are promising from the perspective of the national transplantation program. Nonetheless, secondary programs focused on the prevention of organ failure need further improvement. In particular, current problems include comparatively late-stage referrals from primary to specialist care as well as suboptimal management of diabetes and arterial hypertension (39, 40). This is illustrated by comparably low rates of screening for high blood pressure (41). We recognize that these conditions may have developed given the increased pressure placed on the primary care system due to the overall increase in chronic conditions as well as budgetary constraints (15).

By contrast, the health system in Spain takes an innovative approach to tertiary prevention of end-stage renal disease. Specialty care for end-stage renal disease is organized in dedicated facilities known as "UERCA units." These units promote a multidisciplinary and quality-driven approach to this condition, including standardized protocols for transplant evaluation (42, 43).

Similarly, Spain has taken a multi-faceted approach to the prevention of end-stage liver disease. Following market access of novel antiviral drugs, the Ministry of Health developed a strategic plan that covered monitoring, prevention, and treatment of Hepatitis C Virus (HCV) infection (44). Specifically, the plan included a treatment registry and seroprevalence study, training programs for health professionals, promotion of harm reduction policies, clinical recommendations for HCV screening in primary care, patient guidance, clinical criteria and prioritization for antiviral treatment, and funding agreements (44). Efforts were coordinated by a dedicated committee of relevant stakeholders, combined with a detailed timeframe and performance indicators designed to monitor the success of this strategy (44). Strategies that include implementation and prioritization of treatment for patients with end-stage liver disease (including those on a transplant waiting list) have clearly met with success. Following the introduction of the strategic plan, both HCV-related hospitalizations and the number of patients on the liver transplant waiting list have significantly decreased (45–47).

Spain's implementation of broad public health policies, a specialty care model for end-stage renal failure, and a dedicated strategy focused on eradicating HCV infection are important elements of the national organ donation and transplantation program that should be adopted by other countries. While the Spanish healthcare system, in principle, maintains a strong focus on primary care (15), further progress is needed to address secondary prevention of renal failure. Nonetheless, a strong, interconnected primary care system is crucial to the efforts to prevent organ failure and thus reduce the burden on the organ transplantation program.

Donation and Transplantation

Applying Successful Strategies Used to Promote Deceased Donation to Encourage Living Donation

Living kidney donation rates in Spain lie slightly above the European average (25). Spanish authorities have identified several barriers to living donation including an overall lack of professional knowledge regarding the need for living donation, poor communication with patients, and a lack of knowledge regarding modern surgical techniques (48, 49). Currently, living donation is hampered by the limited coordination between transplant centers, few to no standardized protocols, and insufficient data available to address the overall process (49, 50). Key strategies have been implemented that are designed to overcome these barriers. These strategies include providing additional training opportunities, as well as creating professional guidelines and patient information materials; defining clear responsibilities for living donation coordinators; and implementing standard protocols for patient consultation, evaluation, and referral (48–50). Spain has also established a national and international cross-kidney exchange program and supported public campaigns designed to promote living donations (51, 52).

Thus, specific strategies that have worked well in efforts to promote deceased donation (i.e., assigning specific responsibility for program coordination, offering tailored training opportunities, and placing an emphasis on patient communication) have now been applied to the process of living donation. Strategies that prove to be successful may be considered and adopted by other countries seeking to reform their living donation practices.

Training and Research

Teaching, Training, and Professional Development

Efforts to Train Professionals Are Essential, Especially with Respect to Family Consultation and Communication Skills

Training healthcare professionals involved in organ donation and transplantation is particularly important in Spain (9, 53). Alongside private training institutions, specific public funding is dedicated to the training and accreditation of all professionals that participate in organ donation and transplantation (9, 34, 54). Training modules cover both specific steps along the clinical pathway of organ donation, including donor maintenance, as well as more general topics such as interacting with the media (9). Special emphasis has been placed on training donor transplant coordinators on how to communicate effectively with relatives. These efforts are believed to have contributed significantly to low rates of family refusal in Spain (9, 26). In summary, comprehensive and sustained teaching and training of professionals is another key component of the Spanish organ donation and transplantation program. Other countries should seek to implement national training efforts (and accreditation) or support training resources already available.

Research and Development

Fostering a Culture of Innovation Focused on Strategy, Technology, and the Law

The Spanish organ donation and transplantation program maintains an innovative spirit that can be illustrated by recent advances in the development of protocols designed to encourage DCD. Strategically, DCD donation has been identified as a means to expand the donor pool in Spain (11). Simultaneously, in pursuit of overcoming the technical limitations of DCD and improving graft survival, Spain has pioneered research in the field of normothermic regional perfusion. Transplant professionals apply pre-mortem heparinization to facilitate machine perfusion, use pre-mortem cannulation to monitor brain blood flow, and provide mobile ECMO units to local hospitals (55, 56). Cohorts of patients transplanted with normothermic regional perfusion are currently undergoing follow-up with promising preliminary results (55, 56). These technological advances have been supported by reforms that have legalized DCD and specified post-mortem intervals and clinical protocols to be used in these circumstances (55). Building on the pre-existing infrastructure in donation and transplantation, these advances have provided support for complex clinical protocols in which patients are transferred from emergency treatment into organ donation pathways within relatively short periods of time (55). Countries seeking to reform their organ donation and transplantation programs may wish to adopt some of these protocols. However, everyone needs to be aware of the technical, legal, and procedural preconditions that need to be in place in order to pursue these sophisticated donation pathways in a fully ethical manner.

DISCUSSION

The use of a systematic framework approach demonstrates clearly that the Spanish organ donation and transplantation program offers many examples of best practices across multiple domains. The findings in this review are consistent with previous evaluations of the Spanish system that have emphasized its leading role in organ donation and transplantation policy (9–11, 13). These findings also reflect those from studies that have highlighted successful adaptations of the Spanish program in both high- and low-resource settings (2, 3, 47).

This review also adds dimensions of the Spanish system that have not been integrated into previous reviews of the Spanish system. This study is the first to emphasize disease prevention of organ failure as a vital part of the organ donation and transplantation program in Spain. Despite successful prevention strategies for end-stage liver and renal disease and the large number of organs transplanted, there remains substantial demand. For example, the number of kidney transplants performed in 2019 (74 pmp) accounted for only 5.5% of the patients who began dialysis care during the same year (8, 18). This point illustrates the great importance of implementing demand-side measures designed to reduce the rate of end-organ failure and provides a new perspective on the Spanish transplant system.

Another novel aspect of this review is that it highlighted recent efforts to implement living donation policies. Although the Spanish program's focus on continuous reform is clearly reflected in its living donation policies, current performance falls behind countries such as Turkey, which has achieved exceptional rates for living donation through a combination of financial commitments, education initiatives, and integration of the private sector (48). Overall, this study synthesizes existing lessons learned from the experiences of the Spanish transplant system and also highlights elements that have not been the focus of previous analyses.

Although comprehensive in its approach, the review has several limitations. First, important dimensions of transplant systems, including information technology, infrastructure, and the role of professional societies are not specifically covered in this review. ICU capacity has been discussed in the literature as a factor to be considered when adapting the Spanish model for use by other countries (13, 57). Correspondingly, the importance of ICU capacity in the Spanish context was illustrated during the COVID-19 pandemic when donation rates fell sharply due to ICU occupancy by infected patients and shortages of healthcare personnel (58, 59). However, internationally, success in organ donation and transplantation does not appear to increase in linear proportion with ICU capacity. For example, although Germany has the highest ICU capacity of all OECD countries and has significantly more ICU beds than Spain, it has not achieved similar success in organ donation and transplantation (1, 60). By contrast, Croatia has shown great success in organ donation despite its low ICU capacity compared to other European countries (1, 61, 62). Taken together, it seems that while sufficient baseline ICU capacity in Spain has contributed to its success, this factor alone does not suffice. Future studies might consider the importance of ICU capacity as well as information technology and the role of professional societies in Spain in greater detail.

In conclusion, countries seeking to reform their organ donation and transplantation policies can learn from one another using Spain as a leader and a role model. Dedicated institutions, quality assurance processes, detailed reimbursement schemes, and comprehensive training programs are all crucial features that other countries might adopt while adapting them to their specific needs. The highest priority should be given to these areas, as these have served as critical foundations of the Spanish system and have worked well in other settings, including those with fewer resources (2, 35). Countries may be capable of achieving even higher rates of organ transplantation by fully exploiting the possibility of living donation and seeking additional input designed to direct policy reform in this area.

Once these measures have been implemented, public trust has been gained, and the supporting infrastructure has been deemed to be sufficient, the more sophisticated features of the Spanish program, including innovative DCD protocols, expanded criteria for donations, and admittance to ICU for donation purposes can also be adopted.

Of note, consent policy and broad public awareness campaigns have played a smaller role in the Spanish system. These areas of policy reform might be deprioritized in countries aiming to reform their transplant systems. Finally, the Spanish example illustrates that efforts to strengthen primary care and improve primary, secondary, and tertiary prevention of end-organ disease must be perceived as integral components of any organ donation and transplantation program. Investment in these areas might ease the high demand for organ transplantation in Spain as well as in other countries.

DATA AVAILABILITY STATEMENT

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author.

AUTHOR CONTRIBUTIONS

All authors listed have made a substantial, direct, and intellectual contribution to the work and approved it for publication.

CONFLICT OF INTEREST

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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REFERENCES

1. Dominguez-Gil B. International Figures on Donation and Transplantation 2019. *Newsl Transpl* (2020) 25:51–3.
2. Mah J, Johnston-Webber C, Prionas A, Bušić M, Streit S, Wharton G, et al. Organ Donation in Croatia: the Importance of a National Champion, a Comprehensive Plan, and International Collaborations. *Transpl Int* (2023) 36:11011. doi:10.3389/ti.2023.11011
3. Streit S, Johnston-Webber C, Mah J, Prionas A, Wharton G, Paulino J, et al. Lessons From the Portuguese Solid Organ Donation and Transplantation System: Achieving Success Despite Challenging Conditions. *Transpl Int* (2023) 36:11008. doi:10.3389/ti.2023.11008
4. Matesanz R. International Figures on Donation and Transplantation 2015. Newsletter Transplant (2016). Available from: https://freepub.edqm.eu/publications (Accessed January 7, 2023).
5. Organización Nacional de Trasplantes. Actividad de Donación y Trasplante España (2021). Available from: http://www.ont.es/infesp/Memorias/ACTIVIDAD%20DE%20DONACI%C3%93N%20Y%20TRASPLANTE%20ESPA%C3%91A%202021.pdf (Accessed January 7, 2023).
6. Dominguez-Gil B. International Figures on Donation and Transplantation 2018. *Newsl Transpl* (2019) 24:42–4.
7. Bouwma R, Wiegers T, van Schoten S, Coppen R, Friele R. Study on the Uptake and Impact of the EU Action Plan on Organ Donation and Transplantation (2009-2015) in the EU Member States (2017). European Commission. Available from: https://health.ec.europa.eu/system/files/2019-03/2017_euactionplan_2009-2015_impact_exe_en_0.pdf (Accessed January 7, 2023).
8. Organización Nacional de Trasplantes. Global Observatory on Organ Donation and Transplantation (2023). Available from: http://www.transplant-observatory.org/ (Accessed January 7, 2023).
9. Matesanz R, Dominguez-Gil B. Strategies to Optimize Deceased Organ Donation. *Transplant Rev* (2007) 21(4):177–88. doi:10.1016/j.trre.2007.07.005
10. Matesanz R, Domínguez-Gil B, Coll E, de la Rosa G, Marazuela R. Spanish Experience as a Leading Country: what Kind of Measures Were Taken?: Facing Organ Shortage in Spain. *Transpl Int* (2011) 24(4):333–43. doi:10.1111/j.1432-2277.2010.01204.x
11. Matesanz R, Domínguez-Gil B, Coll E, Mahíllo B, Marazuela R. How Spain Reached 40 Deceased Organ Donors Per Million Population. *Am J Transplant* (2017) 17(6):1447–54. doi:10.1111/ajt.14104
12. Organ and Tissue Authority. International Approaches to Organ Donation Reform. In: *The Australian Organ and Tissue Donation and Transplantation Authority* (2013). (Fact Sheets).
13. Matesanz R, Miranda B. A Decade of Continuous Improvement in Cadaveric Organ Donation: the Spanish Model. *J Nephrol* (2002) 15(1):22–8.
14. Johnston-Webber C, Mah J, Streit S, Prionas A, Wharton G, Mossialos E, et al. A Conceptual Framework for Evaluating National Organ Donation and Transplantation Programs. *Transpl Int* (2023) 36:11006. doi:10.3389/ti.2023.11006
15. OECD. *OECD/European Observatory on Health Systems and Policies. Spain: Country Health Profile 2021*. Brussels: European Observatory on Health Systems and Policies (2021). (State of Health in the EU).
16. The World Bank Group. Population Ages 65 and above (% of Total Population) - Spain (2022). Available from: https://data.worldbank.org/indicator/SP.POP.65UP.TO.ZS?locations=ES (Accessed January 7, 2023).
17. OECD. *Health at a Glance 2021: OECD Indicators*. Paris: OECD Publishing (2021). Available from: https://doi.org/10.1787/ae3016b9-en (Accessed January 7, 2023).
18. ERA-EDTA Registry. *ERA-EDTA Registry Annual Report 2019*. Amsterdam, Netherlands: UMC, Department of Medical Informatics (2021). Available from: https://www.era-online.org/wp-content/uploads/2022/11/ERA-Registry-Annual-Report-2019.pdf (Accessed January 7, 2023).
19. Bikbov B, Purcell CA, Levey AS, Smith M, Abdoli A, Abebe M, et al. Global, Regional, and National burden of Chronic Kidney Disease, 1990–2017: a Systematic Analysis for the Global Burden of Disease Study 2017. *The Lancet* (2020) 395(10225):709–33. doi:10.1016/S0140-6736(20)30045-3
20. Johnston-Webber C, Mah J, Prionas A, Streit S, Wharton G, Bušić M, et al. *National Plan for Solid Organ Donation and Transplantation*. London, UK: Onassis Foundation; Imperial College London; The London School of Economics & Political Science (2021).
21. Bernal-Delgado E, García-Armesto S, Oliva J, Sánchez Martínez FI, Repullo JR, Peña-, et al. *Spain: Health System Review* (2018). Available from: https://eurohealthobservatory.who.int/publications/i/spain-health-system-review-2018 (Accessed January 7, 2023).
22. Moreno L, Colino C, Hombrado A. Spain: Constitutional Transition through Gradual Accommodation of Territories. In: *Territory and Power in Constitutional Transitions*. Oxford, UK: Oxford University Press (2019). 22.
23. Dominguez-Gil B, Coll E, Marazuela R. *Plan Estratégico Órganos 2018-2022*. Madrid, Spain: Organización Nacional de Trasplantes (2018). Available from: http://www.ont.es/infesp/Paginas/plan-estrategico-2018-2022.aspx (Accessed January 7, 2023).
24. Dominguez-Gil B. International Figures on Donation and Transplantation 2020. Newsletter Transplant (2021). Available from: https://freepub.edqm.eu/publications (Accessed January 7, 2023).
25. Dominguez-Gil B. International Figures on Donation and Transplantation 2021. *Newsl Transpl* (2022) 27:46–8.
26. Domínguez-Gil B, Martín MJ, Valentín MO, Scandroglio B, Coll E, López JS, et al. Decrease in Refusals to Donate in Spain Despite No Substantial Change in the Population`s Attitude towards Donation. *Cells Tissues Organs* (2010) 13: 17–24.
27. Conesa C, Ríos A, Ramírez P, Canteras M, Rodríguez MM, Parrilla P. Multivariate Study of the Psychosocial Factors Affecting Public Attitude towards Organ Donation. *Nefrologia* (2005) 25(6):684–97.

28. Conesa C, Ríos A, Ramírez P, Rodríguez MM, Rivas P, Canteras M, et al. Psychosocial Profile in Favor of Organ Donation. *Transpl Proc* (2003) 35(4): 1276–81. doi:10.1016/s0041-1345(03)00468-8
29. Scandroglio B, Domínguez-Gil B, López JS, Valentín MO, Martín MJ, Coll E, et al. Analysis of the Attitudes and Motivations of the Spanish Population towards Organ Donation after Death. *Transpl Int* (2011) 24(2):158–66. doi:10.1111/j.1432-2277.2010.01174.x
30. Díaz-Cobacho G, Cruz-Piqueras M, Delgado J, Hortal-Carmona J, Martínez-López MV, Molina-Pérez A, et al. Public Perception of Organ Donation and Transplantation Policies in Southern Spain. *Transpl Proc.* (2021) 54(3):567–74. Available from: https://www.medrxiv.org/content/10.1101/2021.09.17.21263724v1 (Accessed January 7, 2023).
31. Directorate General Health and Consumers. Eurobarometer: Organ Donation and Transplantation. European Commission (2003). Available from: https://europa.eu/eurobarometer/surveys/browse/all/series/300790 (Accessed January 7, 2023).
32. Global report on organ donation and transplantation. Activity and Legislative & Organizational Issues. Global Observatory on Donation and Transplantation (2020). Available from: https://www.transplant-observatory.org/wp-content/uploads/2022/07/2020-Global-report-para-web.pdf (Accessed January 7, 2023).
33. Matesanz R, Miranda B, Felipe C, Fernandez M, Naya MT. The National Transplant Organization Donation Evolution and Transplant Activity in Spain. *Ann Transplant* (1996) 1(3):45–56.
34. Teixeira JF, Maio R, Immer F, Dominguez JM, Papalois V, Mihály S, et al. The Certification of Transplant Coordinators in Europe. *Transplant Proc* (2014) 46(5):1265–73. doi:10.1016/j.transproceed.2013.12.063
35. Mah J, Johnston-Webber C, Prionas A, Romagnoli J, Streit S, Wharton G, et al. How to Structure a Successful Organ Donation and Transplantation System in Eight (Not So Easy) Steps: An Italian Case Study. *Transpl Int* (2023) 36:11010. doi:10.3389/ti.2023.11010
36. Johnston-Webber C, Mah J, Prionas A, Streit S, Wharton G, Forsythe J, et al. Solid Organ Donation and Transplantation in the United Kingdom: Good Governance is Key to Success. *Transpl Int* (2023) 36:11012. doi:10.3389/ti.2023.11012
37. yuan HC, Iribarren C, McCulloch CE, Darbinian J, Go AS. Risk Factors for End-Stage Renal Disease: 25-Year Follow-Up. *Arch Intern Med* (2009) 169(4): 342–50. doi:10.1001/archinternmed.2008.605
38. Kazancioğlu R. Risk Factors for Chronic Kidney Disease: an Update. *Kidney Int Suppl* (2011) 3(4):368–71. doi:10.1038/kisup.2013.79
39. Pérez-García R, Martín-Malo A, Fort J, Cuevas X, Lladós F, Lozano J, et al. Baseline Characteristics of an Incident Haemodialysis Population in Spain: Results from ANSWER-Aa Multicentre, Prospective, Observational Cohort Study. *Nephrol Dial Transpl* (2009) 24(2):578–88. doi:10.1093/ndt/gfn464
40. Gorostidi M, Sánchez-Martínez M, Ruilope LM, Graciani A, de la Cruz JJ, Santamaría R, et al. Chronic Kidney Disease in Spain: Prevalence and Impact of Accumulation of Cardiovascular Risk Factors. *Nefrología (English Edition)* (2018) 38(6):606–15. doi:10.1016/j.nefro.2018.04.004
41. European Commission. Self-reported Screening of Cardiovascular Diseases and Diabetes Risks by Sex, Age and Income Quintile. Eurostat (2019). Available from: https://ec.europa.eu/eurostat/databrowser/view/hlth_ehis_pa2i/default/table?lang=en (Accessed January 7, 2023).
42. Alcazar Arroyo R, Orte Martinez L, Otero Gonzalez y A. Enfermedad Renal Cronica Avanzada. *Nefrología* (2008) 3:3–6.
43. Prieto-Velasco M, del Pino MD, Buades Fuster JM, Hospital LC, Prades RP, Ruiz San Millán JC, et al. Advanced Chronic Kidney Disease Units in Spain: a National Survey on Standards of Structure, Resources, Results and Patient Safety. *Nefrología* (2020) 40(6):608–22. doi:10.1016/j.nefro.2020.06.006
44. Office of the Secretary for Health and Consumer Affairs. *Strategic Plan for Tackling Hepatitis C in the Spanish National Health System*. Madrid: Ministry of Health, Social Services and Equality (2015). Available from: https://www.sanidad.gob.es/ciudadanos/enfLesiones/enfTransmisibles/hepatitisC/PlanEstrategicoHEPATITISC/docs/PEAHC_eng.pdf (Accessed January 8, 2023).
45. Garrido-Estepa M, Latasa P, Flores-Herrera J, García Comas L. Hepatitis C and Hepatitis C-Related Advanced Liver Disease Hospitalisation Trends before and after the Strategic Plan for Tackling Hepatitis C in the National Health System. *Eur J Gastroenterol Hepatol* (2021) 33(10):1307–15. doi:10.1097/MEG.0000000000001841
46. Vegas JJ, Flores-Herrera J, Latasa P, Garrido-Estepa M. Reduction in Hepatitis C-Related Hospitalizations after the Implementation of the Strategic Plan for Tackling Hepatitis C in the Spanish National Health System: Regional Level Differences. *J Viral Hepat* (2021) 28(6):859–69. doi:10.1111/jvh.13491
47. Berenguer M, Rodríguez GR, Domínguez-Gil B. Significant Impact of New Oral Therapies against HCV on the Waiting List for Liver Transplantation in Spain. *J Hepatol* (2018) 69(4):966–8. doi:10.1016/j.jhep.2018.06.011
48. Domínguez-Gil B, Pascual J. Living Donor Renal Transplantation in Spain: a Great Opportunity. *Nefrología* (2008) 28(2):143–7.
49. Domínguez-Gil B, de la Oliva Valentín M, Martín Escobar E, Cruzado JM, Pascual J, Fernández Fresnedo G. Present Situaltion of Living-Donor Kidney Transplantation in Spain and Other Countries: Past, Present and Future of an Excellent Therapeutic Option. *Nefrología (English Edition)* (2010) 30:3–13. doi:10.3265/Nefrologia.pre2010.Nov.10686
50. Valentín MO, Hernández D, Crespo M, Mahillo B, Beneyto I, Martínez I, et al. Trasplante renal de donante vivo. Análisis de situación y hoja de ruta. Nefrología (2023). Available from: http://www.revistanefrologia.com/es-trasplante-renal-donante-vivo-analisis-avance-S0211699521001132 (Accessed January 7, 2023).
51. La Moncloa. Spain and Italy Take the lead in the First International Cross Kidney Transplant in Southern Europe (2018). Available from: https://www.lamoncloa.gob.es/lang/en/gobierno/news/Paginas/2018/20180808transplant.aspx (Accessed January 7, 2023).
52. Clínic Barcelona. The Hospital Clínic, the First Hospital in Spain to Carry Out 1,000 Living Donor Kidney Transplants. Clínic Barcelona. News (2021). Available from: https://www.clinicbarcelona.org/en/news/the-hospital-clinic-the-first-hospital-in-spain-to-carry-out-1-000-living-donor-kidney-transplants (Accessed August 29, 2021).
53. Paez G, Valero R, Manyalich M. Training of Health Care Students and Professionals: A Pivotal Element in the Process of Optimal Organ Donation Awareness and Professionalization. *Transplant Proc* (2009) 41(6): 2025–9. doi:10.1016/j.transproceed.2009.05.020
54. DTI-TPM Foundation. Training (2022). Available from: https://tpm-dti.com/en-training/ (Accessed January 7, 2023).
55. Miñambres E, Rubio J, Coll E, Domínguez-Gil B. Donation after Circulatory Death and its Expansion in Spain. *Curr Opin Organ Transplant* (2018) 23(1): 120–9. doi:10.1097/MOT.0000000000000480
56. Miñambres E, Suberviola B, Dominguez-Gil B, Rodrigo E, Ruiz-San Millan JC, Rodríguez-San Juan JC, et al. Improving the Outcomes of Organs Obtained from Controlled Donation after Circulatory Death Donors Using Abdominal Normothermic Regional Perfusion. *Am J Transplant* (2017) 17(8):2165–72. doi:10.1111/ajt.14214
57. Matesanz R. Factors Influencing the Adaptation of the Spanish Model of Organ Donation. *Transpl Int* (2003) 16(10):736–41. doi:10.1007/s00147-003-0623-1
58. Dominguez-Gil B. European Directorate for the Quality of Medicines (EDQM). *Newsl Transpl* (2021) 26:48.
59. Domínguez-Gil B, Fernández-Ruiz M, Hernández D, Crespo M, Colmenero J, Coll E, et al. Organ Donation and Transplantation during the COVID-19 Pandemic: A Summary of the Spanish Experience. *Transplantation* (2021) 105(1):29–36. doi:10.1097/TP.0000000000003528
60. Scarpetta S, Pearson M, Colombo F, Guanais F. *Beyond Containment: Health Systems Responses to COVID 19 in the OECD*. Paris, France: OECD Publishing (2020). Available from: https://read.oecd-ilibrary.org/view/?ref=119_119689-ud5comtf84&title=Beyond_Containment:Health_systems_responses_to_COVID-19_in_the_OECD (Accessed January 7, 2023).
61. Bauer J, Brüggmann D, Klingelhöfer D, Maier W, Schwettmann L, Weiss DJ, et al. Access to Intensive Care in 14 European Countries: a Spatial Analysis of Intensive Care Need and Capacity in the Light of COVID-19. *Intensive Care Med* (2020) 46(11):2026–34. doi:10.1007/s00134-020-06229-6
62. The World Bank Group. Population, Total (2023). Available from: https://data.worldbank.org/indicator/SP.POP.TOTL?name_desc=false (Accessed December 4, 2023).

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ORIGINAL RESEARCH
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How to Structure a Successful Organ Donation and Transplantation System in Eight (Not So Easy) Steps: An Italian Case Study

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Valuable information can be obtained from a systematic evaluation of a successful national transplant program. This paper provides an overview of Italy's solid organ transplantation program which is coordinated by the National Transplant Network (Rete Nazionale Trapianti) and The National Transplant Center (Centro Nazionale Trapianti). The analysis is based on a system-level conceptual framework and identifies components of the Italian system that have contributed to improving rates of organ donation and transplantation. A narrative literature review was conducted and the findings were validated iteratively with input from subject matter experts. The results were organized into eight critical steps, including 1) generating legal definitions of living and deceased donation, 2) taking steps to ensure that altruistic donation and transplantation become part of the national culture and a point of pride, 3) seeking out existing examples of successful programs, 4) creating a situation in which it is easy to become a donor, 5) learning from mistakes, 6) working to diminish risk factors that lead to the need for organ donation, 7) increasing the rate of donations and transplantations *via* innovative strategies and policies, and 8) planning for a system that supports growth.

Keywords: organ transplantation, Italy, the Italian transplant network, Centro Nazionale Trapianti, organ donation, transplantation policy, transplant system

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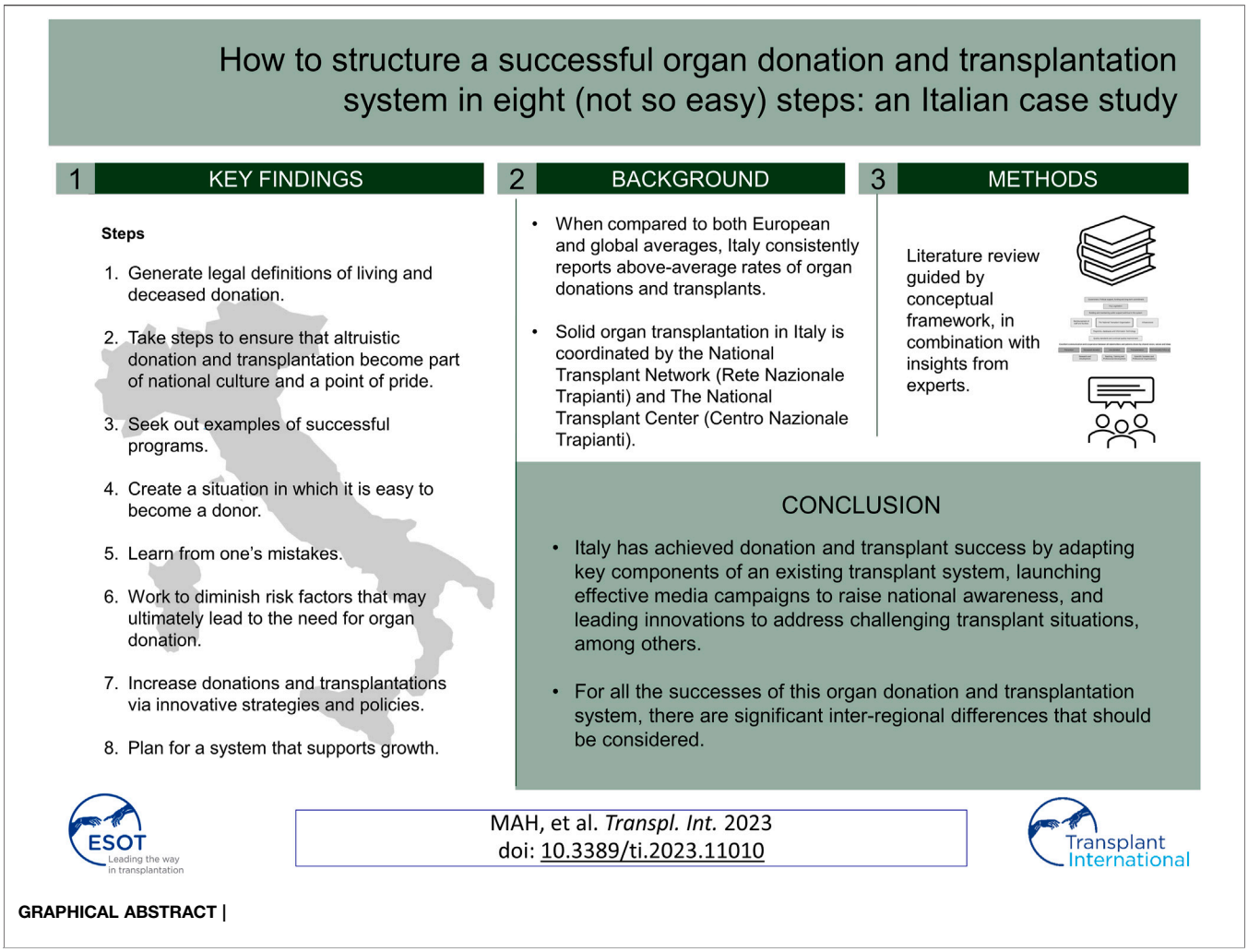
INTRODUCTION

The worldwide increase in the average age of the population suggests that there will be a parallel increase in the number of adults living with chronic medical conditions and that the need for solid organ transplantation will remain high. Thus, there is currently significant interest focused on ways to improve the efficiency and equity of the existing national transplantation systems. Valuable lessons can be learned from countries with successful transplant programs because many of the factors that contribute to their success might be adopted by other jurisdictions and altered to suit their specific contexts and cultures.



GRAPHICAL ABSTRACT |

Italy has developed one of the most successful organ transplant programs in Europe (1). In 2019, Italy was among the top ten countries in terms of the number of deceased donation per million population (1). When compared directly to both European and global averages, Italy consistently reports above-average rates of organ donations and transplants, at 21.54 and 57.9 per million population (pmp), respectively (2). Solid organ transplantation in Italy is coordinated by the National Transplant Network (Rete Nazionale Trapianti) and The National Transplant Center (Centro Nazionale Trapianti [CNT]), which is a technical and scientific organization within the Ministry of Health (Istituto Superiore di Sanita [ISS]) that operates within the Italian National Health Service (Servizio Sanitario Nazionale [SSN]) (3, 4).

Italy has a population of 59.6 million (5) and healthcare is provided by the Italian National Health Service (Servizio Sanitario Nazionale—SSN), which established a tax -based universal healthcare system in 1978 (6). In 2021, Italy spent EUR 2525 *per capita* on healthcare. This represented 8.7% of gross domestic product (GDP). In the same year the European Union (EU) average was 9.9% of GDP, or EUR 3523 *per capita* (5). Italy has one of the highest life expectancies in Europe, at 82.4 years (5) Similar to many other high-income countries, the Italian population is ageing and one of the main drivers of morbidity and mortality in the Italian population is the high burden of cardiovascular diseases (CVD). The prevalence rate of cardiovascular disease was 5,099 per 100,000 persons for men and 3,975 per 100,000 persons for women in 2015 (7). There is also high prevalence of hypertension (52% for men and 38% for women); dyslipidaemia (35% for men and 37% for women); and diabetes (12% in men and 8% in women) (8). Smoking, dietary behaviours, alcohol consumption and low physical activity are key health risk factors in Italy. In particular, smoking in Italy is above the EU average for adults and for adolescents (5). Key health system and health status information is summarized in **Table 1**.

The organ donation and transplantation program in Italy was modelled on the highly successful program developed in Spain. The Italian organ donation and transplantation program consistently achieves above-average rates of both organ donation and transplantation compared to EU member states as well as globally (**Table 2**). This paper will examine the main

features of the Italian program with a focus on the factors that have enabled it to become one of the best organ donation and transplantation programs in the EU.

MATERIALS AND METHODS

Using a conceptual systems framework that addresses the essential elements of a successful system (9), our goal was to determine which components have contributed directly to the increasing rates of organ donation and transplantation reported in Italy. Our analysis will also highlight system innovations that may be useful for countries intending to establish their own transplant systems.

An assessment of the current state of Italy's organ donation and transplantation program was performed based on the aforementioned framework criteria *via* a narrative review of the literature, complemented by interviews with a panel of international experts in transplantation and health systems. This group included one expert specifically from the Italian program. The literature review was conducted *via* a search of the Medline and Web of Science databases. We identified peer-reviewed publications using the keywords "organ donation and transplantation" and "Italy." The search excluded publications that were written in languages other than English or Italian. We also conducted hand searches of the references listed in the original set of studies that were retrieved. One researcher (JM) screened the titles and abstracts and made selections based on their relevance to the study objectives. Grey literature was an important source of information on this topic. These sources included Google Scholar, government websites (Italian National Institute of Health [ISS]), and websites maintained by key international organ donation and transplantation organizations (e.g., Eurotransplant and the European Directorate for the Quality of Medicines).

The findings were organized and coded based on a conceptual systems framework as shown in **Figure 1** (9). Similar to the data collection, this information was generated in multiple steps following an iterative process in which the essential building blocks of this conceptual framework were used to guide the organization of findings that were pertinent to the Italian system. All information was validated by the expert panel and checked for any inconsistencies or misrepresentations. The results are categorized according to the domains of the conceptual framework and in terms of the most important insights derived from the analysis of the Italian program. The analysis focused on structures, processes and distinctive features of the system corresponding to domains of the framework, rather than performance in relation to health outcomes or health system goals.

RESULTS

The following sections present the main findings of the study and highlight the key components of the Italian organ donation and transplantation program that have contributed to its success. The findings are organized according to the domains of the conceptual framework and presented as eight steps that might be undertaken to achieve a similarly successful program (**Table 3**).

Enabling Elements

Government: Key Legislation

Step 1. Generate legal definitions of living and deceased donation.

Organ donation can be a sensitive subject. A carefully considered legislated definition in common language can reduce miscommunication and protect advocates working in organ donation and transplantation systems. Two important pieces of legislation have shaped the legal acceptance of organ donation and transplantation in Italy. First, Law 458/1967 defined living donation (LD) as a lawful practice. Where a living donor program exists, there is ideally a Living Donor Committee and Donor Advocate to assess guide the decision-making process and evaluate medical safety. Sometime later, Law 578/1993 defined deceased donation (DD) by specifying brain death as an "irreversible loss of all cerebral functions and death certification by neurological (independent council of 3 specialists with a 6 h observation time) or cardiac (20 min with no cardiac activity as shown by electrocardiogram) criteria" (10).

An additional piece of critical legislation was established by Law 91/1999. This law specified the structure of governance for the organ transplant system that included the founding of the CNT and the National Technical Transplant Council, the designation of the Regional Transplant Coordinating Centers, and the definition of the role of hospital procurement coordinators (10). This legislation further legitimized the Italian organ donation system and coordination networks and committed resources toward the newly-developed national program.

Building and Maintaining Public Support and Trust in the System

Step 2. Take steps to ensure that altruistic donation and transplantation become part of the national culture and a point of pride.

Positive attitudes reflected by the general public are crucial to the success of any donation and transplant program. Personal stories of organ donations used to treat transplant recipients typically capture the imagination of the public at large. Toward this end, Italy has provided one of the most affecting organ donation stories of all time. In 1994, Nicholas Green was a young American boy on vacation with his family in Southern Italy when he was fatally shot in a failed robbery attempt. His family's decision to donate his organs and corneas elicited worldwide media attention, including movies and books based on his family's story. Nicholas' family received honors from the President of Italy and the Pope (11). As this event occurred during the time in which Italy's transplant program was just beginning to grow, Nicholas' story had a profound effect on the Italian public and brought awareness to the somewhat limited

TABLE 1 | Health system financing and population health in Italy: key statistics.

Health system	References
• Tax-based universal healthcare system provided by the Italian National Health Service [Servizio Sanitario Nazionale (SSN)]	
• Health spending *per capita*, EUR 2525; EU average, EUR 3523	(5)
• Health spending as a percentage of the gross domestic product, 8.7%; EU average, 9.9%	(5)
• Public spending as a percentage of total healthcare expenditure, 74%; EU average, 79.7%	(5)
• Out-of-pocket payments as a percentage of total healthcare expenditure, 23%; EU average, 15.4%	(5)
• Percentage of the population reporting an unmet need for medical care, 1.8%; EU average, 1.7%	(5)
Health status	
• Percentage of the population over 65 years of age, 23.2%; EU average, 20.6%	(5)
• Life expectancy, 82.4 years; EU average, 80.6 years	(5)
• Percentage of adults that smoke daily, 19%; OECD average, 16.5%	(5)
• Liters of alcohol consumed *per capita*, 8L; OECD average, 8.7L	(5)
• Percentage of adults that are overweight or obese (BMI >25), 46%; OECD average, 56.4%	(5)
• Individuals maintained on renal replacement therapy incidence, 165 pmp; prevalence, 1,276 pmp	(5)

EUR, euro; EU, European Union; OECD, Organisation for Economic Co-operation and Development; BMI, body mass index.

TABLE 2 | Numbers and rates of organ donation and transplantation in Italy in 2019 compared to European Union (EU) and global averages from the Global Observatory on Donation and Transplantation (2).

	Italy	Europe	Global
Actual Deceased Donation (DD)	1,495 (25.25)	13,397 (16.47)	41,695 (6.97)
Actual DD After Brain Death (DBD)	1,415 (23.9)	11,242 (13.82)	32,453 (5.43)
Actual DD After Circulatory Death (DCD)	80 (1.35)	2,155 (2.65)	9,242 (1.55)
Total Kidney Transplants	2,139 (36.13)	28,189 (34.66)	102,539 (17.15)
Deceased Kidney Transplants	1,799 (30.39)	20,300 (24.96)	64,104 (10.72)
Living Kidney Transplants	340 (5.74)	7,889 (9.7)	38,435 (6.43)
Total Liver Transplants	1,301 (21.98)	10,794 (13.27)	36,785 (6.15)
Deceased Liver Transplants	1,277 (21.57)	8,969 (11.03)	28,137 (4.71)
Living Liver Transplants	24 (0.41)	1,808 (2.22)	7,644 (1.28)
Heart Transplants	245 (4.14)	2,862 (3.52)	8,857 (1.48)
Lung Transplants	153 (2.58)	2,331 (2.87)	6,811 (1.14)
Pancreas Transplants	42 (0.71)	763 (0.94)	2,352 (0.39)
Small Bowel Transplants	1 (0.02)	39 (0.05)	146 (0.02)
Total Organ Transplants	3,881 (65.56)	44,978 (55.3)	157,490 (26.34)

Data shown are absolute numbers followed by number per million population (pmp) in parentheses; (–) data not available or not applicable.

number of organs that had been donated in the 1990s (12). Italy experienced a three-fold increase in organ donations following this tragedy (11, 12); "l'Effetto Nicholas" triggered by his family's donation of his organs after the accident reflects a change in the national consciousness of the Italian population and their understanding of the importance of organ donation.

Since this event, Italy has consistently invested in national and international media campaigns designed to encourage awareness and ongoing discussion of the topic of organ donation and transplantation. The CNT has coordinated a project (COORENOR-2010/2012) and a Joint Action (FOEDUS-2014/2016) that is part of the pan-Europe EUDONORGAN project; a key component of this project is to raise social awareness of organ donation and transplant programs (13). In October 2014, Italy organized the European Organ Donation Day (EODD) in partnership with the Council of Europe. Nationally, the CNT holds annual campaigns, including "Diamo il meglio di Noi" (for organ tissue and cell transplantation) and "Match it now" (for bone marrow transplantation). Two very successful campaigns launched by CNT known as "Salvo e Gaia" and "Ti Voglio Donare" are targeted at primary and secondary school children, respectively. These programs are designed to make certain that discussions of organ donation and transplantation remain part of the normative culture (14). As a result, Italy continues to show favorable and increasingly positive behaviors and attitudes towards organ donation and transplantation (15).

Equity in organ allocation is also of paramount importance to build trust in the system. The CNT provides national indications to assess candidacy for transplant based on several factors (e.g., blood group, antigen compatibility, age, waiting time, among others). These indications are shared by each transplant centre and each region. While general organ allocation is managed regionally, the CNT oversees organ assignment for specialized populations of pediatrics, emergencies, hyperimmune populations, the split liver program, cross-over kidney program, and organ exchanges with foreign countries and organs in surplus from a region (16). The CNT is also responsible to ensure the allocation procedures are met

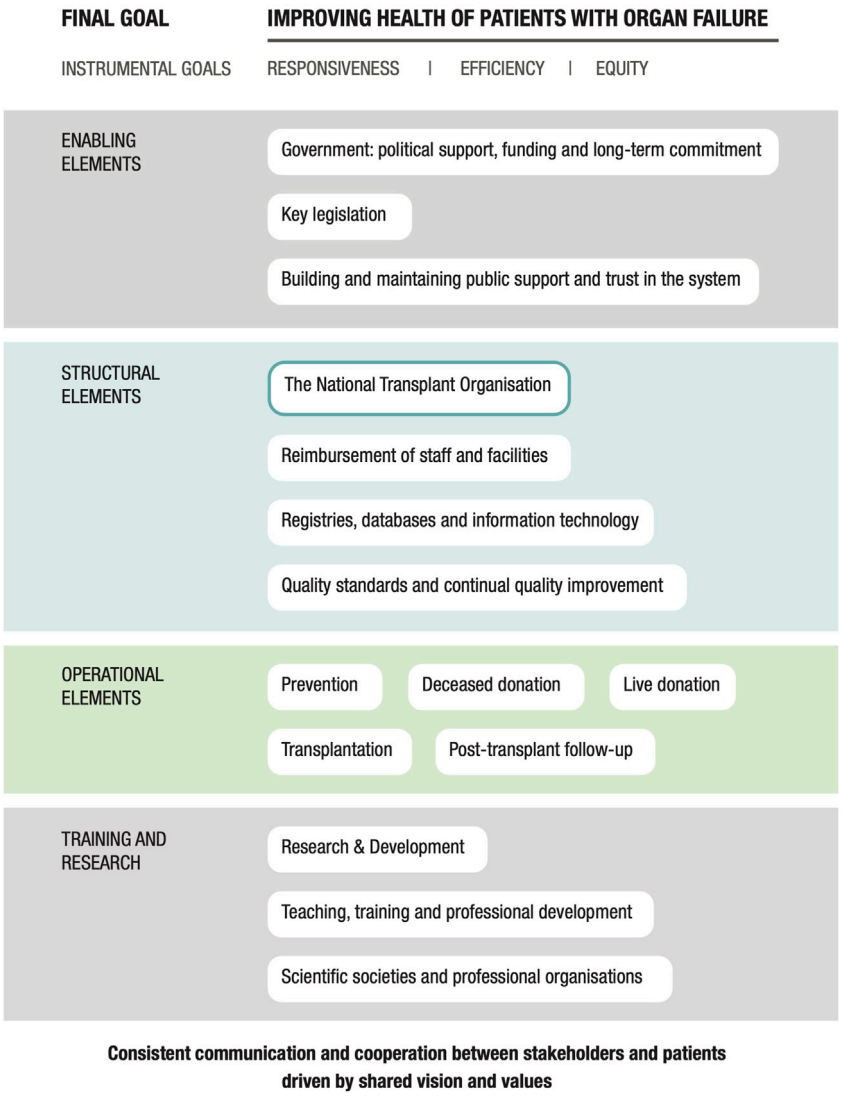


FIGURE 1 | A conceptual framework for evaluating national solid organ donation and transplantation programs: the essential building blocks.

through audits and accreditation (17), which helps maintain a fair transplant system for all.

Structural Elements

The National Transplant Organization (NTO); Infrastructure; Reimbursement of Staff and Facilities

Step 3. Seek out examples of successful programs.

The Italian organ donation and transplantation program is recognized as one of the best adaptations of the Spanish model (18). Elements adopted from the Spanish program include a single NTO that serves as a support agency, a three-level organizational structure with regional centers of excellence (**Table 4**), and similar transplant coordinator programs (18). The overall healthcare systems of the two countries share common features; this may have facilitated the adoption of a similar approach to organ donation and transplantation. For example, both countries provide universal healthcare and have adequate numbers of acute care beds as well as physicians and nurses. A previous study also compared intensive care unit (ICU) beds per million inhabitants in Spain (66.3) versus Italy (60.4) demonstrated similarities with regional variations with the Tuscany region having one of the highest capacities (73.4) (18). These factors undoubtedly provided favorable conditions that permitted Italy to reproduce many of the components of the Spanish organ donation and transplantation model (18). The variable (as opposed to fixed) schemes used to reimburse transplant activity used in both Italy and Spain serve to incentivize hospitals and (in some instances) healthcare professionals to undertake organ donation and transplant activities, most notably the identification of potential donors (18, 19). This success is reflected in organs donated from 370 hospitals across Italy (10). The Italian experience suggests transformation may be facilitated by starting with a

TABLE 3 | Essential components of the Italian organ donation and transplantation program.

Framework Domain	Critical Steps	Details
Enabling Elements: Government: Key Legislation	Step 1: Generate legal definitions of living and deceased donation	Clear legislation focused on issues including controlled and uncontrolled donation after circulatory death, LD, brain death, and the structure of the National Transplant Organization (NTO) served to legitimize the program
Enabling Elements: Building and Maintaining Public Support and Trust in the System	Step 2: Take steps to ensure that altruistic donation and transplantation become part of the national culture and a point of pride	Affecting personal stories featured in sustained media and educational campaigns helped to change attitudes and raise the profile of the organ donation and transplantation program
Structural Elements: The National Transplant Organisation; Infrastructure; Reimbursement of Staff and Facilities	Step 3: Seek out examples of successful programs	Italy has modeled critical components of its system on the program that existed in Spain and adapted them successfully to its own national setting
Structural Elements: Registries, Databases and Information Technology	Step 4: Create a situation in which it is easy to become a donor	A "soft opt-out" policy together with multiple opportunities to register as an organ donor have helped to boost donation rates
Structural Elements: Quality Standards and Continual Quality Improvement	Step 5: Learn from one's mistakes	Mistakes may be perceived as opportunities for learning and can be used to optimize quality and safety
Operational Elements: Prevention	Step 6: Work to diminish risk factors that lead to the need for organ donation	Prevention of organ failure is a national priority. Italy has successfully established several public health and screening programs that address this issue in the primary care setting
Operational Elements: Donation; Transplantation	Step 7: Increase donations and transplantations via innovative strategies and policies	Italy has innovative split liver programs and is a leader in developing novel perfusion techniques. The first laparoscopic robot-assisted pancreas transplant was performed in Italy in 2010
Training and Research: Research and Development; Teaching, training, and Professional Development	Step 8: Plan for a system that supports growth	Italy regularly collaborates in international training programs and research opportunities and participates in international organ exchange schemes

successful plan while recognizing that modifications may be required to adapt it to the needs of a particular country or context.

Registries, Databases and Information Technology

Step 4. Create a situation in which it is easy to become a donor.

Soft opt-out consent policies, such as those adopted by Italy, are important but not sufficient to encourage organ donation (20). In a soft opt-out donation consent policy, individuals are presumed to be candidates for organ donation unless specified otherwise by themselves or their families. Italians who have decided on this matter can register with the National Transplant Information System (Sistema Informativo Trapianti [SIT]) (3). This is a combined registry that captures information on positive or negative consent to organ donation. Registration is prompted on multiple occasions and can be made at the office of health authorities, through voluntary donor associations [i.e., Associazione Italiana Donatori Organi (AIDO)], or (since 2013) when first receiving or renewing national identification cards (21, 22). In 2018, 73.2% of registrants listed positive consent, while 26.8% expressed negative consent (26.8%) (21). Southern Italy has a higher refusal rate (40%) in comparison to the best-performing regions in Tuscany and Northern Italy, with a refusal rate of 20% (10).

The CNT is also responsible for keeping a central repository of people awaiting transplant. It also collects, manages, and analyses activities of the transplant centres for statistical, epidemiological and operational purposes using the Transplant Information System. The CNT keeps reports on adverse reactions, ensures traceability of all organs and tissues, and processes all data transmitted from the different regions related to organ donation and transplantation (17).

Quality Standards and Continual Quality Improvement

Step 5. Learn from one's mistakes.

Regulation and quality assurance is of utmost importance. The quality and safety procedures in the Italian transplant system have undergone extensive review after an incident in 2007 in which three patients received organs from a human immunodeficiency virus-positive donor. In response to this error, the CNT organized a formal committee that generated recommendations on safety, quality assurance, and risk management procedures designed to avoid future incidents (23). Each regional transplantation or coordination center now undergoes periodic audits with special attention paid to safety protocols. Extra resources were allocated to support a team of experts from the CNT's national allocation office that is available at all times for consultation and support. This team includes physicians from the transplantation network, an

infectious disease expert, a pathologist, an individual capable of performing resuscitation, and an expert in clinical immunology (23). In practice, the CNT is responsible for issuing the quality regulations and guidelines and conducting safety checks while the regional centers run quality assurance programs (10). The Italian program adheres to international and European standards (for example, 2010/S3/EU, which is the EU directive on the quality and safety of organs for transplantation) and has also taken the lead on several safety-related initiatives *via* international collaborations (i.e., Alliance O) (10, 23).

Operational Elements

Prevention

Step 6. Work to diminish risk factors that may ultimately lead to the need for organ donation.

Many high-income countries are currently experiencing a substantial change in population demographics. Currently, one out of every five Italians are over 65 years of age (5). Prevention of end-organ disease from cardiovascular risk factors is an integral part of any solid organ transplantation system. The prevalence of chronic kidney disease (CKD) is relatively lower in Italy than in other European countries, with an estimated prevalence of 5.7%–12.7% (24–26). By contrast, Italians exhibit comparatively higher rates of CVD and smoking. The most recent CArdiovascular risk in Renal Patients of the Italian Health Examination Survey (CARHES) study estimates the prevalence of CKD in men and women to be 7.5% and 6.5%, respectively, with a higher prevalence of stages 1–2 than 3–5 (21). In 2016, the incidence of renal replacement therapy in Italy was 144 pmp, which was higher than the European average of 132 pmp (27).

Cardiovascular risk factors are also linked to the development of hepatic and end-stage renal disease (ESRD). The prevention of CKD is recognized by the Italian Ministry of Health as a way to mitigate the development of interdependent conditions that contribute to metabolic syndromes (i.e., diabetes, hypertension, and CVD). Primary prevention strategies in Italy are aimed at reducing all cardiovascular-associated metabolic syndromes *via* strategies that include the promotion of exercise and improved dietary choices. Public health campaigns addressing this issue include "Gaining Health: making healthy choices easy" (Prime Ministerial Decree of 4 May 2007) and participation in the World Action on Salt Program (21). Italy has also focused on secondary prevention initiatives that may prevent the transition from early CKD to ESRD, including renal screening and early detection programs in patients who are at risk or are medically frail.

Donation and Transplantation

Step 7. Increase donations and transplantations *via* innovative strategies and policies.

Italy is an undisputed leader in DD. However, with the need for organs currently outstripping the supply, no country should ignore opportunities to increase the donor pool or the likelihood of successful transplants.

To increase organ donations and transplantations, Italy's living donation program requires augmentation. In 2020, only 304 transplants occurred thanks to living donors in comparison to over 3,000 transplants from deceased donation (28). High living donor kidney transplant activity mainly occurred in three centres (Padua and Bari, previously Pisa) whereas living donor liver transplant activity was highest in Palermo, Rome and Milan (28, 29). A consensus conference recommended focusing on the following education activities: increase communication to patients by primary care and community nephrologists, avoid late referrals to specialists, reduce preconceptions about the priority of living donations, increase educational interventions in people with chronic kidney disease and clinicians who deliver dialysis, and remove obstacles to donation (e.g., reducing individual spending and increasing clinical follow up of donors) (29). Certain regions have had difficulties implementing all recommendations, resulting in the recent launch of a pilot project educational campaign in collaboration with the CNT, the Italian Society of Nephrology, and the National Association of Hemodialysis-Transplant Dialysis (Associazione Nazionale Emodializzati-Dialisi Trapianto) in vulnerable geographic areas (30).

Italy has one of the largest split liver transplantation programs worldwide. The CNT instituted a mandatory split liver policy in 2015 in partnership with the Italian College of Liver Transplantation Program (31). Splitting a donated liver expands the available graft pool for pediatric candidates while maintaining sufficient liver tissue for transplantation in adult candidates (32). Ongoing research will determine how to identify candidates that are best suited for this procedure as well as the use of recipient-donor matching procedures to improve outcomes. Italy currently has the most liberal split liver eligibility policy; a recent assessment revealed no increase in morbidity or mortality associated with these protocols (31). Italy is also a leader in research efforts to maximize potential split donations. This effort is aided by a national transplant organization that invests in organ-exchange networks, fosters collaboration between pediatric and adult centers, and standardizes the training of surgeons who perform split procedures (31).

Italy has also become a leader in novel perfusion techniques. This is largely due to national DCD criteria which require a "no-touch" period of 20 min; this is significantly longer than in most other countries that mandate a 5-min interval during which an individual is monitored before the declaration of death. Historically, this has discouraged the use of DCD in Italy due to concerns regarding the possibility that prolonged warmth and ischemia will reduce the quality and viability of the donor graft (14). However, in recent years, Italy has been experimenting with strategies that might circumvent this problem. In 2007, the first pilot project using normothermic regional perfusion (NRP) was performed successfully on a kidney transplant donor. Since that time, Italy has developed protocols to procure healthy organs from uncontrolled DCDs with the potential for prolonged ischemia. Various strategies have been utilized to maintain organ viability and preservation,

TABLE 4 | Structure of the Italian Transplant Network from the ISS website (3).

National transplant network	
National	National Transplant Center (CNT) • Authority for the donation and transplantation of organs, tissues and cells • Organization of training for transplant specialists Permanent technical consultation for transplants • Consultative body and prepares the technical and operational guidelines for the donation and transplantation of organs, tissues, and cells
Regional	Regional or Interregional Transplant Centers (CRT) • Public structures that coordinate procurement, donation and transplant activities at the regional level and proceed with the assignment of organs
Local	Hospital Coordination • Structures and clinical teams that ensure the immediate communication of donor data to the CRT and CNT, coordinate the administrative documents relating the withdrawal operations, take care of relationships with donor families and collect data on transplants Withdrawal Facilities • Public health facilities where organ, tissue and hematopoietic stem cells are collected for transplantation purposes Transplant Structures • Public hospitals with authorized transplant teams Tissue Institutes • Tissue banks to process, conserve, store and distribute human tissues and cells

including machine perfusion, mechanical ventilation, hypothermic oxygenated machine perfusion, and abdominal NRP. Each hospitals funds these novel programs through finances received from their region or may procure additional resources through research or industry partnerships. The use of these novel and innovative perfusion techniques is balanced by the culture of safety in Italy. For example, the Italian Society of Organ and Tissue Transplantation (Società Italiana Trapianti d'Organo [SITO]) has issued cautious position papers regarding the use of machine perfusion in liver transplantation. Although these preservation techniques are still under development, the initial results are promising and suggest that this may ultimately be a useful way to expand the available organ donor pool in Italy (33).

More than 40 Italian hospitals have transplant programs, including 41 kidney, 22 liver, 11 lung, and 16 heart-dedicated programs. There are also pilot programs dedicated to bowel, pancreatic islet, hand, face, and uterus transplants (10). The use of robotic assistance for transplant surgery was also pioneered in Italy (34). The first laparoscopic robot-assisted pancreas transplant was performed in 2010 at Pisa University Hospital (35). The Milan criteria for liver transplantation for hepatocellular carcinoma is another example of the ongoing research and innovation activities currently taking place in Italy. Italy has also been a leader in the clinical practice and development of protocols for the use of organs with donor or recipient infections, including human immunodeficiency virus (HIV), Hepatitis C and most recently, COVID-19 (36, 37). The innovations introduced in Italy benefit the transplant program by improving both quality and efficiency, as well as highlighting the potential for better outcomes. These efforts have helped to establish transplantation as a pioneering field in Italy and thus to focus attention and acquire resources from national health authorities.

Training and Research

Teaching, Training and Professional Development

Step 8. Plan for a system that supports growth.

The CNT values ongoing development. Many opportunities for sustaining progress are undertaken in conjunction with international partners. Transplant coordinators receive bi-annual training courses organized by the CNT (13). Additional coursework that focuses on organ coordination and improving communication skills are held regionally (13). The CNT also hosts international donor-training courses in conjunction with the University of Padua and Veneto Regional Transplant Center that are designed to help transplant surgeons gain mastery in organ procurement. This coursework is endorsed by the European Society for Organ Transplantation (ESOT) and the European Union of Medical Specialists (UEMS) and is provided free of charge to successful applicants (13).

The pioneers of the Italian Transplant Network established close relationships with their Spanish colleagues early on during the development of the transplant system. This collaboration eventually developed into the South Alliance for Transplant (SAT) network which facilitates knowledge sharing, training collaborations, and expansion of the donor pool. In 2018, Spain and Italy collaborated to perform the first live donor kidney exchange in Southern Europe (38).

In addition to promoting national research advances in the field of organ donation and transplantation, the CNT is also actively involved in European and international research projects and registries. The CNT engaged in bi- and multilateral agreements for international organ exchanges beginning in the early 2000s (10). In collaboration with the World Health Organization, the CNT launched Project NOTIFY, which is "a global interface for the vigilance and surveillance of substances of human origin (39)." This initiative is designed to document

adverse events and reactions to improve donor and recipient safety. Italy is one of the few countries that publishes all transplant data as part of the effort to maintain full transparency in organ allocation and management (40). This process is facilitated by a fully-functional registry that collects activity data on organ donation, retrieval, and transplantation. Data focused on follow-up of all transplant recipients are also collected. The process also includes a reporting system that is used to document serious adverse events and reactions (3).

DISCUSSION

This paper aimed to highlight our current understanding of the critical components contributing to the success of the Italian organ donation and transplantation program. This objective was achieved by referring to a system-level conceptual framework and validating our findings by seeking input from subject matter experts. The results are presented as eight steps (summarized in **Table 3**) that were designed to demonstrate the most important aspects of a successful organ donation and transplantation program. However, this presentation may to some degree conceal the true complexity involved in building a successful program.

In addition to these eight steps, two additional important points arose from this case study. First, the messages conveyed when constructing and implementing a transplant system must be simple and comprehensible. A common language and direction are vital when communicating with individuals from diverse disciplines and backgrounds, including individuals tasked with governing a transplant system and extending to those who carry out donor activities at the local level. Second, each step must be supported by a broad range of sustainable actions, staffing, initiatives, and resources. For example, while altruistic donation and transplantation became part of the national culture in Italy because of an initial emphasis on a tragic story, constant repetition through campaigns and decades of positive relationships with the media will be needed to maintain transparency and goodwill throughout. It is also important to recognize that many of these steps are interconnected. For example, organ donations cannot become accepted as part of the normative culture in the absence of critical infrastructure, including databases and registries that simplify the processing of becoming a donor.

Although alluded to throughout this paper, within the successes of the Italian organ donation and transplantation system, there are notable regional differences whereby the system must be improved for equity and efficiency gains. These activity differences by region are substantial as reported by the 2020 Annual Activity Report (28). For example, the rate of effective donors was highest in the Valle d'Aosta region (47.7 pmp) and lowest in the Basilicata region (5.3 pmp). Differences in donation refusal rates and ICU capacity are briefly mentioned, but there are also variations in procurement rates, number of transplant programs for all types of tissues, consent for on donation, among others (28). Of concern, northern regions appear to consistently have better indicators for all organ donation and transplant activities than southern regions. These regional differences are not limited to transplant activities; geographical inequity has been a longstanding issue in Italy with the more affluent north leading the way in bed capacity, advanced medical equipment, health and community care resources and citizen health outcomes (5, 6). While a thorough analysis of interregional inequity is outside of the scope of this paper, for organ donation and transplantation, these inequities result in some regions being unable to effectively apply the best practice standards recommended by the CNT and this impacts accessibility of transplants for specific populations.

As there are many limitations to the targeted literature review methodology, the scope of this paper must be clear. At each step of this process, from the methods through the data analysis, our purpose was to identify lessons from the Italian transplant system that could be applied to new and developing national organ donation and transplantation systems. A targeted literature review reinforced by expert opinions was deemed to be the best approach to achieving this aim. However, we recognize that this approach to data collection and analysis is prone to bias and we appreciate the uncertainty regarding our conclusions and the ability to apply them in other unique settings. Despite these issues, we believe that this approach was the most feasible way to assemble information that spanned multiple different sectors, including (but not limited to) clinical medicine, public policy, ethics, and media relations. Taken together, our findings provide a starting point for future research into the development of organ donation and transplantation programs.

Notably, the transplant literature rarely discusses the outcomes of transplant programs (i.e., statistics associated with donations and transplants) as the consequence of well-conceptualized and carefully developed and implemented coordination efforts at the systemic level. This paper, together with the other case reports included in this series (41–45) will to some extent address this knowledge gap as they provide new insights on how one might conceptualize the elements required by a developing national organ donation and transplantation system.

DATA AVAILABILITY STATEMENT

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author.

AUTHOR CONTRIBUTIONS

All authors listed have made a substantial, direct, and intellectual contribution to the work and approved it for publication.

CONFLICT OF INTEREST

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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REFERENCES

1. Global Observatory on Donation and Transplantation (GODT). *International Report on Organ Donation and Transplantation Activities: Executive Summary 2019*. Geneva, Switzerland: World Health Organization Collaboration. (2021). Available from: http://www.transplant-observatory.org/wp-content/uploads/2021/06/GODT2019-data_web_updated-June-2021.pdf (Accessed October 1, 2021).
2. Global Observatory on Donation and Transplantation. Country Summary: Italy (2023). Available from: http://www.transplant-observatory.org/summary/ (Accessed February 23, 2023).
3. Salute Md. About Us: SIT – Transplant Information System.(2018). Available from: http://www.trapianti.salute.gov.it/trapianti/dettaglioContenutiCnt.jsp?lingua=italiano&area=cnt&menu=chiSiamo&id=238 (Accessed June 8, 2020).
4. Cardillo M. National transplant center. Istituto Superiore di Sanita (1999). Available from: https://www.iss.it/web/iss-en/transplants (Accessed October 1, 2021).
5. OECD. *Italy: Country Health Profile 2021*. Paris: Organisation for Economic Co-operation and Development (2021). Available from: https://www.oecd-ilibrary.org/social-issues-migration-health/italy-country-health-profile-2021_5bb1946e-en (Accessed June 21, 2023).
6. Mossialos E, Djordjevic A, Osborn R, Sarnak D. *International Profiles of Health Care Systems*. Washington, DC: The Commonwealth Fund (2017). Available from: https://www.commonwealthfund.org/sites/default/files/documents/___media_files_publications_fund_report_2017_may_mossialos_intl_profiles_v5.pdf (Accessed December 29, 2023).
7. Wilkins E, Wilson L, Wickramasinghe K, Bhatnagar P, Leal J, Luengo-Fernandez R, et al. *European Cardiovascular Disease Statistics 2017*. Brussels: European Heart Network (2017).
8. Giampaoli S, Palmieri L, Donfrancesco C, Noce CL, Pilotto L, Vanuzzo D, et al. Cardiovascular Health in Italy. Ten-Year Surveillance of Cardiovascular Diseases and Risk Factors: Osservatorio Epidemiologico Cardiovascolare/Health Examination Survey 1998–2012. *Eur J Prev Cardiolog* (2015) 22: 9–37. doi:10.1177/2047487315589011
9. Johnston-Webber C, Mah J, Streit S, Prionas A, Wharton G, Mossialos E, et al. A Conceptual Framework for Analyzing and Comparing National Organ Donation and Solid Organ Transplantation Programmes. *Transpl Int* (2023) 36:11006. doi:10.3389/ti.2023.11006
10. Costa AN, Lombardini L, Storani D, CNT Working Group. Organ Procurement and Transplantation in Italy. *Transplantation* (2019) 103(6): 1065–9. doi:10.1097/TP.0000000000002570
11. Redelmeier DA, Woodfine JD. Deceased Organ Donation and the Nicholas Effect. *Transplantation* (2013) 96(11):e82–4. doi:10.1097/01.TP.0000437179.48174.92
12. The Nicholas Green Foundation *A Boy's Gift to the World*. La Cañada Flintridge, CA: The Nicholas Green Foundation (2020). Available from: https://nicholasgreen.org/about (Accessed June 8, 2020).
13. Council of Europe European Committee. Critical Factors for success in Deceased Donation: an International Study. In: *Council of Europe European Committee (Partial Agreement) on Organ Transplantation (CD-P-TO)* (2019).
14. Italian Ministry of Health. (2020). Progetto Salvo e Gaia. Available from: https://www.salvoegaia.it/progetto.html (Accessed June 8, 2020).
15. Directorate General Health and Consumers. *Eurobarometer 72.3: Organ Donation and Transplantation*. Brussels: European Commission (2010). Available from: https://ec.europa.eu/commfrontoffice/publicopinion/archives/ebs/ebs_333a_en.pdf (Accessed December 11, 2022).
16. Centro Nazionale Trapianti. Receive a Transplant [Internet]. (2018). Available from: https://www.trapianti.salute.gov.it/trapianti/dettaglioContenutiCnt.jsp?lingua=italiano&area=cnt&menu=cittadini&sottomenu=pazienti&id=249 (Accessed December 10, 2022).
17. Centro Nazionale Trapianti. Le Funzioni Del Centro Nazionale Trapianti [Internet]. (2018). Available from: https://www.iss.it/documents/20126/0/Scheda+funzioni+Cnt.pdf/938d0ec4-e15e-1bb8-1b2e-33965544c1cc?t=1623743024630 (Accessed December 11, 2022).
18. Matesanz R. Factors that Influence the Development of an Organ Donation Program. *Transplant Proc* (2004) 36(3):739–41. doi:10.1016/j.transproceed.2004.03.025
19. Rodríguez-Arias D, Wright L, Paredes D. Success Factors and Ethical Challenges of the Spanish Model of Organ Donation. *The Lancet* (2010) 376(9746):1109–12. doi:10.1016/S0140-6736(10)61342-6
20. Willis BH, Quigley M. Opt-out Organ Donation: on Evidence and Public Policy. *J R Soc Med* (2014) 107(2):56–60. doi:10.1177/0141076813507707
21. Berloco P, Brizzi F, Canu G, Capasso G, Nanni Costa A, Dell'Aquila R, et al. Address Document for Chronic Kidney Disease. Ministry of Health (2017). Available from: https://documenti.sinitaly.org/malattia-renale-cronica/ (Accessed June 8, 2020).
22. AIDO. Associazione Italiana per la Donazione di Organi (2020). Available from: https://www.aido.it/aido/index.htm (Accessed June 8, 2020).
23. Costa AN, Grossi P, Castiglione AG, Grigioni WF, Italian Transplant Research Network. Quality and Safety in the Italian Donor Evaluation Process. *Transplantation* (2008) 85:S52–6. doi:10.1097/TP.0b013e31816c2f05
24. Cirillo M, Laurenzi M, Mancini M, Zanchetti A, Lombardi C, De Santo NG. Low Glomerular Filtration in the Population: Prevalence, Associated Disorders, and Awareness. *Kidney Int* (2006) 70(4):800–6. doi:10.1038/sj.ki.5001641
25. Gambaro G, Yabarek T, Graziani MS, Gemelli A, Abaterusso C, Frigo AC, et al. Prevalence of CKD in Northeastern Italy: Results of the INCIPE Study and Comparison with NHANES. *Clin J Am Soc Nephrol* (2010) 5(11):1946–53. doi:10.2215/CJN.02400310
26. De Nicola L, Donfrancesco C, Minutolo R, Lo Noce C, De Curtis A, Palmieri L, et al. Epidemiology of Chronic Kidney Disease in Italy: Current State and Contribution of the CARHES Study. *G Ital Nefrol* (2011) 28:401–7.
27. Stel VS, de Jong RW, Kramer A, Andrusev AM, Baltar JM, Barbullushi M, et al. Supplemented ERA-EDTA Registry Data Evaluated the Frequency of Dialysis, Kidney Transplantation, and Comprehensive Conservative Management for Patients with Kidney Failure in Europe. *Kidney Int* (2021) 100(1):182–95. doi:10.1016/j.kint.2020.12.010
28. Centro Nazionale Trapianti. *Report 2020 Annual Activity Italian National Transplant Network*. Roma, Italy: Centro Nazionale Trapianti, Istituto Superiore Di Sanità (2020). Available from: https://www.trapianti.salute.gov.it/imgs/C_17_cntPubblicazioni_438_allegato.pdf (Accessed June 8, 2020).
29. Simone S. La donazione di organi da vivente. Presentation Transplant Procurement Management course (2019). Availiable at: https://www.trapianti.salute.gov.it/imgs/C_17_cntPubblicazioni_338_allegato.pdf (Accessed June 8, 2020).
30. Centro Nazionale Trapianti. Donation in Life (2018). Availiable from: https://www.trapianti.salute.gov.it/trapianti/dettaglioContenutiCnt.jsp?lingua=italiano&area=cnt&menu=cittadini&sottomenu=diventare&id=246 (Accessed June 8, 2020).
31. Angelico R, Trapani S, Spada M, Colledan M, Ville de Goyet J, Salizzoni M, et al. A National Mandatory-split Liver Policy: A Report from the Italian Experience. *Am J Transpl* (2019) 19:ajt.2029–43. doi:10.1111/ajt.15300
32. Cintorino D, Spada M, Gruttadauria S, Riva S, Luca A, Volpes R, et al. *In Situ* Split Liver Transplantation for Adult and Pediatric Recipients: An Answer to Organ Shortage. *Transplant Proc* (2006) 38(4):1096–8. doi:10.1016/j.transproceed.2006.02.146
33. De Carlis L, De Carlis R, Muiesan P. Past, Present, and Future of Donation after Circulatory Death in Italy. *Updates Surg* (2019) 71(1):7–9. doi:10.1007/s13304-019-00640-5

34. Giacomoni A, Di Sandro S, Lauterio A, Concone G, Buscemi V, Rossetti O, et al. Robotic Nephrectomy for Living Donation: Surgical Technique and Literature Systematic Review. *Am J Surg* (2016) 211(6):1135–42. doi:10.1016/j.amjsurg.2015.08.019
35. Boggi U, Signori S, Vistoli F, D'Imporzano S, Amorese G, Consani G, et al. Laparoscopic Robot-Assisted Pancreas Transplantation: First World Experience. *Transplantation* (2012) 93(2):201–6. doi:10.1097/TP.0b013e318238daec
36. Morabito V, Grossi P, Lombardini L, Ricci A, Trapani S, Peritore D, et al. Solid Organ Transplantation in HIV+ Recipients: Italian Experience. *Transpl Proc* (2016) 48(2):424–30. doi:10.1016/j.transproceed.2015.12.049
37. Romagnoli R, Gruttadauria S, Tisone G, Maria Ettorre G, De Carlis L, Martini S, et al. Liver Transplantation from Active COVID-19 Donors: A Lifesaving Opportunity worth Grasping? *Am J Transpl* (2021) 21(12):3919–25. doi:10.1111/ajt.16823
38. La Moncloa. 08/08/2018. Spain and Italy Take the lead in the First International Cross Kidney Transplant in Southern Europe [Government/News] (2021). Available from: https://www.lamoncloa.gob.es/lang/en/gobierno/news/Paginas/2018/20180808transplant.aspx (Accessed August 29, 2021).
39. WHO | Project NOTIFY. WHO. World Health Organization (2020). Available from: https://www.who.int/transplantation/tra_notify/en/ (Accessed June 8, 2020).
40. European Commission. European Day for Organ Donation and Transplantation: Transplants: 56 000 People on Waiting Lists in Europe (2011). Available from: https://ec.europa.eu/health/sites/default/files/blood_tissues_organs/docs/art_italy_2011_en.pdf (Acessed October 4, 2021).
41. Johnston-Webber C, Mah J, Prionas A, Streit S, Wharton G, Forsythe J, et al. Solid Organ Donation and Transplantation in the United Kingdom: Good Governance is Key to Success. *Transpl Int* (2023) 36:11012 . doi:10.3389/ti.2023.11012
42. Johnston-Webber C, Prionas A, Wharton G, Streit S, Mah J, Boletis I, et al. The National Organ Donation and Transplantation Program in Greece: Gap Analysis and Recommendations for Change. *Transpl Int* (2023) 36:11013. doi:10.3389/ti.2023.11013
43. Mah J, Johnston-Webber C, Prionas A, Romagnoli J, Streit S, Wharton G, et al. How to Structure a Successful Organ Donation and Transplantation System in Eight (Not So Easy) Steps: An Italian Case Study. *Transpl Int* (2023) 36:11010. doi:10.3389/ti.2023.11010
44. Streit S, Johnston-Webber C, Mah J, Prionas A, Wharton G, Paulino J, et al. Lesson to Learn From the Portuguese Solid Organ Donation and Transplantation System: Achieving Success Despite Challenging Conditions. *Transpl Int* (2023) 36:11008. doi:10.3389/ti.2023.11008
45. Streit S, Johnston-Webber C, Mah J, Prionas A, Wharton G, Cassanova D, et al. Ten Lessons From the Spanish Model of Organ Donation and Transplantation. *Transpl Int* (2023) 36:11009. doi:10.3389/ti.2023.11009

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Organ Donation in Croatia: The Importance of a National Champion, a Comprehensive Plan, and International Collaborations

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The Republic of Croatia is a global leader in organ donation and transplantation despite having fewer resources and more modest healthcare expenditures than other countries in the European Union. The results of an extensive literature review were combined with expert input in an iterative multi-step data collection and evaluation process designed to assess trends in Croatian organ donation and transplantation and identify key elements, policy changes, and drivers of the system that have contributed to its success. Multiple sources of evidence were used in this study, including primary documents, national and international transplantation reports, and insights from critical informants and content experts. The results highlight several key organizational reforms that have substantially improved the performance of the Croatian transplant program. Our findings emphasize the importance of strong central governance led by an empowered national clinical leader acting under the direct auspices of the Ministry of Health and a comprehensive and progressive national plan. The Croatian transplant system is notable for its integrated approach and efficient manner of managing scarce health resources. Collectively, the results suggest that Croatia has become nearly self-sufficient due to its systematic implementation of the guiding principles for organ donation and transplantation.

Keywords: organ donation, organ transplantation, transplantation policy, transplant system, Croatia

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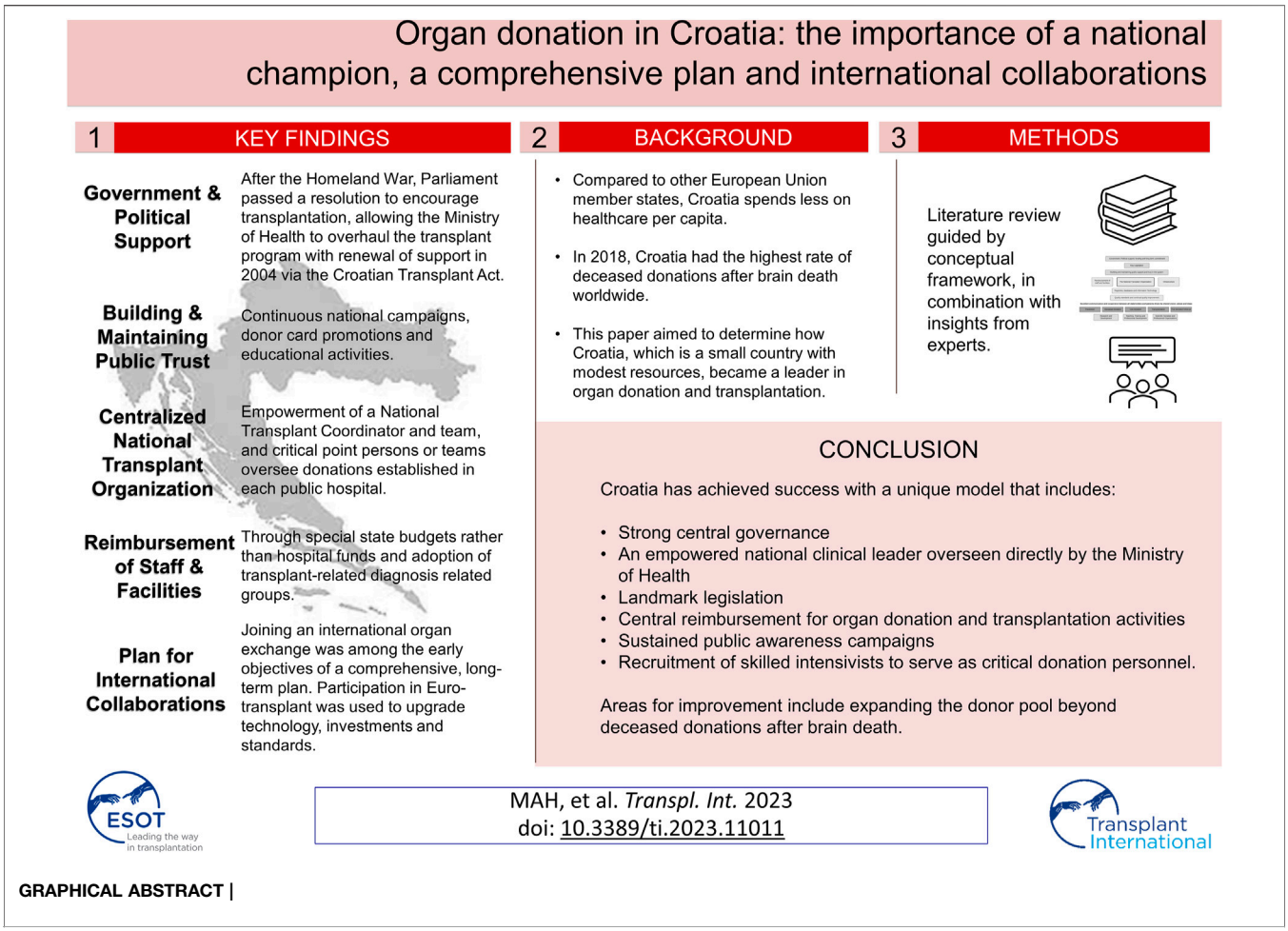
INTRODUCTION

Despite a relatively poor economy compared to other European Union (EU) member states and a 12% reduction in its gross domestic product since the 2008 worldwide economic crisis (1), Croatia has become a global leader in organ donation and transplantation. In 2018, Croatia had the highest rate of deceased donations after brain death (DBD) worldwide, reported at 40.24 per million population (pmp). Total deceased donations in Croatia were second only to those recorded in Spain (which also supports a robust donation after circulatory death (DCD) program). Croatia ranks sixth overall for total transplant activity worldwide (2).

This study aimed to determine how Croatia, which is a small country with modest resources, became a leader in organ donation and transplantation. Our goal is to provide information that may



GRAPHICAL ABSTRACT |

be useful for countries with similar resource constraints that nonetheless wish to improve their transplant systems. We intended to assess trends in transplantation and organ donation from 2000 to 2018/2019 (i.e., before the onset of the COVID-19 pandemic) and identify key elements, policy changes, and drivers of the Croatian transplantation system that have contributed to its success. **Table 1** provides an overview of key statistics on the Croatian healthcare system and population health status, including health spending *per capita*, public versus private health expenditure and number of people on renal replacement therapy.

MATERIALS AND METHODS

Three main sources of evidence were used to develop this case study. First, a targeted narrative literature review was conducted based on the guidelines provided by the conceptual framework developed by Johnston-Webber et al. (6). The literature searches focused on publications listed in the Medline and Web of Science databases. We identified peer-reviewed publications using combinations of the keywords "organ donation and transplantation" and "Croatia." While the search was not limited by year of publication, we excluded publications published in languages other than English or Croatian. We also performed hand-searches of the references listed in the original selections based on their relevance to study objectives and areas identified by the aforementioned conceptual framework. An additional search of grey literature provided additional important information; this information was located by searching Google Scholar, government websites (the Croatian Ministry of Health), and websites of key international organ donation and transplantation organizations. Critical documents were retrieved, including guidelines and resources relevant to Eurotransplant, the South-Eastern Europe Health Network (SEEHN), the European Directorate for the Quality of Medicines & Healthcare, and the Global Observation on Donation and Transplantation (GODT).

We also collected evidence from a panel of international experts in healthcare systems policy and transplantation. The findings from the literature review were initially compiled by one researcher (JM) and were then modified *via* an iterative process following rounds of written and verbal feedback from the expert panel; this included the involvement of the National Transplant Coordinator (NTC) (also an author) providing leadership and feedback throughout. In addition to providing feedback on our

findings, the experts also suggested additional resources or documents that might be included in the text.

This approach to the collection and synthesis of data was designed to provide a holistic overview of the Croatian organ donation and transplantation program; information from both quantitative and qualitative sources was included. Therefore, in addition to efforts to assess quantitative trends in key transplant indicators, the subjective experiences of people who worked in (or closely with) the Croatian transplantation system were also considered. The analysis was designed to include all factors that may have had an impact on the performance of the organ donation and transplantation program. The analysis focused on structures, processes and distinctive features of the system corresponding to domains of the framework, rather than performance in relation to health outcomes or health system goals.

The findings were organized and coded based on the conceptual framework generated by Johnston-Webber et al. (6). The essential building blocks of an organ donation and transplantation program are depicted in **Figure 1**. The tables in the Results section are color-coded to match the conceptual framework. Similar to the data collection, this information was generated in multiple steps following an iterative process in which the essential building blocks of this conceptual framework were used to guide the organization of the findings that were pertinent to the Croatian system. The results were collated and verified based on findings from earlier sources of evidence. We also validated our findings in consultation with key informants and content experts who assisted us in eliminating any inconsistencies or misrepresentations. The results are presented based on critical research objectives and categorized according to the relevant essential building blocks.

RESULTS

Context and Trends Identified in the Croatian Transplant System

A brief historical review will provide insight into the gains made by the Croatian transplant system (7). Croatia, formerly part of Yugoslavia, had an early interest in transplantation dating back to the 1970s. However, years of political and economic turmoil culminating in the Homeland War (1991–1998) precluded the organization of an effective organ donation and transplantation program. After the Homeland War, Croatia was left without adequate management capacity and had no national transplant or donation organization nor any vestiges of an evidence-based organ donation system. The transplant program at that time relied on outdated legislation. At that time, organ donation occurred only sporadically rather than as a routine part of clinical hospital practice. This ultimately resulted in a severe shortage of organs that could be used for transplantation (8). At the turn of the century, Croatia lagged far behind many other countries with respect to the number of organ donations and outcomes (**Figure 2**). To address these unmet needs and overall patient dissatisfaction, in 1998 the Ministry of Health issued an instruction designed to increase the frequency of organ donation, with priority given to organ donations from the deceased (8). One year later (1999), the Croatian Parliament passed a resolution that encouraged organ transplantation. As an adjunct to the National Transplant Organization (NTO), the ministry appointed an NTC who was charged with providing leadership and guidance in implementing the necessary reforms. This action represented a critical turning point for the development of a sustainable organ donation and transplantation system in Croatia, as it facilitated the successful implementation of new policies under the leadership of the NTC *via* a series of organizational measures that strengthened the organ donation and transplantation system.

As a result, Croatia has experienced a continuous improvement in its transplant system (**Figure 3**) (8). While Croatia is currently an undisputed global leader in DBD transplants, very few donations after circulatory death or living donations have been recorded since 2000 (9). Nonetheless, compared to European and global aggregated data for 2019, Croatia remains within the top 15 countries for transplant activity in terms of the number of organs and the number of patients transplanted pmp (10).

Key Elements and Policies Leading to Transplant Reform

The following sections highlight important components that have led to the success of the Croatian organ donation and transplantation program. **Table 2** shows key elements, policies, and drivers which have led to the reform of the national organ donation and transplantation program in Croatia arranged according to the conceptual framework and essential building blocks of an organ donation and transplantation program as described by Johnston-Webber et al. (11). **Table 2** also highlights some features that need improvement. The information to follow is a narrative summary of several elements believed to be of particular significance.

Enabling Elements

Government: Political Support, Funding, Long-Term Commitment and Key Legislation

The first legislation focused on DBD donation in Croatia was enacted in 1982. This legislation was instrumental in setting normative expectations for DBD. The concept of a "soft opt-out" approach with consent for organ donation as the default option has been in place since 1988 (7, 13). New legislation (the Transplant Act) that was adopted in 2004 preserved the soft opt-out approach while adhering to the principles of the Declaration of Istanbul and Convention on Human Rights and Biomedicine (8, 14). In 2012, this legislation was harmonized with the requirements of the EU as specified in Directive 2010/53/EU which defined the quality and safety of human organs intended for transplantation, and Directive 2012/25/EU which focused on the exchange of human organs intended for transplantation between members states (14). There was no specific consideration of DCD in this set of legislative reforms. Thus, Croatia continues to rely on DBD donors alone pending any future reform efforts (9).

TABLE 1 | Health system financing and population health in Croatia: key statistics.

Healthcare system	References
• Mandatory health insurance with healthcare financed by the Croatian Health Insurance Fund (Hrvatski zavod za zdravstveno osiguranje or [HZZO])	(3)
• Health spending *per capita*, 1392 EUR; EU average, 3523 EUR	(3)
• Health spending as a percentage of the GDP, 7.0%; EU average, 9.9%	(3)
• Public spending as a percentage of the total healthcare expenditures, 81.9%; EU average, 79.7%	(3)
• Out-of-pocket payments as a percentage of total healthcare expenditures, 11.5%; EU average, 15.4%	(3)
• Percentage of the population reporting an unmet need for medical care, 1.4%; EU average, 1.7%	(3)
Health status	
• Percentage of the population over 65 years of age, 21.0%; EU average, 20.6%	(3)
• Life expectancy, 77.8 years; EU average, 80.6 years	(3)
• Percentage of adults that smoke daily, 22%, OECD average, 16.5%	(3, 4)
• Percentage of adults that binge drink alcohol, 16.6%	(3)
• Percentage of adults that are overweight or obese (BMI >25), 23%; OECD average, 56.4%	(3, 4)
• Fraction of patients maintained on renal replacement therapy, 622	(5)

EUR, euro; EU, European Union; OECD, Organization for Economic Co-operation and Development; BMI, body mass index.

The aforementioned legislation was instrumental in the development of a strong and unique form of central transplant governance that was suitable for the geography and population size of Croatia. Until 2019, the National Transplant Program was under the jurisdiction of the Directorate of Transplantation and Biomedicine within the Ministry of Health of the Republic of Croatia (MZRH) (15). In 2019, the Ministry underwent an internal reorganization. As a result, decision-making and operational management of the transplant system became significantly less efficient and thus more difficult. Disruption of the governing structure, most notably during the pandemic crisis, had a negative impact on donation and transplantation rates. The observed 35% reduction in the 2019 donation rate was unlikely to be fully attributable to the pandemic as it may also be partially explained by the transition to a less effective administrative management model. Despite these concerns, Croatia remains an example of a unique, successful, and sustainable transplant system with highly effective centralized national management and leadership and strong partnerships with critically-empowered professionals and teams. This integrated model of a centralized and nationally-guided transplant system may have been established deliberately as a logical choice for Croatia, given its small geographical size, relatively homogeneous population, and limited human and financial resources.

The NTC in alliance with key donation personnel and transplant teams has played a significant role in building a sustainable transplant system.

> The NTC started work in 2000 using all available legal instruments and authority of the Ministry to achieve the programme goals set forth and to introduce necessary, often "painful" changes within the health system (7; p. 56).

Building and Maintaining Public Support and Trust in the System

Soft opt-out legislation combined with effective public awareness and media campaigns has fostered a favorable attitude toward donation as embedded in the principle of civil solidarity and responsibility. The Ministry of Health, the Croatian Donor Network, the Croatian Transplant Association, and the Croatian Society of Nephrology, Dialysis, and Transplantation all work together to promote ongoing national campaigns, donor card promotions, and continuous educational activities (**Table 2**) (8). The first coordinated national public awareness campaign was launched in 2005 (7, 16). The following year, the Parliament of Croatia instituted a National Donor Day. Similarly, European Donor Day has been celebrated in Croatia since 2010 with press conferences, expert panels, and events designed to increase general public awareness of organ donation (15, 16). Organ donation is perceived as an altruistic and generous act in Croatia and is generally supported by the country's religious communities (8).

Structural Elements

The National Transplant Organization

Staffing and Structure

Early reform measures were aimed at promoting and optimizing deceased donation in all critical care facilities. Initially, the transplant program in Croatia relied primarily on the work of a few exceptional individuals. In 2000, the Ministry of Health established the NTC which was assigned the crucial role of driving the development of a sustainable national organ donation and transplantation program in accordance with the highest professional and international standards of practice.

The NTC has been instrumental in strengthening hospital capacity for organ donation (particularly for deceased donation) by providing additional medical education *via* a training program, systematic monitoring of performance, and round-the-clock professional and logistical support (8). The NTC provided the support and leadership necessary for the harmonization of legislation with international standards (i.e., directives from the EU, the World Health Organization, and the Council of Europe). The NTC also established a national system for monitoring hospital performance, modifying the funding model, and negotiating and preparing for international cooperation and ultimately membership in Eurotransplant (7, 8).

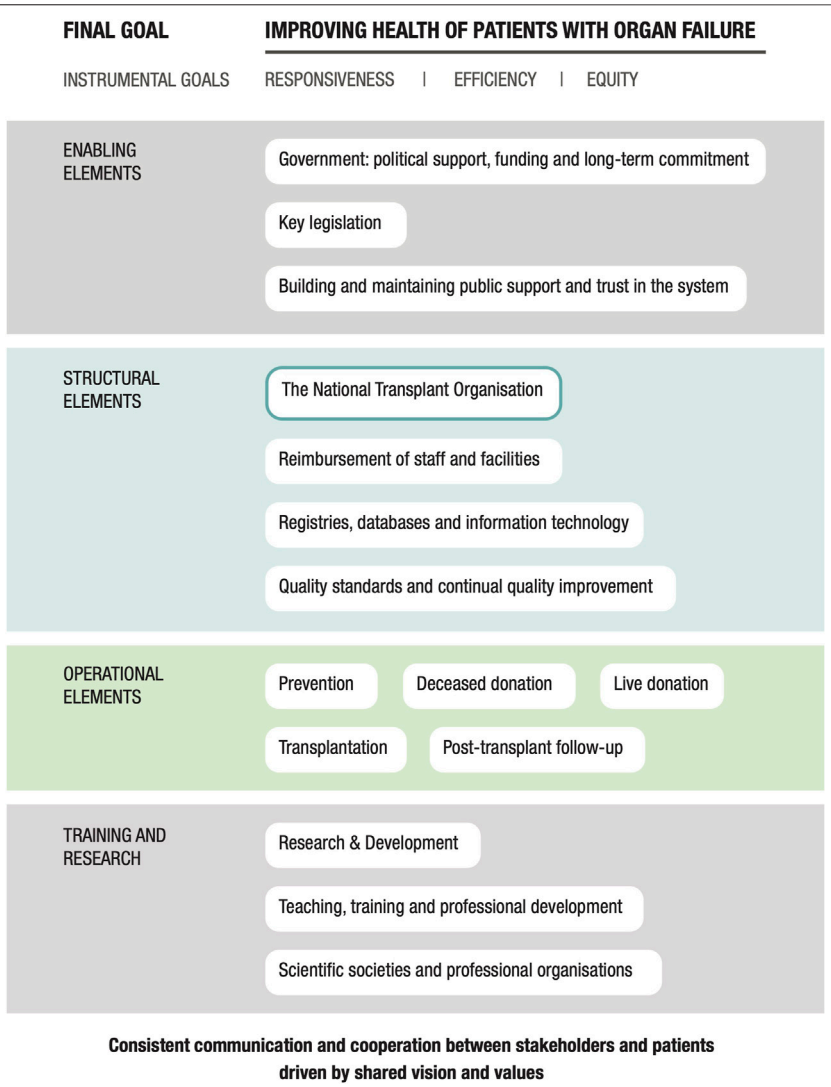


FIGURE 1 | A conceptual framework for evaluating national solid organ donation and transplantation programs.

In addition to providing strong national governance, Croatia has also adjusted the profile and roles of key donation experts who were assigned the role of transplant coordinators to support these initiatives (16). Hospital Transplant Coordinators (HTCs) selected from the most experienced intensive care professionals undergo extensive national or international training to support their important roles in the Deceased Organ Donation Pathway. The commitment of the HTCs to deceased donation and their involvement in this pathway have provided critical support for the sustainable increases in donation rates reported by many Croatian hospitals (7). The HTCs have had a particularly important role in advocating for and promoting hospital practices that consider organ donation as an integral component of end-of-life care (7, 8).

Much of Croatia's success may be attributed to the shared vision and efforts of the professionals involved in this pathway as well as the integrated approach that encompasses both national governance and hospital-based initiatives designed to address all essential components of organ donation and transplantation systems. In addition to the crucial role of the NTC and transplant coordinators, it is critical to recognize the contributions of intensive care teams who also provided strong support for organ donation. The efforts of these individuals were supported by transplantation and tissue typing teams. Together, these groups formed a solid foundation and represented key pillars of the modern Croatian transplant system.

International Collaborations

One of the NTC's strategic goals for reform was to develop international collaborations to address the needs of the most vulnerable groups of patients. An international effort focused on high-urgency liver transplants was initiated in 2004 and 2005 *via* a collaboration with the Italian Transplant Network (Centro Nacionale Trapianti).

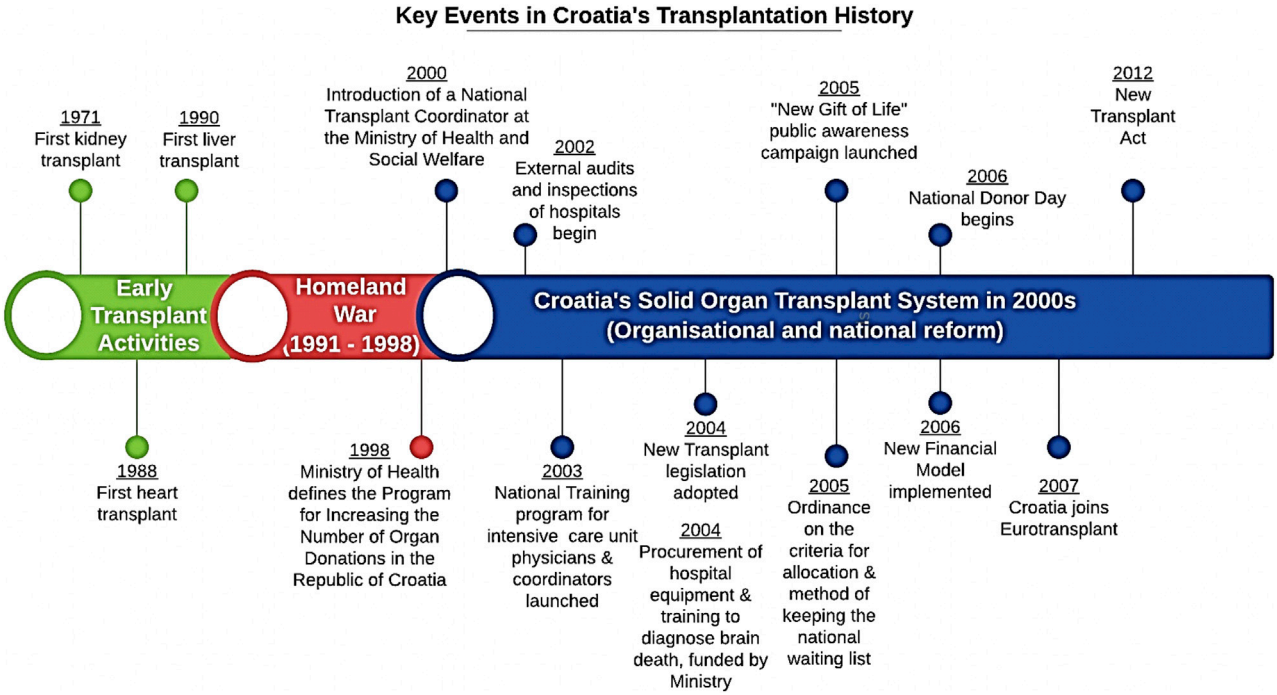


FIGURE 2 | Critical events in the history of organ transplantation in Croatia.

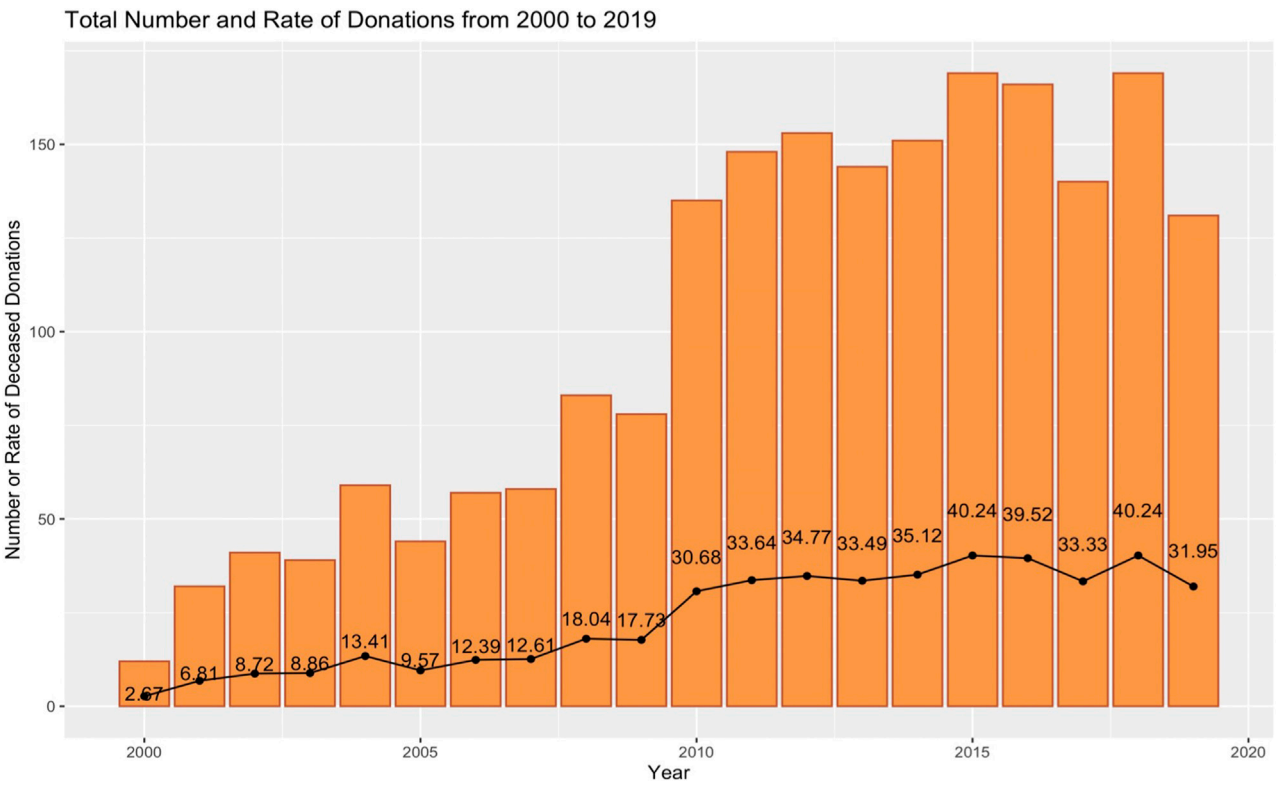


FIGURE 3 | Deceased donation in Croatia from 2000 to 2019 (11). The colored bars indicate the absolute number of deceased donations; the filled circles indicate the donation rate (number per million population [pmp]).

TABLE 2 | Key elements and policies that have led to reform of the national organ donation and transplantation program in Croatia, as reflected in domains of the conceptual framework described by Johnston-Webber et al. (11).

Framework domain	Key features	Details
Enabling Elements: Government: Political Support, Funding, Long-Term Commitment	Full political support, funding, and long-term commitment	• Government-led initiatives began in 1998 with a program designed to increase the frequency of organ donations • The government provided sufficient jurisdiction to the National Transplant Program enabling it to implement change • The government also committed financial resources to this issue (e.g., central reimbursement models for donation and transplant activities) See **Figure 2** for additional government-supported reforms
Enabling Elements: Government: Key Legislation	Legislation implemented early on in the process of transplant reform served to reset societal expectations. This included strong DBD legislation but gaps in DCD legislation	• Early "soft" opt-out legislation (since 1988) • Renewal of support in 2004 *via* the Croatian Transplant Act • Adoption of EU quality and safety standards in 2012 • Legislation currently does not support donation after circulatory death
Enabling Elements: Building and Maintaining Public Support and Trust in the System	Coordinated messages and inter-agency collaboration	• Continuous national campaigns, donor card promotions, and educational activities • Collaborations among representatives of national bodies (transplant, nephrology, and others)
Structural Elements: The National Transplant Organization (NTO)	Centralization and coordination of all aspects of donation and transplantation. Championing donation by clearly designated and expert clinical leadership	• Unique governing structure; the National Transplant Program is part of the Department of Transplantation and Biomedicine under the auspices of the Ministry of Health • Empowerment of an NTC and team (1999) • Efforts to join an international organ exchange scheme were among the early objectives of the comprehensive, long-term plan • Success was achieved *via* an initial focus on diagnosing brain death before moving toward an organ donation agenda • The National Transplant Office (NTO) is available to provide support at all times and uses creative ways to ensure adequate staffing (i.e., medical students)
Structural Elements: Infrastructure	Improvements made to immunology and histocompatibility facilities	• Two fully accredited tissue-typing laboratories were established
Structural Elements: Reimbursement of Staff and Facilities	Reimbursement by the state budget fosters local hospital participation	• Reimbursement from a special state budget rather than hospital funds • Adopted Transplant-related Diagnosis Related Groups
Structural Elements: Quality Standards and Continual Quality Improvement	The strong emphasis on quality improvement is provided in a helpful rather than punitive manner	• External audits and health inspections were established at major hospitals to assess the reasons underlying donor loss • Frontline feedback converted inspections into educational/supervisory opportunities overseen by transplant experts. This has boosted morale and the motivation to revitalize the organ donation and transplantation program • An official quality assurance program was established. This motivated efforts to meet the international criteria required to join Eurotransplant (2009)
Structural Elements: Registries, Databases, and Information Technology	Strengthened by efforts to join an international transplant organization	• Participation in Eurotransplant necessitated an upgrade of information technology and resulted in increased investment in the structure and transparency of transplant waiting lists and organ registries
Operational Elements: Donation	Clearly defined the role(s) of key donation personnel mandated in all public hospitals	• Critical point persons or teams overseeing donations were established (a total of 32, one in each of the public hospitals)
Operational Elements: Deceased Donation	Leader in DBD DCD needs Improvement	See **Figure 3** • Currently, there are no DCD donors. This is a potential area for growth

(Continued on following page)

TABLE 2 | (*Continued*) Key elements and policies that have led to reform of the national organ donation and transplantation program in Croatia, as reflected in domains of the conceptual framework described by Johnston-Webber et al. (11).

Framework domain	Key features	Details
Operational Elements: Live Donation	Needs improvement	• From 2000 to 2019, there were between 3 and 20 LD kidney transplants and 0–4 LD liver transplants per year (10)
Operational Elements: Transplantation	Above average for population size but relies on international collaborations for specific populations. Clearly defined roles have been established for transplantation	• 2018: Sixth globally for all transplant procedures (84.05 pmp) (12) and third globally for heart transplants (8.81 pmp) (12) • From 2000 to 2019, there were no lung transplants or small bowel transplants (10) • Pancreas transplants were performed at a rate of 1–14 per year • Transplant program directors/teams have been established (a total of five, all assigned to university hospitals where the procedures are performed.)
Training and Research: Teaching, Training, and Professional Development	There is a strong emphasis on training and experience	• Highly-skilled intensive care physicians provide critical support for donation programs • Strong emphasis on internationally- recognized training
Training and Research: Scientific Societies and Professional Organizations	International collaborations Leadership of others	• Involvement in multiple international transplant organizations to maintain standards and high-quality training • Bilateral agreements provide more access for specific groups in need of transplants • The Croatian Model has become a leader in the South-Eastern Europe Health Network (SEEHN)

In 2006, once all the key pillars of a successful transplant program had been achieved (e.g., a donor rate above 10 pmp, an around-the-clock central service, and tissue typing laboratory accreditation), the NTC approached the Eurotransplant Board of Management and commenced the negotiation process for membership in Eurotransplant. In 2007, once additional improvements and harmonization with international standards had been achieved, Croatia joined Eurotransplant. This was understood to be a critical step toward achieving quality and excellence, particularly in the fields of immunogenetics (7, 13), organ allocation, and utility of donated organs (7). Membership in Eurotransplant was also viewed as a means of increasing the public trust in the integrity of the Croatian national transplant program. This action had the additional indirect effect of motivating the key donation personnel, most notably critical care teams:

> Namely, the loss, i.e. rejection of "marginal" organs as unacceptable or even rejection of good quality organs, used to be a "privilege" of our transplant centres, which often resulted in revolt and dissatisfaction of hospital transplant coordinators. In what was no doubt an attempt to find "ideal" organs for their recipients, transplant teams often rejected marginal organs, as unacceptable, even in times of organ shortage. Upon joining Eurotransplant, this practice as a result from a "monopolistic" position and lack of competition (in cases where only one transplant centre existed) and a lack of any kind of supervision over ethical justification of such decisions, almost completely disappeared (7; p. 64).

As more organ donations materialized, it became easier to manage the waiting list. Patients on waiting lists were also provided with better screening, organ matching, and pre-operative evaluation, all of which resulted in better transplant outcomes (7).

Reimbursement of Staff and Facilities

As part of the overall effort to counteract the lack of financial resources, the limited number of appropriately-trained health professionals, and inadequate salaries associated with the donation and transplantation program in individual hospitals, new reimbursement schemes were adopted. Beginning in 2006, compensation for organ donation was provided by a special state budget; this ensured that the process involved no financial burden to local hospitals. The cost of the transplant evaluation, assessment, procedures, and operations are paid through Diagnosis Related Groups formulated by HZZO (7). On average, the 70,000–350,000 HRK (Croatian kuna) reimbursement for transplantation (depending on the complexity of a given procedure) is paid directly to the transplant center. Each donor hospital receives 40,000–55,000 HRK to cover the costs of donor recruitment, preparation, and organ retrieval (7). This reimbursement strategy has successfully promoted organ donations at smaller hospitals without transplant programs and has promoted the identification and support of potential donors.

Quality Standards and Continual Quality Improvement

Accountability mechanisms were established early on during this process and include audits and expert supervision. The design of these interventions was based mainly on current methods of health inspection and the Spanish donor quality assurance program. The first external audits and inspections were conducted in 2003 in a selected group of larger hospitals. The goal of these activities was to gain some understanding of the actual rate of brain death and the specific reasons underlying donor loss. This initial approach was upgraded and improved several times since then. A more systematic quality assurance program for DBD donors was introduced in 2009 that included annual desk-based audits. Depending on inspection capacities, on-site audits are conducted every 2 years to assess the performance of deceased organ donation processes. The inspection commission includes a health inspector, the NTC, and selected prominent HTCs. These inspections focus increasingly on educational and motivational strategies, as this method is preferred by the hospital staff. This "soft" approach to quality assurance helps to motivate the staff regarding the implementation of positive change and toward eliminating previously-identified gaps in the deceased donation pathway (7). Transplantation outcomes are assessed separately in each transplant program *via* regular audits of transplant centers at two-year intervals.

Remaining Challenges

The Croatian organ donation and transplantation program has achieved undeniable success. Croatia has contributed to a regional initiative and provides technical assistance designed to promote the development of sustainable transplant systems in neighboring South-Eastern European countries, including Serbia, North Macedonia, Moldova, Bosnia and Herzegovina, Romania, Bulgaria, Montenegro, and Albania). The results of this collaboration, which was spearheaded by the Croatian NTC's Regional Health Development Centre on Organ Donation and Transplant Medicine, show that these countries have all experienced improvements in their organ transplant activities (2011–2015) (17). However, it is important to recognize that one-third to one-half of the donations in several of these countries are from DCDs and LDs.

The gaps in the Croatian program are delineated by the framework approach. At this time, there are no DCD donations in Croatia and very few from LDs (**Table 2**). To enlarge the donor pool, Croatia is considering the development of a controlled DCD (cDCD) program (17). While the Croatian organ donation and transplantation program currently has the infrastructure that would be needed to implement this type of program, it will require additional staff training and a proper legal framework. These components are currently in development (17).

There is always work to be done to maintain public trust in the system and willingness to donate. According to the latest Eurobarometer survey on organ donation, Croatia is above the European average for knowledge of national regulations regarding organ donation and transplantation, and of discussing human organ donation (18). Croatia (53%) is almost at the European average (55%) for willingness to donate own organs. One explanation for positive donation sentiment is that Croatia is a very homogenous country with 90.4% of the population being Croats, 95.6% of the population identifying Croatian as their mother tongue and ~ 91.4% being Christians (the vast majority Catholics) (19). This offers an advantage when it comes to building a pro-donation attitude in society and when it comes to approaching families for donation. However, compared to 53% of Europeans, only 45% of Croatians would be willing to do donate a family member's organs. Reasons not to donate a family's organs include above average fears of manipulation of the human body (18). A larger proportion of Croatians did not have a reason for unwillingness to donate, suggesting an opportunity for initiatives building trust (described above) with the general population (18).

DISCUSSION

This review summarizes the key aspects of the Croatian transplantation system and has highlighted factors that have contributed to its remarkable success. The results of our evaluation are presented with reference to a comprehensive framework that includes system-level elements that are essential for a successful organ donation and transplantation program (6). The case study specifically highlights several components that are of particular importance to the Croatian program. These include landmark legislation, central reimbursement for organ donation and transplantation activities, ongoing public awareness campaigns, and recruitment of skilled intensivists to serve as critical donation personnel. Croatia has achieved success with a unique model that includes strong central governance and the appointment of an empowered national clinical leader whose role is overseen directly by the Ministry of Health. In 2007, Croatia realized its ambition of joining Eurotransplant. To meet these requirements, Croatia needed to strengthen several features of its donation and transplantation program, including factors involved in its infrastructure, registries, and processes.

There remain large gaps in transplantation research at the systems level, particularly with respect to the complex relationships between politics, legislation, and public opinions regarding organ donation and transplant activities. A more complete understanding of these system-level relationships may help us to understand why one transplant program has succeeded while others have failed. The use of a comprehensive, systems-level framework such as the one employed here (11) may help to identify specific areas of strong *versus* poor performance. Our findings present considerations that may be useful to countries that are similar to Croatia in terms of population size and/or financial resources. Croatia is an excellent example of how a small and poorly-resourced country can achieve success in organ donation and transplantation. Our evaluation offers a wealth of information and potential strategies that might be utilized to transform a low-performing into a high-performing program.

This paper builds on previous publications that describe the Croatian organ donation and transplantation model and actions taken that have boosted donation rates (7, 8, 20). However, this analysis is unique because it is the first to explore aspects of governance and policy that might be adapted for use by other nations seeking to develop transplant systems. A major strength of this paper is that the findings were based on multiple sources of information and thus captured a holistic, detailed picture of the system in a real-life context.

We recognize that there are limitations to the chosen methodology. Of note, we understand that the evidence provided may be difficult to generalize and that our findings may not apply to all other contexts and situations. We believe that these concerns are somewhat mitigated by our approach to data collection and analysis, including the use of a conceptual framework and validation of our findings by subject matter experts. We do recognize that the potential bias introduced by these experts may also be a limitation of this work and that their views may not be relevant to all transplant situations. However, given the significant gap in the literature on the nature of successful transplant systems, we hope that these findings, together with the contributions of other reviews in this series, contribute to future research in this area. Additional comparative research focused on the transplant systems in other countries helps to strengthen our understanding of the factors identified as crucial to successful organ donation and transplantation programs. This information is provided by several other papers in this series (21–25).

We were unable to locate full information for several of the domains identified in the conceptual framework. For example, efforts designed to prevent the need for an organ transplant are largely outside the purview of the Croatian organ donation and transplantation program. Likewise, we found very little information that addressed post-transplant follow-up in Croatia or the barriers preventing DCD or LD. However, the use of the framework was helpful as it permitted us to identify these areas as subjects for future research and quality improvement initiatives.

In summary, the Croatian experience demonstrates that countries with relatively modest resources can successfully build world-class organ donation and transplantation systems. Effective processes identified in this study include strong central governance as well as effective leadership at both the political (government and legislation) and clinical (champions and key donation persons) levels. Additionally, the act of joining an international organ exchange scheme helped to guide the transformation process and drive improvements in program quality.

DATA AVAILABILITY STATEMENT

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author.

AUTHOR CONTRIBUTIONS

All authors listed have made a substantial, direct, and intellectual contribution to the work and approved it for publication.

CONFLICT OF INTEREST

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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REFERENCES

1. OECD. *OECD/European Observatory on Health Systems and Policies. Croatia: Country Health Profile 2019, State of Health in the EU*. Brussels: OECD Publishing, Paris/European Observatory on Health Systems and Policies (2019).
2. World Health Organization, GODT, Organización Nacional de Trasplantes (ONT). International Report on Organ Donation and Transplantation Activities. Executive Summary 2018 (2020). Available from: http://www.transplant-observatory.org/global-report-2018/ (Accessed May 16, 2021).
3. OECD. *Croatia: Country Health Profile 2021*. Paris: Organisation for Economic Co-operation and Development (2021). Available from: https://www.oecd-ilibrary.org/social-issues-migration-health/croatia-country-health-profile-2021_717e5510-en (Accessed June 21, 2021).
4. OCED. Health at a Glance 2021 - OECD (2022). Available from: https://www.oecd.org/health/health-at-a-glance/ (Accessed May 8, 2022).
5. HDNDT. Hrvatski Registar Nadomještanja Bubrežne Funkcije | Hrvatsko Društvo Za Nefrologiju, Dijalizu I Transplantaciju (2022). Available from: https://www.hdnd–t.org/registar (Accessed June 21, 2022).
6. Johnston-Webber C, Mah J, Streit S, Prionas A, Wharton G, Mossialos E, et al. A Conceptual Framework for Evaluating National Organ Donation and Transplantation Programs. *Transpl Int* (2023) 36:11006. doi:10.3389/ti.2023.11006
7. Busic M, Lovrencic-Huzj A. Action Taken to Boost Donor Rate in Croatia. In: G Randhawa, editor. *Organ Donation and Transplantation - Public Policy and Clinical Perspectives*. London, UK: InTechOpen (2012). Available from: http://www.intechopen.com/books/organ-donation-and-transplantation-public-policy-and-clinical-perspectives/action-taken-to-boost-donor-rate-in-croatia (Accessed February 16, 2020).
8. Živčić-Ćosić S, Bušić M, Župan Ž, Pelčić G, Anušić Juričić M, Jurčić Ž, et al. Development of the Croatian Model of Organ Donation and Transplantation. *Croat Med J* (2013) 54(1):65–70. doi:10.3325/cmj.2013.54.65
9. Lomero M, Gardiner D, Coll E, Haase-Kromwijk B, Procaccio F, Immer F, et al. Donation after Circulatory Death Today: an Updated Overview of the European Landscape. *Transpl Int* (2020) 33(1):76–88. doi:10.1111/tri.13506
10. WHO collaboration. Global Observatory on Organ Donation and Transplantation (2020). Available from: http://www.transplant-observatory.org/ (Accessed May 27, 2020).
11. GODT. Global Observatory on Donation and Transplantation. Country Summary: Croatia (2020). Available from: http://www.transplant-observatory.org/summary/ (Accessed May 27, 2020).
12. GODT. Data (Charts and Tables) (2020). Available from:http://www.transplant-observatory.org/data-charts-and-tables/ (Accessed May 27, 2020).

13. Republika Hrvatska Ministarstvo zdravstva. Promidžbene Aktivnosti I Kampanje (2020). Available from: https://zdravstvo.gov.hr/programi-i-projekti/nacionalni-programi-projekti-i-strategije/nacionalni-transplantacijski-program/promidzbene-aktivnosti-i-kampanje/2562 (Accessed August 9, 2020).
14. Hrvatski sabor. *Zakon O Presađivanju Ljudskih Organa U Svrhu Liječenja* (2012). 3071, NN 144/2012.
15. Republika Hrvatska Ministarstvo zdravstva. Nacionalni Transplantacijski Program (2012). Available from: https://zdravstvo.gov.hr/nacionalni-transplantacijski-program/1528 (Accessed June 8, 2020).
16. Busic M, Malnar Grubisic B. *Final Report of the Model of Celebrating EDD in Satellite Countries: Developing Guidelines for the Organization of a European Donation Day*. Zagreb, Croatia: Ministry of Health and Social Welfare (2011).
17. Spasovski G, Busic M, Delmonico F. Improvement in Kidney Transplantation in the Balkans after the Istanbul Declaration: where Do We Stand Today? *Clin Kidney J* (2016) 9(1):172–5. doi:10.1093/ckj/sfv116
18. Eurobarometer Directorate General Health and Consumers. Eurobarometer: Organ Donation and Transplantation (2010). Available from: https://europa.eu/eurobarometer/surveys/browse/all/series/300790 (Accessed June 7, 2023).
19. Census of Population. *Households and Dwellings 2011, Population by Citizenship, Ethnicity, Religion and Mother Tongue*. Zagreb, Croatia: Croatian Bureau of Statistics (2013). Report No.: ISSN 1333-1876.
20. Bušić M. Darivanje i presađivanje organa – "Hrvatski model". *Medix* (2011) 16(92/93):144–8.
21. Streit S, Johnston-Webber C, Mah J, Prionas A, Wharton G, Paulino J, et al. Lessons From the Portuguese Solid Organ Donation and Transplantation System: Achieving Success Despite Challenging Conditions. *Transpl Int* (2023) 36:11008. doi:10.3389/ti.2023.11008
22. Streit S, Johnston-Webber C, Mah J, Prionas A, Wharton G, Cassanova D, et al. Ten Lessons From the Spanish Model of Organ Donation and Transplantation. *Transpl Int* (2023) 36:11009. doi:10.3389/ti.2023.11009
23. Mah J, Johnston-Webber C, Prionas A, Romagnoli J, Streit S, Wharton G, et al. How to Structure a Successful Organ Donation and Transplantation System in Eight (Not So Easy) Steps: An Italian Case Study. *Transpl Int* (2023) 36:11010. doi:10.3389/ti.2023.11010
24. Johnston-Webber C, Mah J, Prionas A, Streit S, Wharton G, Mossialos E, et al. Solid Organ Donation and Transplantation in the United Kingdom: Good Governance is Key to Success. *Transpl Int* (2023) 36:11012. doi:10.3389/ti.2023.11012
25. Johnston-Webber C, Prionas A, Wharton G, Streit S, Mah J, Boletis I, et al. The National Organ Donation and Transplantation Program in Greece: Gap Analysis and Recommendations for Change. *Transpl Int* (2023) 36:11013. doi:10.3389/ti.2023.11013

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Solid Organ Donation and Transplantation in the United Kingdom: Good Governance is Key to Success

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The United Kingdom (UK) supports a highly successful organ donation and transplantation program. While the UK originally had one of the lowest organ donation rates in Europe, sustained reforms have resulted in steady improvement. Of note, the UK nearly doubled its rate of deceased donations between 2008 and 2018. In this report, we present a case study of the UK organ donation and transplantation program as an example of a complete system with sound and inclusive governing structures that are strongly integrated with critical programs focused on training and research. This study was based on an initial targeted review of the literature led by a UK expert that included guidelines, national reports, and academic papers. Feedback solicited from other European experts was incorporated into our findings *via* an iterative process. Overall, the study highlights the stepwise evolution of the UK program that ultimately became successful largely due to ongoing collaborative efforts carried out at all levels. Centralized coordination of all aspects of the program remains a key driver of improved rates of organ donation and transplantation. The designation and empowerment of expert clinical leadership have helped to maintain focus and promote ongoing quality improvement.

Keywords: organ donation, organ transplantation, transplantation policy, United Kingdom, UK

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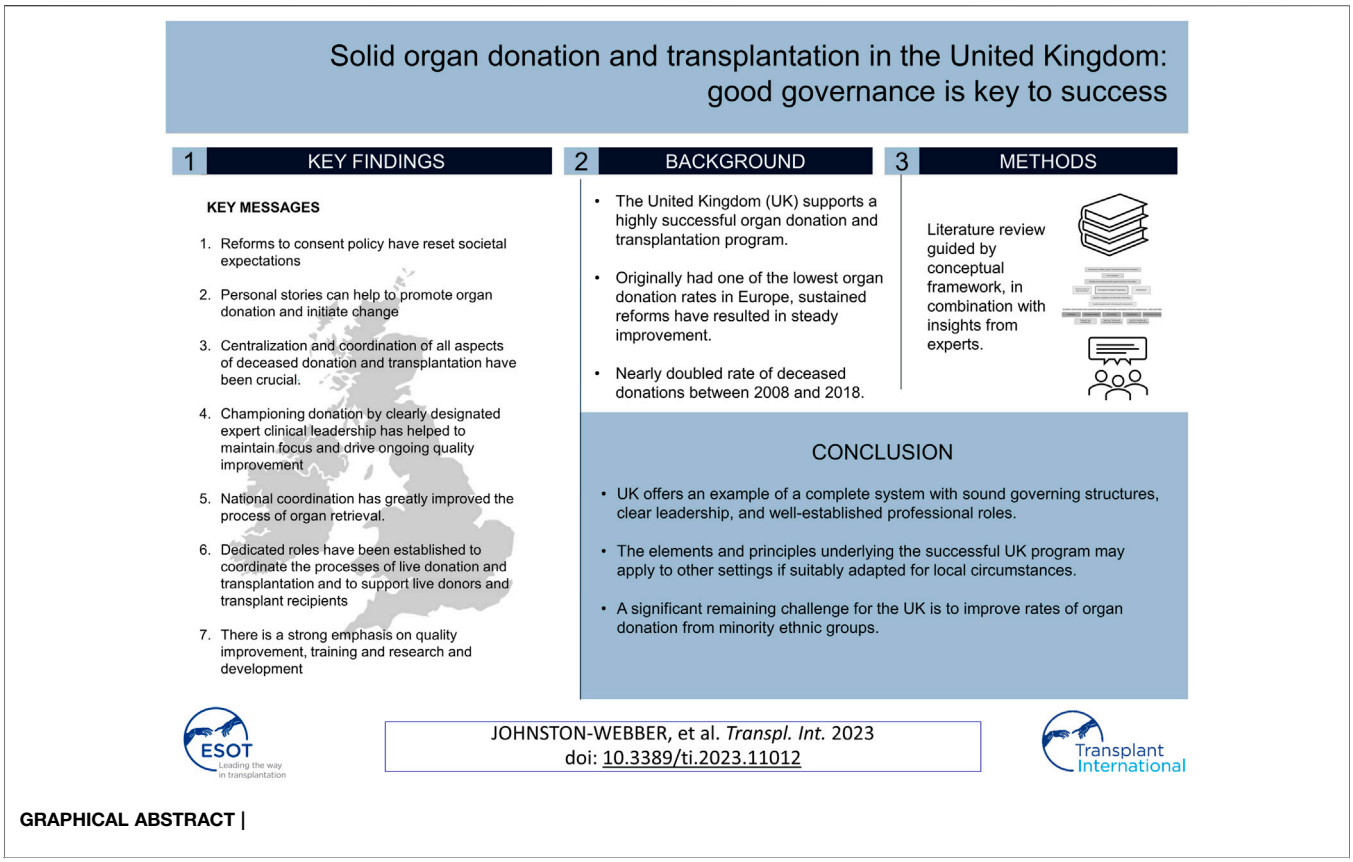
INTRODUCTION

Although the United Kingdom (UK) spends considerably more on healthcare than some of the other European countries with successful organ donation and transplantation programs (e.g., Croatia, Portugal, and Spain (1–3)), it has only recently achieved success in this field. In the early 2000s, the rate of organ donation in the UK was among the lowest in all of Europe. However, largely as a result of a series of reforms that were instituted during the past two decades, organ donation rates in the UK have been increasing steadily. The deceased donation (DD) rate in the UK increased from 13 per million population (pmp) in 2008 (4) to 24.2 pmp in 2018/19 (5).

This paper outlines the key features of the UK solid organ donation and transplantation program. We will highlight the factors that have contributed to the near doubling of its DD rate, which has significantly reduced the number of patients awaiting transplants. We intend to (1) assess recent



GRAPHICAL ABSTRACT |

trends in organ donation and transplantation and (2), describe the critical features and developments that promoted positive change in the UK.

Table 1 provides an overview of key statistics regarding the UK healthcare system and population health status, including health spending *per capita*, key health factors of relevance to organ failure and the number of people on renal replacement therapy.

MATERIALS AND METHODS

Our study of the UK organ donation and transplantation program began with a narrative review of the literature. The searches for this review were conducted using combinations of the keywords "organ donation and transplantation" and "United Kingdom." We retrieved several key documents and resources that were relevant to the national organ donation and transplantation system, including those that examined current legislation in the UK. We also performed thorough searches of the comprehensive websites maintained by the National Health Service Blood and Transplant (NHSBT), the UK's National Transplant Organization (NTO), and the Human Tissue Authority (HTA), as well as related bodies and institutions, including the British Transplantation Society. References were hand-searched to obtain more detailed information. Keywords that were directly relevant to the major issues identified were used to perform a more focused review of the literature. This second review targeted databases that included Medline and Web of Science; internet search engines (e.g., Google Scholar) were also used to retrieve relevant peer-reviewed papers from the academic literature. The searches were not limited by year of publication, although papers written in languages other than English were excluded from further consideration. One researcher screened the titles and abstracts of these papers and identified those that were directly relevant to the objectives of this study. The reference lists of papers in this second set were also hand-searched for additional source material. This approach also facilitated the retrieval of relevant items from the grey literature, including international reports and reviews.

The next stage of the process was performed in consultation with a panel of international experts in organ donation and transplantation, including one expert from the UK. The case study was built according to the domains and elements included in the conceptual framework described in Johnston-Webber et al. (9) that featured the essential building blocks and goals of an organ donation and transplantation program (**Figure 1**). The expert panel provided feedback *via* an iterative process and reviewed consecutive drafts of the case study until all were satisfied that the findings presented were complete and accurate. The experts also suggested relevant resources that might supplement those identified by the aforementioned targeted review. The analysis focused on structures, processes and distinctive features of the system corresponding to domains

TABLE 1 | Health system financing and population health in the UK: key statistics.

Health system	References
• Health spending *per capita*, EUR 2900; EU average, EUR 2884	(6)
• Health spending as a percentage of the gross domestic product, 9.6%; EU average, 9.8%	(6)
• Public spending as a percentage of the total health expenditure, 78.8%	(6)
• Out-of-pocket payments as a percentage of the total health expenditure, 16%; EU average, 15.8%	(6)
• Percentage of the population reporting an unmet need for medical care, 3%	(6)
Health status	
• Percentage of the population over 65 years of age, 18.1%; EU average, 19.4%	(6)
• Life expectancy, 81.3 years; EU average, 80.9 years	(6)
• Percentage of the population that smokes daily, 15.8%; OECD average, 16.5%	(7)
• Litres of alcohol consumed *per capita* per year, 9.7L; OECD average, 8.7L	(7)
• Percentage of the population that is overweight or obese (BMI >25), 64.2%; OECD average, 56.4%	(7)
• Individuals maintained on renal replacement therapy, incidence 122 pmp (England)	(8)
• Individuals maintained on renal replacement therapy, prevalence, 1,038 pmp (England)	(8)

EUR, euro; EU, European Union; OECD, Organisation for Economic Co-operation and Development; BMI, body mass index, pmp = per million population.

of the framework, rather than performance in relation to health outcomes or health system goals.

The results presented below are consistent with the conceptual framework and represent a selection of the key features of the UK program that are relevant to our research objectives.

RESULTS

The UK organ donation and transplantation program has evolved in a step-wise fashion over a comparatively long period of time. Although many challenges remain, the developments in the UK highlight overall success with respect to this endeavour. These accomplishments are the result of many years of tireless campaigning, public engagement, legislative changes, system reviews, adaptation, and targeted reorganization. Several decades of sustained and coordinated efforts from all parties concerned have contributed to this achievement. Of note, there are currently considerable differences with respect to the organization, provision, and delivery of care by the NHS between the four UK jurisdictions (i.e., England, Scotland, Wales, and Northern Ireland). However, since 2005 a single organization, the NHSBT, has taken on the responsibility of coordinating and promoting organ donation and transplantation throughout the UK. The information presented in **Table 2** provides a timeline and brief historical overview of the development of the UK program.

Trends in Organ Donation and Transplantation in the UK

Prevention of organ failure is currently a priority in the UK; this may contribute to the comparatively low incidence and prevalence of patients maintained on renal replacement therapy in this country (17). The public health bodies of all four UK jurisdictions run regular public information and education campaigns aimed at promoting healthy lifestyles and providing warnings about the harmful effects of smoking and excessive alcohol use. Primary and secondary school curricula cover topics that include healthy eating, exercise, and sexual health (18). All UK adults between 40 and 74 years of age are invited to visit their general practitioners for a health check every 5 years. Health checks routinely include discussions focused on lifestyle and general health as well as specific screening for diabetes, hypertension, hypercholesterolemia, and obesity (19). The UK has a robust primary care network and a voluntary annual reward and incentive program known as the Quality and Outcomes Framework (QOF). This program incentivizes primary care physicians to perform regular screenings and monitor the development of risk factors that might lead to organ failure, including hypertension, diabetes, and chronic kidney disease (20).

There has been considerable improvement in organ donation and transplantation in the UK over the past two decades. Possibly the most important factor in achieving this improvement was the work of the Organ Donation Taskforce, whose report detailing 14 recommendations was published in 2008(4). In this study we highlight some of these recommendations. However, it is important to point out that the 14 recommendations were intended to work as a group, and all 14 have been crucial to the improvements which were achieved in the UK program. Although the UK did not quite reach the target set by the "Taking Organ Transplantation to 2020" strategy of 26 DDs pmp by 2020 (12), the DD rate increased from 13 pmp in 2008 (4) to 24.2 pmp in 2018/2019 (5), albeit with a slight drop to 23.8 pmp in 2019/2020 (21). The UK is also a leader in the efforts to promote donation after circulatory death (DCD); these efforts are supported by a consensus statement from the British Transplantation Society and the Intensive Care Society (22), a Code of Practice for the Diagnosis and Confirmation of Death from the Academy of the Medical Royal Colleges (23), and legal guidance issued by the Department of Health in England and Health and Social Care Directorates in Scotland (24, 25). These documents have helped to reassure ICU clinicians that it is entirely appropriate to include consideration of organ donation as part of every end-of-life care pathway. The practice of DCD has grown steadily over the past decade, and now is the source of ~40% of all DDs, a percentage that is higher

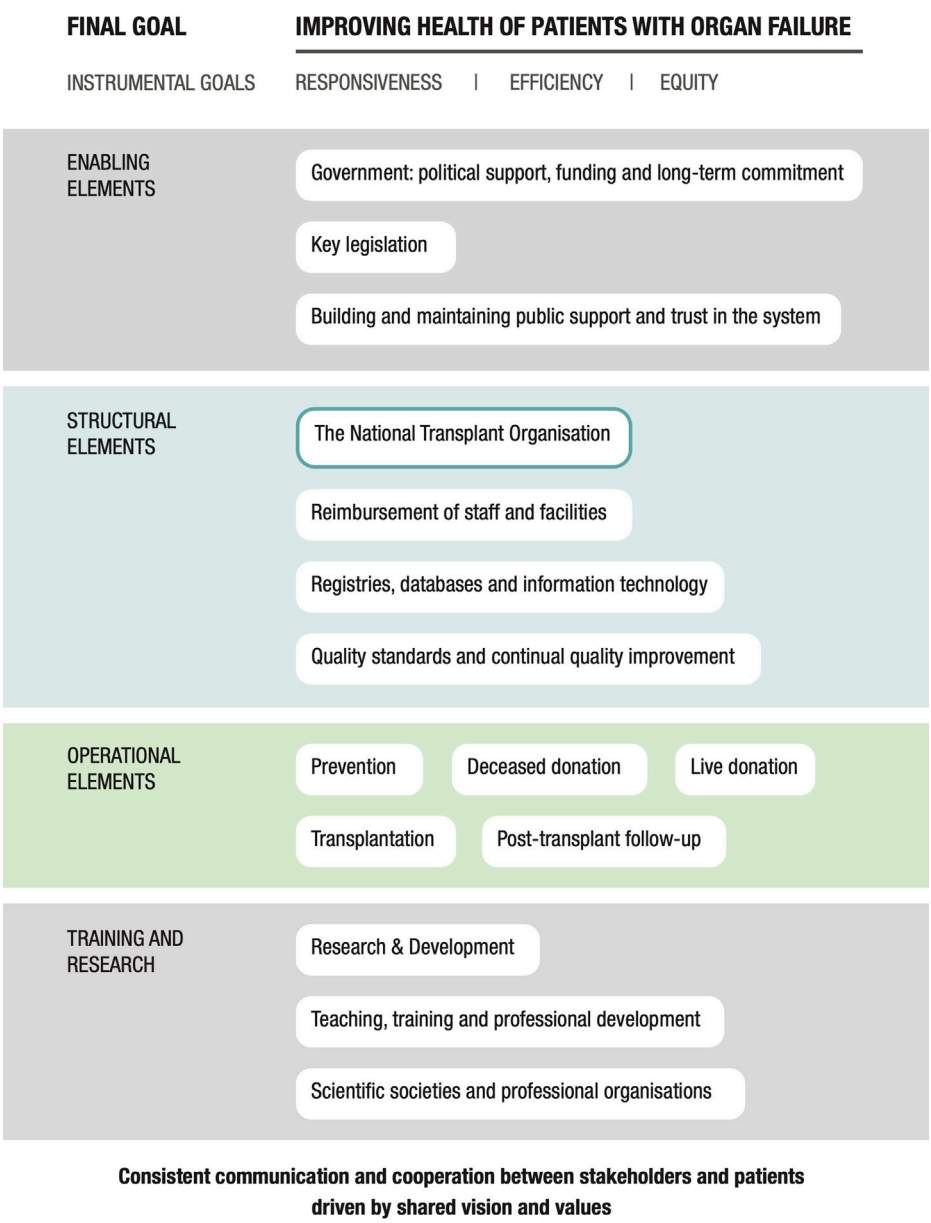


FIGURE 1 | A conceptual framework used to understand and evaluate a national solid organ donation and transplantation program.

than that reported by many comparable countries. Most of these donations involved controlled DCD in intensive care units that were initiated following decisions to withdraw life-sustaining treatments (26). Increasing utilisation of *ex-situ* normo- and hypothermic machine perfusion and *in-situ* normothermic regional perfusion techniques may have also helped to boost the rates of viable organ donations particularly from DCD and extended criteria donors (27, 28). An additional factor in ensuring sustained improvement in the rates of deceased donation has been the implementation of comprehensive reimbursement schedules for all deceased donor care expenses. This ensures that there is no financial burden on participating hospitals which could present a disincentive to undertake these procedures. **Figure 2** shows the absolute numbers of DBD, DCD and living donors across the UK from April 2010 to March 2020.

Transplants have increased considerably over the years. In 2010/2011, 2706 organ transplants were performed in the UK. The number of transplants increased to a high of 4038 in 2016/2017, followed by a slight drop to 3760 in 2019/2020. The number of people on the waiting list dropped from 7814 in 2010/2011 to a low of 6044 in 2017/2018; this was followed by a small increase to 6138 in 2019/2020 (**Figure 3**). The onset of the Coronavirus

TABLE 2 | Main developments in the UK program over the past 25 years.

1994	NHS organ donor registry is organized following a long public campaign to coordinate supply and demand
2000	UK Transplant is formed in 2000 and is tasked with increasing the number of organ donors
Early 2000s	The roles of donor liaison nurses, living donor coordinators, and regional transplant coordinators were established
2003	A transplant framework for England was published entitled "Saving Lives, Valuing Donors" (10)
2004–2005	Human Tissue Act legislation passed in 2004 led to the establishment of the Human Tissue Authority (HTA) in 2005. This authority was tasked with regulating all organizations involved in handling human tissue (Non-Departmental Public Body of the Department of Health and Social Care)
2005	UK Transplant merges with the National Blood Service in 2005 to become the National Health Service Blood and Transplant (NHSBT), a UK-wide Special Health Authority
2006	Human Tissue Act Scotland was enacted
2006–2008	The Organ Donation Taskforce (ODT) investigates and publishes a detailed report. A goal of increasing the deceased organ donation rate (then 13 pmp) by 50% by 2013 was set (4)
2010	In response to the ODT report, the National Organ Retrieval Service (NORS) is established as are the roles of Specialist Nurses in Organ Donation (SN-OD), Clinical Leads in Organ Donation (CL-OD), and Organ Donation Committees. The NORS, SN-OD and CL-OD posts are funded by the NHSBT
2011	National Institute for Health and Care Excellence (NICE) guidance entitled "Organ Donation for Transplantation—Improving donor identification and consent rates for deceased organ donation" was published (updated in 2016) (11)
2014/15	A review of ODT recommendations entitled "Taking Organ Transplantation to 2020" was published. A target of increasing the deceased donation rate from 19.1 pmp to 26 pmp by 2020 is set (12)
2015	Wales passes "soft opt-out" legislation (Human Transplantation [Wales] Act 2013) that was enacted in 2015 (13)
2020	England enacts "soft opt-out" legislation (Organ Donation [Deemed Consent] Act 2019) (14)
2021	Scotland enacts "soft opt-out: legislation (Human Tissue [Authorization] [Scotland] Act 2019) (15)
2023	Northern Ireland enacts "soft opt-out" legislation (Dáithí's Law) (16)

disease-2019 (COVID-19) pandemic most likely had some impact on the rates reported for 2019/2020 as the NHSBT report covers through the end of March of this and each calendar year. Data for the remainder of 2020 onwards have not been included for the purposes of this case study as it has been greatly distorted due to the impact of the COVID-19 pandemic on the normal functioning of the organ donation and transplantation program.

UK-wide family consent rates are also improving slowly and have grown from 62.8% in 2016/2017 to 67.7% in 2019/2020 (both donation after brain death [DBD] and DCD). However, there remain considerable differences in consent rates across the UK. The consent rate in Wales reached 69%, while that in Northern Ireland remained at 62% during 2019/2020 (21). We note that Wales was the first of the four UK jurisdictions to enact "soft opt-out" legislation. Since 2015, Wales has been operating under the Human Transplantation (Wales) Act 2013 (13) which served to amend the 2004 Human Tissue Act and states that one assumes that an individual consents to donation unless otherwise stated, although family members can still register objections. England followed with similar legislation in 2019 (enacted in April 2020) (14). Similarly, in July 2019 the Scottish Parliament passed the Human Tissue (Authorization) (Scotland) Act 2019 (15) which also introduced a "soft opt-out" system; this was enacted in March 2021. Northern Ireland was last to make this change, with "soft opt-out" legislation enacted in spring 2023 (16).

The UK's active living donor (LD) program contributes substantially to the overall transplant rate. In 2019/2020, the UK performed 14.8 LD transplants pmp. Recent data from the NHSBT reveals that 39% of donors are living at the time of donation; these donations account for 21% of all transplant activity. There is also a successful and growing UK-wide kidney exchange scheme (29). This program, which was established in 2007, celebrated its 1000th kidney transplant in 2019 (30).

Key Elements of UK Policy Leading to Programmatic Reform

The following sections present the critical elements contributing to the reform of the UK organ donation and transplantation program. **Table 3** provides a summary of these elements aligned with the elements of the conceptual framework described in Johnston-Webber et al. (9).

Enabling Elements

Government: Key Legislation

Reforms to Consent Policy Have Reset Societal Expectations

"Opt-out" legislation has now been adopted across the UK (13–16). This has changed how conversations about DD are initiated and framed. This effectively facilitates the job of SN-ODs and improves the likelihood of obtaining consent. Wales led the way in enacting this legislation, which appears to have had a net positive effect. Rates of family consent and authorization as well as DD rates in Wales have increased since this legislation was enacted (31). Due to the impact of the COVID-19 pandemic, this paper only presents data up to early 2020, and therefore it is not possible to reflect on whether the changes to the legislation in the other devolved nations have had a similar effect. Each legislative change was preceded by a comprehensive consultation process, including surveys of public perceptions and opinions (32–35). This process was designed to raise the profile of organ donation and transplantation as well as to ensure that there were no unintended consequences of the legislation.

TABLE 3 | Key elements of UK policy that have driven reform. These elements have been aligned with elements of the conceptual framework described in Johnston-Webber et al. (2021) (9).

Framework domain	Key features	Details
Enabling Elements: Government: Key Legislation	Reforms to consent policy have reset societal expectations	• All the constituent countries of the UK have now moved to a "soft opt-out" consent policy
Enabling Elements: Building and Maintaining Public Support and Trust in the System	Personal stories introduced in public information and education campaigns can help to promote organ donation and initiate change	• Moving stories of organ donors and transplant recipients have been effective in the UK setting
Structural Elements: National Transplant Organization (NTO)	The NTO provides centralization and coordination of all aspects of deceased donation and transplantation	NHSBT oversees and coordinates all aspects of deceased organ donation and transplantation *via* • Twelve regional organ donation teams, each serving several specific NHS Trusts and/or Boards • Eight solid organ advisory groups that include clinicians, scientists, and operational managers
	Championing donation by clearly designated expert clinical leadership has helped to maintain focus and drive ongoing quality improvement	• Specialist Nurses in Organ Donation (SN-ODs) and Clinical Leads in Organ Donation (CLODs) work closely with local Organ Donation Committees
	National coordination of the retrieval process	• The National Organ Retrieval Service (NORS) coordinates the retrieval process and thus prevents unnecessary delays • NORS currently includes ten abdominal and six cardiothoracic surgical teams
Structural Elements: Quality Standards and Continual Quality Improvement	A strong emphasis on quality improvement	• Comprehensive data are collected to cover all activities from donor identification to transplant follow-up • All units provide regular activity reports. The NHSBT publishes annual national reports and benchmarking data • The HTA audits and licenses transplant establishments • The HTA provides a platform for reporting serious incidents, as well as issuing alerts and warnings
Operational Elements: Living Donation and Transplantation	Dedicated roles established to coordinate the processes of live donation and transplantation and to support live donors and transplant recipients	• Transplant Recipient Coordinators (TRCs) support potential recipients • Living Donor Coordinators support living donors and organ recipients and promote living donation in their regions
Training and Research: Teaching, Training, and Professional Development	A strong emphasis on training for all staff involved in organ donation and transplantation	• All staff are expected to participate in tailored basic training and regular updates including instruction in specific communication skills • All staff members are expected to maintain a continuing professional development (CPD) portfolio and undergo regular review and appraisal • Advanced training opportunities are available • Junior staff members receive appropriate supervision
Training and Research: Research and Development (R&D)	A strong emphasis on research and development (R&D)	• The NHSBT maintains a designated research Advisory Group known as the Research Innovation and Novel Technologies Advisory Group (RINTAG) • RINTAG produces annual reports on relevant research activity

Building and Maintaining Public Support and Trust in the System

Personal Stories Can Help to Promote Organ Donation and Initiate Change

The recent change to the consent legislation in England has become known as "Max and Keira's Law" after the young girl who was fatally injured in a car accident and the boy who received her donated heart. With the consent of their families, the *Mirror* newspaper ran a prominent and successful campaign which ultimately led to the change in the law of England to an "opt-out" policy (36). Personal accounts that help the public to identify with the poignant mixture of tragedy and joy in situations such as these appeared to have a significant impact in the UK.

Structural Elements

The National Transplant Organization (NTO)

The Impact of Centralization and Coordination of all Aspects of Deceased Donation and Transplantation

Although the NHSBT was established in 2005, many managerial functions remained at the local level. Individual NHS Trusts and Boards were tasked with the responsibility of recruiting coordinators and allied staff members. One key message of the 2008 ODT was that an integrated UK-wide service was essential for effective oversight of all aspects of organ donation and transplantation and that this was a pre-requisite toward efforts to increase the DD rate (4). The NHSBT has now taken on this role and currently has overall responsibility for every step of deceased organ donation and transplantation. The NHSBT works

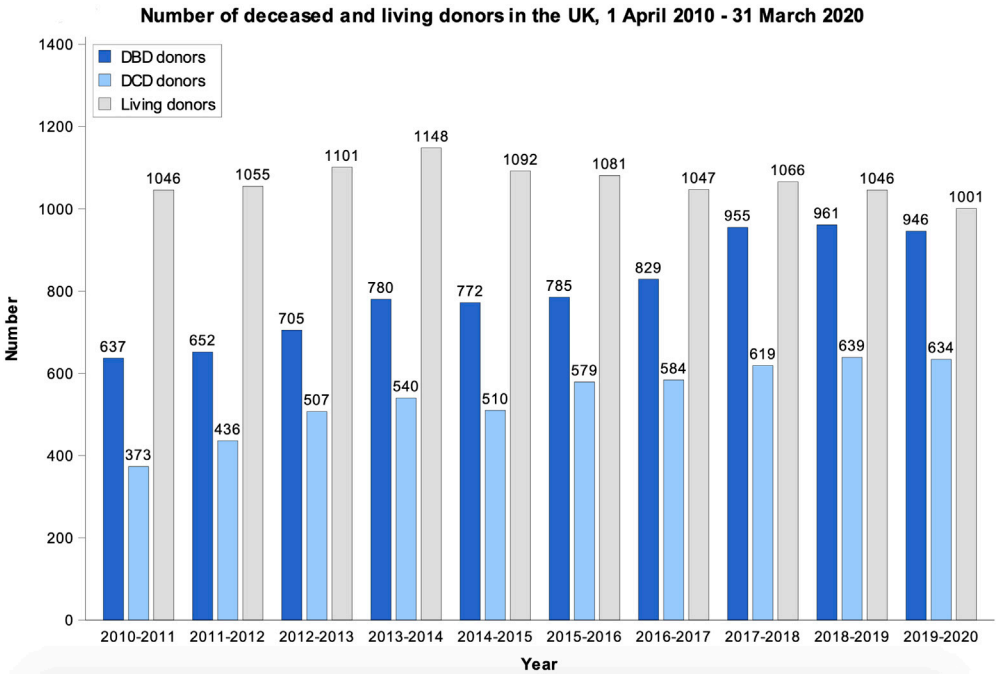


FIGURE 2 | Data from the NHSBT Organ Donation and Transplantation Activity Report 2019/20 showing the absolute numbers of DBD, DCD and Living donors in the UK from April 2010 to March 2020 (21).

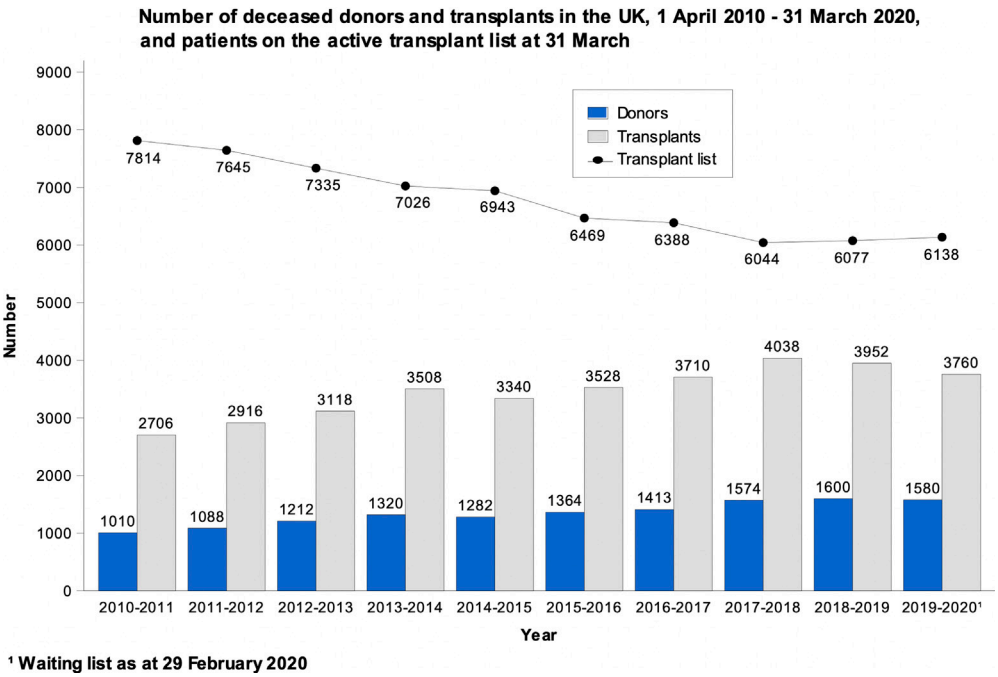


FIGURE 3 | Data from the NHSBT Organ Donation and Transplantation Activity Report 2019/20 showing the absolute number of deceased donors, number of people on the waiting list and transplants performed in the UK from April 2010 to March 2020 (21).

closely with the HTA and the transplant centres, and, in the case of living donation, the HTA authorises all living donations, and ensures that the required standards have been met. The NHSBT maintains the organ donation registry and national transplant database, employs and provides professional development for specialist nurses, clinical leads, and organ retrieval teams, and

establishes local Organ Donation Committees. There is a three-tier system that permits the NHSBT to oversee 12 regional organ donation teams, which in turn provide services to their designated populations and cover several NHS Trusts and Boards. Eight solid organ advisory groups (37) were also established; these groups are critical contributors to the success of the UK program, as they provide a forum at which clinicians, scientists, commissioners, and representatives of the government departments and directorates of health can meet regularly to discuss the current situation and future plans. The advisory groups include lay and patient representation. One key responsibility is to develop the selection, registration and allocation policies for their area of expertise, and these are approved by the Transplant Policy Review Committee acting on behalf of NHSBT. There are specific and detailed selection and allocation policies for each organ (38) and these are based on two key principles; ensuring equity of access to listing for transplantation and achieving the best possible outcomes. The lay and patient representatives of the solid organ advisory groups play an important role in the development of the allocation policies and their participation is vital to how the policies are perceived as fair and helps to protect them from unreasonable external challenges.

Championing Donation by Clearly Designated Expert Clinical Leadership has Helped to Maintain Focus and Drive Ongoing Quality Improvement

Consistent with the recommendations of the ODT report (4), the UK has developed clear clinical roles and leadership hierarchies in hospitals involved in deceased organ donation and retrieval. Specialist Nurses in Organ Donation (SN-ODs) are recruited, employed, and remunerated directly by the NHSBT and provide a round-the-clock service to all hospitals that participate in deceased organ donation. The SN-ODs receive rigorous training in communication skills and family support and thus play key roles in identifying all potential donors and facilitating organ donation and retrieval. The SN-ODs also provide teaching and training to colleagues and are responsible for ensuring that audits, policies, and resources are fully up to date. Additionally, they are responsible for gathering data for the annual Potential Donor Audit Report and inputting this to the NHSBT databases (39). This report gathers data on potential donations and the reasons for which potential donors do not become actual donors. It has been a crucial tool in increasing the number of donations in the UK and validating the presence of SN-ODs in the ICUs (and in other critical care settings).

SN-ODs are supported by Clinical Leads in Organ Donation (CLODs). The CLODs are usually senior physicians that have specialized training in intensive care or emergency medicine and are under a mandate to promote and champion organ donation in their localities. By 2017, 240 CLODs were operating in the UK and were responsible for covering all acute Trusts and Boards (40). CLODs are expected to commit a specific amount of time to the role for which they are reimbursed by the NHSBT. A network of regional CLODs has been established to promote professional support and development on a routine basis, as well as regularly-scheduled regional and national meetings at which all senior staff members are encouraged to attend.

Following the 2008 ODT report, Local Organ Donation Committees were established in every acute Trust or Board. These committees promote and endorse DD in their locality with a primary focus on performance, policy, education, and public promotion. The committee chair is a voluntary role, and this role is fulfilled by individuals from many different backgrounds. The chair works in close collaboration with the other committee members, in particular, local CLODs and SN-ODs (41).

In addition to the local Organ Donation Committees, there is a National Organ Donation Committee, this provides advice and guidance to the NHSBT and serves as the national representative body for the 12 UK regional organ donation teams. The National Organ Donation Committee meets three times a year and members include regional clinical leads and managers as well as senior staff from the ODT directorate of the NHSBT (42).

Organ donation and transplantation have been championed by establishing the roles of the SN-OD, the CLOD, and the Organ Donation Committee in every hospital Trust. Dedicated clinical leadership has removed barriers to organ donation and transplantation, promoted awareness, and fostered public acceptability. Regularly-scheduled meetings and opportunities for professional development promote a culture of collaboration and facilitate cohesion between the many different professionals involved in this process. Importantly, the SN-OD and CLOD posts are centrally funded by the NHSBT so that they are unlikely to be subsumed into other areas of need in the acute care environment.

National Coordination of the Retrieval Process

Before the National Organ Retrieval Service (NORS) was established in 2010, several surgical teams would often be involved simultaneously with a single donor. This frequently led to delays and problems with coordination. Similarly, other clinical commitments would divert focus from the donor and potentially compromise organ viability. The establishment of the centralized NORS, with on-call teams available round-the-clock, has greatly improved the process of organ retrieval. The NORS is commissioned and funded by the NHSBT, thus eliminating any controversy regarding reimbursement for organ retrieval (43).

Operational Elements

Dedicated Roles Established to Coordinate the Processes of Live Donation and Transplantation and to Support Live Donors and Transplant Recipients

Live Donation. Living Donor Coordinators are employed by all NHS Trusts involved in live donation to promote and facilitate living donation as well as guide living donors and their recipients through the transplant process.

Transplantation. On the transplant side of the process, Transplant Recipient Coordinators (TRCs) support potential recipients. There are currently 250 TRCS employed by NHS Trusts and based at 27 transplant units throughout the UK. These individuals play a critical role in the assessment process

and coordinating the transplant waiting list. TRCs also educate patients and their families and coordinate the transplant procedure(44).

Quality Standards and Continual Quality Improvement

A Strong Emphasis on Quality Improvement

All Trusts, Boards, and their constituent hospitals provide detailed reports and updates on their activities on a regularly-scheduled basis and these are collated into an annual activity report by the NHSBT (21). SN-ODs are expected to conduct regular internal audits and collect data on missed potential donors and refusal rates. The NHSBT publishes benchmarking reports that compare the performances of individual Trusts and Boards to one another and highlight donor referral rates and the involvement of SN-ODs in donation discussions. The outcomes and pathways of all potential donor organs are recorded and charted from point of donor eligibility through successful transplantation. Reasons for organ non-retrieval or non-use are also documented, and outcome data are collected for several years post-transplant. Reports of selected serious incidents and examples of excellence are shared to promote learning and inform changes in practice.

Established in 2005, the HTA regulates organ donation and transplantation throughout the UK under The Quality and Safety of Organs Intended for Transplantation Regulations 2012. These regulations transfer the European Union Directive 2010/53/EU on the Standards of Quality and Safety of Human Organs Intended for Transplantation into UK law. Both procurement and transplantation activities are covered by this legislation. In the case of living donation, authorisation must be obtained *via* the HTA which provides independent checks to protect living donors and ensure that their desire to donate is free from any form of coercion. The HTA inspects, audits, and licenses all facilities that participate in organ donation and transplantation activities. The HTA also provides a platform for reporting serious incidents and/or adverse reactions linked to donation or transplantation activities and issues relevant alerts and warnings.

Training and Research

Teaching, Training, and Professional Development

A Strong Emphasis on Training

The ODT report also recommended the need to strengthen training and education and provide ongoing educational support (4); providing and monitoring training is a core responsibility of the NHSBT. The NHSBT, the British Transplantation Society, and several Royal Colleges offer regularly-scheduled seminars, conferences, and training opportunities focused on organ donation and transplantation.

All healthcare professionals involved in organ donation and transplantation are expected to have an up-to-date CPD portfolio and personal development plan and are subject to routine appraisal and revalidation. These individuals are expected to complete basic training appropriate to their roles, and participate in regular educational updates and ongoing professional development. Advanced communication skills, including bereavement and family support, are understood to be crucial components of staff training; the NHSBT provides simulation training courses for all staff members involved in DD (45). SN-ODs are registered nurses, usually with a background in intensive care or trauma and emergency who have undergone 6 months of intensive clinical training for their role on the transplant team. CLODs are senior physicians with training in intensive care or trauma and emergency. These individuals are appointed for 3 years and are expected to participate in a two-day induction within the first year of their appointment.

The London Deanery currently offers specialty rotations in transplant surgery to post-graduate surgical trainees. As part of this program, trainees complete at least 4 years of general surgical training and 2 years of transplant surgical training including organ retrieval. On completion, fellowships are available that provide experience in more complex procedures, including live donor nephrectomies, pancreas transplantation, and liver transplantation (46).

Research and Development

A Strong Emphasis on Research and Development (R&D)

Research and development (R&D) are fully integrated into the NHSBT. These activities are perceived as crucial support for long-term improvements in patient outcomes. A national strategic plan supports an innovative translational program of research activities (47); a dedicated research office and R&D committee publish yearly reports and provide strategic oversight of these activities. The NHSBT Clinical Trials Unit supports researchers through the processes involved in conducting research, from the inception of ideas to dissemination of results (48). All research projects which use donation resources must be approved by The Research Innovation and Novel Technologies Advisory Group (RINTAG) of the NHSBT (49). RINTAG also promotes and supports research activities and ensures overall good governance of all research processes. Before commencement, all projects must be approved both by RINTAG and by the NHS Health Research Authority Research Ethics Committees (REC).

Remaining Challenges

Despite these improvements, there remains a substantial unmet need in the UK. At the beginning of 2020, more than 6,000 people remained on waiting lists for all organ transplants, and three hundred and seventy-seven individuals died in 2019/2020 while awaiting transplants (21). The average waiting time for a kidney transplant in 2019/2020 was 633 days, although this number had fallen from 706 days reported in the previous year.

Rates of donation and family consent from minority ethnic groups are improving but remain problematic. There is a greater likelihood that a matching organ will be found from a donor with the same ethnic background as the recipient. At the same time, ethnic minorities in the UK are more likely to develop hypertension, diabetes, and some forms of hepatitis, thus increasing their susceptibility to organ failure. In 2019/2020 only 7% of the deceased organ donors were members of ethnic minority groups. By contrast, 25% of the transplants were performed on these recipients. On average, Black patients will wait almost a year longer to receive a kidney transplant than white patients (50).

Another challenge is the comparatively few critical care beds available in the UK together with the high occupancy of critical care units. Despite recent increases, the number of critical care beds per 100,000 population in the UK remains consistently low when compared to similar resources available in other equivalent economies (51).

The UK has recently experienced a profound setback with the loss of the UK Donation Ethics Committee (UKDEC), which was a group established in 2009 in response to the aforementioned ODT report. The UKDEC helped to address difficult ethical issues and issued specific guidance on DBD and DCD (52, 53). The efforts of the UKDEC are believed to have contributed to the increased rates of DCD in the UK (54). The UKDEC has also issued guidance focused on particularly sensitive areas including infant and paediatric donation (55, 56) and interventions introduced prior to death designed to optimize organ quality (57). Due to widespread budget cuts and the need for increased fiscal austerity, funding for this valuable resource was withdrawn in 2016.

DISCUSSION

The UK organ donation and transplant program has undergone significant improvement in the past 10 years. Although much remains to be done, the UK offers an example of a complete system with sound governing structures, clear leadership, and well-established professional roles. Centralization and coordination of activities by the NHSBT has proven to be a very effective strategy that is aligned with ongoing and consistent efforts to ensure integration at all levels and nurture a collegial environment in which everyone understands that we are working toward a shared goal. Training and ongoing professional development are core components of the program. Likewise, high standards for data collection and regular reporting are necessary to inform continuous quality improvement. All staff members are encouraged to participate in research projects and audit activities which are clearly understood to be essential tools for guiding policy and future developments.

To the best of our knowledge, this is the first comprehensive case study of the UK organ donation and transplantation program to be published in the academic literature. This case study was informed by the comprehensive conceptual framework devised by Johnston-Webber et al. (9) and drew on a wide range of information sources. Our initial findings were verified and developed further by members of an expert panel, including one individual with specific UK expertise. This effort resulted in a detailed real-life description of the UK program together with an insight into its growth and development over the past two decades. This study highlights features of particular importance to recent improvements in the performance of the UK transplant system.

We acknowledge the limitations of our methodology. The narrative review may have been influenced by the subjective views of the authors. Similarly, the views and insights provided by the expert panel may not be representative of those all professionals working in the field. Likewise, the contexts in which this system developed are in some senses unique to the UK; the lessons learned and insights gained may not be relevant or transferrable to other settings. Additional comparative research on the transplant systems of other countries might help to strengthen the overall impact and transferability of the factors identified in this study (1–3,58, 59).

The creation of a successful organ donation and transplantation program is a highly complex enterprise that involves many different aspects of public policy and requires the support and trust of the general public. Therefore, it is important to perform systematic analyses of these experiences and to identify both positive and negative features of worldwide programs that have been established or remain under development. Many cultural and contextual factors differ profoundly from one setting to another, and policy approaches that were effective in one situation may not be directly transferrable to another. However, we believe that a consideration of the key findings from our review of the UK program may provide valuable insights to other countries and that the elements and principles underlying the successful UK program might apply to other settings if suitably adapted for local preferences and circumstances.

DATA AVAILABILITY STATEMENT

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author.

AUTHOR CONTRIBUTIONS

All authors listed have made a substantial, direct, and intellectual contribution to the work and approved it for publication.

CONFLICT OF INTEREST

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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REFERENCES

1. Mah J, Johnston-Webber C, Prionas A, Bušić M, Streit S, Wharton G, et al. Organ Donation in Croatia: The Importance of a National Champion, a Comprehensive Plan, and International Collaborations. *Transpl Int* (2023) 36: 11011. doi:10.3389/ti.2023.11011
2. Streit S, Johnston-Webber C, Mah J, Prionas A, Wharton G, Paulino J, et al. Lessons From the Portuguese Solid Organ Donation and Transplantation System: Achieving Success Despite Challenging Conditions. *Transpl Int* (2023) 36:11008. doi:10.3389/ti.2023.11008
3. Streit S, Johnston-Webber C, Mah J, Prionas A, Wharton G, Casanova D, et al. Ten Lessons From the Spanish Model of Organ Donation and Transplantation. *Transpl Int* (2023) 36:11009. doi:10.3389/ti.2023.11009
4. Department of Health. *Organs for Transplant; A Report from the Organ Donation Taskforce*. London: UK Department of Health (2008).
5. NHSBT. *Organ Donation and Transplantation Activity Report 2018/2019* (2020). Available from: https://nhsbtdbe.blob.core.windows.net/umbraco-assets-corp/16537/organ-donation-and-transplantation-activity-report-2018-2019.pdf (Accessed February 5, 2020).
6. OECD. *United Kingdom: Country Health Profile 2019* (2022). Available from: https://www.oecd.org/publications/united-kingdom-country-health-profile-2019-744df2e3-en.htm (Accessed June 20, 2022).
7. OECD. *Health at a Glance 2019: OECD Indicators*. OECD (2019). Available from: https://www.oecd-ilibrary.org/social-issues-migration-health/health-at-a-glance-2019_4dd50c09-en (Accessed May 28, 2020).
8. ERA-EDTA Registry. *ERA-EDTA Registry Annual Report 2019*. Amsterdam, Netherlands: UMC, Department of Medical Informatics (2021). Available from: https://www.era-online.org/wp-content/uploads/2022/11/ERA-Registry-Annual-Report-2019.pdf (Accessed January 7, 2023).
9. Johnston-Webber C, Mah J, Streit S, Prionas A, Wharton G, Mossialos E, et al. A Conceptual Framework for Evaluating National Organ Donation and Transplantation Programs. *Transpl Int* (2023) 36:11006. doi:10.3389/ti.2023.11006
10. The Guardian. Saving Lives, Valuing Donors. In: *A Transplant Framework for England* (2021). Available from: http://image.guardian.co.uk/sys-files/Society/documents/2003/07/07/transframeworkfinal.pdf (Accessed May 17, 2021).
11. NICE. *Organ Donation for Transplantation: Improving Donor Identification and Consent Rates for Deceased Organ Donation*. NICE clinical guideline 135. London: National Institute for Health and Clinical Excellence. p. 101.
12. NHSBT. *Taking Organ Transplantation to 2020. A Detailed Strategy* (2020). Available from: https://nhsbtdbe.blob.core.windows.net/umbraco-assets-corp/1395/nhsbt_organ_donor_strategy.pdf (Accessed September 29, 2020).
13. Legislation. *Human Transplantation (Wales) Act 2013*. Queen's Printer of Acts of Parliament (2021). Available from: https://www.legislation.gov.uk/anaw/2013/5/contents/enacted (Accessed May 17, 2021).
14. Legislation. *Organ Donation (Deemed Consent) Act 2019*. Statute Law Database (2021). Available from: https://www.legislation.gov.uk/ukpga/2019/7 (Accessed May 17, 2021).
15. Legislation. *Human Tissue (Authorisation) (Scotland) Act 2019*. Statute Law Database (2021). Available from: https://www.legislation.gov.uk/asp/2019/11/contents (Accessed May 17, 2021).
16. nidirect. *Organ Donation* (2015). Available from: https://www.nidirect.gov.uk/articles/organ-donation (Accessed January 30, 2023).
17. ERA-EDTA Registry. *ERA-EDTA Registry Annual Report 2018*. p. 152. Available from: https://www.era-online.org/wp-content/uploads/2022/11/ERA-Registry-Annual-Report-2018.pdf (Accessed February 5, 2020).
18. PSHE. *Curriculum* (2021). Available from: https://www.pshe-association.org.uk/curriculum (Accessed May 17, 2021).
19. NHS. *NHS Health Check* (2017). Available from: https://www.nhs.uk/conditions/nhs-health-check/ (Accessed May 17, 2021).
20. NHS Digital. *QOF 2019-20* (2021). Available from: https://qof.digital.nhs.uk/ (Accessed May 17, 2021).
21. NHSBT. *Organ Donation and Transplantation Activity Report 2019/20* (2021). Available from: https://nhsbtdbe.blob.core.windows.net/umbraco-assets-corp/19481/activity-report-2019-2020.pdf (Accessed May 18, 2021).
22. British Transplantation Society. *Intensive Care Society, Consensus Statement on Donation after Circulatory Death 2010* (2020). Available from: https://nhsbtdbe.blob.core.windows.net/umbraco-assets-corp/1360/donation-after-circulatory-death-dcd_consensus_2010.pdf (Accessed March 11, 2020).
23. Academy of Medical Royal Colleges. *A Code of Practice for the Diagnosis and Confirmation of Death* (2020). Available from: https://www.aomrc.org.uk/reports-guidance/ukdec-reports-and-guidance/code-practice-diagnosis-confirmation-death/ (Accessed March 11, 2020).
24. Department of Health. *Legal Issues Relevant to Non-heartbeating Organ Donation*. London: UK Department of Health, 12 (2009).
25. The Scottish Government. *Guidance on Legal Issues Relevant to Donation Following Cardiac Death* (2020). Available from: https://www.sehd.scot.nhs.uk/cmo/CMO(2010)11.pdf (Accessed March 11, 2020).
26. ODT Clinical - NHS Blood and Transplant. *Donation after Circulatory Death* (2020). Available from:/deceased-donation/best-practice-guidance/donation-after-circulatory-death/ (Accessed February 19, 2020).
27. Boteon YL, Laing RW, Schlegel A, Wallace L, Smith A, Attard J, et al. Combined Hypothermic and Normothermic Machine Perfusion Improves Functional Recovery of Extended Criteria Donor Livers. *Liver Transpl* (2018) 24(12):1699–715. doi:10.1002/lt.25315
28. Watson C. *UK Protocol for Normothermic Regional Perfusion (NRP) in Controlled Donation after Circulatory Determination of Death*. Available from: https://scts.org/_userfiles/pages/files/transplant/ukprotocolfornormothermicregionalperfusionversion13100421.pdf (Accessed February 9, 2023).
29. Biró P, Haase-Kromwijk B, Andersson T, Ásgeirsson EI, Baltesová T, Boletis I, et al. Building Kidney Exchange Programmes in Europe—An Overview of Exchange Practice and Activities. *Transplantation* (2019) 103(7):1514–22. doi:10.1097/TP.0000000000002432
30. NHS Organ Donation. *UK's Living Kidney Sharing Scheme Hits 1000th Transplant Milestone*. NHS Organ Donation (2021). Available from:/get-involved/news/uk-s-living-kidney-sharing-scheme-hits-1000th-transplant-milestone/ (Accessed May 18, 2021).
31. Madden S, Collett D, Walton P, Empson K, Forsythe J, Ingham A, et al. The Effect on Consent Rates for Deceased Organ Donation in Wales after the Introduction of an Opt-Out System. *Anaesthesia* (2020) 75(9):1146–52. doi:10.1111/anae.15055
32. Scottish Government. *Organ and Tissue Donation and Transplantation: Analysis of Responses*. Edinburgh: Scottish Government, 72 (2017).
33. Department of Health and Social Care. *New Approach to Organ and Tissue Donation in England: Government Response to Public Consultation*. London: UK Department of Health and Social Care. p. 28.
34. Palmer M. *Opt-out Systems of Organ Donation: International Evidence Review*. Welsh Government p. 91.
35. Department of Health NI. *Public Consultation Documenton the Introduction of a Statutory Opt-Out System for Organ Donation for Northern Ireland* (2021). Available from: https://www.health-ni.gov.uk/sites/default/files/consultations/health/doh-organ-donation-consultation.pdf (Accessed May 24, 2021).
36. Mirror. *Max and Kiera's Law* (2021). Available from: https://max-and-keiras-law.mirror.co.uk/ (Accessed May 24, 2021).
37. ODT Clinical. *Advisory Groups - ODT Clinical - NHS Blood and Transplant* (2020). Available from: https://www.odt.nhs.uk/odt-structures-and-standards/clinical-leadership/advisory-groups/ (Accessed March 11, 2020).
38. ODT Clinical - NHS Blood and Transplant. *Policies and Guidance* (2023). Available from: https://www.odt.nhs.uk/transplantation/tools-policies-and-guidance/policies-and-guidance/ (Accessed February 6, 2023).
39. ODT Clinical - NHS Blood and Transplant. *Potential Donor Audit Report* (2023). Available from: https://www.odt.nhs.uk/statistics-and-reports/potential-donor-audit-report/ (Accessed January 31, 2023).
40. ODT Clinical - NHS Blood and Transplant. *Clinical Lead for Organ Donation* (2020). Available from: https://www.odt.nhs.uk/odt-structures-and-standards/clinical-leadership/clinical-lead-for-organ-donation/ (Accessed March 11, 2020).
41. ODT Clinical - NHS Blood and Transplant. *Local Organ Donation Committees* (2023). Available from: https://www.odt.nhs.uk/odt-structures-and-standards/clinical-leadership/local-organ-donation-committees/ (Accessed January 30, 2023).
42. ODT Clinical - NHS Blood and Transplant. *National Organ Donation Committee* (2023). Available from: https://www.odt.nhs.uk/odt-structures-

and-standards/clinical-leadership/national-organ-donation-committee/ (Accessed January 30, 2023).
43. NHSBT ODT clinical. *National Organ Retrieval Services*. ODT Clinical - NHS Blood and Transplant (2020). Available from:/retrieval/national-organ-retrieval-services/ (Accessed March 10, 2020).
44. NHSBT. *Role of Transplant Recipient Co-ordinator*. ODT Clinical - NHS Blood and Transplant (2020). Available from:/odt-structures-and-standards/organ-donation-retrieval-and-transplantation-teams/role-of-transplant-recipient-co-ordinator/ (Accessed April 9, 2020).
45. ODT Clinical - NHS Blood and Transplant. *The National Deceased Donation Course for ICM Trainees* (2021). Available from:/deceased-donation/education-and-training/the-national-deceased-donation-course-for-icm-trainees/ (Accessed May 24, 2021).
46. The Herrick Society. *Training* (2021). Available from: https://www.herricksociety.org.uk/training.php (Accessed April 29, 2021).
47. NHSBT Research and Development. *Strategic Plan 2015-20: Improving Outcomes for Patients and Donors* (2021). Available from: https://nhsbtdbe.blob.core.windows.net/umbraco-assets-corp/1435/strategic_plan_june_2015.pdf (Accessed April 29, 2021).
48. Clinical Trials Unit - NHS Blood and Transplant. *Clinical Trials Unit - NHS Blood and Transplant* (2023). Available from: https://www.nhsbt.nhs.uk/clinical-trials-unit/ (Accessed January 31, 2023).
49. ODT Clinical - NHS Blood and Transplant. *Research, Innovation and Novel Technologies Advisory Group* (2021). Available from:/odt-structures-and-standards/clinical-leadership/research-innovation-and-novel-technologies-advisory-group/ (Accessed April 28, 2021).
50. NHS Organ Donation. *Organ Donation and Ethnicity* (2021). Available from:/helping-you-to-decide/organ-donation-and-ethnicity/ (Accessed May 25, 2021).
51. United Kingdom Government. *International Comparisons of Selected Service Lines in Seven Health Systems. Annex 3 - Review of Service Lines: Critical Care* (2020). Available from: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/382845/Annex_3_Critical_Care1.pdf (Accessed February 5, 2020).
52. UK Donation Ethics Committee; Academy of Medical Royal Colleges. *An Ethical Framework for Donation after Confirmation of Death Using Neurological Criteria (DBD)* (2016). Available from: https://www.aomrc.org.uk/wp-content/uploads/2016/07/Ethical_framework_donation_after_confirmation_death_using_neurological_criteria-2.pdf (Accessed March 11, 2020).
53. UK Donation Ethics Committee. *An Ethical Framework for Controlled Donation after Circulatory Death* (2011). Available from: https://www.aomrc.org.uk/wp-content/uploads/2016/05/Controlled_donation_circulatory_death_consultation_0111.pdf (Accessed March 11, 2020).
54. Shaw D. The Untimely Death of the UK Donation Ethics Committee. *J Med Ethics* (2017) 43(1):63–4. doi:10.1136/medethics-2016-103830
55. UK Donation Ethics Committee; Academy of Medical Royal Colleges. *Organ Donation from Infants with Anencephaly* (2016). Available from: https://www.aomrc.org.uk/reports-guidance/organ-donation-infants-anencephaly/ (Accessed March 11, 2020).
56. UK Academy of Medical Royal Colleges. *Ethical Issues in Paediatric Organ Donation - a Position Paper by the UK Donation Ethics Committee* (2015). Available from: http://www.aomrc.org.uk/wp-content/uploads/2016/04/Paediatric_organ_donation_position_0615-2.pdf (Accessed March 11, 2020).
57. UK Donation Ethics Committee. *Interventions before Death to Optimise Donor Organ Quality and Improve Transplant Outcomes* (2020). Available from: http://www.aomrc.org.uk/wp-content/uploads/2016/04/Generic_interventions_guidance_0914-2.pdf (Accessed March 11, 2020).
58. Mah J, Johnston-Webber C, Prionas A, Romagnoli J, Streit S, Wharton G, et al. How to Structure a Successful Organ Donation and Transplantation System in Eight (Not So Easy) Steps: An Italian Case Study. *Transpl Int* (2023) 36:11010. doi:10.3389/ti.2023.11010
59. Johnston-Webber C, Prionas A, Wharton G, Streit S, Mah J, Boletis J, et al. The National Organ Donation and Transplantation Program in Greece: Gap Analysis and Recommendations for Change. *Transpl Int* (2023) 36:11013. doi:10.3389/ti.2023.11013

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The National Organ Donation and Transplantation Program in Greece: Gap Analysis and Recommendations for Change

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Greece has fallen far behind many comparable European countries in the field of organ donation and transplantation and has made little progress over the past decade. Despite efforts to improve its organ donation and transplantation program, systemic problems persist. In 2019, the Onassis Foundation commissioned a report to be prepared by the London School of Economics and Political Science that focused on the state of the Greek organ donation and transplantation program and proposed recommendations for its improvement. In this paper, we present our analysis of the Greek organ donation and transplantation program together with an overview of our specific recommendations. The analysis of the Greek program was undertaken in an iterative manner using a conceptual framework of best practices developed specifically for this project. Our findings were further developed *via* an iterative process with information provided by key Greek stakeholders and comparisons with case studies that featured successful donation and transplantation programs in Croatia, Italy, Portugal, Spain, and the United Kingdom. Because of their overall complexity, we used a systems-level approach to generate comprehensive and far-reaching recommendations to address the difficulties currently experienced by the Greek organ donation and transplantation program.

Keywords: organ donation, organ transplantation, transplantation policy, transplant system, Greece

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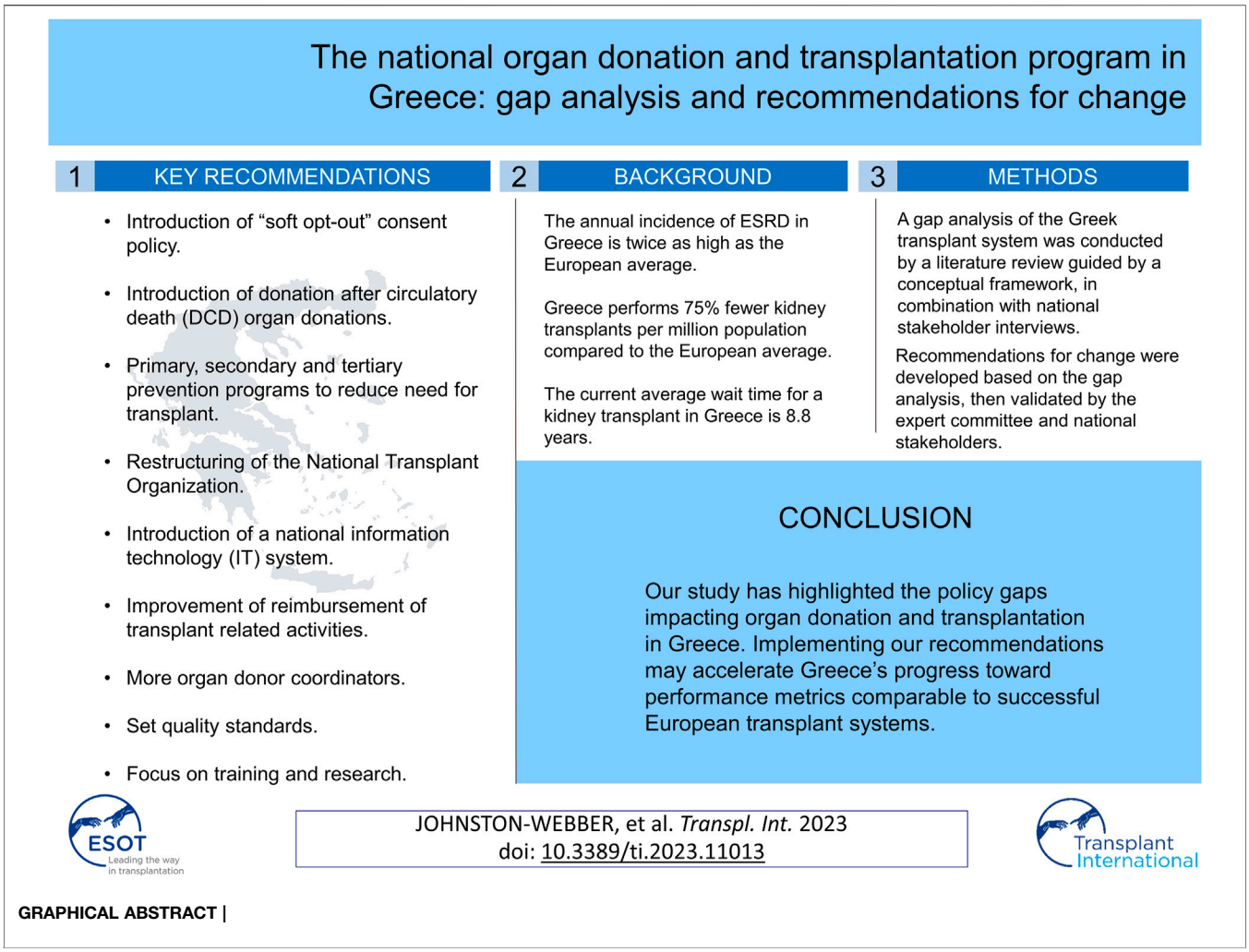
INTRODUCTION

The fields of transplant medicine and surgery have experienced extraordinary advances over the past 50 years. Despite this progress, the process of establishing an efficient and effective organ donation and transplantation program remains a challenge for many countries. Given the extensive scope of the many processes involved, for example, the design of both consent policies and clinical protocols, efforts to develop a successful program that meets the needs of a specific population are by their nature complex and require ongoing commitment, investment, evaluation, and improvement. Given the magnitude of the returns, both in terms of economics and quality of life, the case for investing in a comprehensive organ donation and transplantation service is certainly indisputable.



GRAPHICAL ABSTRACT |

Chronic kidney disease accounts for most cases of organ failure that ultimately lead to transplantation. Greece has among the highest incidences of end-stage renal disease (ESRD) among high-income countries. This outcome is driven by high rates of smoking, obesity, and poor cardiovascular health (1, 2). As a result, there are on average twice as many new dialysis patients per million population (pmp) each year in Greece compared to rates reported in other European countries. For example, in 2017, there were 1,319 patients pmp in Greece who were diagnosed with ESRD. This is far above the European average of 854 patients pmp. The annual incidence of ESRD in Greece is typically twice as high as the European average. In 2017, 252 patients pmp in Greece began renal replacement therapy compared to the European average of 127 patients pmp (3). Other demographic characteristics, notably Greece's aging population together with the overall lack of control over modifiable risk factors will likely increase the incidence of chronic diseases, and hence the need for organ transplants (1, 2, 4).

Although national healthcare expenditure *per capita* in Greece is somewhat below the European average (**Table 1**), it is similar to the *per capita* healthcare spending of several less well-endowed European countries that have developed successful transplantation systems, including Croatia and Portugal (5). Greece was severely affected by the 2008 economic crisis; austerity measures that were imposed at that time resulted in significant cuts to healthcare spending. From 2012 to 2017, the proportion of the gross domestic product (GDP) spent on healthcare in Greece decreased by 9.4% (5). However, other similarly affected countries, including Spain, Portugal, and Croatia have since developed and maintained successful organ donation and transplantation programs (6–10).

There is thus an undeniable need for a more comprehensive and effective organ donation and transplantation program in Greece. However, despite a disproportionally high level of clinical need, Greece lags far behind European countries with respect to rates of organ donation and transplantation. Between 2008 and 2019, Greece reported between 4.1 and 8.9 donors pmp each year (13-24). During the same period, the number of deceased donations in Europe as a whole increased steadily from 10.7 pmp in 2008 to 17.13 pmp in 2019 (25); many countries

out-performed these averages. Greece performs 75% fewer kidney transplants pmp compared to the European average and has the lowest rates of transplantation among members of the Organization for Economic Co-operation and Development (OECD). Furthermore, transplantation rates in Greece have stagnated in recent years (25). According to the Greek National Transplant Organization (NTO) known as the Hellenic Transplant Organization (EOM), the current average wait time for a kidney transplant in Greece is 8.8 years. The average survival of patients that have started on dialysis is 3 years and that one-quarter of these patients will die within 1 year (26).

This paper aims to review the policies on solid organ donation and transplantation in Greece and to evaluate the current performance of its national program. We will also present a brief overview of our recommendations for improvement and reform.

MATERIALS AND METHODS

Two main steps were involved in the development of this study. First, we performed a gap analysis of the Greek organ donation and transplantation program that was guided by a conceptual framework of best practices (**Figure 1**) and further informed by case studies that focused on five successful national organ donation and transplantation programs in other European countries (6–10). We also conducted an extensive series of interviews with Greek stakeholders and international experts from a wide range of sectors that are relevant to organ donation and transplantation. Recommendations for reform of the Greek program were generated based on the results of the gap analysis with additional input from the panel of Greek and international experts. The full list of expert participants is included in **Supplementary Appendix SA2**.

Gap Analysis

We began by conducting a brief narrative review of the relevant peer- and non-peer-reviewed literature. The findings were supplemented with information collected from focused interviews with global, national, and local policy experts (27, 28). The literature search and interview questions were based on a conceptual framework that was developed previously by the research team that highlights the essential building blocks of a successful national solid organ donation and transplantation program (**Figure 1**) (29). The analysis focused on structures, processes and distinctive features of the system corresponding to domains of the framework, rather than performance in relation to health outcomes or health system goals.

Peer-reviewed articles were retrieved from searches of EconLit, MEDLINE (PubMed), Embase (Ovid), Scopus, and Web of Science using several relevant search terms. We restricted our search to papers published between 1 January 1968, and 26 February 2021, that were written in either English or Greek, and included journal research articles, comments, editorials, and reviews. Following the initial compilation of the search results and removal of duplicate entries, we then excluded papers that focused on topics other than solid organ donation and transplantation. We ultimately identified 15 unique peer-reviewed papers that focused specifically on solid organ donation and transplantation in Greece (See **Supplementary Appendix SA1**). A selection of relevant non-peer-reviewed (i.e., grey) literature was identified *via* a Google search and from citations in key published papers. In total, our study incorporated results from 29 non-peer reviewed texts that included policy documents, working papers, conference presentations, and consulting reports.

A series of hour-long telephone interviews were conducted with a panel of 25 expert stakeholders in the field of solid organ donation and transplantation. These individuals were asked to validate and provide information that was complementary to the conclusions drawn from the literature review. A combination of convenience and judgment sampling was used to select interviewees who were accessible and might have professional insight into the policy, clinical, ethical, political, media, and regulatory environment of solid organ donation and transplantation (27). The full list of interviewees is included in **Supplementary Appendix SA2**. We also solicited input from the Greek Ministry of Health, the NTO, and several patient associations.

A semi-structured interview protocol was employed that covered all aspects of solid organ donation and transplantation in Greece, including regulations as well as current and prospective future policies. Time was also provided for unstructured dialog focused on relevant topics.

Recommendations

This case study differs from the others in this series as it includes an additional focus on policy recommendations that might be used to improve the Greek national organ donation and transplantation program. Consensus on the recommendations for the reform and development of the Greek program was reached *via* a structured iterative process. As part of the first step, the research team used the results of the gap analysis to develop a set of preliminary recommendations to provide Greece with a framework to address the gaps and achieve high performance in each area. The project co-chairs then reviewed these recommendations and made several suggestions and refinements. The views of the stakeholder panel were then sought, which generated additional feedback and suggestions. The objective was to elicit feedback from as many disciplines as possible; thus, broad categories of stakeholders consulted included representatives of the NTO, national transplant centers, intensive therapy units, scientific societies, professional bodies, patient associations, the national bioethics committee, national representatives to the World Health Organization (WHO), political authorities, and the press. The research team integrated this feedback with the initial set of recommendations and undertook an additional cycle of review and refinement. The resulting set of recommendations was shared with the international and Greek panels of experts who submitted written feedback and participated in online round-table meetings to provide further comments. These comments were incorporated into a final set of recommendations.

TABLE 1 | Health system financing and population health in Greece: key statistics.

Health system	References
• Highly centralized mixed health system model with a single health insurer	(2)
• Health spending *per capita*, EUR 1603; EU average, EUR 3523	(2)
• Health spending as a percentage of the GDP, 7.8%; EU average, 9.9%	(2)
• Public spending as a percentage of the total health expenditure, 60%; EU average, 80%	(2)
• Out-of-pocket payments as a percentage of the total health expenditure, 35%; EU average, 15.4%	(2)
• Percentage of the population reporting an unmet need for medical care, 8.1%; EU average, 1.7%	(2)
Health status	
• Percentage of the population over 65 years of age, 22.3%; EU average, 20.6%	(2)
• Life expectancy, 81.2 years; EU average, 80.6 years	(2)
• Percentage of the population that smokes daily, 24.9%; OECD average, 16.5%	(11)
• Liters of alcohol consumed *per capita* per year, 6.3L; OECD average, 8.7L	(11)
• Percentage of the population that is overweight or obese (BMI >25), 57.2%; OECD average, 56.4%	(11)
• Individuals maintained on renal replacement therapy; incidence, 269 pmp	(12)
• Individuals maintained on renal replacement therapy; prevalence, 1413 pmp	(12)

EUR, Euro; EU, European Union; OECD, Organisation for Economic Co-operation and Development; BMI, body mass index; GDP, Gross Domestic Product.

RESULTS

Greece has a long history of solid organ transplantation. The information shown below in **Table 2** summarizes some of the key developments and trends in organ donation and transplantation in Greece since 1968.

Gap Analysis

The following sections provide an overview of the main areas in which the organ donation and transplantation program in Greece currently falls short of internationally-recognized standards and highlight areas with the greatest potential for improvement. These results are presented in **Table 3** according to the domains and key elements of the conceptual framework.

Enabling Elements

Government: Political Support, Funding, and Long-Term Commitment; Key Legislation

Inconsistent Political Support, Poorly Designed Legislation, and legislative Gaps Have Seriously Hindered Attempts at Reform

Political commitment and support for the Greek organ donation and transplantation program have always been inconsistent. The structural reforms of the early 2000s, including the foundation of the NTO and the launch of the ODC program, resulted in significant improvements in the donation and transplantation services available in Greece (38). Unfortunately, this initial improvement was not sustained over the long term due to a lack of financial stability, strategic planning, and continuity.

The 2008 national financial crisis disproportionally affected organ donation and transplantation activity in Greece (39). The austerity measures imposed at that time resulted in significant cuts to healthcare spending. Of note, during the years 2012–2017, the fraction of the GDP spent on healthcare in Greece decreased by 9.4% (5). This resulted in a severe restriction of the NTO's budget and resulted in a dramatic downturn (i.e., a 60% decrease) in the rate of organ donation and transplantation (39).

In addition to adequate and consistent funding, political support designed to provide a consistent strategy for improvement will also be needed. In contrast to the roles and responsibilities of NTOs in many European countries (e.g., Italy, Portugal, Spain, and the United Kingdom [UK]), the Greek NTO can play only an advisory role with respect to policy development (6–10). Transplantation policy in Greece is developed by the Ministry of Health with input from the government; the NTO is not an independent authority and it cannot enact reforms (36). Thus, the national transplantation policy in Greece lacks a key pillar of stability and is thus vulnerable to political change.

Greece has developed extensive legislation focused on the definition and diagnosis of brain death. However, there is no separate legislation regarding the definition of brain death as distinct from its relationship with organ donation. This may ultimately create the false impression that a diagnosis of brain death is generated primarily to facilitate organ donation and transplantation. There is also ambiguity as to when to initiate this diagnostic process; the role of ancillary testing to confirm brain death is also poorly defined (35–37).

Greek law allows for organ donation after brain death (DBD) from adult and pediatric patients and for living donation (LD) from adult donors only (35–37). Pediatric LD is prohibited in Greece. Furthermore, there is no legislative provision for controlled or uncontrolled donation after circulatory death (cDCD or uDCD) from either adult or pediatric donors (35-37). As a result, there is no legislation in place that directs the practice of withdrawal of life-saving treatment (WLST) or a legal definition of "no-touch" time (i.e., the minimum time that must elapse between the confirmation of death and the commencement of measures needed to preserve organ viability). There is also no provision for directed or non-directed altruistic donation (DAD or NDAD) (35–37).

There have also been several poorly-planned changes in consent policy that have been introduced over the past decade. In 2011, the Greek government introduced an "opt-out" consent policy and provided 2 years for public information campaigns to take effect (40–42). However, there was little publicity regarding what these

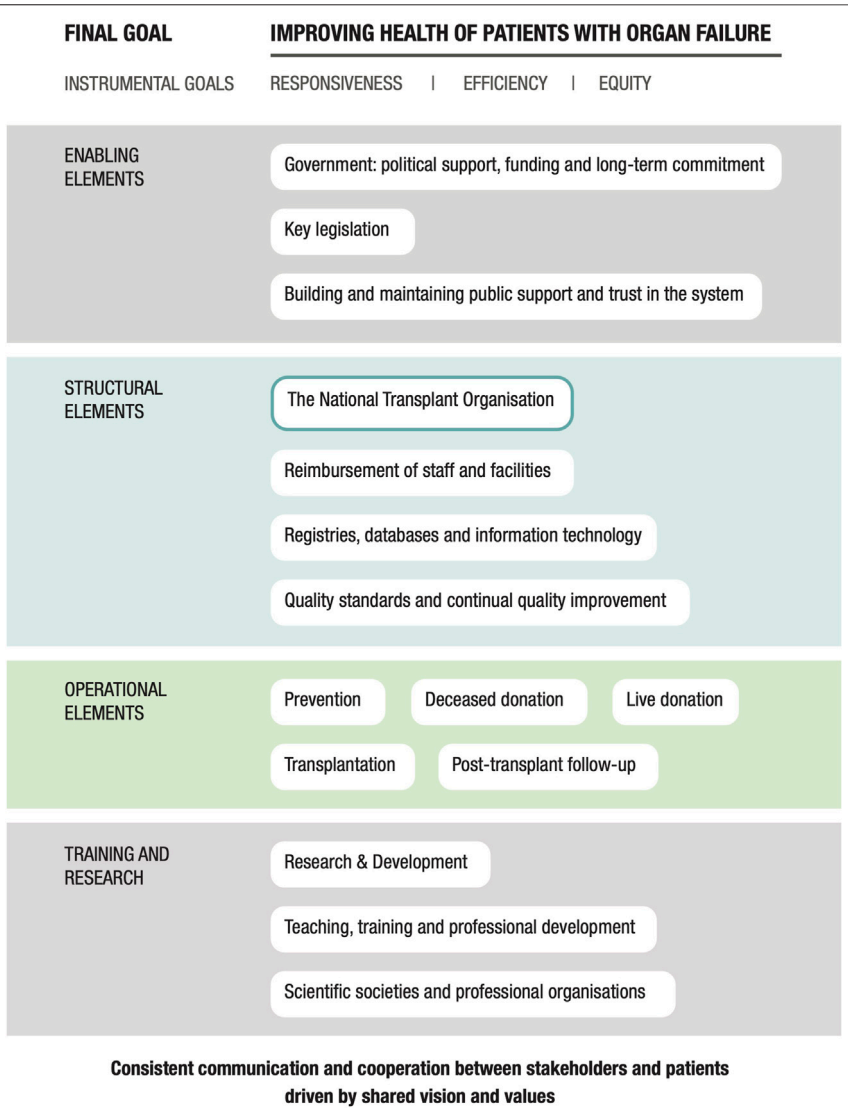


FIGURE 1 | A conceptual framework for a successful national organ donation and transplantation system.

changes actually meant in practice for members of the general population (36–38). This resulted in a significant backlash against the new legislation, with many Greek citizens actively registering their objections to donation (i.e., opting out) (40–42). As a result, the "opt-in" consent policy was re-introduced in 2018 (33, 37). It is critical to recognize that many advanced European transplantation systems (e.g., those in Spain and the UK) include a "soft opt-out" policy in which donation can be pursued in the absence of specific documentation although family consent is required (6, 7).

Building and Maintaining Public Support and Trust in the System

Public Support for Organ Donation and Transplantation has Been Hampered by Mistrust, Limited Knowledge, and a Lack of Understanding

Public trust in the Greek National Organ Donation and Transplantation Program is limited compared to that enjoyed by its European neighbors. While 55% and 53% of Europeans agree in principle to personal or family-member organ donation, only 43% and 41% of Greeks agree with these principles, respectively. One of every two Greek citizens identifies distrust in the system as the primary reason for non-consent (43).

Awareness and understanding of organ donation among members of the general public also remains limited. In a survey conducted in 2019, Symvoulakis et al. (44–47) reported that only one of two respondents in a Greek rural population were aware of the possibility of deceased donation. Similarly, 7 of 10 Greek citizens report that they have never discussed organ donation (39); only 3.8% reported having some knowledge about the national processes and the existing legislative framework designed to promote organ donation (40–43). Of equivalent concern, most healthcare professionals in Greece reported that they did not consider themselves well-informed about organ donation (44–47).

TABLE 2 | Key developments and trends in organ donation and transplantation in Greece.

1968	The first successful deceased donor renal transplant was performed
1972	The first renal transplant program was developed (30–32)
1978–1987	Legislation was gradually introduced that provided a framework and facilitated transplantation activities, including legislation focused on the definition and diagnosis of brain death and the processes to be used for organ donation, retrieval, and transplantation (30–32)
1990–1993	Programs for liver, heart, and pancreas transplants were established (30–32)
1990s–early 2000s	Extensive legislation was introduced that defined all the dimensions of the transplantation sector
2001	The Greek National Transplant Organization (NTO) was founded
2005	An Organ Donation Coordinator (ODC) program was launched as part of the attempt to adopt the "Spanish Model"
2008	Lung transplant programs were initiated (30–32)
2008	Transplantation activity in Greece reached its peak with 28 solid organ transplants performed per million population (pmp). This approached the contemporary European average of ~35 solid organ transplants pmp (22)
2011	Lung and pancreas transplant programs were discontinued (30-32)
2011	A sharp decline in organ donation and transplantation rates was observed. The government instituted major legislative changes including the introduction of an opt-out consent system(30–32)
2013	The opt-out consent system was implemented
2014	A unified and centrally-governed organ allocation system and a national renal transplant registry were introduced (30–32)
2015	A historic low of 11 solid organ transplants pmp was reported. This is less than a quarter of the European average of 46 solid organ transplants pmp reported at this time (25)
2018	An opt-in consent policy was re-introduced (33–37)

In the past, organ donation has been promoted by mass media (26). Nevertheless, Greece does not have an ongoing, targeted communication strategy designed to promote organ donation and transplantation.

Structural Elements

The National Transplant Organization (NTO)

The NTO is Severely Understaffed and Under-resourced and Cannot Drive Change

The Greek NTO lacks the leadership capacity needed to drive change. As outlined above, the Greek NTO has only an advisory role and lacks the authority to enact and follow through with substantial reforms. Recommendations suggested by the NTO can only be implemented upon approval by the national parliament or other political committees. In several of the European countries with successful transplantation systems (i.e., Italy, Portugal, Spain, and the UK), the NTOs are independent bodies with the capacity to enact change without the need for legislative recourse (6–10).

The organizational structure of the Greek NTO includes a president, a managing director, and three departments that are responsible for transplant coordination, management and finances, tissue storage, and histocompatibility testing (48). This structure does not correspond to the objectives and the responsibilities of the organization as defined by national legislation (49).

Furthermore, the Greek NTO is severely short-staffed and under-resourced. National law sets a minimum staffing requirement of eight temporary and 15 permanent employees, all of whom must have appropriate qualifications (36). At the time that this analysis was performed, the Greek NTO staff included only three permanent employees. The 15 locum positions are occasionally filled by professionals from different backgrounds; these positions experience high turnover. The NTO's budget remains very restricted and currently does not provide adequate support for its functions (39).

On paper, the defined national and international responsibilities cover all the essential functions of an NTO that are identified by the conceptual framework (49). However, there was consensus among the interviewees that these responsibilities are not met in practice. However, we do note that Greece actively participates in several international transplant collaboration schemes (for example, collaboration with the Italian National Transplant Centre [CNT]) (50).

Infrastructure

Infrastructure and Human Resources Are not Adequate to Support the Program

There are five accredited transplant centers in Greece. A sixth facility, the Onassis National Transplant Center (ONTRC), is currently under construction with an expected completion date of 2024. However, there is little to no quantitative and qualitative data that address the human resources and infrastructure capacity of either Greek or other European transplant centers. To gain a better understanding of the resources available in these different settings, the research team surveyed all existing transplant centers in Greece as well as major transplant units in Croatia, Italy, Portugal, Spain, and the UK (26). Our results revealed that medical staffing levels in Greek transplant centers were below the average of these five European countries across all specialties (including surgeons, physicians, anesthetists, and others). There is also an urgent need to expand operating theater capacity for both donation and transplantation procedures and to improve access to imaging and other diagnostic services (e.g., endoscopy) across all existing units. Access to pathology services and histocompatibility testing must also be improved (26).

Reimbursement of Staff and Facilities

The Current System Does not Reimburse Organ Donation Activities or Adequately Compensate ODCs, Thus Creating Financial Barriers to Organ Donation

Creating financial incentives and ensuring that all parties involved (including staff and facilities) are adequately reimbursed and

TABLE 3 | Key areas highlighted by the gap analysis in which significant shortfalls in the Greek organ donation and transplantation program were identified.

Framework domain	Key features	Details
Enabling Elements: Government: Political Support, Funding, and Long-Term Commitment	Funding	Lack of financial stability and long-term sustainability
	Government commitment	Lack of strategic planning and continuity
Enabling Elements: Government: Key Legislation	Diagnosis of brain death	Transplant legislation has defined brain death. This gives the false impression of conflicts of interest. There are no clear provisions regarding the performance of diagnostic tests or the role of ancillary testing
	Modes of donation	Pediatric live donation (LD) is prohibited. There are no provisions for adult or pediatric controlled or uncontrolled donation after circulatory death (cDCD/uDCD), withdrawal of life-saving treatment (WLST), "no-touch" time, or directed or non-directed altruistic donation
	Consent policy	An opt-in consent system is in effect
Enabling Elements: Building and Maintaining Public Support and Trust in the System	Creating public trust	There are high levels of public distrust in the system
	Periodic surveys and educational campaigns for the general public	Public awareness of organ donation is limited
	Communication strategies	There are no targeted national communication strategies
Structural Elements: National Transplant Organization	Leadership capacity	The National Transplant Organization (NTO) has no authority to enact reforms in the system
	Organizational structure	The current organizational structure does not correspond with the responsibilities defined by national legislation
	Organizational resources	The program is short-staffed and under-resourced
	National and international responsibilities	The responsibilities defined by legislation follow international best practices. However, the organization's national responsibilities are not met and few international collaborations have been established
Structural Elements: Infrastructure	Workforce	The numbers of transplant surgeons, physicians, and anesthetists are below the European average
	Facilities	There are five transplant centers in Greece. One new transplant center is currently under construction. The goal is to accommodate additional pediatric and adult transplant services. The capacity of the operative theaters and access to imaging, endoscopy, pathology, and histocompatibility services are below the European standard at all five of the existing transplant centers
Structural Elements: Reimbursement of Staff and Facilities	Mechanisms of reimbursement	The KEN-DRG diagnosis-related group reimbursement system covers transplantation activities but not activities related to donation (e.g., maintenance of donors in the intensive care unit, organ retrieval, among other activities). There is no provision for reimbursement of organ donor coordinators for work specifically related to donation
	Incentives	Donation activities represent a considerable financial burden to participating hospitals
Structural Elements: Registries, Databases and Information Technology (IT)	Registries and waiting lists	There are no living donation (LD) registries
	IT and data protection	Critical donor data are not easily accessed by the different parties involved due to the absence of a functional IT system
Structural Elements: Quality Standards and Continual Quality Improvement	Maintaining quality standards	While quality standards for authorization and licensing of transplant units are clearly defined in national legislation, there is no evidence of regular inspection of transplant facilities, equipment, or personnel. There are no quality standards provided to guide donation, pre-transplant, or post-transplant care. A few quality indicators are monitored annually by the NTO.
	Driving quality improvement	Although performance data comparing transplant centers are published every 3 years, there are no nationally agreed-upon procedures designed to facilitate improvement. No evidence of quality improvement interventions was found
Operational Elements: Prevention	Primary prevention	There are no public health programs designed to prevent heart, lung, liver, and kidney disease
	Secondary prevention	There are no screening programs targeting populations at high risk of developing heart, lung, liver, and/or kidney disease

(Continued on following page)

TABLE 3 | (*Continued*) Key areas highlighted by the gap analysis in which significant shortfalls in the Greek organ donation and transplantation program were identified.

Framework domain	Key features	Details
Operational Elements: Deceased Donation	Donation coordination	Although the qualifications, training, duties, and responsibilities of organ donation coordinators (ODCs) are defined by national legislation, there is no legislative provision for protected time to perform duties or any form of financial reimbursement. Most of the ODC posts in Greece remain unfilled
	Donor evaluation and management	There are no nationally agreed-upon guidelines for the evaluation and management of deceased donors
	Organ retrieval, preservation, and transport	There are no nationally agreed-upon protocols for organ retrieval, preservation, or transport
Operational Elements: Live Donation (LD)	Promoting LD	Although there are legislative provisions that address reimbursement of living donors for costs incurred, there are currently no policies that promote living donation
	Assessment of living donors	There are no nationally agreed-upon guidelines for the evaluation and management of living donors
Operational Elements: Transplantation	Referral and assessment for transplant	There are no nationally agreed-upon criteria or standardized processes to guide patient referrals and assessments for suitability for transplant. There are also no nationally agreed-upon criteria for listing decisions
	Transplant coordination	Only seven transplant recipient coordinators, all of whom are all based at the NTO headquarters, are responsible for the coordination of all transplant procedures throughout the entire country. Because of staff shortages, this service is not available on all days or at all times
	Surgery and perioperative care	The lack of physical and human resources hinders timely access to operating theaters. There are no standardized national peri-operative care protocols
	Access to post-transplant care	Patients in transplant units are followed-up routinely by multidisciplinary transplant teams. Some patients need to travel long distances for routine check-ups. There is no provision for shared-care protocols nor any infrastructure to support telemedicine
Operational Elements: Post-Transplant Follow-Up	National follow-up guidelines	National follow-up guidelines are lacking
	National outcomes monitoring	While short-term (1 year) graft and patient survival rates are monitored by the NTO, mid-term and long-term outcomes are not monitored
Training and Research: Research and Development	Research outputs	Minimal research is performed. Participation in international research efforts remains poor
	Research facilities and funding	There are no official research funding bodies. Access to research facilities (e.g., experimental laboratories, experimental surgery facilities) remains limited
Training and Research: Teaching, Training, and Professional Development	Continuous professional development for nurses and intensivists	Organ donation is not included as a core training module for intensivists or their support staff
	Continuous professional development for organ donation coordinators	Although the NTO has developed a sophisticated curriculum for training coordinators in cooperation with the Transplant Procurement Management-Donation and Transplantation Institute (TPM-DTI), this program is no longer operational
	Continuous professional development for physicians and transplant surgeons	There are no dedicated training programs for transplant surgeons or physicians
Professional Organizations and Scientific Societies	Engagement	Professional organizations and scientific societies are not involved in the development of national transplantation policy

compensated for their work is a key feature of a successful transplantation system (6-10, 29). The diagnosis-related group reimbursement system (KEN-DRG) currently captures all transplantation activities in Greece and provides reimbursement to transplant units. However, the KEN-DRG does not reimburse donation activities (51). This discrepancy creates significant financial disincentives for donation units. Moreover, there is no legislative provision for the financial reimbursement of ODCs (52).

Registries, Databases, and Information Technology (IT)

There is Currently no Integrated IT System that Can be Accessed by all Personnel who are Tasked with Coordinating Organ Donation and Transplantation

Although the Greek NTO manages an organ donor registry, a non-donor registry, a DBD donor registry, and the national waiting lists, the lack of a centralized IT system is a key

weakness as there is no mechanism in place that facilitates the timely and efficient exchange of information between the components of the donation and transplantation program.

Quality Standards and Continual Quality Improvement

There is an Urgent Need for Improved Quality Standards and a Clear Quality Improvement Strategy

National legislation has defined a series of quality standards that must be met prior to the authorization and licensing of transplant units (53). Similarly, the NTO is responsible for undertaking regular inspections (49, 53). However, we found no evidence of any regularly-scheduled inspections of transplant facilities, equipment, or personnel. No procedures designed to facilitate the improvement of organizations unable to meet expected standards have been established. At present, there are no quality standards in place that govern donation, pre-transplant, or post-transplant care.

A few quality indicators are monitored by the NTO and included in annual reports (13–24). While benchmarking performance data from each of the transplant centers are published every 3 years (13–24), these reports provided no evidence of quality improvement interventions.

Operational Elements

Prevention

There are no Public Health Policies in Place Aimed at Reducing the Demand for Organ Transplantation

Greece has not adopted any public health programs designed to promote healthy diets (e.g., reduced consumption of salt, fat, and sugar), increased physical activity, limiting alcohol consumption, or smoking cessation. Greece has not promoted interventions designed to reduce the risk of hepatitis (e.g., prevention of intravenous drug use, avoiding high-risk sexual behaviors, undergoing immunization if possible) or to improve health literacy. High-risk populations are not screened for heart, lung, liver, and/or kidney disease. However, prompt access to tertiary prevention, most notably dialysis care, has been established (54). The quality of these tertiary prevention services is not monitored or evaluated on a regular basis.

Deceased Donation; Live Donation; Transplantation; Post-Transplant Follow-Up

There are Significant Gaps at all Stages of the Clinical Pathway, From Donation to Post-Transplant Follow-Up

Inadequate coordination of the donation process is one of the most important policy gaps identified in this report. The role of Organ Donation Coordinator (ODC) was first introduced in 1999 as a result of national legislation in Greece (36). The competencies, duties, and responsibilities of the role were clearly defined by this legislation. The ODC program was launched in 2005 with 55 coordinators who had received high-quality training (52, 55). Unfortunately, several factors intervened, including discontinuation of the training program, lack of protected time needed to perform duties, lack of financial compensation, and the perceived anti-social nature of working hours made the role very unpopular, and ODC recruitment became nearly impossible.

Another significant gap is the lack of national guidelines that can be used to inform the donation process. This includes guidelines for both deceased and living donor evaluation, organ retrieval, preservation, transport, and living donor follow-up. Several critical factors must be in place to support living donation, including the establishment of organ exchange schemes, the reimbursement of the financial losses of living donors, and the *a priori* prioritization of living donors on any transplant waiting list (in case of future need). These factors have all been enshrined in legislation to promote living donation (37). Despite this, Greece has not developed any national policies that raise public awareness and dispel misconceptions about living donations. Greece has also not focused on the creation of partnerships between referring specialists and the transplantation program that may be needed to promote living donation.

There are clear gaps in all the steps of the transplantation process. Beginning with pre-transplant care**,** there are no nationally agreed-upon criteria or processes for referral for assessment of suitability for transplant in Greece (1). Although deceased donor kidneys are allocated *via* a national waiting list using a universal point-based allocation system, Greece has no nationally agreed-upon, organ-specific criteria for prioritizing transplant listings.

The coordination of the transplant process itself is also deficient. Greece has only seven transplant recipient coordinators (TRCs), all of whom are based at the NTO headquarters in Athens, and are responsible for the coordination of all transplant procedures in the entire country. Because of the small number of TRCs, transplant coordination services are not available at all times.

With respect to operative and peri-operative care, feedback from the interviewees suggested that the lack of physical capacity (e.g., operating theatres) and human resources (e.g., surgeons and anesthetists) limits timely access to transplant procedures. There are no standardized national peri-operative care protocols in Greece.

There are also no national guidelines that direct follow-up care of transplanted patients (e.g., no directive regarding the frequency of follow-up or preferred immunosuppression strategies). Transplant recipients receive routine follow-ups from multidisciplinary teams in transplant units. There is no established system that permits local health centers to provide care. Thus, some patients need to travel long distances for routine follow-up appointments. This is a source of significant stress and unnecessary expense. Furthermore, mid-to long-term outcome data are not systematically collected or monitored (13–24).

Training and Research

Teaching, Training, and Professional Development

There are Very Few Teaching, Training, or Professional Development Opportunities and no Official Training Programs for Healthcare Professionals

In the early 2000s, the NTO initiated a training program for ODCs, that was undertaken in part with cooperation with the Transplant Procurement Management-Donation and Transplantation Institute (TPM-DTI) in Barcelona (55). The training program featured a sophisticated curriculum that was in accordance with international best practices (29, 52).

Unfortunately, there was little continuity and the program has since been abandoned; from 2006 to 2012, no training was available at all.

At the present time, Greece offers no official training programs (fellowships) for transplant surgeons and physicians. Individuals typically gain experience in transplantation during their subspecialty training (i.e., as part of their training in general surgery or general nephrology) or independent practice (i.e., at a European transplant center). Greece offers no official training in organ donation and transplantation for intensivists, anesthetists, or nurses.

Research and Development

Research and Development are not a Current Priority; the National Scientific Societies and Professional Bodies are not Involved in the Organ Donation and Transplantation Program

Transplantation research in Greece is not a priority; the resources allocated to medical research and development are below the European average (56). Since 1985, only 12 original research transplantation studies have been performed in academic institutions throughout the country (4). Greece participates only infrequently in international collaborative studies. There is insufficient high-level coordination of research activities in the field of organ donation and transplantation. There are no national research funding bodies or established pathways for researchers seeking funding. Moreover, the results of our survey demonstrated that transplant professionals in Greece have little to no access to the limited number of existing research facilities (26).

The national scientific societies (e.g., The Greek Transplantation Society, The Greek Society of Anesthesiology, and The Hellenic Society of Nephrology) and the professional bodies (e.g., the Greek Medical Association) are not engaged in the development of national transplantation policy and at present have no institutional or advisory roles.

Recommendations

The full set of recommendations for reform of the Greek organ donation and transplantation program can be found in the Report for a New National Solid Organ Donation and Transplantation Plan in Greece (26). Due to the complex nature of this discipline, the recommendations cover many different aspects of the healthcare system and its governance in Greece. The overall intention of these recommendations is to align the organ donation and transplantation program with performance standards established by other European countries. Full implementation of some of the recommendations will necessitate wider health system reform. Thus, it is important to emphasize that while some components may seem to be more important than others, all are interconnected and interdependent. To achieve better rates of successful organ donation and transplantation, system-wide change will be critical. Neglect of one or more of the domains of the framework may result in ongoing underperformance. As a result, the successful implementation of these reforms will require strong commitment and collaboration between a wide range of stakeholders. It will also need strong top-down coordination accompanied by bottom-up engagement and implementation. This will require consistent support and commitment from the government.

The key recommendations which must be implemented if Greece hopes to improve its organ donation and transplantation program are outlined in the following sections. These sections reflect specific domains of the framework and the gaps identified in our analysis.

Government and Key Legislation

Long-term support from the central government will be needed to promote reform. Sustainable funding sources will need to be identified, and the NTO should be relaunched as an independent body with the authority to enact change.

Legislative reform will also be required to move toward a "soft opt-out" consent policy. This legislation must be complemented by public awareness campaigns and appropriate training of transplant professionals. Changes will be needed to separate the legislation focused on the neurological diagnosis of death and the principles of (DBD). Clinicians must receive regular training on the diagnosis of brain death, and the NTO must take the lead in establishing legislative provisions for DCD. A Pilot DCD program should be established in selected centers that already have the appropriate expertise and infrastructure.

Reducing the Need for Transplants, and Building and Maintaining Public Support and Trust

Policies aimed at reducing the need for transplantation must be developed. Primary, secondary, and tertiary preventative strategies must be devised and implemented.

Greece needs to build and maintain public support and trust in the transplant system by focusing on organ donation as a critical component of an altruistic society. Achieving this goal will require adherence to the strictest ethical standards, implementation of rolling public awareness and educational campaigns, and maintaining good relations with the media.

NTO, Databases and IT, Reimbursement, and Infrastructure

The re-launched, independent NTO must be appropriately staffed and provided with adequate funding. The recommendations provide clear and specific guidance for the governance, structure, and funding of the NTO and include recommendations for the establishment of a dedicated leadership team. A key responsibility of the relaunched Greek NTO will be to establish and maintain a national IT system with associated databases that can be used to improve the efficiency and effectiveness of the donation and transplantation program.

There is an urgent need to expand operating theater capacity (for both donation and transplantation procedures) and to improve access to imaging and other diagnostic services, for example, endoscopy. The KEN-DRG system must be revised to ensure that all activities related to organ donation and transplantation are adequately reimbursed, including the efforts of staff, participating units, and supporting services.

Patient-Centered Care

Transplant recipients (as well as their families and loved ones) and live donors must be the central focus of the national donation and

transplantation program in Greece. Policies and procedures must be developed that promote collaborative engagement with patients, families, and caregivers, not only with respect to their own cases but also in all aspects of system planning and development.

Donation, Transplantation, and Follow-Up

The existing donation and transplantation workforce needs to be expanded. There is a particular need to increase the number of specially-trained ODCs who will then be appointed to every unit participating in organ donation. All processes along the clinical pathway, including patient follow-up, need to be subject to nationally agreed-upon protocols that are consistent with internationally-defined best practices. The NTO, alongside a panel of experts with organ-specific expertise, should be fully involved in generating this guidance.

Living donation (LD) is currently underutilized and should ultimately become a cornerstone of the donation and transplantation program in Greece. Pre-emptive renal transplantation from a living donor should become the treatment of choice for ESRD. Dialysis assessments must always involve discussions regarding the feasibility of transplantation and the possibility of identifying a living donor.

Quality Standards, Quality Improvement, and Scientific professional Organizations

The existing national system of quality assurance should be strengthened and expanded to include pre-transplant care. Existing quality indicators on donation and transplantation should be broadened and updated regularly. The NTO should develop additional capacity to support healthcare facilities seeking to reach compliance with regular audits based on key performance indicators conducted by the Body of Inspectors for Health and Welfare Services (SEYYP).

Professional organizations and scientific societies must be consulted at all stages of this programmatic expansion. The board of the NTO should include representatives from relevant organizations. These representatives should play pivotal roles in developing and ratifying guidelines, protocols, regulatory standards, and training programs for use throughout Greece.

Teaching, Training, and Professional Development

Greece must develop a national strategy that provides tailored and continuous training for healthcare professionals in all areas that are relevant for organ donation and transplantation. Dedicated training modules that follow existing guidelines created by the European Union of Medical Specialists should be available for use.

Improving the performance of the organ donation and transplantation system requires an innovative research and development program. All units and staff must be actively supported and encouraged to participate in research activities at local, national, and international levels.

Implementation Task Force

The implementation of the preceding recommendations will be a complex and time-consuming task. Thus, we recommend the establishment of an implementation task force that will be chaired by the permanent secretary of the Ministry of Health. We recommend the establishment of a 7–10-person task force that includes representatives from key interests. Annual reports focused on overall progress should be submitted for review.

DISCUSSION

This is the first comprehensive, systems-level study of the Greek organ donation and transplantation program published to date, and the first attempt to provide comprehensive recommendations for reform. Our findings were evaluated using a novel conceptual framework that takes a wide view of the field and attempts to capture all factors which might influence the success of a national donation and transplantation program. Thus, this study captures aspects of the Greek program that had not been considered in previous evaluations of Greece's comparatively poor performance. Our study was also based on existing published and unpublished literature on solid organ donation and transplantation and was further informed by extensive rounds of interviews with numerous global, national, and local policy stakeholders in the field.

One limitation of this study was that the analysis was not designed to capture data focused on all aspects of a donation and transplant program (e.g., equity). We also recognize that the subjective views of the authors may have influenced the narrative review of the literature. Furthermore, we are aware that the views expressed by the interviewees may not be fully representative of all those working in the field of organ donation and transplantation in Greece.

Our study has highlighted numerous policy gaps with a significant impact on the national solid organ donation and transplantation program in Greece. A national reform program designed to address these policy gaps and implement the required policy changes should become a national priority. The recommendations provided represent a comprehensive set of potential policy priorities that can be used to strengthen the Greek national organ donation and transplantation system. Implementing these recommendations may accelerate Greece's progress toward a national organ donation and transplantation program with performance metrics that are comparable to successful programs that have been developed in other European countries. This would deliver immeasurable improvements to the quality of life of thousands of individuals as well as their families.

As with all major policy reforms, the success of these efforts will rely on the manner of their implementation. One frequently observes a gap between policy plans and their implementation. Because of the extensive nature of the recommendations, coordination of the reforms will be a complex process. An implementation task force may play a crucial role in this endeavor and thus should have a formal mandate from the government to lead the policy design process and oversee the implementation of these reforms. The task force should also be provided with the responsibility of preparing the legislation needed to support the reform program as well as establishing a clear roadmap with due regard for the phasing of and interdependencies between the various programmatic elements. This roadmap should include clear targets and milestones that will ensure appropriate sequencing, for example, making certain that the capacity of the donation and transplantation workforce and infrastructure increases in concert

with the coordination capacity of the system as well as increased rates of consent and availability of organs for transplant.

Finally, the task force should commit itself to rigor and transparency. For example, the task force might publish an annual report that highlights progress and identifies the gaps remaining to be addressed. Transparency will also be needed to support efforts to strengthen public support for organ donation and transplantation which will also be critical to the program's success.

DATA AVAILABILITY STATEMENT

The original contributions presented in the study are included in the article/**Supplementary Material**, further inquiries can be directed to the corresponding author.

AUTHOR CONTRIBUTIONS

All authors listed have made a substantial, direct, and intellectual contribution to the work and approved it for publication.

CONFLICT OF INTEREST

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontierspartnerships.org/articles/10.3389/ti.2023.11013/full#supplementary-material

REFERENCES

1. Sombolos K, Tsakiris D, Boletis J, Vlahakos D, Siamopoulos KC, Vargemezis V, et al. Multicenter Epidemiological Study to Assess the Population of CKD Patients in Greece: Results from the PRESTAR Study. *PLoS One* (2014) 9: e112767. doi:10.1371/journal.pone.0112767
2. OECD OECD/European Observatory on Health Systems and Policies (2021), *Country Health Profile 2021, State of Health in the EU*, OECD Publishing, Paris Greece. doi:10.1787/4ab8ea73-en
3. ERA-EDTA. *ERA-EDTA Registry Annual Report 2017* (2017). 152.
4. Phdtheses. National Archive of PhD Theses (2021). Available from: https://phdtheses.ekt.gr/eadd/simple-search?query=ΜΕΤΑΜΟΣΧΕΥΣΕΙΣ&rpp=80&sort_by=0&order=ASC (Accessed February, 2021).
5. OECD iLibrary. 2022. OECD iLibrary. doi:10.1787/8643de7e-en
6. Mah J, Johnston-Webber C, Prionas A, Romagnoli J, Streit S, Wharton G, et al. How to Structure a Successful Organ Donation and Transplantation System in Eight (Not So Easy) Steps: An Italian Case Study. *Transpl Int* (2023) 36:11010. doi:10.3389/ti.2023.11010
7. Streit S, Johnston-Webber C, Mah J, Prionas A, Wharton G, Cassanova D, et al. Ten Lessons From the Spanish Model of Organ Donation and Transplantation. *Transpl Int* (2023) 36:11009. doi:10.3389/ti.2023.11009
8. Streit S, Johnston-Webber C, Mah J, Prionas A, Wharton G, Paulino J, et al. Lessons From the Portuguese Solid Organ Donation and Transplantation System: Achieving Success Despite Challenging Conditions. *Transpl Int* (2023) 36:11008. doi:10.3389/ti.2023.11008
9. Johnston-Webber C, Mah J, Prionas A, Streit S, Wharton G, Forsythe J, et al. Solid Organ Donation and Transplantation in the United Kingdom: Good Governance is Key to Success. *Transpl Int* (2023) 36:11012. doi:10.3389/ti.2023.11012
10. Mah J, Johnston-Webber C, Prionas A, Bušić M, Streit S, Wharton G, et al. Organ Donation in Croatia: The Importance of a National Champion, a Comprehensive Plan, and International Collaborations. *Transpl Int* (2023) 36:11011. doi:10.3389/ti.2023.11011
11. OECD. OECD Health at a Glance (2021). Available from: https://www.oecd.org/health/health-at-a-glance/ (Accessed February, 2021).
12. ERA-EDTA Registry. *ERA-EDTA Registry Annual Report 2019*. Amsterdam, the Netherlands: Amsterdam UMC, location AMC, Department of Medical Informatics (2019).
13. Greek National Transplant Organization. *Organ Donation and Transplantation Activity Report 2008*. Athens, Greece: The Greek National Transplant Organization (2008). Available from: https://www.eom.gr (Accessed February, 2021).
14. Greek National Transplant Organization. *Organ Donation and Transplantation Activity Report 2009*. Athens, Greece: The Greek National Transplant Organization (2009). Available from: https://www.eom.gr (Accessed February, 2021).
15. Greek National Transplant Organization. *Organ Donation and Transplantation Activity Report 2010*. Athens, Greece: The Greek National Transplant Organization (2010). Available from: https://www.eom.gr (Accessed February, 2021).
16. Greek National Transplant Organization. *Organ Donation and Transplantation Activity Report 2011*. Athens, Greece: The Greek National Transplant Organization (2011). Available from: https://www.eom.gr (Accessed February, 2021).
17. Greek National Transplant Organization. *Organ Donation and Transplantation Activity Report 2012*. Athens, Greece: The Greek National Transplant Organization (2012). Available from: https://www.eom.gr (Accessed February, 2021).
18. Greek National Transplant Organization. *Organ Donation and Transplantation Activity Report 2013*. Athens, Greece: The Greek National Transplant Organization (2013). Available from: https://www.eom.gr (Accessed February, 2021).
19. Greek National Transplant Organization. *Organ Donation and Transplantation Activity Report 2014*. Athens, Greece: The Greek National Transplant Organization (2014). Available from: https://www.eom.gr (Accessed February, 2021).
20. Greek National Transplant Organization. *Organ Donation and Transplantation Activity Report 2015*. Athens, Greece: The Greek National Transplant Organization (2015). Available from: https://www.eom.gr (Accessed February, 2021).
21. Greek National Transplant Organization. *Organ Donation and Transplantation Activity Report 2016*. Athens, Greece: The Greek National Transplant Organization (2016). Available from: https://www.eom.gr (Accessed February, 2021).
22. Greek National Transplant Organization. *Organ Donation and Transplantation Activity Report 2017*. Athens, Greece: The Greek National Transplant Organization (2017). Available from: https://www.eom.gr (Accessed February, 2021).

23. Greek National Transplant Organization. *Organ Donation and Transplantation Activity Report 2018*. Athens, Greece: The Greek National Transplant Organization (2018). Available from: https://www.eom.gr (Accessed February, 2021).
24. Greek National Transplant Organization. *Organ Donation and Transplantation Activity Report 2019*. Athens, Greece: The Greek National Transplant Organization (2019). Available from: https://www.eom.gr (Accessed February, 2021).
25. World Health Organisation. *Global Observatory on Organ Donation and Transplantation*. Geneva, Switzerland: GODT. (2020). Available from: http://www.transplant-observatory.org/ (Accessed February, 2021)
26. Mossialos E, Papalois VE. *Report for a New National Solid Organ Donation and Transplantation Plan in Greece*. Athens, Greece: London School of Economics, Imperial College London, Onassis Foundation (2021).
27. Marshall MN. Sampling for Qualitative Research. *Fam Pract* (1996) 13:522–5. doi:10.1093/fampra/13.6.522
28. Gilson L. *Health Policy and Systems Research: A Methodology Reader*. Alliance HPSR/WHO (2012). p. 474.
29. Johnston-Webber C, Mah J, Streit S, Prionas A, Wharton G, Mossialos E, et al. A Conceptual Framework for Evaluating National Organ Donation and Transplantation Programs. *Transpl Int* (2023) 36:11006. doi:10.3389/ti.2023.11006
30. Galanaki V. *Chronic Kidney Disease and Renal Transplantation-Non-Related Donor and Greek Reality*. dissertation. Thessaloniki, Greece: Aristotle University of Thessaloniki Medical School (2014). Available from: https://Ikee.lib.Auth.Gr/Record/299061/Files/Gri-2018-22202.pdf.
31. Papoutsakis S. *The Era of Transplantations*. Patras, Greece: ACHAIKI IATRIKI (2012). Available from: http://www.iedep.gr/images/stories/teuxi/issue31_1/The_Era_Transplantations.pdf (Accessed February, 2021).
32. Fotis A. *The Family of the Potential Organ Donor Facing the Dilemma of Organ Donation*. dissertation. Greek: Open University. School of Social Studies (2015).
33. Law 4512/2018. *Non-related Organ Donor – Organ Donor NTO ID Card Act 2018 (Greek Parliament)* (2018). Law 4512/2018 Article 260 paragraph 2.
34. Law 1383/1983. *Retrieval and Transplantation of Human Tissues and Organs Act 1983 (Greek Parliament)* (1983). Law 1383/1983.
35. Mavroforou A, Giannoukas A, Michalodimitrakis E. Organ and Tissue Transplantation in Greece: the Law and an Insight into the Social Context. *Med L* (2004) 23:111–25.
36. Law 2737/1999. *Transplantation of Human Tissues and Organs Act 1999 (Greek Parliament)* (1999). Law 2737/1999.
37. Law 3984/2011. *Organ Donation and Transplantation Act 2011 (Greek Parliament)* (2011). Law 3984/2011.
38. Karatzas T, Katsani M, Mitropoulou E, Nikolaou E, Vosnides A, Kostakis A. Substantial Increase in Cadaveric Organ Transplantation in Greece for the Period 2001–2005. *Transpl Proc* (2007) 39:797–800. doi:10.1016/j.transproceed.2007.03.053
39. Giorgakis E, Singer A, Khorsandi SE, Prachalias A. Transplantation Crisis at the Time of Economic Recession in Greece. *Public Health* (2018) 160:125–8. doi:10.1016/j.puhe.2018.03.031
40. Sotiropoulos GC, Machairas N. Organ Donation during the Financial Crisis in Greece. *The Lancet* (2016) 388:957–8. doi:10.1016/S0140-6736(16)31488-X
41. Athanasios P. Organ Transplants and "Presumed Consent": Laws 2737/1999 and 3984/2011, the National Experience and Future Trends. *Vima Tou Asklipiou J* (2014) 13:259–70.
42. Bottis M. The New Greek Statute on Organ Donation-Yet Another Effort to Advance Transplants. *Eur J Health L* (2012) 19:391–5. doi:10.1163/157180912x651400
43. Directorate General Health and Consumers. *Eurobarometer 72.3: Organ Donation and Transplantation*. Brussels, Belgium: European Commission (2010). Available from: https://ec.europa.eu/commfront office/publicopinion/archives/ebs/ebs_333a_en.pdf (Accessed February, 2021).
44. Symvoulakis EK, Komninos ID, Antonakis N, Morgan M, Alegakis A, Tsafantakis E, et al. Attitudes to Kidney Donation Among Primary Care Patients in Rural Crete, Greece. *BMC Public Health* (2009) 9:54. doi:10.1186/1471-2458-9-54
45. Symvoulakis EK, Tsimtsiou Z, Papaharitou S, Palitzika D, Markaki A, Stavroulaki E, et al. Kidney Organ Donation Knowledge and Attitudes Among Health Care Professionals: Findings from a Greek General Hospital. *Appl Nurs Res* (2012) 25:283–90. doi:10.1016/j.apnr.2012.05.001
46. Symvoulakis EK, Markaki A, Anyfantakis D, Rachiotis G. Organ Donation Awareness: Rethinking Media Campaigns. *Int J Health Pol Manag* (2018) 7:1165–6. doi:10.15171/ijhpm.2018.85
47. Symvoulakis EK, Markaki A, Galanakis C, Klinis S, Morgan M, Jones R. Shifting towards an Opt-Out System in Greece: a General Practice-Based Pilot Study. *J Med Sci* (2013) 10:1547–51. doi:10.7150/ijms.7027
48. EOM. Hellenic Transplant Organization. Organization Chart. (2010). Available at: https://www.eom.gr/organogramma/ (Accessed February, 2021)
49. Regulation of the Greek National Transplant Organization Act. *Regulation of the Greek National Transplant Organization Act 2001 (President of the Greek Republic)*. Athens, Greece: 6th Precedential Decree of 2001 (2001).
50. Peritore D, Pretagostini R, Di Ciaccio P, Fiaschetti P, Gabbrielli F, Oliveti A, et al. Italy-Greece Cooperation for Transplantation of Medically Urgent Greek Patients: Is it an Effective, Efficient Model? *Transpl Proc* (2012) 44:1843–5. doi:10.1016/j.transproceed.2012.06.049
51. Hellenic Ministry of Health. KEN-DRG System (2015). Available from: https://www.moh.gov.gr/articles/health/domes-kai-draseis-gia-thn-ygeia/kwdikopoihseis/709-kleista-enopoihmena-noshlia-1 (Accessed February, 2021).
52. Qualifications and Duties of Organ Transplant Coordinators Act. *Qualifications and Duties of Organ Transplant Coordinators Act 2002 (President of the Greek Republic)*. Athens, Greece: 93rd Precedential Decree of 2002 (2002).
53. Ministerial Decree of 2005 M4a/71720-part-B. *Solid Organ Transplant Centers Regulation Act 2005*. Athens, Greece: Greek Minister of Health (2005).
54. ENE. Hellenic Society of Nephrology Archive (2020). Available from: https://www.ene.gr (Accessed February, 2021).
55. Karatzas T, Menoudakou G, Chatzixiros E, Kyrkou B, Maleskou S, Kostakis A. Improving the Organ Transplantation Program in Greece: Institution of Local Transplant Coordinators' Network. *Transpl Proc* (2007) 39:793–6. doi:10.1016/j.transproceed.2007.03.096
56. Economou C, Kaitelidou D, Karanikolos M, Maresso A. Greece: Health System Review. *Health Syst Trans* (2017) 19:1–166.

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