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Acceptance of Organs From Deceased Donors: Results of a Global Survey

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Background. With <10% of transplantation needs being met, one contributing factor may be the potential subjectivity in transplant specialists' acceptance of organs. Such decisions, if influenced by knowledge and/or comfort gaps, warrant intervention. We assessed knowledge and comfort gaps regarding deceased donation (DD) among critical care specialists and organ acceptance among transplant specialists. **Methods.** The Transplantation Society working group surveyed specialists on end-of-life management and organ acceptance. Participants, stratified by country DD rates, ranked their current and desired levels of knowledge or comfort (on a 0–100 scale) for survey questions. The differences between current and desired knowledge and comfort were reported as gaps. **Results.** Among 438 responses, the largest global knowledge gaps were for positive serology for Chagas (gap 30), multidrug-resistant bacterial infection (gap 23.5), HIV (gap 20), cancer history <5 y (gap 20), primary brain malignancies (gap 17.5), and high-risk behavior (gap 16). The largest global comfort gaps were for positive serology for Chagas (gap 29.5), multidrug-resistant bacterial infection (gap 21), excessive alcohol use (gap 20), primary brain malignancies (gap 20), and high-risk behavior (gap 16). Relevant knowledge and comfort gaps, both ranging from 10 to 50, were observed in the acceptance of organs from donors after circulatory determination of death. In general, countries with higher DD rates demonstrated smaller knowledge and comfort gaps than countries with lower DD rates. **Conclusions.** This survey reveals important knowledge and comfort gaps in DD organ acceptance. Targeted education could increase organ utilization and help address transplantation shortages.

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INTRODUCTION

Less than 10% of global organ transplantation needs are currently met.[1] In 2024, in the United States, 11 244 organs (20.7%) were recovered and not transplanted: 29.3% of kidneys, 25.1% of pancreases, 11.5% of livers, 11.3% of lungs, 4.9% of intestines, and 1.9% of hearts.[2] Similar patterns of unused organs have been documented in Europe,[3] suggesting that the problem extends beyond simple organ availability to encompass complex decision-making processes around organ acceptance and utilization. The reasons for refusing organs are multifaceted, including donor-related factors and organ-specific

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quality concerns.[4-15] Subjective factors, including professional knowledge, comfort levels, logistics, and institutional culture, may play substantial roles in determining which organs are accepted for transplantation.

Therefore, a global survey was conceived with the aim of finding, listing, and ranking knowledge and comfort gaps in deceased donor (DD) identification and organ acceptance worldwide (with a gap being the measurable difference between the current and desired level). A knowledge gap pertains to the current background of scientific or clinical information (What do I know about this?), while a comfort gap relates to the confidence (or the skills) to perform an act (How comfortable do I feel about…?). There are different types of learning needs: perceived needs (I know what I do not know), unperceived needs (I do not know what I do not know), and misperceived needs (I think I know something, but I do not).[16] Medical educators use gap analyses as an evidence-based tool to help them understand the barriers that interfere with healthcare practice. Therefore, by identifying the most important gaps, scientific/medical education activities can be planned to target areas of need, starting with those with higher values, prioritizing topics, and optimizing resource allocation.[16-18]

MATERIALS AND METHODS

A working group of The Transplantation Society (TTS), comprising representatives from all regions of the world, including critical care specialists, transplant clinicians, and surgeons with experience in organ transplantation who worked in countries with varying organ donation rates, was formed. This working group created a needs assessment survey covering program structure, policies, finances, end-of-life management, DD acceptance, organ-specific topics, and education on organ donation and transplantation (**Table S1, SDC**, https://links.lww.com/TXD/A913). The TTS Executive and the Ethics committees approved the survey. A link to the web-based survey (SurveyMonkey) was sent via email to its members, to the members of 19 international, national, and regional societies and organizations, and to 6 TTS sections (**Table S2, SDC**, https://links.lww.com/TXD/A913). The survey was available from May 2022 to March 2023. Everyone who completed and submitted the questionnaire was deemed to have consented to the use of their answers.

The respondents to the survey ranked their self-perceived current and desired knowledge and comfort levels on a visual analog scale (0–100). Differences between desired and current levels were reported as gaps (Figure 1A–D), where the higher the gaps, the stronger the need for educational interventions.

Participants were divided into 5 groups based on the mean DD rate per million population (PMP) in their country of practice. We calculated the countries' PMP rates using the Global Observatory on Donation and Transplantation (GODT) data (2016–2021, excluding 2020 because of the COVID-19 pandemic). The groups comprised: (1) no DD reported or no data provided to GODT; (2) <10 DD PMP; (3) 10–19.9; (4) 20–29.9; and (5) ≥30. We compared knowledge and comfort gaps across countries with varying DD rates. Categorical questions requiring yes, no, or uncertain answers were reported as totals and percentages. Knowledge and comfort gaps were presented as medians and interquartile ranges. Statistical analyses were performed using Stata (Version 18 SE; College Station, TX). Based on multiple analyses and the small sample size, comparative statistics are not presented. Data are reported descriptively. Graphs were created using GraphPad Prism 7.0e (GraphPad Software Inc., San Diego, CA).

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M.C. conceptualized the survey, interpreted the data, created tables and figures, and wrote the article. S.S. conceptualized the survey, interpreted the data, and reviewed/edited the article. A.H.G. interpreted the data, created all the figures and 1 table, and reviewed/edited the article. H.S.M. performed the statistical analysis. M.A., S.B., K.M.D., N.K., M.G., V.K., C.D., M.A.F., C.A., B.H.T., P.G.P., O.I., J.H., H.E., G.F.F., E.J.E., H.P., M.B., J.S., M.M., L.D.I., M.B., B.D.G.G., J.G., J.T., W.J.H., J.M., P.S., K.D., A.Z., and G.E.G. conceptualized the survey and reviewed/edited the article.

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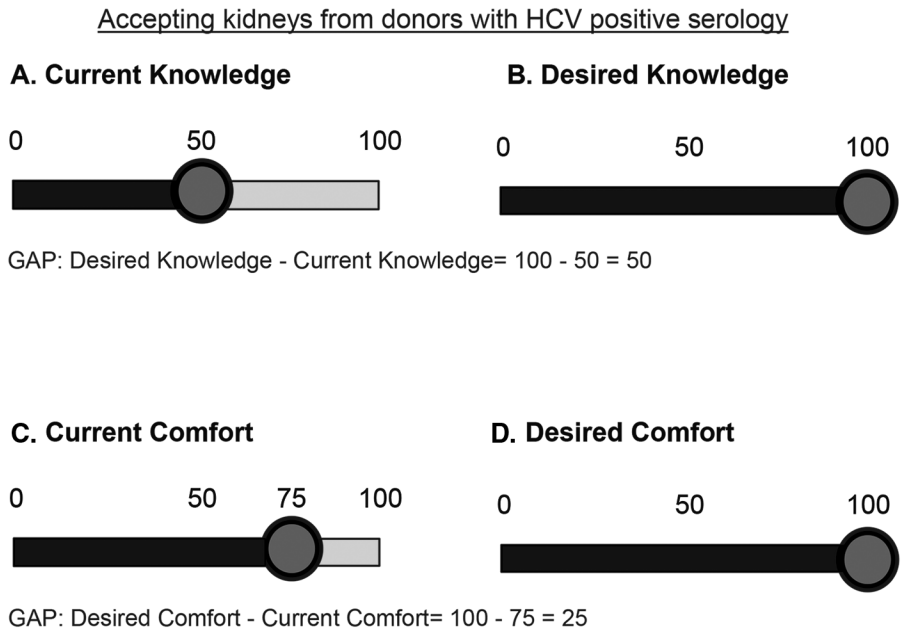

FIGURE 1. Methods to calculate gaps. A visual analog scale (0–100) was used to assess self-perceived knowledge and comfort with each survey question. A, Current knowledge. B, Desired knowledge. C, Current comfort. D, Desired comfort. HCV, hepatitis C virus.

RESULTS

Demographic Data

We received 535 responses from 68 countries. We removed 97 respondents (80 with incomplete information, 3 pediatric transplant specialists, and 14 duplicate answers). We analyzed 438 responses (158 females, 265 males, and 15 of unspecified sex; mean age 54 ± 12 y). Respondents were divided into 5 groups according to their countries' mean DD rates (Figure 2).

Critical Care Specialists

Forty-seven critical care specialists (20 females, 25 males, 2 unspecified; age 50 ± 10 y) participated (**Table S3A, SDC**, https://links.lww.com/TXD/A913).

Among the 13 topics that we assessed, the global median gaps were small, ranging from 0 to 9 in knowledge and 0 to 1 in comfort (Figure 3A and B; **Table S3B** and **C** [**SDC**, https://links.lww.com/TXD/A913]).

We observed gaps in knowledge regarding the following topics: donation after circulatory determination of death (DCD), relative and absolute contraindications to DCD, identification and referral of potential organ donors, and donor medical suitability. There were no knowledge gaps in the remaining questions. There were no gaps in comfort in any of the questions.

When analyzing the results by country groups (G1–G5), those with higher donation rates showed smaller knowledge gaps in the following topics: apnea testing for the neurological determination of death (NDD), contraindications for NDD, ancillary testing for NDD, and DCD (**Table S3B, SDC**, https://links.lww.com/TXD/A913). We observed comfort gaps only in DCD (**Table S3C, SDC**, https://links.lww.com/TXD/A913).

Countries from G2 to G5 reported a high rate of available regulatory mechanisms or frameworks for NDD (Figure 3C). However, in the case of DCD, countries with lower DD rates (G1–G3) showed a higher proportion of negative answers (Figure 3D).

All Transplant Specialists

We analyzed 285 answers from transplant specialists (105 females, 180 males; aged 54 ± 11 y; **Table S4A** [**SDC**, https://links.lww.com/TXD/A913]).

We evaluated 19 topics covering 3 domains: infections, cancer and high-risk behavior, and tissue typing aspects. The global median knowledge gaps ranged from 3 to 30, and global median comfort gaps from 4 to 29.5 (Figure 4A–C; **Table S4B** and **C** [**SDC**, https://links.lww.com/TXD/A913]).

With regard to the acceptance of donors with infections, the highest (and similar) gaps in both knowledge and comfort in descending order were observed in the following topics: Chagas disease positive serology, multidrug-resistant bacterial infection, SARS-COV-2 positive polymerase chain reaction (PCR), hepatitis B surface antigen positive serology, isolated anti-hepatitis B core antibody (HBcAb) positive serology, and hepatitis C virus (HCV) positive serology (Figure 4A–C; **Table S4B** and **C** [**SDC**, https://links.lww.com/TXD/A913]).

We observed a higher knowledge gap compared with comfort in the acceptance of donors with HIV positive serology. Also, there was greater comfort than a knowledge gap regarding the acceptance of donors with positive blood cultures undergoing appropriate treatment (Figure 4A–C; **Table S4B** and **C** [**SDC**, https://links.lww.com/TXD/A913]).

In the context of accepting donors with cancer and high-risk behavior, higher (and similar) knowledge and comfort gaps were found in primary brain malignancies, high-risk social behavior, and excessive cigarette smoking. On the other hand, there was a higher gap in knowledge compared with comfort in the event of a history of cancer <5 y. On the contrary, there was a higher gap in comfort versus a minimal gap in knowledge in the acceptance of donors with excessive alcohol use (Figure 4A–C; **Table S4B** and **C** [**SDC**, https://links.lww.com/TXD/A913]).

The results (in decreasing order) of the analyses of tissue typing aspects showed higher (and similar) gaps in knowledge and comfort in the following topics: the role of

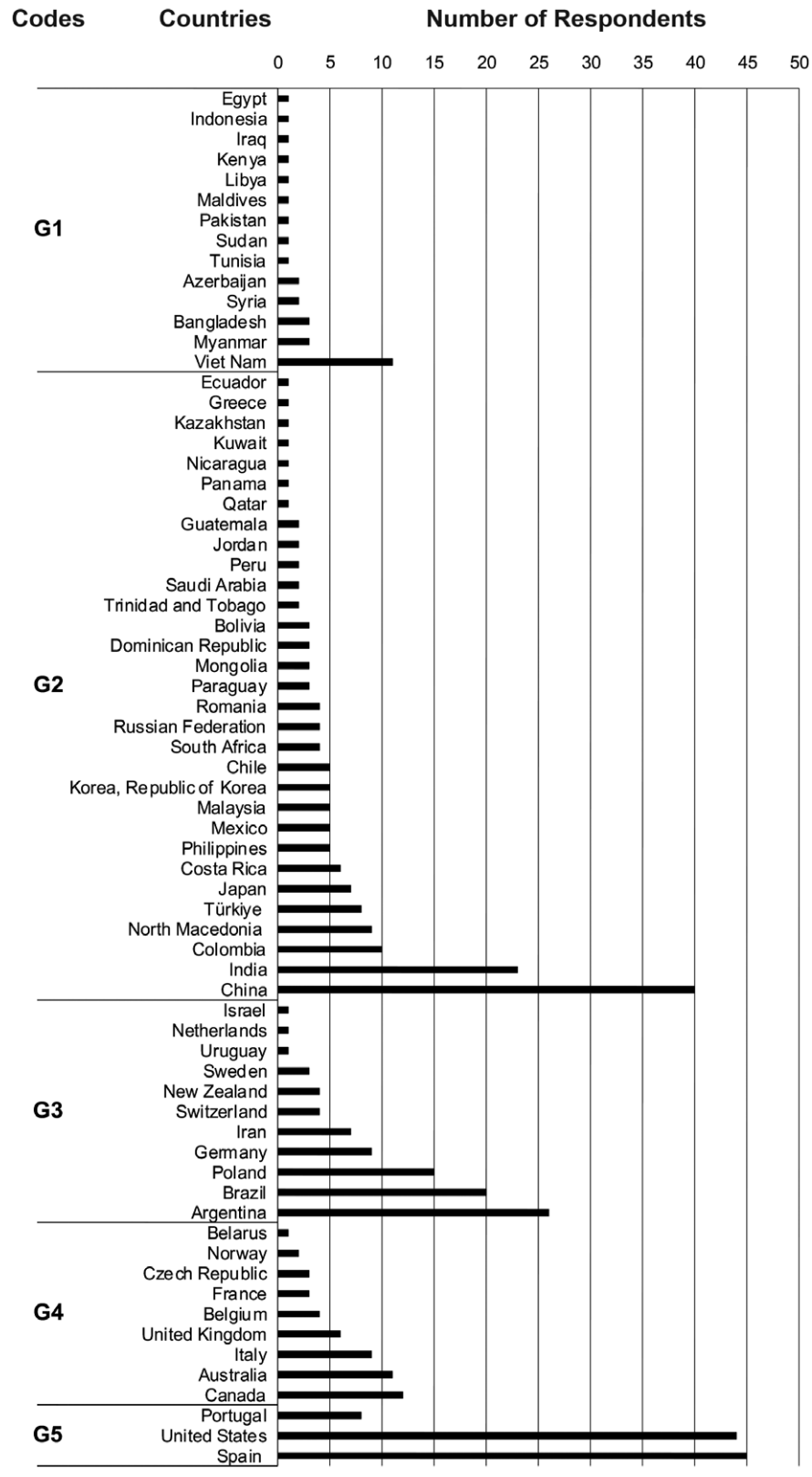

FIGURE 2. Number of respondents per country and country code according to deceased organ donation rate per million population.

cell-free DNA in noninvasive diagnosis of acute rejection, pretransplant HLA-antibody testing for immunological risk stratification, definition and characterization of unacceptable donor HLA antigens, understanding of the impact of non-HLA antibodies on transplant outcomes, and application of crossmatch testing methods. We observed a greater gap between comfort and knowledge in post-transplantation surveillance for donor-specific antibody (Figure 4A–C; **Table S4B** and **C** [SDC, https://links.lww.com/TXD/A913]).

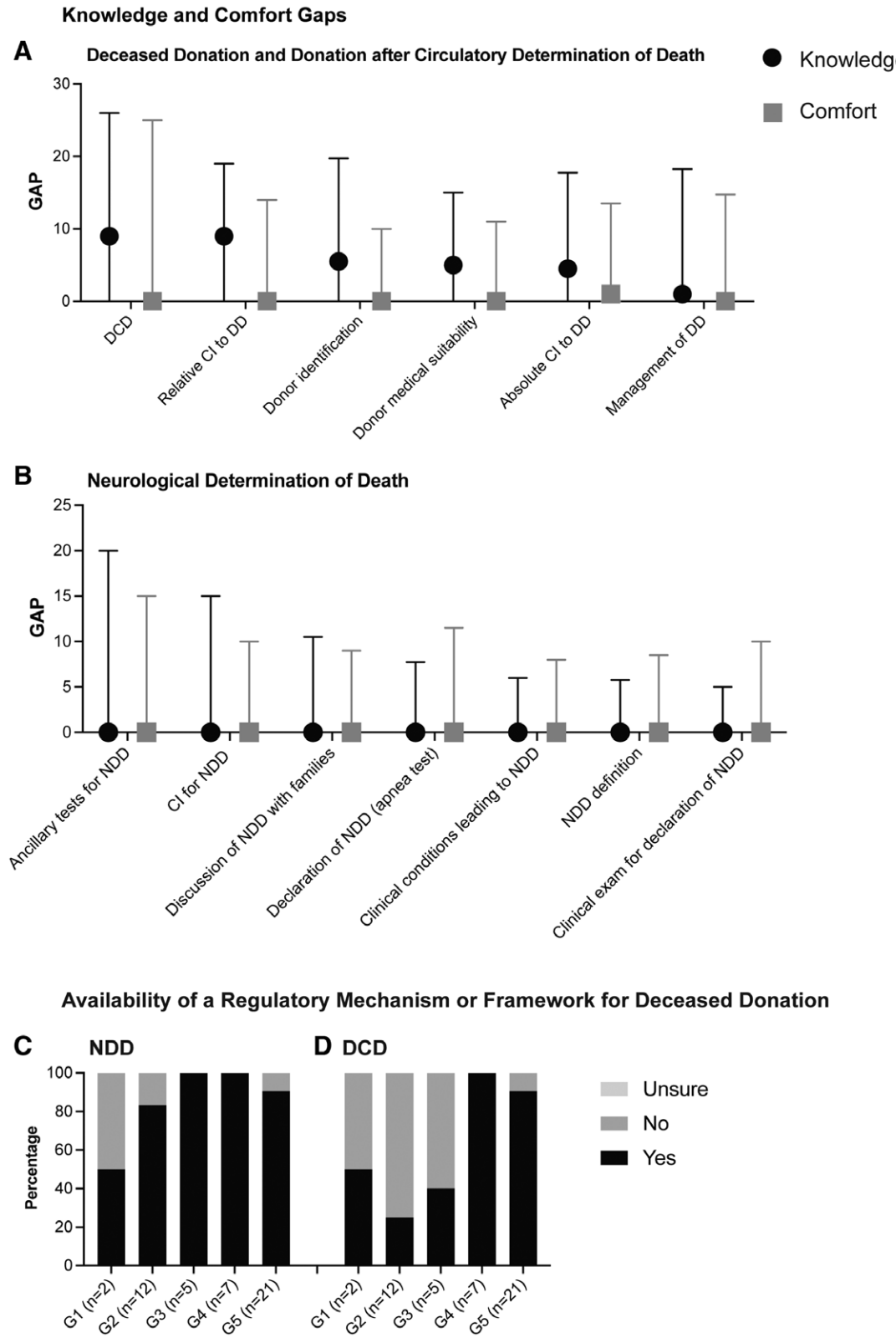

FIGURE 3. Critical care specialists. This figure depicts the median global knowledge and comfort gaps among critical care specialists regarding topics related to DD and to DCD (A), and aspects associated with NDD (B). Survey responses about the availability of a regulatory mechanism or framework for DD are depicted according to NDD (C) and DCD (D). The x-axis represents the respondents' groups (G) 1 to 5 according to their mean DD rate PMP: G1: no data; G2: <10 PMP; G3: 10–19.9 PMP; G4: 20–29.9 PMP; G5: ≥30 PMP. The y-axis shows responses (%) as "Yes," "No," or "Unsure." CI, contraindications; DCD, donation after circulatory determination of death; DD, deceased donation; NDD, neurological determination of death; PMP, per million population.

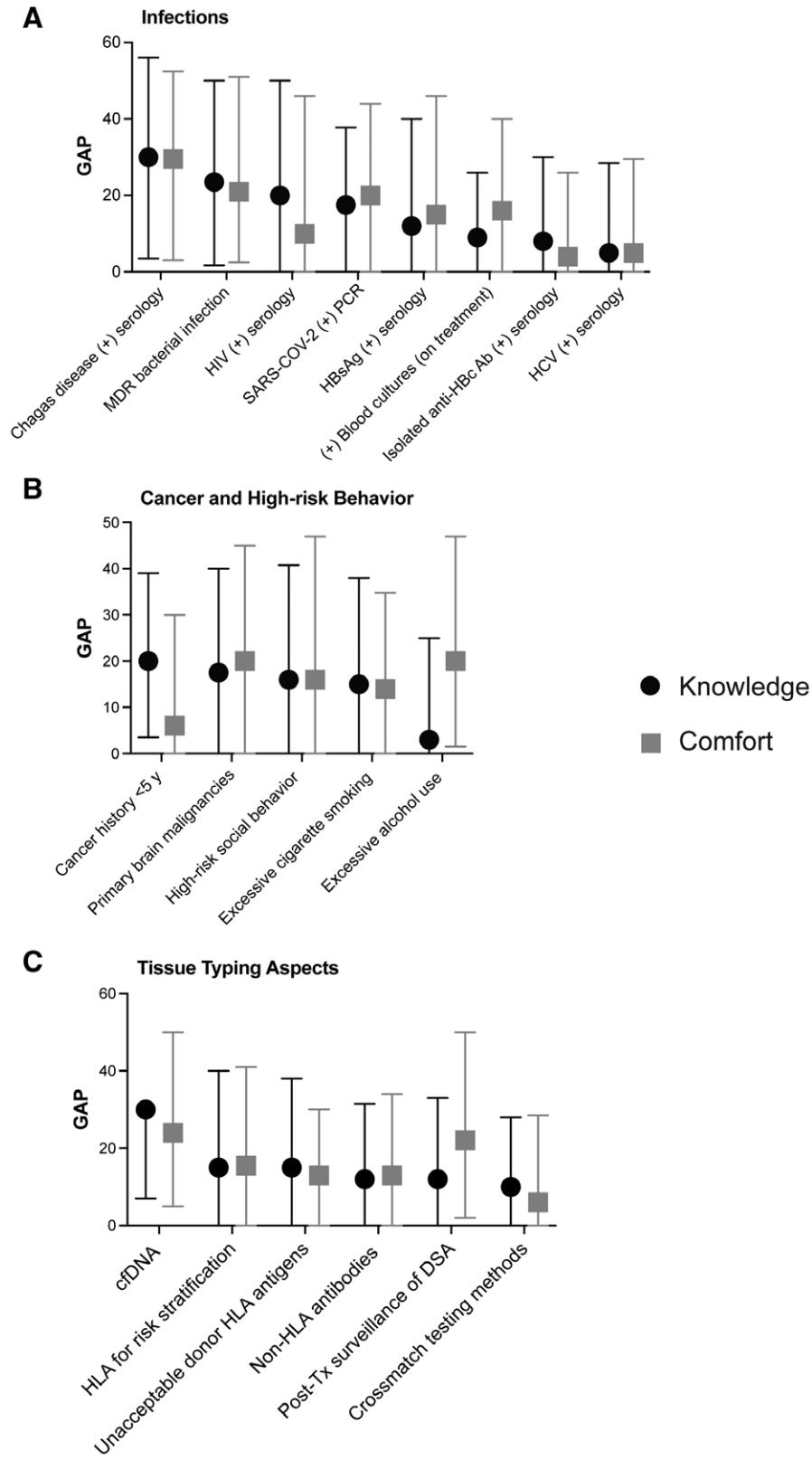

FIGURE 4. All transplant specialists. The figure shows the median global knowledge and comfort gaps among all transplant specialists regarding deceased donor acceptance according to infections (A), cancer and high-risk behavior (B), and tissue typing aspects (C). cfDNA, cell-free DNA; DSA, donor-specific antibody; HBcAb, hepatitis B core antibody; HBsAg, hepatitis B surface antigen; HCV, hepatitis C virus; MDR, multidrug-resistant; PCR, polymerase chain reaction.

When analyzing the results by groups of countries (G1–G5), those with higher DD rates showed smaller knowledge gaps in the acceptance of the following donors: high-risk DD, those with a history of excessive cigarette smoking or alcohol use, hepatitis B surface antigen positive serology, isolated anti-HBcAb positive serology, HCV positive serology, DD with positive blood cultures undergoing appropriate treatment, and posttransplant surveillance for donor-specific antibodies (**Table S4B** [**SDC**, https://links.lww.com/TXD/A913]). With regard to comfort, smaller gaps were observed in higher DD countries in the following topics: high-risk DD, history of excessive cigarette smoking, isolated anti-HBcAb positive serology, HCV positive serology, HIV positive serology, DD with positive blood culture undergoing appropriate treatment, and application of crossmatch testing methods (**Table S4C**, **SDC**, https://links.lww.com/TXD/A913).

Kidney Transplant Specialists

Two hundred sixteen kidney transplant specialists participated (60 females, 148 males, 8 unspecified; aged 53 ± 12 y; **Table S5A** [**SDC**, https://links.lww.com/TXD/A913]).

Among the 10 topics that were evaluated, the global median knowledge gaps ranged from 3 to 19.5, and the global median comfort gaps ranged from 3 to 18.5 (Figure 5; **Table S5B** and **C** [**SDC**, https://links.lww.com/TXD/A913]).

Acute kidney injury was the only topic with the highest (and similar) gaps in knowledge and comfort. Then, in descending order, we observed similar knowledge and comfort gaps in the following topics: DCD, diabetes mellitus, donors recovering from COVID-19 (PCR-negative), donors aged >70 and 75 y, and donors <10 y. Acceptance of dual kidneys and kidney donor profile index >85% were associated with higher global knowledge gaps than comfort gaps. Of note, we found that acceptance of expanded criteria donor had the lowest knowledge and comfort gaps (Figure 5A). However, when the results were reported by DD rate (G1–G5), higher gaps were generally observed among those with lower donation rates (**Table S5B** and **C** [**SDC**, https://links.lww.com/TXD/A913]).

The availability of perfusion pumps at local hospitals and within the same city, as well as the accessibility of air transport for kidneys, increased with countries' organ DD rates (Figure 5B–D).

Liver Transplant Specialists

We analyzed 81 answers from liver transplant specialists (23 females, 58 males; aged 53 ± 11 y) who participated (**Table S6A**, **SDC**, https://links.lww.com/TXD/A913).

We analyzed 6 topics in which the global median knowledge gaps ranged from 1 to 13, and the global median comfort gaps ranged from 1 to 10 (Figure 6A; **Table S6B** and **C** [**SDC**, https://links.lww.com/TXD/A913]).

The largest knowledge gap was observed in the acceptance of DCD livers, decreasing toward split livers (Figure 6A). The largest comfort gaps were observed in the acceptance of livers from DCD and those with steatosis (Figure 6A).

The availability of perfusion devices increased from G2 (22%) to G4 (75%) and decreased to 47% in G5 (Figure 6B). The transportation of DD livers by plane ranged from 50% (G4) to 87% (G5; Figure 6C).

When analyzing the results by organ donation rate (G1–G5), we observed larger knowledge and comfort gaps in the acceptance of liver donation from DCD, from pediatric to adult recipients, and from donors >70 y old in countries with low DD rates. We found a larger knowledge gap, but not in comfort, with the acceptance of split livers, in countries with low DD rates (**Table S6B** and **C**, **SDC**, https://links.lww.com/TXD/A913).

Heart Transplant Specialists

Twenty-one transplant specialists participated (5 females, 15 males, 1 unspecified; aged 56 ± 11 y; **Table S7A** [**SDC**, https://links.lww.com/TXD/A913]).

We evaluated 19 topics, divided into 4 categories: medications, cardiac arrest and death, imaging, and age and others. The global median knowledge gaps ranged from 10 to 40, and the global median comfort gaps ranged from 10 to 44.5 (Figure 7A–D; **Table S7B** and **C** [**SDC**, https://links.lww.com/TXD/A913]).

The highest and most similar median knowledge and comfort gaps were observed in the use of >2 inotropic medications and dobutamine >5 μg/kg/min (Figure 7A). Decreasing knowledge gaps were seen from cardiac arrest >30 min to cardiac arrest <24 h (Figure 7B). Comfort gaps were variable, being highest for cardiac arrest >20 min (Figure 7B). With regard to imaging, the highest and most similar median knowledge and comfort gaps were found in left ventricular ejection fraction <45%, valvular disease, mild coronary artery disease, and mild-to-moderate left ventricular hypertrophy (Figure 7C). Finally, knowledge gaps decreased among donors ventilated for >10 d and among donors >60 y (Figure 7D). The highest comfort gap was observed in DD with sodium 165–170 mmol/L (Figure 7D).

Although the sample size was small, when the data were analyzed by DD rate, we observed the lowest median knowledge gaps across all topics in the higher donation rate DD countries (G5; **Table S7B** [**SDC**, https://links.lww.com/TXD/A913]). However, comfort varied (**Table S7C**, **SDC**, https://links.lww.com/TXD/A913).

Lung Transplant Specialists

Twenty lung transplant specialists participated (5 females, 15 males; aged 45 ± 12 y; **Table S8A** [**SDC**, https://links.lww.com/TXD/A913]).

Seven topics were studied. The global median knowledge gaps ranged from 7 to 41, and the global median comfort gaps ranged from 4.5 to 23.5 (Figure 8; **Table S8B** and **C** [**SDC**, https://links.lww.com/TXD/A913]).

Median knowledge gaps in the acceptance of lungs from DD decreased from a ratio of pressure of oxygen in arterial blood to the inspired oxygen fraction of 250 mm Hg to donor age >60 y. Median comfort gaps varied (Figure 8).

Although the sample size was small, when the data were analyzed by DD rate, we found the lowest knowledge and comfort gaps in higher DD countries regarding the acceptance of lungs from donors >60 y and those with a history of excessive cigarette smoking (**Table S8B** and **C**, **SDC**, https://links.lww.com/TXD/A913).

Pancreas and Islets Transplant Specialists

Fifty-five pancreas transplant specialists participated (10 females, 45 males; aged 58 ± 13 y; **Table S9A** [**SDC**, https://links.lww.com/TXD/A913]).

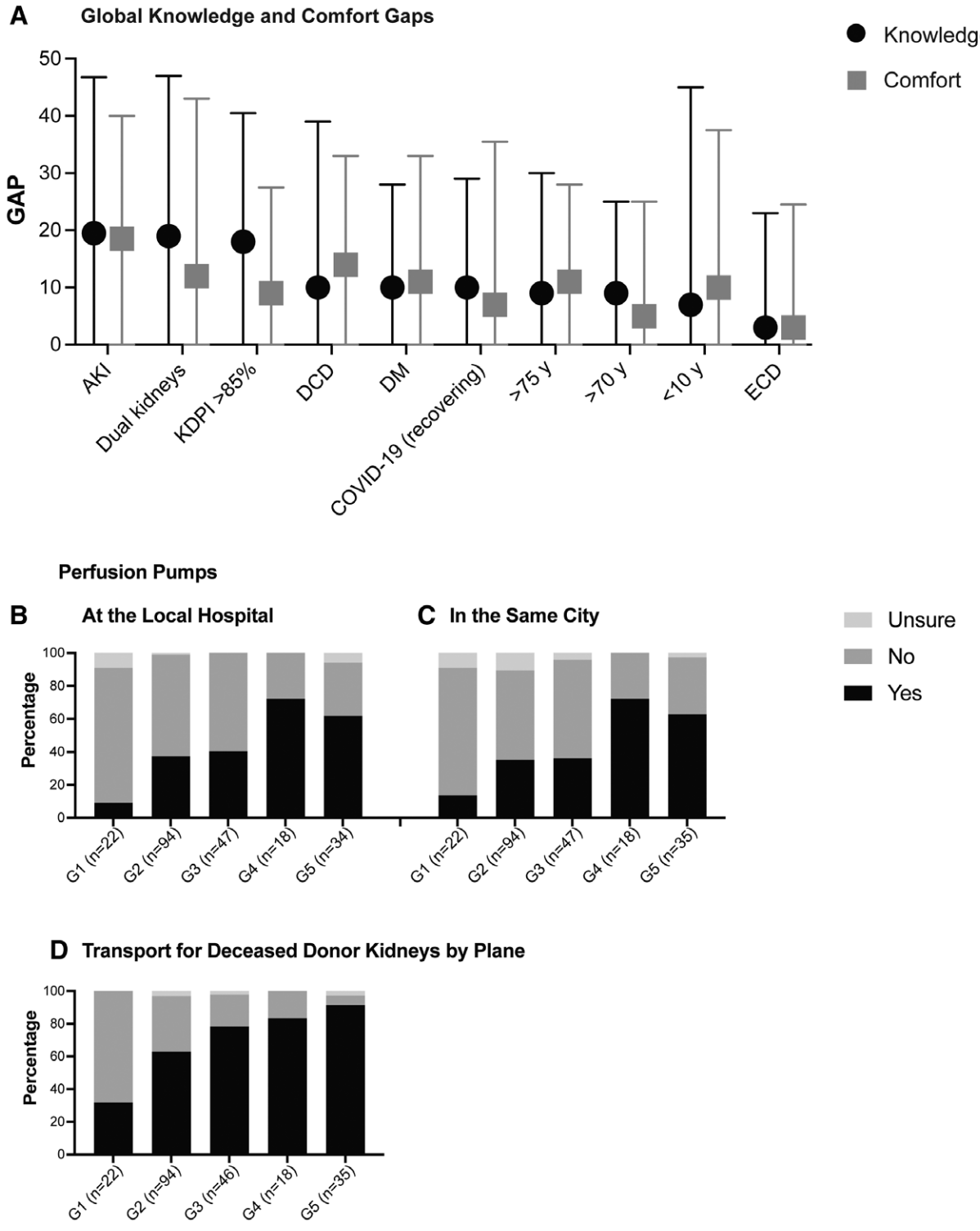

FIGURE 5. Kidney transplant specialists. The figure depicts the median global knowledge gaps among kidney transplant specialists regarding the acceptance of different types of deceased kidney donors (A). The availability of perfusion pumps at local hospitals (B) and in the same city (C), as well as transportation by plane for deceased donor kidneys (D), is shown according to the countries' mean deceased donation (DD) rate PMP. The x-axis depicts the groups G1: no data; G2: <10 PMP; G3: 10–19.9 PMP; G4: 20–29.9 PMP; G5: ≥30 PMP. The y-axis shows responses (%) as "Yes," "No," or "Unsure." AKI, acute kidney injury; DCD, donation after circulatory determination of death; DM, diabetes mellitus; ECD, expanded criteria donor; KDPI, kidney donor profile index; PMP, per million population.

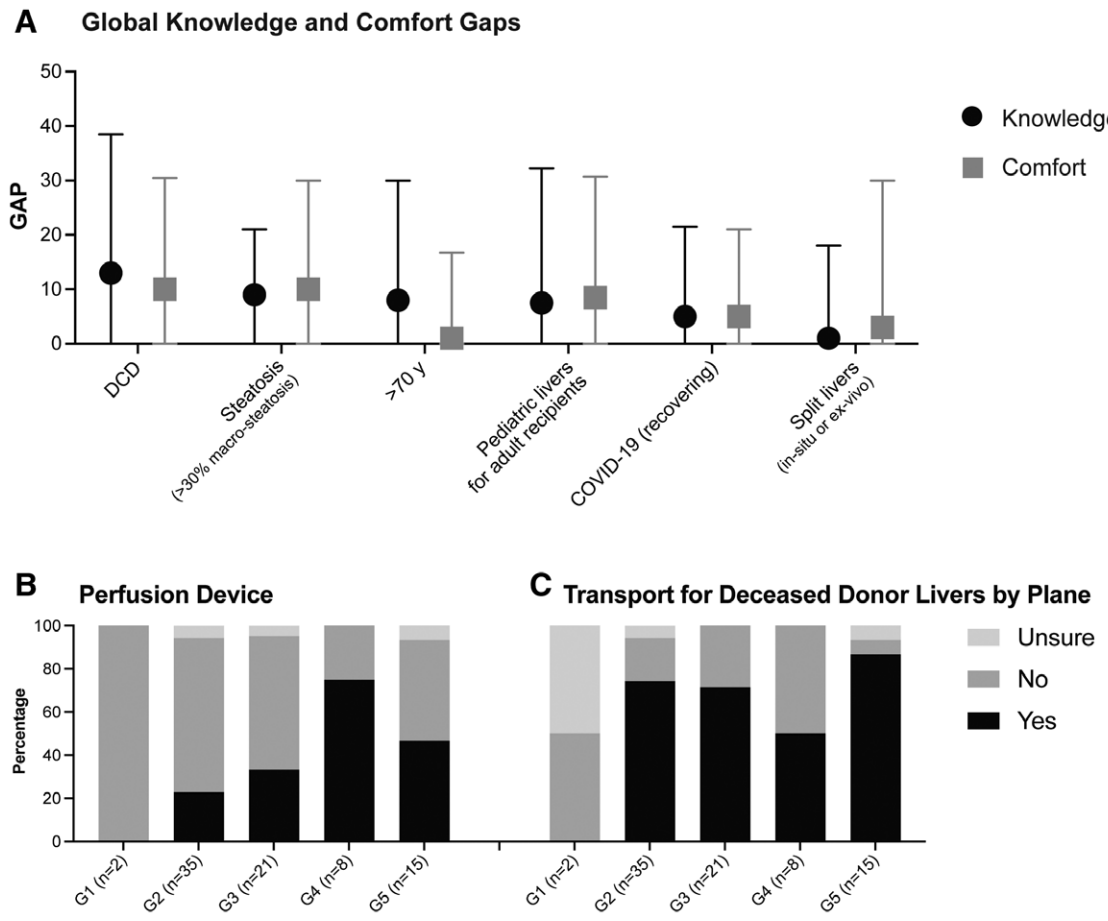

FIGURE 6. Liver transplant specialists. The figure depicts the median global knowledge and comfort gaps among liver transplant specialists regarding the acceptance of different types of deceased liver donors (A). The availability of a perfusion device (B) and transportation by plane for deceased donor livers (C) is shown according to the countries' mean deceased donation (DD) rate PMP. The x-axis depicts the groups G1: no data; G2: <10 PMP; G3: 10–19.9 PMP; G4: 20–29.9 PMP; G5: ≥30 PMP. The y-axis shows responses (%) as "Yes," "No," or "Unsure." DCD, donation after circulatory determination of death; PMP, per million population.

We assessed 7 topics related to pancreas acceptance. The global median knowledge gaps ranged from 0 to 45, and the global median comfort gaps ranged from 5.5 to 31 (Figure 9A). Median knowledge gaps decreased from accepting donors with type 2 diabetes to donors recovering from COVID-19 (negative PCR), while comfort gaps varied (Figure 9A).

When data were analyzed by DD rate, both knowledge and comfort gaps varied (**Table S9B** and **C**, **SDC**, https://links.lww.com/TXD/A913).

We evaluated 4 topics related to islet acceptance. The global median knowledge gaps ranged from 4 to 15.5, and the global median comfort gaps ranged from 11.5 to 24.5 (Figure 9B). Median knowledge gaps decreased from accepting donors with anoxia to accepting pediatric donors for adult recipients, while comfort gaps varied (Figure 9B).

We did not observe a consistent pattern in knowledge and comfort gaps when the data were analyzed by DD rate (**Table S9D** and **E**, **SDC**, https://links.lww.com/TXD/A913). Countries in G4 reported the highest rate of islet isolation from DD pancreas (Figure 9C).

Small Bowel Transplant Specialists

Fifteen small bowel transplant specialists participated (4 females, 11 males; aged 49 ± 9 y; **Table S10A** [**SDC**, https://links.lww.com/TXD/A913]).

We analyzed 6 topics. The global median knowledge gaps ranged from 2.5 to 50, and the global median comfort gaps ranged from 5 to 50 (Figure 10A; **Table S10B** and **C** [**SDC**, https://links.lww.com/TXD/A913]).

The largest knowledge and comfort gaps were observed in DCD and then decreased to simultaneous in situ liver recovery (Figure 10A).

Because of the low number of responses, we could not identify a pattern in knowledge and comfort gaps when analyzing the data by DD rate (**Table S10B** and **C**, **SDC**, https://links.lww.com/TXD/A913).

The availability of ex vivo perfusion devices was similar across groups of countries stratified per DD rate (Figure 10B).

Vascularized Composite Allograft Specialists

Five participants (1 female, 4 males; aged 56 ± 9 y) from Argentina, China, Italy, Türkiye, and the United States

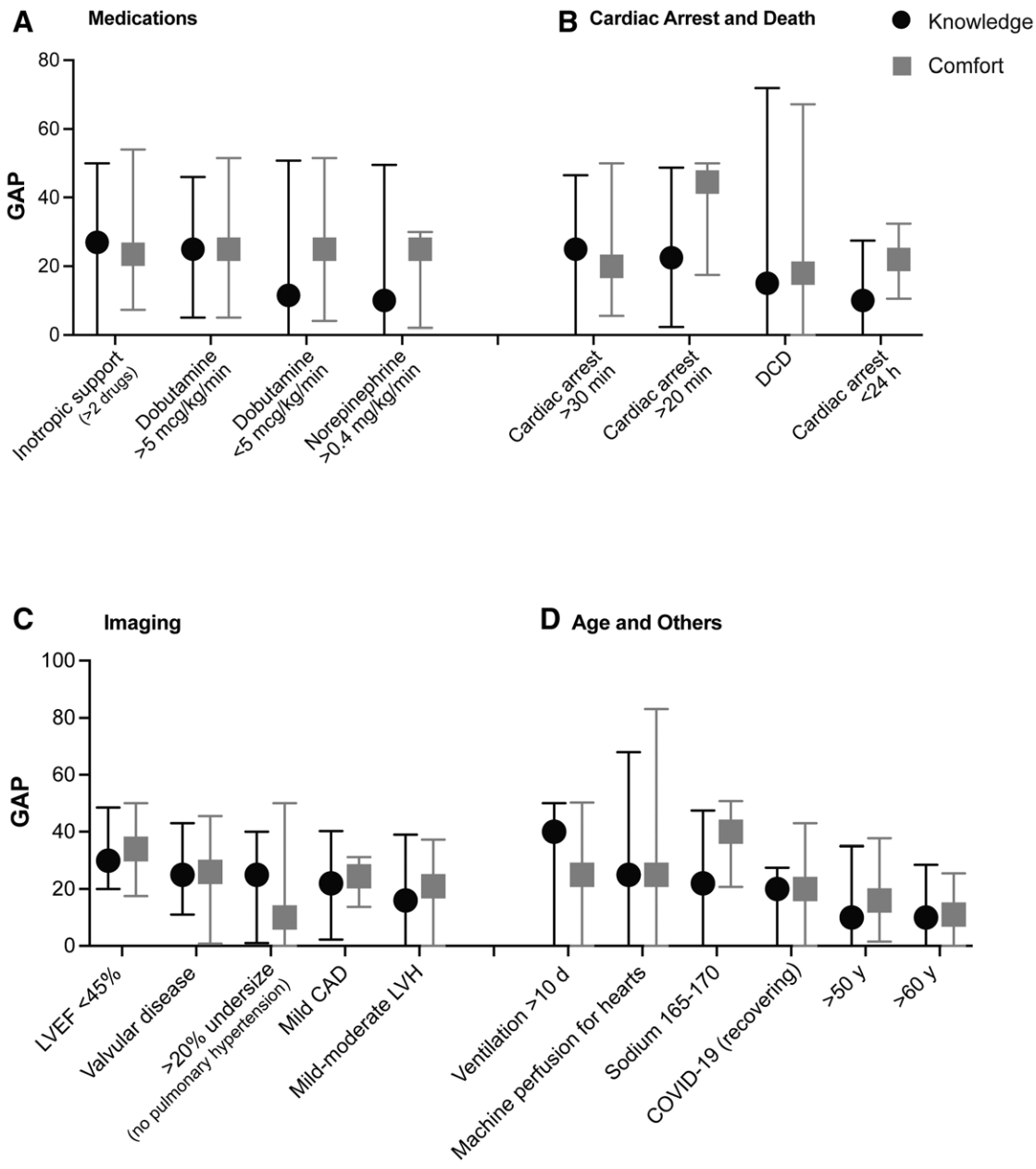

FIGURE 7. Heart transplant specialists. The figure depicts the median global knowledge and comfort gaps among heart transplant specialists regarding the acceptance of different types of heart donors, according to medications used (A), cardiac arrest and death (B), imaging (C), and age and others (D). CAD, coronary artery disease; DCD, donation after circulatory determination of death; LVEF, left ventricular ejection fraction; LVH, left ventricular hypertrophy.

participated (**Table S11A, SDC**, https://links.lww.com/TXD/A913). We analyzed 13 topics. The answers are shown in **Table S11B–D** (**SDC**, https://links.lww.com/TXD/A913).

DISCUSSION

Our findings show knowledge and comfort gaps among critical care and transplant professionals regarding end-of-life management and the acceptance of DD organs. Professional education is a potentially modifiable factor contributing to organ acceptance. This survey provides evidence-based information for the development of local, national, and international transplantation educational programs.

In general, countries with low DD rates demonstrated high knowledge and comfort gaps. This suggests a self-reinforcing cycle in which limited experience leads to reduced confidence, which, in turn, may contribute to more conservative organ acceptance practices and perpetuate low DD rates.

Important strides in different areas of organ donation and transplantation, such as in ethics, pharmacology, immunology, diagnostics, xenotransplantation, and surgical techniques, just to name a few of them, are having a positive impact on clinical

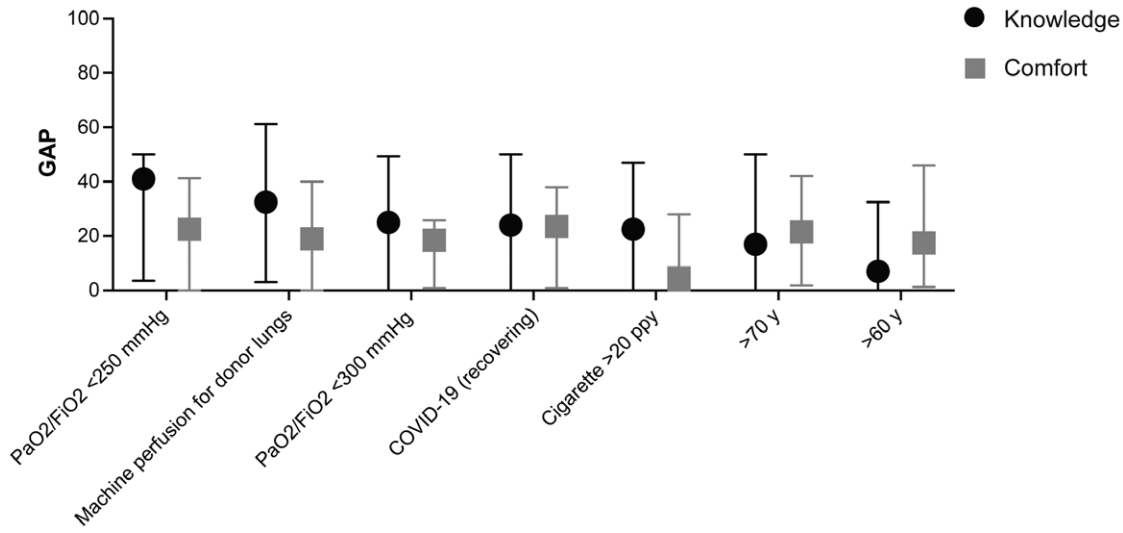

FIGURE 8. Lung transplant specialists. The figure depicts the median global knowledge and comfort gaps among lung transplant specialists regarding the acceptance of different types of deceased lung donors. PaO_2/FiO_2, ratio of pressure of oxygen in arterial blood to the inspired oxygen fraction.

practice. Therefore, staying abreast of new information and applying it to daily practice is challenging for any member of donation and transplantation teams.

Critical care and donation specialists play a key role in identifying and managing potential DD. International experts have focused on defining the concept of death. In collaboration with the World Health Organization, an international group proposed a definition of death based on the permanent loss of capacity for consciousness and all brainstem functions.[19]

In our survey, the availability of regulatory mechanisms for NDD appeared broadly comparable across groups, except in countries with no DD or no data reporting to the GODT. This observation could be related to the impact of the World Brain Death Project, in which the basic clinical criteria for NDD were proposed.[20] In the survey, countries with low DD rates showed a greater need to develop regulatory mechanisms for DCD, underscoring the distinction between NDD and DCD. Recently, the Santander Summit suggested a unified concept of death (combining circulatory and neurological criteria of death), based on the permanent cessation of brain functions. The authors highlighted the importance of reducing differences in DD and raising the acceptance of organs from DCD.[21]

The published literature addresses recommendations and outcomes regarding the acceptance of DD, in particular those with high-risk behavior, at risk of transmission of infections, and with a history of malignancies,[4-9,21-33] as well as topics related to tissue typing.[34-37] Evidence can guide transplant specialists about the acceptance of organs from DD, such as kidneys,[38-47] livers,[11,48-50] hearts,[13,51,52] lungs,[14,53-55] pancreas/islets,[12,56-58] small bowels,[15] and composite vascularized tissues.[59]

A common pattern observed in our survey across transplant specialists was the presence of gaps in the acceptance of organs from DCD.

The evolution of perfusion strategies (normothermic regional perfusion, normothermic machine perfusion, hypothermic machine perfusion, and hypothermic oxygenated machine perfusion) may improve access and outcomes after transplantation of hearts, livers, and kidneys from DCD.[60]

The gaps may result in negative economic consequences. Unused organs waste hundreds of millions of dollars annually, while waitlist patients incur high costs. The total annual cost of treating patients with chronic kidney disease is projected to increase from US$161.95 billion in 2022 to US$173.41 billion in 2027.[61] Education may cost-effectively reduce waste, mortality, and healthcare expenditures.

Variations in knowledge and comfort highlight opportunities for quality improvement through standardized education and certification. Practicing transplant surgeons and clinicians should have basic knowledge of the key aspects of organ acceptance from DD. For topics with larger gaps, knowledge should be updated regularly through various mechanisms, for example, keeping up to date with the literature, participating in institutional rounds/seminars, attending webinars, and attending national, regional, and international transplant congresses. International societies should define global competency standards. Quality metrics on organ acceptance, combined with regular preparedness assessments, can identify gaps and guide continuous improvement. Peer-review and consultation networks can increase comfort, harmonize practice, and provide case-based learning for complex cases.

The results of our survey may contribute to creating future opportunities for technology-enabled decision support, including artificial intelligence and machine-learning tools. Telemedicine and virtual consultation networks can further mitigate geographic disparities by linking emerging centers with expert teams for real-time guidance.

This survey has limitations. Among TTS members, the response rate was 7.3% (438/6060). The number of respondents was particularly small among specialists in heart, lung, small bowel, and vascularized composite allografts. However, it has been reported that high versus low survey response rates may not be associated with better outcomes.[62]

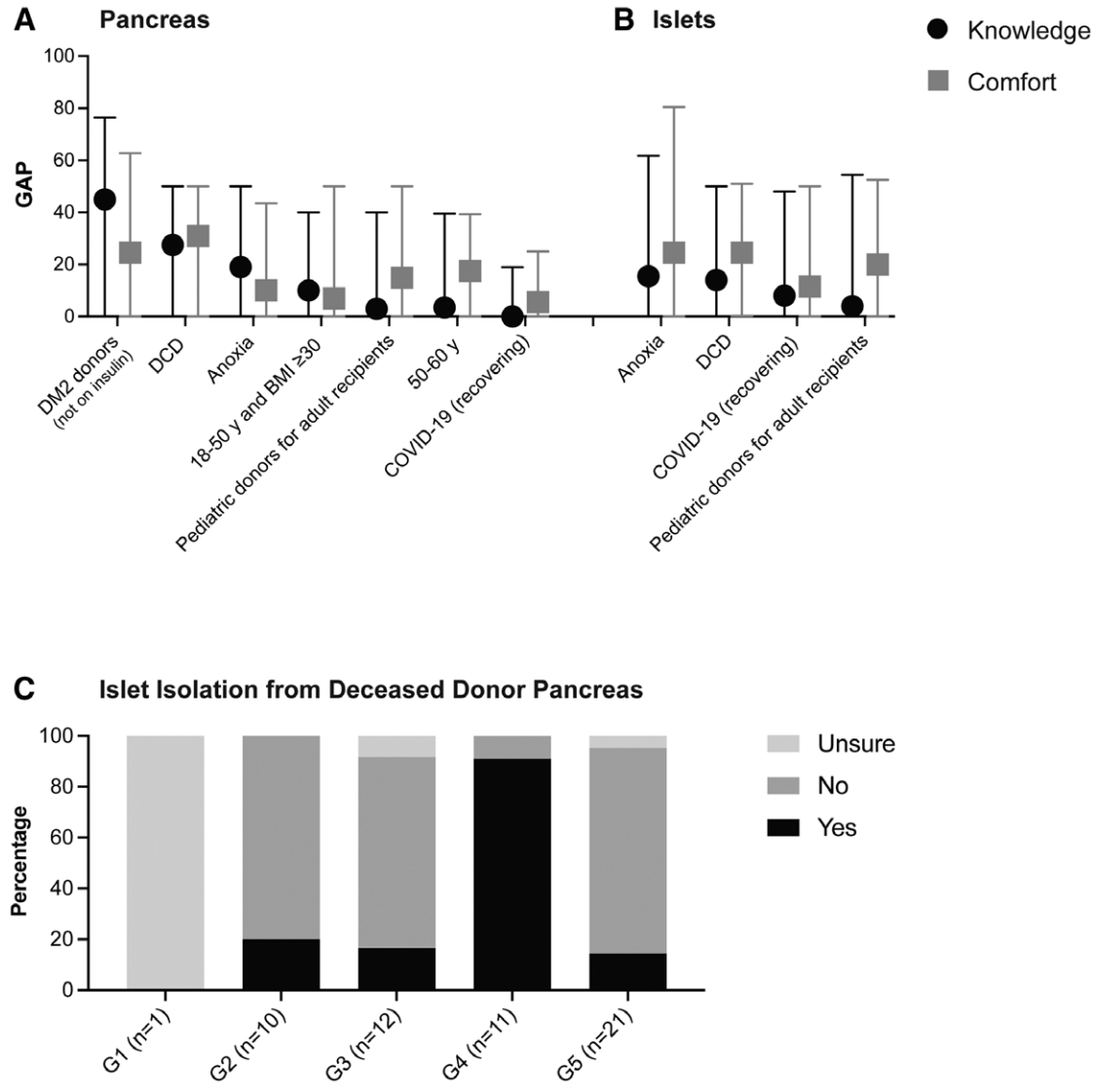

FIGURE 9. Pancreas and islet transplant specialists. The figure illustrates the median global knowledge and comfort gaps among pancreas transplant specialists regarding the acceptance of pancreas (A) and islets (B) from deceased donors. Islet isolation (C) is shown according to the countries' mean deceased donation (DD) rate PMP. The x-axis depicts the groups G1: no data; G2: <10 PMP; G3: 10–19.9 PMP; G4: 20–29.9 PMP; G5: ≥30 PMP. The y-axis shows responses (%) as "Yes," "No," or "Unsure." BMI, body mass index; DCD, donation after circulatory determination of death; DM2, diabetes mellitus type 2; PMP, per million population.

We did not capture participants' years of experience in transplantation, nor did we include a question about acceptance of lungs from DCD. We acknowledge that regional differences in knowledge and comfort levels may affect the generalizability of the results. The sample size may not be representative of all critical care and transplant professionals in the surveyed countries, and estimates of gaps may be biased downward or upward, depending on who chose to respond. We acknowledge that our results are at risk of social acceptability, acquiescence, and nonresponse bias.

To the best of our knowledge, this is the first global survey to analyze knowledge and comfort gaps regarding various aspects of end-of-life care, acceptance of DD, and organ-specific issues that may explain the current low DD rates worldwide.

CONCLUSIONS AND CALL TO ACTION

Global transplantation faces a key paradox: despite severe shortages, many recovered organs are unused. Our findings support the consideration of targeted educational initiatives and competency-based training programs as potential strategies to improve organ acceptance worldwide. Future studies should evaluate whether these interventions translate into measurable changes in transplantation activity.

We suggest that governments, regulators, the World Health Organization, and professional transplantation societies, such as TTS, integrate competency standards into training and licensure, fund education and exchange programs, and implement oversight. Investment in workforce preparedness is a moral and strategic imperative to honor organ donors and reduce the global transplant shortfall.

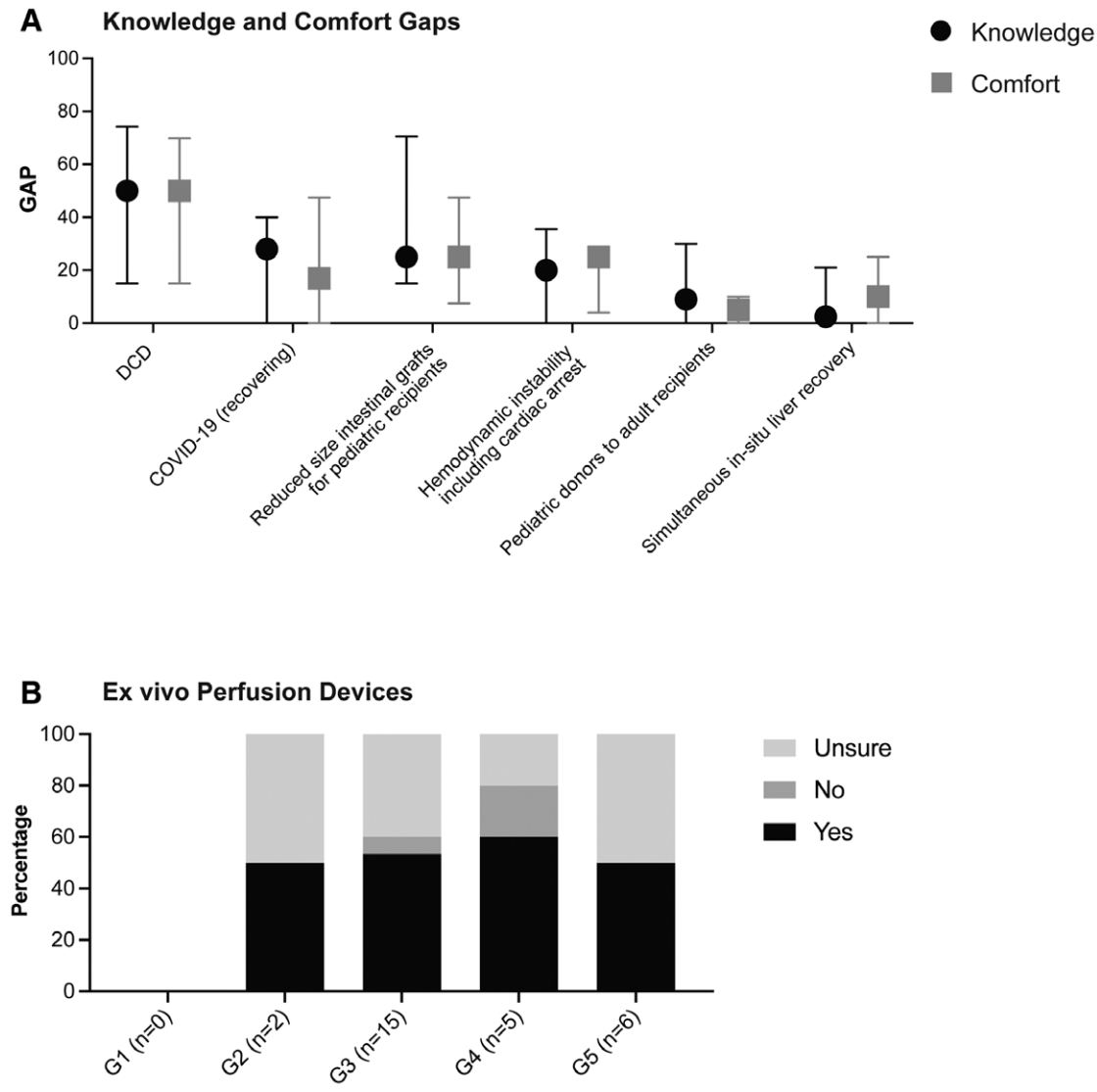

FIGURE 10. Small bowel transplant specialists. The figure depicts the median global knowledge and comfort gaps among small bowel transplant specialists regarding the acceptance of different types of small bowel from deceased donors (A). The availability of ex vivo perfusion devices (B) is shown according to the countries' mean deceased donation (DD) rate PMP. The x-axis depicts the groups G1: no data; G2: <10 PMP; G3: 10–19.9 PMP; G4: 20–29.9 PMP; G5: ≥30 PMP. The y-axis shows responses (%) as "Yes," "No," or "Unsure." DCD, donation after circulatory determination of death; PMP, per million population.

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REFERENCES

1. Global Observatory on Donation and Transplantation. Available at https://www.transplant-observatory.org/wp-content/uploads/2025/02/2023-data-global-report-20022025.pdf. Accessed July 25, 2025.
2. Israni AK, Zaun DA, Martinez A, et al. OPTN/SRTR 2024 annual data report: deceased organ donation. *Am J Transplant*. 2026;26:S551–S584.
3. European Directorate for the Quality of Medicines & HealthCare. Available at https://www.edqm.eu/en/newsletter-transplant. Accessed November 17, 2025.
4. White SL, Rawlinson W, Boan P, et al. Infectious disease transmission in solid organ transplantation: donor evaluation, recipient risk, and outcomes of transmission. *Transplant Direct*. 2019;5:e416.
5. Ison MG, Grossi P; AST Infectious Diseases Community of Practice. Donor-derived infections in solid organ transplantation. *Am J Transplant*. 2013;13:22–30.
6. Lim WH, Au E, Teixeira-Pinto A, et al. Donors with a prior history of cancer: factors of non-utilization of kidneys for transplantation. *Transpl Int*. 2023;36:11883.
7. Thomson IK, Hedley J, Rosales BM, et al. Potential organ donors with primary brain tumours: missed opportunities for donation and transplantation identified in Australian cohort study 2010-2015. *ANZ J Surg*. 2022;92:2996–3003.
8. Greenhall GHB, Rous BA, Robb ML, et al. Organ transplants from deceased donors with primary brain tumors and risk of cancer transmission. *JAMA Surg*. 2023;158:504–513.

9. Turra V, Manzi J, Rombach S, et al. Donors with previous malignancy: when is it safe to proceed with organ transplantation? *Transpl Int*. 2025;38:13716.
10. Lentine KL, Smith JM, Lyden GR, et al. OPTN/SRTR 2024 annual data report: kidney. *Am J Transplant*. 2026;26:S22–S145.
11. Kwong AJ, Lake JR, Schladt DP, et al. OPTN/SRTR 2024 annual data report: liver. *Am J Transplant*. 2026;26:S214–S320.
12. Kandaswamy R, Stock PG, Miller JM, et al. OPTN/SRTR 2024 annual data report: pancreas. *Am J Transplant*. 2026;26:S146–S213.
13. Colvin MM, Smith JM, Stomberski CT, et al. OPTN/SRTR 2024 annual data report: heart. *Am J Transplant*. 2026;26:S367–S473.
14. Valapour M, Masotti M, Schladt DP, et al. OPTN/SRTR 2024 annual data report: lung. *Am J Transplant*. 2026;26:S474–S550.
15. Horslen SP, Raghu VK, Schladt DP, et al. OPTN/SRTR 2024 annual data report: intestine. *Am J Transplant*. 2026;26:S321–S366.
16. Temerty Faculty of Medicine, University of Toronto/Continuing Professional Development. Resources & quick tips. Available at https://www.cpd.utoronto.ca/accreditation/resources-quick-tips/. Accessed June 15, 2025.
17. Moore DE, Chappell K, Sherman L, et al. A conceptual framework for planning and assessing learning in continuing education activities designed for clinicians in one profession and/or clinical teams. *Med Teach*. 2018;40:904–913.
18. Thomas PA, Kern DE, Hughes MT, et al. *Curriculum Development for Medical Education: A Six-Step Approach*. 3rd ed. Johns Hopkins University Press; 2015.
19. Shemie SD, Wilson LC, Hornby L, et al. A brain-based definition of death and criteria for its determination after arrest of circulation or neurologic function in Canada: a 2023 clinical practice guideline. *Can J Anaesth*. 2023;70:483–557.
20. Greer DM, Shemie SD, Lewis A, et al. Determination of brain death/death by neurologic criteria: the World Brain Death Project. *JAMA*. 2020;324:1078–1097.
21. Gardiner D, McGee A, Kareem Al Obaidli AA, et al. Developing and expanding deceased organ donation to its maximum therapeutic potential: an actionable global challenge from the 2023 Santander Summit. *Transplantation*. 2025;109:10–21.
22. Konieczka A, Kornasiewicz O, Skalski M, et al. Understanding alcohol abuse in deceased donors: effects on liver transplant results. *J Clin Med*. 2025;14:2773.
23. Muller E, Barday Z, Mendelson M, et al. HIV-positive-to-HIV-positive kidney transplantation—results at 3 to 5 years. *N Engl J Med*. 2015;372:613–620.
24. Selhorst P, Combrinck CE, Manning K, et al. Longer-term outcomes of HIV-positive-to-HIV-positive renal transplantation. *N Engl J Med*. 2019;381:1387–1389.
25. Durand CM, Massie A, Florman S, et al; HOPE in Action Investigators. Safety of kidney transplantation from donors with HIV. *N Engl J Med*. 2024;391:1390–1401.
26. Morales JM, Andrés A, Campistol JM. Hepatitis C virus and organ transplantation. *N Engl J Med*. 1993;328:511–512; author reply 513.
27. Gordon CE, Adam GP, Jadoul M, et al. Kidney transplantation from hepatitis C virus–infected donors to uninfected recipients: a systematic review for the KDIGO 2022 hepatitis C clinical practice guideline update. *Am J Kidney Dis*. 2023;82:410–418.
28. Huprikar S, Danziger-Isakov L, Ahn J, et al. Solid organ transplantation from hepatitis B virus-positive donors: consensus guidelines for recipient management. *Am J Transplant*. 2015;15:1162–1172.
29. Jiang H, Wu J, Zhang X, et al. Kidney transplantation from hepatitis B surface antigen positive donors into hepatitis B surface antibody positive recipients: a prospective nonrandomized controlled study from a single center. *Am J Transplant*. 2009;9:1853–1858.
30. Bartelt L, van Duin D. An overview of COVID-19 in solid organ transplantation. *Clin Microbiol Infect*. 2022;28:779–784.
31. Chin-Hong PV, Schwartz BS, Bern C, et al. Screening and treatment of Chagas disease in organ transplant recipients in the United States: recommendations from the Chagas in transplant working group. *Am J Transplant*. 2011;11:672–680.
32. Xiao D, Craig JC, Chapman JR, et al. Donor cancer transmission in kidney transplantation: a systematic review. *Am J Transplant*. 2013;13:2645–2652.
33. Mahíllo B, Martín S, Molano E, et al. Malignancies in deceased organ donors: the Spanish experience. *Transplantation*. 2022;106:1814–1823.
34. Lan JH, Kadatz M, Chang DT, et al. Pretransplant calculated panel reactive antibody in the absence of donor-specific antibody and kidney allograft survival. *Clin J Am Soc Nephrol*. 2021;16:275–283.
35. Wade J, Roback JD, Krummey SM, et al. Implementing virtual crossmatch based diagnostic management teams in human leukocyte antigen laboratories and transplant programs. *Transpl Immunol*. 2022;73:101629.
36. Lefaucheur C, Louis K, Morris AB, et al; STAR 2022 Working Group. Clinical recommendations for posttransplant assessment of anti-HLA (human leukocyte antigen) donor-specific antibodies: a sensitization in transplantation: assessment of risk consensus document. *Am J Transplant*. 2023;23:115–132.
37. Park S, Sellares J, Tinel C, et al. European Society of Organ Transplantation consensus statement on testing for non-invasive diagnosis of kidney allograft rejection. *Transpl Int*. 2023;36:12115.
38. Massie AB, Luo X, Chow EKH, et al. Survival benefit of primary deceased donor transplantation with high-KDPI kidneys. *Am J Transplant*. 2014;14:2310–2316.
39. Goussous N, De Leon F, Alghannam K, et al. Outcomes using high KDPI kidneys in recipients over 65 y of age. *Transplant Direct*. 2024;10:e1738.
40. Cohen JB, Eddinger KC, Locke JE, et al. Survival benefit of transplantation with a deceased diabetic donor kidney compared with remaining on the waitlist. *Clin J Am Soc Nephrol*. 2017;12:974–982.
41. Mohan S, Tanriover B, Ali N, et al. Availability, utilization and outcomes of deceased diabetic donor kidneys; analysis based on the UNOS registry. *Am J Transplant*. 2012;12:2098–2105.
42. Boffa C, van de Leemkolk F, Curnow E, et al. Transplantation of kidneys from donors with acute kidney injury: friend or foe? *Am J Transplant*. 2017;17:411–419.
43. Hall IE, Akalin E, Bromberg JS, et al. Deceased-donor acute kidney injury is not associated with kidney allograft failure. *Kidney Int*. 2019;95:199–209.
44. Liu C, Alasfar S, Reese PP, et al. Trends in the procurement and discard of kidneys from deceased donors with acute kidney injury. *Am J Transplant*. 2022;22:898–908.
45. Nita GE, Gopal JP, Khambalia HA, et al. Kidney transplantation from donors with acute kidney injury: are the concerns justified? A systematic review and meta-analysis. *Transpl Int*. 2023;36:11232.
46. Rogers J, Farney AC, Orlando G, et al. Dual kidney transplantation from donors at the extremes of age. *J Am Coll Surg*. 2019;228:690–705.
47. Montero N, Redondo-Pachón D, Pérez-Sáez MJ, et al. Dual kidney transplantation as a strategy to use expanded criteria donors: a systematic review. *Transpl Int*. 2018;31:838–860.
48. Tector AJ, Mangus RS, Chestovich P, et al. Use of extended criteria livers decreases wait time for liver transplantation without adversely impacting posttransplant survival. *Ann Surg*. 2006;244:439–450.
49. Bowring MG, Massie AB, Schwarz KB, et al. Survival benefit of split-liver transplantation for pediatric and adult candidates. *Liver Transpl*. 2022;28:969–982.
50. Di Maira T, Cailliez V, Domínguez-Gil B, et al. Regional variations and trends in liver transplantation practices across Europe. *JHEP Rep*. 2025;7:101424.
51. Wayda B, Angleitner P, Smits JM, et al. Disparities in donor heart acceptance between the USA and Europe: clinical implications. *Eur Heart J*. 2023;44:4665–4674.
52. Shah A, Robinson J, Goerlich CE, et al. Impact of donor coronary artery disease on recipient outcomes in heart transplantation. *J Card Surg*. 2024. https://doi.org/10.1155/2024/4957703.
53. Okahara S, Levvey B, McDonald M, et al. Influence of the donor history of tobacco and marijuana smoking on early and intermediate lung transplant outcomes. *J Heart Lung Transplant*. 2020;39:962–969.
54. Kukreja J, Campo-Canaveral de la Cruz JL, Van Raemdonck D, et al. The 2024 American Association for Thoracic Surgery expert consensus document: current standards in donor lung procurement and preservation. *J Thorac Cardiovasc Surg*. 2025;169:484–504.
55. Cypel M, Yeung JC, Liu M, et al. Normothermic ex vivo lung perfusion in clinical lung transplantation. *N Engl J Med*. 2011;364:1431–1440.
56. Proneth A, Schnitzbauer AA, Schenker P, et al. Extended pancreas donor program-The EXPAND study: a prospective multicenter trial testing the use of pancreas donors older than 50 years. *Transplantation*. 2018;102:1330–1337.
57. Muñoz-Bellvís L, López-Sánchez J. Donor risk factors in pancreas transplantation. *World J Transplant*. 2020;10:372–380.
58. Doppenberg JB, Nijhoff MF, Engelse MA, et al. Clinical use of donation after circulatory death pancreas for islet transplantation. *Am J Transplant*. 2021;21:3077–3087.

59. Nichols DS, Testa G, Johannesson L, et al. OPTN/SRTR 2024 annual data report: vascularized composite allograft. *Am J Transplant*. 2026;26:S585–S612.
60. Brubaker AL, Schold JD, Schnickel GT. The evolution of deceased organ donation in the US. *JAMA*. 2026;335:1033–1036.
61. Inside CKD. US—Healthcare costs associated with CKD. Available at https://www.insideckd.com. Accessed November 27, 2025.
62. Fosnacht K, Sarraf S, Howe E, et al. How important are high response rates for college surveys? *Rev Higher Educ*. 2017;40:245–265.

APPENDIX

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