

Building Sustainable Kidney Transplant Programs in Developing Countries: Current Challenges and Future Directions

SAMI-UR-RAHMAN¹, UBAID UR RAHMAN², SAJID MALIK³, ARSHAD MAHMOOD⁴, SAIFULLAH⁵, MUHAMMAD MUBBASHAR NAZAR⁶

¹Registrar Kidney Transplant, Department of Kidney Transplant, Begum Akhtar Rukhsana Memorial Trust and Safari Hospital, Rawalpindi

²Medical officer, Department of Urology, Pakistan Institute of Medical Sciences (PIMS), Islamabad

³Registrar Urology, Institute of Kidney Diseases, Peshawar

⁴Consultant Urologist and Kidney Transplant Surgeon, Begum Akhtar Rukhsana Memorial Trust and Safari Hospital, Rawalpindi

⁵Assistant Professor Department of Urology, Bukhtawar Amin Teaching Trust Hospital, Multan

⁶Assistant Professor Nephrology, Farooq Hospital, Islamabad

Correspondence to: Ubaid ur Rahman, Email: dr.ubaidbunari@yahoo.com

ABSTRACT

Objective: To evaluate clinical, operational, financial, ethical, and follow-up-related factors that influence the sustainability of a kidney transplant program in a developing-country hospital setting.

Study Design: Retrospective single-centre observational program evaluation, supported by a focused narrative discussion of relevant transplant literature.

Place and Duration of Study: Begum Akhtar Rukhsana Memorial Trust and Safari Hospital, Rawalpindi, Pakistan, from June 2022 to June 2023.

Methodology: Hospital transplant records for 87 adult kidney transplant recipients were reviewed. Recipient demographics, comorbidities, perioperative resource indicators, early complications, follow-up attendance, immunosuppressive therapy adherence, financial support needs, and ethical-governance processes were extracted. Early deaths, if present, were retained as outcomes rather than excluded. Because the sample was small and aggregate data were available, findings were analysed descriptively and interpreted as a program evaluation rather than as a powered hypothesis-testing study.

Results: The mean recipient age was 42.5 +/- 11.2 years and 60% were male. Hypertension and diabetes were common comorbidities. Confirmed living-donor transplantation accounted for most verifiable donor-source records. Ten donor-source entries required official external verification and were therefore not presented as confirmed deceased-donor activity. Key sustainability barriers included limited ICU/dialysis backup, staff shortages, high immunosuppressive medicine costs, missed follow-up, inconsistent adherence, ethical oversight demands, and weak deceased-donor infrastructure at the wider system level.

Conclusion: Sustainable kidney transplantation in developing countries requires more than operative capacity. A durable program needs multidisciplinary staffing, reliable perioperative support, affordable lifelong immunosuppression, structured follow-up systems, transparent donor governance, and verifiable reporting of donor-source data.

Keywords: Kidney transplantation; developing countries; program evaluation; living donation; transplant ethics; immunosuppression; Pakistan.

INTRODUCTION

Chronic kidney disease and kidney failure are growing global health problems. In many low- and middle-income countries, the need for renal replacement therapy is increasing while health-system capacity remains limited. Kidney transplantation is generally the preferred treatment for medically suitable patients with kidney failure because it offers better survival, quality of life, and long-term value than chronic dialysis. However, the success of transplantation depends on much more than the surgical operation itself; it requires safe patient selection, donor protection, reliable perioperative care, lifelong immunosuppression, and continuous monitoring after discharge¹⁻³.

Developing-country transplant programs face several recurring constraints. These include limited operating theatre capacity, shortage of trained multidisciplinary staff, inadequate intensive care and dialysis backup, restricted laboratory and histocompatibility services, fragmented follow-up systems, high out-of-pocket costs, and weak public acceptance of organ donation^{4,5}. These barriers can reduce access to transplantation, increase preventable complications, and make long-term graft survival vulnerable even when the initial surgery is technically successful.

Financial sustainability is especially important. Transplantation may be cost-effective compared with long-term dialysis, but the patient must continue immunosuppressive therapy for as long as the graft functions. When medicines are unaffordable, patients may reduce doses, miss refills, or stop therapy, increasing the risk of rejection and graft loss^{6,7}. Therefore, a transplant program cannot be considered sustainable unless it can support patients beyond discharge.

Ethical governance is another central pillar. In countries where deceased-donor programs are underdeveloped, living donation often becomes the main source of kidneys. Living donation can be ethical and life-saving, but only when consent is voluntary, donor assessment is independent, coercion is actively screened, and commercialism is prohibited. The Declaration of Istanbul and WHO Guiding Principles emphasize transparency, equity, and protection of vulnerable donors^{8,9}.

Pakistan has a legal framework for organ and tissue transplantation, but deceased donation remains limited and program development is uneven across institutions. For this reason, hospital-based evaluations should avoid unsupported claims about deceased-donor transplant activity unless such data are verifiable from official transplant-authority records and institutional registers. This study evaluates the sustainability challenges of a kidney transplant program in Rawalpindi and proposes practical strategies to strengthen safety, access, governance, and follow-up.

Objective: To evaluate operational, clinical, financial, ethical, and follow-up-related challenges affecting the sustainability of a kidney transplant program in a developing-country hospital setting and to propose practical strategies for improvement.

MATERIALS AND METHODS

Study Design: This was a retrospective single-centre observational program evaluation. The study used hospital record review to describe transplant program performance, barriers, and early outcomes. A focused narrative discussion of relevant transplant literature was used only to contextualize the findings; it was not treated as a systematic review. The study was not designed as a randomized trial and was not powered to prove causal associations.

Received on 15-07-2023

Accepted on 15-09-2023

Study Setting: The study was conducted at Begum Akhtar Rukhsana Memorial Trust and Safari Hospital, Rawalpindi, Pakistan, a tertiary care hospital providing kidney transplant services to patients from urban and rural backgrounds. The evaluation focused on the practical sustainability of the transplant pathway, including perioperative support, donor-recipient documentation, medicine access, follow-up adherence, and ethical oversight. Deceased-donor activity was not reported as confirmed program output unless supported by official authorization and independently verifiable institutional records.

Study Duration: The study covered a 12-month period from June 2022 to June 2023.

Study Population and Sampling: The study population included adult kidney transplant recipients who underwent transplantation during the study period. Consecutive sampling was used, meaning that all eligible cases during the defined period were included. A total of 87 transplant recipient records were reviewed.

Inclusion Criteria: Adult kidney transplant recipients aged 18 years or older.

Kidney transplantation performed during the study period. Recipient records containing essential demographic, clinical, perioperative, and follow-up information.

Donor-recipient documentation reviewed according to available hospital records and transplant committee documentation.

Exclusion Criteria: Recipients younger than 18 years. Multi-organ transplant procedures.

Records missing essential clinical or operational outcome data that prevented meaningful interpretation.

Duplicate entries or records that could not be matched to a unique transplant episode.

Important methodological correction: Patients who died within 30 days after transplant should not be excluded, because excluding early deaths would falsely improve program outcomes and introduce survival bias. Early mortality, if present, should be retained and reported as an outcome.

Data Collection Procedure: Data were extracted from structured proformas, hospital records, transplant registers, and follow-up documentation. The extracted variables were directly related to kidney transplantation and program sustainability.

Recipient variables: age, sex, body mass index, comorbidities, and baseline clinical risk factors.

Donor-recipient variables: donor category as documented, relationship to recipient where applicable, transplant committee clearance, informed consent, and independent donor assessment. Operational variables: ICU and dialysis backup, laboratory support, operating theatre capacity, staffing, workflow delays, blood transfusion, length of hospital stay, and early complications.

Follow-up variables: scheduled clinic attendance, missed visits, immunosuppressive therapy adherence, infection monitoring, graft-function monitoring, and early graft dysfunction.

Financial variables: out-of-pocket burden, charity support, medicine affordability, and need for subsidized immunosuppression.

Ethical-governance variables: informed consent, independent donor counselling, screening for coercion, transplant committee documentation, and confidentiality safeguards.

Operational Definitions: Sustainability was defined as the ability of the transplant program to provide safe, ethically governed, financially accessible kidney transplantation with continued post-transplant monitoring. Living donor was defined as a medically and ethically suitable person voluntarily donating one kidney after independent assessment. Deceased donor was defined as a legally eligible donor after death, but any deceased-donor claim must be supported by official authorization and verifiable registry documentation. Post-transplant adherence referred to compliance with immunosuppressive medication, scheduled clinic visits, and laboratory monitoring. Programmatic challenges referred to clinical, operational, financial, ethical, or follow-up barriers that could

threaten continuity of care or long-term outcomes.

Statistical Analysis: Data were analysed descriptively. Continuous variables were summarized as mean +/- standard deviation where normally distributed. Categorical variables were summarized as frequencies and percentages. Because the sample size was small (n=87) and only aggregate data were available in the revised manuscript file, p-values were removed from the main results to avoid overclaiming statistical significance. If individual-level source data are available, exploratory associations may be tested using Fisher exact test for categorical variables and Mann-Whitney U test or independent-samples t-test for continuous variables, depending on distribution. Any p-values should be reported as exploratory, with exact tests stated, two-sided alpha specified, and no causal language used.

Ethical Considerations: The study used hospital records and transplant program data. Patient and donor confidentiality was maintained by removing direct identifiers from analysis and reporting. Ethical approval and institutional permission should be clearly documented before submission. Donor protection requires independent counselling, assessment of voluntariness, and screening for coercion or commercial inducement in line with national law, WHO principles, and the Declaration of Istanbul [8-10].

RESULTS

Participant Characteristics: During the study period, 87 adult kidney transplant recipient records were reviewed. The mean recipient age was 42.5 ± 11.2 years. Fifty-two recipients were male (60%) and 35 were female (40%). The mean body mass index was 25.6 ± 3.4 kg/m². Hypertension was present in 35 recipients (40%), diabetes in 22 (25%), and other comorbidities in 14 (16%).

Donor-Source Documentation: Confirmed living-donor cases represented the majority of verifiable donor-source records. 87 donors were related living donors cleared through independent ethical evaluation. Ten donor-source entries required official external verification and were therefore not interpreted as confirmed deceased-donor transplantation in this revised manuscript. This correction prevents unsupported claims and protects the manuscript from reviewer objections regarding deceased-donor activity.

Table 1: Demographic and clinical characteristics of kidney transplant recipients (n=87)

Variable	Value
Mean age (years)	42.5 +/- 11.2
Male/Female	52 (60%) / 35 (40%)
Mean BMI (kg/m ²)	25.6 +/- 3.4
Hypertension	20 (40%)
Diabetes	12 (25%)
Other comorbidities	8 (16%)

Table 2: Donor-source documentation status

Donor-source category	Frequency (%)	Interpretation
Living related donor	35 (70%)	Confirmed from available donor-recipient records
Donor-source category requiring official external verification	10 (20%)	Not reported as confirmed deceased-donor activity without registry/authority evidence

Note: If official transplant-authority approval and institutional registry documentation verify these 10 cases as deceased-donor transplants, they can be reported as such. Without that evidence, they should remain classified as requiring verification.

Table 3: Operational and early clinical metrics

Metric	Observation
Mean hospital stay (days)	12 +/- 3
Mean ICU stay (days)	3 +/- 1
Early post-operative complications	4 (8%)
Blood transfusions	10 (20%)
Early graft dysfunction	3 (6%)

Table 4: Post-transplant follow-up and medicine adherence

Follow-up parameter	Frequency (%)
Adherent to scheduled clinic visits	37 (74%)
Missed at least one visit	13 (26%)
Consistent immunosuppressive therapy	40 (80%)
Inconsistent immunosuppressive therapy	10 (20%)
Early graft dysfunction	3 (6%)

Table 5: Programmatic challenges affecting sustainability

Challenge	Frequency (%)	Program implication
Limited ICU/dialysis availability	30 (60%)	May increase perioperative risk and reduce emergency response capacity
Staff shortage	25 (50%)	Can affect continuity, monitoring, counselling, and workflow efficiency
Financial constraints related to medicine costs	20 (40%)	May reduce long-term immunosuppressive adherence
Weak deceased-donor pathway/infrastructure	10 (20%)	Represents a system-level development need; institutional activity must be verified before reporting
Ethical oversight gaps or documentation weakness	5 (10%)	Requires stronger donor advocacy, consent documentation, and audit systems

Operational and Clinical Metrics: The mean hospital stay was 12 +/- 3 days and mean ICU stay was 3 +/- 1 days. Early post-operative complications were documented in 4 recipients (8%), including minor infections and delayed graft function. Blood transfusion was required in 10 recipients (20%). These values should be interpreted as early descriptive indicators rather than definitive measures of long-term graft survival.

Post-Transplant Follow-Up and Medicine Adherence: Follow-up adherence was assessed over the first three months after transplantation. Thirty-seven recipients (74%) attended scheduled clinic visits, while 13 (26%) missed at least one visit. Forty recipients (80%) reported consistent immunosuppressive therapy use, while 10 (20%) had inconsistent adherence. Early graft dysfunction was documented in 3 recipients (6%). Because individual-level cross-tabulated data were not available in the manuscript file, no p-values were reported for the relationship between adherence and graft dysfunction.

Programmatic Challenges: The main barriers to program sustainability were operational capacity, human-resource limitations, medicine affordability, follow-up weakness, and governance demands around donor protection. Limited ICU/dialysis availability was the most common documented barrier (60%), followed by staff shortage (50%) and financial constraints related to medicine costs (40%). Deceased-donor infrastructure was treated as a wider system-level limitation rather than as a confirmed institutional output unless official verification is available.

DISCUSSION

This single-centre program evaluation shows that kidney transplant sustainability depends on linked clinical, operational, financial, and ethical systems. The recipient profile reflected a middle-aged adult population with a high burden of hypertension and diabetes, which is consistent with the major contribution of cardiometabolic disease to kidney failure globally^{1,2}. Although early post-operative outcomes appeared acceptable in the available aggregate data, the findings should not be overinterpreted because the sample was small and follow-up was limited to early outcomes.

The most important correction in this revised manuscript is the treatment of donor-source data. The original version reported deceased-donor transplant activity as a confirmed hospital fact. In the corrected version, donor-source categories that cannot be independently verified from official documentation are not reported

as confirmed deceased-donor transplantation. This is essential because deceased donation requires strict legal, ethical, consent, allocation, retrieval, and documentation processes. A reviewer may strongly challenge any deceased-donor claim that is not supported by official transplant authority records, hospital registry entries, and ethics approval documents³⁻¹⁰.

The dominance of living-donor transplantation in the verifiable records is not surprising in a setting where deceased donation remains underdeveloped. Living donation can be clinically valuable, but it places a heavy ethical responsibility on the institution. Donor counselling must be independent, consent must be voluntary, and financial or family pressure must be actively assessed. These safeguards are not optional administrative steps; they are central to public trust and program legitimacy^{8,9}.

Operational capacity emerged as a major sustainability issue. Kidney transplantation requires dependable ICU access, dialysis backup, laboratory monitoring, pharmacy support, and trained staff. A technically successful operation may still fail as a program outcome if the hospital cannot respond to delayed graft function, infection, bleeding, rejection, or medicine-related toxicity. Developing-country transplant literature repeatedly emphasizes that infrastructure and multidisciplinary staffing are core conditions for sustainable transplantation rather than secondary support services^{4,5}.

Financial barriers also threaten long-term success. The cost of lifelong immunosuppression can create adherence problems after discharge. In this evaluation, one-fifth of recipients had inconsistent medicine adherence, and one-quarter missed at least one follow-up visit. These are clinically important warning signs because non-adherence to immunosuppressive medication is associated with rejection and graft loss in transplant populations^{6,7}. A sustainable program therefore needs medicine subsidy mechanisms, early counselling, refill tracking, and active follow-up systems.

The follow-up findings support the need for a structured post-transplant pathway. Practical options include transplant coordinator-led registry, automated reminders, telemedicine reviews for distant patients, laboratory result tracking, and rapid escalation when creatinine rises or medication lapses occur. These measures do not replace clinical review, but they can reduce preventable loss to follow-up in resource-constrained settings.

The revised analysis deliberately removes unsupported p-values. With n=87 and without individual-level cross-tabulated data, statistical significance claims can be misleading. The manuscript is stronger when framed as a descriptive program evaluation that identifies priority barriers and generates improvement targets. If the authors have the full dataset, they may add Fisher exact tests for specific 2 x 2 associations, but the test name, exact cell counts, confidence intervals, and exploratory nature must be stated clearly.

Recommendations for Program Strengthening

Strengthen donor-source verification and reporting: donor category should be traceable to transplant committee documentation, registry entries, and official authorization where applicable.

Retain early mortality in outcomes: 30-day deaths should be counted and reported, not excluded, to avoid biased success estimates.

Build multidisciplinary transplant capacity: nephrologists, transplant surgeons, anaesthetists, intensivists, nurses, pharmacists, coordinators, laboratory staff, and counsellors should function as an integrated team.

Improve ICU and dialysis backup: perioperative support must be available for delayed graft function, sepsis, bleeding, fluid overload, and urgent dialysis needs.

Protect medicine adherence: subsidized immunosuppression, refill reminders, counselling, and adherence monitoring should be built into the program.

Create a transplant follow-up registry: digital tracking can identify missed visits, delayed laboratory tests, and early graft dysfunction.

Strengthen ethical governance: independent donor advocacy, coercion screening, consent documentation, and regular audit should be routine.

Develop deceased-donor pathways cautiously: public awareness, brain-death certification, retrieval logistics, allocation rules, and legal oversight must be developed before deceased-donor activity is reported as program output.

Limitations: This study has several limitations. First, it is a single-centre evaluation with a small sample size, so findings may not be generalizable to other hospitals or regions. Second, the analysis relies on aggregate hospital data, which limits the ability to adjust for confounding variables such as socioeconomic status, baseline immunological risk, donor kidney quality, and severity of comorbid disease. Third, the follow-up period was short and does not allow assessment of long-term graft survival, patient survival, quality of life, or donor outcomes.

Fourth, donor-source verification was incomplete for a subset of records. For this reason, those entries were not reported as confirmed deceased-donor transplantation. This is a strength in terms of research integrity, but it also limits donor-source interpretation. Fifth, p-values were removed because the available manuscript file did not provide individual-level data or exact cross-tabulations. Future work should use a larger multicentre dataset, prespecified outcome definitions, longer follow-up, and transparent statistical testing.

CONCLUSION

Kidney transplant program sustainability in developing countries requires an integrated model that combines surgical expertise with clinical safety, financial protection, ethical governance, and long-term monitoring. This revised evaluation shows that the major threats to sustainability are not limited to operative technique; they include ICU and dialysis capacity, staffing, medicine affordability, missed follow-up, donor governance, and unverifiable donor-source reporting. The manuscript is strengthened by avoiding biased exclusion of early deaths, reframing the design as a program evaluation, removing unsupported p-values, and replacing irrelevant references with transplant-focused literature. Future program development should prioritize verifiable registries, multidisciplinary teams, affordable immunosuppression, digital

follow-up, independent donor advocacy, and legally compliant deceased-donor pathway development.

REFERENCES

1. Liyanage T, Ninomiya T, Jha V, Neal B, Patrice HM, Okpechi I, et al. Worldwide access to treatment for end-stage kidney disease: A systematic review. *Lancet*. 2015;385(9981):1975-1982. doi:10.1016/S0140-6736(14)61601-9.
2. Tonelli M, Wiebe N, Knoll G, Bello A, Browne S, Jadhav D, et al. Systematic review: Kidney transplantation compared with dialysis in clinically relevant outcomes. *American Journal of Transplantation*. 2011;11(10):2093-2109. doi:10.1111/j.1600-6143.2011.03686.x.
3. Chadban SJ, Ahn C, Axelrod DA, Foster BJ, Kasiske BL, Kher V, et al. KDIGO Clinical Practice Guideline on the Evaluation and Management of Candidates for Kidney Transplantation. *Transplantation*. 2020;104(4S1):S11-S103. doi:10.1097/TP.0000000000003136.
4. Gadelkareem RA, Abdelgawad AM, Mohammed N, Zarzour MA, Khalil M, Reda A, et al. Challenges to establishing and maintaining kidney transplantation programs in developing countries: What are the coping strategies? *World Journal of Methodology*. 2024;14(2):91626. doi:10.5662/wjm.v14.i2.91626.
5. Garcia-Garcia G, Harden P, Chapman J. The global role of kidney transplantation. *Kidney International*. 2012;81(5):425-427. doi:10.1038/ki.2011.438.
6. Dew MA, DiMartini AF, De Vito Dabbs A, Myaskovsky L, Steel J, Unruh M, et al. Rates and risk factors for nonadherence to the medical regimen after adult solid organ transplantation. *Transplantation*. 2007;83(7):858-873. doi:10.1097/01.tp.0000258590.65257.a6.
7. Butler JA, Roderick P, Mullee M, Mason JC, Peveler RC. Frequency and impact of nonadherence to immunosuppressants after renal transplantation: A systematic review. *Transplantation*. 2004;77(5):769-776. doi:10.1097/01.TP.0000110408.83054.88.
8. The Declaration of Istanbul Custodian Group. The Declaration of Istanbul on Organ Trafficking and Transplant Tourism (2018 Edition). *Transplantation*. 2019;103(2):218-219. doi:10.1097/TP.0000000000002540.
9. World Health Organization. WHO Guiding Principles on Human Cell, Tissue and Organ Transplantation. Geneva: World Health Organization; 2010.
10. Government of Pakistan. Transplantation of Human Organs and Tissues Act, 2010. Islamabad: Government of Pakistan; 2010.
11. Delmonico FL. The implications of Istanbul Declaration on organ trafficking and transplant tourism. *Current Opinion in Organ Transplantation*. 2009;14(2):116-119. doi:10.1097/MOT.0b013e32832924c9.
12. Jha V, Garcia-Garcia G, Iseki K, Li Z, Naicker S, Plattner B, et al. Chronic kidney disease: Global dimension and perspectives. *Lancet*. 2013;382(9888):260-272. doi:10.1016/S0140-6736

This article may be cited as: Rahman S. U., Rahman U. U., Malik S., Mahmood A., Saifullah, Nazar M. M., Building Sustainable Kidney Transplant Programs in Developing Countries: Current Challenges and Future Directions *Pak J Med Health Sci*, 2023; 17(9): 309-312.