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POST-TRANSPLANT HEALTH MONITORING IN KIDNEY TRANSPLANT RECIPIENTS

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ABSTRACT

Background: Kidney transplantation represents the optimal renal replacement therapy for patients with end-stage chronic kidney disease. Post-transplant monitoring quality plays a crucial role in preserving graft function, preventing complications, and improving treatment outcomes. Aim was to analyze health status monitoring in patients after kidney transplantation and to evaluate treatment outcomes as indicators of healthcare quality.

Methods: We conducted a retrospective, descriptive study of 30 kidney transplant recipients. We collected data from medical records with approval from the Ethics Committee of the University Hospital Center Zagreb. The analysis included demographic and clinical characteristics, comorbidities, immunosuppressive therapy, laboratory indicators of graft function, post-transplant complications, and outcomes during follow-up and at 5 years after transplantation. We analyzed the data using descriptive statistics.

Results: The median age of participants was 48 years (range 13–75). Most patients were receiving immunosuppressive therapy (90,67%) and attended regular follow-up visits. The most frequent comorbidity was arterial hypertension. Laboratory parameters indicated generally satisfactory graft function. Infectious complications were common, predominantly viral infections, particularly cytomegalovirus infection. Despite the high incidence of infections, most patients had favorable outcomes with preserved graft function. Graft loss occurred in 10% of patients, and one death was recorded.

Conclusions: The results indicate a well-organized and consistent approach to post-transplant monitoring of kidney transplant recipients. Systematic health monitoring, timely identification of potential complications, and continuous nursing care are important components of post-transplant follow-up and may support graft function and overall quality of care. However, since this study is descriptive, it cannot establish a causal relationship between these aspects of care and clinical outcomes.

Keywords: *kidney transplantation, patient monitoring, healthcare quality, immunosuppression, nursing care.*

INTRODUCTION

Chronic kidney disease (CKD) represents one of the most complex global public health challenges today. Epidemiological trends indicate a continuous increase in the number of patients progressing to end-stage renal disease who require renal replacement therapy. According to estimates from the Global Burden of Disease Study, nearly 700 million people worldwide were living with CKD in 2019, while approximately 19 million new cases were diagnosed. Compared with 1990, incidence and prevalence have risen substantially, reflecting the disease's growing global burden. This trend is primarily associated with demographic changes—including population aging and population growth—as well as an increasing prevalence of chronic non-communicable diseases such as diabetes mellitus and arterial hypertension. These factors are well-established contributors to the onset and progression of CKD and significantly increase mortality and loss of healthy life years (1).

Although hemodialysis and peritoneal dialysis are standardized and effective life-sustaining therapies for end-stage renal failure, numerous studies confirm that kidney transplantation remains the optimal therapeutic modality, offering superior quality of life, longer survival, and lower long-term healthcare costs (2). Advances in transplantation medicine globally, as well as in the Republic of Croatia, have significantly improved

access to and success rates of organ transplantation. Supported by a well-structured national transplantation program and active membership in the international exchange network Eurotransplant, Croatia consistently ranks among the leading European countries in donor rates and transplantation outcomes (3). The national program's effectiveness is grounded in a clear legal framework, comprehensive national guidelines, and standardized procedures for evaluating, selecting, and following up donors and recipients (4,5,6).

In accordance with international guidelines, the ethical dimension of the transplantation process must align with recommendations from organizations such as the European Directorate for the Quality of Medicines & Health Care (EDQM). These frameworks emphasize mandatory psychosocial assessment and continuous support for patients and their families throughout the entire transplant process (7).

The post-transplant period represents a critical phase for long-term treatment outcomes. Systematic and structured monitoring of patients' health status enables timely detection of early and late complications, including acute and chronic rejection, infectious events, and adverse effects of immunosuppressive therapy. In line with international quality standards, post-transplant monitoring protocols are considered essential indicators of transplantation centers' performance. Key indicators include graft survival, renal function parameters, rehospitalization rates, and adherence to the prescribed immunosuppressive regimen (7).

Post-transplant monitoring involves clinical, laboratory, and, when necessary, radiological assessments. Laboratory evaluation includes regular measurements of serum creatinine, urea, electrolytes, complete blood count, and serological markers of infection. Clinicians assess graft function by monitoring urine output, measuring arterial blood pressure, and performing ultrasonographic evaluation of the transplanted kidney. Clinicians continuously monitor serum levels of immunosuppressive drugs to tailor therapy to the patient's individual immunological risk. Clinicians also pay particular attention to psychosocial dimensions, including mental health, treatment adherence, and subjective quality of life (7,8).

Models of post-transplant care organization vary across healthcare systems. Highly developed systems rely on frequent specialist visits, regular laboratory testing, and telemedicine solutions enabling continuous patient monitoring. Conversely, in resource-limited settings, care is often decentralized, with periodic evaluations and greater reliance on digital communication tools to interact with the transplant team (7,9).

Telemedicine and digital health technologies are increasingly recognized as essential components for improving the quality of post-transplant care. Teleconsultations reduce the need for frequent in-person visits to transplant centers and enable timely clinical interventions if the patient's condition worsens. Mobile applications and digital platforms support symptom tracking, laboratory value logging, medication reminders, and enhanced communication within the multidisciplinary team. These tools are particularly beneficial for patients living in remote areas, as they reduce the risk of non-adherence and delayed intervention, thereby contributing to long-term graft stability (10).

This study aimed to systematically evaluate post-transplant monitoring as an indicator of healthcare quality by analyzing the relationship between demographic characteristics, clinical variables, laboratory parameters of graft function, the incidence and types of post-transplant complications, and key treatment outcomes in the post-transplant period.

METHODS

This study was a retrospective, observational investigation based on analysis of medical records from patients after kidney transplantation. The research follows a descriptive–analytical design, with the primary aim of examining the monitoring of patients' health status after kidney transplantation as an indicator of healthcare quality.

The study included 30 kidney transplant recipients followed from 2020 to 2025. Each year, we randomly selected five patients who regularly attended scheduled post-transplant follow-up visits and were in their fifth year after kidney transplantation. Thus, we selected five eligible patients each year from 2020 through 2025, for a total sample of 30 participants.

We required regular attendance at follow-up visits because we extracted all study data retrospectively from patients' medical records. This criterion ensured sufficient continuity and completeness of documented clinical and laboratory data for the analysis.

We collected data retrospectively from available patient medical records. We structured all collected data in a tabular format in Microsoft Excel, which we designed specifically for this study. We analyzed demographic, clinical, and laboratory variables relevant to assessing post-transplant follow-up quality.

The following variables were examined:

- **Demographic variables:** sex, age at the time of transplantation.
- **Clinical variables:** donor type (living or deceased), pre-emptive transplantation (yes/no), presence of post-transplant complications, graft loss, patient death.
- **Follow-up variables:** regularity of attendance at follow-up visits, laboratory parameters (creatinine, urea, eGFR), outcome at five years after transplantation.

Indicators used to assess the quality of post-transplant monitoring included graft function (assessed using serum creatinine and eGFR values), graft survival, mortality, and regularity of patients' follow-up visits. We used these indicators to assess the effectiveness and quality of post-transplant care.

We performed statistical analyses using Microsoft Excel.

Continuous variables were presented as means, medians, and ranges, while categorical variables were expressed as absolute and relative frequencies. Because of the small sample size, we interpreted the results descriptively, without complex statistical tests, emphasizing clinical interpretation and assessment of monitoring quality.

ETHICS STATEMENT

The study followed the ethical principles of the Declaration of Helsinki. The Ethics Committee of the University Hospital Center Zagreb approved data collection and analysis. All study data were anonymized, and patient identity was fully protected. The data were used exclusively for scientific and research purposes.

RESULTS

The study included 30 kidney transplant recipients. The following section presents participants' demographic characteristics, transplantation and therapy-related variables, comorbidities, laboratory indicators of graft function, and outcomes during post-transplant follow-up. Table 1 shows the study population's demographic characteristics.

Table 1. Demographic characteristics.

Sex (number, percentage)	Male	19 (63.0%)
	Female	11 (36.0%)
Years (median, range)	48 (13-75)	

The median age at transplantation was 48 years (range: 13-75 years), and the sample was predominantly male. Table 2 presents characteristics related to the transplantation procedure, follow-up visit regularity, and immunosuppressive therapy use.

Table 2. Characteristics of Transplantation and Immunosuppression.

Variable		N (%)
Donor type	Deceased	25 (83.3%)
	Alive	5 (16.6%)
Preemptive transplantation	Yes	5 (16.6%)
	No	25 (83.3%)
Regularity of follow-up attendance	Regularly (≥80%)	29 (96.6%)
	Irregularly (<80%)	1 (3.3 %)
Immunosuppression	Yes	29 (96.6%)
	No	1 (3.3%)

Most patients received a kidney from a deceased donor, with high rates of regular follow-up attendance and immunosuppressive therapy use. Table 3 presents the most common comorbidities among participants.

Table 3. Comorbidity Profile of the Participants.

Variable		N (%)
Hypertension	Yes	18 (60.0%)
	No	12 (40.0%)
Diabetes	Yes	5 (16.6%)
	No	25 (83.3%)
Cardiovascular Disease	Yes	11 (36.6%)
	No	19 (63.3%)

The most common comorbidity was arterial hypertension, while diabetes mellitus and cardiovascular diseases were present in a smaller proportion of participants. Table 4 presents the laboratory parameters used to assess transplanted kidney function.

Table 4. Laboratory Indicators of Graft Function.

Variable	Median (IQR)
Serum creatinine, μmol/L	134.5 (61-764)
Urea, mmol/L	10.25 (2.2-36.2)
eGFR, ml/min/1.73 m2	55.0 (15-105)
Potassium, mmol/L	4.35 (3.6-5.6)
Sodium, mmol/L	140.5 (127-148)

The laboratory parameter values indicate generally satisfactory graft function in most patients during the follow-up period. Table 5 presents the incidence of graft rejection and infectious complications.

Table 5. Transplant Rejection.

Variable		N (%)
Acute Rejection	Yes	7 (23.3%)
	No	23 (76.6%)
Chronic Rejection	Yes	8 (26.6%)
	No	22 (73.3%)
Infection	Yes	29 (96.6%)
	No	1 (3.3%)

Acute and chronic graft rejection were recorded in a smaller proportion of patients, while infectious complications were present in the majority of the study population. During the post-

transplant follow-up period, most patients developed infectious complications. Viral infections were the most common, with CMV as the predominant pathogen, whereas infections caused by BK, EBV, and JC viruses were less frequent. In addition to viral infections, patients developed urinary tract infections, and a smaller number developed systemic infections, including sepsis. Some individuals developed simultaneous or recurrent infections caused by multiple pathogens during follow-up.

Most patients recovered with preserved graft function; however, in a smaller subset, infections were associated with graft dysfunction, graft loss, or death. Table 6 presents patient outcomes during the post-transplant follow-up period and at five years after transplantation.

Table 6. Patient Outcomes During Post-Transplant Follow-Up.

Variable		N (%)
Outcome Status	Clinically stable	20 (66.6%)
	Permanent Graft Damage	1 (3.3%)
	Clinical recovery	4 (13.3%)
	Clinical deterioration	2 (6.6%)
	Graft Failure	2 (6.6%)
	Death	1 (3.3%)
Outcome at Five-Year Follow-Up	Clinically stable	20 (66.6)
	Graft functioning	4 (13.3%)
	Clinical deterioration	1 (3.3%)
	At Risk of Graft Loss	1 (3.3%)
	Graft Failure	3 (10.0%)
	Death	1 (3.3%)

Most patients had a stable clinical course with preserved graft function, while graft loss and mortality occurred in only a small number of cases. Analysis of clinical notes showed that most patients maintained stable kidney function in the transplanted kidney throughout follow-up, with no signs of progressive deterioration. In a smaller number of patients, specific clinical circumstances were documented—including pregnancy, the need for repeated immunoadsorption procedures, or frequent urinary tract infections—yet graft function remained preserved despite the increased risk.

Severe adverse outcomes were observed in a small subset of patients and included graft loss requiring a return to hemodialysis, including cases of early graft failure. One death related to sepsis was recorded. The analysis of clinical notes further confirmed that most patients maintained stable graft function during follow-up. At the same time, severe adverse outcomes were rare and primarily associated with serious complications such as sepsis or early graft loss.

DISCUSSION

This study analyzed post-transplant monitoring after kidney transplantation as a key indicator of healthcare quality. The findings demonstrate strong organization and effectiveness in post-transplant follow-up, reflected in frequent outpatient visits, stable graft-function laboratory parameters, and a relatively low incidence of severe adverse outcomes, including graft loss and mortality. These findings indicate that systematic, continuous post-transplant monitoring is an important component of organized follow-up care, while the observed clinical outcomes provide a descriptive overview of long-term results in the studied population.

This study's results are consistent with the retrospective analysis by Szymańska and colleagues, which included 438 kidney transplant recipients and examined outpatient follow-up frequency and five-year post-transplant outcomes. The authors reported that structured follow-up, combined with a multidisciplinary approach, significantly improved graft and patient survival, with five-year graft survival approaching 90%. These findings support the present study's conclusions despite the smaller sample size (11).

The demographic characteristics of the included patients—median age of 48 years and a predominance of male participants—align with epidemiological patterns commonly observed among kidney transplant recipients. The presence of comorbidities, particularly arterial hypertension and cardiovascular disease, is expected in this population and underscores the complexity of care in the post-transplant period. In Szymańska et al., cardiovascular disease and pre-transplant diabetes were significant predictors of poorer outcomes, aligning with the high prevalence of these comorbidities in our cohort. However, they did not have a significant negative impact due to effective monitoring and clinical management (11).

The laboratory parameters analyzed in this study indicate that graft function was preserved and stable over the follow-up period. The stability of electrolyte levels is particularly noteworthy and reflects effective therapeutic oversight and individualized adjustments of immunosuppressive therapy. Regular laboratory monitoring is therefore a core indicator of high-quality post-transplant healthcare.

Infectious complications were common, with viral infections—particularly cytomegalovirus (CMV)—most prevalent. The findings are comparable to those of Al Atbee and Tuama, who documented CMV infection in more than 80% of kidney transplant recipients and found that infection rates were associated with immunosuppressive regimens and the immunological profiles of donors and recipients (12). Despite the high incidence of CMV infection, timely diagnosis and therapeutic intervention preserved graft function in most patients, consistent with this study's outcomes.

Regular follow-up and adherence to immunosuppressive therapy proved to be essential for maintaining graft function. This is further supported by the cohort study by Boghani and colleagues, who found that patients with good adherence had

nearly a threefold higher likelihood of long-term graft survival than non-adherent patients (13). The high regularity of follow-up attendance in this study can therefore be viewed as a key contributing factor to the favorable outcomes observed.

Graft rejection occurred in a small number of cases, while the majority of patients maintained functional grafts even five years after transplantation. Graft loss and mortality were rare, suggesting satisfactory long-term success in this cohort and further reinforcing the importance of structured post-transplant monitoring as a fundamental component of quality care.

The findings also highlight the crucial role of nursing professionals in post-transplant surveillance, particularly continuous monitoring of clinical status, assessment of laboratory parameters, early recognition of complications, and structured patient education on therapy, self-management, and infection prevention. These conclusions align with the review by Albangi and colleagues, who emphasized that comprehensive and continuous nursing care is essential for long-term transplant success, including adherence, early detection of infections and rejection, and psychosocial support (14).

International evidence further supports the importance of a multidisciplinary approach, showing that well-organized post-transplant care, accompanied by structured patient education, improves long-term graft survival and quality of life for transplant recipients (15).

This study's limitations include its small sample size, retrospective design, and reliance on the availability and completeness of medical records, which may limit the scope of the analysis. Nevertheless, these limitations do not diminish the value of the findings, which highlight post-transplant monitoring as a key indicator of healthcare quality.

CONCLUSION

Kidney transplantation remains the most effective treatment modality for end-stage chronic kidney disease, with the quality of post-transplant care playing a pivotal role in long-term graft preservation and favorable clinical outcomes. This study found that systematic, regular post-transplant monitoring is associated with stable laboratory parameters, a low incidence of severe adverse outcomes, and effective management of complications, particularly infectious ones. These findings underscore that continuous monitoring of clinical and biochemical indicators, consistent patient participation in follow-up visits, and adherence to standardized protocols represent key indicators of high-quality healthcare.

Future research should include longitudinal assessments of quality of life among kidney transplant recipients, analyses of the impact of digital tools and telemedicine on treatment adherence and long-term outcomes, and comparative evaluations of different models of post-transplant care organization across various healthcare systems.

AUTHORS CONTRIBUTION

The authors declared that they contributed equally. All authors approved the submitted version.

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CONFLICT OF INTEREST

The authors declare that the research was conducted without any commercial or financial relationships that could be construed as a potential conflict of interest.

GENERATIVE AI STATEMENT

The authors used a generative AI tool to assist with language editing, formatting, and journal-specific manuscript preparation. The authors critically reviewed, revised, and verified all AI-assisted output and take full responsibility for the final content. The authors used no AI tools for data collection, analysis, or interpretation.

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