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REVIEW

CKD in Migrants: From Epidemiology to Challenges

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Chronic kidney disease (CKD) is now considered a global health burden. In addition to the well-known clinical risk factors, social determinants of the disease such as poverty, low birthweight, and lack of access to health services play an important role, with the prevalence of disease modified by various socioeconomic factors, including migration. Herein, we explore the intersection of CKD and migration by examining how migrant populations can modify global prevalence and therapy of CKD global prevalence, including the challenges faced by migrant populations in accessing nephrology units. In addition, we provide suggestions for improving their care.

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CKD is a major public health problem affecting approximately 10% of the world's population, with millions of people progressing to kidney failure (KF) each year and requiring dialysis or transplantation to survive.[1]

CKD presents in various forms across different regions, influenced by environmental, occupational, genetic, and socioeconomic factors. Migration is an additional determinant that warrants attention, because it is associated with distinct CKD features and risk factors. Moreover, it has increased significantly mainly because of economic instability and political conflicts. By the end of 2023, 117.3 million people worldwide were forcibly displaced as a consequence of persecution, conflict, violence, human rights violations, and events seriously disrupting public order.[2]

Migration is a complex and multifactorial process influenced by political, economic, social, demographic, and environmental conditions. Factors such as conflict, poverty, inequality, and climate change are major drivers of forced displacement, often beyond individual control. At the same time, social networks, diasporic ties, and digital communication can facilitate migration by shaping aspirations and opportunities. Personal characteristics, including education, family status, and individual motivation, also play a key role in the decision to migrate.[3] These determinants influence migrants' health profiles and disease risks in highly variable ways, depending on the migration context and whether movement is voluntary or forced. In some countries, it has been observed that migrants tend to have better health than the native-born population, a phenomenon referred to as the "healthy immigrant effect," which is largely attributed to positive health selection. However, this advantage tends to diminish over time as immigrants adapt to the host society.[4] Recent evidence indicates that international migrants have a mortality advantage compared with

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general populations. This mortality benefit mainly concerns migrants living in high-income countries (HICs) for study, employment, or family reunification. However, these findings might not be generalizable to more marginalized groups residing in low- and middle-income countries (LICs and LMICs), for whom available data remain scarce.[5] Many migrants settle in neighboring LICs and LMICs,[6] which are often underequipped to manage complex chronic diseases such as CKD.[7] Meanwhile, HICs frequently face ethical and logistical challenges in integrating refugee patients into their health care systems.[8]

Although migrants are generally healthier on arrival, some may carry latent infections acquired in their countries of origin, which can become clinically relevant or reactivate over time.[9] Moreover, the adoption of a Western lifestyle following migration from LICs and LMICs to HICs has been associated with an increased risk of noncommunicable diseases such as obesity and diabetes.[10] In contrast, migrants who relocate to or within LICs or LMICs, may face additional health risks associated with overcrowded living conditions, unsafe water, poor sanitation, and limited access to health care, which can further exacerbate the burden of infectious and chronic disease.[9,11]

The effects of migration on the management of not-dialysis and on-dialysis CKD differ widely among host countries, and are largely shaped by the health care infrastructure, the geopolitical context, and the economic conditions of refugees as host communities. These challenges are further complicated by unique ethical dilemmas in each setting. Providing appropriate care for displaced individuals with CKD involves a complex balance between clinical necessity and systemic limitations, because a correct approach to CKD encompasses measures from screening of patients to treatment of risk factors, treatment of the etiology of CKD, and follow-up over time. Migrants often face barriers to health care access, including language difficulties, lack of insurance, and cultural differences, which can lead to delayed diagnosis and inadequate management of CKD.[7,8]

Taken together, these observations indicate that CKD represents a relevant health issue among migrants, regardless of where they resettle. Although the underlying causes may differ, the overall burden of CKD in migrant populations should not be overlooked. This growing and context-specific burden of kidney disease has important implications for clinical care and health systems worldwide.

In this review, we evaluated the principal aspects that could be related to this migration phenomenon. In addition, we discussed the health-related challenges faced by migrants.

CKD: Not Only Dialysis

CKD has risen in the list of noncommunicable diseases by overcoming prevalence; mortality; and costs of diabetes, neoplasia, cardiovascular, and chronic respiratory diseases.[12] Indeed, on May 23, 2025, the World Health Organization recognized CKD as a priority for global health.[13] Among, noncommunicable diseases, CKD has mortality rates that have increased most rapidly in the recent decades and reached the first cause of mortality among noncommunicable disease.[14] CKD affects an estimated 850 million people globally, with the vast majority residing in LICs and LMICs.[15,16]

According to data from the Global Burden of Disease study, the global prevalence and burden of CKD has increased substantially (almost doubled) between 1990 and 2016, mainly because of population growth and aging.[15] In recent decades, the global burden of CKD has continued to increase, with particularly marked increases observed in regions such as North Africa, the Middle East, Eastern Europe, Western Asia, and parts of Latin America.[17] Data from LICs are often optimistic even if the registries are not completely updated.[1] Although reduction in age-standardized mortality and morbidity rates helped to mitigate the trend in many regions, this effect was outweighed in areas such as high-income North America, Central Latin America, Oceania, Southern Sub-Saharan Africa, and Central Asia, where the expansion of diabetes and the consequent increased burden of CKD, exceeded the impact of demographic factors alone.[15] The global burden of illness from CKD reflects not only the increasing prevalence of common noncommunicable causes such as diabetes, obesity, and hypertension, but also an unexpectedly incidence of CKD from infections and unknown etiologies in specific geographic regions, the so-called CKD hotspots.[18,19]

Although there is clear geographical variability in demographic and epidemiological patterns, and cause-specific decomposition analyses consistently identify diabetes, obesity, and hypertension as the main contributing factors to CKD worldwide, there are significant differences that must be taken into account when a patient migrates to another region; like CKD of unknown etiology (CKDu), CKD because of infectious causes, environmental and toxic factors, and secondary to sickle cell disease.[15,18–20]

Diabetes contributes substantially to the burden of CKD in many HICs such as Central Europe, Australasia, East and Southeast Asia, high-income North America, high-income Asia Pacific, and Oceania, whereas its impact was comparatively lower in Sub-Saharan Africa. Similarly, hypertension's influence was pronounced in Central Europe and East Asia but less significant in Eastern Europe, Central Latin America, and Central Asia.[1,15]

In recent years, increasing attention has been directed toward a form of CKD not explained by traditional risk factors such as diabetes or hypertension, commonly referred to as CKDu.[21] The prevalence of CKDu may be $> 10\%$ in certain rural communities of Central America and South Asia, while remaining below 2% in other regions.[22] This entity has been identified particularly in LICs and LMICs, including Central America, Sri Lanka, India, and other regions, most often affecting young agricultural workers. It is likely related to chronic dehydration, prolonged heat exposure, pesticide use, and environmental contaminants.[22] Clinically, CKDu is characterized by the absence of significant proteinuria and by histological findings consistent with chronic tubulointerstitial nephropathy with secondary glomerular and vascular sclerosis.[21]

Mesoamerican nephropathy (MeN) in a regional form of CKDu observed among young male agricultural workers in Central America (El Salvador, Nicaragua, Guatemala, Costa Rica, and Panamá), particularly among sugarcane workers, but identified in various other agricultural sectors as well. It is often diagnosed in advanced stages, typically when KF is already present. It may begin with acute kidney injury marked by symptoms such as fever, nausea, back pain, muscle weakness, and leukocyturia in otherwise healthy individuals. In some cases, the condition progresses quickly to CKD.[23] The exact cause remains unknown; it is believed to be linked to chronic dehydration, heat stress, and possibly exposure to agrochemicals.[24] Studies have identified urinary markers of kidney damage in Mesoamerican adolescents from MeN-prevalent areas, suggesting that children living in high-risk regions of Nicaragua may experience subclinical kidney injury even before occupational exposure.[25] A genetic component has been proposed as a contributing factor.[23] Notably, El Salvador and Nicaragua are listed among the 10 countries with the highest CKD-related mortality worldwide, reflecting the severe public health impact of this disease in Central America.[26]

Migrants from regions such as El Salvador or Nicaragua may present with advanced kidney dysfunction in host countries unaccustomed to seeing such clinical patterns. The delayed recognition of CKDu may result in misdiagnosis or underestimation of the true burden.

Another region where cases of CKDu have been reported is Sri Lanka, which has experienced an epidemic of chronic interstitial nephritis among agricultural communities unrelated to traditional causes, particularly in the North Central Province. Factors under investigation include groundwater contamination, heavy metals, and herbicides.[27] To investigate the pathology of CKDu in Sri Lanka, 64 renal biopsies from patients in the North Central Provinceal were analyzed. The most common findings were interstitial fibrosis and tubular atrophy, often with mononuclear cell infiltration. Other frequent features included glomerular sclerosis, collapse, and vascular changes such as intimal thickening and arteriolar hyalinosis, supporting the hypothesis of an environmental or occupational origin.[28] The migration of affected individuals, or even of asymptomatic family members with genetic predisposition, should raise awareness in hosting countries and calls for broader diagnostic perspectives.

India is another region affected by CKDu, with a high prevalence reported among rural and agricultural communities, particularly in the state of Andhra Pradesh, where the disease is referred to as Uddanam nephropathy. It mainly affects agricultural workers, shows tubular atrophy and interstitial fibrosis on biopsy, and is suspected to be linked to water-borne agrochemicals, silica, chemical flavors in betel nuts, and pesticides.[29] Additional CKDu-affected regions have been identified in Mexico and Egypt.[30,31]

Individuals originating from CKDu-endemic regions such as Central America, Sri Lanka, and India who migrate to HICs or nonendemic countries may not be promptly recognized by the health care systems of their host countries. This can lead to delayed diagnosis and inadequate or late treatment, resulting in a poorer prognosis.[32] The lack of medical and institutional awareness outside endemic areas represents an emerging challenge for global health and for the management of migrants affected by CKDu. Conversely, migrants moving to or working in regions where CKDu is endemic may themselves be at increased risk of developing the disease because of exposure to environmental and occupational hazards.

There is some evidence on returnee migrants to South Asia who develop CKDu, likely secondary to occupational exposures acquired abroad. Recent qualitative research among labor migrants returning from Gulf countries and Malaysia has reported multiple contributing factors, including prolonged heat exposure, dehydration, poor living conditions, and excessive use of painkillers, all of which may predispose to kidney injury and CKDu development.[33] Beyond these occupational and environmental determinants, returnee migrants frequently encounter significant challenges in accessing health care services. In many instances, medical care abroad is limited or interrupted, and workers with serious illnesses are repatriated without adequate management. Upon returning home, they often continue treatment at their own expense and face further barriers related to cost, availability of specialized services, and delayed diagnosis.[33]

In many LICs and LMICs, and particularly in tropical and subtropical regions, CKD often arises from infectious. CKDs associated with endemic infections are more prevalent in sub-Saharan Africa, where infections such as schistosomiasis, malaria, tuberculosis, and HIV contribute substantially to the burden of CKD. This reflects the so-called "double burden" of disease, in which both noncommunicable and infectious conditions coexist and jointly exacerbate kidney health disparities across the region.[34] In Egypt and other parts of sub-Saharan Africa, schistosomiasis remains an important contributor to CKD. This parasitic infection, caused by *Schistosoma haematobium*, can lead to chronic inflammation and scarring of the urinary tract and kidneys. With increasing migration from these regions to Europe and North America, nephrologists are now encountering schistosomiasis-related renal disease, often unfamiliar in nonendemic settings.[35]

Infectious diseases remain a significant public health concern across the Asia-Pacific region, and renal involvement is frequently observed in many of them. Notable examples include malaria, leptospirosis, scrub typhus, tuberculosis, hepatitis B and C virus, dengue hemorrhagic fever, and Hantaan virus infections.[36] Economic, geographic, and structural barriers severely hinder access to renal care across the Asia-Pacific region, where infection-related CKD remains predominant and clinical management is challenged by fragile health care systems and limited epidemiological surveillance.[36]

Moreover, tropical and subtropical regions with poor sanitation conditions, such as certain areas of Latin America and Southeast Asia, show a significant prevalence of CKD secondary to infections transmitted through contaminated water and vectors. Leptospirosis and malaria are the most clearly linked to CKD progression after acute kidney injury episodes.[37,38] Other infections, such as dengue, yellow fever, chikungunya, and scrub typhus may cause structural and inflammatory renal injury that can persist beyond the acute phase and contribute to chronic kidney impairment.[39–42]

In some regions, environmental and toxic factors may contribute to the development of kidney disease. In tropical regions, for instance, the ingestion of toxic herbs or chemicals, poisoning use of traditional herbal remedies.[43,44] Aristolochic acid nephropathy represents a paradigmatic form of CKD secondary to exposure to toxic agents. In endemic regions of the Balkans, chronic exposure occurs through the ingestion of contaminated food, whereas in Asian countries, exposure mainly results from the use of traditional herbal preparations containing aristolochic acids.[45]

Additional emerging pattern is the impact of sickle cell disease on kidney health. Sickle cell nephropathy may present as proteinuria, hematuria, or progression to CKD, but its recognition requires a high index of suspicion in populations not typically screened for hemoglobinopathies.[46] The highest prevalence of sickle cell disease is found in sub-Saharan Africa, particularly in the western and central regions, followed by India, parts of the Middle East (including Saudi Arabia and Bahrain), and to a lesser extent in the Mediterranean basin and the Caribbean.[47]

In these areas, the prevalence of proteinuria and CKD among individuals with sickle cell disease is high, with studies reporting microalbuminuria in 25% to 40% of cases and progression to end-stage kidney disease in a substantial proportion of cases.[48–52] As migration continues to reshape population demographics, sickle cell–related kidney disease may become increasingly relevant in new geographic contexts, like USA where the disorder affects approximately 100,000 people and occurs almost exclusively among individuals of African descent.[53–55] CKD in this population is a major determinant of early mortality, with patients who progress to end-stage renal disease showing a markedly reduced survival compared with non–sickle cell cohorts.[56,57]

Another setting where an increase in sickle cell nephropathy is being observed is Canada, largely as a result of migration from regions where sickle cell disease is more prevalent.[58,59] Therefore, considering the migratory flows that have occurred in recent years, there is a clear need for greater awareness among health care professionals and policy makers to ensure early diagnosis and the prompt initiation of specific treatments for sickle cell disease and its renal complications. Despite advances in care, this condition still carries a high risk of morbidity and mortality, particularly when kidney involvement develops. This attention should not be limited to traditionally high-prevalence regions but should extend to all countries experiencing demographic changes due to migration, including those where sickle cell disease has historically been rare. Strengthening screening programs, improving access to specialized care, and promoting education about the disease could help mitigate the growing burden and improve long-term outcomes.[47]

People from diverse regions bring with them a spectrum of disease etiologies that may be uncommon or even unknown to health care systems in host countries. This creates both challenges and opportunities: the challenge of recognizing and appropriately diagnosing uncommon kidney diseases, and the opportunity to deepen global understanding of CKD in its multiple manifestations. The phenomenon becomes relevant in the contemporary era marked by large-scale global mobility, driven by labor migration, displacement, or asylum seeking.

Understanding the shifting landscape of CKD through the lens of migration not only enhances patient care but also promotes equity and inclusion in medical practice. As health care systems become increasingly multicultural, education and collaboration across borders are essential. Raising awareness of region-specific kidney diseases, expanding research on environmental and occupational exposures, and building capacity for early detection will be vital steps toward addressing CKD as a truly global challenge. Peculiar causes of CKD across migrant populations are depicted in Table 1.

Challenges and Opportunities for Migrant CKD Patients

Migrant populations living with CKD face a distinct and complex set of challenges. They are often disproportionately affected by traditional CKD risk factors such as diabetes, obesity, and hypertension, because of socioeconomic disparities and lifestyle factors. Limited access to healthy food, unstable employment, poor housing conditions, and chronic stress all contribute to the early development and progression of these conditions, which are often underdiagnosed and poorly managed.[60–62]

The vulnerability of migrants with CKD is even more pronounced in certain subgroups, such as children and adolescents living in refugee settings. Studies involving refugee populations, for instance among Syrian children, have reported a high frequency of kidney and urinary tract disorders, with care often compromised by language barriers, lack of medical records, and irregular follow-up.[63] In the context of migration, women represent a high-risk group, because barriers to appropriate health care are deeply rooted in social, economic, and cultural inequities.[64] Pregnant women with CKD are particularly fragile, especially in LICs and LMICs, where limited resources, inadequate access to specialized care, and social disparities further exacerbate maternal and fetal risks. These women require individualized, multidisciplinary management and counseling.[65] Environmental and human-made disasters, such as armed conflicts, droughts, floods, and heatwaves, can further intensify migration flows and exacerbate health vulnerabilities. Children, pregnant women, the frail, and those with chronic diseases are among the most vulnerable populations affected by such events[66] These crises often disrupt health care systems, lead to

Table 1. Main types of chronic kidney disease and regional distribution

CKD type	Main geographic distribution	Key etiological / contributing factors	Typical affected population	Clinical / pathological features
Diabetic kidney disease	HIC (Central Europe, Australasia, East and Southeast Asia, High-income North America, High-income Asia Pacific, and Oceania)	Poor glycemic control, metabolic syndrome, obesity	Middle-aged and older adults	Proteinuric CKD with progressive decline in eGFR
Hypertensive nephropathy	Central Europe and East Asia but less significant in Eastern Europe, Central Latin America and Central Asia	Chronic high blood pressure, limited treatment access	Adults with long-standing hypertension	Proteinuric CKD with progressive decline in eGFR (± microhematuria)
CKD of unknown etiology (CKDu, including Mesoamerican nephropathy)	Central America (El Salvador, Nicaragua), South Asia (Sri Lanka, India), Egypt, parts of Africa	Heat stress, dehydration, agrochemical exposure, contaminated groundwater, possible genetic predisposition	Young male agricultural workers	Chronic tubulointerstitial nephropathy with minimal proteinuria; often presents at advanced stages
Infection-related CKD	Sub-Saharan Africa, South & Southeast Asia, Latin America, Pacific regions	Chronic infections (HIV, schistosomiasis, malaria, tuberculosis, hepatitis B/C, leptospirosis) and vector-borne diseases (dengue, chikungunya, scrub typhus, yellow fever) leading to recurrent or unresolved AKI "Double Burden"	Adults and children in endemic areas	Glomerulonephritis, interstitial nephritis, chronic fibrosis secondary to infection
Toxic and environmental nephropathies	Balkans, South & East Asia	Aristolochic acid, herbal toxins, contaminated food/water, heavy metals	Rural populations using traditional herbal medicine	Chronic interstitial fibrosis, tubular atrophy
Sickle cell nephropathy	Sub-Saharan Africa, India, Middle East, Caribbean; emerging in USA, Canada, Europe	Sickle cell disease	Individuals of African or Indian descent	Proteinuria, hematuria, progression to CKD and ESKD

AKI, acute kidney injury; CKD, chronic kidney disease; CKDu, chronic kidney disease of unknown etiology; eGFR, estimated glomerular filtration rate; ESKD, end-stage kidney disease; HIC, high-income countries.

inadequate housing, limit access to safe water and essential medicines, and cause interruptions in dialysis or follow-up care, particularly among kidney transplant recipients. In the case of children, separation from or loss of family members must also be taken into consideration.[67]

In addition to these medical and logistical challenges, psychosocial difficulties are prevalent among refugees, many of whom suffer from mental health conditions such as posttraumatic stress disorder or depression[68]; these conditions certainly do not favor the propensity to seeek help for "physical" diseases.

Migrants face major additional barriers in accessing renal care. A recent study in Italy found that 78.1% of migrants were unaware of their kidney health upon arrival, and a significantly higher rate of late referral to nephrology clinics was observed among them.[69] Language and cultural differences can hinder effective communication between patients and health care providers, resulting in misunderstandings and suboptimal care. In addition, many migrants lack health insurance, which makes it difficult to afford essential medications and treatments. Access to specialized care is particularly complex for those living in areas with limited access to health care services per se.[12,69] Linguistic and cultural differences, as components of ethnicity, may create significant barriers to integration and health care access, because they shape communication patterns and influence interactions between migrants and health care providers.[70] Effective integration of migrants and refugees into the host country's health care system requires the implementation of linguistic mediation services, culturally sensitive care, and health orientation programs.[71,72] In addition, national policies should ensure equitable access to treatment and continuity of care regardless of legal status.[8,71] Engaging refugee communities in the design of health care and social services would further ensure that these systems are built from the outset around the specific needs of people from refugee backgrounds.[73]

Indeed, the shortage of specialized nephrology services in underserved regions further limits access to adequate care,[68] mostly in areas affected by migration crises, where resources are often insufficient to provide costly treatments like dialysis or transplantation.[7,14]

The degree of risk varies depending on the CKD stage and the type of treatment required. For refugees and migrants, these risks are heightened by challenges such as limited health care availability, lack of access to medications, poor nutrition, insufficient medical follow-up, unsafe living environments, and frequent dehydration. There are considerable gaps in research concerning medication availability during different migration stages, including departure, transit, and deportation.[74]

Given these multiple medical, social, economic, and legal barriers, migrant patients with CKD often face precarious situations regarding their treatment continuity and overall health outcomes. One of the greatest challenges migrants faces is that when they seek medical care and require renal replacement therapy, their immigration status is reviewed, and because they are often not in the country legally, they are only clinically stabilized and returned to their country of origin, where they no longer receive proper treatment or lose contact or clinical follow-up.[75]

Environmental factors play an important role in shaping CKD prevalence. Findings from the RODAM (Research on Obesity and Diabetes among African Migrants) cross-sectional study, which compared a group of Ghanaians living in Europe to their counterparts living in Ghana, revealed a lower CKD prevalence among migrants in Europe, even after adjusting for age, sex, and common risk factors such as hypertension and diabetes. Notably, among individuals with hypertension or diabetes, Ghanaian migrants in Europe showed a significantly lower rate of CKD than those with the same conditions living in Ghana.[76] A second longitudinal study further confirms these findings, reporting a lower incidence of CKD among Ghanaian migrants in Amsterdam compared with those residing in Ghana. The study identified age, female sex, alcohol consumption, uric acid levels, and hypertension as key predictors of CKD incidence; and highlighted minimal progression to end-stage kidney disease among migrants in Europe.[77] These findings reinforce the idea that environmental and lifestyle conditions such as access to health care, living environments, and possibly diet significantly influence the onset and progression of CKD. These observations are consistent with the so-called "healthy immigrant effect," which describes the tendency of migrants to display better overall health and lower mortality than native-born populations upon arrival in host countries. This advantage, primarily observed in high-income settings, is largely attributed to positive health selection and protective social or behavioral factors that precede migration. However, the "healthy immigrant effect" is not uniform across all migrant groups and tends to diminish over time because of acculturation, socioeconomic disadvantage, discrimination, and limited access to health care.[4,78] In addition, progressive adoption of the host country's lifestyle—often characterized by dietary changes, reduced physical activity, and increased exposure to metabolic and environmental risk factors—may further contribute to the gradual loss of this initial health advantage.[79]

In Emilia-Romagna, a northern Italian region with a high proportion of foreign-born residents, the PIRP

(Prevenzione Insufficienza Renale Progressiva) program provided valuable insights. The program, which integrates general practitioners and nephrologists to monitor and slow CKD progression, analyzed 30.702 patients seen between April 1, 2004, and June 30, 2020. Of these, 963 (3.1%) were immigrants. The largest immigrant subgroup was from Eastern Europe, followed by those from HICs, Arab countries, Sub-Saharan Africa, Latin America, South Asia, and East Asia. The prevalence of CKD among immigrants is increasing faster than in the native population. Overall, immigrants tended to present with more severe disease and had worse prognoses at follow-up. Because general practitioners serve as the main entry point into PIRP, disparities in CKD stage at enrollment may reflect differences in health care access and utilization. Patients from HICs showed CKD profiles similar to Italians, likely because of shared genetic and socioeconomic factors. Latin American immigrants displayed a low-risk profile, with low rates of diabetes and obesity and the highest baseline estimated glomerular filtration rate. Conversely, South Asian and East Asian immigrants represented the highest-risk groups, experiencing faster declines in estimated glomerular filtration rate and the highest 4-year risk of KF. Sub-Saharan Africans, despite being the youngest group with relatively preserved kidney function and low rates of diabetes and obesity, also showed a high risk of progressing to KF. Patients from Arab countries exhibited a dysmetabolic profile, including hypertension, obesity, high cholesterol, and diabetes; and experienced fast disease progression. At 4-year follow-up, approximately 20% of patients from South Asia, Eastern Europe, and Arab countries progressed to KF, compared with only 11% of Italians and Latin Americans.[80] These findings not only confirm significant clinical differences between Italian and migrant patients with CKD but more importantly, also highlight the variability among migrant subgroups in terms of CKD features and risk of disease progression.

Renal Replacement Therapy for Migrants

The number of people receiving renal replacement therapy exceeds 2·5 million worldwide and is projected to double to 5·4 million by 2030; however, in many countries, there is a shortage of renal replacement services, and an estimated 2·3 million adults have died prematurely because of lack of access to this treatment.[81]

The management of KF among migrant and refugee populations poses significant ethical and systemic challenges for health systems. As global displacement increases, nephrologists are increasingly tasked with providing care for individuals with KF who arrive in regions where dialysis and transplant services are available. The urgent initiation of life-preserving therapies—combined with the long-term nature of dialysis and the complexities associated with kidney transplantation—creates ongoing demands on health care infrastructure and personnel. These interventions not only involve substantial and continuous financial resources but also require consistent follow-up, coordination of services, and access to specialized care. For patients lacking secure legal status or comprehensive health insurance, these conditions are often difficult to be met.[8]

Access to health care services for refugees and asylum seekers across Europe differs significantly, with legal status playing a key role in determining eligibility. Typically, individuals who are formally registered as refugees are more likely to receive financial support for the treatment of KF than those without legal recognition. For example, Switzerland mandates health insurance for all residents staying longer than 3 months, which includes undocumented refugees thus granting them access to kidney replacement therapies through the standard insurance framework. In contrast, Belgium offers health care coverage to asylum seekers via the Federal Agency for the Reception of Asylum Seekers (FEDASIL), whereas responsibility for medical costs transitions to local authorities once asylum status is granted.[8] In Italy, emergency medical services are available to everyone, regardless of citizenship. Asylum seekers and individuals granted refugee status are fully entitled to the same health care benefits as Italian citizens, as long as they are enrolled in the national health system. Once registered, they are issued a health card that permits access to a comprehensive range of services, including both primary care and hospital-based treatment. For undocumented migrants, a temporary health care identification code known as the STP (Straniero Temporaneamente Presente: Temporarily Present Foreigner) can be issued. This code, that lasts 6 months with possible renewal, allows access to urgent and essential medical care.[69]

In the USA, access to care for KF among refugees, asylum seekers, and undocumented migrants is extremely limited and highly dependent on state legislation. In most states, only emergency dialysis is provided; that is, treatment is offered when patients present in critical condition through Emergency Medicaid and in compliance with the Emergency Medical Treatment and Labor Act.[82] This approach is associated with significantly higher morbidity and mortality than with scheduled dialysis, as well as greater health care costs and a negative impact on quality of life.[83] Currently, 20 states (40%) and Washington, D.C., provide coverage for routine dialysis for patients with end-stage kidney disease, whereas the remaining states restrict access to emergency-only dialysis.[84]

According to recent international data, individuals with refugee status represent approximately 1.5% of the total dialysis patient population in Europe. However, this proportion is not uniform across all regions.[85] In the USA, undocumented migrants make up around 3% of the general population and account for 27% of those without health insurance. It is estimated that about 6,500 of them rely on dialysis for survival. In the absence of a standardized national approach, a significant portion, estimated between 30% and 50%, only gains access to dialysis in acute, life-threatening circumstances.[86]

Many patients with KF remain unaware of the seriousness of their condition and often do not receive regular medical follow-up before the need for dialysis. The absence of early diagnosis and intervention contributes to late referrals to nephrology services and frequently leads to unplanned, urgent hospitalizations where dialysis must begin without adequate preparation. In such scenarios, lacking health care coverage can further hinder timely access to treatment, prompting emergency administrative measures to secure essential medical support for the patient.[69]

As documented in a Spanish study, migrant patients with uremia are more likely to undergo in-center hemodialysis rather than peritoneal dialysis (PD).[87] One major barrier to the use of PD among migrant populations is the language barrier and absence of a stable residence and inadequate hygienic conditions, all essential for safe home-based treatment. For example, in California, where PD is available to undocumented immigrants, one of the primary barriers is the lack of space to store supplies at home.[88]

Compared with chronic dialysis, migrant patients face more limitations in accessing kidney transplantation. Although kidney transplantation represents the preferred treatment option for many patients with KF and tends to be more cost-effective over time, the practical and ethical considerations surrounding transplantation in refugee and migrant populations are particularly intricate. Kidney transplantation remains relatively rare among migrant populations, largely because of a combination of structural, administrative, and socio-political barriers. These include the absence of health insurance coverage, limited access to deceased donor organs, and restrictive eligibility criteria adopted by some transplant centers for non-citizens.[86,88] Despite these barriers, recent evidence suggests that kidney transplantation in undocumented or uninsured populations is both clinically safe and effective when posttransplant care is adequately supported. In a cohort study conducted in California, undocumented immigrant transplant recipients achieved long-term outcomes comparable to those of citizens and permanent residents, demonstrating that kidney transplantation can be equally successful in this population when access to immunosuppressive therapy and follow-up care is ensured.[89] However, ensuring optimal transplant outcomes requires not only access to posttransplant care but also adequate pretransplant education and preparation. This step is often missing for migrants and refugees, who in many settings gain access to renal replacement therapy only through emergency dialysis.[90] As described in qualitative studies, patients who start treatment under such conditions frequently lack awareness of their kidney disease, receive little or no education about transplantation, and are excluded from early nephrology follow-up or transplant evaluation pathways.[91] Consequently, when transplantation becomes possible, they are often unprepared for the complexities of long-term care and adherence to immunosuppressive therapy. A study conducted in Colorado among migrant recipients who had previously relied on emergency-only dialysis describes persistent uncertainty surrounding their ability to maintain health insurance coverage and, consequently, uninterrupted access to immunosuppressive therapy. Although transplantation leads to clear improvements in quality of life, autonomy, and mental well-being, many patients continue to experience anxiety about the potential loss of medication funding once charitable or temporary insurance programs expire.[90]

In many cases, national, regional, or institutional policies explicitly or implicitly hinder the inclusion of migrants on transplant waiting lists. In addition, health care professionals may be reluctant to refer or accept migrant patients for transplantation, particularly when there are concerns about their long-term residency status as well as doubts regarding their capacity to maintain consistent medical follow-up and adhere reliably to immunosuppressive therapy.[92]

As further support, a recent survey among European nephrologists found that just 25% indicated migrant patients were routinely considered eligible for kidney transplantation, underscoring the persistent disparities and limited access to transplant services throughout Europe.[93]

The issue of access to kidney transplantation for refugees remains highly variable across health care systems. A survey conducted jointly by the ISN and the European Renal Association/European Dialysis and Transplant Association sought to explore how refugees with KF are managed globally. According to their findings, only a small majority of centers (57.5%) reported that they would list refugees for deceased donor kidney transplantation, if recipients could legally stay in the country. Interestingly, 17.4% of centers indicated that they placed refugee patients on the transplant waiting list regardless of their legal status. However, access was significantly restricted in a notable portion of centers: 15.7% stated they never waitlisted refugee patients, whereas another 9.1% said they only accepted refugees for living-donor transplantation if the patient could both provide a donor and cover the associated costs.[85]

Interestingly, a significant proportion of migrant patients (> 60%) indicate they may have access to a potential living kidney donor, revealing an underutilized pathway for improving care.[94]

For younger undocumented individuals without significant comorbidities, living donor transplantation does not not only result in strong clinical outcomes but could be economically advantageous for health care systems compared with the ongoing burden and costs of chronic dialysis.[94]

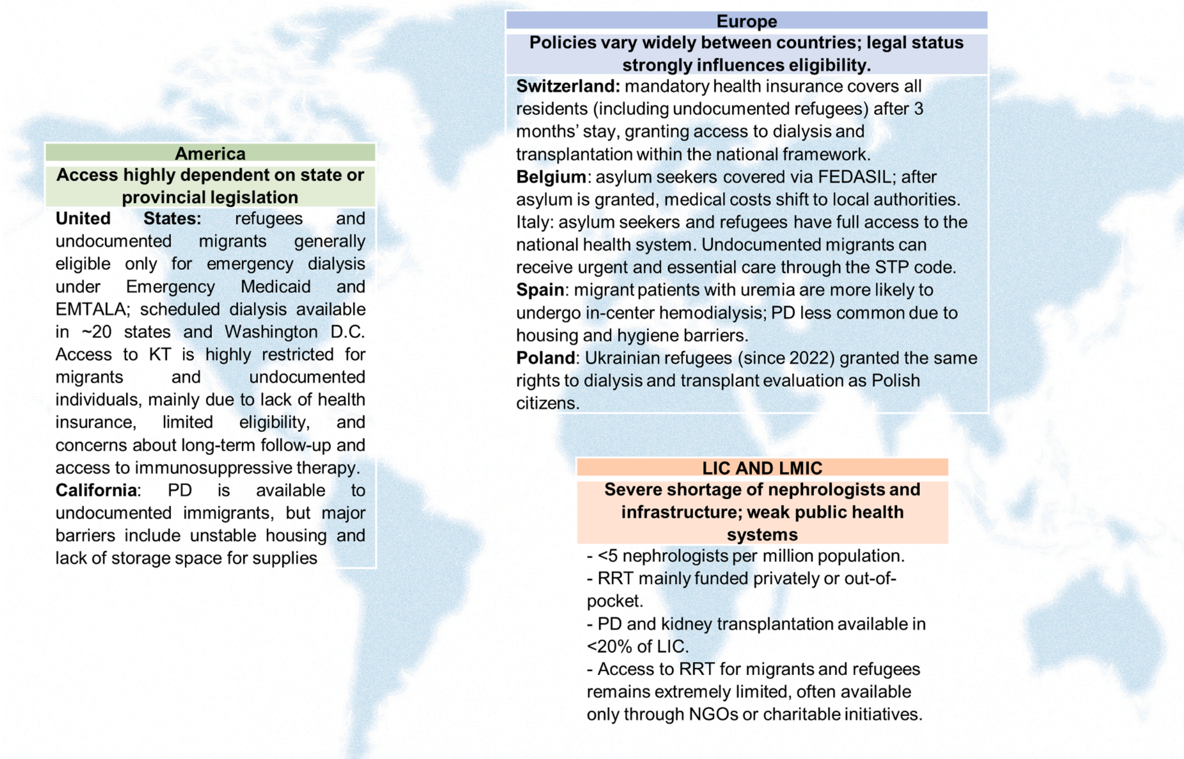
In a context where legal and financial barriers hinder access to transplantation, many migrants remain trapped in chronic dialysis. By pooling expertise, advocating for uniform policies, and sharing best practices, international stakeholders can work collaboratively to dismantle the legal, financial, and logistical barriers that currently prevent thousands of displaced individuals from accessing lifesaving kidney transplantation.[95] For example, Poland's response to the Ukrainian refugee crisis offers a concrete model: beginning in early 2022, millions of Ukrainians fleeing conflict were granted the same rights to dialysis and transplant evaluation as Polish citizens. Patients eligible for transplantation, including those already on dialysis, were referred to specialized transplant teams with the expertise and authorization to list candidates on the National Waiting List. This list is managed by Poland's national transplant authority (Poltransplant) under the supervision of the Ministry of Health. Ukrainian transplant recipients receive follow-up care identical to that provided to Polish citizens, along with immunosuppressive medications dispensed at a nominal cost of < 1 Euro per package.[95]

The context and availability of renal replacement therapies in patients with kidney diseases in LICs and LMICs, particularly among migrant populations, are severely limited. The management of CKD among migrants presents distinct and often more severe challenges, reflecting broader systemic barriers that also affect local populations.

In LICs and LMICs, there are < 5 nephrologists per million population, and kidney care is predominantly privately funded or paid out-of-pocket by patients. Basic diagnostic tests, such as estimated glomerular filtration rate and albuminuria, are often unavailable, hindering early detection and appropriate management of kidney disease. The gap becomes even more pronounced at end-stage of kidney disease, because hemodialysis, although available in most countries, remains largely inaccessible to the majority of patients in LMICs because of high out-of-pocket costs, limited public funding, and insufficient infrastructure. Moreover, PD and kidney transplantation are available in only a small minority of LICs.[96,97] Policies ensuring access for migrants and refugees in these settings are generally absent or nonspecific. Access to renal replacement therapies for migrants, refugees, and stateless individuals is extremely limited and depends on the same economic and infrastructural barriers that affect the local population. There are no dedicated national programs, and health coverage for these groups is almost always nonexistent; treatment is often denied or available only through charitable initiatives or nongovernmental organizations.[95,97]

Differences in health care policies for migrants are reported in Figure 1, whereas in Table 2, we present a summary of the challenges, opportunities, and possible solutions.

At the international level, the ISN is contributing to the dissemination of kidney care and research in developing countries. The ISN-ACT Committee, as stated on the ISN website (https://www.theisn.org/in-action/research/clinical-trials-isn-act/), works to protect the rights of clinical trial participants, both investigators and patients, particularly in developing countries, thereby supporting the growth of ethical and collaborative kidney research worldwide. In line with these efforts, during the 156th session of the World Health Organization, resolution EB156/CONF./6 "Reducing the burden of noncommunicable diseases through promotion of kidney health and strengthening prevention and control of kidney disease" was approved. The resolution emphasizes the integration of early detection and management of kidney disease into national health policies and calls for universal access to



Europe

Policies vary widely between countries; legal status strongly influences eligibility.

Switzerland: mandatory health insurance covers all residents (including undocumented refugees) after 3 months' stay, granting access to dialysis and transplantation within the national framework.

Belgium: asylum seekers covered via FEDASIL; after asylum is granted, medical costs shift to local authorities.

Italy: asylum seekers and refugees have full access to the national health system. Undocumented migrants can receive urgent and essential care through the STP code.

Spain: migrant patients with uremia are more likely to undergo in-center hemodialysis; PD less common due to housing and hygiene barriers.

Poland: Ukrainian refugees (since 2022) granted the same rights to dialysis and transplant evaluation as Polish citizens.

America

Access highly dependent on state or provincial legislation

United States: refugees and undocumented migrants generally eligible only for emergency dialysis under Emergency Medicaid and EMTALA; scheduled dialysis available in ~20 states and Washington D.C. Access to KT is highly restricted for migrants and undocumented individuals, mainly due to lack of health insurance, limited eligibility, and concerns about long-term follow-up and access to immunosuppressive therapy.

California: PD is available to undocumented immigrants, but major barriers include unstable housing and lack of storage space for supplies

LIC AND LMIC

Severe shortage of nephrologists and infrastructure; weak public health systems

- <5 nephrologists per million population.
- RRT mainly funded privately or out-of-pocket.
- PD and kidney transplantation available in <20% of LIC.
- Access to RRT for migrants and refugees remains extremely limited, often available only through NGOs or charitable initiatives.

Figure 1. Examples of migrant policies on access to health care in patients with chronic kidney disease. Overview of regional differences in legislation, eligibility criteria, and structural barriers affecting access to RRT for migrants and refugees across America, Europe, and LICs and LMICs. KT, kidney transplantation; LIC, low-income country; LMIC, low- and middle-income country; NGO, nongovernmental organization; RRT, renal replacement therapy; PD, peritoneal dialysis.

the full spectrum of quality and sustainable care services, including PD, hemodialysis, kidney transplantation, and conservative kidney care. These services should by delivered by an adequately trained health workforce, to all individuals without any discrimination, with particular emphasis on those at risk, in vulnerable and marginalized situations, including indigenous peoples, pregnant women, and children and to ensure all patients have equitable access to appropriate care. This would provide universal access to care for individuals regardless of their country of origin.[13]

Table 2. Challenges, opportunities, and recommendations

Domain	Challenges	Opportunities / Recommendations
Early diagnosis and prevention	Limited screening, late referral, lack of epidemiological data, poor awareness among migrants and clinicians	Integrate CKD screening in primary care and refugee health programs; develop culturally adapted education campaigns; strengthen registries to capture migrant data
Access to health care	Legal status influencing eligibility; lack of insurance; cost barriers; geographic inequities in LICs/LMICs	Promote universal coverage and inclusion regardless of legal status; expand community and NGO-based clinics; harmonize policies across host countries
Communication and cultural barriers	Language difficulties; limited health literacy; mistrust of health systems	Implement linguistic mediation and cultural competence training; involve community health workers; provide translated educational materials
CKD management and follow-up	Fragmented care during migration; loss of medical records; poor continuity of care	Establish cross-border referral systems; digital health records accessible across regions; coordinated multidisciplinary follow-up programs
Dialysis access	Emergency-only dialysis in many settings; infrastructural and hygienic barriers for PD	Advocate for scheduled dialysis as standard of care; support home-based dialysis through housing assistance; training for PD in migrant-friendly centers
Kidney transplantation	Exclusion from waiting lists due to legal or insurance status; lack of pre-transplant education, concerns about ensuring long-term follow-up and access to immunosuppressive therapy	Harmonize ethical and legal frameworks; ensure equal eligibility criteria; provide pre-transplant counseling and post-transplant medication coverage

CKD, chronic kidney disease; LICs, low-income countries; LMICs, low- and middle-income countries; NGO, nongovernmental organization; PD, peritoneal dialysis.

Conclusion

Migration poses significant challenges for the management of CKD. Addressing these challenges requires a multifaceted approach that includes improving access to care, providing culturally competent services, and conducting further research.

Public health initiatives should focus on raising awareness about CKD risk factors and promoting early detection among migrant communities, as well as increasing the availability of nephrology services in underserved areas.[98]

Health care providers should receive training on cultural sensitivity and communication skills to effectively serve diverse patient populations and to gain knowledge of the most prevalent diseases in the areas of origin of these patients, in order to better understand the prevalence and risk factors of CKD in migrant populations, as well as the possibilities and the effectiveness of intervention.[99]

By implementing these strategies, health care systems can not only better serve migrant patients with CKD and improve their health outcomes but can also reduce the general economic burden of CKD in those countries; that is, a "win-win" strategy.

DISCLOSURE

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AUTHOR CONTRIBUTIONS

KC and VS-P conceived and drafted the manuscript. MDN contributed to the writing and development of the manuscript and prepared the figures. RA, GB and LH reviewed the manuscript. GZ and GLM supervised and reviewed the manuscript. LDN and MP contributed to the conceptualization and supervision of the study and to the development of the manuscript.

REFERENCES

1. Bikbov B, Purcell C, Levey AS. Global, regional, and national burden of chronic kidney disease, 1990–2017: a systematic analysis for the Global Burden of Disease Study 2017. *Lancet*. 2020;395:709–733. https://doi.org/10.1016/S0140-6736(20)30045-3
2. UNHCR The UN Refugee Agency. UNHCR global trends report 2023. UNHCR Oper Data Portal; 2023. Accessed January 1, 2026. https://data.unhcr.org/en/documents/details/101302
3. Castelli F. Drivers of migration: why do people move? *J Travel Med*. 2018;25:tay040. https://doi.org/10.1093/jtm/tay040
4. Markides KS, Rote S. The healthy immigrant effect and aging in the United States and other Western countries. *Gerontologist*. 2019;59:205–214. https://doi.org/10.1093/geront/gny136
5. Aldridge RW, Nellums LB, Bartlett S, et al. Global patterns of mortality in international migrants: a systematic review and meta-analysis. *Lancet*. 2018;392:2553–2566. https://doi.org/10.1016/S0140-6736(18)32781-8
6. UNHCR The UN Refugee Agency. Mid-year Trends; 2024. Accessed November 21, 2024. https://www.unhcr.org/mid-year-trends
7. Pawłowicz-Szlarska E, Luyckx V, Sever MS, Tuglular S, Więcek A. Ten tips on how to manage kidney health in migrants and refugees. *Clin Kidney J*. 2025;18:1–11. https://doi.org/10.1093/ckj/sfaf132
8. Van Biesen W, Vanholder R, Ernandez T, Drewniak D, Luyckx V. Caring for migrants and refugees with end-stage kidney disease in Europe. *Am J Kidney Dis*. 2018;71:701–709. https://doi.org/10.1053/j.ajkd.2017.10.015
9. Greenaway C, Castelli F. Infectious diseases at different stages of migration: an expert review. *J Travel Med*. 2019;26:taz007. https://doi.org/10.1093/jtm/taz007
10. Agyemang C, Beune E, Meeks K, et al. Innovative ways of studying the effect of migration on obesity and diabetes beyond the common designs: lessons from the RODAM study. *Ann N Y Acad Sci*. 2017;1391:54–70. https://doi.org/10.1111/nyas.13204
11. Willen SS, Knipper M, Abadía-Barrero CE, Davidovitch N. Syndemic vulnerability and the right to health. *Lancet*. 2017;389:964–977. https://doi.org/10.1016/S0140-6736(17)30261-1
12. Torra R. Kidney health matters: a global imperative for public health. *Nephrol Dial Transplant*. 2024;39:1371–1374. https://doi.org/10.1093/ndt/gfae083
13. World Health Organization (WHO). Seventy-eighth World Health Assembly – daily update; 2025. Accessed July 21, 2025. https://www.who.int/news/item/23-05-2025-seventy-eighth-world-health-assembly—daily-update–23-may-2025
14. Kidney disease: a global health priority. *Nat Rev Nephrol*. 2024;20:421–423. https://doi.org/10.1038/s41581-024-00829-x
15. Xie Y, Bowe B, Mokdad AH, et al. Analysis of the Global Burden of Disease study highlights the global, regional, and national trends of chronic kidney disease epidemiology from 1990 to 2016. *Kidney Int*. 2018;94:567–581. https://doi.org/10.1016/j.kint.2018.04.011
16. Jager KJ, Kovesdy C, Langham R, Rosenberg M, Jha V, Zoccali C. A single number for advocacy and communication-worldwide more than 850 million individuals have kidney diseases. *Kidney Int*. 2019;96:1048–1050. https://doi.org/10.1016/j.kint.2019.07.012
17. Ying M, Shao X, Qin H, et al. Disease burden and epidemiological trends of chronic kidney disease at the global, regional, national levels from 1990 to 2019. *Nephron*. 2024;148:113–123. https://doi.org/10.1159/000534071
18. Li MJ, Liu HY, Zhang YQ, Li SR, Zhang JH, Li R. Global burden of chronic kidney disease and its attributable risk factors (1990–2021): an analysis based on the global burden of disease study. *Front Endocrinol (Lausanne)*. 2025;16:1563246. https://doi.org/10.3389/fendo.2025.1563246
19. Obrador GT, Levin A. CKD hotspots: challenges and areas of opportunity. *Semin Nephrol*. 2019;39:308–314. https://doi.org/10.1016/j.semnephrol.2019.02.009

20. Drueke TB, Wiecek A, Massy ZA. New obesity guidelines and implications for CKD. *Kidney Int Rep*. 2025;10:1305–1308. https://doi.org/10.1016/j.ekir.2025.03.022

21. Rao IR, Bangera A, Nagaraju SP, et al. Chronic kidney disease of unknown aetiology: a comprehensive review of a global public health problem. *Trop Med Int Health*. 2023;28: 588–600. https://doi.org/10.1111/tmi.13913

22. Rutter CE, Njoroge M, Cooper PJ, et al. International prevalence patterns of low eGFR in adults aged 18–60 without traditional risk factors from a population-based cross-sectional disadvantaged populations eGFR epidemiology (DEGREE) study. *Kidney Int*. 2025;107:541–557. https://doi.org/10.1016/j.kint.2024.11.028

23. Fischer RSB, Mandayam S, Chavarria D, et al. Clinical evidence of acute Mesoamerican nephropathy. *Am J Trop Med Hyg*. 2017;97:1247–1256. https://doi.org/10.4269/ajtmh.17-0260

24. Wesseling C, Crowe J, Hogstedt C, Jakobsson K, Lucas R, Wegman DH. The epidemic of chronic kidney disease of unknown etiology in Mesoamerica: a call for interdisciplinary research and action. *Am J Public Health*. 2013;103: 1927–1930. https://doi.org/10.2105/AJPH.2013.301594

25. Leibler JH, Ramirez-Rubio O, Velázquez JJA, et al. Biomarkers of kidney injury among children in a high-risk region for chronic kidney disease of uncertain etiology. *Pediatr Nephrol*. 2021;36:387–396. https://doi.org/10.1007/s00467-020-04595-3

26. Lozier M, Turcios-Ruiz RM, Noonan G, Ordunez P. Chronic kidney disease of nontraditional etiology in Central America: a provisional epidemiologic case definition for surveillance and epidemiologic studies. *Rev Panam Salud Publ*. 2016;40: 294–300.

27. Gunasekara TDKSC, De Silva PMCS, Chandana EPS, et al. Environmental heat exposure and implications on renal health of pediatric communities in the dry climatic zone of Sri Lanka: an approach with urinary biomarkers. *Environ Res*. 2023;222:115399. https://doi.org/10.1016/j.envres.2023.115399

28. Nanayakkara S, Komiya T, Ratnatunga N, et al. Tubulointerstitial damage as the major pathological lesion in endemic chronic kidney disease among farmers in North Central Province of Sri Lanka. *Environ Health Prev Med*. 2012;17:213–221. https://doi.org/10.1007/s12199-011-0243-9

29. Abraham G, Agarwal SK, Gowrishankar S, Vijayan M. Chronic kidney disease of unknown etiology: hotspots in India and Other Asian countries. *Semin Nephrol*. 2019;39: 272–277. https://doi.org/10.1016/j.semnephrol.2019.02.005

30. Gutierrez-Peña M, Zuñiga-Macias L, Marin-Garcia R, et al. High prevalence of end-stage renal disease of unknown origin in Aguascalientes Mexico: role of the registry of chronic kidney disease and renal biopsy in its approach and future directions. *Clin Kidney J*. 2021;14:1197–1206. https://doi.org/10.1093/ckj/sfaa229

31. El Minshawy O. End-stage renal disease in the El-Minia Governorate, upper Egypt: an epidemiological study. *Saudi J Kidney Dis Transpl*. 2011;22:1048–1054.

32. Swaminathan S, Chacko B. 'A disease of disparity': chronic kidney disease of unknown aetiology in endemic immigrant communities. *Intern Med J*. 2022;52:1437–1440. https://doi.org/10.1111/imj.15869

33. Regmi P, Aryal N, Bhattarai S, Sedhain A, K CRK, Van Teijlingen E. Exploring lifestyles, work environment and health care experience of Nepalese returnee labour migrants diagnosed with kidney-related problems. *PLoS One*. 2024;19: 1–16. https://doi.org/10.1371/journal.pone.0309203

34. Hodel NC, Hamad A, Praehauser C, et al. The epidemiology of chronic kidney disease and the association with non-communicable and communicable disorders in a population of sub-Saharan Africa. *PLoS One*. 2018;13:1–17. https://doi.org/10.1371/journal.pone.0205326

35. Barsoum RS. Schistosomiasis and the kidney. *Semin Nephrol*. 2003;23:34–41. https://doi.org/10.1053/snep.2003.50003a

36. Jha V, Prasad N. CKD and infectious diseases in Asia Pacific: challenges and opportunities. *Am J Kidney Dis*. 2016;68:148–160. https://doi.org/10.1053/j.ajkd.2016.01.017

37. Phannajit J, Lertussavavivat T, Limothai U, et al. Long-term kidney outcomes after leptospirosis: a prospective multicentre cohort study in Thailand. *Nephrol Dial Transplant*. 2023;38:2182–2191. https://doi.org/10.1093/ndt/gfad030

38. Batte A, Nakulima V, Namazzi R, et al. Malaria associated pathogenesis of chronic kidney disease (MAP-CKD): a prospective study of children hospitalized with severe malaria. *BMC Nephrol*. 2025;26:390. https://doi.org/10.1186/s12882-025-04333-7

39. Gurugama P, Jayarajah U, Wanigasuriya K, Wijewickrama A, Perera J, Seneviratne SL. Renal manifestations of dengue virus infections. *J Clin Virol*. 2018;101:1–6. https://doi.org/10.1016/j.jcv.2018.01.001

40. Burdmann EA. Flaviviruses and kidney diseases. *Adv Chronic Kidney Dis*. 2019;26:198–206. https://doi.org/10.1053/j.ackd.2019.01.002

41. Costa DMDN, Gouveia PADC, Silva GEB, et al. The relationship between Chikungunya virus and the kidneys: a scoping review. *Rev Med Virol*. 2023;33:e2357. https://doi.org/10.1002/rmv.2357

42. Pathak S, Chaudhary N, Dhakal P, et al. Clinical profile, complications and outcome of scrub typhus in children: a hospital based observational study in central Nepal. *PLoS One*. 2019;14:e0220905. https://doi.org/10.1371/journal.pone.0220905

43. Jha V, Parameswaran S. Community-acquired acute kidney injury in tropical countries. *Nat Rev Nephrol*. 2013;9:278–290. https://doi.org/10.1038/nrneph.2013.36

44. Jha V, Chugh KS. Nephropathy associated with animal, plant, and chemical toxins in the tropics. *Semin Nephrol*. 2003;23:49–65. https://doi.org/10.1053/snep.2003.50003

45. Lukinich-Gruia AT, Nortier J, Pavlović NM, et al. Aristolochic acid I as an emerging biogenic contaminant involved in chronic kidney diseases: a comprehensive review on exposure pathways, environmental health issues and future challenges. *Chemosphere*. 2022;297:134111. https://doi.org/10.1016/j.chemosphere.2022.134111

46. Nath KA, Hebbel RP. Sickle cell disease: renal manifestations and mechanisms. *Nat Rev Nephrol*. 2015;11:161–171. https://doi.org/10.1038/nrneph.2015.8

47. Thomson AM, McHugh TA, Oron AP. Global, regional, and national prevalence and mortality burden of sickle cell disease, 2000–2021: a systematic analysis from the Global

Burden of Disease Study 2021. *Lancet Haematol*. 2023;10: e585–e599. https://doi.org/10.1016/S2352-3026(23)00118-7

48. Derebail VK, Ciccone EJ, Zhou Q, Kilgore RR, Cai J, Ataga KI. Progressive decline in estimated GFR in patients with sickle cell disease: an observational cohort study. *Am J Kidney Dis*. 2019;74:47–55. https://doi.org/10.1053/j.ajkd.2018.12.027
49. Elzorkany K, Alsalman M, AlSahlawi M, et al. Prevalence and predictors of Sickle Cell Nephropathy A single-center experience. *Sci Rep*. 2024;14:1–7. https://doi.org/10.1038/s41598-024-79345-8
50. Ndour EHM, Mnika K, Tall FG, et al. Biomarkers of sickle cell nephropathy in Senegal. *PLoS One*. 2022;17:e0273745. https://doi.org/10.1371/journal.pone.0273745
51. Anto EO, Obirikorang C, Acheampong E, et al. Renal abnormalities among children with sickle cell conditions in highly resource-limited setting in Ghana. *PLoS One*. 2019;14: e0225310. https://doi.org/10.1371/journal.pone.0225310
52. Roy NB, Carpenter A, Dale-Harris I, Dorée C, Estcourt LJ. Interventions for chronic kidney disease in people with sickle cell disease. *Cochrane Database Syst Rev*. 2023;8:CD012380. https://doi.org/10.1002/14651858.CD012380.pub3
53. Kavanagh PL, Fasipe TA, Wun T. Sickle cell disease: a review. *JAMA*. 2022;328:57–68. https://doi.org/10.1001/jama.2022.10233
54. Wethers DL. Sickle cell disease. *NY Med*. 1973;29:354–357. https://doi.org/10.1056/NEJMra1510865
55. Hassell KL. Population estimates of sickle cell disease in the U.S. *Am J Prev Med*. 2010;38(4 Suppl):S512–S521. https://doi.org/10.1016/j.amepre.2009.12.022
56. Zahr RS, Saraf SL. Sickle cell disease and CKD: an update. *Am J Nephrol*. 2024;55:56–71. https://doi.org/10.1159/000534865
57. McClellan AC, Luthi JC, Lynch JR, et al. High one year mortality in adults with sickle cell disease and end-stage renal disease. *Br J Haematol*. 2012;159:360–367. https://doi.org/10.1111/bjh.12024
58. Corriveau-Bourque C, Bruce AA. The changing epidemiology of pediatric hemoglobinopathy patients in northern Alberta, Canada. *J Pediatr Hematol Oncol*. 2015;37:595–599. https://doi.org/10.1097/MPH.0000000000000442
59. Lieberman L, Kirby M, Ozolins L, Mosko J, Friedman J. Initial presentation of unscreened children with sickle cell disease: the Toronto experience. *Pediatr Blood Cancer*. 2009;53:397–400. https://doi.org/10.1002/pbc.22023
60. Norris KC, Beech BM. Social determinants of kidney health: focus on poverty. *Clin J Am Soc Nephrol*. 2021;16:809–811. https://doi.org/10.2215/CJN.12710820
61. Crews DC, Kuczmarski MF, Miller ER 3rd, Zonderman AB, Evans MK, Powe NR. Dietary habits, poverty, and chronic kidney disease in an urban population. *J Ren Nutr*. 2015;25: 103–110. https://doi.org/10.1053/j.jrn.2014.07.008
62. Adjei DN, Stronks K, Adu D, et al. Cross-sectional study of association between psychosocial stressors with chronic kidney disease among migrant and non-migrant Ghanaians living in Europe and Ghana: the RODAM study. *BMJ Open*. 2019;9: e027931. https://doi.org/10.1136/bmjopen-2018-027931
63. Balat A, Kilic BD, Aksu B, et al. Kidney disease profile and encountered problems during follow-up in Syrian refugee children: a multicenter retrospective study. *Pediatr Nephrol*. 2022;37:393–402. https://doi.org/10.1007/s00467-021-05046-3
64. García GG, Iyengar A, Kaze F, Kierans C, Padilla-Altamira C, Luyckx VA. Sex and gender differences in chronic kidney disease and access to care around the globe. *Semin Nephrol*. 2022;42:101–113. https://doi.org/10.1016/j.semnephrol.2022.04.001
65. Piccoli GB, Ahmed SB, Fakhouri F, et al. Women and kidney health: conclusions from a Kidney Disease: improving Global Outcomes (KDIGO) Controversies Conference. *Kidney Int*. 2025;108:355–379. https://doi.org/10.1016/j.kint.2025.02.021
66. Dries D, Reed MJ, Kissoon N, et al. Special Populations: care of the critically ill and injured during pandemics and disasters: CHEST consensus statement. *Chest*. 2014;146(Suppl):e75S–e86S. https://doi.org/10.1378/chest.14-0737
67. Sever MS, Sever L, Vanholder R. Disasters, children and the kidneys. *Pediatr Nephrol*. 2020;35:1381–1393. https://doi.org/10.1007/s00467-019-04310-x
68. Aoun M, Koubar SH. Impact of forced human migration on management of end-stage kidney disease in host countries. *Semin Nephrol*. 2020;40:363–374. https://doi.org/10.1016/j.semnephrol.2020.06.004
69. Alfano G, Albinelli A, Ferri C, et al. Migrants on hemodialysis (HD): clinical characteristics, outcome and quality of life. *J Nephrol*. 2025;38:1057–1067. https://doi.org/10.1007/s40620-025-02281-x
70. Segal UA. Globalization, migration, and ethnicity. *Public Health*. 2019;172:135–142. https://doi.org/10.1016/j.puhe.2019.04.011
71. Cervantes L, Rizzolo K, Carr AL, et al. Social and cultural challenges in caring for Latinx individuals with kidney failure in urban settings. *JAMA Netw Open*. 2021;202:e2125838. https://doi.org/10.1001/jamanetworkopen.2021.25838
72. Brandenberger J, Tylleskär T, Sontag K, Peterhans B, Ritz N. A systematic literature review of reported challenges in health care delivery to migrants and refugees in high-income countries - the 3C model. *BMC Public Health*. 2019;19:755. https://doi.org/10.1186/s12889-019-7049-x
73. Peprah P, Lloyd J, Harris M. Health literacy and cultural responsiveness of primary health care systems and services in Australia: reflections from service providers, stakeholders, and people from refugee backgrounds. *BMC Public Health*. 2023;23:2557. https://doi.org/10.1186/s12889-023-17448-z
74. Aljadeeah S, Kielmann K, Michielsen J, Payedimarri AB, Ravinetto R. Access to medicine among asylum seekers, refugees and undocumented migrants across the migratory cycle: a scoping review protocol. *BMJ Open*. 2022;12: e068917. https://doi.org/10.1136/bmjopen-2022-068917
75. Sharma SK, Upadhyaya MK. Migrant work and kidney health in Nepal: prevention is better than cure. *Kidney360*. 2024;5: 1563–1565. https://doi.org/10.34067/KID.0000000000000550
76. Adjei DN, Stronks K, Adu D, et al. Chronic kidney disease burden among African migrants in three European countries and in urban and rural Ghana: the RODAM cross-sectional study. *Nephrol Dial Transplant*. 2018;33:1812–1822. https://doi.org/10.1093/ndt/gfx347

77. Mungamba MM, Chilunga FP, Van Der Linden EL, et al. Incidence, long-term predictors and progression of chronic kidney disease among African migrants and non-migrants: the transcontinental population-based prospective RODAM cohort study. *BMJ Glob Health*. 2025;10:1–12. https://doi.org/10.1136/bmjgh-2024-016786
78. Ruhnke SA, Reynolds MM, Wilson FA, Stimpson JP. A healthy migrant effect? Estimating health outcomes of the undocumented immigrant population in the United States using machine learning. *Soc Sci Med*. 2022;307:115177. https://doi.org/10.1016/j.socscimed.2022.115177
79. Dawson AZ, Garacci E, Ozieh M, Walker RJ, Egede LE. The relationship between immigration status and chronic kidney disease risk factors in immigrants and US-born adults. *J Immigr Minor Health*. 2020;22:1200–1207. https://doi.org/10.1007/s10903-020-01054-x
80. Gibertoni D, Mammana L, Gherardi G, Baschieri E, Minora F, Santoro A. Presentation and outcome of chronic kidney disease in Italian and immigrant citizens: results from the Emilia-Romagna PIRP project. *J Nephrol*. 2022;35:179–190. https://doi.org/10.1007/s40620-021-00984-5
81. Liyanage T, Ninomiya T, Jha V, et al. Worldwide access to treatment for end-stage kidney disease: a systematic review. *Lancet*. 2015;385:1975–1982. https://doi.org/10.1016/S0140-6736(14)61601-9
82. Welles CC, Cervantes L. Barriers to providing optimal dialysis care for undocumented immigrants: policy challenges and solutions. *Semin Dial*. 2020;33:52–57. https://doi.org/10.1111/sdi.12846
83. Cervantes L, Tuot D, Raghavan R, et al. Association of emergency-Only vs Standard hemodialysis with mortality and health care use among undocumented immigrants with end-stage renal disease. *JAMA Intern Med*. 2018;178:188–195. https://doi.org/10.1001/jamainternmed.2017.7039
84. Santos PMG, Narayan A, Hong AS, et al. Landscape of emergency Medicaid and health care coverage for undocumented immigrants in the US. *JAMA Intern Med*. 2025;185:866–873. https://doi.org/10.1001/jamainternmed.2025.0604
85. Van Biesen W, Vanholder R, Vanderhaegen B, et al. Renal replacement therapy for refugees with end-stage kidney disease: an international survey of the nephrological community. *Kidney Int Suppl (2011)*. 2016;6:35–41. https://doi.org/10.1016/j.kisu.2016.09.001
86. Raghavan R. Caring for undocumented immigrants with kidney disease. *Am J Kidney Dis*. 2018;71:488–494. https://doi.org/10.1053/j.ajkd.2017.09.011
87. Arenas-Jiménez MD, Fernandez-Martin JL, Herrera G, et al. Differences in dialysis modality choice between immigrant and native populations in Barcelona, Spain. *Nefrologia (Engl Ed)*. 2025;45:59–67. https://doi.org/10.1016/j.nefroe.2024.12.003
88. Fortin MC, Williams-Jones B. Should we perform kidney transplants on foreign nationals? *J Med Ethics*. 2014;40:821–826. https://doi.org/10.1136/medethics-2013-101534
89. Eguchi N, Tantisattamo E, Chung D, et al. Outcomes among undocumented immigrant kidney transplant recipients in California. *JAMA Netw Open*. 2023;6:e2254660. https://doi.org/10.1001/jamanetworkopen.2022.54660
90. Rizzolo K, Rockey N, Camacho C, Gardner C, Giusti S, Cervantes L. The transplant experience for undocumented immigrant patients formerly receiving emergency dialysis and caregivers. *JAMA Netw Open*. 2024;7:e2354602. https://doi.org/10.1001/jamanetworkopen.2023.54602
91. Villani V, Bertuzzi L, Butler G, et al. Provision of transplant education for patients starting dialysis: disparities persist. *Heliyon*. 2024;10:e36542. https://doi.org/10.1016/j.heliyon.2024.e36542
92. Martin DE, Fadhil RAS, Więcek A. Ethical aspects of kidney donation and transplantation for migrants. *Semin Nephrol*. 2022;42:151271. https://doi.org/10.1016/j.semnephrol.2022.07.005
93. Rafat C, Pawlowicz-Szlarska E, Alfano G, et al. Kidney failure care for migrants: a European survey. *J Nephrol*. 2025;38:1313–1327. https://doi.org/10.1007/s40620-025-02290-w
94. Linden EA, Cano J, Coritsidis GN. Kidney transplantation in undocumented immigrants with ESRD: a policy whose time has come? *Am J Kidney Dis*. 2012;60:354–359. https://doi.org/10.1053/j.ajkd.2012.05.016
95. Stock PG, Nagral S, Rondeau E, et al. Transplantation in the context of migration and refugees: a summary of the DICG and TTS Ethics Committee workshop, Buenos Aires, Argentina, September 2022. *Transplantation*. 2024;108:1476–1487. https://doi.org/10.1097/TP.0000000000004918
96. Qarni B, Osman MA, Levin A, et al. Kidney care in low- and middle-income countries. *Clin Nephrol*. 2020;93:S21–S30. https://doi.org/10.5414/CNP92S104
97. Bello AK, Okpechi IG, Levin A, et al. An update on the global disparities in kidney disease burden and care across world countries and regions. *Lancet Glob Health*. 2024;12:e382–e395. https://doi.org/10.1016/S2214-109X(23)00570-3
98. Sekkarie MA, Abdel-Rahman EM. Cultural challenges in the care of refugees with end-stage renal disease: what western nephrologists should know. *Nephron*. 2017;137:85–90. https://doi.org/10.1159/000477362
99. Horváth Á, Molnár P. A review of patient safety communication in multicultural and multilingual healthcare settings with special attention to the U.S. and Canada. *Dev Heal Sci*. 2022;4:49–57. https://doi.org/10.1556/2066.2021.00041