ISN Global Kidney Health Atlas

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FOREWORD

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End-stage kidney disease (ESKD) is a major public health problem due to associated adverse health consequences and costs of treatment. People with ESKD require frequent and intensive care that is burdensome to their lifestyles and expensive. In many countries where ESKD care is not publicly funded, people with ESKD are unable to receive treatment, resulting in poor health outcomes and often death. It is projected that in 2030, 14.5 million people will have ESKD and need treatment, yet only 5.4 million will actually receive it due to economic, social, and political factors. There are several options for ESKD treatment. Kidney replacement therapy (KRT) can be delivered through hemodialysis (HD), peritoneal dialysis (PD), or transplantation; alternatively patients can be offered non-dialytic comprehensive conservative care. Understanding the benefits and limitations of each option requires consideration of the individual patient, local context, and capacity. The high cost of HD is a key barrier for many countries. According to recent estimates, the cost of HD for one patient is approximately USD 100,000 per year. Using less costly alternatives such as PD or comprehensive conservative care may be a more suitable option in resource-limited settings. Moreover, HD may not always be the most appropriate treatment option for ESKD. Therefore selecting the best route of care is imperative from a financial, clinical, and patient-centered perspective.

Efforts to prevent ESKD through appropriate acute kidney injury (AKI) and chronic kidney disease (CKD) detection strategies are needed to reduce the burden the disease. Health information systems are essential for collecting information to guide surveillance programs and further support decision making with respect to policies and resource allocation. Identifying key barriers to the prevention and appropriate management of ESKD is important if solutions are to be developed. It is necessary to understand the global status of kidney care to inform governmental policies and strategies aimed at improving ESKD care.

On behalf of the International Society of Nephrology (ISN), I am delighted to present the second iteration of the Global Kidney Health Atlas (GKHA). This version is a topical survey that focuses on understanding the global burden of ESKD and capacity for care delivery across countries and regions. The GKHA project is a multinational, cross-sectional survey designed to assess the current capacity for kidney care across all world regions, as part of the ISN's Closing the Gaps initiative. The 160 participating countries (out of 182 approached), account for over 98% of the world's population.

The survey results provide an overview of the current capacity for ESKD care, focusing on disease prevention and management. The findings will be applied to engage relevant stakeholders across countries and regions to advocate for improved access to and quality of kidney care. The data have appreciable policy implications, as they provide a platform for holding governments accountable by measuring country and region progress over time.

We synthesized the various approaches to ESKD care across all world regions; identified opportunities to strengthen relevant health systems; and explored potential mechanisms to capitalize on these opportunities. We found several common barriers to optimal ESKD care delivery across countries and regions: poor funding for ESKD care (dialysis and transplantation), particularly in low income nations; limited workforce capacity; and significant variations in the development and organization of care structures. Most of these challenges reflect economic differences, as well as political and socio-cultural factors.

These common challenges should be addressed to strengthen health systems and policies for optimal kidney care. We suggest potential strategies to address these challenges, and discuss them for low and lower-middle income settings where KRT is unavailable or unaffordable. This work is important, as it provides benchmarks for monitoring ESKD care capacity over time; moreover, we provide organizational and country-level recommendations on how gaps in care may be addressed.

David Harris

EXECUTIVE SUMMARY

This work aims to improve understandings of inter- and intra-national variability around the globe with respect to the capacity to deliver care for end-stage kidney disease (ESKD). Using the domains of health services defined by the World Health Organization (WHO), this survey summarizes and compares the availability, accessibility, and affordability of high-quality care for patients with kidney failure.

A total of 160 countries (out of 182 countries contacted) representing over 98% of the world's population responded to the survey. The results reveal several pertinent findings. Nearly half of all countries provide public funding for non-dialysis CKD care, and 64% provide public funding for dialysis and transplantation. The provision of public funding for ESKD care is less common in low income countries. Nephrologists are primarily responsible for ESKD care in 92% of countries surveyed. Worldwide, the median number of nephrologists is 9.95 per million population (pmp); low income countries have the fewest nephrologists (0.2 pmp), followed by lower-middle (1.6 pmp), upper-middle (10.8), and high (23.2 pmp) income countries.

Chronic hemodialysis (HD) services are available in all countries that completed the survey. Chronic peritoneal dialysis (PD) and kidney transplantation services are available in 76% and 74% of countries, respectively. Availability of chronic PD and transplantation services increases with country income. Only 23% of low income countries offer either chronic PD or kidney transplantation. Overall, in 72% of countries with available dialysis services, at least half of patients with ESKD are able to access dialysis at the onset of kidney failure. However, access in low income countries is quite low (5%). Overall, 30% of countries reported within-country differences in how ESKD care is delivered between children and adults. This discrepancy is more pronounced in low income countries (61%). Similarly, 24% of countries reported differences in how KRT is delivered between children and adults. Variation is highest in low income countries (57%), and reduces with increasing country income. Among countries with PD available, only 4% report PD as the initial treatment for most ESKD patients.

Only 13 registries for acute kidney injury (AKI) and 19 registries for non-dialysis chronic kidney disease (CKD) exist. Among the countries surveyed, 66% have dialysis registries and 57% have transplantation registries. Overall, 73 countries have current national strategies for non-communicable diseases (NCDs) and 21 countries have strategies under development; 69 countries have national strategies for improving CKD care. No low income countries have specific CKD care policies, whereas 29% of lower-middle, 29% of upper-middle, and 55% of high income countries have policies. Worldwide, AKI, CKD, and ESKD are recognized as health priorities by only 13%, 51%, and 58% of governments, respectively. Governmental recognition of CKD and ESKD as health priorities is more common in high and upper-middle income countries.

The top barriers to optimal ESKD care are economic factors (reported by 64% of countries); patient knowledge or attitude (in 63%

of countries); nephrologist availability (in 60% of countries); physician availability, access, knowledge, and/or attitude (in 58% of countries); distance from care or prolonged travel time (in 55% of countries); and availability, access, and capability of the healthcare system (in 55% of countries).

Overall, the results reveal significant disparities related to key components of high-quality kidney care. Key recommendations for closing these gaps are as follows:

- Increase health care financing for ESKD prevention and management;
- Address workforce shortages by developing effective multidisciplinary teams, task shifting (e.g., allowing primary care practitioners to play a greater role in treatment) and harnessing the potential of telemedicine;
- Develop and implement context-specific surveillance systems based on available capacity and resources;
- Promote ESKD prevention and treatment by implementing policies, incorporating CKD into global NCD strategies, supporting advocacy groups, and mitigating barriers to care;
- Promote PD as the initial mode of treatment and remove barriers to practical, cost-effective supplies of PD solutions;
- Support the development of innovative, cost-effective dialysis methodologies;
- Develop appropriate legislative and policy frameworks to support kidney transplantation in all countries; and
- Increase access to conservative care delivery where appropriate.

The initial iteration of the GKHA demonstrated variability in global kidney care, with significant gaps in kidney care across all of the WHO health domains, particularly in low and lower-middle income countries. The key focus of the initial exercise was to broadly collect information across the full spectrum of CKD. Due to the large scope, there was lack of granularity in the information collated and limited data on other facets of optimal kidney care delivery such as quality, affordability, and accessibility. Therefore, the aim of this second iteration of the GKHA is to specifically define the current global status of ESKD care structures and organization using a more robust and comprehensive approach. This information is helpful for identifying inconsistencies of care around the globe to guide strategic development and to further document the current status of ESKD care as a means to monitor future progress. The next steps to enhance kidney care delivery are multifactorial. Preventing ESKD through appropriate AKI and CKD detection programs is essential. Furthermore, supporting non-dialysis CKD through enhanced public funding will slow the progression of kidney disease, thereby reducing the use of expensive and resource-intensive kidney replacement therapies and the burden of ESKD on patients and their families.

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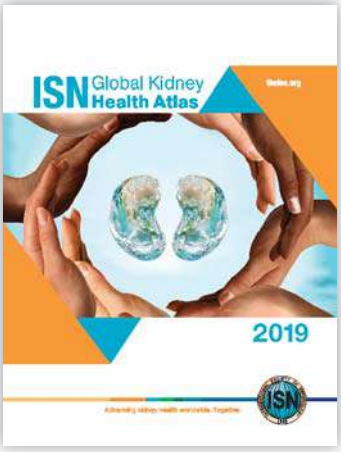

The GKHA Co-chairs would like to extend our profound gratitude to all the people that contributed to making this project another great success. We relied on our key stakeholders (leaders of the national nephrology societies and ISN regional board members) to provide and vet information from individual countries and regions. Several individuals have contributed in different ways to make this exercise fruitful despite the complexity of work and tight timeline. In particular, we would like to thank Meaghan Lunney who operationally led the project, drafted the report, and contributed to the analysis plan. We also thank Mohamed Osman for his great contribution and leadership with the desk research. We thank Kara Stephenson Gehman (Academe Partners Limited; academepartners.com) for her help in clarifying the report, and John Labots (John Labots Graphic Design Inc.; johnlabots.com) for presenting our analyses so appealingly. We thank Sandrine Damster, Senior Research Project Manager at the International Society of Nephrology (ISN), for her support in organizing and conducting the survey and her project management expertise. We thank the Alberta Kidney Disease Network (Sue Szigety, Sophanny Tiv) and ISN staff (Luca Segantini, Jo-Ann Donner, Luisa Strani, and Claire Van Der Linden) for their support. The leadership and support of the executive committee of the ISN towards the success of this initiative is greatly appreciated.

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Dr. David Johnson is full-time Director of the Metro South and Ipswich Nephrology and Transplant Service (MINTS) and Medical Director of the Queensland Renal Transplant Service at Princess Alexandra Hospital, Brisbane, Australia; Professor of Medicine and Professor of Population Health at University of Queensland; and Director of the Centre for Kidney Disease Research, Brisbane, Australia. He has a number of international leadership responsibilities, including President of the International Society for Peritoneal Dialysis, Councillor of the International Society of Nephrology (ISN), Co-Chair of the ISN Global Kidney Health Atlas, Co-Chair of the Global PDOPPS Steering Committee and Chair of SONG-PD. He is currently a chair or member of 10 national and 6 international guideline groups and has influenced policy and practice through his leadership as Deputy Chair of the Australian NHMRC Better Evidence and Translation in Chronic Kidney Disease (BEAT-CKD) program, Deputy Chair of the Australasian Kidney Trials Network (AKTN), Chair of the Primary Healthcare Education Advisory Committee to Kidney Health Australia (PEAK), Co-Chair of the Australasian Creatinine and eGFR Consensus Working Party, Co-Chair of the Australasian Proteinuria Consensus Working Party, Member and Past-Chair of the ANZDATA Registry Peritoneal Dialysis Working Group, and Past-Chair of the Queensland Statewide Renal Clinical Network.

Having published over 800 original manuscripts in peer-reviewed journals and presented over 470 abstracts at national and international scientific meetings, he brings critical expertise in designing and conducting multi-center, multi-national randomized controlled trials (RCTs), developing national and international registries, and using innovative research methodologies (such as registry-based RCTs). He has held lead roles in over 40 recent clinical studies, including high-impact, large, multi-center RCTs that have informed global clinical practice (e.g., IDEAL, balANZ, HONEYPOT, TESTING, HERO, IMPENDIA), and is currently principal investigator of the CKD-FIX trial.

He has won numerous awards for both his basic science and clinical research studies, including the Australian and New Zealand Society of Nephrology TJ Neale Award for “outstanding contributions to nephrologic science” (2005), the U.S. National Kidney Foundation International Distinguished Medal (2014) and the Canadian Society of Nephrology Dimitrios Oreopoulos Award (2017). He was a Queensland finalist for the Australian of the Year Award in 2009 and was awarded a Public Service Medal by the Governor-General of Australia in 2011 for outstanding public service, particularly for research into the early detection and management of kidney disease.

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Dr. Aminu Bello qualified as MD in Nigeria and underwent specialist clinical training in internal medicine and nephrology in Nigeria, the United Kingdom, and Canada. He obtained the Membership of the Royal College of Physicians (MRCP), and completed his Masters and PhD degrees in Nephrology/Epidemiology at the University of Sheffield in the United Kingdom (under the supervision of Prof Meguid El-Nahas). After completing his PhD, he went on to complete a post-doctoral clinical and research fellowship in nephrology at the University of Alberta, Canada (under the supervision of Dr. Marcello Tonelli).

Dr. Bello is a physician-scientist with major research interests in improving outcomes of patients with CKD. He is a member of the Alberta Kidney Disease Network (AKDN): a team of scientists, policymakers, clinical leaders, educators, and knowledge translation experts who study health services solutions to reduce the burden of CKD and other chronic diseases.

His work is funded by provincial and national research organizations including the Canadian Institutes of Health Research (CIHR). He reviews regularly for the major general medical and nephrology journals, including The Lancet, JAMA, BMJ, and Kidney International. He has over 100 peer-reviewed scientific publications.

A major substantive contribution he has made involved translating clinical research into practice and facilitating understanding of clinical practice guidelines. Dr. Bello was a co-author of the 2015 Canadian Society of Nephrology commentary on the KDIGO [Kidney Disease: Improving Global Outcomes] clinical practice guideline for CKD evaluation and management that contextualizes the global CKD management guideline for the Canadian health system. One issue that arose during the development of the commentary was the lack of an effective mechanism to monitor uptake of guidelines in primary care, where > 90% of patients with CKD are managed. Dr. Bello subsequently partnered with the Canadian Primary Care Sentinel Surveillance Network (CPCSSN) to establish a CKD surveillance system in Canadian primary care in collaboration with existing platforms (CDC CKD Surveillance in the United States and National CKD Audit teams in the United Kingdom) and national networks such as the Canadian Society of Nephrology, CANN-NET (Canadian Kidney Knowledge Translation and Generation Network), and Can-SOLVE CKD (Canadians Seeking Solutions and Innovations to Overcome Chronic Kidney Disease).

He is keenly interested in global health initiatives to improve nephrology practice and education in emerging nations. He is currently a Co-Chair for the International Society of Nephrology (ISN) Global Kidney Health Atlas Project; an initiative for capturing the kidney health care status across all regions and countries of the world to facilitate the development and implementation of strategies to enhance global equity in kidney care.

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ABBREVIATIONS

ACE	Angiotensin-converting enzyme
AKI	Acute kidney injury
ARB	Angiotensin II receptor blocker
CKD	Chronic kidney disease
CVC	Central venous catheter
ESKD	End-stage kidney disease
GFR	Glomerular filtration rate
GKHA	Global Kidney Health Atlas
HD	Hemodialysis
ISN	International Society of Nephrology
KDIGO	Kidney Disease: Improving Global Outcomes
KRT	Kidney replacement therapy
NCD	Non-communicable disease
NGO	Non-governmental organization
NIS	Newly Independent States [of the former Soviet Union]
OECD	Organisation for Economic Co-operation and Development
OSEA	Oceania and South East Asia
PCP	Primary care physician
PD	Peritoneal dialysis
PMP	Per million population
PPP	Purchasing power parity
PROMS	Patient-reported outcome measures
UHC	Universal health coverage
UN	United Nations
USD	United States Dollar
WHO	World Health Organization

Note: This list is not comprehensive, but covers frequently used abbreviations.

KEY TERMS

Appropriate referral and management: Availability of an organized system and/or structures to ensure that people with CKD who may benefit from specialist care are properly referred for specialist assessment.

Capacity: The ability to perform appropriate tasks effectively, efficiently, and sustainably.

Conservative (non-dialytic) kidney care: Comprehensive conservative care is defined as planned, holistic, patient-centered care for patients with CKD stage 5, according to Kidney Disease: Improving Global Outcomes (KDIGO).

Identification and early detection: Availability of an organized system and/or structures for identification of people with risk factors for CKD: hypertension, diabetes, cardiovascular diseases (e.g., ischemic heart disease, heart failure, peripheral vascular disease, and stroke), urological problems (e.g., structural urinary tract disease, kidney stones, prostatic disorders), multisystem diseases (e.g., systemic lupus erythematosus, rheumatoid arthritis, infective endocarditis, etc.), or a family history of kidney disease.

Identification: Measures performed among at-risk populations to identify individuals with risk factors or early stages of disease who do not yet have symptoms.

International dollar: Based on a standard exchange rate (purchasing power parity [ppp]), an international dollar would buy in a given country a comparable amount of goods and services that a U.S. dollar would buy in the United States.

KRT availability: Availability of an organized system and/or structures to deliver dialysis and/or kidney transplantation when and where needed.

Monitoring of complications, risk factor control, and disease progression: Availability of an organized system and/or structures to ensure that people with established CKD are receiving guideline-concordant clinical care.

Non-communicable diseases: Diseases that cannot be transmitted from person to person, notably, cardiovascular diseases (e.g., heart attack, stroke), cancer, chronic respiratory disease (e.g., chronic obstructive pulmonary disease, asthma), and diabetes.

Policy: An official decision or set of decisions designed to carry out a course of action endorsed by a government body, including a set of goals, priorities, and general directions for attaining these goals. A policy document may include a strategy to implement the policy.

Program: A planned set of activities or procedures directed at a specific purpose.

Registry: A systematic collection of data to evaluate specified outcomes for a defined population to serve one or more predetermined scientific, clinical, or policy purposes.

Strategy: A long-term plan designed to achieve a particular goal for AKI or CKD care.

Under development: Still being created or finalized; not yet in the implementation phase.

ABSTRACT

Background

End-stage kidney disease (ESKD) represents an advanced stage of CKD with an irreversible loss of kidney function, leading to a need for kidney replacement therapy (KRT). The global burden of ESKD is significant due to high treatment costs and extensive impacts on patient health and well-being. While a variety of treatment options exist, little is known about how access to treatment and characteristics of treatment delivery (e.g., quality indicators, funding mechanisms) vary around the globe. Additionally, the current scope of kidney-specific health information systems (i.e., registries, electronic health records) is unknown. Lastly, in light of multiple competing health priorities worldwide, it is important to understand variations in government prioritization and strategic planning processes to bridge policies and opportunities where appropriate. This Global Kidney Health Atlas (GKHA) is the outcome of an ISN initiative aimed at closing these knowledge gaps and coordinating efforts to facilitate the delivery of optimal ESKD care worldwide.

Objectives:

1. To provide a high-level overview of the burden of ESKD as well as the current state of ESKD care and how it is organized and structured around the world.
2. To conduct a comparative analysis of the capacity to deliver care across countries and regions in order to identify key strengths and weaknesses of various systems and explore opportunities for regional networking and collaboration to improve ESKD care.
3. To provide an advocacy tool to engage major stakeholders (e.g.,WHO, World Bank, UN, OECD, European Union, individual country governments) to support the expansion of available services for ESKD care.

Methods

Desk Research

In collaboration with an expert librarian, we conducted a two-part comprehensive search of government reports, academic research, and gray literature to synthesize the most current epidemiological data on the burden and treatment of ESKD. This literature search set the context for a groundbreaking detailed survey of key stakeholders.

GKHA Survey

To facilitate an understanding of how capacity for kidney care varies over time and between countries, the GKHA provides concise, relevant, and synthesized information on the delivery of care across different health systems. Together, these components of the GKHA provide a global perspective of the prevalence and incidence of treated ESKD, such as hemodialysis (HD),

peritoneal dialysis (PD), and transplantation. In addition, the GKHA summarizes the costs associated with delivering KRT and compares cost ratios of different treatment modalities across countries and regions. Moreover, it provides an overview of existing healthcare system structures for ESKD care, including: funding models for CKD and ESKD care; workforce capacity; availability and quality of KRT; health information systems; and leadership, advocacy, and barriers to optimal ESKD care. Finally, a synthesis, comparison, and analysis of country and regional data are provided to inform the efforts of policymakers, practitioners, and researchers to enhance access to and quality of care for patients with ESKD.

The overall approach is summarized in Table A.

Table A | Methods and data sources

Objective	Methods/ approach	Coverage/ elements	Primary data sources	Secondary data sources
To obtain a snapshot of individual country and regional health system characteristics, and specific elements relevant to ESKD care	■ Survey	■ WHO UHC Domains[1]	■ Survey data ■ Interviews	■ WHO Global Observatory ■ UN, World Bank and OECD reports on NCDs ■ Published data/reports
To obtain data on relevant ESKD treatment epidemiology (HD, PD, transplantation) across countries and regions	■ Scoping review	■ Estimates for ESKD incidence and prevalence ■ Estimates for KRT cost	■ Survey data ■ Interviews	■ Systematic reviews and consortia publications ■ World Health Report ■ World Health Indicators ■ Global NCD Repository ■ IDF Diabetes Atlas ■ WHF World Cardiovascular Disease Atlas ■ Kidney registries

1 Health finance and service delivery, health workforce, medicines and medical products, information systems, and governance and leadership.

ESKD = end-stage kidney disease, GBD = global burden of disease, HD = hemodialysis, IDF = International Diabetes Federation, KRT = kidney replacement therapy, NCDs = non-communicable diseases, OECD = Organisation for Economic Co-operation and Development, PD = peritoneal dialysis, UHC = universal health coverage, UN = United Nations, WHF = World Heart Federation, WHO = World Health Organization

Results

A total of 160 countries (out of 182 countries contacted) responded to the survey. The countries that responded to the survey account for 98% of the world's population. Service delivery practices, funding mechanisms, and available technologies vary widely across countries and regions. Key findings for each domain are as follows.

Health finance and service delivery

Nearly half of all countries (48%) provide public funding for non-dialysis CKD care, with 28% charging patients no fees and 20% charging some fees at the point of delivery. Public funding for non-dialysis CKD care is more prevalent in high income countries. Low income countries report the highest use of private funding for CKD care.

In total, 64% of countries provide public funding for KRT (dialysis and transplantation), with 43% charging no fees at the point of delivery and 21% charging some fees. Public funding for KRT is more prevalent in high income countries. Low income countries report the highest use of private funding for KRT. Over half of all countries provide public funding (either completely free or with some fees at the point of care delivery) for surgery to create vascular access for HD: 58% cover central venous catheter insertion, and 54% cover fistula or graft creation. Kidney transplantation surgery is publicly funded (either completely free or with some fees at the point of care delivery) in 53% of countries.

Health workforce for kidney care

Nephrologists are primarily responsible for ESKD in 92% of countries. Worldwide, the median number of nephrologists is 9.95 per million population (pmp). The density of nephrologists increases with income, with low income countries reporting the lowest prevalence (0.2 pmp), followed by lower-middle (1.6 pmp), upper-middle (10.8), and high (23.2 pmp) income countries. Similarly, the prevalence of nephrology trainees increases with income, with low income countries reporting the lowest prevalence (0.1 pmp), followed by lower-middle (0.6 pmp), upper-middle (1.2 pmp), and high (3.7 pmp) income countries.

Over 70% of countries reported a shortage of nephrologists. Low income countries reported the greatest shortages: over 90% reported workforce shortages of nephrologists, interventional radiologists, surgeons, and transplant coordinators.

Essential medicines and technologies

Chronic HD services are available in all countries that completed the survey. Chronic PD and kidney transplantation services are available in 76% and 74% of countries, respectively. Availability of chronic PD and transplantation services increases with income. Only 23% of low income countries offer either chronic PD or kidney transplantation.

Most countries, irrespective of income, reported the capacity to manage anemia and blood pressure. Similarly, in most countries, tests, facilities and treatments to manage electrolyte disorders and chronic metabolic acidosis are highly available, except for oral sodium bicarbonate or potassium exchange resins, which are available in just 72% and 62% of countries, respectively. The ability to manage renal bone disease varies. Most countries have the capacity to measure serum calcium and phosphorous and to administer calcium-phosphate binders. However, fewer countries have the capacity to administer non-calcium-based phosphate binders or cinacalcet. Serum parathyroid hormone measurement services are available in 65% of countries, and surgical services for parathyroidectomy are generally available in only 56% of countries.

Overall, in 72% of countries with available dialysis services, at least half of patients with ESKD are able to access dialysis at the onset of kidney failure. However, access in low income countries is quite low (5%). Among countries with PD available, only 4% report PD as the initial treatment for most ESKD patients.

Although 74% of countries offer kidney transplantation, accessibility to these services is low, particularly in lower-middle and low income countries. Among countries with kidney transplantation available, 64% of high income countries reported high access to care for most patients, compared to 30% of upper-middle, 13% of lower-middle, and 0% of low income countries.

Quality indicators for HD and PD are similarly measured and reported. Blood pressure is measured and reported most of the time (HD: 86%; PD: 85%), as is hemoglobin (HD: 88%; PD: 84%). Patient survival and bone mineral markers for both HD and PD patients are measured and reported in approximately 70% of countries. Technique survival is routinely measured and reported for HD patients in 51% of countries and for PD patients in 61% of countries. Small solute clearance and patient-reported outcome measures (PROMS) are only measured and reported in approximately 60% and 30% of countries, respectively. More countries measure and report quality indicators for kidney transplant recipients.

Conservative care is delivered in 81% of countries surveyed. The availability of conservative care does not appear to be associated with income level. However, access to chosen or medically-advised conservative care increases with country income level: 87% of high income countries offer chosen conservative care, compared to 64% of upper-middle, 43% of lower-middle and 33% of low income countries. The provision of non-medical components of conservative care such as psychological, cultural, and spiritual support for patients receiving conservative care also increases with country income, but remains low, being provided in just 52% of high, 30% of upper-middle, 31% of lower-middle, and 19% of low income countries.

Health information systems

Only 13 AKI registries and 19 non-dialysis CKD registries exist. Among the countries surveyed, 66% have dialysis registries (59% of which require provider participation) and 57% have transplantation registries (65% of which require provider participation).

Irrespective of income level, most countries screen people with hypertension, diabetes, or urological conditions for CKD. Chronic users of nephrotoxic medications, people with a family history of CKD, and high-risk ethnic groups are screened for CKD in few countries, regardless of country income level. Screening of patients with cardiovascular diseases, autoimmune or multisystem disorders, or those over 65 years of age is less common, and increases with country income level.

Leadership and governance

Overall, 73 (46%) countries have current national strategies for NCDs, and 21 (13%) countries have strategies under development. National strategies for improving CKD care exist in 69 (43%) countries. Among these, 32 (20%) are standalone strategies for CKD care and 37 (23%) are incorporated in general NCD management strategies. Overall, 53 (33%) countries have CKD-specific policies. No low income countries have policies, whereas 29% of lower-middle, 29% of upper-middle, and 55% of high income countries have policies.

Worldwide, AKI, CKD, and ESKD are recognized by governments as health priorities in only 13%, 51%, and 58% of countries, respectively. Governments of high and upper-middle income countries tend to recognize CKD and ESKD as health priorities more often. Similarly, there are few advocacy groups for AKI, CKD, and ESKD; they exist in only 14%, 63%, and 39% of countries worldwide. Both CKD and ESKD advocacy groups are more common in high, upper-middle, and lower-middle income countries than in low income countries.

The top barriers to optimal ESKD care are: economic factors (64% of countries), patient knowledge or attitude (63%); nephrologist availability (60%); physician availability, access, knowledge, and/or attitude (58%); distance from care or prolonged travel time (55%); and availability, access, and capability of the healthcare system (55%).

Conclusion

This second iteration of the GKHA focuses specifically on ESKD care. The survey results demonstrate significant inter- and intra-regional variability in current capacity to deliver ESKD care. Important gaps exist in the availability and affordability of services, workforce capacity, characteristics of ESKD care delivery, adoption of health information systems, and strategies and policies for CKD and ESKD care.

The findings have implications for the development of policies to promote optimal ESKD care delivery. Specifically, efforts should be directed toward preventing ESKD by providing affordable and appropriate AKI and CKD care. Detection programs targeted at high-risk individuals are needed, particularly for AKI. Increasing universal health coverage for medications in early-stage CKD is important to slow disease progression and prevent the need for costly ESKD therapies. Promoting PD and conservative care as treatment options in situations where HD may not be appropriate or too expensive may enable optimal and feasible ESKD care.

Overall, ESKD treatment strategies are complex, as they involve multiple key health system factors; characteristics of local contexts, such as competing priorities and resource limitations, must be considered. The aim of the GKHA initiative is to summarize the current global state of ESKD care. By sharing these findings, we hope to guide policy and advocacy efforts to promote optimal and universal ESKD care, and to provide benchmarks that will help countries track their progress over time.

SECTION 1

INTRODUCTION

1.1 CKD

Chronic kidney disease (CKD) is an immense public health problem; the already high burden of disease is increasing relentlessly worldwide, and the cost of providing adequate care for all CKD patients is overwhelming in many countries.[1-6] Previously known as chronic renal failure, CKD is a condition characterized by a gradual loss of kidney function. Because the kidneys play a critical role in filtering waste and excess fluid from the body, impaired kidney function can have detrimental effects to health. This can also lead to the development of other conditions, such as heart failure or cardiovascular problems. Approximately 10% of the world's population is living with CKD; however, CKD incidence and prevalence differ significantly across countries and world regions.[7,8] Although people of every age and race are affected by CKD, people from disadvantaged populations may be at higher risk for the condition (and associated morbidity and mortality) due to socio-economic factors and limited access to care.[7-11]

Figure 1.1 | Classification of CKD

- Low risk (if no other markers of kidney disease, no CKD)
- Moderately increased risk
- High risk
- Very high risk

				Persistent albuminuria categories Description and range		
				A1	A2	A3
				Normal to mildly increased	Moderately increased	Severely increased
				<30 mg/g <3 mg/mmol	30–300 mg/g 3–30 mg/mmol	>300 mg/g >30 mg/mmol
GFR categories Description and range	G1	Normal or high	≥90 ml/min per 1.73 m²			
	G2	Mildly decreased	60–89 ml/min per 1.73 m²			
	G3a	Mildly to moderately decreased	45–59 ml/min per 1.73 m²			
	G3b	Moderately to severely decreased	30–44 ml/min per 1.73 m²			
	G4	Severely decreased	15–29 ml/min per 1.73 m²			
	G5	Kidney failure	<15 ml/min per 1.73 m²			

Levin A, Stevens PE, Bilous RW, et al. Kidney Disease: Improving Global Outcomes (KDIGO) CKD Work Group. KDIGO 2012 clinical practice guideline for the evaluation and management of chronic kidney disease. Kidney Int Supp. 2013;3(1):1-150. Reproduced with permission.

In 2012, a nonprofit organization, Kidney Disease: Improving Global Outcomes (KDIGO),[12] updated the clinical definition of CKD to persistent (> 3 months) abnormal kidney function, as measured by a glomerular filtration rate (GFR) consistently below 60 ml/min/1.73m^2.

CKD is divided into six stages of worsening progression based on GFR (see Figure 1.1).[5] End-stage kidney disease (ESKD), or kidney failure, occurs when the estimated GFR is less than 15 ml/min/1.73m^2, at which point kidney replacement therapy (KRT) typically is required.

1.2 The burden of ESKD

CKD can progress to ESKD in a number of ways. High blood pressure, or hypertension, is one of the leading causes of worsening kidney function. Hypertension can be managed in a variety of ways, including through medications, diet, and physical activity. Signs of worsening kidney function are increased protein in the urine (proteinuria) or increased creatinine in the blood. It is important to monitor these markers over time and to use therapies to delay progression in order to manage CKD and prevent further kidney damage. Medications such as angiotensin-converting enzyme (ACE) inhibitors and angiotensin receptor blockers (ARBs) may help protect kidney function by reducing proteinuria and blood pressure.[13] Dietary changes such as reduced sodium intake may also reduce blood pressure and proteinuria,[14] thereby slowing or preventing disease progression to ESKD. Diets lower in protein may also lighten the workload on the kidneys, thereby reducing proteinuria and slowing the development of ESKD.[15]

Over 90% of people with ESKD in low and lower-middle income countries are not receiving KRT.

Despite these well-established preventive strategies, many people are living with ESKD. Approximately 0.1% of the world's population has ESKD, and estimates suggest a higher prevalence in upper-middle (0.1%) and high (0.2%) income countries, compared to low (0.05%) or lower-middle (0.07%) income countries.[7] However, the proportion of people with ESKD who are not receiving treatment in the form of dialysis or transplantation is much higher in low (96%) and lower-middle (90%) income countries than in upper-middle (70%) and high (40%) income countries (Figures 1.2, 1.3).[7] This limited access to KRT in low and lower-middle income countries warrants attention, as associated ESKD morbidity and mortality rates are high in these nations.

Although data on the incidence of ESKD are sparse, estimates suggest a number of contributory factors. These include a greater burden of ESKD risk factors (age, diabetes, hypertension, and obesity), a larger percentage of gross domestic product spent on health care, improving survival rates among those living with CKD, and increased access to KRT.[16] The incidence of diabetes-related ESKD is rising faster than the overall incidence of ESKD,[16] suggesting the importance of appropriate diabetes management practices to reduce the burden of ESKD.

ESKD morbidity and mortality depend greatly on the quality of treatment received. Limited access to dialysis is common in low and lower-middle income countries, resulting in a high number of preventable deaths. Kidney transplantation results in lower mortality and risk of cardiovascular events and improved quality of life compared with dialysis.[17] Regardless, access to transplantation is limited in many countries due to a number of health system (e.g., personnel, infrastructure, system coordination, and

financing) and cultural (e.g., public and professional attitudes, legal environment) factors.[18] Worldwide, patients are increasingly opting for conservative care as an alternative to KRT;[16] however, optimal delivery may not be possible in countries where palliative or end-of-life care is limited by resources.[19] Ensuring appropriate treatment for ESKD, whether dialysis, transplantation, or conservative care, is an important public health focus for major stakeholders around the world (i.e., the ISN, governments, patients, and care providers).

1.3 Treatment for ESKD

1.3.1 KRT

KRT involves either dialysis or kidney transplantation. There are two modalities of dialysis: peritoneal dialysis (PD) and hemodialysis (HD). In PD, a catheter is placed into the patient's abdomen and fluid is added to collect and remove waste from the body. PD is administered either continuously or intermittently. For patients with very low kidney function, continuous PD is recommended.[20] Typically, patients perform PD in their own homes.

In HD, blood is removed from the body and cleaned by a machine which uses a filter to remove waste and excess fluid. The duration and frequency of HD are important factors that influence treatment quality. A longer treatment time may be advantageous, particularly among those with significant volume overload.[21] While standard care practices involve dialysis three times per week, the potential benefits of more frequent treatments are currently being studied.[21] During

Figure 1.2 | The state of KRT need, access, and projections into the future

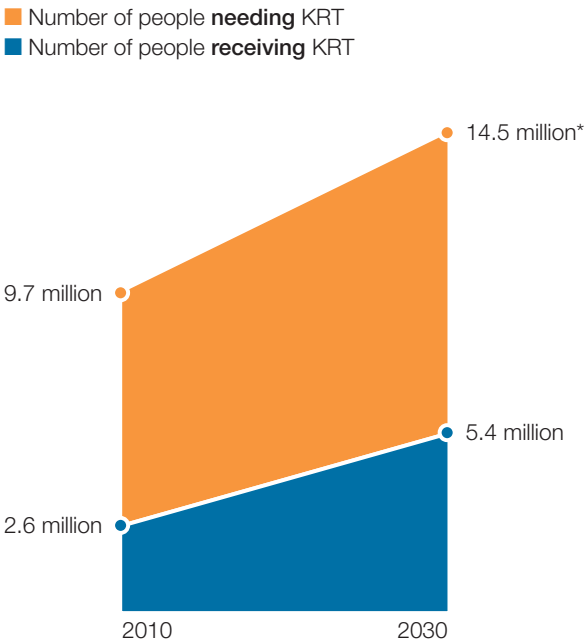
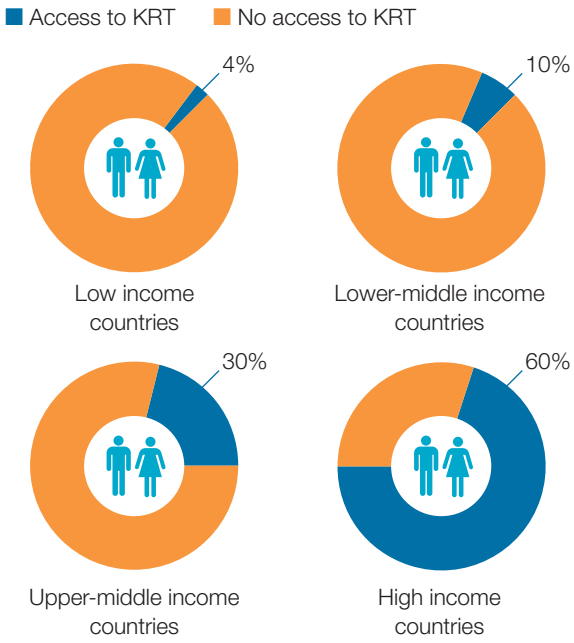


Figure 1.3 | Income-related variability in access to KRT



Estimated number of people needing and receiving KRT worldwide and by World Bank income groups in 2010 and 2030.[7]

* Calculated based on Liyanage et al.'s[7] projections of future KRT received.

Need defined as all patients with ESKD who require KRT (maintenance dialysis or kidney transplant) for survival.
Access defined as ESKD patients receiving KRT.
Regional variability depicted by World Bank income groups based on 2017 country classification. Available at: https://datahelpdesk.worldbank.org/knowledgebase/articles/906519-world-bank-country-and-lending-groups.

HD, blood is collected by the machine through one of three types of vascular access: fistula, graft, or catheter. HD can be performed at a hospital, a dialysis center, or a patient's home.

Deciding which modality is appropriate for each patient is a complex process. Often, available resources, expertise, and the patient's condition (i.e., stability, other health problems), guide the modality choice.[22] The decision also may depend on other factors, such as a patient's education level or desire for independence, wait time for transplantation, and distance to a dialysis center, among others.[23] The age of the patient at the time of treatment initiation may also be an important consideration.[24] The long-term effect of modality choice is unclear. Although some researchers compare the outcomes of PD and HD in registry studies,[23,25] they cannot consider differences in patients' health at the time of treatment initiation, which likely affects treatment outcomes. Additionally, because HD is more resource-intensive, PD may be more feasible than HD in lower income countries.[26]

Kidney transplantation is the other (perhaps preferable) KRT method whereby a recipient receives a kidney from either a live or a deceased donor. Prospective recipients are examined, and if eligible for surgery, are placed on a waiting list until an appropriate match is available. Following the transplantation surgery, patients are monitored and given anti-rejection medications or immunosuppressive agents to prevent their bodies from attacking their new kidneys. There are a number of barriers to kidney transplantation, especially a patient's socio-economic status.[27] Kidney transplantation also is highly resource-intensive, and many low and lower-middle income countries lack the human and financial resources to perform the surgery. Additionally, cultural, legal, and political barriers may impede organ donation, thereby limiting the benefit of this treatment option in some countries.[28]

The costs of KRT are exceedingly high and consume a significant proportion of health care budgets in developed countries. Many developed countries spend 2–3% of their health care budgets on treatment for patients with ESKD, even though these patients comprise just 0.1–0.2% of the total population. KRT remains unattainable in most developing countries due to associated costs.[3,5,10] It is estimated that more than 80% of all patients receiving treatment for ESKD reside in developed countries, which have relatively larger elderly populations and universal access to care for kidney disease. Developing countries have similar CKD incidence rates, but much lower prevalence of treated kidney failure than the developed world.[7,8] Many estimates place the reported prevalence of treated ESKD in sub-Saharan Africa at less than one-tenth that of the United States. Although comprehensive data are not readily available from less developed countries, it appears that proportionately fewer patients in these regions receive treatment for ESKD.[7,8]

Many developed countries spend 2–3% of their health care budgets on treatment for patients with ESKD, even though these patients comprise just 0.1–0.2% of the total population.

1.3.2 Conservative care

Conservative care refers to the management of health conditions using non-invasive practices, whereby the intent is to maintain health as much as possible and mitigate adverse events. The concept of conservative care in ESKD is relatively new.[29] In this context, conservative care is the management of ESKD without the use of KRT. In 2013, the definition of conservative care for ESKD management was established as "planned holistic patient-centered care for patients with G5 CKD,"[29] which can include a number of components such as interventions to delay worsening renal function or minimize adverse events; shared decision-making; active symptom management; communication plans;

psychological, social, and family support; and cultural or spiritual care.[29] Patients who receive conservative care are likely to experience symptoms, and therefore should supplement treatment with appropriate palliative care.[30,31]

Deciding whether to manage ESKD through traditional methods (dialysis or kidney transplantation) or conservative care requires careful consideration of each patient's health status and wishes. The initiation of dialysis in the elderly may actually result in increased frailty, loss of independence, and decreased cognitive functioning.[32] The burden of dialysis is substantial, and many patients prefer conservative care due to the impact of dialysis on quality of life.[33] Furthermore, dialysis, when compared to conservative care, does not appear to prolong life or improve physical and mental health outcomes among patients over 80 years of age or those with multiple other health problems.[34] The benefits of conservative care on patient quality of life, combined with a lack of evidence that dialysis leads to better outcomes in some settings and lower costs of conservative care[35] suggest that conservative care may be a more appropriate option for some patients with ESKD.

Conservative care may be optimal in resource-limited countries where dialysis is not available. While not a deliberate action intended to limit access to KRT, KDIGO refers to this as "choice-restricted conservative care."[29] Efforts to increase international awareness and standardization of conservative care, particularly in this setting, is important to optimize care for people with ESKD, and importantly, improve their quality of life.

1.3.3 Essential medications in ESKD care

The kidneys perform a number of important life functions. For example, they produce vitamin D, control blood pressure, and promote red blood cell production. As a result, people with ESKD take many medications, typically 10–12 a day,[36] to replace these functions. These often include phosphate binders, vitamin D preparations, calcimimetics, antihypertensives, antidiabetics, erythropoiesis-stimulating agents, and iron supplements.[36]

Not surprisingly, the high cost of medication is a major barrier to patients with ESKD. Among HD patients, those with lower incomes tend to exhibit lower adherence to medication regimens,[37] presumably due to the associated expense. Studies have shown that lower co-payments (i.e., lower out-of-pocket expenses for patients) are associated with better medication adherence among patients with chronic conditions such as diabetes and heart failure.[38]

1.4 Access to and quality of ESKD care worldwide

Despite therapies such as PD, HD, and kidney transplantation, many people in the world suffer from untreated ESKD. It has been estimated that over 2 million people die each year due to limited access to KRT, most of whom live in low and lower-middle income countries.[7] Dialysis is expensive in low and lower-middle income countries, and can cost nearly USD 1,500 per patient each year.[39] Even in countries where KRT is accessible, the quality of care may vary considerably, both within and between countries. Variation in dialysis practices may contribute to differences in KRT outcomes observed worldwide.[16] International guidelines may help narrow the gaps in care delivery, where possible. Additionally, government support and prioritization may improve both access to and quality of dialysis. However, it is important to consider other interventions that may be more

Over 2 million people die each year due to limited access to KRT.

cost-effective and pragmatic in settings where the costs of dialysis are a substantial burden.[39] For example, conservative care may be more appropriate in such settings, allowing patients to receive the best possible care when dialysis is not achievable.

Kidney transplantation often is the preferred type of KRT. However, gaps exist with respect to both organ availability and system-level resources required for the operation. Transplantation is highly resource-intensive, and shortages in deceased donor organs further limit access.[40] Limitations associated with infrastructure, the workforce, and legal frameworks as well as religious, cultural, and social constraints may contribute to low transplantation rates in some countries, among other factors.[41] Due to the success of kidney transplantation and limited organ supply, vulnerable people are at risk of organ trafficking and transplant tourism. Policies to protect donor and recipient safety, enforce standards, and prohibit unethical practices are needed.

1.5 AKI

Acute kidney injury (AKI) is a sudden reduction in kidney function (usually within a timeframe ranging from hours to days) and manifests clinically as a reversible acute increase of nitrogen waste products (serum urea and creatinine levels). In the past, AKI was referred to as acute renal failure (ARF).[42,43] AKI is a common condition associated with hospitalization and is especially common among critically ill patients, up to 40% of patients at ICU admission and 60% of patients during hospitalization. Common causes of AKI include fluid losses, infections, drugs, or toxins.[44,45] In developing countries, diarrheal illnesses and nephrotoxins (usually herbal medications) contribute significantly to the development of AKI.[43,44,46]

AKI and CKD are closely related; CKD is a known risk factor for AKI and vice versa. Both AKI and CKD increase the risk for cardiovascular disease,[47-49] among other adverse outcomes. Appropriate, timely treatment of AKI is critical, as it can reverse kidney damage; untreated, AKI can lead to CKD progression and ultimately, ESKD.

1.6 Health information systems

Health information systems are used to collect and manage health-related data. According to the World Health Organization (WHO), a health information system is critical for decision-making; its main functions include data generation and compilation, analysis and synthesis, and communication and use.[50]

Despite their importance, renal registries are lacking, particularly in lower income countries.

Well-designed health information systems are imperative for health care. Proper information management helps ensure patient safety and quality of care by reducing mistakes, improving clinical decision-making, and enabling access to information in real time.[51] In addition to health information systems that collect and store individual patient health information (e.g., electronic medical records), databases or registries of population health information are important tools for achieving quality health care. Patient registries can provide hospital administrators with information on current and future resource demands. Registries also help researchers learn more about health conditions,

thereby identifying ways to prevent or manage them. Moreover, the Agency for Healthcare Research and Quality (AHRQ) suggests that patient registries may facilitate the delivery of patient-centered care.[52] Collecting data on population health statistics over time also enables programs targeted at reducing the prevalence or incidence of a specific health condition to be evaluated.

Health information systems are critical tools in the management of kidney disease. Early diagnosis is important to slow progression; registries not only help primary care physicians manage people in these early stages, but also provide patients with tools to monitor and manage their health.[53] Registries of people with ESKD are important mechanisms for monitoring trends in disease burden and outcomes, and for policy planning (e.g., to estimate transplantation needs and plan appropriately for organ procurement systems). Despite their importance, renal registries are lacking, particularly in lower income countries.[54]

Monitoring population health data may be particularly important in low and lower-middle income countries. Current status must be documented to assess the impacts of future programs and predict future resource needs. Organizational, behavioral, and economic barriers, limited access to information systems, and a lack of capacity building may impede the creation and functionality of robust health information systems in these settings.[55] Future efforts to determine how to best operate these systems may be beneficial.

1.7 National health policies

Appropriate leadership and governance are essential healthcare system components[50] that facilitate priority setting, strategy development, and policymaking activities.[56] A policy is a specific official decision or set of decisions designed to carry out a course of action endorsed by a government body. In addition to priorities, goals, and general guidelines for their attainment, a policy document may include a detailed implementation strategy.[57] A health policy includes decisions, plans, and actions intended to achieve a specific health care goal.[58] Health policies create standardized approaches to promote equitable delivery of high-quality care, and can increase awareness and promote advocacy around important health matters. Advocacy groups or nonprofits may urge the creation of policies, or vice versa, by demonstrating need, importance, and interest. Despite the worldwide commitment to implementing noncommunicable disease (NCD) prevention and control strategies,[59] kidney disease policies often are lacking. Due to the burden of CKD and its association with other NCDs, its inclusion in these strategies may yield significant global benefits.[60]

1.8 A global ESKD strategy

The International Society of Nephrology (ISN) is dedicated to ensuring that all people have equitable access to sustainable kidney health. The ISN has developed several programs (www.theisn.org/programs) and initiatives (www.theisn.org/research) focused on education, training and research, and improving kidney disease awareness and detection.

The ISN recognizes the global challenges associated with diagnosis and treatment of CKD, especially in low and lower-middle income countries where other challenges abound. The ISN facilitates kidney care by providing educational assistance and guidance, training caregivers, and setting up facilities. When individual countries are unable to meet targets, support can be provided to

intergovernmental organizations through existing regional nephrology associations, e.g., AFRAN (African Association of Nephrology), SLANH (Society of Nephrology and Hypertension), and APSN (Asian Pacific Society of Nephrology).

Universal health care coverage for the prevention and early management of kidney disease greatly reduces disease burden and saves lives. AKI is reversible and early treatment can prevent progression to CKD. By increasing funding for AKI detection and treatment, various affiliated bodies can help prevent progression to more severe and costly conditions. Similarly, including the targeting of associated risk factors as part of the global health agenda may result in a significant reduction of CKD worldwide. National and regional governments can play an important role in this effort by improving legislation and increasing funding for treatment of kidney diseases. Increasing access to adequate treatment for risk factors, dialysis therapies, and kidney transplantation may further contribute to a reduction in the burden of kidney disease. A better understanding of the global capacity for kidney care and how that capacity varies around the world is essential to combatting kidney disease. Knowing which policies and healthcare systems currently facilitate or impede kidney care helps set benchmarks and opportunities for improvement. Furthermore, understanding how these capacities vary across regions or countries could inform recommendations and help identify areas where knowledge or resource sharing may yield great benefits.

The ISN's Closing the Gaps initiative provides a comprehensive strategy for CKD care worldwide.

A central goal of the ISN is its Closing the Gaps initiative (https://www.theisn.org/focus/ckd). This program provides a comprehensive strategy to address issues related to the delivery of CKD care worldwide by defining global needs and the current state of CKD care, and closing identified gaps through ISN research, education, and advocacy activities.[61] GKHA is part of this Closing the Gaps initiative and focuses on documenting the current capacity of care worldwide.[62] The GKHA is a multinational, cross-sectional survey designed to assess the current capacity for kidney care across all world regions. Published in 2017, the first iteration of the GKHA explored inter- and intra-national variability around the globe with respect to capacity for kidney care delivery, as defined by the WHO's domains of health services. The 2017 GKHA demonstrated significant inter- and intra-regional variability in global kidney care, with significant gaps related to the kidney health workforce, health service delivery, essential medicines and technologies, health financing, leadership and governance, health information systems, strategies and policy frameworks, and research capacity and development, particularly in low and middle income countries. These findings provided the foundation for a global CKD surveillance and benchmarking network.

Prevention of ESKD and improving access to care is a significant focus of the ISN (https://www.theisn.org/focus/eskd-focus); its programs are designed to improve understandings of ESKD and its determinants, highlight the necessary standards of ESKD care, and enhance the ability to treat ESKD in resource-constrained settings. This second iteration of the GKHA survey is aimed at defining the current global status of the structures and organization of ESKD care. It focuses on the capacity and readiness of nations to achieve universal access to equitable integrated ESKD care, including KRT and conservative care. By understanding and potentially helping to shape relevant health policies, practices, and infrastructure, the ISN aims to facilitate the implementation of equitable and ethical care for kidney patients in all regions and countries of the world.

SECTION 2

METHODS

2.1 Overview

This iteration of the GKHA is the product of collaborative efforts with regional and national project leaders. Two key methods were used to produce the atlas: a desk research component, which involved searching literature and other data sources to calculate estimates; and a key opinion leader survey, whereby three leaders from each country (a nephrology society leader, a leader of a consumer representative organization, and a policymaker) submitted details on national kidney care capacity and practices with a specific focus on KRT.

Assistance from international contacts, collaborators, ISN leaders, and regional board members was sought to facilitate both approaches during the development of the GKHA. Project leaders at the regional and national levels ensured the inclusion of local nephrology association leaders, consumer representatives, policymakers, and other opinion leaders across regions and countries. Project leaders organized and followed up on responses for all countries within a specific world region; played a liaison role between the steering committee, ISN, and regional stakeholders; helped gain access to additional data sources and contacts for surveys; identified or served as opinion leaders on the project for each specific world region; and identified or served as resource persons to vet and review regional data.

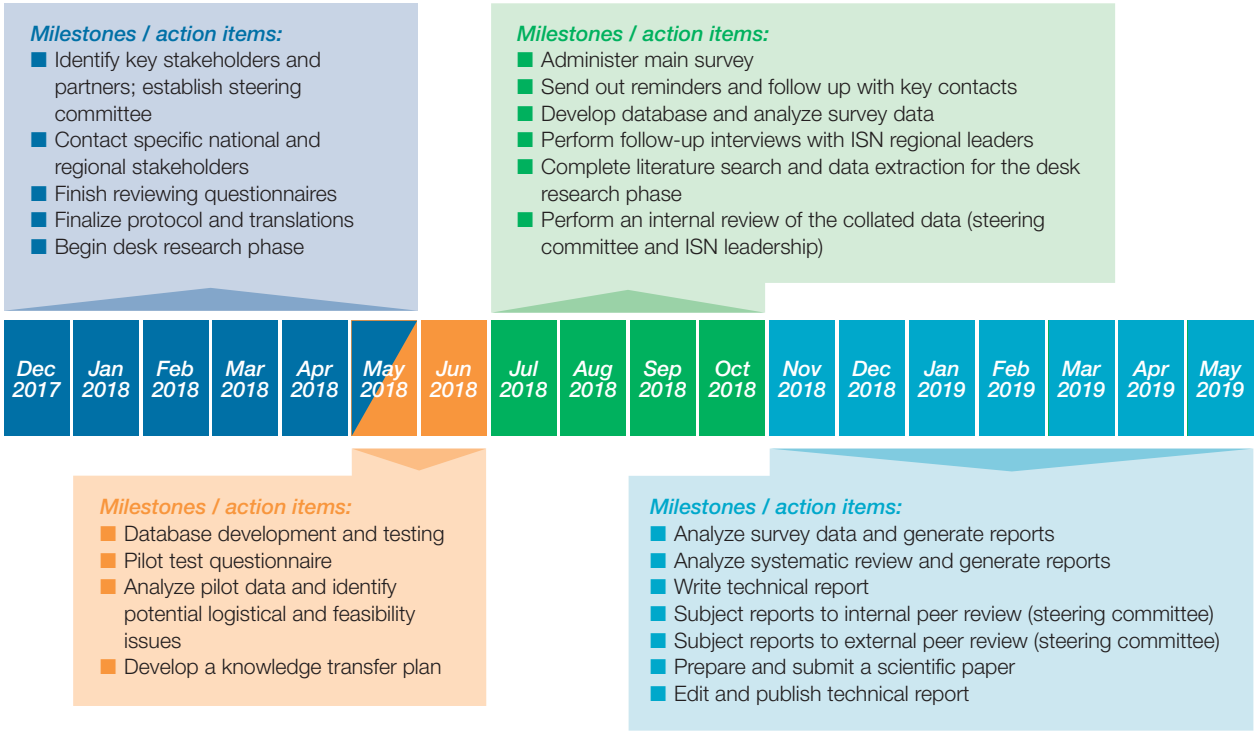
2.2 Scope and timeline

This report pertains to 218 countries recognized by the World Bank and specifically focuses on countries with ISN affiliate societies. Regional boards for the 10 ISN regions coordinated the work performed in each of the countries. Each region's work was led by a steering committee and working group within the stipulated timeline (Figure 2.1). The 10 ISN regions are:

1. Africa
2. Eastern & Central Europe
3. Latin America & the Caribbean*
4. Middle East
5. North America & the Caribbean*
6. North & East Asia
7. Oceania & South East Asia
8. Newly Independent States & Russia
9. South Asia
10. Western Europe

* Within the ISN, the islands of the Caribbean are affiliated with either North America & the Caribbean or Latin America & the Caribbean (see Appendix Table A2.1). For simplicity, the main body of the Atlas refers to these regions as North America and Latin America.

Figure 2.1 | Timeline of the GKHA project



2.3 Desk research

Desk research efforts included a review of published scientific literature, government reports, and other relevant data sources on the various aspects of ESKD epidemiology and health system characteristics corresponding to each of the WHO universal health coverage (UHC) domains (i.e., service delivery, health workforce, information systems, medicines and medical products, financing, and leadership) (Tables 2.1 and 2.2). Although published literature is important to consider, much of the available evidence was expected to be found in gray literature, including websites and reports with limited circulation. The national and regional project leaders helped identify these sources and conducted a detailed gray literature search by following a strategy designed by an expert research librarian. To gather information on current kidney care practices and the burden and costs of ESKD, three literature reviews were performed:

1. A broad literature review of national health system characteristics associated with each of the WHO UHC domains with an emphasis on important elements relevant to the organization and delivery of ESKD care.
2. A systematic review of relevant ESKD epidemiology data on disease burden and outcomes across countries and regions, including:
   - Prevalence and incidence of overall ESKD (treated);
   - Dialysis (HD and PD) incidence and prevalence;
   - HD incidence and prevalence;
   - PD incidence and prevalence;
   - Kidney transplantation incidence and prevalence;
   - Kidney transplantation by donor type (living or deceased).

Table 2.1 | General health system characteristics: WHO UHC domain and relevant data sources

Building blocks	Indicators/metrics	Data sources	Essential elements
Country profile	▶ Total population (millions) ▶ Gross national income per capita	▶ Literature reviews	▶ Demographic and economic characteristics
Health service delivery	▶ Description of healthcare system: public/private health insurance funded by national taxation/income contributions covering all/a proportion of the population; ratio of public/private MDs, renal care centers and/or HD centers.	▶ Literature reviews ▶ Surveys ▶ Interviews	▶ Comprehensiveness ▶ Accessibility ▶ Coverage ▶ Quality ▶ Coordination ▶ Efficiency ▶ Accountability
Health workforce	▶ Density of physicians (per 10,000 population) ▶ Density of nursing and midwifery personnel (per 10,000 population) ▶ Density of pharmaceutical personnel (per 10,000 population)	▶ Literature reviews ▶ Surveys ▶ Interviews ▶ WHO Global Observatory	▶ Reach and distribution ▶ Accessibility
Health information systems	▶ Health information system performance index	▶ Literature reviews ▶ Surveys ▶ Interviews	▶ Reach ▶ Scope ▶ Comprehensiveness
Essential medicines and technologies	▶ Median availability of selected generic medicines in public and private sectors (%) ▶ Median consumer price ratio of selected generic medicines in public and private sectors	▶ Literature reviews ▶ Surveys ▶ Interviews ▶ WHO Global Observatory	▶ Equitable access ▶ Quality and safety ▶ Cost-effectiveness
Health financing	▶ Total expenditure on health as a percentage of GDP ▶ General government expenditure on health as a percentage of total expenditure on health ▶ Private expenditure on health as a percentage of total expenditure on health ▶ General government expenditure on health as a percentage of total government expenditure ▶ Out-of-pocket expenditure as a percentage of private expenditure on health ▶ Private prepaid plans as a percentage of private expenditure on health	▶ Literature reviews ▶ WHO Global Observatory ▶ Database	▶ Availability of funds ▶ Extent of financial risk protection
Leadership and governance (national policies and frameworks)	▶ National non-communicable chronic disease policy (where it exists): overarching disease policy targeting long term conditions including CVD, diabetes, cancer, CKD, etc.	▶ Literature reviews ▶ Surveys ▶ Interviews ▶ WHO Global Observatory ▶ WHO NCD Strategy	▶ Existence of appropriate policies and strategies ▶ Adoption of policies and strategies

CKD = chronic kidney disease, CVD = cardiovascular disease, GDP = gross domestic product, HD = hemodialysis, MD = medical doctor, NCD = non-communicable disease, WHO = World Health Organization

Table 2.2 | CKD-centric health system characteristics: WHO UHC domains and relevant data sources

Domain	Indicators/metrics	Data sources	Essential elements
Health service delivery	▶ Number of health facilities for general CKD care ▶ KRT services (e.g., number of health facilities offering HD, PD, transplantation services per country) ▶ Public vs. private ▶ Non-dialysis CKD care structure ▶ KRT care structure	▶ Literature reviews ▶ Surveys ▶ Interviews	▶ Accessibility of dialysis and kidney transplant units to all residents within a country ▶ Access to medications ▶ Reimbursement of treatment and care ▶ Kidney transplant waiting list ▶ Access to psycho-social counseling and support ▶ Existence, strength, role of patient organizations in each country
Health workforce	▶ Number of nephrologists (per million population) ▶ Number of general physicians (per 10,000 population) ▶ Number of community health workers (per 10,000 population) ▶ Number of nurses (per 10,000 population) ▶ Regional distribution ▶ Nephrology trainees/graduates per year ▶ Availability of multidisciplinary teams	▶ Literature reviews ▶ Surveys ▶ Interviews ▶ WHO Global Observatory	▶ Professionals (GPs, nephrologists, diabetologists, endocrinologists, cardiologists, other related disciplines): total and as a ratio to whole population/ or dialysis population ▶ Financial resources, remuneration and incentives (including those for GPs/specialists to identify and manage CKD patients) ▶ Presence of other credentialed health care providers (e.g., nephrology nurses, dieticians)
Health information systems	▶ CKD (non-dialysis) registry ▶ KRT registry	▶ Literature reviews ▶ Surveys ▶ Interviews	▶ Reach ▶ Scope
Essential medicines and technologies	▶ ACEi/ARBs ▶ Statins ▶ Aspirin ▶ Other blood pressure medications ▶ Anemia medications (EPO/iron) ▶ CKD-MBD (calcium binders, renagel, cinacalcet) ▶ Specific (GN and transplant) ▶ Dialysis availability, access and coverage ▶ Transplant availability, access and coverage	▶ Literature reviews ▶ Surveys ▶ Interviews ▶ WHO Global Observatory (for some essential medicines)	▶ Access to medications that manage risk factors to prevent the development or progression of AKI or CKD
Health financing	▶ Total expenditure for CKD and ESKD ▶ Public and private contributions ▶ Out-of-pocket payments for essential medicines ▶ Out-of-pocket payments for non-dialysis CKD care ▶ Out-of-pocket payments for dialysis ▶ Out-of-pocket payments for transplant	▶ Literature reviews ▶ Surveys ▶ Interviews ▶ WHO Global Observatory	▶ Fund medications to prevent the development or progression of AKI or CKD
Leadership and governance (national policies and frameworks)	▶ Guidelines/frameworks on CKD and ESKD care ▶ Advocacy efforts and initiatives ▶ Early detection and prevention programs ▶ eGFR reporting	▶ Literature reviews ▶ Surveys ▶ Interviews ▶ WHO Global Observatory ▶ WHO NCD Strategy	▶ Availability, awareness, and adoption of policies and guidelines targeted toward kidney care

ACEi = angiotensin-converting enzyme inhibitor, ARB = angiotensin receptor blocker, AKI = acute kidney injury, CKD = chronic kidney disease, eGFR = estimated glomerular filtration rate, EPO = erythropoietin, GN = glomerulonephritis, GP = general practitioner, HD = hemodialysis, KRT = kidney replacement therapy, MBD = mineral bone disorder, MDT = multidisciplinary team, NCD = non-communicable disease, PD = peritoneal dialysis, WHO = World Health Organization

3. A scoping review of KRT cost estimates across countries and regions, including:
    - Cost of maintenance HD;
    - Cost of maintenance PD;
    - Cost of kidney transplantation (the first year); and
    - Cost ratio of maintenance HD to maintenance PD.

2.3.1 Scoping review of health system characteristics

The objective of the broad review was to obtain a snapshot of individual country and regional health system characteristics and specific elements relevant to ESKD care, focused on the general WHO UHC domains (Table 2.1) and specific domains related to kidney disease (Table 2.2). The comprehensive search strategy was developed in conjunction with an expert medical librarian.

Data sources included:

- Data and reports published by the WHO Global Observatory, UN, World Bank, and OECD;
- Both published and unpublished documents from international organizations/bodies (i.e., OECD, WHO, UN, Commonwealth Fund, World Bank, EU and its affiliates, etc.), and reports published by national governments (and occasionally regional governments within countries) on the organization and delivery of ESKD care; and
- Additional literature identified by key stakeholders (i.e., opinion leaders, national nephrology society leaders, ISN leaders) and through consultation with national nephrology societies and ISN regional boards.

2.3.2 Systematic review of relevant ESKD epidemiological data

The objective of the systematic review was to collect epidemiological data on the incidence and prevalence of KRT. Health system features across countries and regions with implications for ESKD care were also reviewed.

Data on key estimates of KRT were defined by the incidence and prevalence of ESKD (overall) and by different dialysis modalities (HD and PD) and kidney transplantation. These data were extracted from key reports, including annual reports of the ESKD renal registries and databases such as the Global Observatory on Donation and Transplantation (GODT), as well as identified relevant published and gray literature.

Data sources included:

- Statistics/published reports from national and regional government agencies (where available) identified during our gray literature search and by experts;
- Reports published by international organizations (WHO, World Bank, UN, and OECD), including world health statistics and health system reports;
- Leaders of national and regional nephrology associations and key opinion leaders who helped us gather data relevant to all aspects of the inventory;
- Published scientific literature on the various aspects of KRT epidemiology, economics, and organization of care according to standard guidelines[63,64] which, as in our previous work, provided additional complementary data for the atlas;[65,66]
- A gray literature search based on a strategy developed with assistance from an expert research librarian and tailored to the six UHC domains and the taxonomy developed by the WHO; and
- Renal registries that collect data on patients with ESKD who receive KRT, which were identified through a rapid review of publications and annual reports produced by governments and renal professional associations (Table 2.3).

Table 2.3 | Renal registries from the 10 ISN regions used as data sources[54]

ISN region	Renal registry	Year established	Incidence of ESKD	Prevalence of ESKD	Dialysis	Transplant
Africa	South Africa	2012	Yes	Yes	Yes	Yes
Eastern & Central Europe	Romanian Renal Registry	1993	Yes*	Yes*	Yes*	Yes*
	Turkish National Registry	1990	Yes	Yes	Yes	Yes
Latin America	Brazilian Registry of Dialysis	1998	Yes	Yes	Yes	-
	Colombia Healthcare Database	2008	-	-	Yes	Yes
	Latin American Dialysis and Transplantation Registry	1991	Yes	Yes	Yes	Yes
	Sociedad Argentina de Nefrologia (SAN)	2004	Yes	Yes	Yes	Yes
	Uruguayan Registry of Dialysis	1981	Yes	Yes	Yes	Yes
Middle East & North Africa	United Arab Emirates Renal Diseases Registry	1980	Yes	Yes	-	-
NIS & Russia	Russian Registry	1998	Yes*	Yes*	Yes*	Yes*
North America	British Columbia Renal Database	2008	-	-	-	-
	Canadian Organ Replacement Registry (CORR)	1994	Yes	Yes	Yes	Yes
	Canadian Pediatric End-Stage Renal Disease Database	2010	Yes	Yes	Yes	Yes
	Database of the Renal Research Institute (MONDO)	2000	-	-	-	-
	North American Pediatric Renal Trials and Collaborative Studies	1992	No	No	Yes	Yes
	The Renal Disease Registry (Ontario Renal Network)	1981	Yes	Yes	Yes	Yes
	US Renal Data System (USRDS)	1988	Yes	Yes	Yes	Yes
North & East Asia	Hong Kong Renal Registry	1985	Yes	Yes	Yes	Yes
	Korean Renal Registry	1985	Yes	Yes	Yes	Yes
	Malaysian National Renal Registry	1993	Yes	Yes	Yes	Yes
	Shanghai Dialysis Registry	1996	-	-	Yes	No
	Singapore Renal Registry	2001	Yes	Yes	Yes	Yes
	Taiwan Renal Registry Data System	1987	Yes	Yes	Yes	No
	Thailand Renal Replacement Therapy Registry	1997	Yes	Yes	Yes	Yes
OSEA	Australia and New Zealand Dialysis and Transplant Registry (ANZDATA)	1963	Yes	Yes	Yes	Yes
South Asia	None	-	-	-	-	-

* Covered in ERA-EDTA registry

continued

Table 2.3 | continued

ISN region	Renal registry	Year established	Incidence of ESKD	Prevalence of ESKD	Dialysis	Transplant
Western Europe	Austrian Dialysis and Transplant Registry (OEDTR)	1990	-	-	-	-
	Belgian Society of Nephrology (NBVN)	1996	-	-	-	-
	Catalan Renal Registry (RMRC)	1984	Yes*	Yes*	Yes*	Yes*
	Danish Registry on Regular Dialysis and Transplantation (DNSL)	1990	Yes*	Yes*	Yes*	Yes*
	Dutch Renal Registry (RENIN)	1986	Yes*	Yes*	Yes*	Yes*
	European Renal Association – European Dialysis and Transplant Association (ERA-EDTA)	1963	Yes	Yes	Yes	Yes
	Finnish Registry for Kidney Diseases	1964	Yes*	Yes*	Yes*	Yes*
	Greek Registry (Hellenic Society of Nephrology)	2000	Yes*	Yes*	Yes*	Yes*
	Groupement des Nephrologues Francophones de Belgique (GNFB)	1995	-	-	-	-
	Italian Dialysis and Transplant Registry (RIDT)	1996	Yes	Yes	Yes	Yes
	Norwegian Renal Registry	1994	Yes	Yes	Yes	Yes
	Portuguese Society of Nephrology	1997	Yes*	Yes*	Yes*	Yes*
	Scottish Renal Registry (SRR)	1991	Yes	Yes	Yes	Yes
	Spanish Society of Nephrology Register	1997	Yes	Yes	Yes	Yes
	Swedish Renal Registry	2007	Yes*	Yes*	Yes*	Yes*
	Swiss Registry	2013	Yes*	Yes*	Yes*	Yes*
	United Kingdom Renal Registry (UKRR)	1997	Yes	Yes	Yes	Yes
	Valencian Renal Registry	1992	Yes*	Yes*	Yes*	Yes*

Source: A global overview of renal registries: a systematic review, 2015.[54] Adapted with permission.

* Covered in ERA-EDTA registry

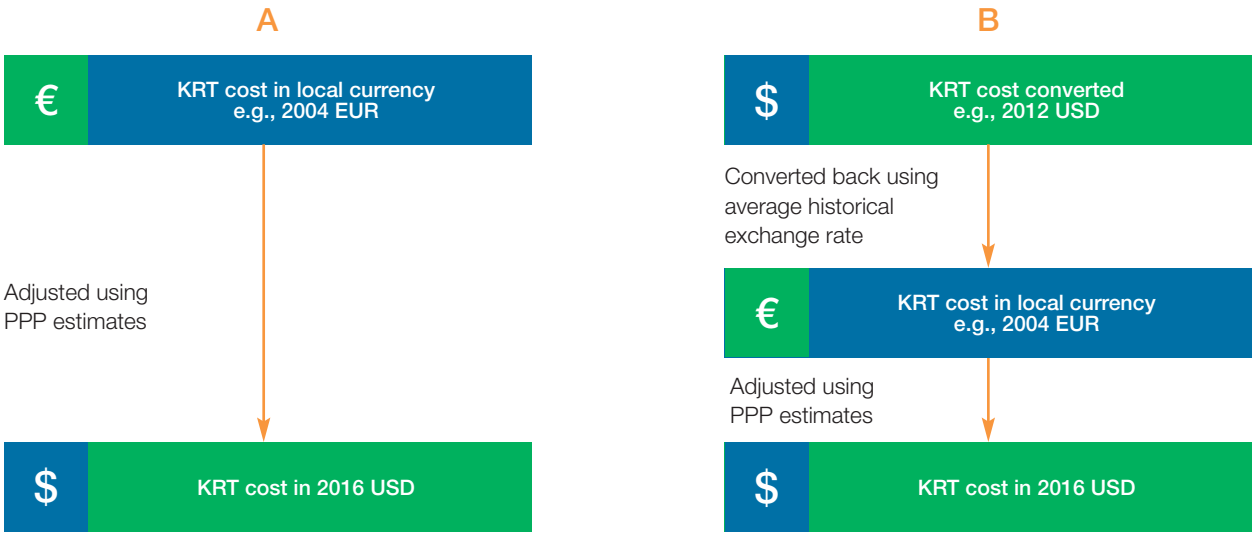
ERA-EDTA = European Renal Association: European Dialysis and Transplant Association, ISN = International Society of Nephrology, NIS = Newly Independent States

2.3.3 Scoping review of KRT cost estimates

To obtain data on KRT costs with implications for ESKD care, we conducted a scoping review of published articles and gray literature in which estimates for any of the different KRT modalities at the country level were reported. Since most of the included studies were from countries using different currencies and from different years, we used international cost comparison techniques (Figure 2.2).

The annual cost of KRT was extracted directly from a study if the average cost over a one-year period was provided. When KRT costs were reported per session, week, or month, we calculated annual costs using techniques similar to those in previously published studies. We also compared the average cost of maintenance HD with that of maintenance PD using an estimated cost ratio. If the ratio of the two means was greater than 1 (HD/PD>1), the PD cost was less than the HD cost, and vice versa (Figure 2.2).

Figure 2.2 | KRT cost adjustments and standardization



EUR = euro, KRT = kidney replacement therapy, PPP = purchasing power parity, USD = United States Dollar

Framework was adopted from a previously published economic study comparing diabetes treatment costs across countries. Reference: Seuring T, Archangelidi O, and Suhrcke M. The economic costs of type 2 diabetes: a global systematic review. Pharmacoeconomics 33.8 (2015): 811-831.

Adjustment using PPP estimates: PPP refers to a standard price index (exchange rate) by the International Comparison Program that enables currency and price level standardization between countries. Reference: World Bank Group. Purchasing Power Parities and the Real Size of World Economies. 2014. Available at: http://siteresources.worldbank.org/ICPEXT/Resources/2011-ICP-Global-Report.pdf

Historical exchange rate: The exchange rate between the local study currency and international dollars in the year of study conduct (or one year prior to publication if study year not stated).

2.4 Survey

2.4.1 Development and validation

The GKHA project was a multinational, cross-sectional survey conducted by the ISN to assess current capacity for KRT around the world. Through our international contacts, collaborators, ISN leaders, and regional boards, we identified project leaders at the regional and national levels, including national nephrology association leaders and opinion leaders.

Duties for regional project leaders included:

- To organize and follow up on responses for all countries within the region;
- To serve as a liaison between the steering committee, ISN, and regional stakeholders;
- To provide access to additional data sources and contacts for surveys;
- To identify or serve as an opinion leader on the project for the region; and
- To identify or serve as a resource person to vet and review regional data.

Duties for national project leaders included:

- To organize and follow up on responses within the country;
- To serve as a liaison between the steering committee, ISN, and national stakeholders;
- To provide access to additional data sources and contacts for surveys;
- To identify or serve as an opinion leader on the project for the country; and
- To identify or serve as a resource person to vet and review data for the country.

The GKHA questionnaire, which was designed to collect information about national capacities and responses to NCD prevention and control, was based on a framework informed by a number of documents, including WHO UHC: Supporting Country Needs, the ISN AKI "0 by 25" initiative, WHO NCD Surveys (2000, 2005, 2010, 2013), the World Heart Federation "25 by 25" initiative, the International Diabetes Federation Global Diabetes Atlas, the WHO Global Atlas on Cardiovascular Disease Prevention and Control, Lancet commissions in other chronic disease domains, as well as multiple UN policy documents on strategies and policy for NCDs.[69-72]

The initial survey questions were further developed through a series of reviews with relevant experts, the ISN Executive Committee, and regional leadership. The questionnaire was peer reviewed for content validity and comprehensiveness before it was piloted with the 10 ISN regional boards to identify any logistical and feasibility issues (e.g., translation needs). The format and content of the questionnaire were finalized based on feedback and identified issues, including translating the original English language survey instrument into French and Spanish.

2.4.2 Structure

The questionnaire was designed in five modules that assessed the national and regional profiles for readiness, capacity, and response to ESKD corresponding to each of the six UHC domains.[50] Specifically, the modules focused on:

- Health finance and service delivery (UHC domains 1 and 2), with questions evaluating funding mechanisms (CKD and KRT) and intra-national variations in ESKD care delivery and oversight;
- Health workforce for nephrology care (UHC domain 3), with questions evaluating clinical responsibility and availability of health care providers essential for ESKD care delivery;
- Essential medications and health product access for ESKD care (UHC domain 4), with questions evaluating the capacity for KRT service provision, preparation for KRT, and nutritional services; access to dialysis and transplant options and the quality of those options; access to conservative care; KRT accessibility and affordability, and cost reimbursement plans;

- Health information systems and statistics (UHC domain 5), with questions evaluating the availability of registries and/or other surveillance systems for AKI or CKD; and
- Leadership and governance (UHC domain 6), with questions evaluating national health policies and strategies, advocacy (AKI, CKD, ESKD), and barriers to optimal ESKD care delivery.

The questionnaire was accompanied by a detailed information sheet about the GKHA, detailed instructions for completion, and a glossary defining key terms used in the survey.

2.4.3 Sampling

A non-probability, purposive sampling approach was employed to identify potential survey respondents. Specifically, national and regional nephrology leaders identified key stakeholders through the ISN, including representatives of national nephrology societies, policymakers (including those directly responsible for the organization of kidney care and those with more general responsibilities), patient organizations, foundations, and other advocacy groups.

Key stakeholders were sent invitations to participate that included a link to the survey's online portal (an electronic questionnaire via REDCap Cloud, www.redcapcloud.com). Respondents were asked specifically about important within-country heterogeneity and were asked to identify other potential key respondents, thereby increasing the likelihood that relevant information would be widely captured. The survey was conducted from July to September 2018. During this period, intensive follow-ups were conducted by email and telephone with ISN regional and national leaders to ensure complete and timely responses.

2.4.4 Data handling

To facilitate data collation, responses to the French and Spanish surveys were first converted to English by certified translators. Then, data from all individual questionnaires were automatically extracted and cleaned using Microsoft Excel and merged into a single file to create the global database. This was housed in a secured centralized computer system with automated backups. ISN regional leaders were consulted to ensure that collated data were consistent with their understandings and were of high quality. Each regional board reviewed their output to clarify any ambiguity or inconsistencies. Any major inconsistencies that remained after the reviews were systematically addressed during follow-up inquiries with the stakeholders involved with the survey. Further validation was carried out at the national and regional levels by triangulating the findings with published literature and gray sources of information (i.e., government reports and other sources provided by the survey respondents).

2.4.5 Analysis

A framework developed by the WHO, Assessing National Capacity for the Prevention and Control of NCDs was leveraged during statistical analysis of the collated data.[73] The analysis was conducted using STATA 15 software (Stata Corporation, 2017). Using country as the unit of analysis, responses were summarized based on the key questionnaire domains using a descriptive statistical approach and reported as counts and percentages. Results were stratified by ISN region and by World Bank income group. Results were examined with a focus on identifying key gaps and challenges across the various domains based on the pre-existing protocol, and reported according to the Guidelines for Accurate and Transparent Health Estimates Reporting (GATHER) statement.[74]

DESK RESEARCH
FINDINGS

SECTION 3

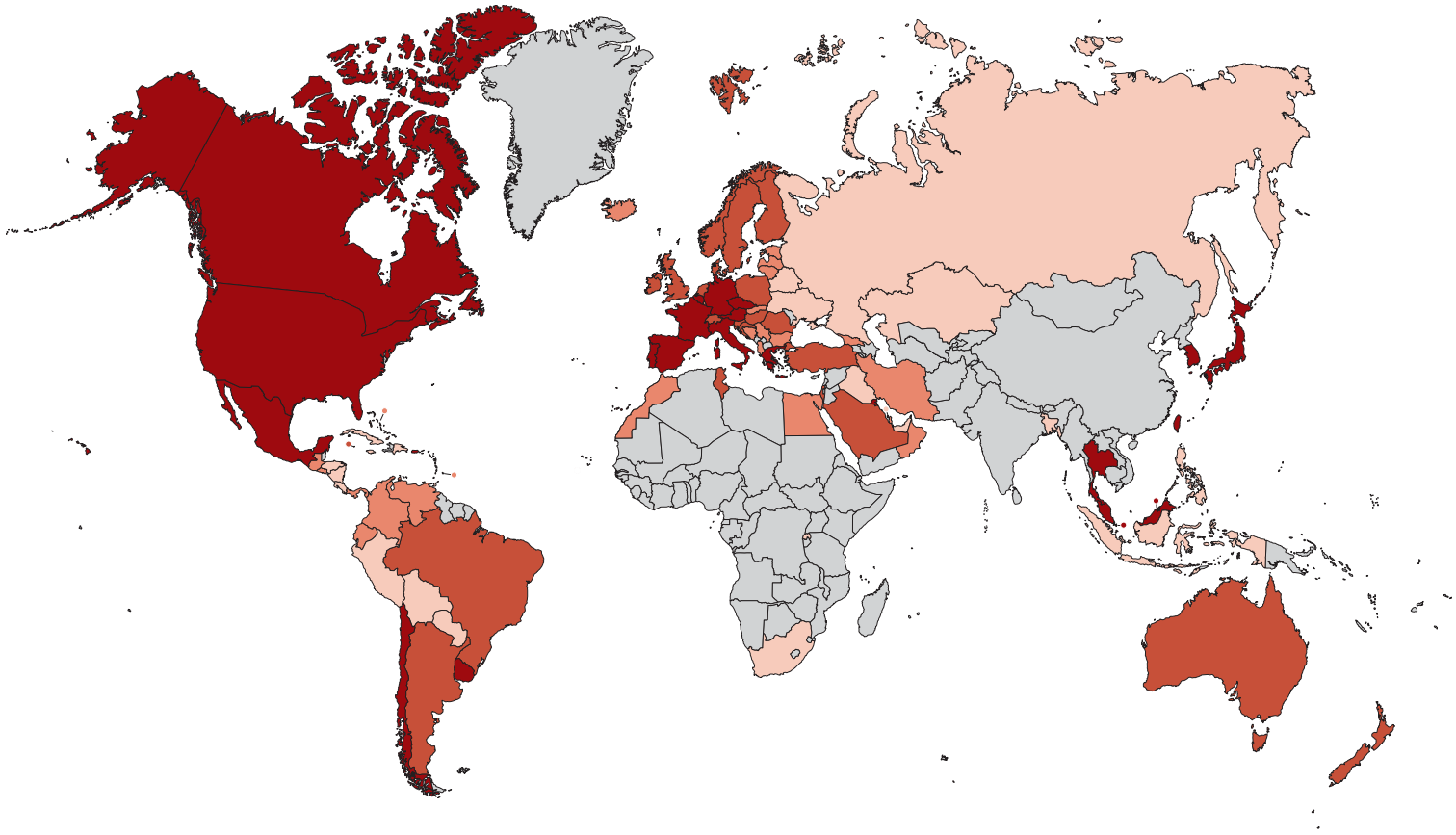
DESK RESEARCH FINDINGS

3.1 Treated ESKD

Information on the prevalence of treated ESKD (i.e., the number of dialysis patients or kidney transplant recipients) is available in 42% (n = 91) of countries worldwide (Map 3.1.1). The majority of these are high or upper-middle income countries. Only one low income country (Rwanda) and less than 10% of African countries have data available on the prevalence of treated ESKD. The average number of people receiving ESKD globally is 759 per million population (pmp); prevalence ranges greatly from 4 pmp in Rwanda to 3392 pmp in Taiwan. The prevalence of treated ESKD increases with income level. The rate of treated ESKD is 966 pmp in high income countries compared to 550.2 pmp in

Map 3.1.1 | Global prevalence of treated ESKD

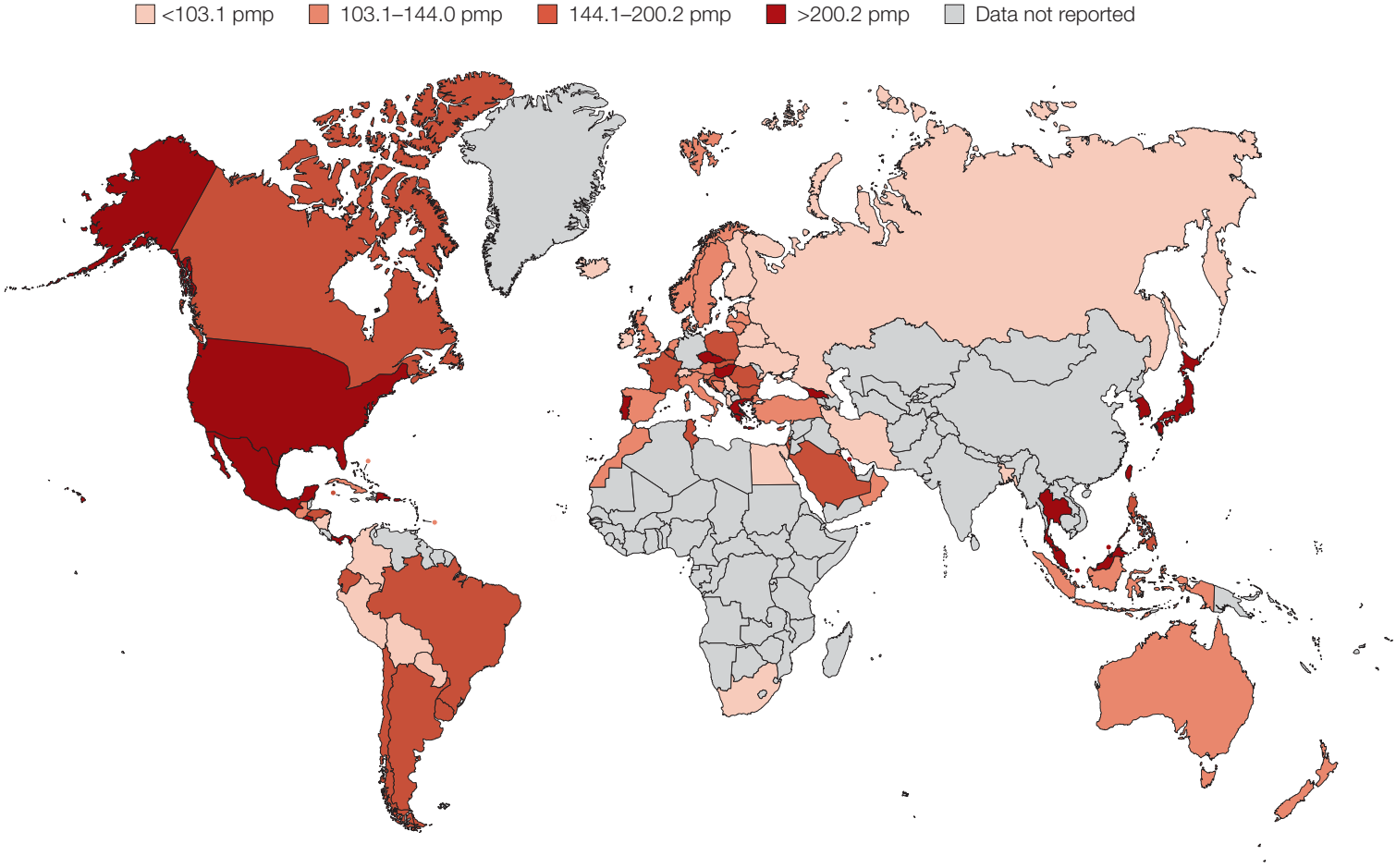
Rate per million population (pmp), age ≥ 18 years



upper-middle, 321 pmp in lower-middle, and 4.4 pmp in low income countries. Prevalence rates are below the global average in Africa, Latin America, the Middle East, North America, NIS and Russia, and South Asia, and above or equal to the global average in Eastern and Central Europe, North and East Asia, Oceania and South East Asia (OSEA), and Western Europe.

Map 3.1.2 | Global incidence of treated ESKD

Rate per million population (pmp), age ≥ 18 years



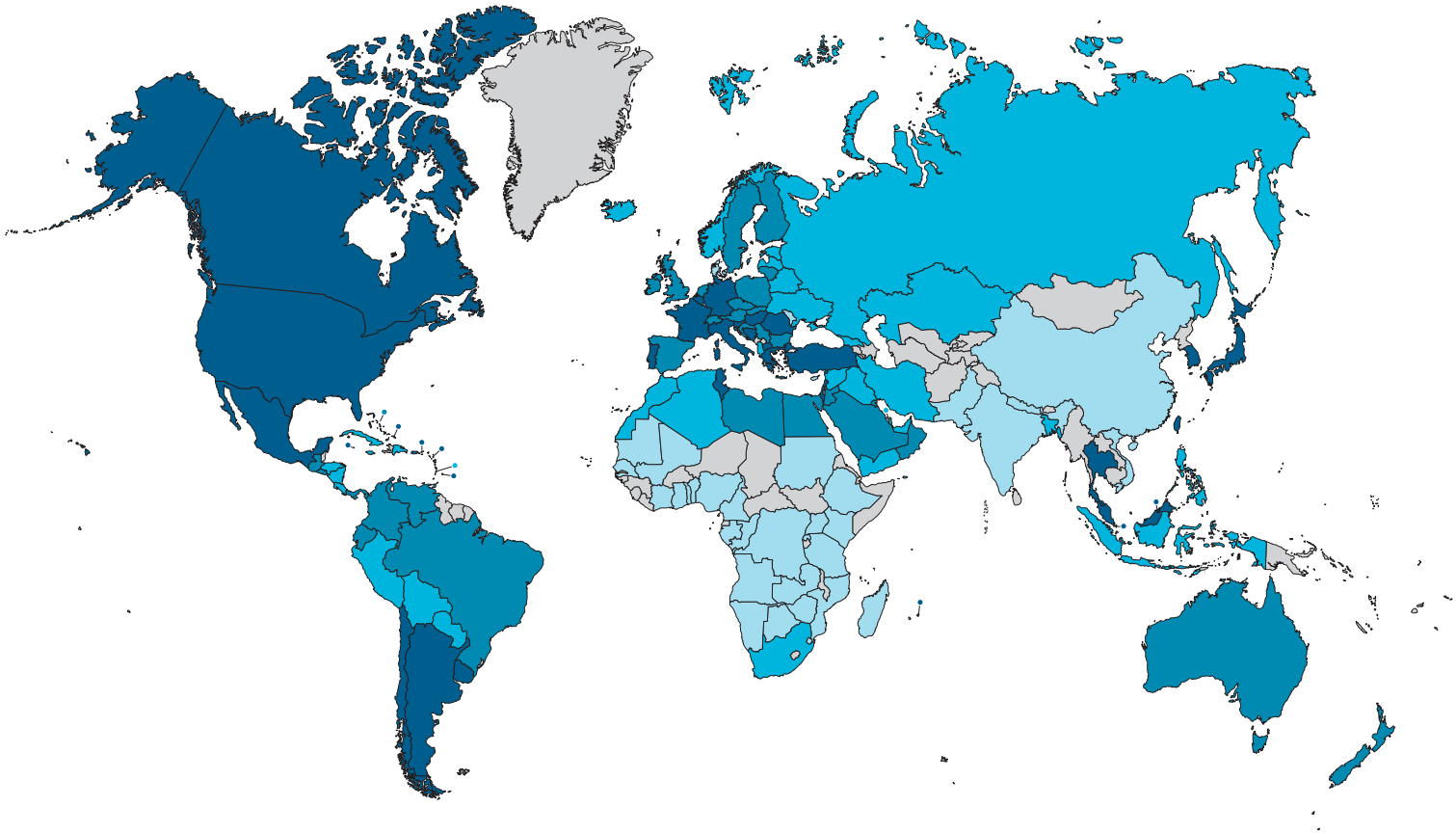
Information on the incidence of treated ESKD (i.e., new dialysis patients or kidney transplant recipients) is available in 36% (n = 79) of countries worldwide (Map 3.1.2). No low income countries, and less than 10% of African countries have data available. The average number of new ESKD diagnoses worldwide is 144 pmp, ranging greatly from 20.2 pmp in Paraguay to 493 pmp in Taiwan. Incidence of treated ESKD increases with income level. In high income countries, the incidence of ESKD treatment is 149 pmp, compared to 126 pmp in upper-middle and 129.9 pmp in lower-middle income countries. The incidence of treated ESKD is below the global average in Africa, the Middle East, NIS and Russia, South Asia, and Western Europe, and above the global average in Eastern and Central Europe, Latin America, North America, North and East Asia, and OSEA.

3.2 Chronic dialysis

Information on the prevalence of chronic dialysis, (either HD or PD) is available in 61% (n = 133) of countries worldwide (Map 3.2.1). The average prevalence of chronic dialysis globally is 343 pmp, ranging greatly from 0.5 pmp in Tanzania to 3251 pmp in Taiwan. The prevalence of chronic dialysis increases with income level. In high income countries, the prevalence of chronic dialysis is 620 pmp compared to 339 pmp in upper-middle, 94.5 pmp in lower-middle, and 3.4 pmp in low income countries. Prevalence rates are below the global average in Africa, NIS and Russia, and South Asia, and above the global average in Eastern and Central Europe, Latin America, the Middle East, North America, North and East Asia, OSEA, and Western Europe.

Map 3.2.1 | Global prevalence of chronic dialysis

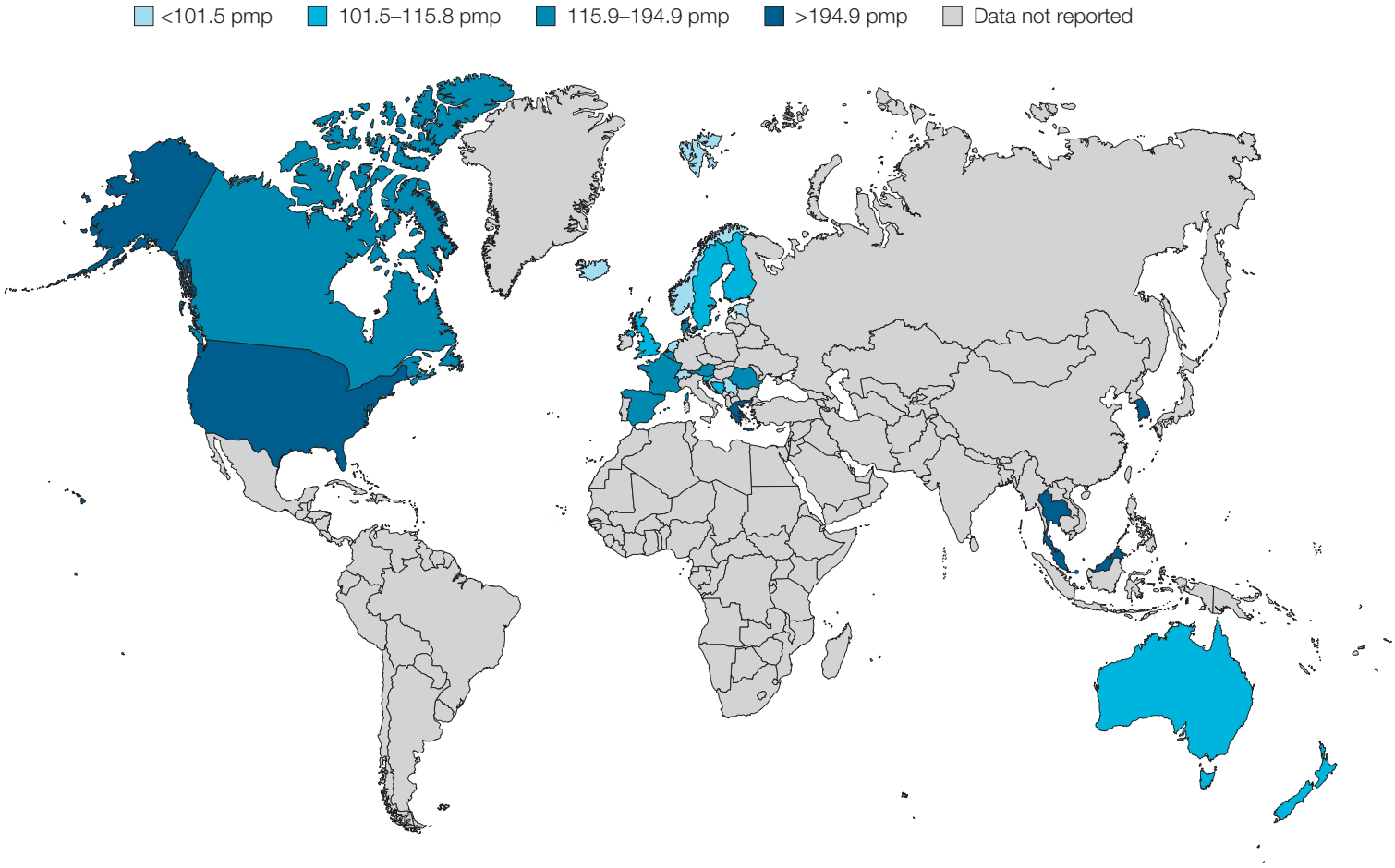
Rate per million population (pmp), age ≥ 18 years



Information on the incidence of chronic dialysis (either HD or PD) is limited (Map 3.2.2). Only 12% of countries worldwide (n = 26), all of which are upper-middle (n = 5) or high (n = 21) income, have data available. Countries in Africa, Latin America, the Middle East, North and East Asia, NIS and Russia, and South Asia do not have any data available on the incidence of chronic dialysis. Globally, the average number of people initiating chronic dialysis is 116 pmp, ranging from 83.5 pmp in Iceland to 374.1 pmp in the United States. The incidence rate of chronic dialysis is higher in the 5 upper-middle income countries (175.9 pmp) than in the 21 high income countries (114.5 pmp). Incidence rates are below the global average in Eastern and Central Europe, and Western Europe, and above the global average in North America and OSEA.

Map 3.2.2 | Global incidence of chronic dialysis

Rate per million population (pmp), age ≥ 18 years

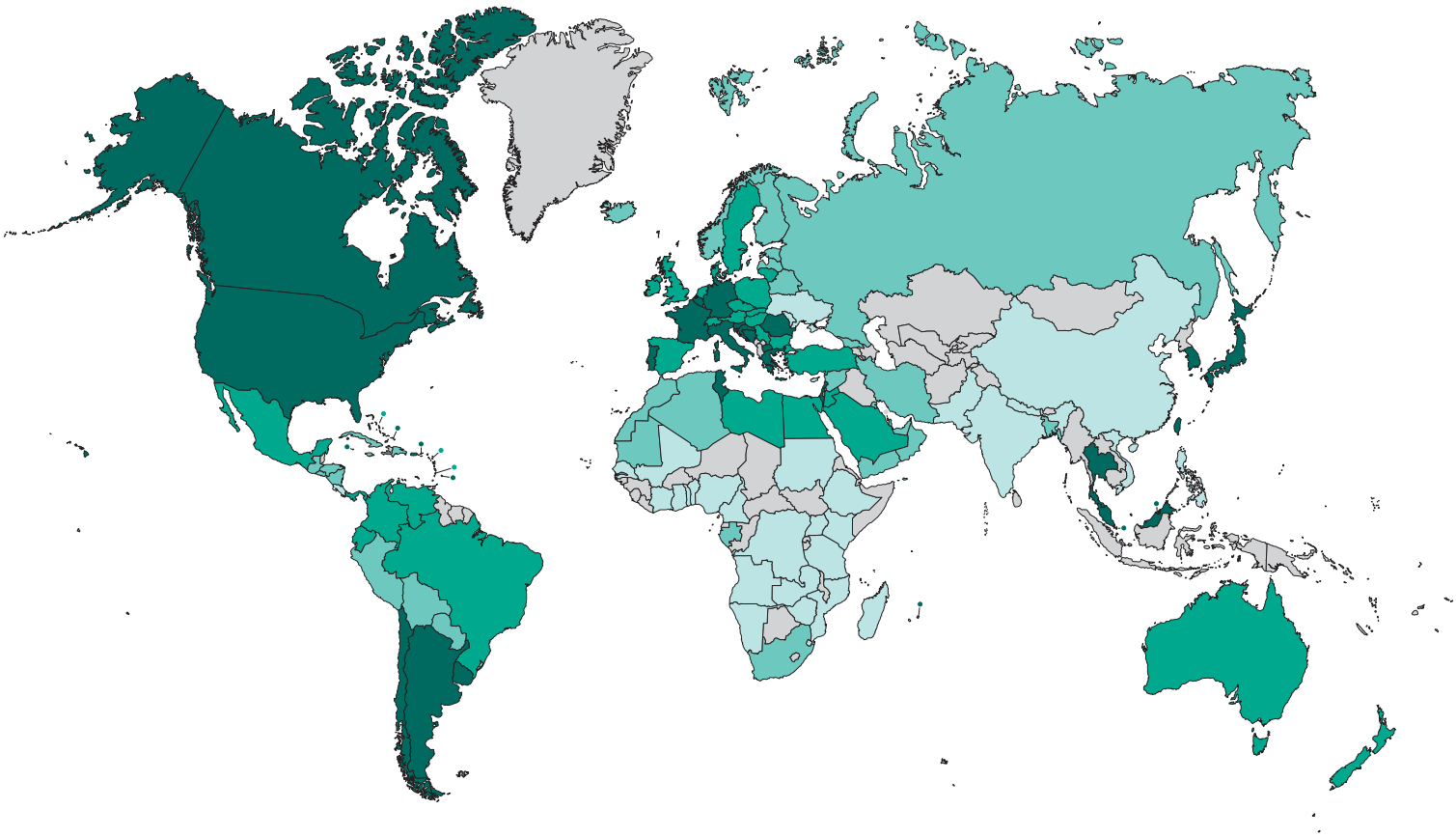


3.3 Chronic HD

Information on the prevalence of chronic HD is available in 58% (n = 126) of countries worldwide (Map 3.3.1). Globally, the average prevalence of chronic HD is 298.4 pmp, ranging greatly from 0.4 pmp in the Congo to 2148.4 pmp in Japan. Prevalence of chronic HD increases with income level. In high income countries, the number of people receiving chronic HD is 513.7 pmp, compared to 334.1 pmp in upper-middle, 67.9 pmp in lower-middle, and 3.9 pmp in low income countries. Average prevalence of chronic HD is below the global average in Africa, the Middle East, NIS and Russia, and South Asia, and above the global average in Eastern and Central Europe, Latin America, North America, North and East Asia, OSEA, and Western Europe.

Map 3.3.1 | Global prevalence of chronic HD

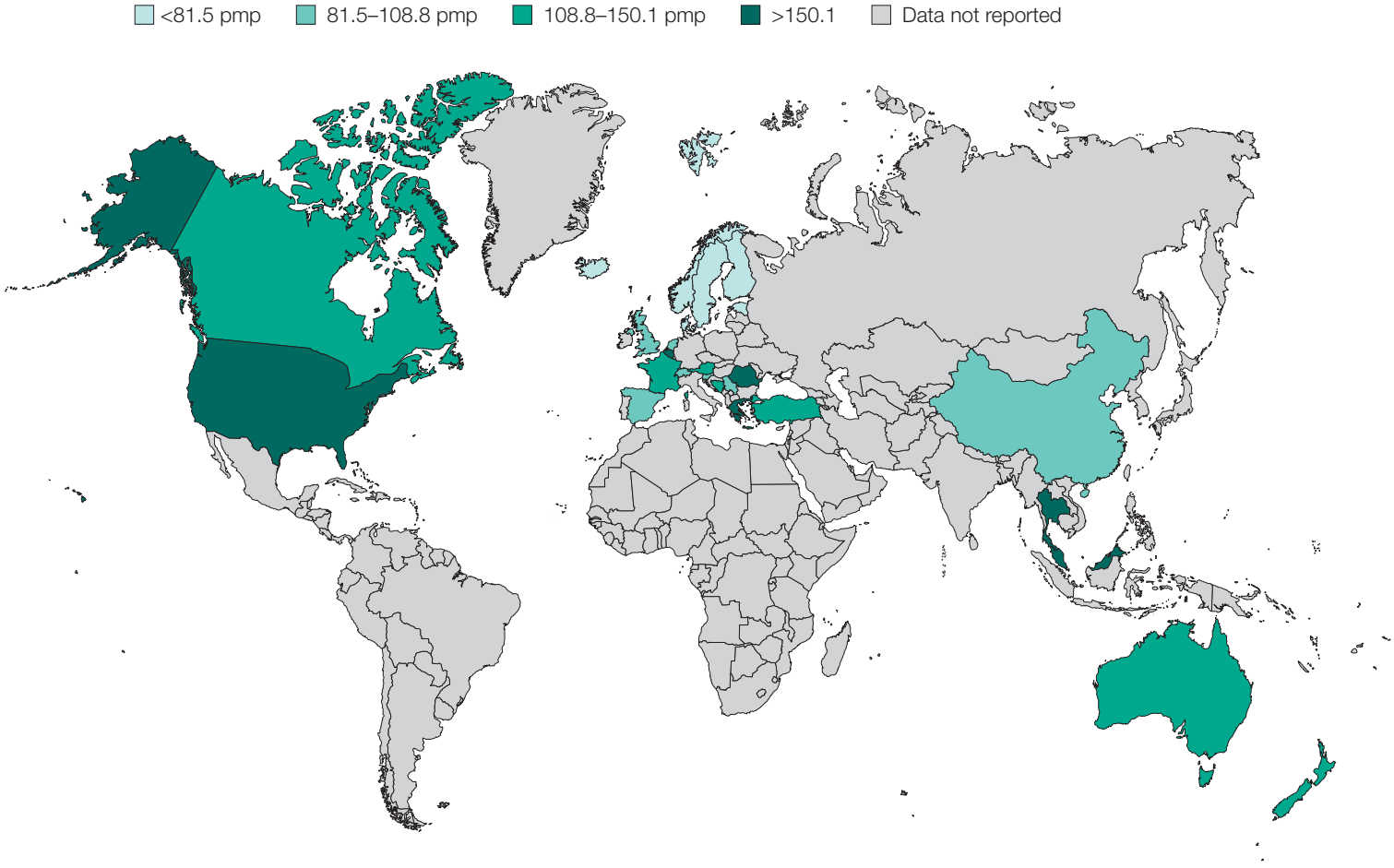
Rate per million population (pmp), age ≥ 18 years



Information on the incidence of chronic HD is available in 12% (n = 26) of countries worldwide, all of which are upper-middle (n = 7) or high income (n = 19) (Map 3.3.2). Data are not available for countries in Africa, Latin America, Middle East, NIS and Russia, or South Asia. Globally, the average number of people initiating chronic HD treatment is 108.8 pmp, ranging from 65.3 pmp in Norway to 336.7 pmp in the United States. Incidence rates are higher in upper-middle income countries (122.5 pmp) than in high income countries (101.5 pmp). Average incidence rates are below the global average in Eastern and Central Europe, North and East Asia, and Western Europe, and above the global average in North America and OSEA.

Map 3.3.2 | Global incidence of chronic HD

Rate per million population (pmp), age ≥ 18 years

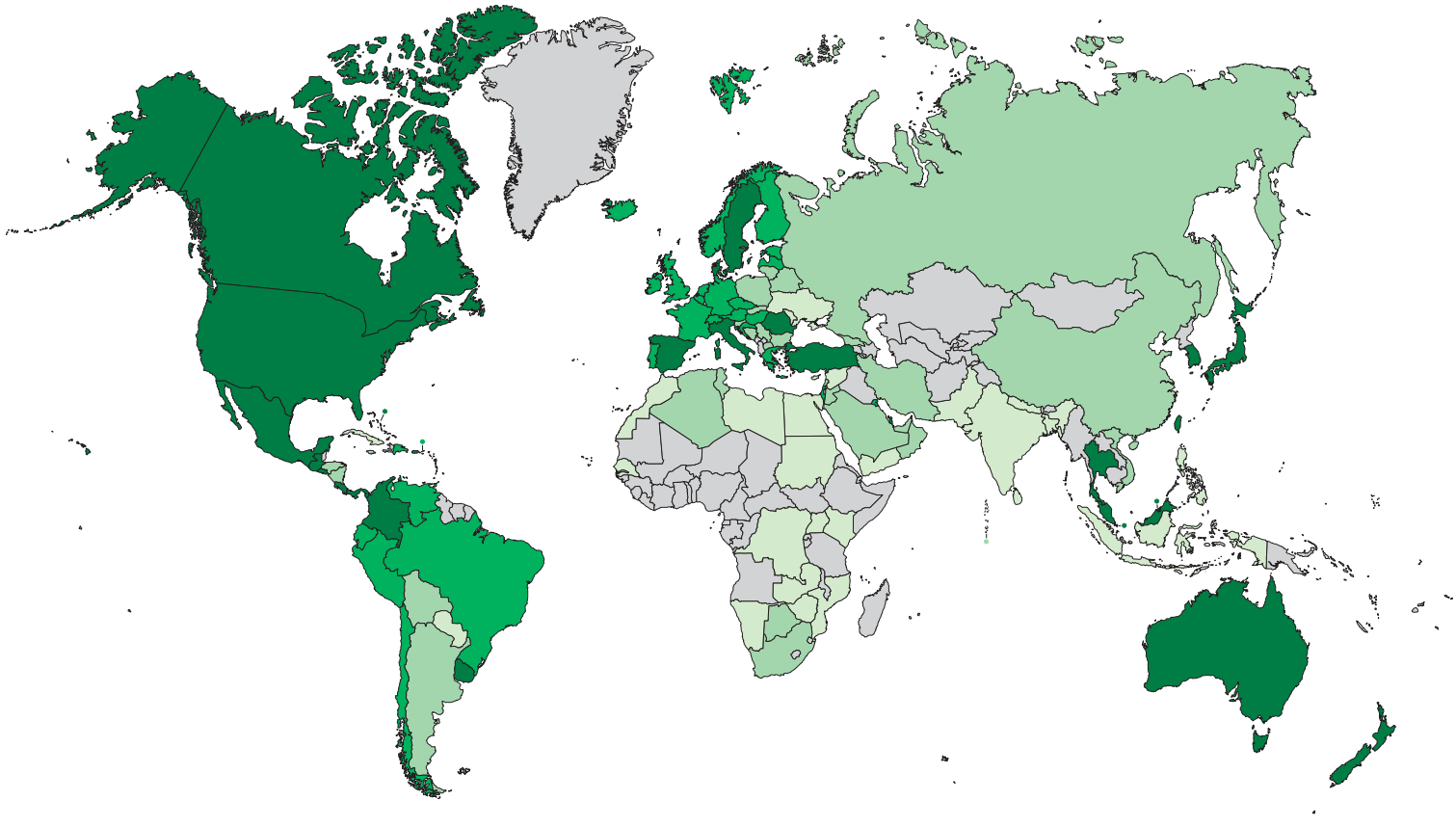


3.4 Chronic PD

Half of all countries worldwide (n = 110) have information available on the prevalence of chronic PD (Map 3.4.1). Globally, the average number of people receiving chronic PD treatment is 38.1 pmp, ranging from 0.1 pmp in Egypt to 486.7 pmp in Mexico. Prevalence of chronic PD increases with income. In high income countries, prevalence is 53 pmp, compared to 26.5 pmp in upper-middle, 5.8 pmp in lower-middle, and 0.9 pmp in low income countries. Prevalence of chronic PD is below the global average in Africa, Eastern and Central Europe, the Middle East, NIS and Russia, and South Asia, and above the global average in Latin America, North America, North and East Asia, OSEA, and Western Europe.

Map 3.4.1 | Global prevalence of chronic PD

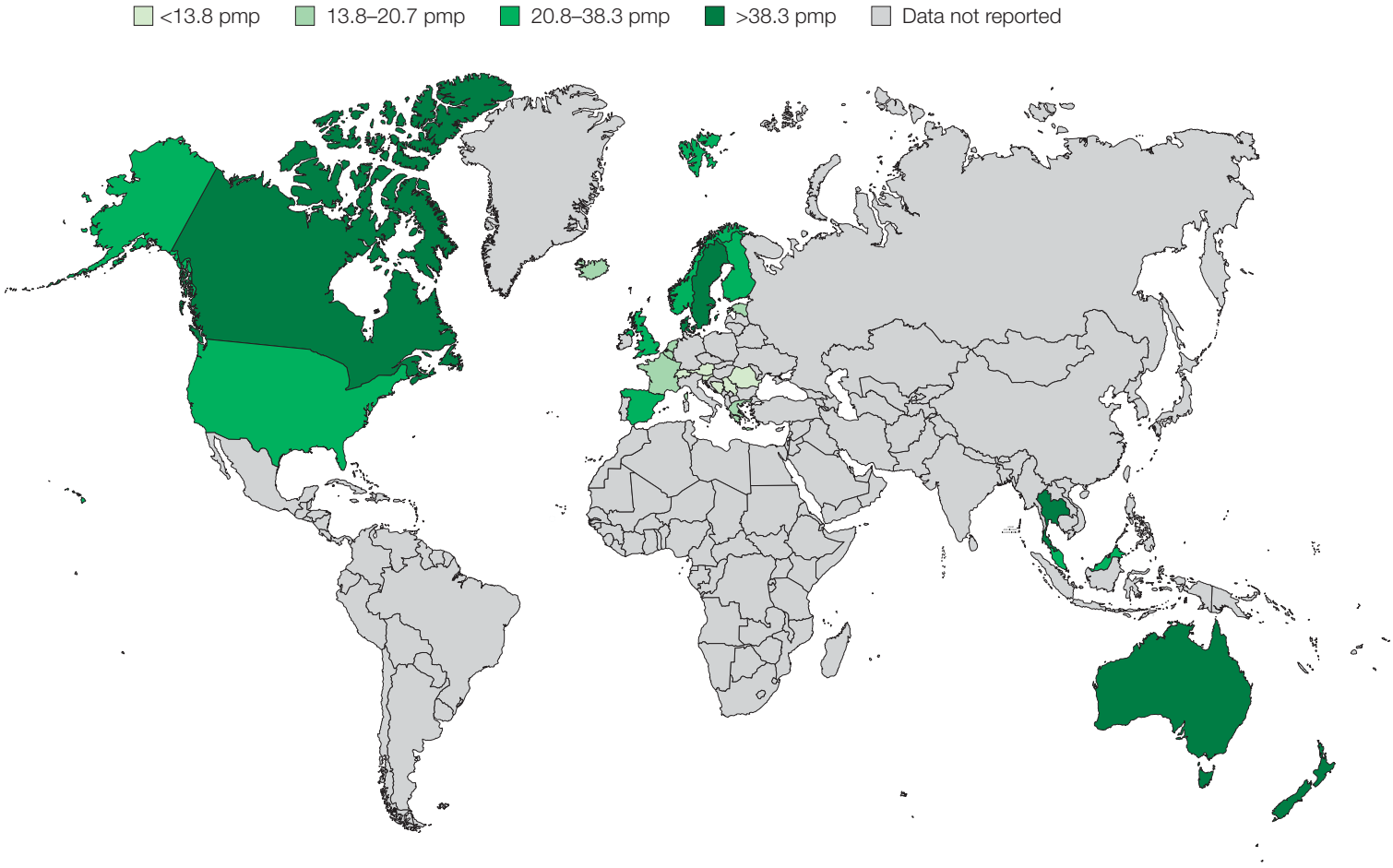
Rate per million population (pmp), age ≥ 18 years



Information on the incidence of chronic PD is available in 11% (n = 24) of countries worldwide, all of which are upper-middle (n = 5) or high income (n = 19) (Map 3.4.2). No countries in Africa, Latin America, Middle East, North and East Asia, NIS and Russia, or South Asia have data on the incidence of chronic PD. Globally, the average number of people initiating chronic PD treatment is 20.8 pmp, ranging from 2.4 pmp in Romania to 140.6 pmp in Thailand. In high income countries, the average number of patients initiating chronic PD treatment is 23.5 pmp. Although average incidence of chronic PD in upper-middle income countries is 5 pmp, values ranged widely from 2.4 pmp in Romania to 140.6 pmp in Thailand. Average incidence of chronic PD is below the global average in Eastern and Central Europe, and Western Europe, and above the global average in North America (specifically, Canada and the United States).

Map 3.4.2 | Global incidence of chronic PD

Rate per million population (pmp), age ≥ 18 years

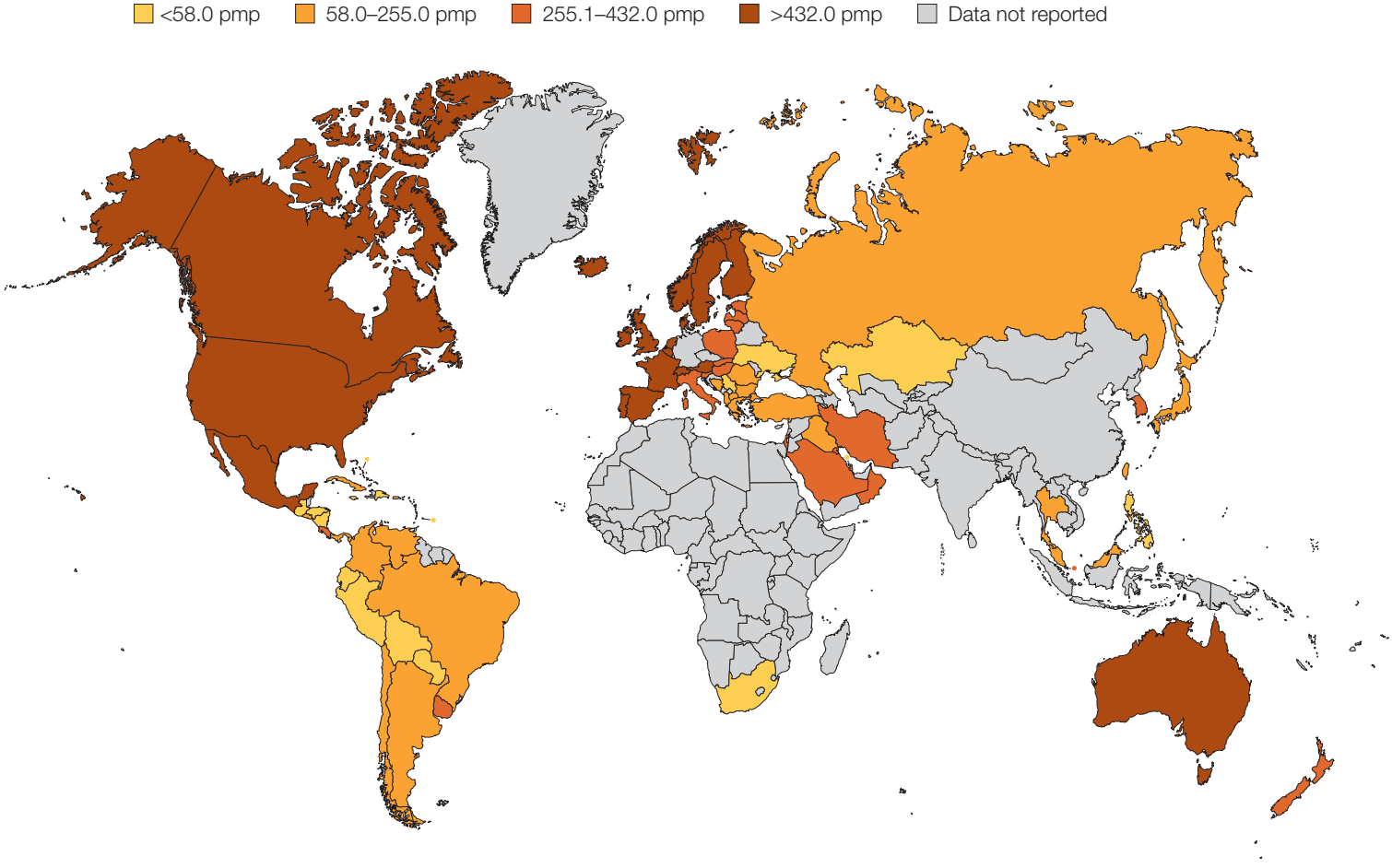


3.5 Kidney transplantation

Information available on the prevalence of kidney transplantation is available in 34% (n = 75) of countries worldwide (Map 3.5.1). No low income countries or countries in South Asia have data available. Globally, the average number of people who have received kidney transplants is 255 pmp, ranging from 3.1 pmp in the Bahamas to 693 pmp in Portugal. On average, high income countries have a much higher prevalence of kidney transplantation (363 pmp) than upper-middle (80 pmp) or lower-middle (27 pmp) income countries. The prevalence of kidney transplantation is below the global average in Africa, Latin America, North America, North and East Asia, OSEA, and NIS and Russia, and above the global average in Eastern and Central Europe, the Middle East, and Western Europe.

Map 3.5.1 | Global prevalence of kidney transplantation

Rate per million population (pmp), age ≥ 18 years

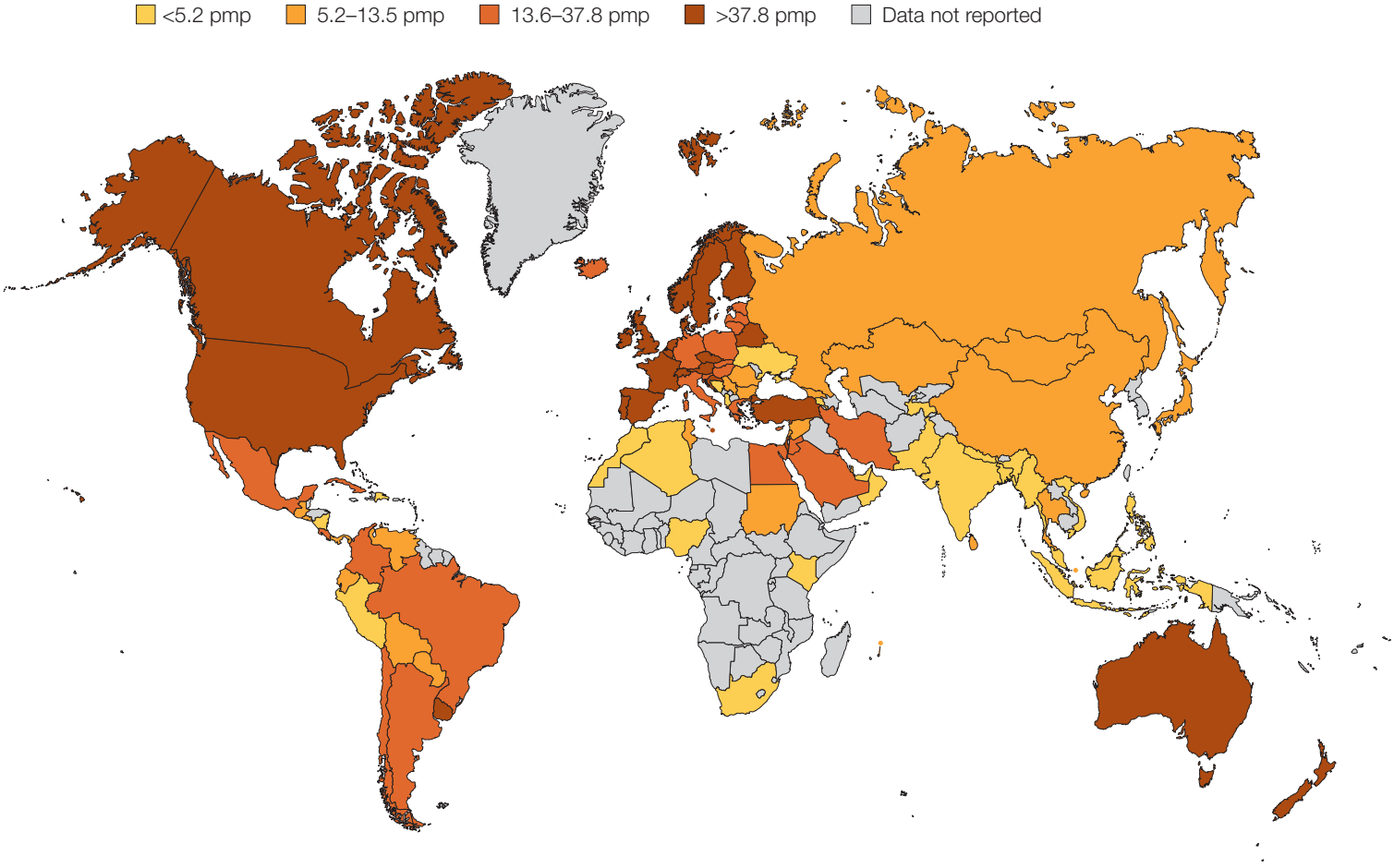


Information on the incidence of kidney transplantation is available in 45% (n = 98) of countries (Map 3.5.2). Globally, the average number of new kidney transplantations is 13.6 pmp, ranging from 0.04 pmp in Myanmar to 70.5 pmp in Spain. Incidence of transplantation increases with income level. In high income countries, the incidence rate is 38.6 pmp compared to 9.4 pmp in upper-middle and 4.3 pmp in lower-middle income countries.

Nepal is the only low income country with data available, reporting an incidence rate of 3.5 pmp. Incidence rates for kidney transplantation are below the global average in Africa, Latin America, the Middle East, North and East Asia, OSEA, NIS and Russia, and South Asia, and above the global average in Eastern and Central Europe, North America (specifically, Canada and the United States), and Western Europe.

Map 3.5.2 | Global incidence of kidney transplantation

Rate per million population (pmp), age ≥ 18 years



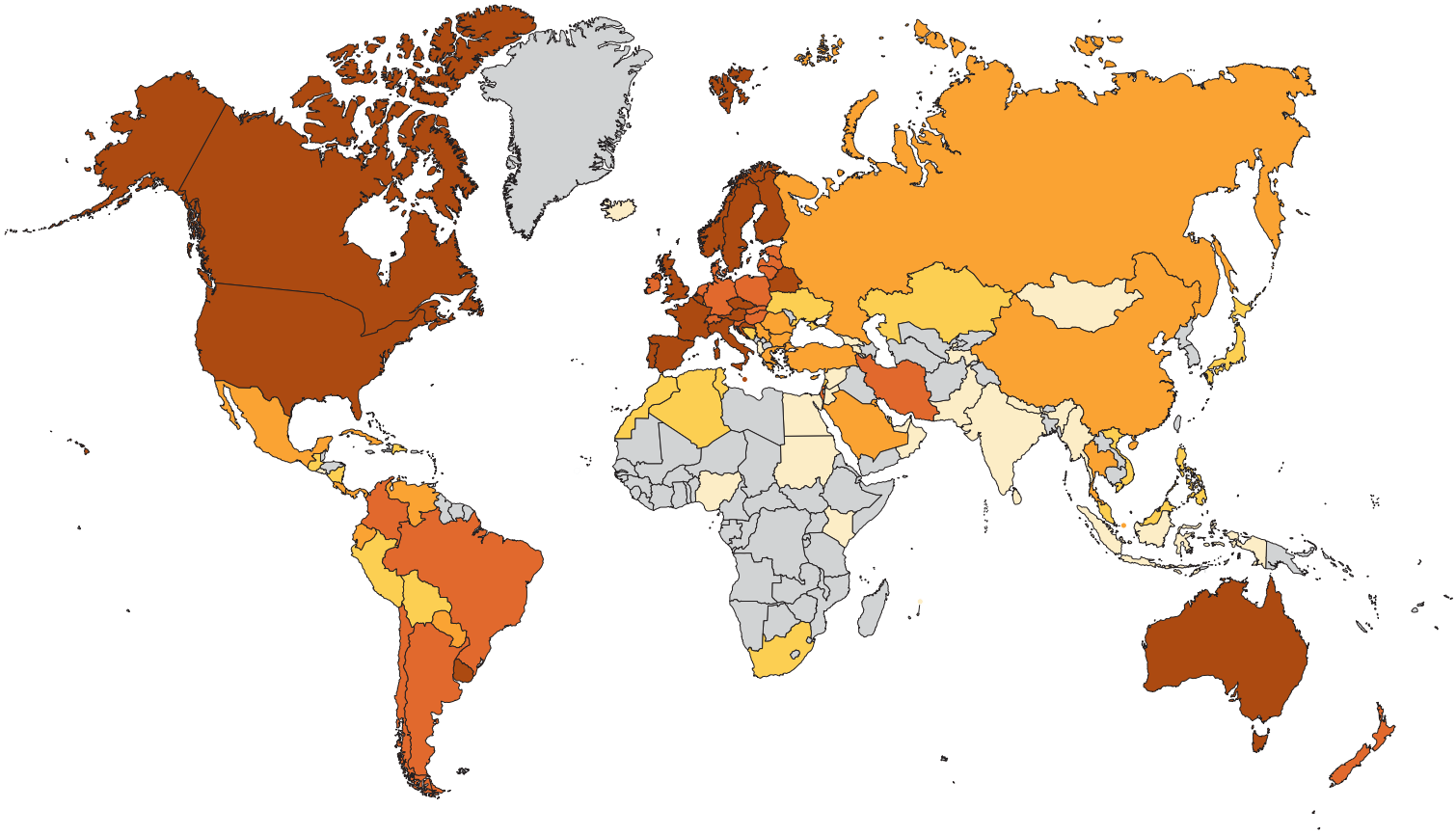
Information on the incidence rate for kidney transplantation using organs from deceased donors is available in 45% (n = 98) of countries worldwide (Map 3.5.3). Among these 98 countries, 23 report a rate of 0 surgeries pmp, meaning only kidneys from living donors are used in transplantation. No low income countries reported kidney transplantation using organs from deceased donors. Among the 75 countries that offer kidney transplantation using organs from deceased donors, the average incidence is 15.1 pmp. Incidence rates increased with income level. High income countries have much higher rates for transplantation using organs from deceased donors (27.1 pmp) than upper-middle (5.2 pmp) and lower-middle (0.2) income countries. Overall, the incidence of kidney transplantation using organs from deceased donors is below the global average in Africa, Latin America, the Middle East, North and East Asia, and NIS and Russia, and above the global average in Eastern and Central Europe, North America (specifically, Canada and the United States), and Western Europe.

Map 3.5.3 | Global incidence of deceased donor kidney transplantation

Rate per million population (pmp), age ≥ 18 years

<2.9 pmp | 2.9–15.1 pmp | 15.2–29.4 pmp | >29.4 pmp

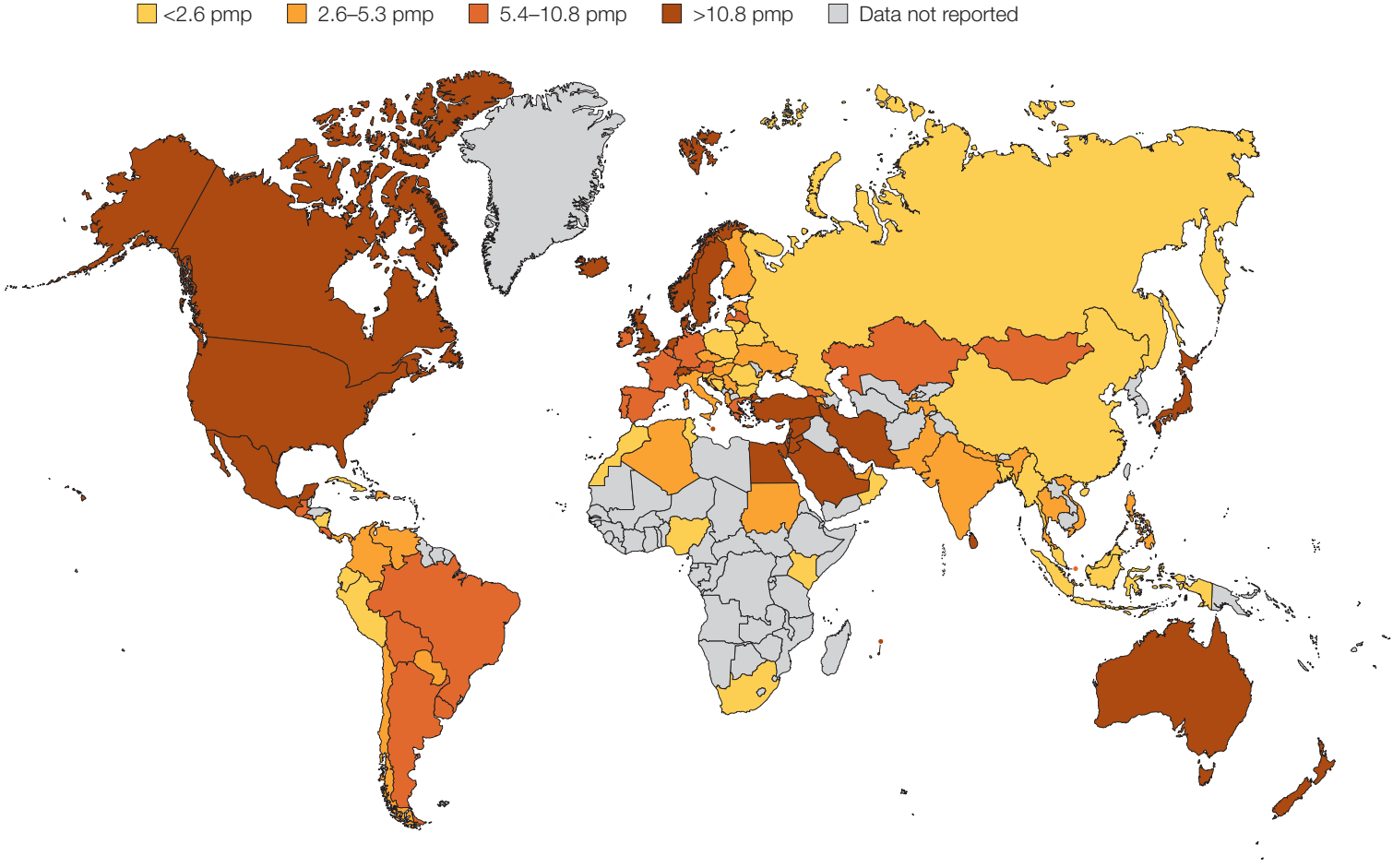
Deceased donation N/A (not available) | Data not reported



Information on the incidence rate for kidney transplantation using organs from living donors is available in 42% (n = 97) of countries worldwide (Map 3.5.4). Globally, the average rate for transplants using organs from living donors is 5.3 pmp, ranging from 0.4 pmp in Myanmar to 33.2 pmp in Turkey. Nepal is the only low income country with data available, reporting an incidence rate of 3.5 pmp. High income countries have the highest incidence rate (7.5 pmp), followed by upper-middle income countries (2.9 pmp), and lower-middle income countries (4 pmp). Overall, the incidence of kidney transplantation using organs from living donors is below the global average in Africa, Eastern and Central Europe, Latin America, OSEA, NIS and Russia, and South Asia, and above the global average in the Middle East, North America (specifically, Canada and the United States), and Western Europe.

Map 3.5.4 | Global incidence of living donor kidney transplantation

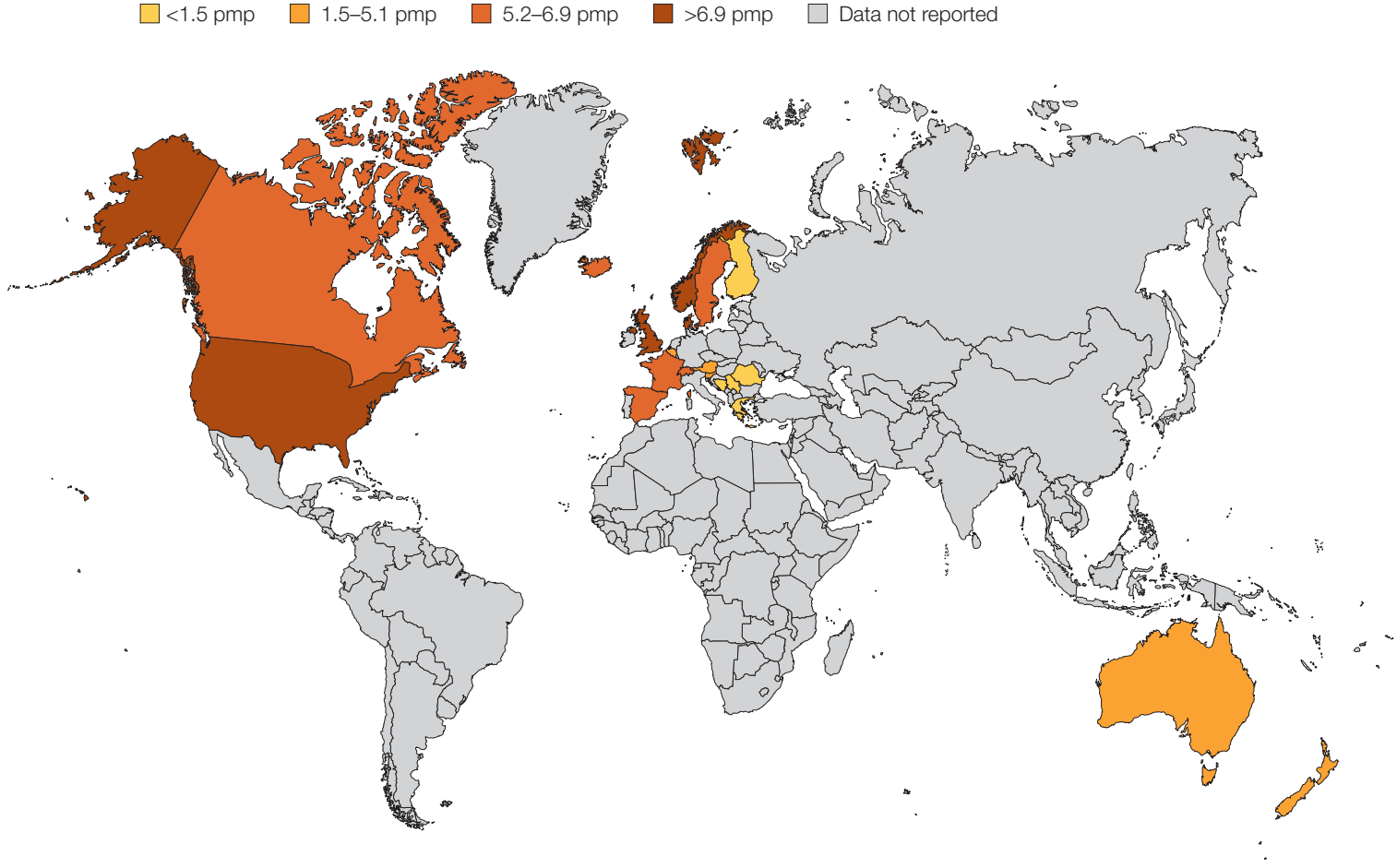
Rate per million population (pmp), age ≥ 18 years



Information on the incidence of pre-emptive kidney transplantation performed before dialysis is required is available in 10% (n = 20) of countries worldwide (Map 3.5.5). No data are available from low or lower-middle income countries or countries in Africa, Latin America, the Middle East, North and East Asia, NIS and Russia, or South Asia. Among the 20 countries with available data, the average number of pre-emptive kidney transplantation surgeries worldwide is 5.2 pmp, ranging from 0.3 pmp in Bosnia and Herzegovina to 12.4 pmp in Norway. The rate is higher in high income countries (5.8 pmp) than in upper-middle income countries (0.7 pmp). Overall, the incidence of pre-emptive kidney transplantation is below the global average in Eastern and Central Europe and OSEA, and above the global average in North America (specifically, Canada and the United States).

Map 3.5.5 | Global incidence of pre-emptive kidney transplantation

Rate per million population (pmp), age ≥ 18 years



3.6 Costs of KRT

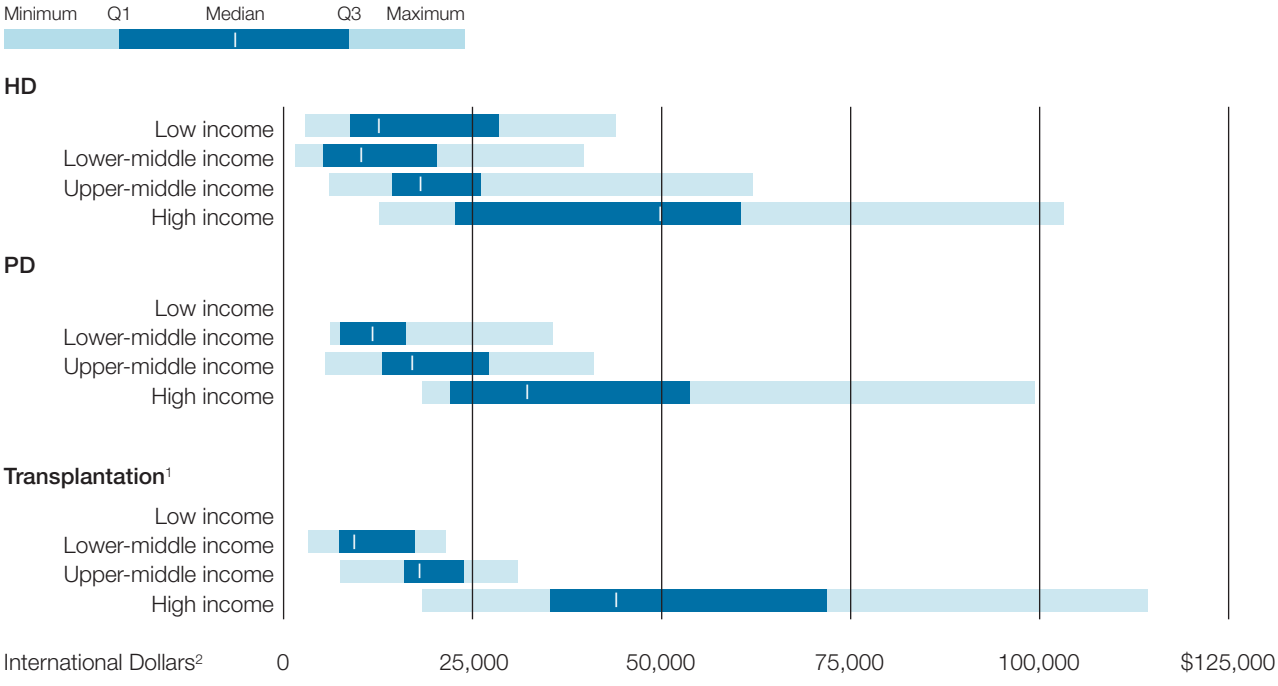
3.6.1 Maintenance HD

Nearly half of all countries (44%; n = 97) have data available on the annual cost of maintenance HD—specifically, in-center HD. Nearly half (46%, n = 45) of these are high income countries. Only 5 low income countries (Cambodia, Burundi, Democratic Republic of Congo, Nepal, and Tanzania) have data available. Overall, the global average annual cost of maintenance HD is 22,617 international dollars (equivalent to the USD value in 2016) per person, ranging from 1,560 international dollars in Cameroon to 103,187 international dollars in the Netherlands. The average cost of maintenance HD increases with country income level, except for low income countries, where the average cost is higher than in lower-middle income countries. High income countries have the highest average cost of maintenance HD (49,720 international dollars), followed by upper-middle income countries (17,990 international dollars), low income countries (12,480 international dollars) and lower-middle income countries (10,140 international dollars). Only high income countries have an average cost above the global average (Figure 3.1).

3.6.2 Maintenance PD

Overall, 40% (n = 87) of countries have data available on the annual cost of maintenance PD, mainly continuous ambulatory PD. The majority (49%, n = 43) of these are high-income countries. Only 1 low-income country (Democratic Republic of Congo) have data available. Overall, the global average annual cost of maintenance PD is 20,524 international dollars per person. This ranges from 5,520 international dollars in Tunisia to 99,280 international dollars in the United Arab Emirates.

Figure 3.1 | Annual cost of KRT, by World Bank income group



1 Transplantation costs are for the first year only. Data from low income countries are only available for HD.

2 Equivalent to the USD value in 2016

The average cost of maintenance PD increases with country income level. High income countries have the highest average cost of maintenance PD (32,109 international dollars), followed by upper-middle income countries (16,919 international dollars), and lower-middle income countries (11,633 international dollars). Only high income countries have an average cost above the global average (Figure 3.1).

3.6.3 Kidney transplantation

Among all countries, 24% (n = 51) have data available on the first-year costs of kidney transplantation, most of which relate to transplant surgery. Nearly half (49%, n = 25) of these are high-income countries. No low-income countries have data available. Overall, the global average first-year cost of kidney transplantation is 25,356 international dollars. Costs range from 3,285 international dollars in Bangladesh to 114,220 international dollars in France. The average first-year cost of kidney transplantation increases with country income level. High-income countries have the highest average first-year cost of kidney transplantation (43,901 international dollars), followed by upper-middle income countries (17,870 international dollars), and lower-middle income countries (9,238 international dollars). Only high income countries have an average cost above the global average (Figure 3.1).

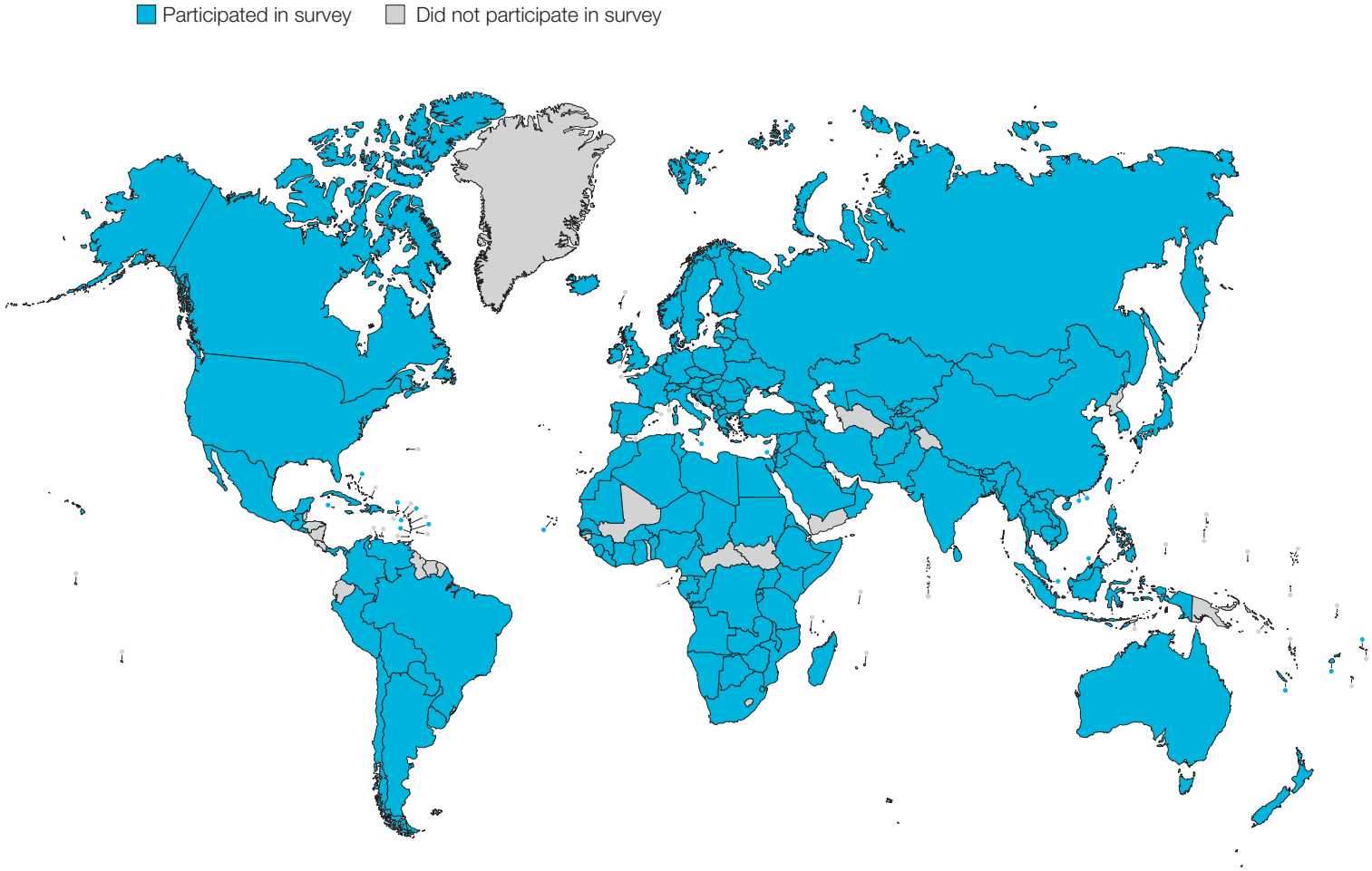
3.6.4 Comparing costs of maintenance HD with maintenance PD

In 59% of countries (n = 51), the annual per patient cost ratio of maintenance HD to maintenance PD exceeds 1, meaning PD is less expensive. Conversely, in 40% of countries (n = 35), the annual per patient cost ratio is less than 1, meaning HD is less expensive. The cost ratio equals 1 in only one country (Namibia), where costs of both treatments are similar. The cost ratio of maintenance HD to maintenance PD ranges greatly from 0.43 in Bosnia and Herzegovina to 4.27 in Iceland. Data on HD and/or are not available for 11 countries, thus the cost ratio cannot be estimated. No low income countries have data to compare cost ratios. Among high income countries, 65% (n = 28) have HD to PD cost ratios greater than 1, and 35% (n = 15) have cost ratios less than 1. Among upper-middle income countries, 62% (n = 15) have cost ratios greater than 1, and 38% (n = 9) have cost ratios less than 1. Among lower-middle income countries, 39% (n = 7) have cost ratios greater than 1, and 61% (n = 11) have cost ratios less than 1.

SURVEY FINDINGS

SURVEY RESPONSE

A total of 160 countries responded to the survey, comprising 98% of the world's population.



There was adequate representation based on number of countries and population size across regions (Appendix 1: Table A1.1). The affiliations of survey respondents were: nephrologists (82%), non-nephrologist physicians (7%), health care professionals (non-physician) (2%), administrators/ policymakers (5%), and others affiliated with kidney disease patient advocacy (3%) (Appendix 1: Table A1.2). The complete list of countries is provided in Appendix 2: Table A2.1.

SECTION 4

HEALTH CARE FINANCE AND SERVICE DELIVERY

4.1 Healthcare system and funding mechanism

Nearly half (48%; n = 77) of all countries provide public funding for non-dialysis CKD care, with 28% charging patients no fees and 20% charging some fees (Table 4.1) at the point of delivery. Care is funded through a combination of public and private systems in 48 countries (30%), and through multiple systems (i.e., government, NGOs, and communities) in 14 countries (9%). Fees for CKD care are covered by private systems and out-of-pocket expenditures in 12 countries, and solely by private systems through health insurance in just 1 country (Liechtenstein). Other funding models are used in 7 countries (4%).

Table 4.1 | Funding models for non-dialysis CKD

	Publicly funded by government and free at the point of delivery N (%)	Publicly funded by government with some fees at the point of delivery N (%)	Mix of public and private funding systems N (%)	Solely private and out-of-pocket N (%)	Solely private through health insurance providers N (%)	Multiple systems programs provided by government, NGOs, and communities N (%)	Other N (%)
Overall	**45 (28)**	**32 (20)**	**48 (30)**	**12 (8)**	**1 (1)**	**14 (9)**	**7 (4)**
ISN region							
Africa	6 (14)	9 (21)	13 (31)	6 (14)	0 (0)	5 (12)	3 (7)
Eastern & Central Europe	11 (58)	4 (21)	3 (16)	0 (0)	0 (0)	0 (0)	1 (5)
Latin America	1 (6)	1 (6)	11 (61)	1 (6)	0 (0)	3 (17)	1 (6)
Middle East	7 (64)	1 (9)	3 (27)	0 (0)	0 (0)	0 (0)	0 (0)
NIS & Russia	4 (44)	1 (11)	1 (11)	2 (22)	0 (0)	1 (11)	0 (0)
North America	2 (20)	1 (10)	6 (60)	1 (10)	0 (0)	0 (0)	0 (0)
North & East Asia	2 (29)	2 (29)	2 (29)	0 (0)	0 (0)	1 (14)	0 (0)
OSEA	3 (20)	2 (13)	6 (40)	1 (7)	0 (0)	2 (13)	1 (7)
South Asia	1 (14)	1 (14)	2 (29)	1 (14)	0 (0)	2 (29)	0 (0)
Western Europe	8 (38)	10 (48)	1 (5)	0 (0)	1 (5)	0 (0)	1 (5)
World Bank income group							
Low income	3 (13)	2 (9)	6 (26)	5 (22)	0 (0)	4 (17)	3 (13)
Lower-middle income	7 (19)	9 (24)	8 (22)	6 (16)	0 (0)	5 (14)	2 (5)
Upper-middle income	12 (29)	5 (12)	20 (49)	0 (0)	0 (0)	4 (10)	0 (0)
High income	23 (40)	16 (28)	14 (24)	1 (2)	1 (2)	1 (2)	2 (3)

Rows may not total to 100% due to rounding.

Compared to the global average, countries in Eastern and Central Europe, the Middle East, NIS and Russia, North and East Asia, and Western Europe provide more public funding, whereas countries in Africa, Latin America, North America, OSEA, and South Asia provide less public funding (Table 4.1).

Public funding for non-dialysis CKD care is more prevalent in high income countries (68%) than in upper-middle (41%), lower-middle (43%) and low income countries (22%) (Table 4.1). Low income countries report the highest use of private funding (22%), followed by lower-middle (16%), high (1%), and upper-middle (0%) income countries.

Public funding for KRT (i.e., dialysis and transplantation) is more common than for non-dialysis CKD care (Table 4.2). Overall, 64% (n = 102) of countries provide public funding for KRT, with 43% charging no fees at the point of delivery and 21% charging some fees. Care is funded through a mix of public and private systems in 34 countries (21%) and through multiple systems (government, NGOs, and communities) in 10 countries (6%). Fees for KRT are covered by private systems and/or out-of-pocket expenditures in 7 countries, and exclusively by health insurance providers in just 1 country (Liechtenstein). Other funding models are used in 4 countries (3%).

Compared to the global average, countries in Eastern and Central Europe, the Middle East, NIS and Russia, North and East Asia, and Western Europe provide more public funding, whereas countries in Africa, Latin America, North America, OSEA, and South Asia provide less public funding (Table 4.2). Overall, public funding for KRT is more prevalent in high income countries (78%) than in upper-middle (61%), lower-middle (57%) or low (48%) income countries (Table 4.2).

Table 4.2 | Funding models for KRT

	Publicly funded by government and free at the point of delivery N (%)	Publicly funded by government with some fees at the point of delivery N (%)	Mix of public and private funding systems N (%)	Solely private and out-of-pocket N (%)	Solely private through health insurance providers N (%)	Multiple systems programs provided by government, NGOs, and communities N (%)	Other N (%)
Overall	**68 (43)**	**34 (21)**	**34 (21)**	**7 (4)**	**1 (1)**	**10 (6)**	**4 (3)**
ISN region							
Africa	11 (26)	11 (26)	12 (29)	3 (7)	0 (0)	3 (7)	1 (2)
Eastern & Central Europe	15 (79)	1 (5)	2 (11)	0 (0)	0 (0)	0 (0)	1 (5)
Latin America	4 (22)	3 (17)	9 (50)	1 (6)	0 (0)	1 (6)	0 (0)
Middle East	10 (91)	1 (9)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
NIS & Russia	6 (67)	2 (22)	0 (0)	0 (0)	0 (0)	0 (0)	1 (11)
North America	2 (20)	0 (0)	7 (70)	1 (10)	0 (0)	0 (0)	0 (0)
North & East Asia	1 (14)	5 (71)	1 (14)	0 (0)	0 (0)	0 (0)	0 (0)
OSEA	4 (27)	5 (33)	2 (13)	1 (7)	0 (0)	3 (20)	0 (0)
South Asia	1 (14)	1 (14)	1 (14)	1 (14)	0 (0)	3 (43)	0 (0)
Western Europe	14 (67)	5 (24)	0 (0)	0 (0)	1 (5)	0 (0)	1 (5)
World Bank income group							
Low income	5 (22)	6 (26)	5 (22)	4 (17)	0 (0)	1 (4)	1 (4)
Lower-middle income	11 (30)	10 (27)	6 (16)	2 (5)	0 (0)	7 (19)	1 (3)
Upper-middle income	18 (44)	7 (17)	15 (37)	0 (0)	0 (0)	1 (2)	0 (0)
High income	34 (59)	11 (19)	8 (14)	1 (2)	1 (2)	1 (2)	2 (3)

Rows may not total to 100% due to rounding.

Among the 142 countries that provide at least partial public funding for KRT, 75% cover all residents (Table 4.3). Universal coverage is more common in countries located in Eastern and Central Europe, Latin America, NIS and Russia, North and East Asia, OSEA, and Western Europe than in countries located in Africa, the Middle East, North America, and South Asia.

In public funding models, universal coverage for KRT increases with income level (Table 4.3). Among high income countries, 87% provide universal coverage, compared to 75% of upper-middle, 70% of lower-middle, and 50% of low income countries.

Among countries that provide at least partial public funding for KRT, 45% cover all aspects of treatment. Other countries exclude specific aspects of care from coverage, including: management of associated complications such as anemia, bone disease, and malnutrition (20%); conservative kidney care (19%); transplantation (17%); dialysis (3%); and other aspects of care (8%).

All countries with public funding systems cover dialysis except for 25% of countries in NIS and Russia, 8% of countries in OSEA, and 3% of countries in Africa (Figure 4.1). Countries in South Asia, North America, Africa, and NIS and Russia are more likely to exclude transplantation from publicly funded services compared to those in Latin America, OSEA, Eastern and Central Europe, the Middle East, and North and East Asia. Conservative care is more commonly excluded from publicly funded services in countries in South Asia, NIS and Russia, Africa, OSEA, and Latin America, compared to countries in Eastern and Central Europe, North America, the Middle East, North and East Asia, and Western Europe. Management of associated complications (i.e., anemia, bone disease, malnutrition) is excluded from public coverage more often in countries in South Asia, NIS and Russia, Africa, and North America, than in North and East Asia, OSEA, Latin America, Eastern and Central Europe, Western Europe, and the Middle East. Countries in Eastern and Central Europe, the Middle East, North and East Asia, and Western Europe are more likely to include all elements of kidney care in public coverage, compared to countries in OSEA, Latin America, South Asia, Africa, NIS and Russia, and North America (Figure 4.1).

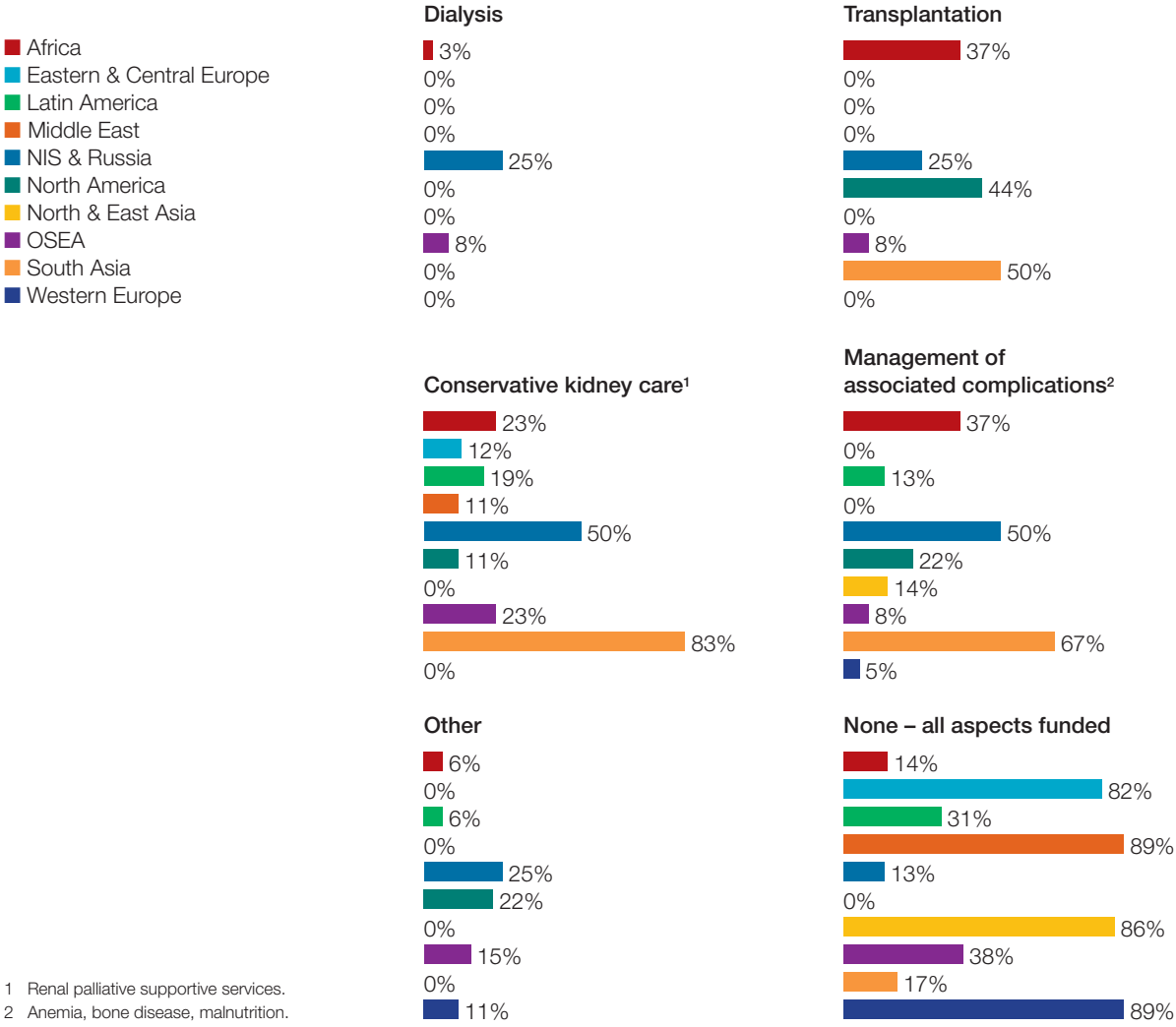
High income countries are more likely to provide public funding for all elements of KRT (75%) compared to upper-middle (43%), lower-middle (19%), and low (0%) income countries (Figure 4.2). Dialysis is covered in all high and low income countries and is excluded from coverage in 10% of lower-middle and 3% of upper-middle income countries. Transplantation is excluded in just 2% of high income countries, compared to 15% of upper-middle, 26% of lower-middle, and 50% of low income countries (Figure 4.2).

Table 4.3 | Extent of universal coverage for KRT in countries with publicly funded systems

	Countries covering all residents N (%)	Countries not covering all residents N (%)
Overall	**107 (75)**	**35 (25)**
ISN region		
Africa	20 (56)	16 (44)
Eastern & Central Europe	18 (100)	0 (0)
Latin America	14 (88)	2 (13)
Middle East	3 (27)	8 (73)
NIS & Russia	8 (100)	0 (0)
North America	5 (56)	4 (44)
North & East Asia	6 (86)	1 (14)
OSEA	11 (92)	1 (8)
South Asia	3 (50)	3 (50)
Western Europe	19 (100)	0 (0)
World Bank income group		
Low income	8 (50)	8 (50)
Lower-middle income	23 (70)	10 (30)
Upper-middle income	30 (75)	10 (25)
High income	46 (87)	7 (13)

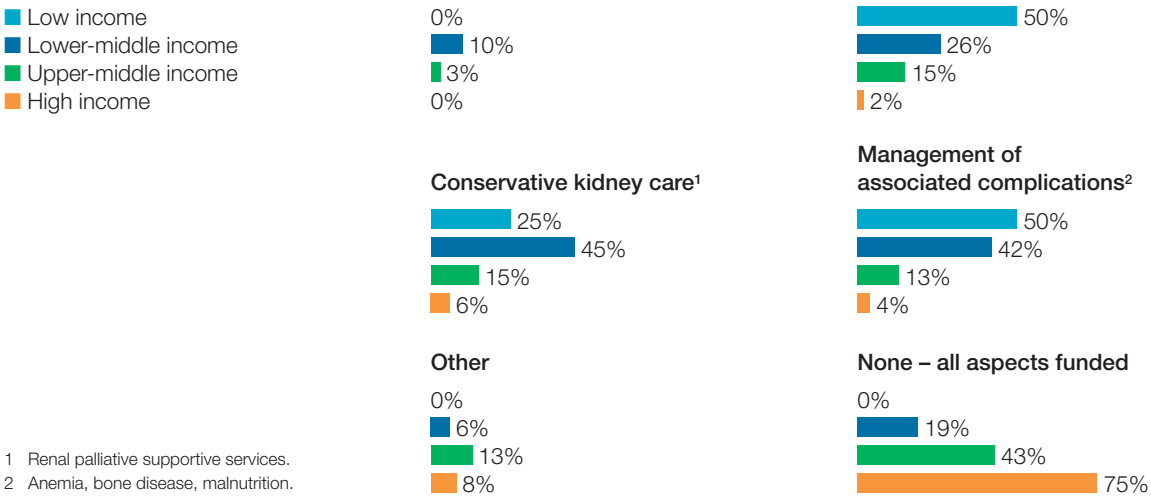
Rows may not total to 100% due to rounding.

Figure 4.1 | Aspects of KRT excluded from public funding, by ISN region



1 Renal palliative supportive services.
2 Anemia, bone disease, malnutrition.

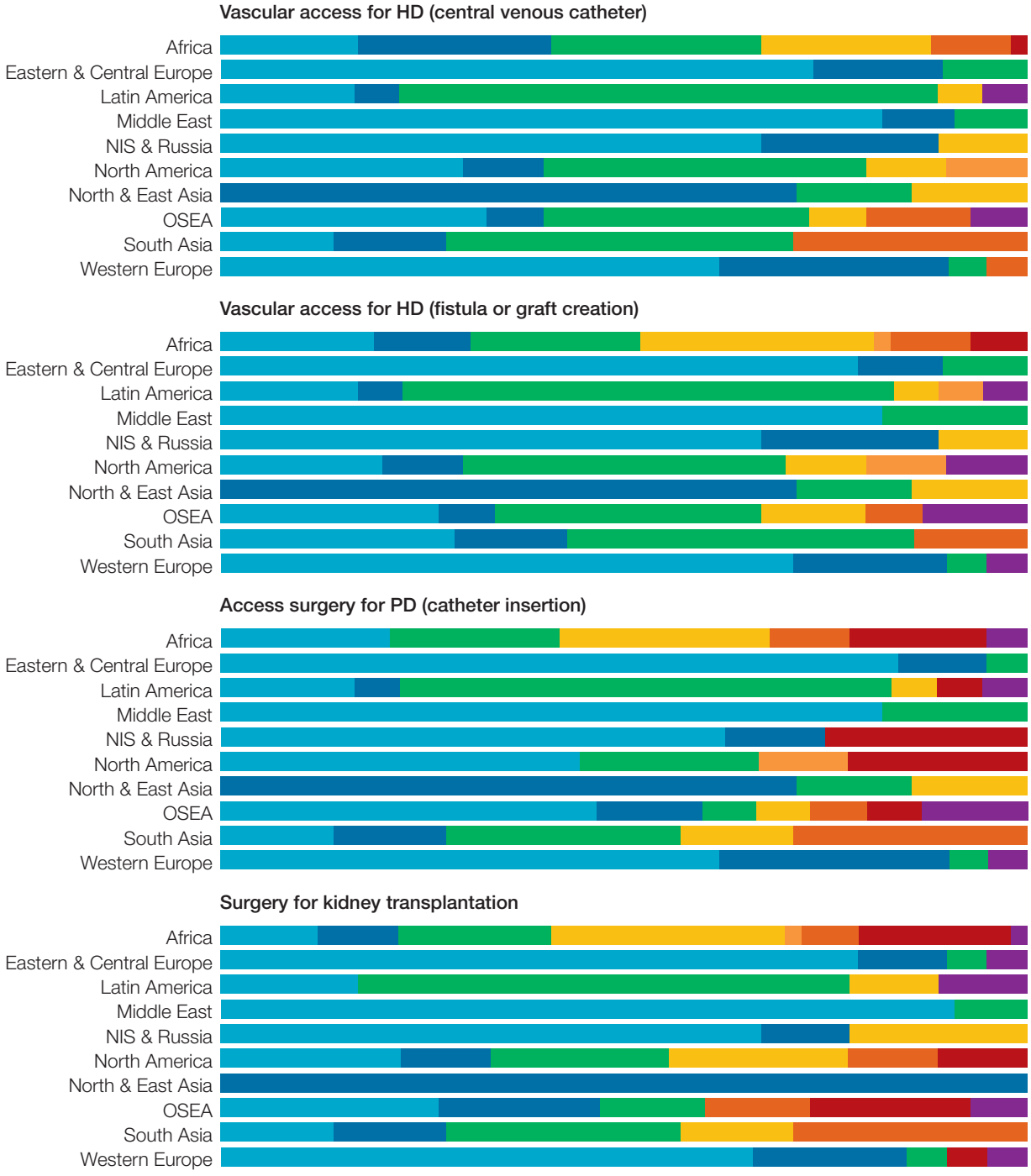
Figure 4.2 | Aspects of KRT excluded from public funding, by World Bank income group



1 Renal palliative supportive services.
2 Anemia, bone disease, malnutrition.

Figure 4.3 | Funding models for KRT-related surgical services, by ISN region

- Publicly funded by government and free at the point of delivery (%)
- Publicly funded by government with some fees at the point of delivery (%)
- Mix of public and private funding systems (%)
- Soley private and out-of-pocket (%)
- Soley private through health insurance providers (%)
- Multiple systems – programs provided by government, NGOs, and communities (%)
- Not applicable (KRT not available in my country) (%)
- Other (%)



Coverage for surgical services for KRT, including creation of fistulas, grafts, and central venous catheters (CVCs) for HD, catheter insertion for PD, and kidney transplantation varies worldwide. Over half of all countries provide public funding (either completely free or with some fees at the point of care delivery) for surgery to create vascular access for HD: 58% cover CVC insertion, and 54% cover fistula or graft creation. Countries in Eastern and Central Europe, the Middle East, NIS and Russia, North and East Asia, and Western Europe have higher coverage rates for these services than countries in Africa, Latin America, North America, OSEA, and South Asia (Figure 4.3).

Surgery to create access for PD (i.e., catheter insertion) is publicly funded (either completely free or with some fees at the point of care delivery) in 54% of countries. Countries in Eastern and Central Europe, the Middle East, NIS and Russia, North and East Asia, OSEA, and Western Europe have higher coverage rates than countries in Africa, Latin America, North America, and South Asia (Figure 4.3).

Kidney transplantation surgery is publicly funded (either completely free or with some fees at the point of care delivery) in 53% of countries. Countries in Eastern and Central Europe, the Middle East, NIS and Russia, North and East Asia, and Western Europe have higher coverage rates compared to countries in Africa, Latin America, North America, OSEA, and South Asia.

4.2 Within-country variation in ESKD care delivery

Worldwide, 60% of countries report no regional variation in how ESKD care is delivered (Table 4.4). Within-country variation is highest in OSEA, Africa, South Asia, and North America. Regional variation in care delivery is more likely in low income countries (65%) than in lower-middle (49%), upper-middle (46%), and high (18%) income countries (Figure 4.4).

Similarly, variation in the ESKD care delivered to children vs. that delivered to adults is more common in low income countries (61%) compared to lower-middle (39%), upper-middle (20%) and high (19%) income countries (Figure 4.5). Access to KRT varies between children and adults in 57% of low, 39% of lower-middle, 12% of upper-middle, and 9% of high income countries (Figure 4.6).

Figure 4.4 | Within-country variation in ESKD care delivery, by World Bank income group

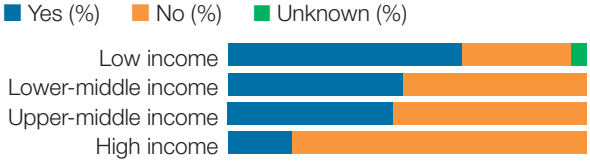


Table 4.4 | Within country variation in ESKD care delivery

	Reported variation N (%)	Reported no variation N (%)
Overall	**62 (40)**	**95 (60)**
ISN region		
Africa	26 (62)	16 (38)
Eastern & Central Europe	4 (21)	15 (79)
Latin America	6 (33)	12 (67)
Middle East	1 (9)	10 (91)
NIS & Russia	2 (22)	7 (78)
North America	4 (44)	5 (56)
North & East Asia	1 (14)	6 (86)
OSEA	10 (67)	5 (33)
South Asia	4 (57)	2 (29)
Western Europe	4 (19)	17 (81)
World Bank income group		
Low income	15 (65)	7 (30)
Lower-middle income	18 (49)	19 (51)
Upper-middle income	19 (46)	22 (54)
High income	10 (18)	47 (82)

Totals for South Asia and low income rows do not total 100% as data are unknown for one country (Afghanistan).

Figure 4.5 | Within-country variation in ESKD care delivery (children vs. adults), by World Bank income group

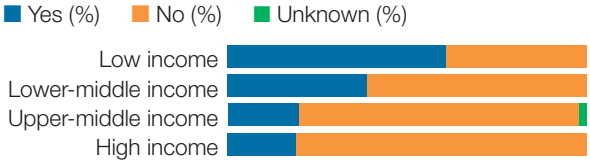
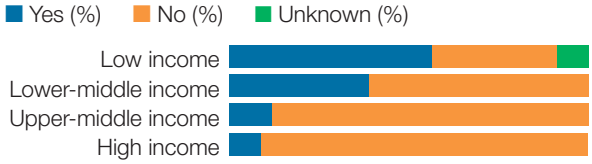


Figure 4.6 | Within-country variation in KRT care accessibility (children vs. adults), by World Bank income group



4.3 Oversight of ESKD care

Oversight of ESKD varies worldwide (Table 4.5). Structured ESKD management systems do not exist in 13% of low, 10% of upper-middle, and 3% of lower-middle income countries. All high income countries have structured ESKD management systems. Globally, ESKD care is managed at the national level in 56% of countries; by hospitals, trusts, and organizations in 38% of countries; at the provincial, regional, or state level in 21% of countries; by NGOs in 4% of countries; and via other management structures in 8% of countries (Table 4.5).

Table 4.5 | ESKD management structures

	National body N (%)	Provincial, regional, state level only N (%)	Hospitals, trusts, organizations N (%)	NGOs N (%)	No organized system N (%)	Other N (%)
Overall	**89 (56)**	**34 (21)**	**61 (38)**	**7 (4)**	**8 (5)**	**12 (8)**
ISN region						
Africa	17 (40)	3 (7)	13 (31)	0 (0)	4 (10)	4 (10)
Eastern & Central Europe	16 (84)	3 (16)	5 (26)	1 (5)	0 (0)	1 (5)
Latin America	11 (61)	4 (22)	8 (44)	0 (0)	2 (11)	1 (6)
Middle East	10 (91)	3 (27)	1 (9)	1 (9)	0 (0)	0 (0)
NIS & Russia	8 (89)	3 (33)	1 (11)	0 (0)	1 (11)	0 (0)
North America	3 (30)	2 (20)	7 (70)	0 (0)	0 (0)	0 (0)
North & East Asia	7 (100)	2 (29)	4 (57)	0 (0)	0 (0)	0 (0)
OSEA	8 (53)	7 (47)	11 (73)	3 (20)	1 (7)	0 (0)
South Asia	2 (29)	0 (0)	1 (14)	1 (14)	0 (0)	4 (57)
Western Europe	7 (33)	7 (33)	10 (48)	1 (5)	0 (0)	2 (10)
World Bank income group						
Low income	6 (26)	1 (4)	8 (35)	1 (4)	3 (13)	5 (22)
Lower-middle income	20 (54)	9 (24)	11 (30)	0 (0)	1 (3)	2 (5)
Upper-middle income	33 (80)	7 (17)	15 (37)	4 (10)	4 (10)	2 (5)
High income	30 (52)	17 (29)	27 (47)	2 (3)	0 (0)	3 (5)

Rows may not total to 100% due to rounding.

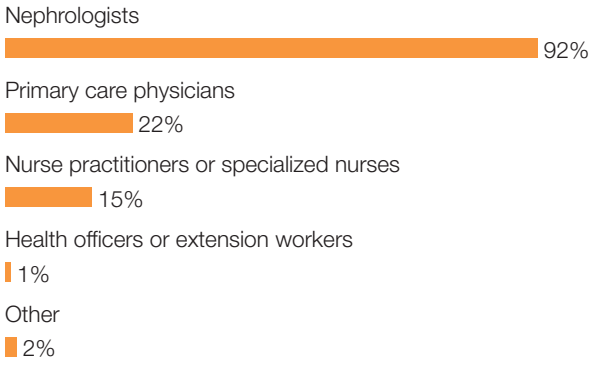
SECTION 5

HEALTH WORKFORCE FOR NEPHROLOGY CARE

5.1 Clinical responsibility

Nephrologists are primarily responsible for ESKD care delivery in 92% of countries; in relatively few countries ESKD care also is provided by primary care physicians (in 22% of countries), multidisciplinary teams (19%), nurse practitioners (15%), health care extension workers (1%; 2 countries: Lao PDR and Tajikistan), and other providers (2%; 3 countries: Eritrea, Fiji, and Pakistan) (Figure 5.1).

Figure 5.1 | Health care providers primarily responsible for ESKD care



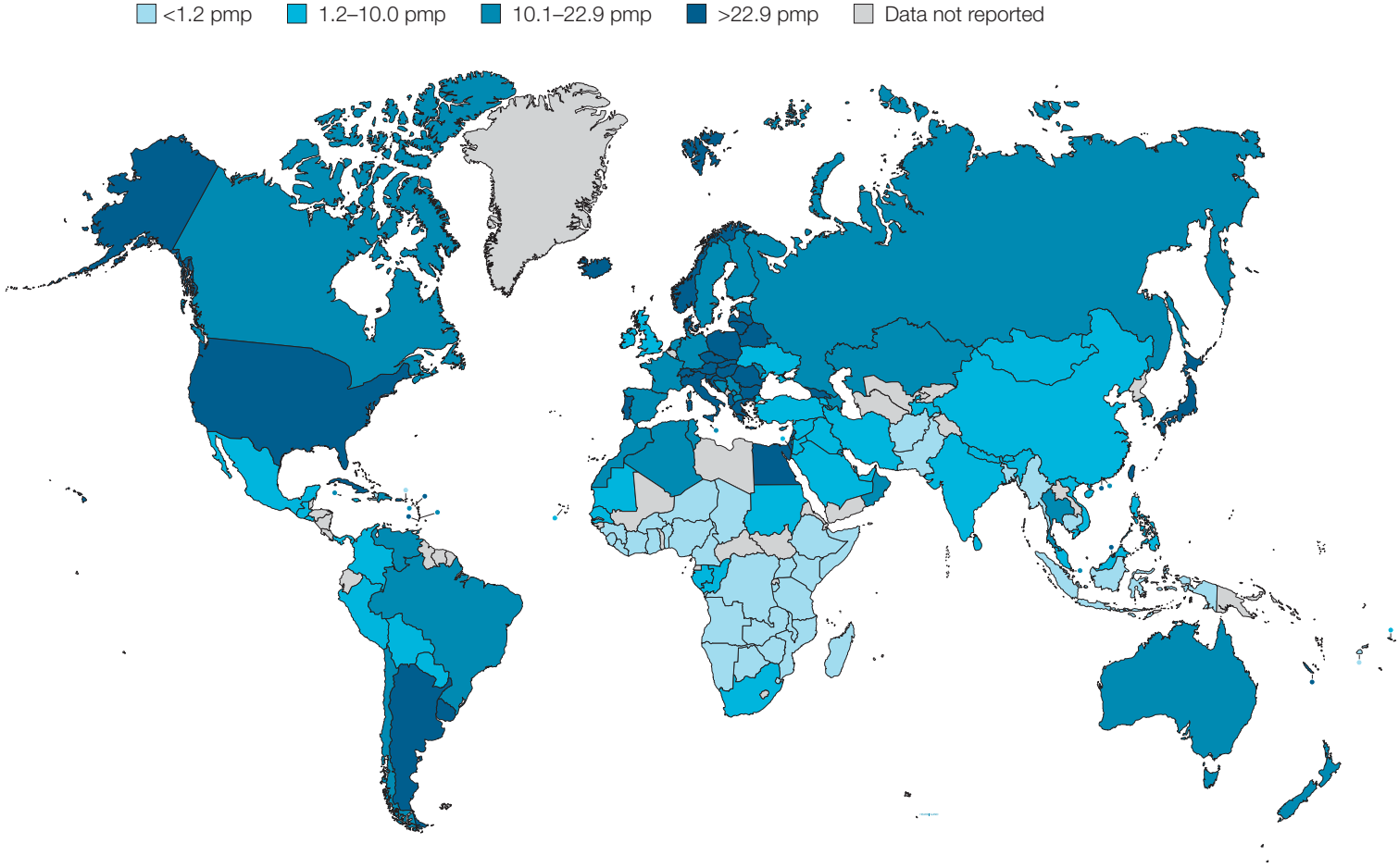
5.2 Workforce

Worldwide, the median number of nephrologists is 9.95 pmp (Map 5.1). Nephrologists are more prevalent in Western Europe (24.4 pmp), Eastern and Central Europe (25.6 pmp), North and East Asia (19.5 pmp), North America (18.1 pmp), and NIS and Russia (14.4 pmp) than in Latin America (9.8 pmp), the Middle East (8.1 pmp), OSEA (5.7 pmp), South Asia (1.2 pmp), and Africa (0.6 pmp). The prevalence of nephrologists increases with country income, with low income countries reporting the lowest prevalence (0.2 pmp), followed by lower-middle (1.6 pmp), upper-middle (10.8), and high (23.2 pmp) income countries.

The median number of nephrology trainees is 1.4 pmp (Map 5.2). Nephrology trainees are more prevalent in Western Europe (5.8 pmp), Eastern and Central Europe (3.3 pmp), North and East Asia (3.2 pmp), the Middle East (1.8 pmp), NIS and Russia (1.6 pmp), and Latin America (1.4 pmp) than in North America (Canada and the United States only) (1.7 pmp), OSEA (1.0 pmp), Africa (0.4 pmp), and South Asia (0.3 pmp). The prevalence of nephrology trainees increases with country income, with low income countries reporting the lowest prevalence (0.1 pmp), followed by lower-middle (0.6 pmp), upper-middle (1.2 pmp), and high (3.7 pmp) income countries.

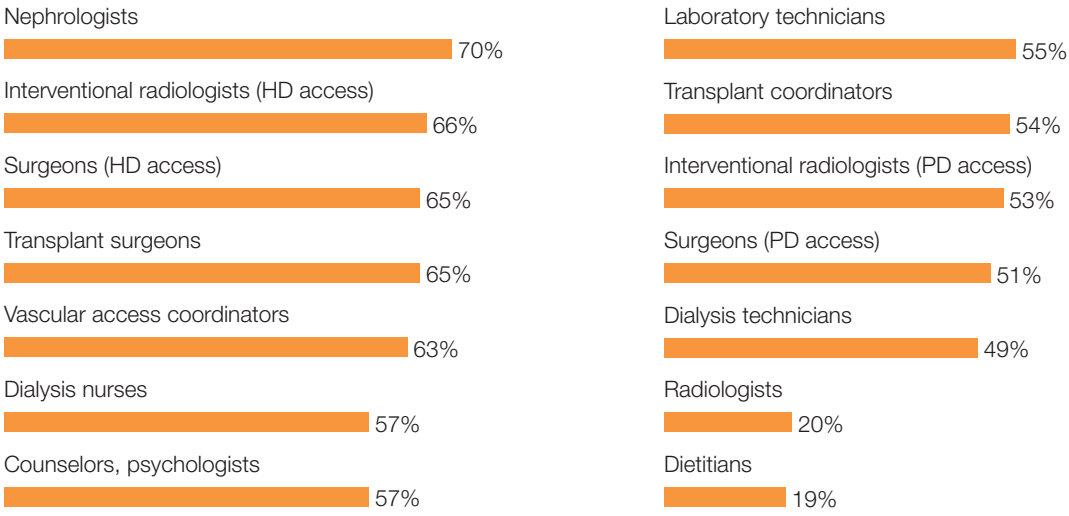
Map 5.1 | Global prevalence of nephrologists

Rate per million population (pmp)



Most countries have critical shortages of health care providers essential for ESKD care. Many countries do not have enough nephrologists (70%); interventional radiologists for HD access (66%) or PD access (53%); surgeons for transplantation (65%), HD access (65%), and PD access (53%); vascular access coordinators (63%); counselors or psychologists (57%); dialysis nurses (57%); laboratory technicians (55%); transplant coordinators (54%); dialysis technicians (49%); radiologists (ultrasound technicians) (20%); and dietitians (19%) (Figure 5.2). Only seven countries (Cuba, Cyprus, Finland, Kenya, Liechtenstein, New Caledonia, and Spain) report no shortages of any provider type. Over 90% of low income countries have shortages of nephrologists, interventional radiologists, surgeons, and transplant coordinators (Figure 5.3). Over 80% of lower-middle income countries have shortages of nephrologists, interventional radiologists (HD access only), and vascular access coordinators. In upper-middle income countries, the most common shortages are for interventional radiologists (HD access only) (80%), transplant surgeons (76%), vascular access coordinators (71%), surgeons (HD access) (68%), and nephrologists (66%). In high income countries, the most common shortages are for nephrologists (53%), surgeons (HD access) (46%), and dialysis nurses (44%) (Figure 5.3).

Figure 5.2 | Shortages of health care providers essential for ESKD care



Map 5.2 | Global prevalence of nephrology trainees

Rate per million population (pmp)

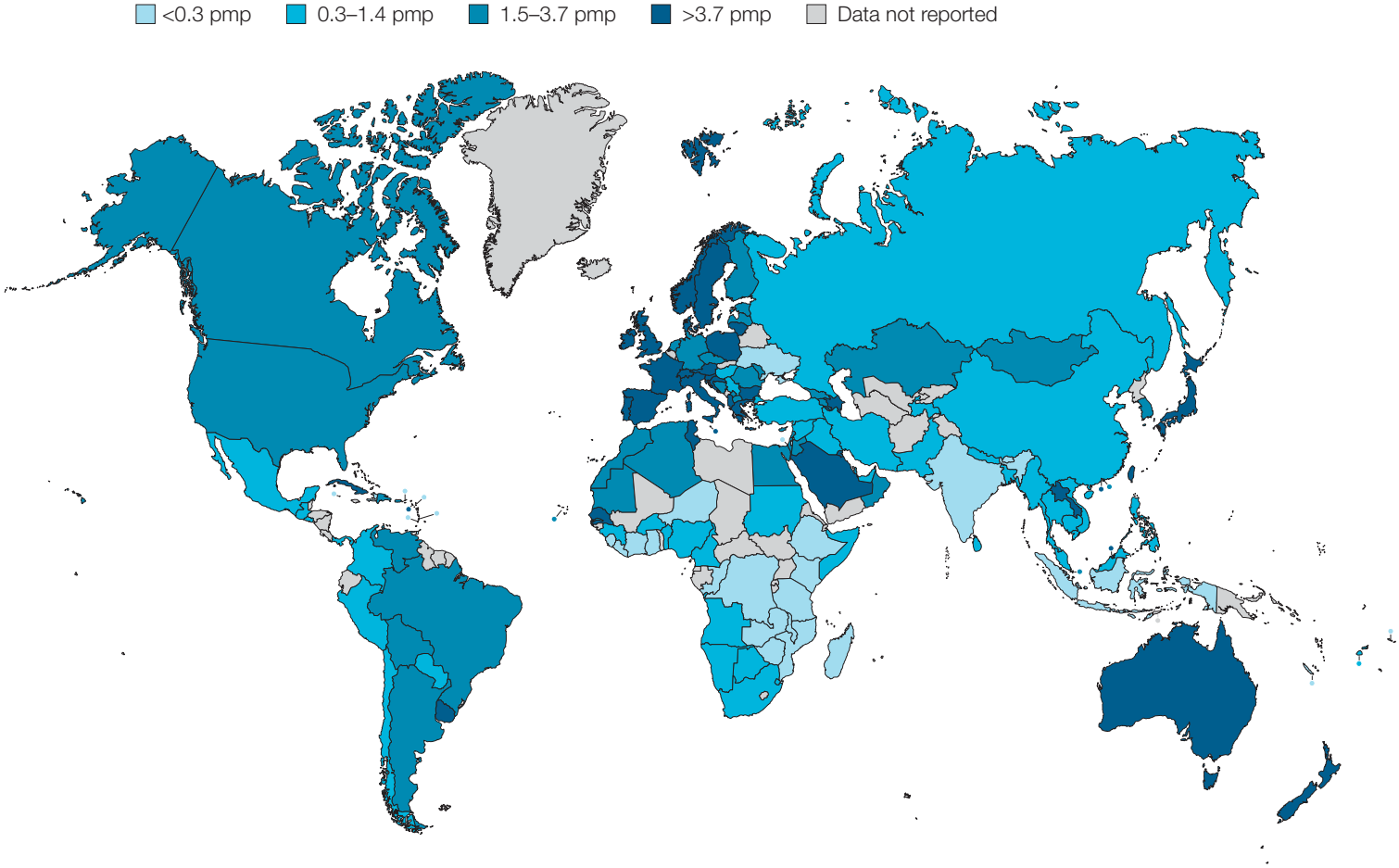
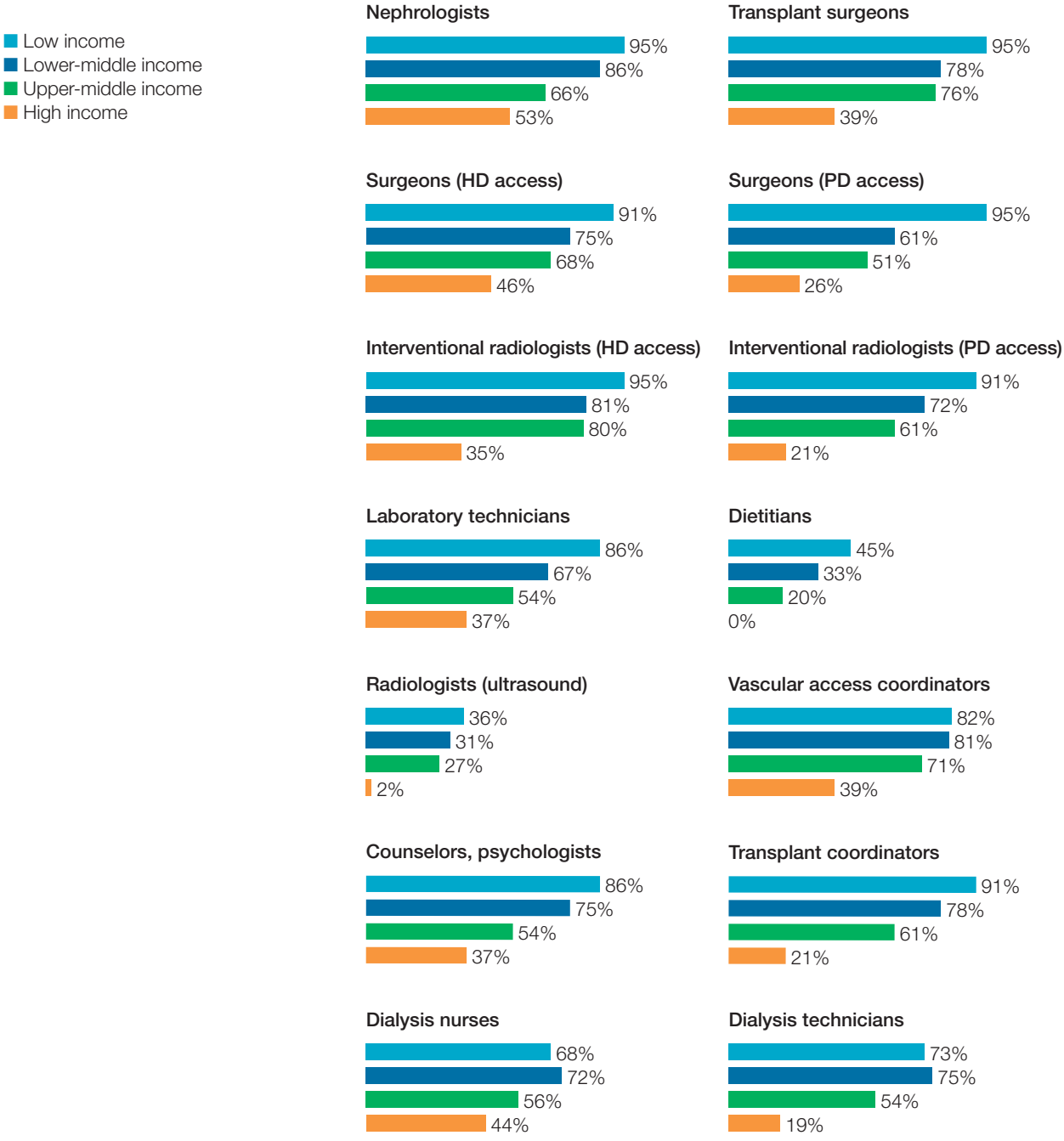


Figure 5.3 | Shortages of health care providers essential for ESKD care, by World Bank income group



SECTION 6

ACCESS TO ESSENTIAL MEDICATIONS AND HEALTH PRODUCTS

6.1. Capacity for KRT service provision

Chronic HD services are available in all countries that completed the survey (Figures 6.1, 6.2), and chronic PD services are available in 119 countries (76%), including all countries in North and East Asia and Western Europe, and most countries in Eastern and Central Europe (95%), Latin America (89%), South Asia (86%), the Middle East (82%), OSEA (80%), North America (78%), and NIS and Russia (75%) (Figure 6.1). Chronic PD services are available in less than half of the countries in Africa (41%). Access to chronic PD increases with country income (Figure 6.2); chronic PD is accessible in just 23% of low income countries, compared to 61% of lower-middle, 90% of upper-middle, and 96% of high income countries (Figure 6.2).

Figure 6.1 | Availability of chronic dialysis and kidney transplantation services, by ISN region

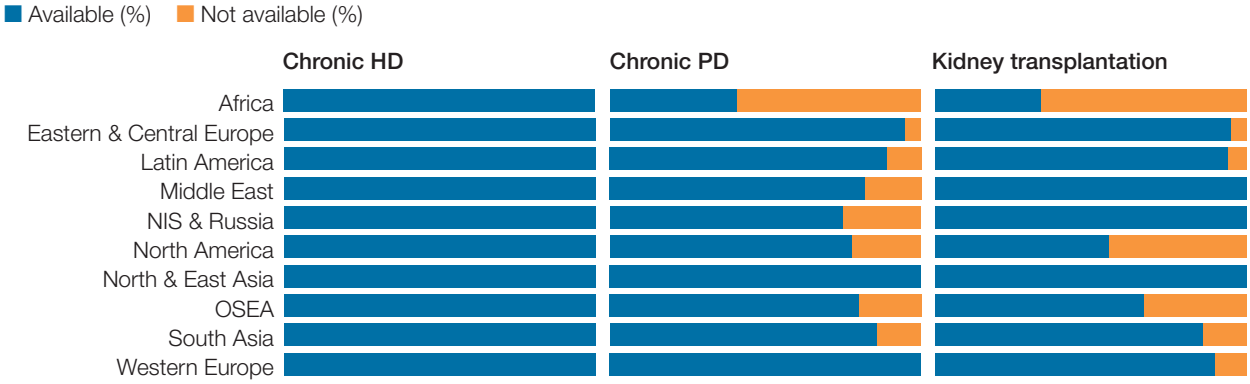
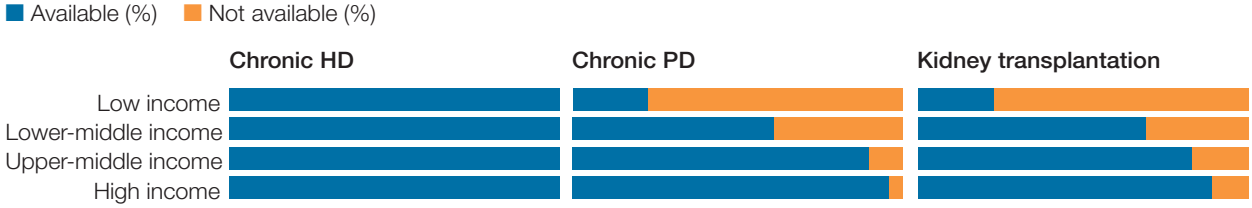


Figure 6.2 | Availability of chronic dialysis and kidney transplantation services, by World Bank income group



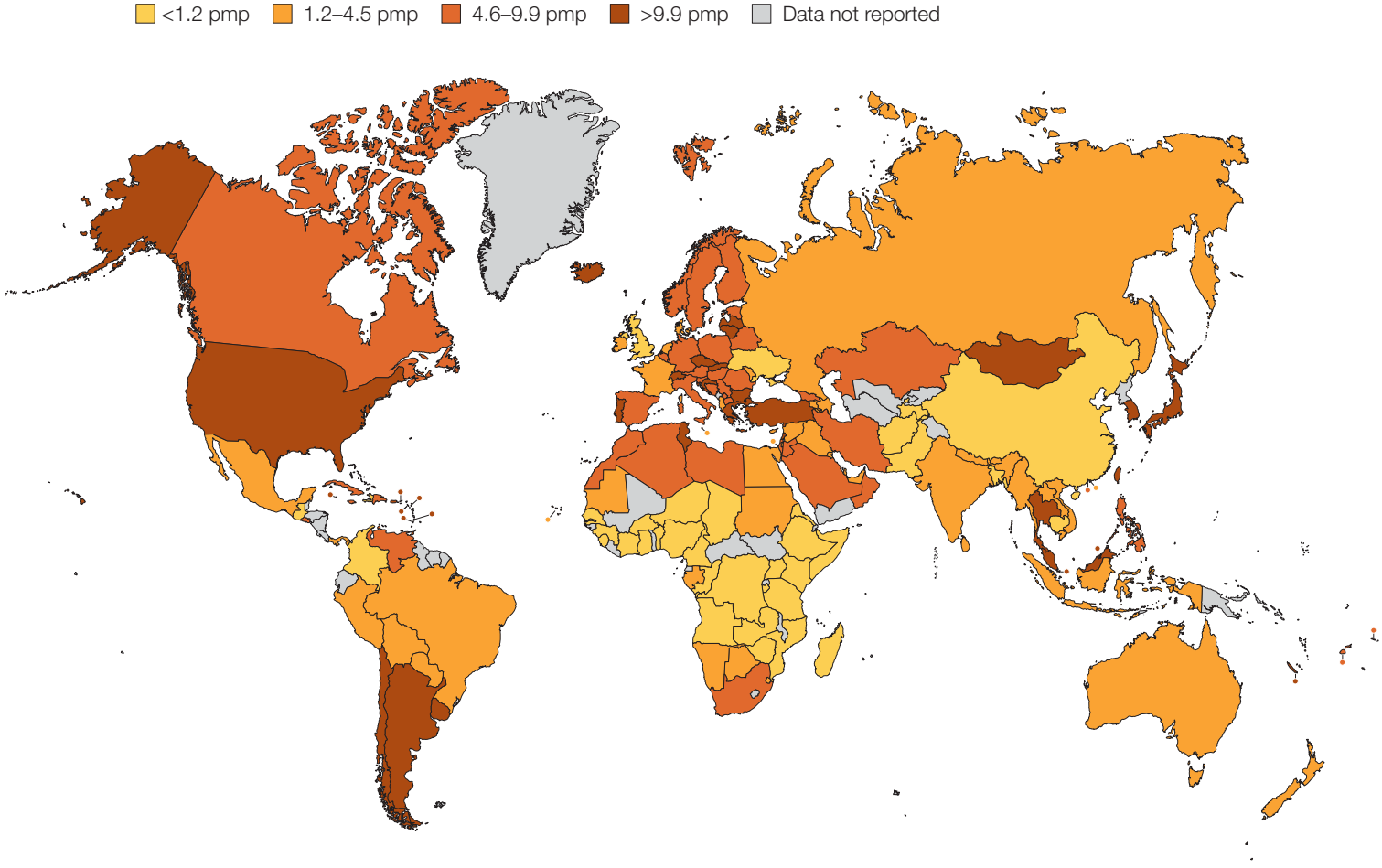
Kidney transplantation services are available in 114 countries (74%), including all countries in the Middle East, NIS and Russia, and North and East Asia, and most countries in Eastern and Central Europe (95%), Latin America (94%), Western Europe (90%), South Asia (86%), OSEA (67%), and North America (56%). Only 34% of countries in Africa offer kidney transplantation services (Figure 6.1). Similarly, accessibility of kidney transplantation services increases with income level (Figure 6.2); kidney transplantation is accessible in only 23% of low income countries, compared to 69% of lower-middle, 83% of upper-middle, and 89% of high income countries (Figure 6.2).

Among the countries with chronic HD services, the global average is 4.5 centers pmp (Map 6.1). Countries with the highest HD center density include New Caledonia (47.7 pmp), Liechtenstein (35.9 pmp), Taiwan (35.4 pmp), Japan (34.8 pmp), the Cayman Islands (33.6 pmp), and the British Virgin Islands (27.9 pmp). Countries with the lowest density include Mozambique (0.1 pmp), Chad (0.1 pmp), and Burundi, the Congo, Ethiopia, Guinea, Madagascar, Niger, and Uganda (all 0.2 pmp) (Map 6.1).

Among the countries with chronic PD services, the global average is 1.3 centers pmp (Map 6.2). Countries with the highest PD center density include New Caledonia (26.5 pmp), Liechtenstein

Map 6.1 | Availability of centers that provide chronic HD

Rate per million population (pmp)



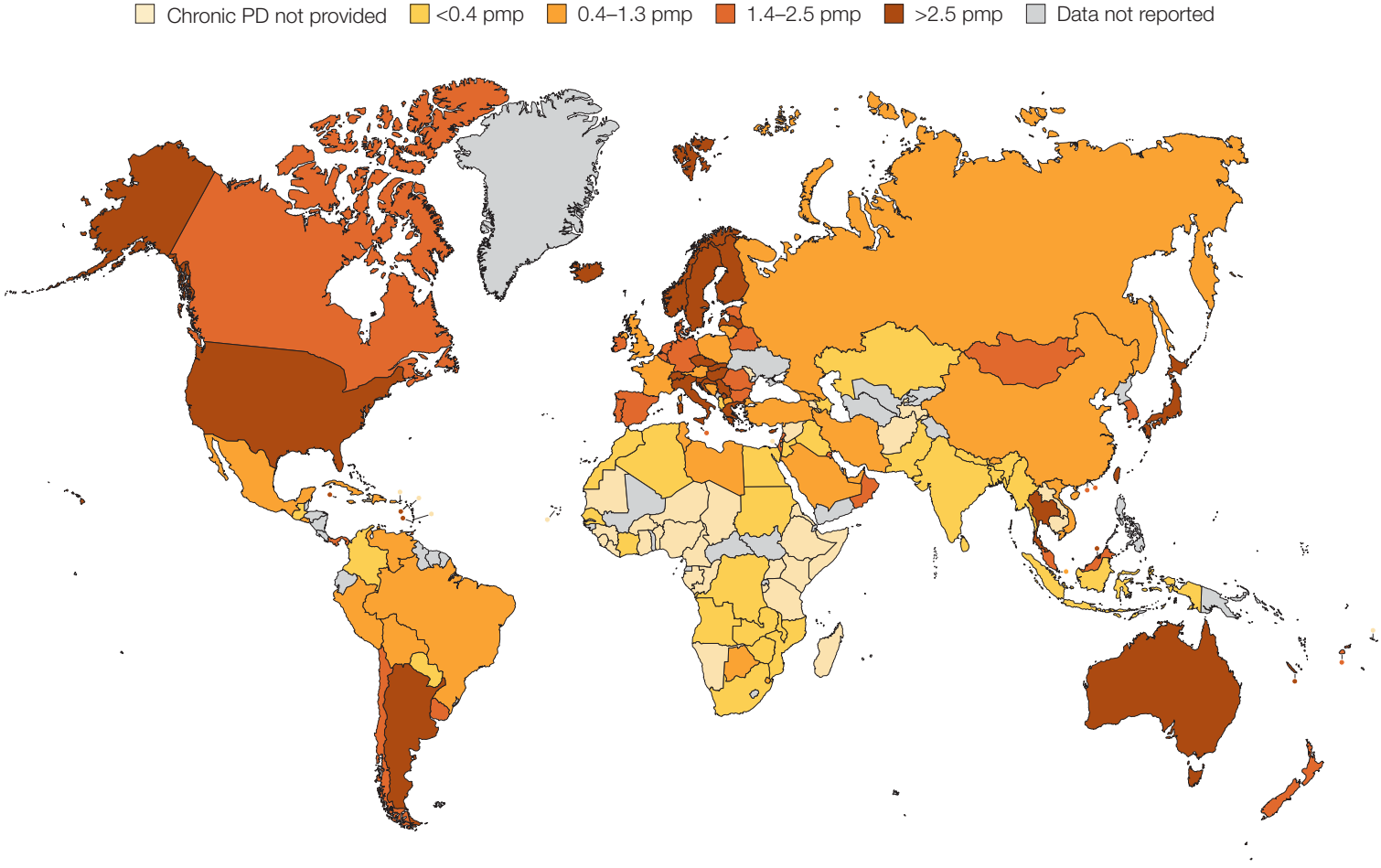
(25.9 pmp), Nevis (18.8 pmp), and the Cayman Islands (16.8 pmp). Countries with the lowest density include Pakistan (0.01 pmp), the Congo (0.02 pmp), Angola (0.03 pmp), Bangladesh (0.04 pmp), Cote d'Ivoire (0.04 pmp), Mozambique (0.04 pmp), and Malawi (0.05 pmp) (Map 6.2).

Among the countries with kidney transplantation services, the global average is 0.4 centers pmp (Map 6.3). Countries with the highest densities include: Antigua and Barbuda (10.4 centers pmp); Iceland (5.8 centers pmp); Malta (2.2 centers pmp); Brunei Darussalam (2.22 centers pmp); Macau SAR, China (1.7 centers pmp); and Mexico (1.4 centers pmp) (Map 6.3).

Among the countries where kidney transplantation is available, sources of donated kidneys vary: kidneys from a combination of deceased and living donors are used in 82 countries (72%); kidneys only from living donors are used in 32 countries (28%). No countries use kidneys only from deceased donors. Among countries with transplantation services, all 5 low income countries (Afghanistan, Ethiopia, Haiti, Nepal, Tanzania) only use kidneys from living donors, compared to 62% of lower-middle, 24% of upper-middle, and 8% of high income countries. Kidneys from a combination of living and deceased donors are used in 92% of high, 76% of upper-middle, and

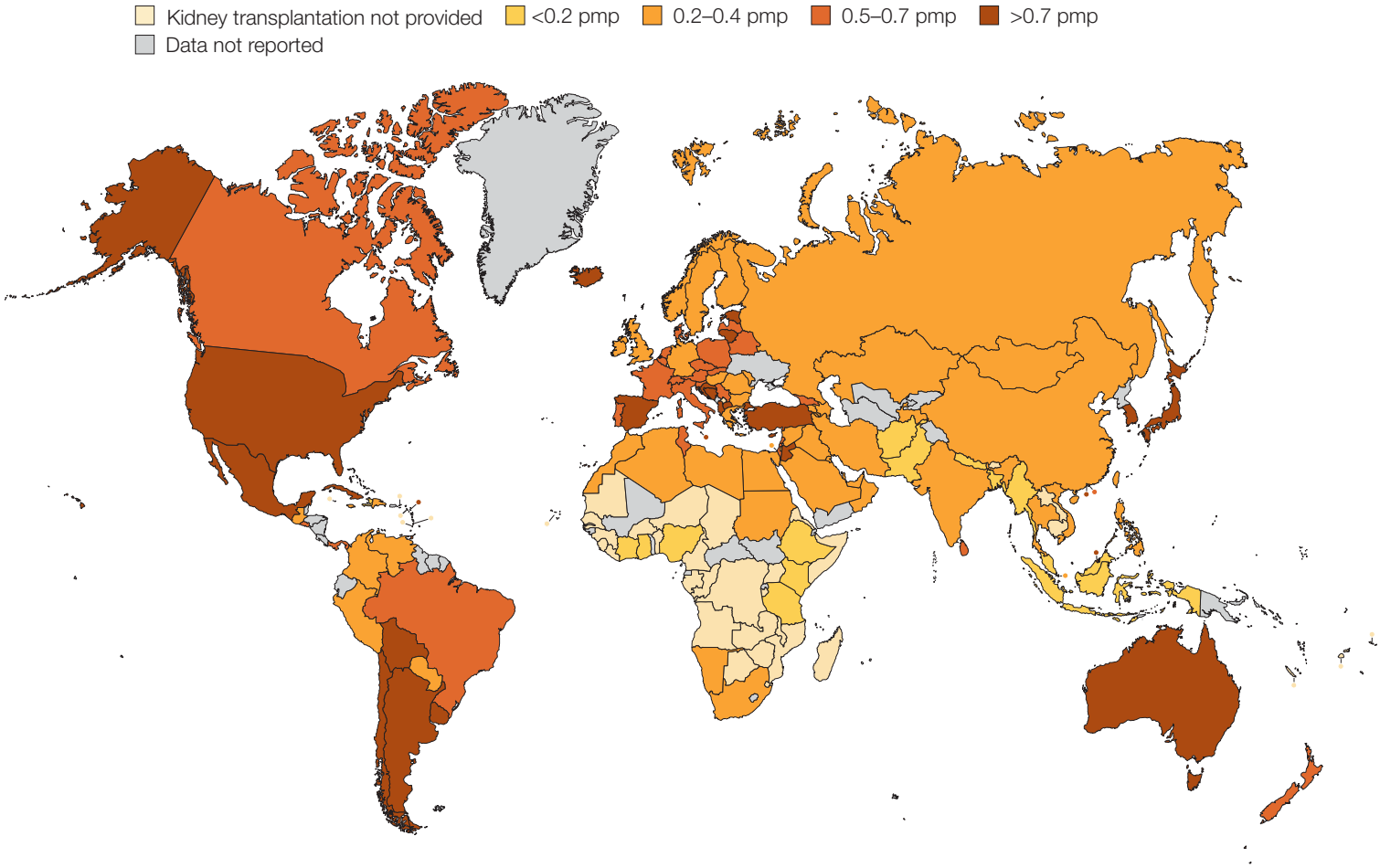
Map 6.2 | Availability of centers that provide chronic PD

Rate per million population (pmp)



Map 6.3 | Availability of centers that perform kidney transplantation

Rate per million population (pmp)



38% of lower-middle income countries with these services (Figure 6.3).

Among the countries that offer kidney transplantation, 62% have national transplantation waitlists, 19% only have regional waitlists, and 19% have no waitlist. Among the 5 low income countries with kidney transplantation services, 1 country (Afghanistan) has a regional waitlist and the other 4 have no waitlist (Figure 6.4). National waitlists are most common in high income (90%) and upper-middle (68%) income countries. Among lower-middle income countries, only 2 (8%) have national waitlists, and more than half do not have any type of waitlist (Figure 6.4).

Figure 6.3 | Source of donated kidneys, by World Bank income group

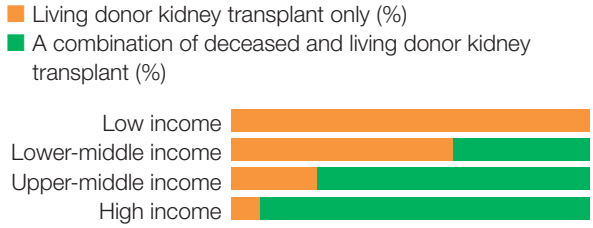
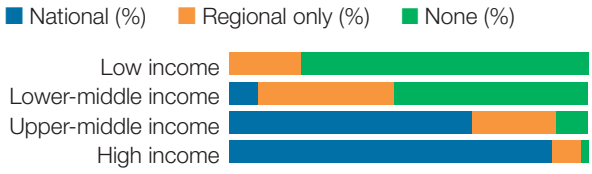


Figure 6.4 | Type of kidney transplantation waitlist, by World Bank income group

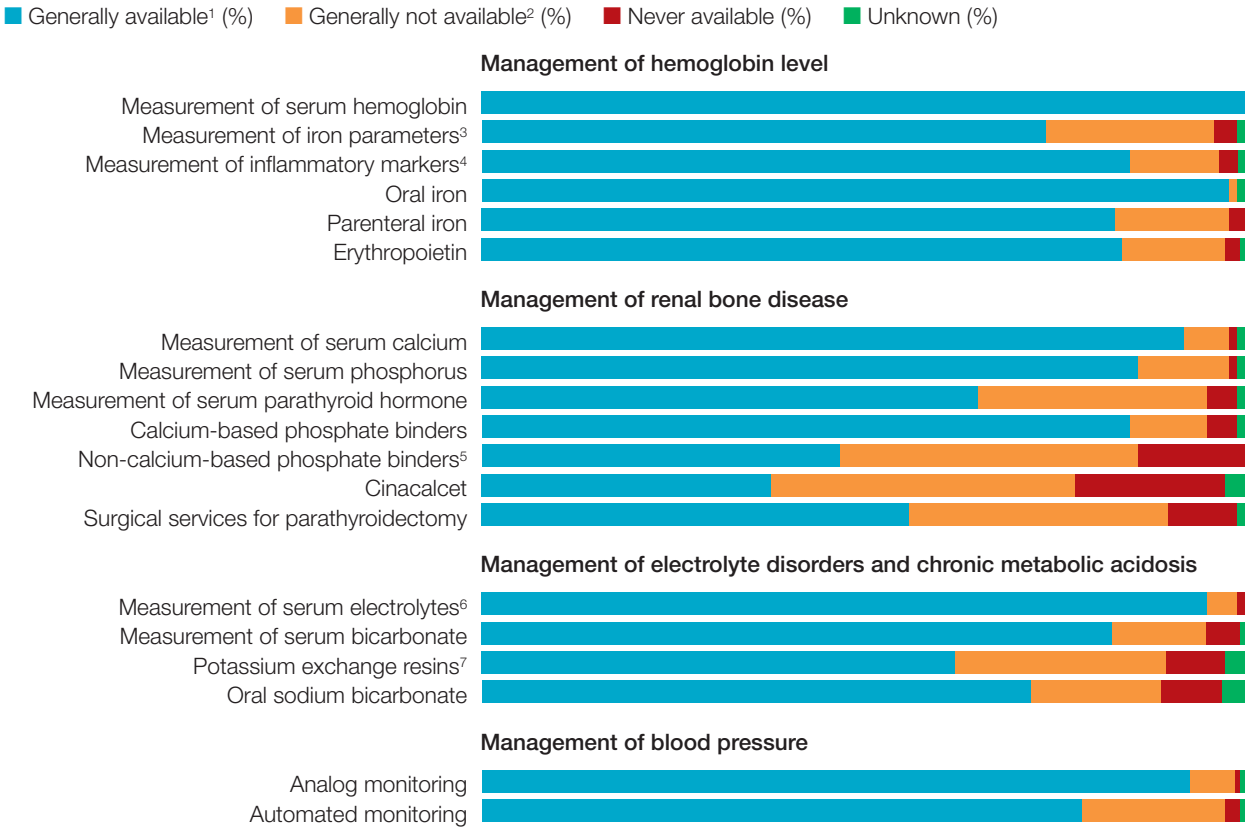


6.2 Availability of services for ESKD care

Availability of services for ESKD care varies globally. Hemoglobin measurement services are generally available in most countries. All countries (100%) have the capacity to measure serum hemoglobin, 98% have the capacity to provide oral iron supplementation, 85% have the capacity to measure inflammatory markers (e.g., serum C-reactive protein [CRP]), 84% have the capacity to administer erythropoietin, 83% have the capacity to administer parenteral (intravenous) iron, and 74% have the capacity to monitor iron parameters (Figure 6.5).

The capacity to manage renal bone disease also varies. Among the countries participating in the survey, the vast majority have the capacity to measure serum calcium (92%) and serum phosphorous (86%) and to administer calcium-phosphate binders (85%), whereas relatively fewer countries have the capacity to administer non-calcium-based phosphate binders (47%) and cinacalcet (37%). Overall, 65% of countries have the capacity to measure serum parathyroid hormone and 56% are able to provide surgical services for parathyroidectomy (Figure 6.5).

Figure 6.5 | Availability of services for ESKD care



1 Generally available: in 50% or more centers (hospitals or clinics)
2 Generally not available: in less than 50% of centers (hospitals or clinics)
3 Iron, ferritin, transferrin saturation
4 e.g., serum C-reactive protein
5 e.g., sevelamer
6 e.g., sodium, potassium, chloride
7 e.g., kayexalate

The capacity to manage electrolyte disorders and chronic metabolic acidosis is high in most countries (Figure 6.5). Nearly all countries (95%) have the capacity to measure serum electrolytes and 83% have the capacity to measure serum bicarbonate. Nearly three-quarters (72%) of countries have the capacity to administer oral sodium bicarbonate and nearly two-thirds (62%) of countries have the capacity to administer potassium exchange resins (for example, Kayexalate).

In most countries (93%), blood pressure is monitored through analog techniques (Figure 6.5). Management of blood pressure through automated blood pressure monitoring is less common, but still generally available in 79% of countries.

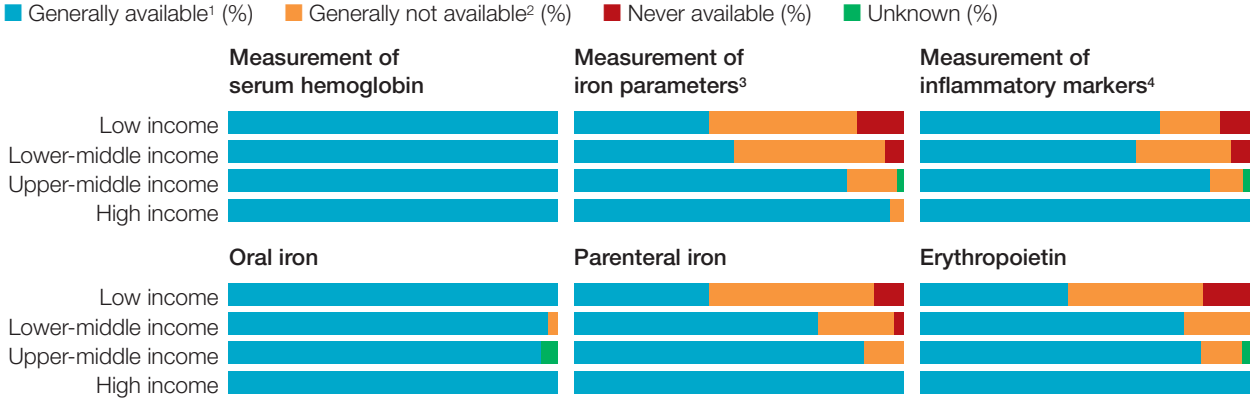
Irrespective of income level, all countries have the capacity to measure serum hemoglobin levels and nearly all administer oral iron (Figure 6.6.1). The capacity to measure iron parameters increases with income level: this service is offered in 41% of low income countries, compared to 49% of lower-middle, 83% of upper-middle and 96% of high income countries (Figure 6.6.1). The capacities to administer parenteral iron and erythropoietin are also lower in low income countries; these services are generally available in just 41% and 45% of countries, respectively (Figure 6.6.1).

The capacity to measure serum parathyroid hormone for renal bone disease management is tied to country income level; these services are generally available in just 27% of low and 31% of lower-middle income countries. Similarly, surgical services for parathyroidectomy are generally available in only 27% of low and 23% of lower-middle income countries. Cinacalcet is less available in low, lower-middle, and upper-middle income countries compared to high income countries, as are non-calcium-based phosphate binders (Figure 6.6.2).

Measurement of serum electrolytes to manage electrolyte disorders and chronic metabolic acidosis is commonly available in most countries, irrespective of income (Figure 6.6.3). The capacity to measure serum bicarbonate exists in 95% of high, 85% of upper-middle, 69% of lower-middle, and 59% of low income countries. Potassium exchange resins are less available in low income countries, as is oral sodium bicarbonate (Figure 6.6.3).

Analog blood pressure monitoring is available in most countries, irrespective of income (Figure 6.6.4). Automated blood pressure monitoring is generally available in 98% of high, 73% of low, 71% of upper-middle, and 60% of lower-middle income countries (Figure 6.6.4).

Figure 6.6.1 | Management of hemoglobin level, by World Bank income group



1 Generally available: in 50% or more centers (hospitals or clinics)
2 Generally not available: in less than 50% of centers (hospitals or clinics)
3 Iron, ferritin, transferrin saturation
4 e.g., serum C-reactive protein

Figure 6.6.2 | Management of renal bone disease, by World Bank income group

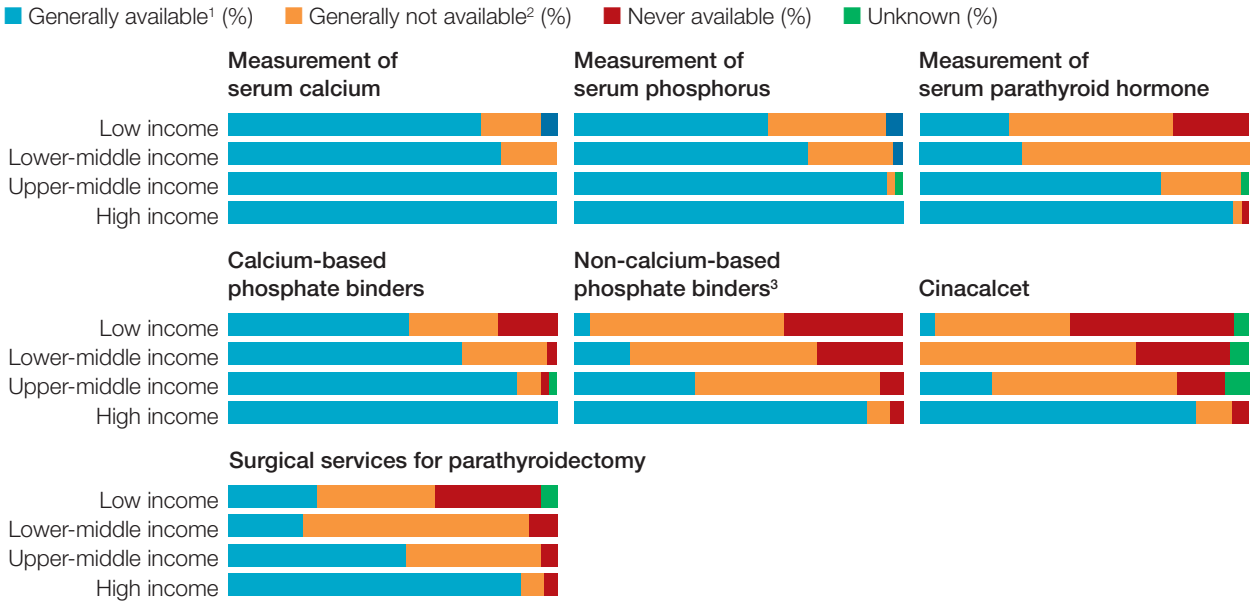


Figure 6.6.3 | Management of electrolyte disorders and chronic metabolic acidosis, by World Bank income group

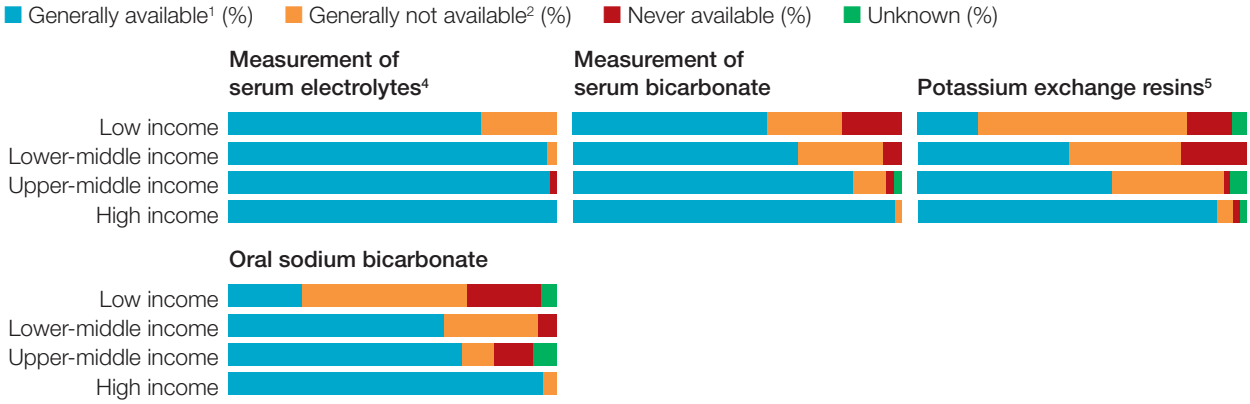
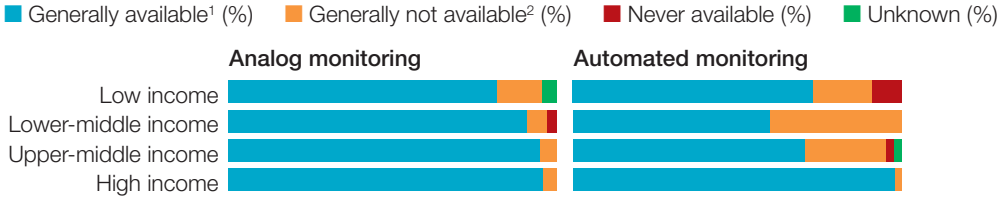


Figure 6.6.4 | Management of blood pressure, by World Bank income group



1 Generally available: in 50% or more centers (hospitals or clinics)
2 Generally not available: in less than 50% of centers (hospitals or clinics)
3 e.g., sevelamer
4 e.g., sodium, potassium, chloride
5 e.g., kayexalate

6.3 Accessibility of KRT

Overall, in 72% of countries with available dialysis services, at least half of patients with ESKD are able to access dialysis at the onset of kidney failure. Accessibility is highest in Eastern and Central Europe, Latin America, the Middle East, NIS and Russia, North America, North and East Asia, and Western Europe (Figure 6.7). Accessibility is lowest in South Asia, Africa, and OSEA, where less than half of patients with ESKD in 83%, 65%, and 33% of countries, respectively, are able to access dialysis at the onset of kidney failure (Figure 6.7).

Accessibility to dialysis at the onset of kidney failure increases with income level (Figure 6.8). Among countries with dialysis services available, accessibility in high (96%) and upper-middle (83%) income countries is higher than in lower-middle (61%) and low (5%) income countries. Low access to dialysis, defined as less than 10% of patients having access to dialysis at the onset of kidney failure, exists in 76% of low income countries, compared to only 4% of high income countries (Figure 6.8).

Among countries with PD available, only 5 countries (4%) reported PD as the initial treatment for more than half of ESKD patients: Eastern and Central Europe (1 country: Croatia), Latin America (2 countries: El Salvador, Mexico), NIS and Russia (1 country: Azerbaijan), and North and East Asia (1 country: Hong Kong SAR) (Figure 6.9). Five countries (4%) reported that PD is never the initial treatment: Africa (3 countries: Angola, Egypt, Zimbabwe), Latin America (1 country: Bolivia), and South Asia (1 country: Pakistan).

Figure 6.7 | Accessibility of KRT at the onset of ESKD, by ISN region

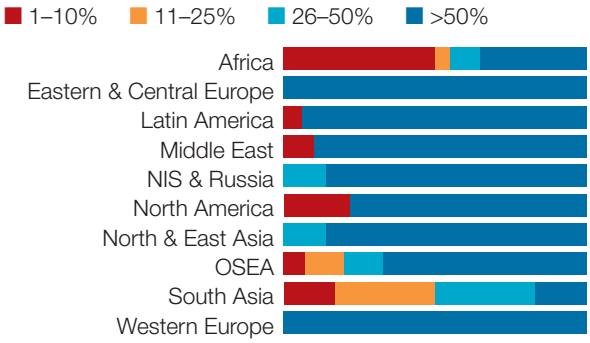


Figure 6.8 | Accessibility of KRT at the onset of ESKD, by World Bank income group

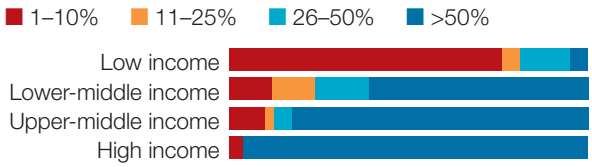
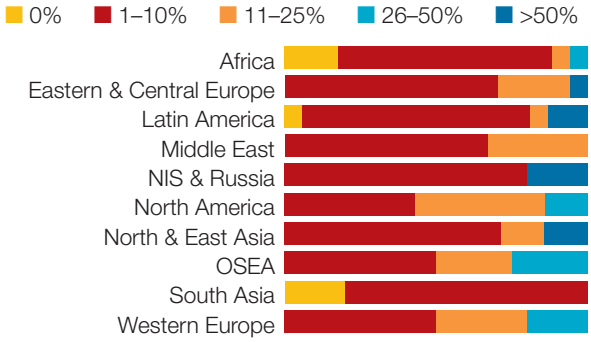


Figure 6.9 | Proportion of patients typically initiating treatment with PD, by ISN region



Irrespective of income level, the proportion of ESKD patients who initiate treatment with PD is low (typically < 50%). Among the 5 countries reporting that ESKD treatment is never initiated with PD, 1 is low-income, 3 are lower-middle income and 1 is upper-middle income (Figure 6.10). Among the 5 countries reporting PD as the initial treatment for more than half of ESKD patients, 2 are high income, 2 are upper-middle, and 1 is lower-middle income (Figure 6.10).

Overall, accessibility to kidney transplantation services is low. In 36% of countries that offer kidney transplantation, less than 11% of patients who have ESKD and are suitable candidates for transplants are able to access services. Access to existing services is lowest in North and East Asia, South Asia, Africa, and OSEA (Figure 6.11). Access is highest in Western Europe, Eastern and Central Europe, and the Middle East (Figure 6.11).

Access to transplantation increases with a country income level (Figure 6.12). In countries with available transplantation services, access is low (i.e., fewer than 11% of patients are able to access transplantation services in all low income countries), compared to 65% of lower-middle, 36% of upper-middle, and 16% of high income countries. More than half (64%) of high income countries reports high access to care (i.e., at least half of patients eligible for transplants are able to access services), compared to 30% of upper-middle and 13% of lower-middle income countries. No low income countries reports high access to transplantation services (Figure 6.12).

Among countries with KRT available, access to KRT services varies. The level of within-country variation due to geographic characteristics decreases with income level (Figure 6.13). In most high income countries, geographic variation is less common for HD and transplantation, and moderate for access to PD services (Figure 6.13).

Figure 6.10 | Proportion of patients typically initiating treatment with PD, by World Bank income group

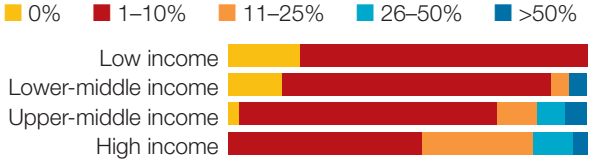
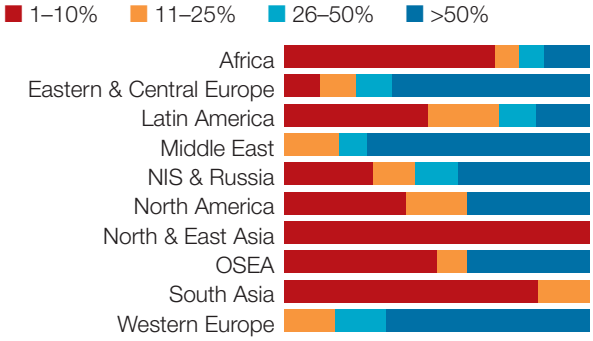
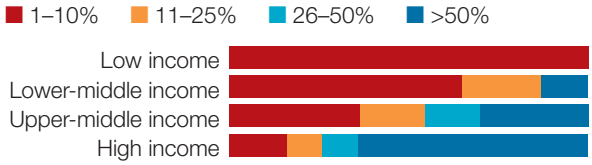


Figure 6.11 | Accessibility[1] of kidney transplantation, by ISN region



1 The proportion of ESKD patients suitable for transplant who are able to access it.

Figure 6.12 | Accessibility[1] of kidney transplantation, by World Bank income group



1 The proportion of ESKD patients suitable for transplant who are able to access it.

Access to KRT also varies depending on patient characteristics (e.g., gender, employment status). The level of within-country variation due to patient characteristics varies, but generally is lowest in high income countries (Figure 6.14). Overall, variation due to patient characteristics (Figure 6.14) is lower than variation due to geographic characteristics (Figure 6.13).

Figure 6.13 | Within-country geographic variation in access to KRT, by World Bank income group

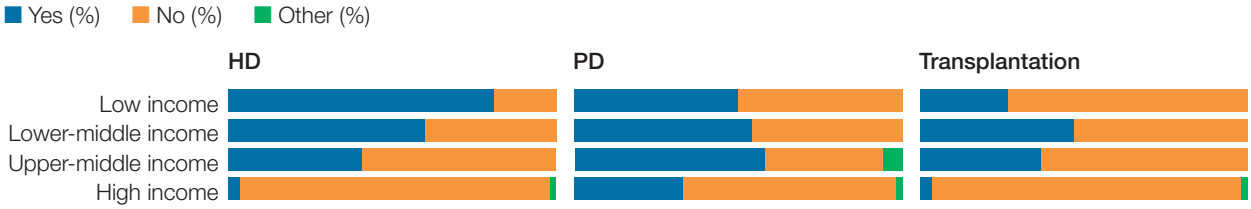
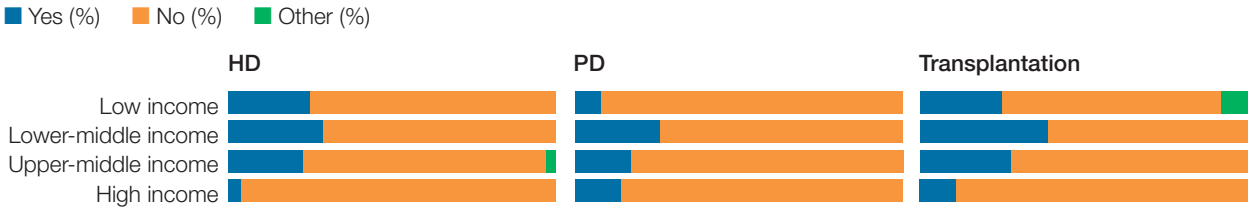


Figure 6.14 | Variation in access to KRT based on patient characteristics, by World Bank income group



6.4 Affordability of KRT

Among the countries with HD available, 29% cover all treatment costs, including medications. Only 8% of countries require patients to pay for all costs out-of-pocket. Regions with the highest proportions of countries that exclusively cover all HD-related costs are Western Europe, NIS and Russia, Eastern and Central Europe, Latin America, and South Asia (Figure 6.15). Treatment cost coverage varies globally, and increases with income level. Nearly half (41%) of high income countries cover all HD-related costs, compared to 21% of upper-middle, 19% of lower-middle, and 28% of low income countries (Figure 6.16).

Among the countries with PD available, 29% cover all treatment costs, including medications. Only 7% of countries require patients to pay for all costs out-of-pocket. Regions with the highest proportions of countries that exclusively cover all costs related to PD treatment are Africa, Eastern and Central Europe, the Middle East, NIS and Russia, and Western Europe (Figure 6.15). Similarly, coverage of PD-related costs increases with income level (Figure 6.16). Among high income countries, 38% exclusively cover costs, compared to 29% of upper-middle, 24% of lower-middle, and 0% of low income countries (Figure 6.16).

Among the countries with kidney transplantation available, 31% cover all treatment costs associated with transplantation. Only 9% of countries require patients to pay for all costs out-of-pocket. Regions with the highest proportions of countries that exclusively cover all costs related to transplantation are Eastern and Central Europe, NIS and Russia, and Western Europe (Figure 6.15). Coverage of transplantation is

Figure 6.15 | Proportion of treatment costs (including medications) paid directly by patients, by ISN region

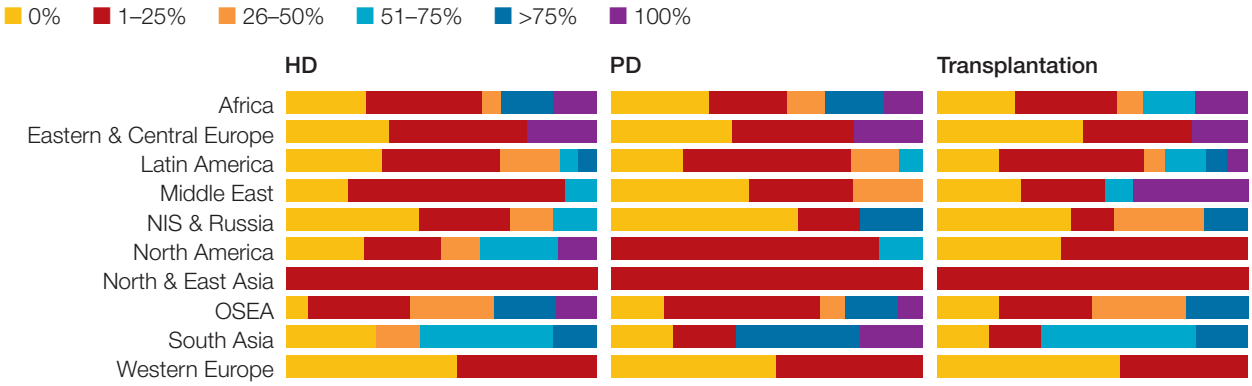
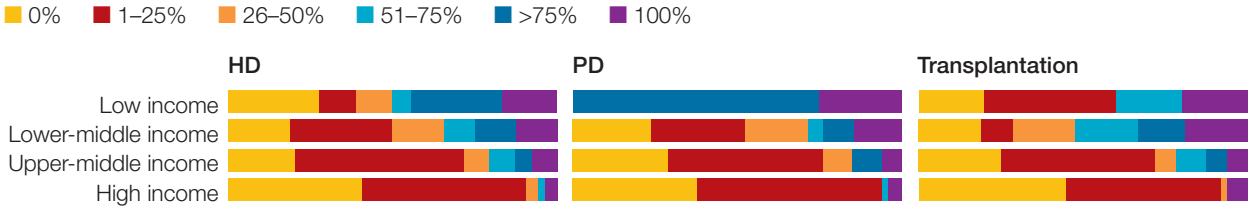


Figure 6.16 | Proportion of treatment costs (including medications) paid directly by patients, by World Bank income group



highest in high income countries, among which 44% exclusively cover transplant-related costs, compared to 24% of upper-middle, 17% of lower-middle, and 20% of low income countries (Figure 6.16).

Co-payment levels (i.e., the proportion of treatment costs covered by patients) vary worldwide across all three types of KRT. Within-country geographic variation in HD-related co-payment levels decreases as country income level increases (Figure 6.17). For PD-related costs, within-country geographic variation is minimal, with no low income countries reporting geographic variation and only 4% (n = 2) of high income countries reporting variation (Figure 6.17). Transplantation-related co-payment levels vary geographically within just 4% of high income countries, compared to 14% of upper-middle, 21% of lower-middle, and 14% of low income countries (Figure 6.17).

Co-payment levels also vary due to patient characteristics (e.g., age, gender, employment status) but appear to be less associated with a country's income level than within-country geographic variation. HD-related co-payment levels vary due to patient characteristics in 26% of high, 29% of upper-middle, 40% of lower-middle, and 12% of low income countries (Figure 6.18). PD-related co-payment levels vary due to patient characteristics in 19% of high, 15% of upper-middle, 28% of lower-middle, and 13% of low income countries (Figure 6.18). Similarly, transplant co-payment levels vary due to patient characteristics in 16% of high, 14% of upper-middle, 24% of lower-middle, and 13% of low income countries (Figure 6.18).

Figure 6.17 | Within-country geographic variation in co-payments for KRT, by World Bank income group

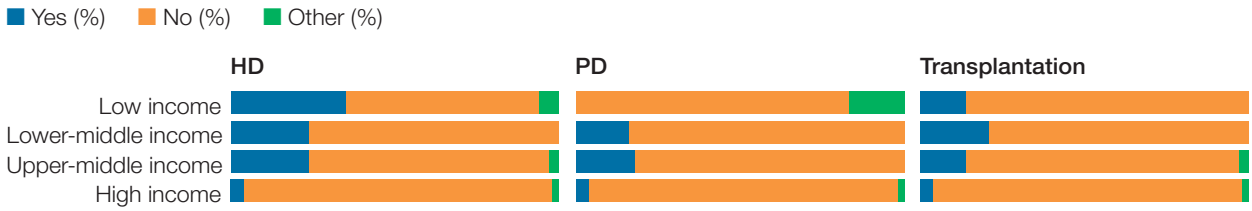
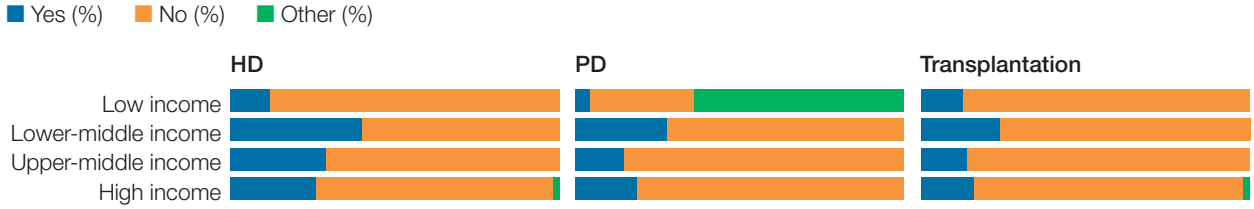


Figure 6.18 | Variation in co-payments for KRT based on patient characteristics, by World Bank income group

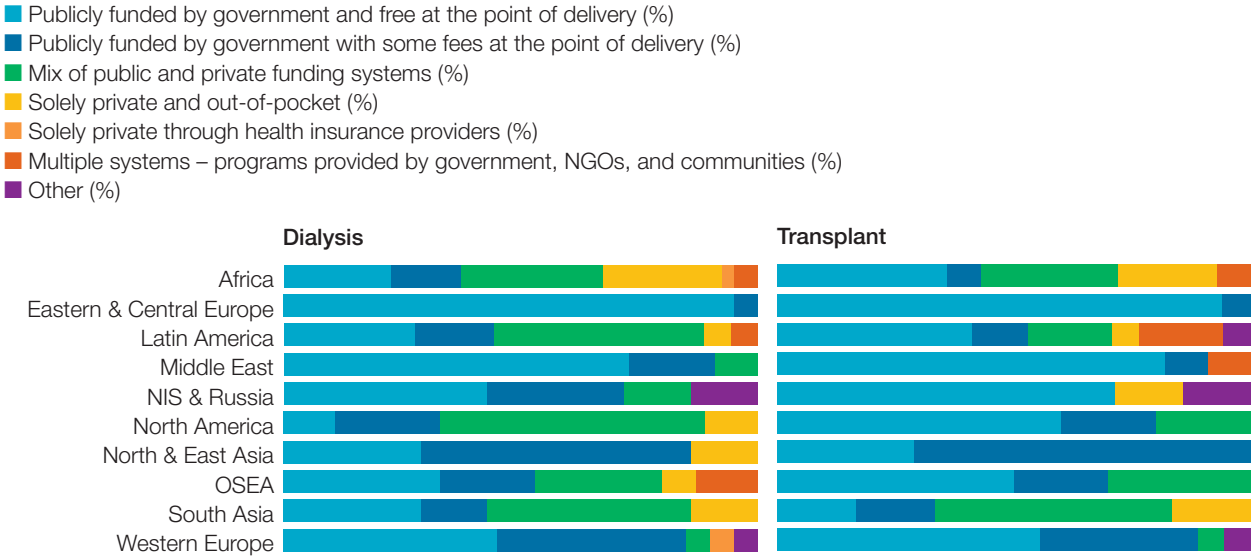


6.5 Medication funding models for patients on KRT

Among the countries that offer dialysis, 61% provide governmental funding for patients' medications; of these countries, 41% charge patients no fees at the point of delivery and 21% charge some fees at the point of delivery. In contrast, 11% fund medications for dialysis patients exclusively though private sources. Funding models vary globally. All countries in Eastern and Central Europe cover dialysis patients' medications exclusively through government funding, as do 91% of countries in the Middle East, 86% of countries in North and East Asia, 85% of countries in Western Europe, and 72% of countries in NIS and Russia (Figure 6.19). Nearly half of the countries in OSEA (53%) and Latin America (45%) cover dialysis patients' medications exclusively through government funding; relatively fewer countries in South Asia (43%), Africa (38%), and North America (33%) do so. (Figure 6.19). Among the 17 countries that fund dialysis patients' medications exclusively through private sources, 11 are in Africa (28% of the region). No countries in Eastern and Central Europe, the Middle East, or NIS and Russia fund dialysis patients' medications solely through private sources (Figure 6.19).

Among the countries that offer kidney transplantation, 75% cover patients' medication costs through government funding; 57% of these countries charge patients no fees at the point of delivery and 18% charge some fees. In contrast, 5% fund transplant patients' medications exclusively though private sources. Funding models vary globally. All countries in Eastern and Central Europe and North and East Asia cover transplant patients' medication costs exclusively through government funding, as do 91% of countries in the Middle East and 89% of countries in Western Europe. Only 34% of countries in South Asia (n = 2) cover transplant patients' medication costs through government funding (Figure 6.19). Among the 6 countries that fund transplant patients' medications exclusively through private sources, 3 are in Africa (21% of the region). No countries in Eastern and Central Europe, the Middle East, North America, North and East Asia, OSEA, or Western Europe fund transplant patients' medications solely through private or out of out-of-pocket sources (Figure 6.19).

Figure 6.19 | Funding models for KRT patients, by ISN region



6.6 Vascular access for KRT

Over 50% of patients initiate HD treatment with functioning vascular access (i.e., an arteriovenous fistula or graft), a tunneled dialysis catheter, or a temporary dialysis catheter in 18%, 13% and 46% of countries, respectively (Figure 6.20).

Moreover, patient education on the best means of access and the optimal timing for surgery (e.g., 6 months and 1 month prior to the initiation of HD and PD, respectively) is lacking. Only 19% of countries reported that patients receive education almost all (i.e., more than 75%) of the time, and 60% of countries reported that patients receive education less than 50% of the time (Figure 6.20).

Methods of access at the initiation of HD also vary by country income (Figure 6.21). Patients in low income countries are less likely to start HD with functioning vascular access or a tunneled dialysis catheter than countries in other income groups and are more likely to initiate treatment with a temporary dialysis catheter. Patients initiate HD with a temporary catheter almost all of the time in more than half (57%) of low income countries, compared to patients in 21% of lower-middle, 23% of upper-middle, and 5% of high income countries (Figure 6.21). Similarly, it is less common to receive education on access types and timely surgery in low income countries; 15% of low income countries reported that patients never receive education or undergo surgery within an appropriate time period prior to starting treatment. In contrast, 30% of high income countries provide patients with education and timely surgery almost all of the time (Figure 6.21).

Figure 6.20 | Types of vascular access for KRT

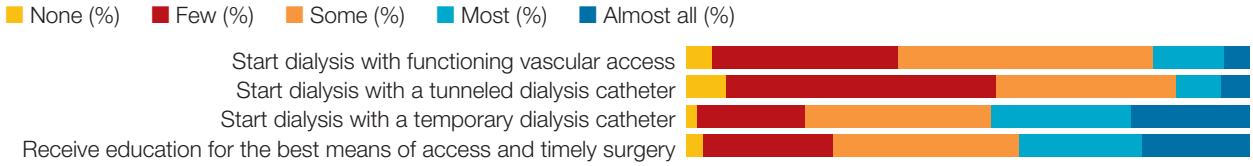
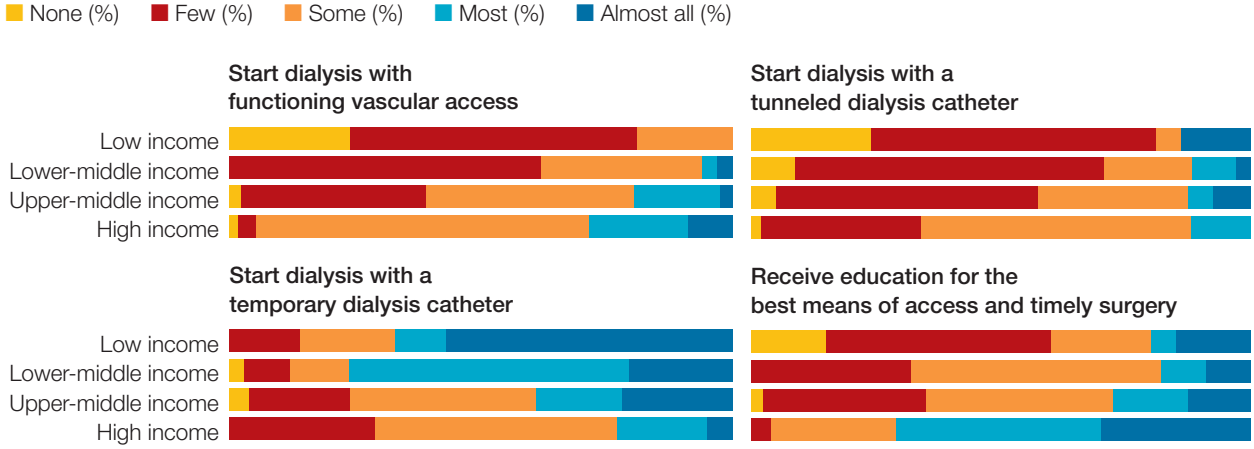


Figure 6.21 | Types of vascular access for KRT, by World Bank income group



6.7 Quality of KRT services

Respondents were asked to disclose how often their countries measure and report key quality indicators for HD service delivery. Among the countries in which patients have access to HD services, 32% measure patient-reported outcome measures (PROMS) almost all of the time (Figure 6.22). Indicators that are commonly measured and reported almost all of the time include blood pressure (86%), hemoglobin/hematocrit (88%), small solute clearance (61%), bone mineral markers (60%), and patient survival (70%). Technique survival is measured and reported nearly all of the time in 51% of countries worldwide (Figure 6.22).

Measuring and reporting of quality HD indicators generally increases with country income level: 17% of low income countries never measure PROMS, compared to 9% of high income

Figure 6.22 | Proportion of centers that measure and report quality indicators for HD service delivery

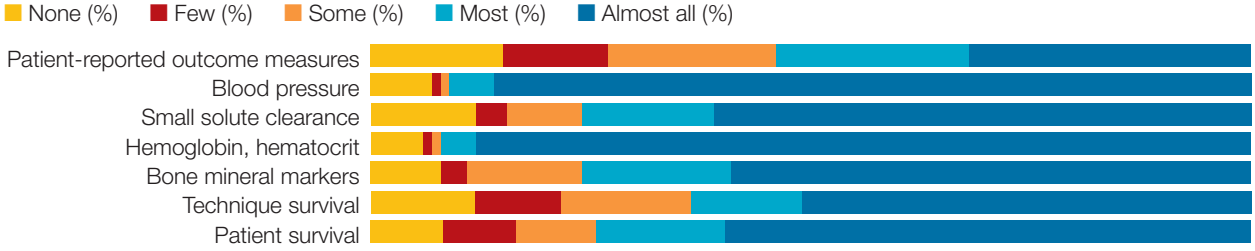
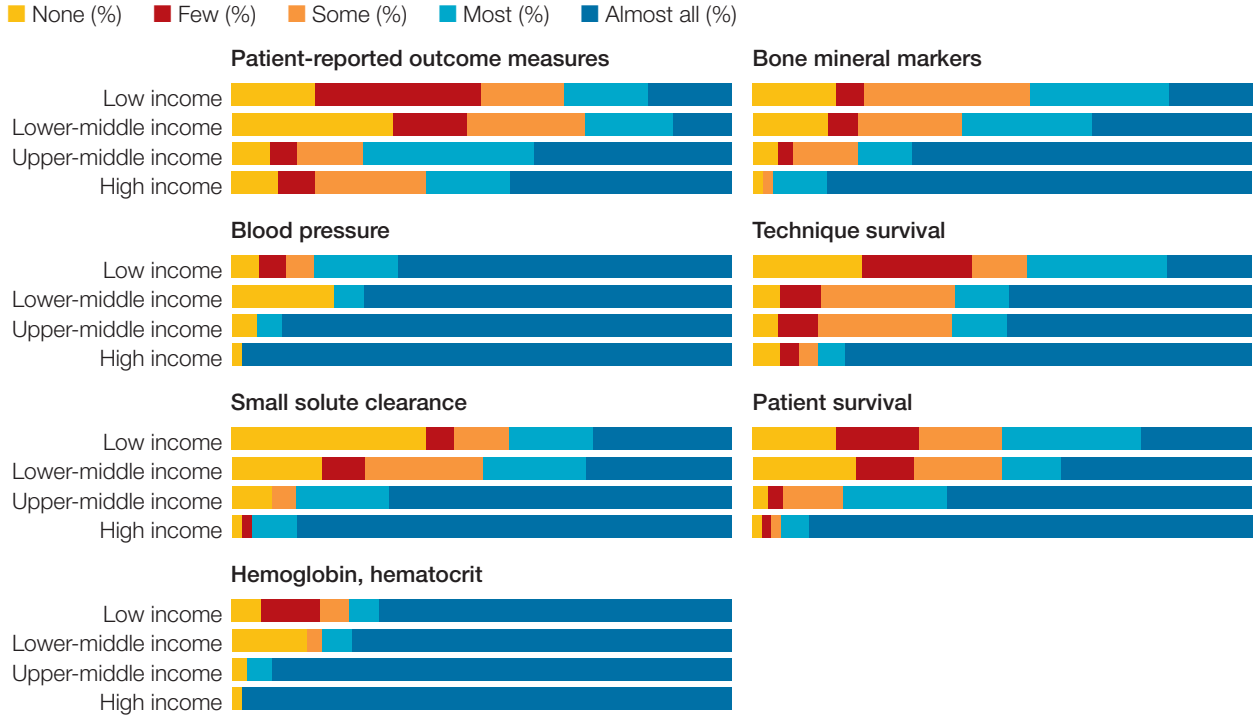


Figure 6.23 | Proportion of centers that measure and report quality indicators for HD service delivery, by World Bank income group



countries (Figure 6.23). Nearly all high income countries (87%) measure and report small solute clearance almost all of the time, compared to 68% of upper-middle, 29% of lower-middle, and 28% of low income countries. Similarly, 85% of high income countries measure bone mineral markers in HD patients almost all of the time, compared to 68% of upper-middle, 32% of lower-middle, and 17% of low income countries (Figure 6.23). Technique and patient survival are reported, respectively, in 81% and 93% of high income countries, compared to only 49% and 61% of upper-middle, 24% and 48% of lower-middle, and 17% and 14% of low income countries, respectively. Most countries, irrespective of income, measure blood pressure and hemoglobin/hematocrit (Figure 6.23).

Among the countries in which PD services are delivered, 32% of countries measure PROMS almost all of the time (Figure 6.24). Indicators that are commonly measured and reported almost all of the time include blood pressure (85%) and hemoglobin/hematocrit (84%). Small solute clearance, bone mineral markers, and technique survival are almost always measured in 58%, 68%, and 61% of countries, respectively. Patient survival is measured and reported nearly all of the time in 73% of countries worldwide (Figure 6.24).

Measuring and reporting of PD quality indicators generally increases with increasing income level: 40% of low income countries never measure PROMS, compared to just 7% of high income countries (Figure 6.25). Nearly all high income countries (85%) measure and report small solute clearance almost all of the time, compared to 45% of upper-middle, 17% of lower-middle, and 0% of low income countries. Similarly, technique survival is almost always reported in 89% of high, 45% of upper-middle, 28% of lower-middle and 0% of low income countries (Figure 6.25). Bone mineral markers are almost always measured in PD patients in 85% of high income countries, compared to 70% of upper-middle, 22% of lower-middle, and 40% of low income countries. Patient survival is reported in 93% of high income countries, but just 20% of low income countries. Blood pressure and hemoglobin/hematocrit are commonly measured in almost all countries, irrespective of income: 96% of high income, 82% of upper-middle income, and 80% of low income countries report on both measurements. Measuring of blood pressure and hemoglobin/hematocrit is less common in lower-middle income countries: 56% and 50% of countries report blood pressure and hemoglobin/hematocrit measurements, respectively (Figure 6.25)

Among the countries in which kidney transplantation services are delivered, 45% measure PROMS almost all of the time (Figure 6.26). A large proportion of countries report patient survival (77%), kidney allograft function (73%), and graft survival (72%) almost all of the

Figure 6.24 | Proportion of centers that measure and report quality indicators for PD service delivery

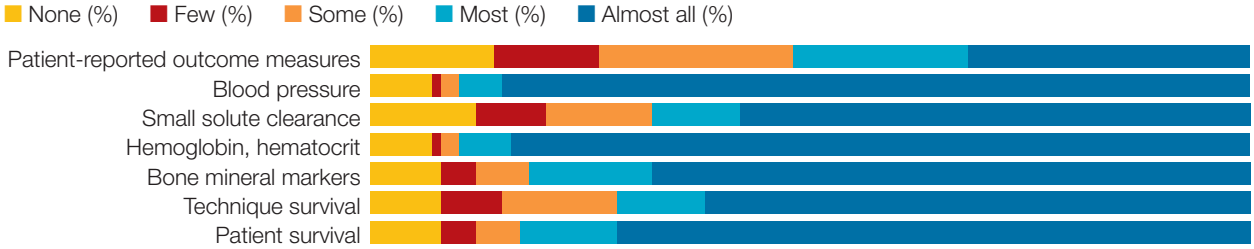
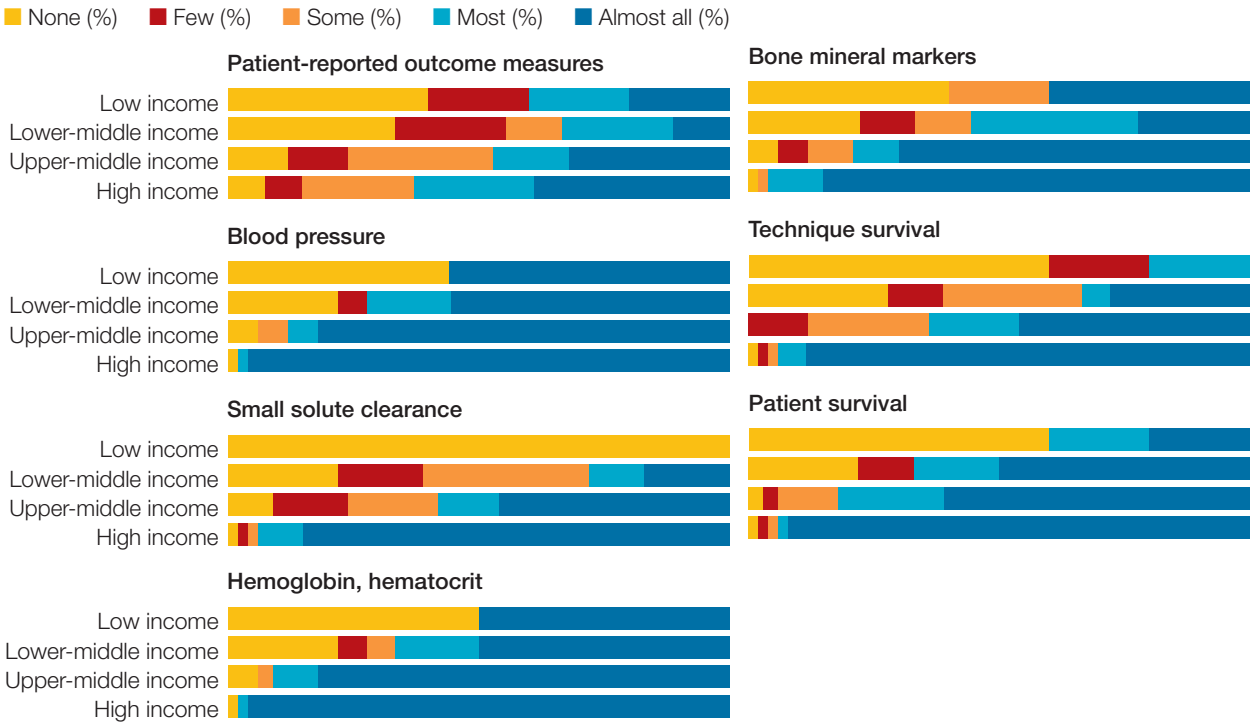


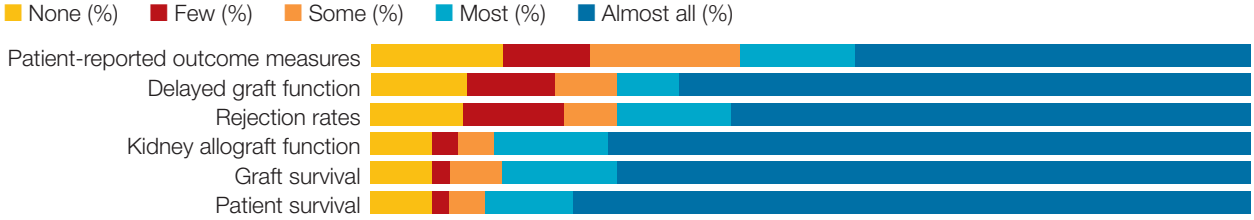
Figure 6.25 | Proportion of centers that measure and report quality indicators for PD service delivery, by World Bank income group



time. The majority of countries also report delayed graft function (65%) and rejection rates (59%) almost all of the time (Figure 6.26).

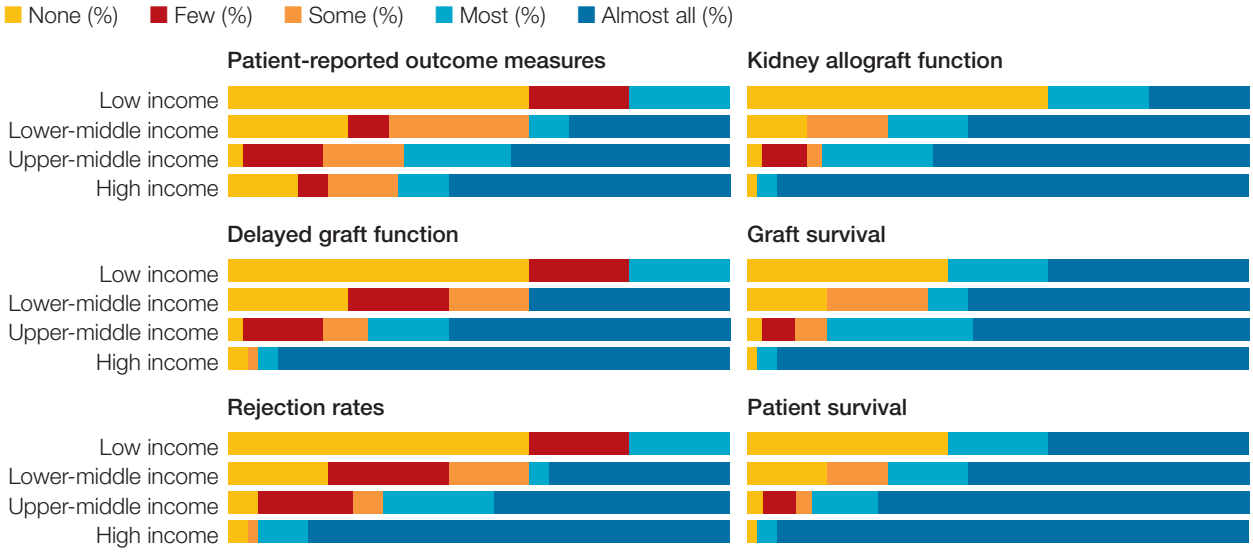
As with PD and HD, measuring and reporting of kidney transplantation quality indicators increases with increasing country income level. More than half (60%) of low income countries never report on PROMS, compared to just 14% of high income countries (Figure 6.27). Delayed graft function and rejection rates are almost always measured, respectively, in 90% and 84% of high income countries, compared to 56% and 47% of upper-middle, and 40% and 36% of lower-middle income countries. No low income countries (0%) measure these indicators almost all of the time

Figure 6.26 | Proportion of centers that measure and report quality indicators for kidney transplantation service delivery



(Figure 6.27). Kidney graft allocation, graft survival, and patient survival are measured in 94% of high income countries; in contrast, these indicators are measured, respectively, in just 20%, 40%, and 40% low income countries. Just over half of upper-middle and lower-middle income countries measure these indicators nearly all of the time (Figure 6.27).

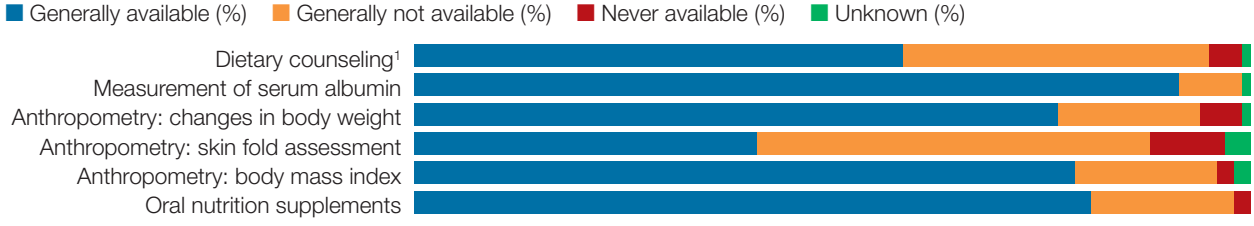
Figure 6.27 | Proportion of centers that measure and report quality indicators for PD service delivery, by World Bank income group



6.8 Availability of nutritional services

Nutritional services for kidney care are generally available worldwide. Measurement of serum albumin is generally available in 92% of countries, and oral nutrition supplements are generally available in 81% of countries. Body mass index and changes in body weight are generally measured in 79% and 77% of countries, respectively. Skin fold assessments are less common, being generally available in just 41% of countries. Services for dietary counseling are generally available in 59% of countries worldwide (Figure 6.28).

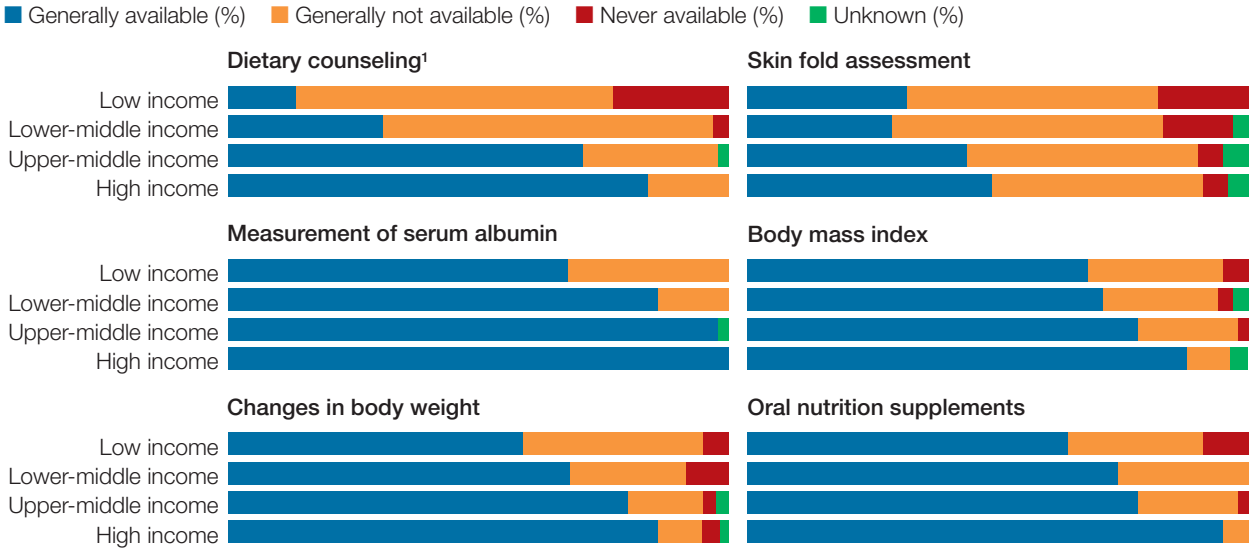
Figure 6.28 | Availability of nutritional services for kidney care



1 By a person trained in nutrition.

The availability of nutritional services increases with country income level. Oral nutrition supplements are generally available in 95% of high income countries, compared to 78% of upper-middle, 74% of lower-middle, and 64% of low income countries (Figure 6.29). Dietary counseling is generally available in 84% of high and 71% of upper-middle income countries, but only 31% of lower-middle and 14% of low income countries. Measurement of serum albumin is generally available worldwide, but availability increases with increasing country income level; serum albumin is measured in 68% of low, 86% of lower-middle, 98% of upper-middle, and 100% of high income countries. Anthropometric measurements (body mass index and changes in body weight) also are generally available in most countries, but again, availability increases with increasing country income level; body mass index and changes in body weight are measured, respectively, in 68% and 59% of low, 71% and 69% of lower-middle, 78% and 80% of upper-middle, and 88% and 86% of high income countries (Figure 6.29).

Figure 6.29 | Availability of nutritional services for kidney care, by World Bank income group



1 By a person trained in nutrition.

6.9 Availability of conservative care

Conservative care, defined by KDIGO[29] as planned, holistic, patient-centered care for patients with stage 5 CKD, is delivered in 81% (n = 124) of countries. All countries in North and East Asia and South Asia, and the vast majority of countries in Africa (80%), Eastern and Central Europe (95%), the Middle East (82%), OSEA (93%), and Western Europe (90%) offer conservative care (Figure 6.30). In contrast, less than half of the countries in Latin America (44%), and just over half of the countries in NIS and Russia (57%) and North America (67%) deliver conservative care (Figure 6.30). The availability of conservative care does not appear to be associated with country income level: 84% of high, 80% of upper-middle, 74% of lower-middle, and 82% of low income countries provide conservative care (Figure 6.31).

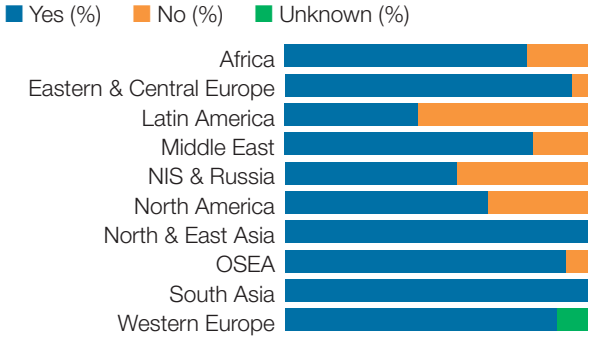
Among the countries that provide conservative care, 55% have choice-restricted conservative care generally available for patients with resource constraints that prevent or limit access to KRT, and 64% have chosen or medically-advised conservative care generally available for patients who opt out of available dialysis services.

Moreover, 48% of countries with conservative care adopt a multidisciplinary team approach to care and 33% use shared decision-making tools (e.g., practice guidelines for providers and patient decision aids). Systematic active recognition and management of symptoms associated with advanced kidney failure are generally available in 66% of countries offering conservative care. Psychological, cultural, and spiritual support are systematically provided to people receiving conservative care in 37% of countries offering this service. Additional training in conservative care is generally available for health care providers in 26% of countries that offer conservative care. Lastly, conservative care is easily accessible in different settings (e.g., homes, hospitals, hospice care, nursing homes) in 41% of countries offering this service (Figure 6.32).

Availability of choice-restricted conservative care increases slightly with country income level: 41% of low, 56% of lower-middle, 58% of upper-middle, and 58% of high income countries offer choice-restricted conservative care in at least 50% of clinics and hospitals (Figure 6.33). Access to chosen or medically-advised conservative care differs more by country income level: 87% of high income countries offer chosen conservative care, compared to 64% of upper-middle, 43% of lower-middle, and 33% of low income countries.

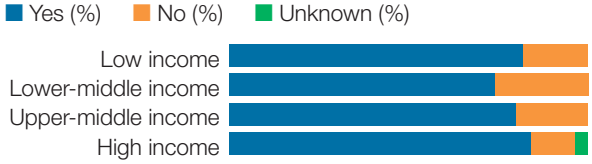
The use of a multidisciplinary team in conservative care delivery is more common in high income countries: multidisciplinary teams deliver conservative care in 67% of high income countries, compared to 48% of upper-middle, 25% of lower-middle, and 25% of low income countries. Similarly, the adoption of shared decision making practices increases with country

Figure 6.30 | Availability of conservative care, by ISN region



Unknown in two countries (Western Europe: Finland and Germany)

Figure 6.31 | Availability of conservative care, by World Bank income group



Unknown in two countries (Western Europe: Finland and Germany)

income level, but is generally available in only half (50%) of high income countries, and just 24% of upper-middle, 29% of lower-middle, and 12% of low income countries. The provision of psychological, cultural, and spiritual support also increases with country income, but remains low, being provided in just 52% of high, 30% of upper-middle, 31% of lower-middle, and 19% of low income countries. Approximately half of low (50%), lower-middle (48%), and upper-middle (55%) income countries systematically manage symptoms, as do 89% of high income countries. Furthermore, additional training for health care providers and accessible conservative care services are available, respectively, in 0% of low, 24% and 27% of lower-middle, 21% and 28% of upper-middle, and 39% and 70% of high income countries (Figure 6.33).

Figure 6.32 | Characteristics of available conservative care

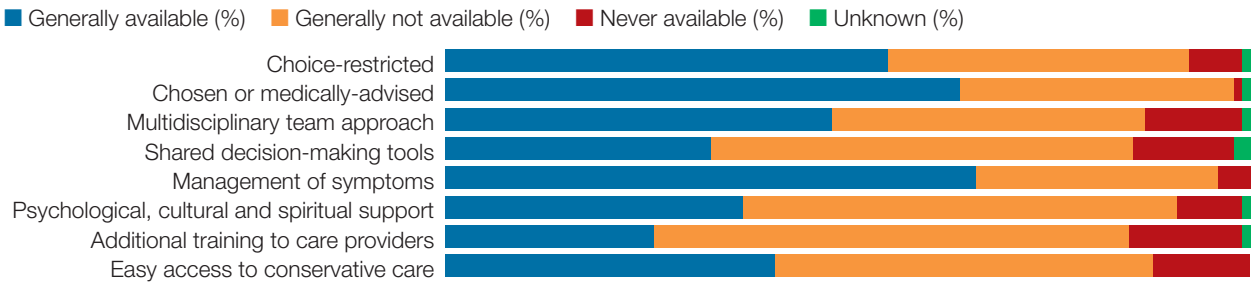
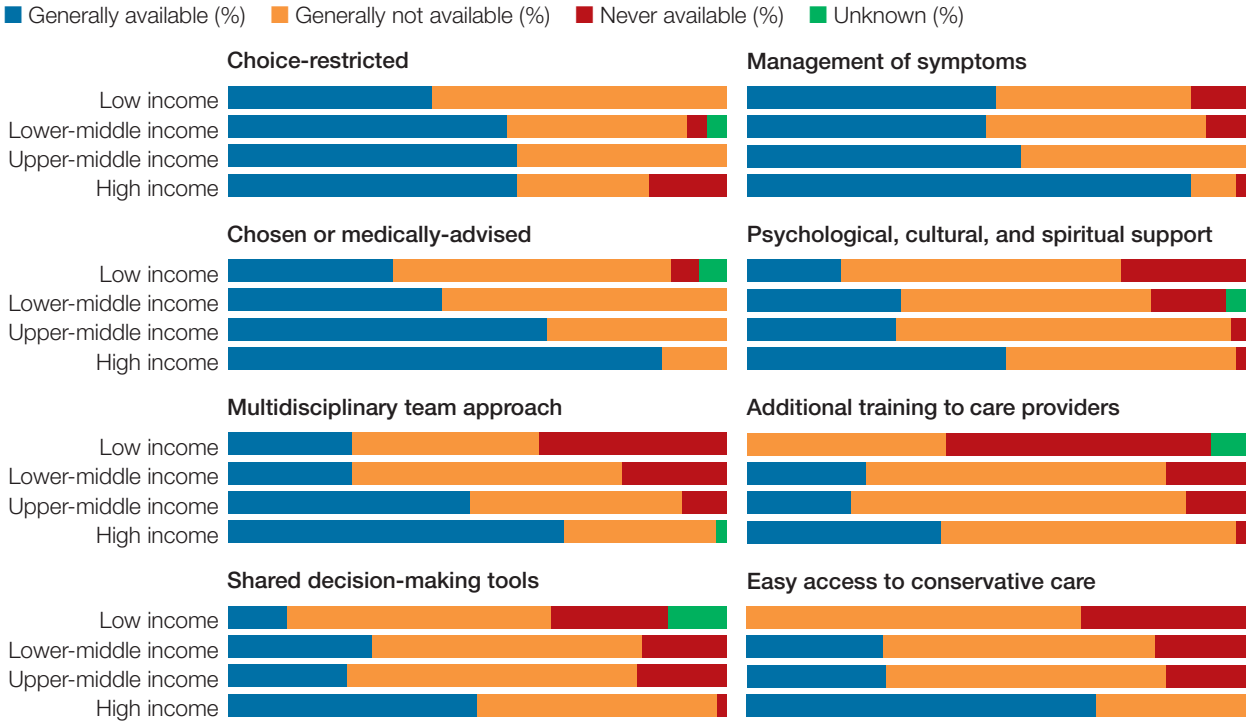


Figure 6.33 | Characteristics of available conservative care, by World Bank income group



SECTION 7

HEALTH INFORMATION SYSTEMS

7.1 Registries

Worldwide, just 13 countries have registries for AKI and 19 have registries for non-dialysis CKD (Table 7.1). Registries for dialysis (n = 101, 66%) and kidney transplantation (n = 88, 57%) are more common.

Registries for AKI are more common in NIS and Russia (14%), North and East Asia (14%), Eastern and Central Europe (11%), Africa (10%), Western Europe (10%), and the Middle East (9%) than in OSEA (7%), Latin America (6%), North America (0%) and South Asia (0%) (Figure 7.1).

Non-dialysis CKD registries are more common in NIS and Russia (29%), North and East Asia (29%), Latin America (28%), and OSEA (13%) than in Western Europe (15%), the Middle East (9%), Africa (7%), Eastern and Central Europe (5%), North America (0%), and South Asia (0%) (Figure 7.1).

Table 7.1 | Prevalence of renal registries

	AKI N (%)	Non-dialysis CKD N (%)	Dialysis N (%)	Transplantation N (%)
Overall	**13 (8)**	**19 (12)**	**101 (66)**	**88 (57)**
ISN region				
Africa	4 (10)	3 (7)	18 (44)	6 (15)
Eastern & Central Europe	2 (11)	1 (5)	17 (89)	17 (89)
Latin America	1 (6)	5 (28)	14 (78)	13 (72)
Middle East	1 (9)	1 (9)	6 (55)	8 (73)
NIS & Russia	1 (14)	2 (29)	5 (71)	6 (86)
North America	0 (0)	0 (0)	4 (44)	3 (33)
North & East Asia	1 (14)	2 (29)	7 (100)	7 (100)
OSEA	1 (7)	2 (13)	10 (67)	8 (53)
South Asia	0 (0)	0 (0)	2 (29)	1 (14)
Western Europe	2 (10)	3 (15)	18 (90)	19 (95)
World Bank income group				
Low income	2 (9)	2 (9)	4 (18)	0 (0)
Lower-middle income	4 (11)	4 (11)	18 (51)	10 (29)
Upper-middle income	2 (5)	2 (5)	31 (76)	27 (66)
High income	5 (9)	11 (20)	48 (86)	51 (91)

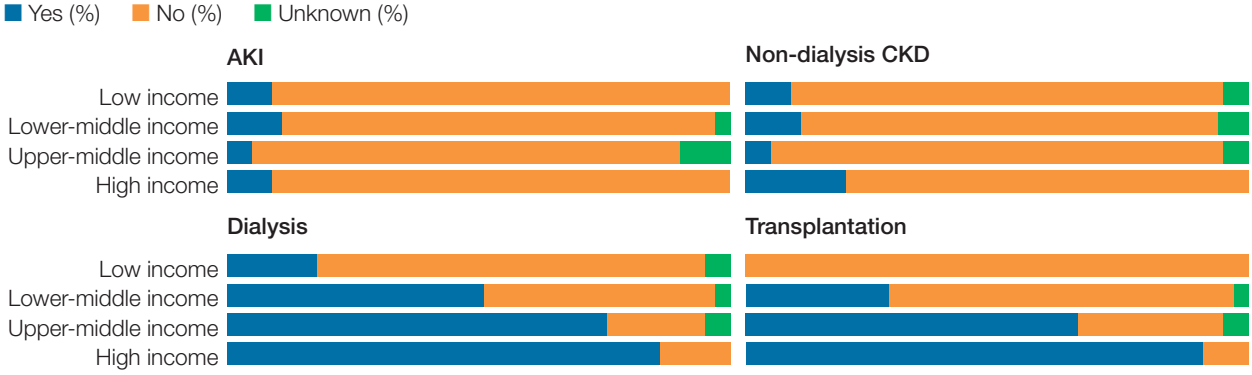
Dialysis registries are more common in North and East Asia (100%), Western Europe (90%), Eastern and Central Europe (89%), Latin America (78%), NIS and Russia (71%), and OSEA (67%) than in the Middle East (55%), Africa (44%), North America (44%), and South Asia (29%) (Figure 7.1).

Registries for transplantation are more common in North and East Asia (100%), Western Europe (95%), Eastern and Central Europe (89%), NIS and Russia (86%), the Middle East (73%), and Latin America (72%) than in OSEA (53%), North America (33%), Africa (15%), and South Asia (14%) (Figure 7.1).

AKI registries exist in 2 low, 4 lower-middle, 2 upper-middle, and 5 high income countries (Figure 7.2). Similarly, non-dialysis CKD registries exist in 2 low, 4 lower-middle, 2 upper-middle, and 11 high income countries. High income countries are more likely to have registries for dialysis and transplantation (86% and 91%, respectively), than upper-middle (76% and 66%, respectively), lower-middle (51% and 29%,

Figure 7.1 | Prevalence of renal registries, by ISN region

Figure 7.2 | Prevalence of renal registries, by World Bank income group



respectively), and low (18% and 0%, respectively) income countries (Figure 7.2).

Among the 13 countries with AKI registries, provider participation is mandatory in 8 (62%) countries and voluntary in 5 (38%) countries. Participation varies by region and income. Both registries in Western Europe require provider participation. Latin America and the Middle East each have 1 country with an AKI registry that requires provider participation (Table 7.2).

Likewise, NIS and Russia, North and East Asia, and OSEA each have 1 country with an AKI registry, but provider participation is voluntary. Participation in nearly all registries in Africa is mandatory and participation in 1 of the 2 registries in Eastern and Central Europe is mandatory (Table 7.2). Both AKI registries in low income countries require participation, compared to half of the registries in lower-middle and 80% of the registries in high income countries (Table 7.2).

Table 7.2 | Provider participation in AKI and CKD registries

Country	ISN region	World Bank group	Mandatory	Voluntary
AKI registry				
Azerbaijan	NIS & Russia	Upper-middle income		●
British Virgin Islands	Latin America	High income	●	
Congo, Rep.	Africa	Lower-middle income	●	
Eritrea	Africa	Low income	●	
Guinea	Africa	Low income	●	
Lao PDR	OSEA	Lower-middle income		●
Malta	Western Europe	High income	●	
Moldova	Eastern & Central Europe	Lower-middle income	●	
Mongolia	North & East Asia	Upper-middle income		●
Oman	Middle East	High income	●	
Slovenia	Eastern & Central Europe	High income		●
United Kingdom	Western Europe	High income	●	
Zambia	Africa	Lower-middle income		●
CKD registry				
Argentina	Latin America	High income		●
Azerbaijan	NIS & Russia	Upper-middle income		●
Bolivia	Latin America	Lower-middle income	●	
Brunei Darussalam	OSEA	High income	●	
Colombia	Latin America	Upper-middle income	●	
Congo, Rep.	Africa	Lower-middle income	●	
Eritrea	Africa	Low income	●	
Guinea	Africa	Low income	●	
Japan	North & East Asia	High income		●
Lao PDR	OSEA	Lower-middle income	●	
Malta	Western Europe	High income		●
Oman	Middle East	High income		●
Puerto Rico	Latin America	High income	●	
Slovak Republic	Eastern & Central Europe	High income	●	
Sweden	Western Europe	High income		●
Taiwan, China	North & East Asia	High income		●
United Kingdom	Western Europe	High income	●	
Uruguay	Latin America	High income		●

Among the 19 countries with non-dialysis CKD registries, participation is mandatory in 10 (53%) countries and voluntary in 8 countries (42%); participation type was not reported in 1 country (5%) (Tajikistan) (Table 7.2). Similarly, participation in non-dialysis CKD registries varies by region and income. Registries in all 3 countries in Africa require participation, as do the registries in 1 country in Eastern and Central Europe and 2 countries in OSEA (Table 7.2). All CKD registries in the Middle East (n = 1), and North and East Asia (n = 2) have voluntary participation. Among the 5 countries in Latin America with CKD registries, participation is mandatory in 3 and voluntary in 2. Among the 3 countries in Western Europe, participation is voluntary in 2 and mandatory in 1. Two CKD registries exist in NIS and Russia: participation is voluntary in 1 country and was not reported in the other. Both low income countries and the 3 lower-middle income countries reporting data require provider participation in CKD registries (Table 7.2). In the 2 upper-middle income countries with registries, participation is mandatory in 1 country and voluntary in the other. Among the 11 high income countries with CKD registries, participation is mandatory in 4 (36%) countries and voluntary in 7 (64%) countries (Table 7.2).

Among the countries with dialysis registries, participation is mandatory in 59%, voluntary in 36%, and unknown or not reported in 5%. Mandatory participation in dialysis registries is highest in the Middle East (83%), Latin America (79%), and OSEA (70%) (Figure 7.3). Among the 88 countries with transplantation registries, participation is mandatory in 57 (65%), voluntary in 26 (30%), and unknown or not reported in 5 (6%). Mandatory participation in transplantation registries is highest in Latin America (92%), the Middle East (88%), and Western Europe (74%) (Figure 7.3).

Participation is mandatory in 100% of the 4 low income countries with dialysis registries, compared to 59% of lower-middle, 57% of upper-middle, and 63% of high income countries (Figure 7.4). Among countries with transplantation registries, participation is mandatory in 63% of lower-middle, 58% of upper-middle, and 73% of high income

Figure 7.3 | Provider participation in dialysis and transplantation registries, by ISN region

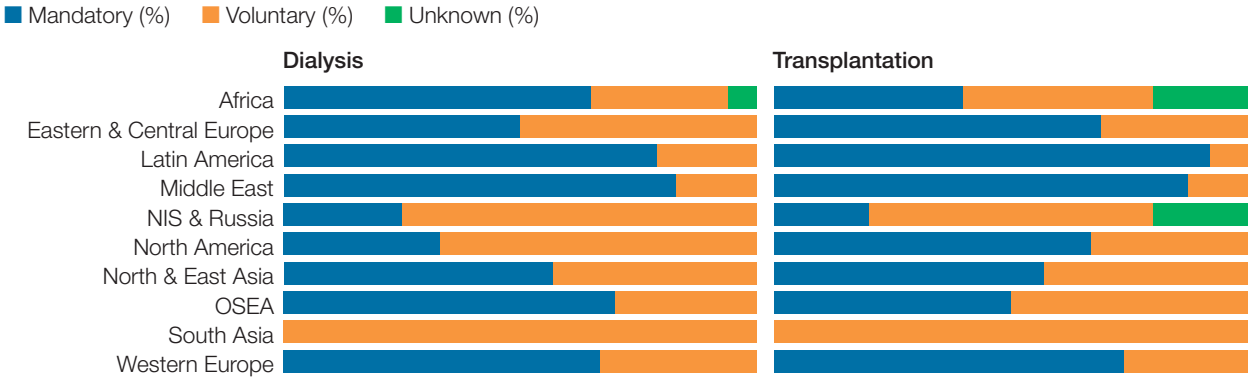
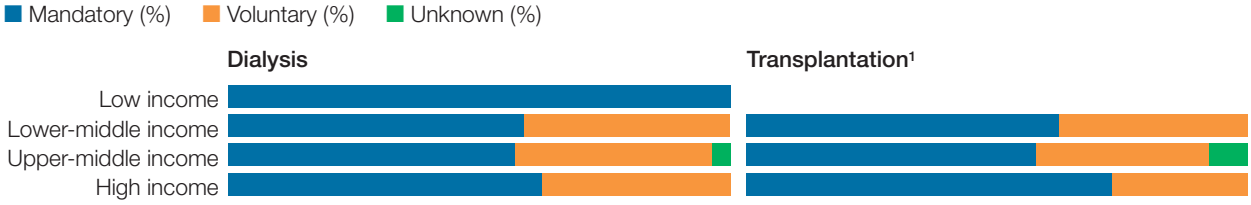


Figure 7.4 | Provider participation in dialysis and transplantation registries, by World Bank income group



1 No low income countries reported a transplant registry

countries. No low income countries reported transplantation registries (Figure 7.4).

Among the 13 countries with AKI registries, 6 have national registries, 4 have local (e.g., hospital-run) registries, and 2 have regional (e.g., state- or province-level) registries (Table 7.3). Respondents from 1 country (Azerbaijan) did not report geographic coverage. Both of the AKI registries in low income countries are national. Among the 4 registries in lower-middle income countries, half are regional and half are local. One of the 2 registries in upper-middle income countries is local and coverage was not reported for the other. Among the 5 AKI registries in high income countries, 4 are national and 1 is local (Table 7.3).

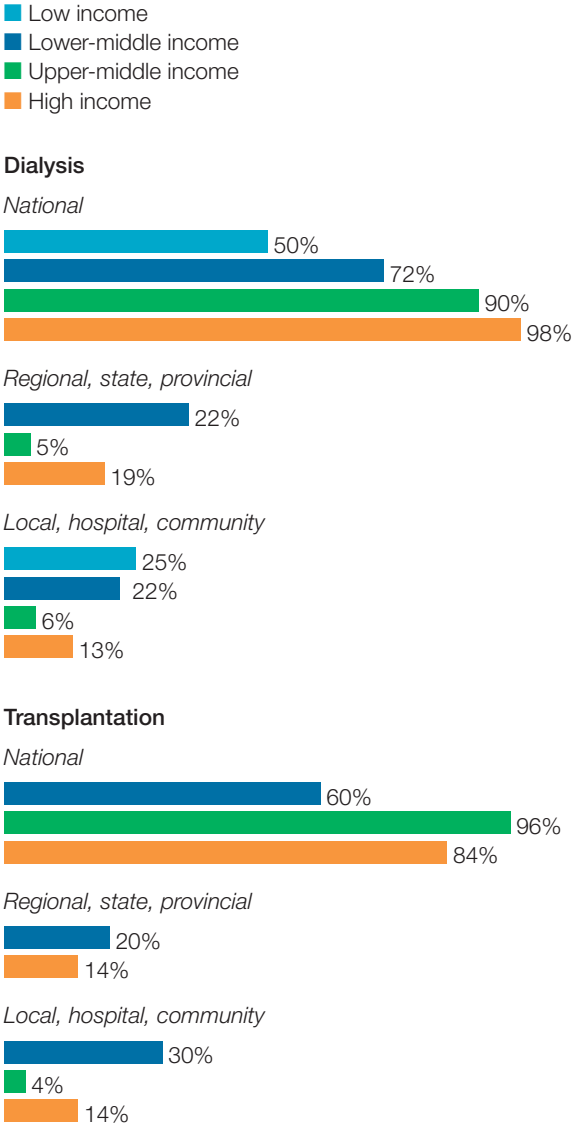
Geographic coverage also varies among the 19 non-dialysis CKD registries. There are 13 national registries, 7 local registries, and 4 regional

Table 7.3 | Geographic coverage of AKI and CKD registries

Country	ISN region	World Bank group	National	Regional, state, provincial	Local, hospital, community
AKI registry					
British Virgin Islands	Latin America	High income			●
Congo, Rep.	Africa	Lower-middle income		●	
Eritrea	Africa	Low income	●		
Guinea	Africa	Low income	●		
Lao PDR	OSEA	Lower-middle income			●
Malta	Western Europe	High income	●		
Moldova	Eastern & Central Europe	Lower-middle income			●
Mongolia	North & East Asia	Upper-middle income			●
Oman	Middle East	High income	●		
Slovenia	Eastern & Central Europe	High income	●		
United Kingdom	Western Europe	High income	●		
Zambia	Africa	Lower-middle income		●	
CKD registry					
Argentina	Latin America	High income	●		
Azerbaijan	NIS & Russia	Upper-middle income	●		
Bolivia	Latin America	Lower-middle income	●		
Brunei Darussalam	OSEA	High income			●
Colombia	Latin America	Upper-middle income			●
Congo, Rep.	Africa	Lower-middle income		●	
Eritrea	Africa	Low income			●
Guinea	Africa	Low income	●		
Japan	North & East Asia	High income	●	●	●
Lao PDR	OSEA	Lower-middle income			●
Malta	Western Europe	High income	●		
Oman	Middle East	High income	●		
Puerto Rico	Latin America	High income		●	
Slovak Republic	Eastern & Central Europe	High income	●		
Sweden	Western Europe	High income	●		
Taiwan, China	North & East Asia	High income	●		●
Tajikistan	NIS & Russia	Lower-middle income	●	●	●
United Kingdom	Western Europe	High income	●		
Uruguay	Latin America	High income	●		

registries. Two CKD registries exist in low income countries: 1 is national and the other is local. Among the 4 registries in lower-middle income countries, 1 is national only, 1 is regional only, 1 is local only, and 1 is available at all levels (national, regional, local). Two registries exist in upper-middle income countries: 1 is national and the other is local. Among the 11 registries in high income countries, 7 are national, 1 is regional, 1 is local, 1 is available across all levels (national, regional, and local), and 1 is both national and local (Table 7.3).

Figure 7.5 | Geographic coverage of dialysis and transplantation registries, by World Bank income group



Nearly all (89%) dialysis registries are national. Regional and local registries are available in 15% and 13% of countries, respectively. Higher income countries are more likely to have national dialysis registries: 50% of low, 72% of lower-middle, 90% of upper-middle, and 98% of high income countries have national dialysis registries. Regional dialysis registries exist in 4 lower-middle, 2 upper-middle, and 9 high income countries. Local dialysis registries exist in 1 low, 4 lower-middle, 2 upper-middle, and 6 high income countries (Figure 7.5).

Among countries with transplant registries, 85% are national. Regional and local registries exist in 10% and 13% of countries, respectively. No low income countries reported transplant registries. Transplant registries are national in most upper-middle (96%) and high income (84%) countries, and in just over half (60%) of lower-middle income countries. Regional transplant registries exist in 7 high and 2 lower-middle income countries; local transplant registries exist in 7 high, 1 upper-middle, and 3 lower-middle income countries (Figure 7.5).

Among the 13 countries with AKI registries, data collected include the etiology of AKI (10 countries), the incidence of AKI (9 countries), requirements for KRT (9 countries), mortality (9 countries), hospitalizations (7 countries), and risk factors for AKI (6 countries) (Table 7.4). Two low income countries have AKI registries; both capture all data except for the incidence of AKI, which is captured only in 1 of the 2 countries. Among the 4 lower-middle income countries with AKI registries: risk factors for AKI are covered in 2 countries; the etiology of AKI is covered in all 4 countries; incidence of AKI, hospitalizations, and requirements for KRT are covered in 3 countries; and patient mortality is covered in 2 countries (Table 7.4). Among the 2 upper-middle income countries with AKI registries, 1 covers risk factors, both cover the etiology and incidence of AKI, 1 covers requirements for KRT, 1 covers mortality, and none cover hospitalizations (Table 7.4). Five high income countries have AKI registries: 4 cover mortality, 3 cover the incidence of AKI and requirement for KRT, 2 cover etiology of AKI and hospitalizations, and 1 covers risk factors for AKI (Table 7.4).

Among the 19 non-dialysis CKD registries, 12 cover the whole spectrum of CKD (i.e., stages 1-5) and 5 cover advanced CKD only (stages 4/5); stage coverage was not reported for registries in 2 countries (Azerbaijan and Sweden) (Table 7.5). Both of the registries in low income countries cover all stages, as do 3 of the registries in lower-middle countries and 7 of the registries in high income countries (Table 7.4). Registries in 1 lower-middle, 1 upper-middle, and 3 high income countries cover advanced stages only (Table 7.5).

Table 7.4 | Content coverage of AKI registries, by World Bank income group

Country	ISN region	World Bank group	Risk factors for AKI	Etiology of AKI	Incidence of AKI	Hospitalizations	Requirement for KRT	Mortality
Azerbaijan	NIS & Russia	Upper-middle income	●	●	●		●	
British Virgin Islands	Latin America	High income		●			●	●
Congo, Rep.	Africa	Lower-middle income	●	●	●	●	●	●
Eritrea	Africa	Low income	●	●		●	●	●
Guinea	Africa	Low income	●	●	●	●	●	●
Lao PDR	OSEA	Lower-middle income	●	●	●	●	●	
Malta	Western Europe	High income	●	●	●	●	●	●
Moldova	Eastern & Central Europe	Lower-middle income		●	●	●	●	●
Mongolia	North & East Asia	Upper-middle income		●	●			●
Oman	Middle East	High income						●
Slovenia	Eastern & Central Europe	High income			●			
United Kingdom	Western Europe	High income			●	●	●	●
Zambia	Africa	Lower-middle income		●				

Table 7.5 | Content coverage of CKD registries, by World Bank income group

Country	ISN region	World Bank group	Whole spectrum (stages 1-5)	Advanced CKD only (stages 4/5)
Argentina	Latin America	High income	●	
Bolivia	Latin America	Lower-middle income		●
Brunei Darussalam	OSEA	High income	●	
Colombia	Latin America	Upper-middle income		●
Congo, Rep.	Africa	Lower-middle income	●	
Eritrea	Africa	Low income	●	
Guinea	Africa	Low income	●	
Japan	North & East Asia	High income	●	
Lao PDR	OSEA	Lower-middle income	●	
Malta	Western Europe	High income		●
Oman	Middle East	High income		●
Puerto Rico	Latin America	High income	●	
Slovak Republic	Eastern & Central Europe	High income	●	
Taiwan, China	North and East Asia	High income	●	
Tajikistan	NIS & Russia	Lower-middle income	●	
United Kingdom	Western Europe	High income		●
Uruguay	Latin America	High income	●	

In dialysis registries, modality is covered most often (95%), followed by the etiology of ESKD (90%), patient mortality (82%), process measures (65%), hospitalizations (43%), and patient-reported outcome measures (24%). Dialysis registries exist in 4 low, 18 lower-middle, 31 upper-middle, and 48 high income countries, and the etiology of ESKD is captured in 75%, 94%, 81%, and 96% of registries in those countries, respectively (Figure 7.6). Similarly, the modality of dialysis is covered in 75%, 94%, 90%, and 100% of the registries in low, lower-middle, upper-middle, and high income countries, respectively. Process-based measures are captured in 50% of the registries in low, 44% of the registries in lower-middle, 52% of the registries in upper-middle, and 83% of the registries in high income countries. Hospitalizations are captured in 50% of the registries in low, 33% of the registries in lower-middle, 35% of the registries in upper-middle, and 50% of the registries in high income countries (Figure 7.8). PROMS are included in 50% of the registries in low, 22% of the registries in lower-middle, 19% of the registries in upper-middle, and 25% of the registries in high income countries. Lastly, nearly all registries in high

Figure 7.6 | Content coverage of registries for dialysis, by World Bank income group

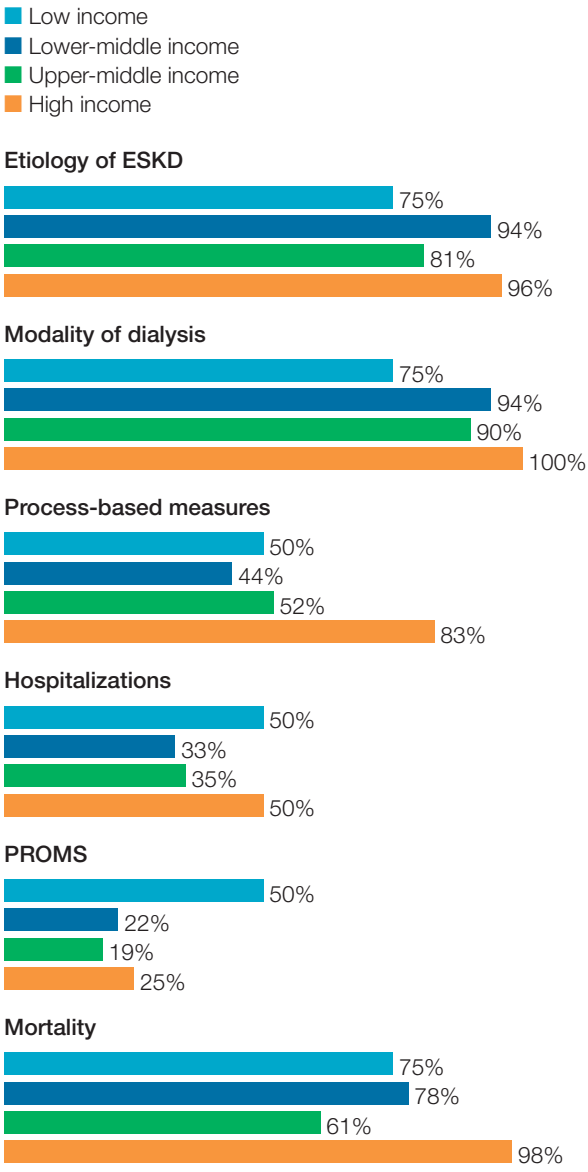
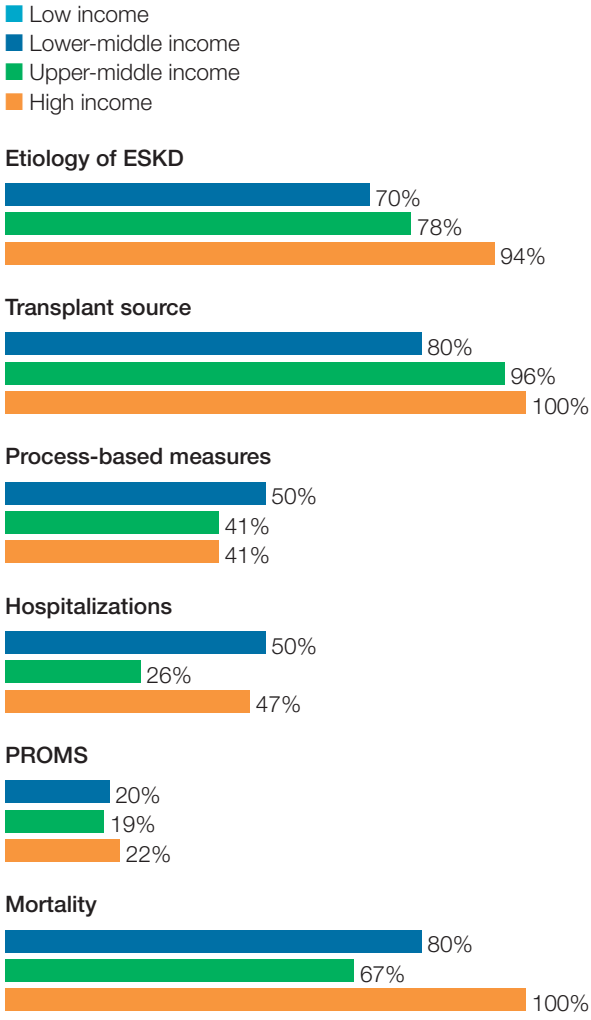


Figure 7.7 | Content coverage of registries for transplantation, by World Bank income group



income countries (98%), and most registries in low (75%), lower-middle (78%) and upper-middle (61%) income countries include patient mortality data (Figure 7.6).

The majority (97%) of countries with transplant registries capture the donor source (living or deceased), and most collect data on patient mortality (86%) and the etiology of ESKD (85%). Less than half collect data on process-based measures (42%) or hospitalizations (41%), and few (20%) collect PROMS. Nearly all (98%) registries in high income countries capture the etiology of ESKD, as do 78% of registries in upper-middle and 70% of registries in lower-middle income countries (Figure 7.7). Donor type (living or deceased) and patient mortality are reported in all registries in high income countries and most registries in upper-middle (96% and 67%, respectively) and lower-middle (80% for each measure) income countries. Less than half of the registries in high (41%) and upper-middle (41%) income countries capture process-based measures, whereas half (50%) of the registries in lower-middle income countries capture these data. Similarly, hospitalizations are reported in fewer than half of the registries in high (47%) and upper-middle (26%) income countries, and half (50%) of the registries in lower-middle income countries. Irrespective of income level, few transplant registries collect PROMS: 22% of registries in high, 19% of registries in upper-middle, and 20% of registries in lower-middle income countries collect these data (Figure 7.7).

7.2 Identification of disease (AKI and CKD)

Overall, practices to identify CKD in high-risk groups are common. Patients with diabetes and hypertension are screened for CKD in 93% and 89% of countries, respectively. People with autoimmune or multisystem disorders, or cardiovascular diseases are screened in 75% of countries. People in other high-risk groups are also are screened for CKD: patients with urological disorders are screened in 72% of countries, people with a family history of CKD are screened in 48% of countries, people aged 65 years or older are screened in 45% of countries, chronic users of nephrotoxic medications are screened in 43% of countries, and high-risk ethnic groups are screened in 10% of countries. Routine testing for CKD is not offered in 12 countries (Afghanistan, Angola, Gambia, Georgia, Germany, Kenya, Kosovo, Libya, Mauritania, Poland, Senegal, and Turkey).

At least 90% of countries in all regions screen patients with hypertension for CKD except for Eastern and Central Europe, where 82% of countries screen, and South Asia, where 14% of countries screen (Figure 7.8). Similarly, at least 90% of countries screen diabetes patients for CKD in all regions except for South Asia, where only 14% of countries screen. Routine CKD screening of other high-risk patients (e.g., people with cardiovascular diseases, autoimmune disorders, urological disorders, etc.) is less common in Africa, Eastern and Central Europe, OSEA, and South Asia (Figure 7.8).

CKD screening of people with hypertension or diabetes is common, irrespective of income level (Figure 7.9). Patients with cardiovascular diseases are screened in 64%, 65%, 76%, and 85% of low, lower-middle, upper-middle, and high income countries, respectively. Similarly, 50%, 78%, 76%, and 81% of low, lower-middle, upper-middle, and high income countries screen for CKD among people with autoimmune or multisystem disorders. People over 65 years of age are screened for CKD in 36%, 22%, 50%, and 59% of countries in low, lower-middle, upper-middle, and high income countries, respectively. Likewise, the prevalence of CKD screening for people with urological conditions similarly is moderate across all income levels (73% of low, 70% of lower-middle, 71% of upper-middle, and 73% of high income countries). CKD screening among chronic users of nephrotoxic medications is

low, irrespective of income level, and occurs in 45% of low, 30% of lower-middle, 38% of upper-middle, and 54% of high income countries. Patients with a family history of CKD are screened in nearly half of all countries, irrespective of income level (50% of low, 41% of lower-middle, 45% of upper-middle, and 54% of high income countries).

Few countries (5% of low, 8% of lower-middle, 2% of upper-middle, and 19% of high income countries) reported screening high-risk ethnic groups for CKD (Figure 7.9).

Among all countries, ethnic groups are at higher risk for AKI and CKD in 31% and 23% of countries, respectively. For AKI, ethnic groups are at higher

Figure 7.8 | Adoption of practices to identify CKD in high-risk groups, by ISN region

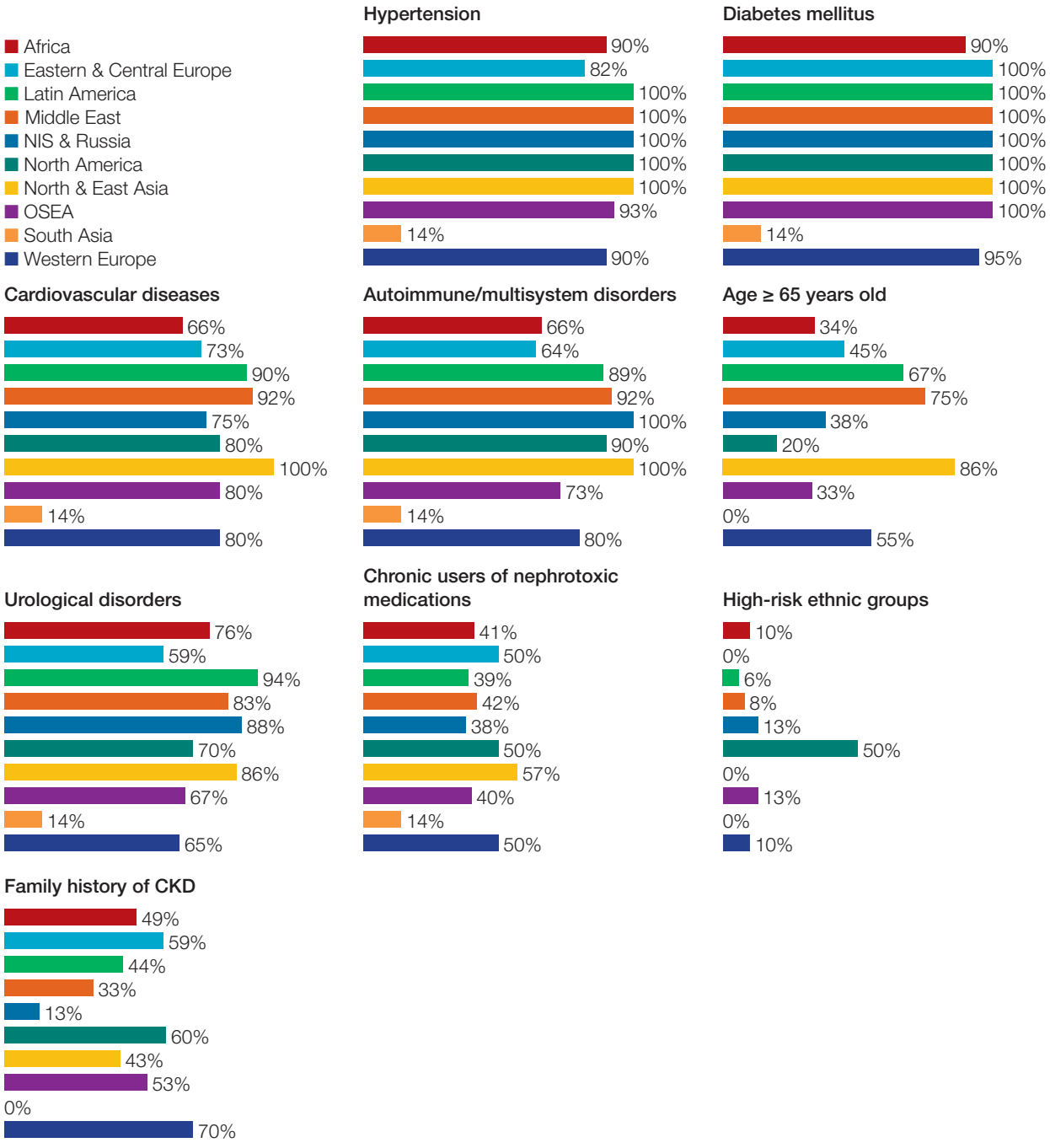
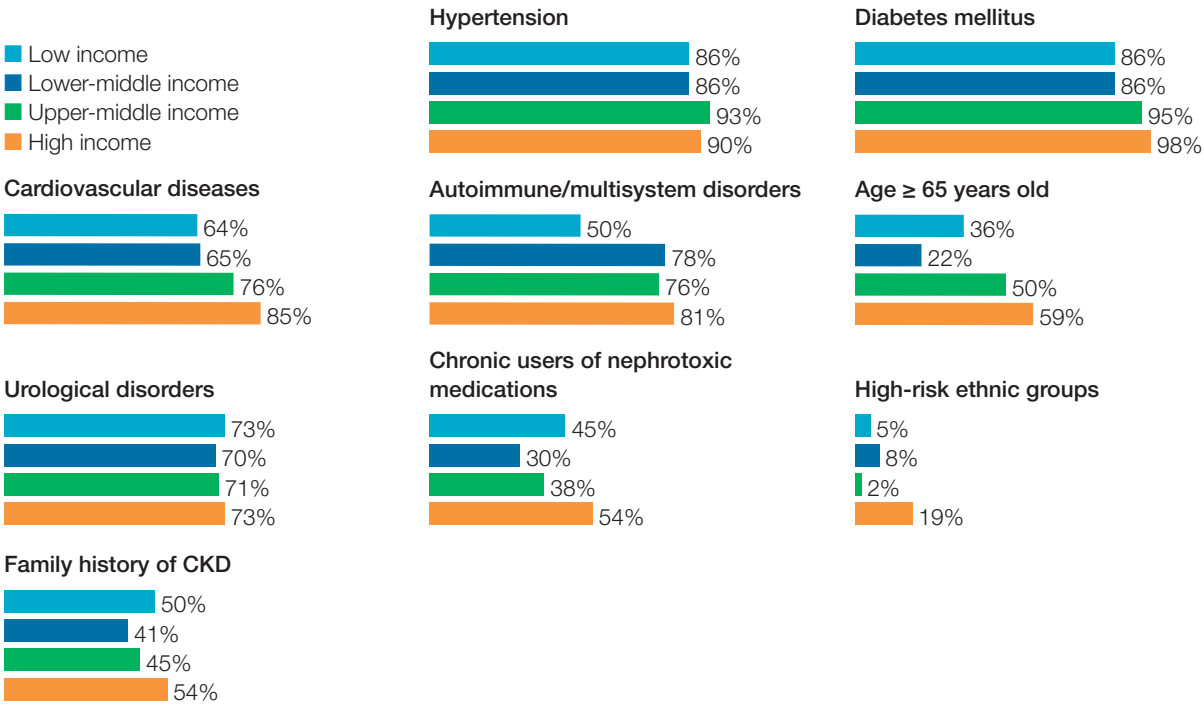


Figure 7.9 | Adoption of practices to identify CKD in high-risk groups, by World Bank income group



risk in 14% of low, 31% of lower-middle, 32% of upper-middle, and 38% of high income countries (Figure 7.10). Ethnic groups are at higher risk for CKD in 6% of lower-middle, 32% of upper-middle, and 36% of high income countries. No low income countries reported ethnic groups being at a higher risk for CKD (Figure 7.10).

Only 6 countries currently have AKI detection programs: 1 lower-middle (Congo), 3 upper-middle (Albania, Iran, Thailand), and 2 high (Oman, United Kingdom) income countries (Figure 7.11). Systems to detect CKD are much more common: 35 countries (23%) have existing programs. CKD detection programs are more common in high

Figure 7.10 | Proportion of countries that report an ethnic group at a higher risk for kidney disease than the general population, by World Bank income group

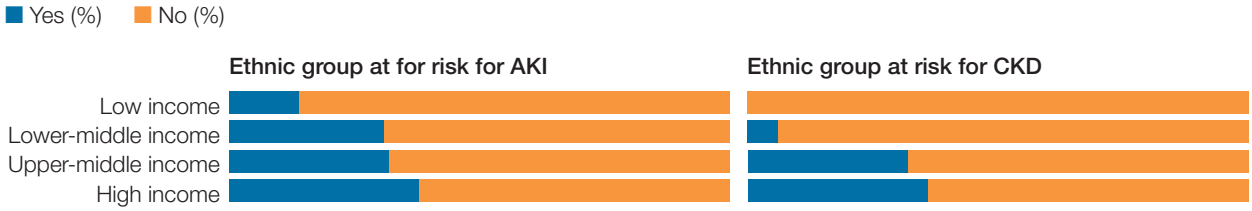


Figure 7.11 | Existence of current AKI and CKD detection programs, by World Bank income group

(30%; n = 17), upper-middle (24%; n = 10), and lower-middle (20%; n = 7) income countries than in low income countries (5%; n = 1) (Figure 7.11).

Implementation approaches vary among the 6 countries with current AKI detection programs: 1 country adopts only a reactive approach, 1 country uses only active screening through routine health encounters, 2 countries use both methods of active screening (routine health encounters and specific screening processes), and 1 country uses all 3 types as well as other methods (Table 7.6). Implementation approaches also vary among the 35 countries with current CKD detection programs: 17 countries adopt reactive approaches, 17 countries implement active screening through routine health encounters, 12 countries actively screen through specific processes, and 4 adopt other approaches (Australia, Egypt, Kenya, and Samoa). The 1 low income country implements active screening through routine health encounters, and the 7 lower-middle income countries use a mix of reactive approaches (n = 3), routine health encounters (n = 3), specific screening processes (n = 2), and other implementation approaches (n = 2) (Figure 7.12). Among the 10 upper-middle income countries with current CKD detection programs, 6 adopt reactive approaches, 6 actively screen during routine health encounters, 4 use specific screening processes, and one screens through other means. Lastly, among the 17 high income countries with current CKD detection programs, 8 use reactive approaches, 7 screen during routine health encounters, 6 use specific screening processes, and 1 uses other approaches (Figure 7.12).

Figure 7.12 | Methods of implementing CKD detection programs, by World Bank income group

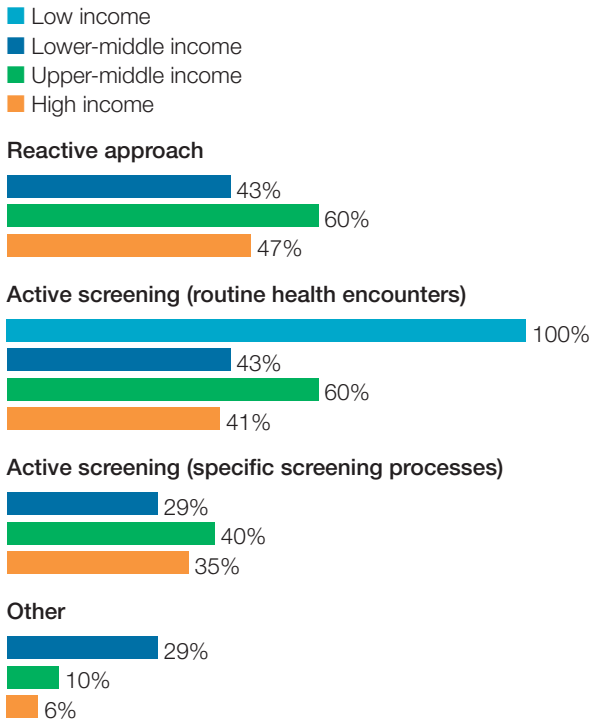


Table 7.6 | Methods of implementing AKI detection programs

Country	ISN region	World Bank group	Etiology reactive approach	Active screening (routine health encounters)	Active screening (specific screening processes)	Other	Not reported
Albania	Eastern & Central Europe	Upper-middle income		●	●		
Congo, Rep.	Africa	Lower-middle income		●			
Iran, Islamic Rep.	Middle East	Upper-middle income					●
Oman	Middle East	High income		●	●		
Thailand	OSEA	Upper-middle income	●	●	●	●	
United Kingdom	Western Europe	High income	●				

SECTION 8

LEADERSHIP, ADVOCACY, AND BARRIERS TO ESKD CARE

8.1 Policy and strategy

Nearly half (47%) of the countries surveyed have current national strategies for non-communicable diseases (NCDs) (Figure 8.1): 63% of high, 44% of upper-middle, 37% of lower-middle, and 32% of low income countries (Table 8.1, Figure 8.2). An additional 21 countries (14% overall) have strategies under development. Almost half (41%) of low income countries do not have existing strategies or strategies under development, compared to 26% of lower-middle, 32% of upper-middle, and 20% of high income countries.

Figure 8.1 | Existence of a national strategy for NCDs

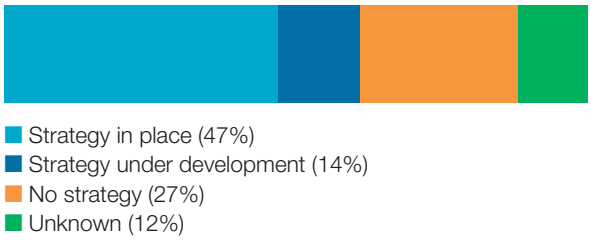


Table 8.1 | Existence of a national strategy for NCDs

	Yes N (%)	Yes, under development N (%)	No N (%)	Unknown N (%)
Overall	**73 (47)**	**21 (14)**	**42 (27)**	**18 (12)**
ISN region				
Africa	14 (34)	5 (12)	16 (39)	6 (15)
Eastern & Central Europe	9 (47)	4 (21)	5 (26)	1 (5)
Latin America	10 (56)	3 (17)	4 (22)	1 (6)
Middle East	3 (27)	1 (9)	6 (55)	1 (9)
NIS & Russia	2 (29)	2 (29)	2 (29)	1 (14)
North America	6 (67)	1 (11)	1 (11)	1 (11)
North & East Asia	5 (71)	0 (0)	1 (14)	1 (14)
OSEA	12 (80)	1 (7)	1 (7)	1 (7)
South Asia	2 (29)	3 (43)	2 (29)	0 (0)
Western Europe	10 (50)	1 (5)	4 (20)	5 (25)
World Bank income group				
Low income	7 (32)	3 (14)	9 (41)	3 (14)
Lower-middle income	13 (37)	9 (26)	9 (26)	4 (11)
Upper-middle income	18 (44)	6 (15)	13 (32)	4 (10)
High income	35 (63)	3 (5)	11 (20)	7 (13)

Rows may not total to 100% due to rounding.

Overall, 69 countries (44%) have a national strategy for improving CKD care. Among these, 32 (46%) have a standalone strategy for CKD care and the remaining 37 (54%) have a strategy that is part of a general strategy for NCD management. Over half (53%) of the countries surveyed do not have a strategy for CKD care. While more than half of the countries in Latin America, North and East Asia, OSEA, and Western Europe have CKD strategies, such strategies are less common in North America (44%), Eastern and Central Europe (42%), Africa (34%), South Asia (29%), the Middle East (18%), and NIS and Russia (0%) (Figure 8.3).

Among the 32 CKD-specific strategies, 22 (69%) cover non-dialysis dependent CKD, 24 (75%) cover chronic dialysis, and 22 (69%) cover kidney transplantation.

Among the CKD-specific strategies, non-dialysis dependent CKD is covered in all 3 strategies in North and East Asia, both strategies in the Middle East, and most strategies in Latin America (7/8), Western Europe (4/5), Eastern and Central Europe (3/4), and OSEA (3/5) (Figure 8.4). The CKD-specific strategy in South Asia (Sri Lanka) does not address non-dialysis dependent CKD.

Chronic dialysis is included in most CKD-specific strategies. All strategies in Africa (4), North and East Asia (3), and South Asia (1) cover dialysis, as do most strategies in Latin America (7/8), Eastern and Central Europe (3/4), and Western Europe (3/5) (Figure 8.4). One of the 2 strategies in the Middle East and 2 of the 5 strategies in OSEA cover dialysis.

All 3 CKD-specific strategies in North and East Asia and the 1 strategy in South Asia (Sri Lanka) cover kidney transplantation (Figure 8.4), as do most strategies in Latin America (7/8), Eastern and Central Europe (3/4), and Western Europe (3/5). One of the 2 strategies in the Middle East and 2 of the 5 strategies in OSEA cover kidney transplantation. (Figure 8.4).

Among the 37 general NCD strategies that include CKD, 19 (51%) cover non-dialysis dependent CKD, 20 (54%) cover chronic dialysis, and 13 (35%) cover kidney transplantation. Both strategies in North and East Asia and most strategies in OSEA (3/4) and Africa (6/10) cover CKD (Figure 8.4). Only half of the strategies in Latin America (3/6) and North America (2/4) cover CKD; even fewer strategies in Western Europe (2/6) and Eastern and Central Europe (1/4) include CKD. Both general NCD strategies

Figure 8.2 | Existence of a national strategy for NCDs, by World Bank income group

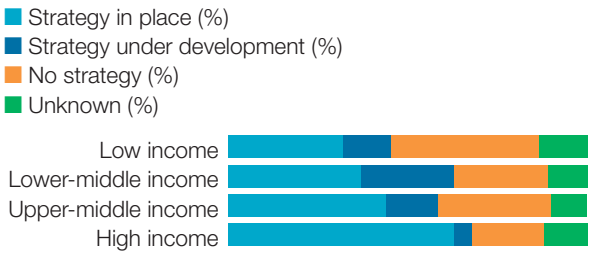
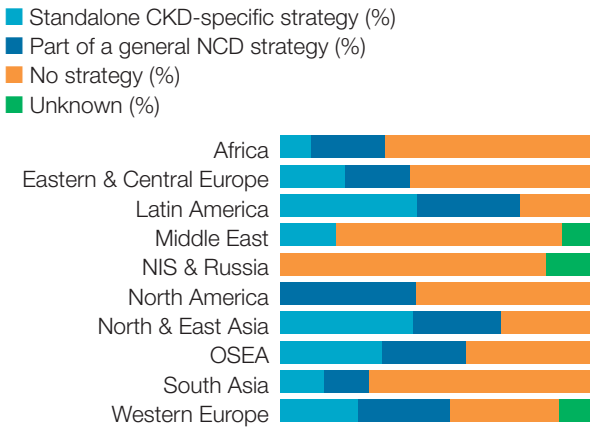


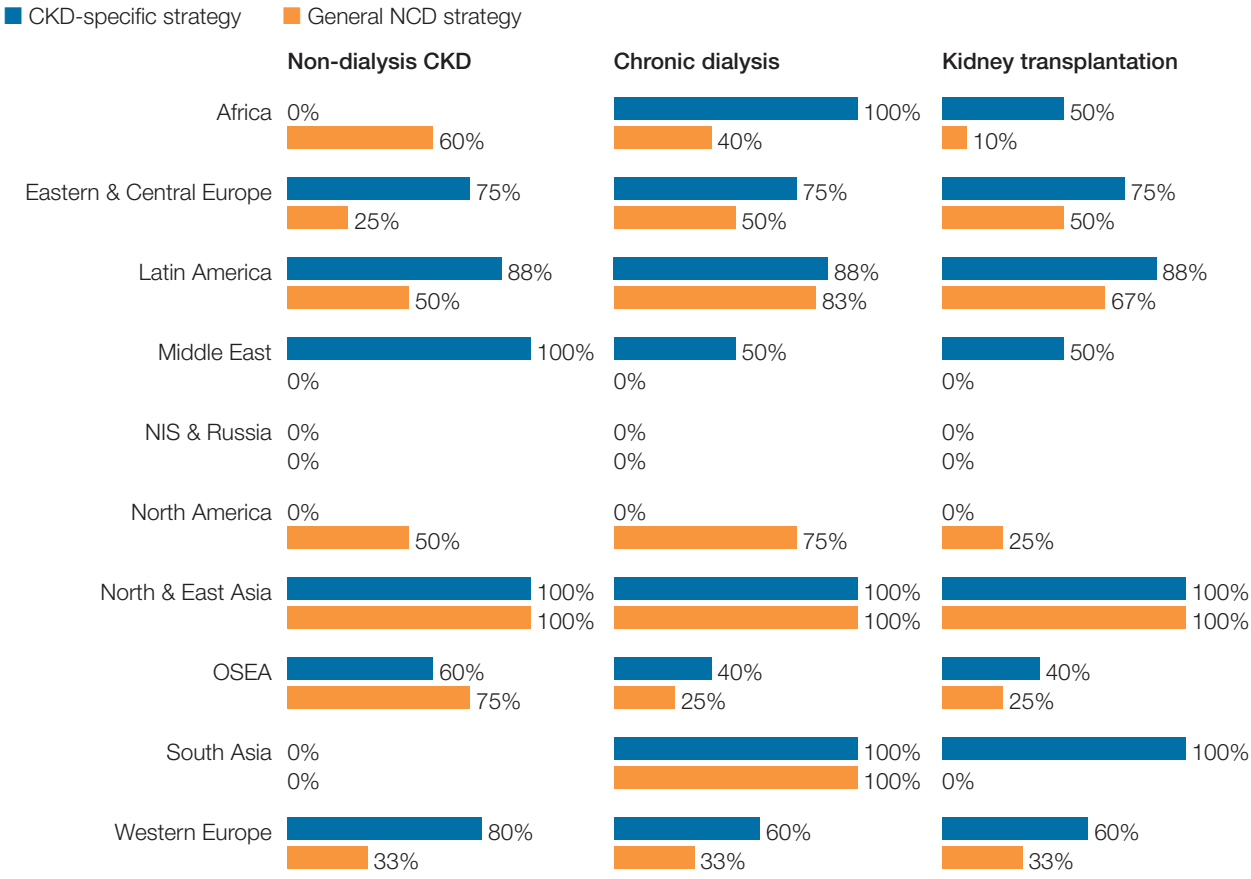
Figure 8.3 | Existence of a national strategy for improving CKD care, by ISN region



in North and East Asia and the 1 strategy in South Asia (India) include chronic dialysis, as do 5 of the 6 strategies in Latin America and 3 of the 4 in North America (Figure 8.4). Dialysis is included in general NCD strategies less frequently in Eastern and Central Europe (2/4), Africa (4/10), Western Europe (2/6), and OSEA (1/4). Both general NCD strategies in North and East Asia cover kidney transplantation, as do most strategies in Latin America (4/6) (Figure 8.4). Half of the strategies in Eastern and Central Europe (2/4), Western Europe (3/6), North America (1/4), and OSEA (1/4), and just 1 of the 10 strategies in Africa cover transplantation. The 1 general NCD strategy in South Asia (India) does not include transplantation. No countries in the Middle East or NIS and Russia have general NCD strategies that cover any elements of kidney care (Figure 8.4).

Overall, 34% of countries have CKD-specific policies (Table 8.2). The percentage of countries with policies exceeds the global average in Eastern and Central Europe (58%), North and East Asia (57%), OSEA (53%), Western Europe (45%), Latin America (39%), and the Middle East (36%), and falls below the global average in North America (33%), Africa (15%), South Asia (14%), and NIS and Russia (0%) (Table 8.2). No low income countries have CKD-specific policies, whereas 29% of lower-middle, 29% of

Figure 8.4 | Kidney conditions covered by CKD-specific and general NCD strategies, by ISN region



These data are only for countries that reported a strategy.

Table 8.2 | Existence of CKD-specific policies

	Yes N (%)	No N (%)	Unknown N (%)
Overall	**53 (34)**	**94 (61)**	**7 (5)**
ISN region			
Africa	6 (15)	34 (83)	1 (2)
Eastern & Central Europe	11 (58)	8 (42)	0 (0)
Latin America	7 (39)	10 (56)	1 (6)
Middle East	4 (36)	7 (64)	0 (0)
NIS & Russia	0 (0)	6 (86)	1 (14)
North America	3 (33)	4 (44)	2 (22)
North & East Asia	4 (57)	3 (43)	0 (0)
OSEA	8 (53)	7 (47)	0 (0)
South Asia	1 (14)	6 (86)	0 (0)
Western Europe	9 (45)	9 (45)	2 (10)
World Bank income group			
Low income	0 (0)	22 (100)	0 (0)
Lower-middle income	10 (29)	24 (69)	1 (3)
Upper-middle income	12 (29)	26 (63)	3 (7)
High income	31 (55)	22 (39)	3 (5)

Rows may not total to 100% due to rounding.

upper-middle, and 55% of high income countries have such policies (Figure 8.5).

Among the countries with CKD policies, 38 (83%) have national CKD policies only, 5 (11%) have regional policies only, and 3 (7%) have both national and regional CKD policies. No low income countries have CKD policies at any level (Figure 8.6). Among the lower-middle income countries with policies, 8 (89%) have national policies and 1 (11%) has a regional policy. Among the upper-middle income countries with policies, 11 (92%) have national policies only and 1 (8%) has both a national and regional policies. Among the high income countries with CKD policies, 19 (76%) have national policies only, 4 (16%) have regional policies only, and 2 (8%) have both national and regional policies (Figure 8.6).

Figure 8.5 | Existence of CKD-specific policies, by World Bank income group

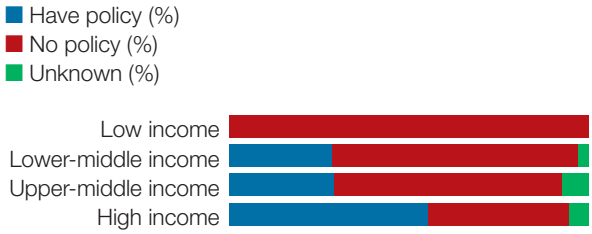
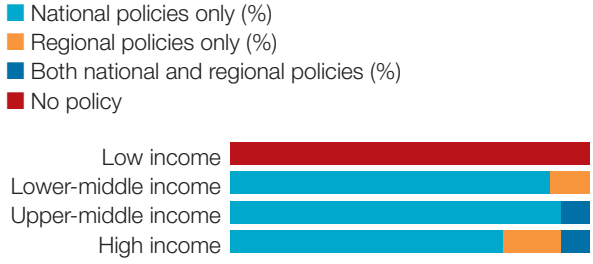


Figure 8.6 | Existence of CKD policies, by World Bank income group



8.2 Advocacy

Worldwide, 13% of governments recognize AKI as a health priority (Table 8.3, Figure 8.7). The percentage of countries recognizing AKI as a health priority exceeds the global average in the Middle East (18%), Africa (17%), Eastern and Central Europe (16%), NIS and Russia (14%), North and East Asia (14%), and OSEA (13%), and falls below the global average in Latin America (11%), North America (11%), Western Europe (5%), and South Asia (0%). Governmental recognition of AKI as a health priority is more common in lower-middle income countries (23%) than in high (11%), upper-middle (10%) and low (9%) income countries (Table 8.3).

AKI advocacy groups exist in only 14% of countries worldwide (Table 8.3, Figure 8.8). The percentage of countries with AKI advocacy groups exceeds the global average in South Asia (29%), Western Europe (25%), Eastern and Central Europe (16%), NIS and Russia (14%), and North and East Asia (14%), and falls below the global average in Africa (12%), Latin America (11%), North America (11%), OSEA (7%) and the Middle East (0%). The existence of AKI advocacy groups does not appear to relate to country income; such groups are present in 9% of low, 14% of lower-middle, 10% of upper-middle, and 18% of high income countries (Table 8.3).

Overall, governmental support is greater for CKD than for AKI. More than half (51%) of national governments worldwide recognize CKD as a health priority (Table 8.4, Figure 8.7). At least half of the national governments in North America (78%), North and East Asia (71%), Latin America

Table 8.3 | Advocacy and support for AKI treatment and prevention

	Governmental recognition of AKI as a health priority N (%)		Presence of advocacy group for AKI N (%)	
Overall	**20**	**(13)**	**21**	**(14)**
ISN region				
Africa	7	(17)	5	(12)
Eastern & Central Europe	3	(16)	3	(16)
Latin America	2	(11)	2	(11)
Middle East	2	(18)	0	(0)
NIS & Russia	1	(14)	1	(14)
North America	1	(11)	1	(11)
North & East Asia	1	(14)	1	(14)
OSEA	2	(13)	1	(7)
South Asia	0	(0)	2	(29)
Western Europe	1	(5)	5	(25)
World Bank income group				
Low income	2	(9)	2	(9)
Lower-middle income	8	(23)	5	(14)
Upper-middle income	4	(10)	4	(10)
High income	6	(11)	10	(18)

Figure 8.7 | Government support for AKI, CKD, and ESKD treatment and prevention

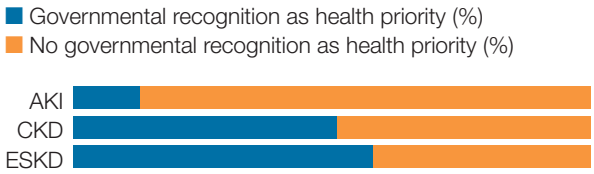
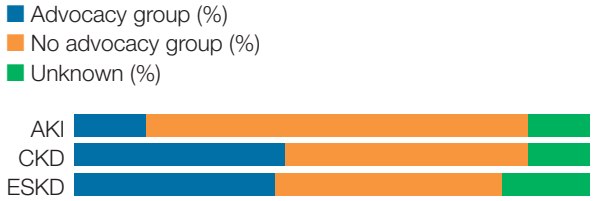


Figure 8.8 | Advocacy for AKI, CKD, and ESKD treatment and prevention



(67%), Eastern and Central Europe (53%), and Western Europe (50%) recognize CKD as a health priority, whereas less than half of the governments in Africa (49%), OSEA (47%), the Middle East (36%), NIS and Russia (29%), and South Asia (29%) recognize CKD as a health priority. More governments of high (57%) and upper-middle (63%) income countries tend to recognize CKD as a health priority than governments of lower-middle (43%) and low (27%) income countries (Table 8.4).

Similarly, advocacy for CKD is much greater than for AKI. CKD advocacy groups exist in 63 (41%) of countries (Table 8.4, Figure 8.8). CKD advocacy groups are present in more than half of the countries in North and East Asia (71%), North America (67%), OSEA (60%), South Asia (57%), and Latin America (56%), and in less than half of the countries in Eastern and Central Europe (47%), Africa (29%), the Middle East (27%), Western Europe (20%), and NIS and Russia (14%). Advocacy groups for CKD are present in a higher percentage of high (43%), upper-middle (49%), and lower-middle (40%) income countries than of low income countries (23%) (Table 8.4).

Governmental support for ESKD prevention and KRT is similar to that for CKD, and is prevalent in 58% of countries (Table 8.5, Figure 8.7). The percentage of governments providing support for ESKD prevention and KRT exceeds the global average in North and East Asia (100%), NIS and Russia (86%), Eastern and Central Europe (74%), the Middle East (73%), North America (67%), and Western Europe (65%), and falls below the global average in South Asia (57%), OSEA (53%), Latin America (44%), and Africa (37%). Governmental support for ESKD increases with income level, with governments of 23% of low, 57% of lower-middle, 61% of upper-middle, and 70% of high income countries providing support (Table 8.5).

Table 8.4 | Advocacy and support for CKD treatment and prevention

	Governmental recognition of CKD as a health priority N (%)	Presence of advocacy group for CKD N (%)
Overall	**79 (51)**	**63 (41)**
ISN region		
Africa	20 (49)	12 (29)
Eastern & Central Europe	10 (53)	9 (47)
Latin America	12 (67)	10 (56)
Middle East	4 (36)	3 (27)
NIS & Russia	2 (29)	1 (14)
North America	7 (78)	6 (67)
North & East Asia	5 (71)	5 (71)
OSEA	7 (47)	9 (60)
South Asia	2 (29)	4 (57)
Western Europe	10 (50)	4 (20)
World Bank income group		
Low income	6 (27)	5 (23)
Lower-middle income	15 (43)	14 (40)
Upper-middle income	26 (63)	20 (49)
High income	32 (57)	24 (43)

Table 8.5 | Advocacy and support for ESKD and KRT

	Governmental recognition of ESKD/KRT as a health priority N (%)	Presence of advocacy group for ESKD/KRT N (%)
Overall	**89 (58)**	**60 (39)**
ISN region		
Africa	15 (37)	12 (29)
Eastern & Central Europe	14 (74)	8 (42)
Latin America	8 (44)	9 (50)
Middle East	8 (73)	1 (9)
NIS & Russia	6 (86)	2 (29)
North America	6 (67)	5 (56)
North & East Asia	7 (100)	6 (86)
OSEA	8 (53)	6 (40)
South Asia	4 (57)	4 (57)
Western Europe	13 (65)	7 (35)
World Bank income group		
Low income	5 (23)	4 (18)
Lower-middle income	20 (57)	12 (34)
Upper-middle income	25 (61)	20 (49)
High income	39 (70)	24 (43)

The extent of advocacy for ESKD and KRT is similar to CKD. Advocacy groups for ESKD are present in 39% of countries worldwide (Table 8.5, Figure 8.8). The percentage of countries with ESKD advocacy groups exceeds the global average in North and East Asia (86%), South Asia (57%), North America (56%), Latin America (50%), Eastern and Central Europe (42%), and OSEA (40%), and falls below the global average in Western Europe (35%), Africa (29%), NIS and Russia (29%), and the Middle East (9%). ESKD advocacy groups exist in a higher percentage of high (43%), upper-middle (49%), and lower-middle (34%) income countries than of low (18%) income countries (Table 8.5).

8.3 Barriers to optimal ESKD care

Many barriers to optimal ESKD care exist (Table 8.6). More than half of countries worldwide experience barriers related to economic factors (64%); patient knowledge or attitude (63%); nephrologist availability (60%), physician availability, access, knowledge, and/or attitude (58%); distance from care or prolonged travel time (55%); or availability, access, and capability of the health care system (55%). Overall, 45% of countries reported a lack of political priority and 10% of countries reported other barriers to optimal ESKD care, while 8% of countries reported no barriers.

Table 8.6 | Barriers to optimal ESKD care

	Geography[1] N (%)	Physician[2] N (%)	Patient[3] N (%)	Nephrologist[4] N (%)	Healthcare system[5] N (%)	Lack of political priority N (%)	Economic factors N (%)	Other N (%)	None N (%)
Overall	**85 (55)**	**89 (58)**	**97 (63)**	**92 (60)**	**85 (55)**	**70 (45)**	**99 (64)**	**15 (10)**	**13 (8)**
ISN region									
Africa	32 (78)	32 (78)	30 (73)	34 (83)	34 (83)	23 (56)	39 (95)	5 (12)	1 (2)
Eastern & Central Europe	6 (32)	7 (37)	8 (42)	6 (32)	9 (47)	10 (53)	10 (53)	2 (11)	1 (5)
Latin America	14 (78)	12 (67)	15 (83)	14 (78)	13 (72)	10 (56)	12 (67)	3 (17)	0 (0)
Middle East	2 (18)	6 (55)	8 (73)	6 (55)	1 (9)	2 (18)	4 (36)	0 (0)	1 (9)
NIS & Russia	2 (29)	3 (43)	4 (57)	4 (57)	2 (29)	3 (43)	5 (71)	0 (0)	0 (0)
North America	3 (33)	4 (44)	6 (67)	4 (44)	5 (56)	3 (33)	7 (78)	0 (0)	0 (0)
North & East Asia	4 (57)	4 (57)	3 (43)	3 (43)	3 (43)	2 (29)	3 (43)	0 (0)	0 (0)
OSEA	12 (80)	13 (87)	13 (87)	12 (80)	11 (73)	8 (53)	11 (73)	4 (27)	0 (0)
South Asia	7 (100)	7 (100)	7 (100)	7 (100)	7 (100)	6 (86)	6 (86)	0 (0)	0 (0)
Western Europe	3 (15)	1 (5)	3 (15)	2 (10)	0 (0)	3 (15)	2 (10)	1 (5)	10 (50)
World Bank income group									
Low income	19 (86)	19 (86)	19 (86)	20 (91)	21 (95)	15 (68)	20 (91)	2 (9)	0 (0)
Lower-middle income	25 (71)	24 (69)	23 (66)	26 (74)	24 (69)	17 (49)	32 (91)	3 (9)	1 (3)
Upper-middle income	27 (66)	26 (63)	32 (78)	29 (71)	26 (63)	26 (63)	32 (78)	4 (10)	0 (0)
High income	14 (25)	20 (36)	23 (41)	17 (30)	14 (25)	12 (21)	15 (27)	6 (11)	12 (21)

1 Distance from care or prolonged travel time
2 Availability, access, knowledge, attitude
3 Knowledge, attitude
4 Availability
5 Availability, access, capability

Barriers vary across ISN regions. Geographic barriers are high in Africa (78%), Latin America (78%), North and East Asia (57%), OSEA (80%), and South Asia (100%). Geographic barriers are less prevalent in Eastern and Central Europe (32%), the Middle East (18%), NIS and Russia (29%), North America (33%), and Western Europe (15%). Barriers due to limited availability of nephrologists are most prevalent in South Asia (100% of countries), Africa (83%), OSEA (80%), and Latin America (78%). Nephrologist availability is a barrier in more than half of the countries in NIS and Russia (57%) and the Middle East (55%), and in a significant proportion of countries in North America (44%), North and East Asia (43%), and Eastern and Central Europe (32%). Healthcare system-level barriers are most prevalent in South Asia (100%), Africa (83%), OSEA (73%), Latin America (72%), and North America (56%). Healthcare system related barriers exist in nearly half (47%) of the countries in Eastern and Central Europe as well as countries in North and East Asia (43%), NIS and Russia (29%), and the Middle East (9%).

In low income countries, barriers related to the healthcare system (95%), nephrologist availability (91%), and lack of political priority (68%) are highly prevalent (Table 8.6), whereas these barriers are much less prevalent in high income countries (25%, 30%, and 21%, respectively). Barriers related to nephrologist availability and healthcare systems are prevalent in more than half of lower-middle (74% and 69%, respectively) and upper-middle (71% and 63%, respectively) income countries. Among the 13 countries with no reported barriers to optimal ESKD care, 12 are high income countries and 1 is a lower-middle income country (Table 8.6).

SECTION 9

DISCUSSION

9.1 Gaps in services and resources

The ISN has been working collaboratively with existing organizations and initiatives at the international and national levels to promote early detection and effective treatment of kidney disease in order to improve patient health and quality of life. By understanding and potentially helping to shape relevant health policies, practices and infrastructure, the ISN aims to facilitate the implementation of equitable and ethical care for kidney patients in all regions and countries of the world. Over the last few years, the ISN has specifically focused on facilitating the development and implementation of strategies to enhance ESKD care in terms of availability, equity, and access.

The GKHA is a worldwide initiative aimed at identifying and evaluating global capacity for kidney care, using the WHO's key building blocks of a functional health system as a framework.[50] The first assessment in 2017[62] revealed variability in global kidney care, with significant gaps in kidney care across all domains, particularly in low and lower-middle income countries. This publication describes the results of the second iteration of the survey aimed at specifically defining the current global status of the burden of ESKD, and the structures and organization of care delivery. This information helps reveal gaps in care structures and delivery systems around the globe to guide strategic development and to further document the current status of ESKD care as a means to inform advocacy efforts and strategies, and to monitor progress toward closing identified gaps.

A key finding of this survey is the immense variability across countries in terms of funding for KRT. For instance, whilst most countries fund dialysis and transplantation through public sources, fewer than half (48%) of low income countries and just over half (57%) of lower-middle income countries provide public funding for KRT (with no charge or some fees at the point of delivery). This obviously amplifies limitations associated with KRT accessibility and equity of care across countries, thereby contributing to increased mortality and morbidity risk associated with kidney disease.

However, it is apparent that countries have done well in terms of providing the necessary infrastructure and technology for KRT, as all countries offer HD and three-quarters offer PD and transplantation. Unfortunately, availability is much more limited for chronic PD or transplantation services, particularly in low income countries. Given the high costs of chronic HD facilities, increasing access to these other means of ESKD care, specifically PD, may allow countries with limited resources to improve access to care. However, very few countries reported initiating ESKD care with PD. Although this service is typically less expensive than HD, costs may be a barrier for some countries. Overall, accessibility of kidney transplantation services is low, particularly in low income countries. Irrespective of income level, conservative care is highly available. However, access to medically-advised (in contrast to resource-constrained) conservative care differs more by country income level: the majority of high income countries offer this service, compared to just one-third of low income countries. Availability of services to appropriately manage ESKD also is limited in some areas. The capacity to manage (i.e., test and treat) anemia, high blood pressure, electrolyte disorders, and chronic metabolic

acidosis is high in most countries surveyed, whereas the capacity to manage renal bone disease is limited, particularly in low and lower-middle income countries. By ensuring adequate workforce and funding levels, many countries can easily advance and make meaningful progress toward ensuring high quality ESKD care.

Our results confirm initial findings from the baseline survey for the GKHA regarding responsibility for kidney care delivery. In most of the countries surveyed, nephrologists are primarily responsible for delivering ESKD care. In terms of distribution, the density of nephrologists in high income countries is over 60 times that of low income countries, and the majority of low income countries reported key shortages of other health care professionals involved in kidney care, particularly interventional radiologists, surgeons, and transplant coordinators.

The role of comprehensive health information systems (e.g., renal registries) in monitoring CKD to prevent progression to ESKD and as an essential element in optimal CKD delivery cannot be overemphasized. Overall, few registries for AKI and non-dialysis CKD management exist. Similarly, few systems to detect AKI exist in practice: only six countries reported having processes in place.

Fewer than half of the countries surveyed reported a national strategy for improving CKD care and one-third reported CKD-specific policies. Government recognition of CKD (63% of countries) and ESKD (58% of countries) was much higher than recognition of AKI (13% of countries). In addition to issues with financing, inadequate workforce, and lack of political will (i.e., government recognition), many barriers to optimal ESKD care exist, including: patient knowledge or attitude; distance from care or prolonged travel time; and availability, access, and capability of the healthcare system, particularly in low income countries.

Compared to 125 countries in the initial survey, this survey covers 160 countries and over 98% of the world's population. In addition to the availability of KRT, the current survey findings explore other elements of care, such as accessibility, quality, and affordability. In both surveys, all countries reported chronic HD as an available service. In the previous survey, 95 out of 119 (80%) countries reported chronic PD as an available service, compared to 119 out of 156 (76%) countries in the current survey, including 4 countries (Bolivia, Egypt, Fiji, and Swaziland) that had previously reported PD as unavailable. However, 4 countries (Armenia, Kenya, Syria, and Uganda) that had reported PD as an available service in the previous survey reported it as unavailable in the current survey. In the previous survey, 94 out of 119 (79%) countries reported kidney transplantation as an available service, compared to 114 out of 155 (74%) countries in the current survey. Tanzania is the only country that had reported kidney transplantation as unavailable in the previous survey, yet reported it as available in the current survey.

In the previous survey, registries for CKD and AKI were reported in 9 and 8 out of 117 (8% and 7%) countries, respectively, compared to 18 and 13 out of 154 (12% and 8%) countries in the current survey. Seven countries that had reported no CKD registry in the previous survey (Argentina, Colombia, Japan, Lao PDR, Oman, Slovakia, and Taiwan) reported the existence of a CKD registry in the current survey. However, 3 countries (Albania, Norway, and West Bank and Gaza) that had previously reported the existence of a CKD registry reported no registry in the current survey. Five of the countries that had reported no AKI registry in the previous survey (Lao PDR, Mongolia, Oman, United Kingdom, and Zambia) reported one in this survey, and 4 countries (Albania, Pakistan, Poland, and West Bank and Gaza) that had previously reported the existence of an AKI registry reported no registry in the current survey. More countries are developing KRT registries. In the previous survey, 75 and 68 out of 117 countries reported having registries for dialysis and transplantation, respectively; in the current survey, those figures have increased to 101 and 88 out of 154 countries, respectively.

Key implications of the findings from this survey iteration are discussed in the sections that follow relative to the key domains covered in the survey.

9.2 Implications

9.2.1 Health finance and service delivery

Nearly half (48%) of all countries provide public funding for non-dialysis CKD care. High income countries are more likely to cover non-dialysis CKD care (68% of countries) than upper-middle (41%), lower-middle (43%) and low (22%) income countries. Low income countries reported the highest use of private funding (22%), followed by lower-middle (16%), high (1%), and upper-middle (0%) income countries. Non-dialysis CKD care is imperative for preventing ESKD. Many elements of this care (medications and monitoring to reduce risk of progression and minimize disease complications) can be costly to patients. Countries that do not cover these care costs may bear a higher burden of ESKD due to reduced capacity to prevent progression of CKD because patients may not be able to afford appropriate care.

Public funding for dialysis and transplantation is more common than for non-dialysis CKD care across countries. Overall, 64% of countries provide public funding for KRT, with 43% charging no fees at the point of delivery and 21% charging some fees. High income countries reported public funding for KRT more often (78%) than upper-middle (61%), lower-middle (57%) and low (48%) income countries. Governments of more than half of low income countries do not fund KRT, which may result in mortality that could be prevented through appropriate KRT care. Delivering appropriate KRT is expensive, and implementing universal coverage for all patients worldwide will be a challenging task. Other forms of treatment (PD or conservative care, for example) may be suitable options in countries with limited capacity to provide universal funding for HD or transplantation.

Half of all countries provide public funding for surgery to create vascular access for dialysis. For HD, 58% of countries cover costs of surgery to insert a central venous catheter, and 54% cover costs to insert a fistula or create a graft. Surgery to create access for PD (i.e., catheter insertion) is publicly funded in 54% of countries. Appropriate and proper access to dialysis is essential for effective dialysis treatment outcomes. Just under half of countries, most of which are in the low and lower-middle income categories, do not cover costs associated with access creation. Including this element of care in government coverage (in places that fund dialysis treatments) may result in improved dialysis outcomes for patients, reducing unnecessary complications that are costly.

Worldwide, 40% of countries reported regional variation in ESKD care delivery, in terms of organization, structures, and service delivery patterns. Variation in care delivery is more likely in low income countries than in lower-middle, upper-middle, and high income countries. Variation in access to KRT between children and adults was also reported; variation is highest in low income countries, followed by lower-middle, upper-middle, and high income countries.

The management of ESKD varies worldwide. Structured ESKD management systems do not exist in 13% of low, 10% of upper-middle, and 3% of lower-middle income countries. All high income countries have structured ESKD management systems. ESKD care is managed by national governments in 56% of countries; hospitals, trusts, and organizations in 38% of countries; provincial, regional, or state governments in 21% of countries; NGOs in 4% of countries; and other management structures in 8% of countries. The presence of a structured system enables the standardized delivery of ESKD care as well as systematic monitoring of process measures, which are important to ensure high quality and equitable care.

9.2.2 Health workforce for nephrology care

Nephrologists are primarily responsible for ESKD care delivery and oversight in 92% of countries. Worldwide, the median number of nephrologists is 9.95 pmp. The average density of nephrologists increases with income; it is 0.2 pmp in low income countries, followed by 1.6 pmp in lower-middle, 10.8 pmp in upper-middle, and 23.2 pmp in high income countries. The median number of nephrology trainees is 1.4 pmp. Similarly, density of trainees increases with income; it is 0.1 pmp in low income, 0.6 pmp in lower-middle, 1.2 pmp in upper-middle, and 3.7 pmp in high income countries. While these densities do not consider factors such as burden of CKD or ESKD, or densities of other health care professionals who share the workload for ESKD care, more nephrologists are needed in low income countries. Task shifting, which involves training primary care providers, nurses, or other appropriate professionals to provide ESKD care with remote guidance from nephrologists and/or support from standard algorithms, may help improve capacity to deliver high quality ESKD care in countries with limited nephrologist availability.

Most countries reported shortages of health care providers essential for ESKD care. In addition to the shortage of nephrologists reported by 70% of countries surveyed, other health care professionals are in limited supply, including interventional radiologists for HD access (66%) or PD access (53%); surgeons for transplantation (65%), HD access (65%), and PD access (53%); vascular access coordinators (63%); counselors or psychologists (57%); dialysis nurses (57%); laboratory technicians (55%); transplant coordinators (54%); dialysis technicians (49%); radiologists (ultrasound technicians) (20%); and dietitians (19%). Increasing the number of these health care professionals to create multidisciplinary teams is important, considering the complexity of care for ESKD patients. Furthermore, distributing the workload for ESKD care across multiple providers will increase the overall capacity of care, which is particularly important in areas with significant nephrologist shortages.

9.2.3 Access to essential medications, health products, and technologies for ESKD care

All countries reported availability of chronic HD services, and 76% of countries reported availability of chronic PD services. However, only 23% of low income countries reported availability of chronic PD services, compared to 61% of lower-middle, 90% of upper-middle, and 96% of high income countries. Increasing the use of PD, particularly in countries with limited resources, may help improve access to ESKD care. The low PD uptake in low income nations reflects limited infrastructure (e.g., an inability to manufacture PD fluids and other consumables locally), limited training and experience in delivering PD, and a lack of patient motivation due to socio-cultural and economic factors.

Furthermore, variation in how both ESKD care in general, and KRT specifically, are delivered across children and adults was reported. Nearly 30% of countries reported within-country differences in how ESKD care and KRT is delivered between children and adults. This discrepancy is most common in low and lower-middle income countries.

Similarly, 74% of countries reported having transplantation services available; moreover, accessibility increases with income level. Only 23% of low income countries offer transplantation, compared to 69% of lower-middle, 83% of upper-middle, and 89% of high income countries. Kidney transplantation is well-established as the preferred method of KRT. Access to transplantation can be improved by promoting kidney donation and increasing the number of facilities and surgeons, particularly in low income settings.

Due to the complexity of ESKD, services to detect, monitor, and manage anemia, bone disease, electrolyte disorders, and metabolic acidosis are critical for optimal care delivery. Most countries, irrespective of income, reported the capacity to measure hemoglobin and blood pressure. Similarly, the capacity to manage electrolyte disorders and chronic metabolic acidosis is high in most

countries, with the exception of oral sodium bicarbonate and potassium exchange resins, which are available in just 72% and 62% of countries, respectively. In contrast, the capacity to manage renal bone disease varies. Most countries have the capacity to measure serum calcium and phosphorus and to administer calcium-phosphate binders. However, fewer countries have the capacity to administer non-calcium-based phosphate binders or cinacalcet. Ability to measure serum parathyroid hormone is available in 65% of countries, and surgical services for parathyroidectomy are generally available in only 56% of countries. Overall, capacity to monitor these conditions is acceptable; however, treatment options are limited. Increasing the availability of medications to manage electrolyte disorders and chronic metabolic acidosis (oral sodium bicarbonate or potassium exchange resins) and bone mineral disease (non-calcium phosphate binders or cinacalcet) is important to prevent complications associated with ESKD.

Overall, in 72% of countries with available dialysis services, at least half of patients with ESKD are able to access dialysis at the onset of kidney failure. However, access in low income countries is quite low (5%). Timely access to dialysis at the onset of ESKD is important to optimally prepare patients for treatment and reduce the risk of adverse events, including heightened mortality risk.[75] Among countries with PD available, only 4% report it as the initial treatment for most ESKD patients. Initiating KRT with PD may improve survival during the first two years of treatment; moreover, it is less expensive and more convenient, as it can be performed in a patient's home on a flexible schedule.[76] Although the initiation of KRT with PD should be promoted in all countries, low income countries may particularly benefit due to the lower associated costs.

Although 74% of countries have facilities available for kidney transplantation, accessibility to services is low, particularly in lower-middle and low income settings. Among countries with kidney transplantation available, most patients have high access to care in 64% of high income countries, compared to 30% of upper-middle, 13% of lower-middle, and 0% of low income countries. Increasing the capacity to perform kidney transplantation services, particularly in lower-middle and low income countries, is challenging due to cost constraints, limitations in the requisite infrastructure and expertise, as well as socio-cultural factors in some settings.

In nearly half (46%) of the countries surveyed, patients typically initiate HD with a temporary dialysis catheter. Patients in low income countries are less likely to start HD with functioning vascular access or a tunneled dialysis catheter than patients in other countries, and are more likely to initiate treatment with a temporary dialysis catheter. Initiating treatment with functioning vascular access is important to ensure effective patient outcomes and efficient dialysis treatment. However, in certain emergency situations, temporary catheters are used as life-saving measures before permanent access is created or until kidney function is recovered (in situations of AKI). Properly monitoring early-stage CKD patients to sufficiently prepare them for the initiation of dialysis if progression to ESKD occurs will help ensure timely insertion of permanent vascular access. Similarly, patient education on the best means of access and the optimal timing for surgery is lacking. Only 19% of countries reported that patients receive education more than 75% of the time. Monitoring patients with deteriorating kidney function is important to ensure they have sufficient time to decide on appropriate means of access if dialysis is eventually needed.

The proportion of centers that measure and report quality indicators for dialysis service delivery varies. Quality indicators for HD and PD are similarly measured and reported. Blood pressure is measured and reported most of the time (HD: 86%; PD: 85%), as is hemoglobin (HD: 88%; PD: 84%). Patient survival and bone mineral markers for both HD and PD patients are measured and reported in approximately 70% of countries. Technique survival is routinely measured and reported for HD patients in 51% of countries and for PD patients in 61% of countries. Small solute

clearance and PROMS are only measured and reported in approximately 60% and 30% of countries, respectively. Centers in more countries measure and report quality indicators for kidney transplant recipients. In most countries, centers report patient survival (77%), kidney allograft function (73%), and graft survival (72%). In more than half of the countries surveyed, centers report delayed graft (65%) and rejection rates (59%), and in nearly half of the countries (45%), centers routinely measure and report on PROMS. Across all forms of KRT, measuring and reporting of quality indicators increases with country income level. Systematic and consistent monitoring of process indicators is important to ensure all patients within a country receive high quality and equitable care. Efforts to promote the use of quality indicators in KRT care through access to guidelines, incentives, and feasible monitoring systems (i.e., databases or registries) may improve the quality of care provided.

Nutritional services for kidney care are generally available worldwide. Measurement of serum albumin is generally available in 92% of countries, and oral nutrition supplements are generally available in 81% of countries. Anthropometric measurement services (BMI and body weight) are available in most countries, whereas skin fold assessments are only available in 41% of countries. Dietary counseling is generally available in 59% of countries worldwide. Due to the complex dietary needs of ESKD patients, increasing access to dietitians or other dietary counselors is important to reduce risks of hyperkalemia and bone mineral disease, among others.

Conservative care is delivered in 81% of countries that participated in the survey. The availability of conservative care does not appear to be associated with country income level. However, access to chosen or medically-advised conservative care increases with country income level: 87% of high income countries offer chosen conservative care, compared to 64% of upper-middle, 43% of lower-middle, and 33% of low income countries. Recognizing that dialysis or transplantation may not always be the most optimal or feasible KRT option is important to ensure treatment is appropriate for patients. Conservative care is more than just the default option when conventional KRT options such as dialysis or transplantation are unavailable or inaccessible (i.e., due to resource constraints or geographic barriers); in appropriate circumstances, this mode of care leads to similar outcomes as conventional KRT. To ensure greater uptake and quality, guidelines and provider education and training about how to optimally deliver conservative care are needed. The decision to choose conservative care over other KRT approaches is important; providers and patients must collaborate during the decision-making process to ensure the most optimal treatment option is delivered, considering factors such as lifestyle, health outcomes (comorbidity index, life expectancy), and resource availability.

Conservative care involves multiple health care providers, a range of medical and psychological treatments, and ongoing symptom monitoring. The use of a multidisciplinary team, the adoption of shared decision-making practices, and the provision of psychological, cultural, and spiritual support in conservative care delivery increases with country income level, but remains low overall. Additional training for health care providers is lacking as well; it is offered in 0% of low, 24% of lower-middle, 21% of upper-middle, and 39% of high income countries. Evidence-based guidelines to increase awareness and education around how to deliver conservative care are needed.

9.2.4 Health information systems

Registries for AKI and non-dialysis CKD, which are necessary to prevent ESKD, are lacking worldwide, irrespective of country income level. Only 13 AKI registries and 19 non-dialysis CKD registries exist. Registries for managing ESKD are more common: 66% of countries have dialysis registries (59% of which require provider participation) and 57% have transplantation registries (65% of which require provider participation). Registries to monitor AKI or early stage CKD are critical for preventing or reducing disease progression to ESKD. Global

capacity to develop and implement these registries must be improved, along with data comprehensiveness and quality. Furthermore, mandatory provider participation helps to ensure registries are complete.

Overall, practices to identify CKD among high-risk groups are common. Most countries, irrespective of income level, screen for CKD among people with hypertension, diabetes, or urological conditions. Chronic users of nephrotoxic medications, people with a family history of CKD, or high-risk ethnic groups are screened for CKD in few countries, regardless of country income level. Screening of patients with cardiovascular diseases, autoimmune or multisystem disorders, or those over 65 years of age is moderate, and increases with country income level. The prevalence of CKD detection programs increases with country income level; 35 countries have CKD detection programs, and most are implemented through active approaches to identify at-risk patients through the use of pre-existing databases or electronic systems. Only six countries currently have AKI detection programs.

9.2.5 Leadership, advocacy, and barriers to ESKD care

Overall, 47% of countries have current national strategies for NCDs and 14% of countries are developing them. Strategies are less common in low income countries, whether current or under development. Among the countries surveyed, 44% have national strategies to improve CKD care: 46% are standalone strategies, and 54% are sub-strategies of general NCD management strategies.

Among the 32 CKD-specific strategies, 69% cover non-dialysis dependent CKD, 75% cover chronic dialysis, and 69% cover kidney transplantation. Among the 37 countries with general NCD strategies that include CKD, 51% cover non-dialysis dependent CKD, 54% cover chronic dialysis, and 35% cover kidney transplantation.

Overall, 34% of countries have CKD-specific policies. Among the countries with CKD policies, 83% have national CKD policies only, 11% have regional policies only, and 7% have both national and regional CKD policies. No low income countries have policies, whereas 29% of lower-middle, 29% of upper-middle, and 55% of high income countries have policies. It is important for low income countries to develop CKD-specific policies to optimize the delivery of consistent and high quality ESKD care.

Worldwide, AKI, CKD, and ESKD are recognized as health priorities by only 13%, 51%, and 58% of governments, respectively. Only a few governments recognize AKI as a health priority, and country income level does not appear to be a factor. However, more governments of high and upper-middle income countries tend to recognize CKD and ESKD as health priorities than governments of lower-middle and low income countries. Governmental recognition of AKI, CKD, and ESKD as health priorities must increase to support the prioritization of policies and strategies that ensure adequate care for these conditions, which ultimately have great impacts on health care costs and residents' well-being.

Similarly, advocacy groups for AKI, CKD, and ESKD exist in only 14%, 63%, and 39% of countries worldwide. The existence of AKI advocacy groups does not appear to relate to country income level. Both CKD and ESKD advocacy groups are more common in high, upper-middle, and lower-middle income countries than in low income countries. Advocacy groups and government support may be closely linked, and increased advocacy through organizations and institutions may help guide policymakers' decisions about how to prioritize competing health care needs. Increasing public awareness of the impacts of ESKD and prevention practices through media and other resources may help promote advocacy for CKD and persuade political leaders to take action.

Many barriers to optimal ESKD care exist, especially economic factors (reported by 64% of countries); patient knowledge or attitude (63%); nephrologist availability (60%); physician availability, access, knowledge, and/or attitude (58%);

distance from care or prolonged travel time (55%); and availability, access, and capability of the healthcare system (55%). In low income countries, barriers related to the healthcare system (95%), nephrologist availability (91%), and lack of political will (68%) are highly prevalent, whereas these barriers are much less prevalent in high income countries. Among the 13 (8%) countries with no reported barriers to optimal ESKD care, 12 are high income countries and 1 is a lower-middle income country. Efforts to understand why these barriers exist and importantly, how they can be reduced or mitigated, are crucial to increase global capacity to deliver kidney care.

9.3 Optimizing ESKD care in resource-limited countries

Although approximately 0.1% of the world's population has ESKD, many people who require KRT do not receive treatment. The high cost of KRT is limiting, particularly when countries do not provide public funding for it. A much larger proportion of people with ESKD in low and lower-middle income countries are not receiving dialysis or transplantation services compared to those in upper-middle and high income countries. HD and transplantation are expensive, and including these services in UHC plans may not be possible in all countries. However, alternatives to these forms of KRT exist that are less costly, and in some cases, more appropriate. For example, in patients requiring dialysis, PD may result in similar or better health outcomes than HD, with more patient convenience and fewer costs. For elderly patients or those with limited financial resources, conservative care may be a more suitable KRT option than dialysis or transplantation.

Nevertheless, focusing on the prevention of ESKD is the most optimal approach, particularly in settings with limited resources. Strategies and policies that ensure appropriate screening to identify CKD and monitoring of patients with declining kidney function to prevent progression to ESKD are essential. Less than half (44%) of the countries surveyed have national strategies for improving CKD care, and among these strategies, only 46% specifically address CKD. Similarly, only 34% of countries have CKD-specific policies, none of which are low income countries. Promoting governmental recognition of CKD as a health priority and creating and strengthening advocacy groups may be appropriate strategies to increase national awareness of CKD and influence policy development. Only 51% and 58% of governments recognize CKD and ESKD, respectively, as health priorities. Although advocacy groups for CKD are more common than those for ESKD (they exist in 63% and 39% of countries, respectively), few advocacy groups exist overall.

Increasing knowledge and resource sharing between countries with similarities is another approach to reduce financial barriers. Guidelines provide benchmarks and best practice standards for capacity building (i.e., enhancement of knowledge and skills amongst care providers). Similarly, delegating workloads amongst a variety of health care professionals can not only help address shortages of nephrologists or other providers, but also help create multidisciplinary teams which are essential for delivering optimal kidney care.

Overall, competing priorities and limited resources are realities that hinder the optimization of ESKD prevention and treatment. However, solutions and opportunities exist to reduce the burden of kidney disease across all countries.

9.4 Recommendations

This edition of the GKHA, which focuses on ESKD management, highlights key areas that require attention to improve worldwide capacity for kidney care. The desk research findings illustrate the global burden of ESKD and particularly, treatment needs that go unmet in many low income countries. The survey results reveal the current global capacity for ESKD care. It is important to document where we are today, not only to evaluate progress over time, but also to provide benchmarks that enable countries to set priorities for capacity improvement. Public funding for KRT is limited, particularly in low income countries. Workforce shortages are noteworthy across all country income levels, and nearly all low income countries reported shortages of nephrologists, interventional radiologists, surgeons, and transplant coordinators. Although HD is available in most countries, fewer countries offer PD, transplantation, and chosen or medically-advised conservative care. Few registries exist for AKI and CKD, and detection programs are rare; more registries and detection programs must be implemented to help prevent ESKD. Lastly, policies, government support, and advocacy across the spectrum of kidney care are needed.

In this section, we describe each of these priorities and suggest remedial strategies.

9.4.1 Increase health care financing for ESKD prevention and management

Less than 30% of countries provide public funding for non-dialysis CKD care with no costs to patients at the point of care delivery. Public funding for dialysis and transplantation is more common; however, less than half of countries surveyed fully cover all KRT costs, with no patient fees at the point of care delivery. In countries that do provide public funding, coverage is not always equal across all residents,[77,78] particularly in low income countries. Affordability of chronic HD treatment is a non-medical barrier for patients,[79] and other KRT options, such as PD or home-administered HD, may address this gap in care.[80] Furthermore, it is important to increase coverage for dialysis to reduce patient costs for KRT, where possible. However, the costs of dialysis and transplantation are high, and governments need to decide where to best allocate funding. Priority-setting tools (e.g., lists of essential medicines, health benefit plans, and health technology assessment agencies) may help guide evidence-based priority-setting;[81] however, the local context should be considered when making such decisions.

9.4.2 Address workforce shortages through multidisciplinary teams and telemedicine

Most countries—particularly low income countries—experience a shortage of at least one health care professional essential for ESKD care delivery. While more nephrologists are needed, high costs of training are a barrier. Delegating tasks for ESKD care delivery across a number of appropriate health care professionals is important, not only to increase the availability of existing nephrologists, but also to promote the use of multidisciplinary teams. Involving nurses, dietitians, pharmacists, and other professionals in decision-making and ESKD care delivery will make services more comprehensive and increase overall capacity to respond to patients' needs.

There is also an opportunity for telemedicine to expand the reach of nephrologists and other health care professionals, both nationally and internationally. For example, the Extension for Community Healthcare Outcomes (ECHO) model improves access to care for underserved populations with complex health problems[82] and has been used across a variety of disciplines. The application of telemedicine in kidney care (i.e., telenephrology) to increase the capacity of ESKD care delivery in limited-resource settings is a promising direction.[83]

9.4.3 Incorporate the collection and reporting of quality indicators in ESKD care

While increased accessibility to KRT in general is a great achievement, access to high-quality ESKD treatment is important. Measurement and reporting of quality indicators for the delivery of HD, PD, and transplantation vary globally. In dialysis care, blood pressure and hemoglobin are measured often; however, small solute clearance, bone mineral markers, and technique survival are only measured and reported in 50–70% of countries. Quality indicators for kidney transplant recipients are more commonly measured and reported. Irrespective of KRT type, measuring and reporting of quality indicators decrease with country income level. Furthermore, the use of PROMS in care delivery and evaluation is low across all forms of KRT. Increasing the use of PROMS may help measure clinical effectiveness and promote the use of patient-centered care. Moreover, PROMS may serve as potential prognostic markers to help monitor patients' health status.[84]

Developing platforms to collect and evaluate quality indicators for KRT is important to optimize the delivery of ESKD treatment. Monitoring quality indicators helps identify when the quality of care is not ideal; such information can initiate and guide the development of appropriate quality improvement programs. Furthermore, these global indicators provide benchmarks to help guide practice for ESKD care delivery.

9.4.4 Expand health information systems to prevent and manage ESKD

Health information systems play a broad role in the healthcare system. They can be used to track individual health data (e.g., electronic health records) which can help guide care delivery, and population data which can be used to research health conditions and guide decisions around priorities, policies, and resource allocation. Few countries have existing registries for AKI and non-dialysis CKD. These tools are essential for monitoring and preventing progression to ESKD. Furthermore, information on the prevalence of early-stage CKD may help guide resource allocation decisions by enabling future demand for ESKD care to be predicted.

Similarly, systems for detecting AKI and CKD through active screening approaches are important. The use of electronic alert systems to detect AKI has had significant effects on improving recovery and reducing the severity of AKI events.[85] Incorporating prompts into primary care electronic medical records (EMRs) to detect patients at high risk for CKD could be a cost-effective strategy to prevent ESKD.[86] Decision aids integrated into EMRs have been shown to significantly reduce eGFR loss,[87] suggesting the potential of these tools to help reduce the prevalence of ESKD.

9.4.5 Promote ESKD prevention and treatment by implementing policies, strategies, and advocacy, and mitigating barriers

Lastly, delivering high quality kidney care requires strategies and policies. Increasing governmental recognition of CKD and ESKD as health priorities may facilitate the development of strategies and policies to improve kidney care, although governments have competing priorities to consider. Connecting CKD and ESKD care with existing NCD strategies is practical, as CKD is associated with significant increases in cardiovascular mortality and multiplies risks of other key NCDs, such as diabetes and hypertension.[60] Strategies on how to incorporate CKD into existing NCD strategies have been proposed.[88] Increasing awareness about the health and cost consequences of kidney disease[88] may help strengthen government support for kidney care policies and initiatives worldwide.

It is also critical to address the variability in access to care among marginalized population groups, particularly women and children. This work has demonstrated inequities in kidney care delivery amongst children, particularly in low and lower-middle income settings. Further, this survey highlights a need to address issues of

equitable treatment as a key policy-making priority for governments and international stakeholder organizations. Decisions about these issues are complex due to competing demands for scarce resources available for health care and other social services. For instance, the costs to deliver and sustain KRT are generally high, and may be out of reach for governments of many countries. However, strategies such as increasing awareness about the burden of kidney disease and promoting ESKD-prevention (early detection and treatment) activities with appropriate cost-effective therapies would be affordable in many settings.[9]

9.5 Opportunities to build capacity

Tackling global kidney care is a challenging endeavor that requires joint efforts from multiple organizations, health care professionals, government agencies, and researchers. During the first ISN Global Kidney Policy Forum in Mexico in April 2018, the ISN identified 12 opportunities for global health and kidney care communities to collaboratively challenge global kidney health:

1. Work within current frameworks promoted by the WHO and the United Nations, such as the Sustainable Development Goals, the 2030 Agenda for Sustainable Development,[89] UHC,[90] and the life-course approach in the context of Health 2020,[91] to develop and implement policies to ensure integration and synergies for kidney disease prevention and treatment within existing initiatives.
2. Develop and implement public health policies to prevent or reduce risk factors for CKD in adults and children. These include strategies to promote maternal and child health and nutrition; reduce the burdens of diabetes, hypertension, obesity and tobacco consumption; promote safe work environments; and prevent infectious diseases.
3. Implement and support ongoing surveillance mechanisms to better understand and quantify the burdens of AKI and CKD within and outside the context of NCDs, specifically by developing robust national and regional registries for AKI, CKD, and ESKD.
4. Educate the public and at risk populations about kidney disease within NCD education campaigns.
5. Improve awareness of kidney disease among health care workers at all levels and ensure appropriate access to essential tools and medications required for diagnosis and treatment.
6. Work towards UHC to permit sustainable access to effective and affordable medication to treat risk factors for kidney disease and delay kidney disease (e.g., hypertension, diabetes, cardiovascular disease) and its progression.
7. Support education for a skilled nephrology workforce to implement prevention and treatment of kidney disease at all stages.
8. Implement early detection, prevention, and treatment strategies for AKI.
9. Integrate early evidence-based treatment for CKD, acknowledging important synergies with diabetes, hypertension, and cardiovascular disease.
10. Develop and implement transparent policies governing just and equitable access to kidney disease care, including dialysis and transplantation, according to international standards and to support, safe, ethical, affordable, and sustainable programs.
11. Promote and expand kidney transplantation programs within countries and across regions.
12. Support local, regional, and transnational research on kidney disease to advance understandings of prevention and treatment strategies.

The GKHA aims to align with the objectives and activities of the WHO, World Bank, and other stakeholder organizations which are already working to close the identified gaps in health care. Examples of where renal services could align include:

1. The WHO Triple Billion Target,[92] which aims to enhance primary health care to improve access to and quality of essential services. Strategies include: sustainable financing and financial protection; improving access to essential medicines and health products; ensuring an adequate workforce and providing advice on labor policies; refining national health policies; and enhancing surveillance systems to improve monitoring, data, and information.
2. The General Programme of Work (GPW) 13 Impact Framework,[93] which provides a strategic approach to tracking joint efforts by Member States, the WHO Secretariat, and partners to achieve the Sustainable Development Goals. The proposed 13th GPW is the WHO's five-year strategy outlining the mission, strategic priorities, and strategic and organizational shifts to achieve the health-related Sustainable Development Goals.
3. The Global Strategy on Human Resources for Health: Workforce 2030;[94]
4. The WHO Framework on integrated people-centered health care;[95]
5. The United Nations Sustainable Development Goals;[89]
6. The United Nations Children's Fund (UNICEF): Inequities in children/variations in care;[96] and
7. World Bank-led initiatives to support UHC.[97]

9.6 Conclusion

This iteration of the GKHA survey has revealed high variability in the delivery of ESKD care globally. Chronic HD services are offered in most countries; however, PD services are less available, particularly in low income countries. Similarly, transplantation is less available in low income countries and only one-third of countries in Africa offer transplantation. Among the 36% of countries that offer kidney transplantation, fewer than 10% of ESKD patients who are suitable candidates for transplants are able to access services. Overall, KRT is least accessible in South Asia, Africa, and OSEA. Ensuring adequate facilities and workforces to deliver high quality KRT is important, as is ensuring that these services are affordable to patients. Patients in only 43% of countries worldwide are not charged any fees at the point of KRT delivery.

The use of PD or conservative care for ESKD treatment should be encouraged where appropriate. PD is the preferred dialysis method in terms of patient convenience and cost; yet, among countries with PD available, only five reported PD as the initial treatment for most patients.

Although conservative care is available in many countries, such services are available in relatively few lower-middle or low income countries. Similarly, psychological, cultural, and spiritual support for patients receiving conservative care is limited in lower-middle and low income countries and only available in half of high income countries.

Lastly, nearly all countries reported significant workforce shortages, which dramatically impact the availability and quality of KRT care. Over 90% of low income countries have shortages of nephrologists, interventional radiologists, surgeons, and transplant coordinators.

The findings reported in this atlas reveal where efforts should be directed to improve global capacity to deliver high quality ESKD care; in particular, efforts should focus on increasing access to PD and conservative care. Furthermore, it is necessary to increase advocacy and develop policies, health information systems and detection programs to prevent ESKD.

Moving forward, efforts aimed at preventing

9.7 Future work

disease progression are critical to reducing the global burden of ESKD. Providing universal coverage for medications to treat common risk factors and manage complications is vital. Improving capacity for kidney transplantation by addressing workforce shortages, low organ supplies, high service costs, legalization limitations, and a lack of infrastructure is also important and may offset the costs of expensive KRT options such as HD.

Incorporating elements of CKD into existing national NCD strategies may help increase awareness of ESKD and provide direction on how to prevent and manage ESKD in a locally appropriate context. Policies around CKD and ESKD care (dialysis, transplantation, and conservative care) are necessary to drive these strategies, and governmental support may be achieved by demonstrating the devastating impact of ESKD on patients and the healthcare system. Lastly, utilizing effective and less costly treatment options such as PD or conservative care may allow for the provision of high-quality care for ESKD patients, particularly in resource-limited settings.

Overall, these strategies aim to include CKD and ESKD in worldwide initiatives to promote universal health care and chronic disease prevention. Due to the close link between kidney health and many other chronic NCDs, plenty of opportunities exist to ensure universal and equitable access to high quality kidney care for all.

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APPENDIX 1

SURVEY RESPONSE

Table A1.1 | Countries and population covered by survey responses

	Number of countries	Total population (millions)	Number of countries that completed survey	Total population of countries that completed survey (millions)
Overall	**218**	**7501.3**	**160**	**7338.5**
ISN region				
Africa	54	1263.7	42	1213.2
Eastern & Central Europe	21	215.2	19	209.2
Latin America	31	631.4	18	592.4
Middle East	13	243.7	11	213.6
NIS & Russia	10	276.8	10	276.8
North America	14	370.5	10	370.0
North & East Asia	7	1596.7	7	1596.7
OSEA	31	717.0	15	681.3
South Asia	8	1752.5	7	1752.2
Western Europe	29	433.7	21	433.1
World Bank income group				
Low income	30	655.9	23	585.3
Lower-middle income	50	2997.8	38	2941.3
Upper-middle income	58	2601.6	41	2569.3
High income	80	1246.0	58	1242.5

Table A1.2 | Disciplinary affiliation of survey respondents

	Nephrologists N (%)		Physicians (non-nephrologists) N (%)		Health professionals (non-physician) N (%)		Policymakers N (%)		Other[1] N (%)	
Overall	**260**	**(82)**	**22**	**(7)**	**7**	**(2)**	**17**	**(5)**	**11**	**(3)**
ISN region										
Africa	48	(76)	8	(13)	3	(5)	2	(3)	2	(3)
Eastern & Central Europe	32	(89)	1	(3)	0	(0)	2	(6)	1	(3)
Latin America	33	(85)	3	(8)	0	(0)	2	(5)	1	(3)
Middle East	26	(90)	1	(3)	1	(3)	1	(3)	0	(0)
NIS & Russia	11	(79)	0	(0)	1	(7)	2	(14)	0	(0)
North America	12	(71)	3	(18)	0	(0)	0	(0)	2	(12)
North & East Asia	20	(95)	1	(5)	0	(0)	0	(0)	0	(0)
OSEA	20	(95)	1	(5)	0	(0)	0	(0)	0	(0)
South Asia	12	(71)	3	(18)	0	(0)	0	(0)	2	(12)
Western Europe	29	(81)	1	(3)	1	(3)	2	(6)	3	(8)
World Bank income group										
Low income	24	(69)	8	(23)	2	(6)	1	(3)	0	(0)
Lower-middle income	62	(83)	3	(4)	3	(4)	4	(5)	3	(4)
Upper-middle income	70	(85)	5	(6)	0	(0)	5	(6)	2	(2)
High income	104	(83)	6	(5)	2	(2)	7	(6)	6	(5)

1 Other types of stakeholders (e.g., nurses, community health officers).

APPENDIX 2

LIST OF COUNTRIES

Table A2.1 | List of countries by ISN region and World Bank income group

Countries that participated in the survey are highlighted.

Country	ISN region	Income group
Afghanistan	South Asia	Low income
Albania	Eastern & Central Europe	Upper-middle income
Algeria	Africa	Upper-middle income
American Samoa	OSEA	Upper-middle income
Andorra	Western Europe	High income
Angola	Africa	Upper-middle income
Antigua and Barbuda	North America & the Caribbean	High income
Argentina	Latin America & the Caribbean	High income
Armenia	NIS & Russia	Lower-middle income
Aruba	Latin America & the Caribbean	High income
Australia	OSEA	High income
Austria	Western Europe	High income
Azerbaijan	NIS & Russia	Upper-middle income
Bahamas, The	North America & the Caribbean	High income
Bahrain	Middle East	High income
Bangladesh	South Asia	Lower-middle income
Barbados	North America & the Caribbean	High income
Belarus	NIS & Russia	Upper-middle income
Belgium	Western Europe	High income
Belize	Latin America & the Caribbean	Upper-middle income
Benin	Africa	Low income
Bermuda	North America & the Caribbean	High income
Bhutan	South Asia	Lower-middle income
Bolivia	Latin America & the Caribbean	Lower-middle income
Bosnia and Herzegovina	Eastern & Central Europe	Upper-middle income
Botswana	Africa	Upper-middle income
Brazil	Latin America & the Caribbean	Upper-middle income
British Virgin Islands	Latin America & the Caribbean	High income
Brunei Darussalam	OSEA	High income
Bulgaria	Eastern & Central Europe	Upper-middle income
Burkina Faso	Africa	Low income
Burundi	Africa	Low income
Cabo Verde	Africa	Lower-middle income
Cambodia	OSEA	Lower-middle income

Country	ISN region	Income group
Cameroon	Africa	Lower-middle income
Canada	North America & the Caribbean	High income
Cayman Islands	North America & the Caribbean	High income
Central African Republic	Africa	Low income
Chad	Africa	Low income
Channel Islands	Western Europe	High income
Chile	Latin America & the Caribbean	High income
China	North & East Asia	Upper-middle income
Colombia	Latin America & the Caribbean	Upper-middle income
Comoros	Africa	Low income
Congo, Dem. Rep.	Africa	Low income
Congo, Rep.	Africa	Lower-middle income
Costa Rica	Latin America & the Caribbean	Upper-middle income
Cote d'Ivoire	Africa	Lower-middle income
Croatia	Eastern & Central Europe	High income
Cuba	Latin America & the Caribbean	Upper-middle income
Curaçao	Latin America & the Caribbean	High income
Cyprus	Eastern & Central Europe	High income
Czech Republic	Eastern & Central Europe	High income
Denmark	Western Europe	High income
Djibouti	Africa	Lower-middle income
Dominica	Latin America & the Caribbean	Upper-middle income
Dominican Republic	Latin America & the Caribbean	Upper-middle income
Ecuador	Latin America & the Caribbean	Upper-middle income
Egypt, Arab Rep.	Africa	Lower-middle income
El Salvador	Latin America & the Caribbean	Lower-middle income
Equatorial Guinea	Africa	Upper-middle income
Eritrea	Africa	Low income
Estonia	Eastern & Central Europe	High income
Ethiopia	Africa	Low income
Faroe Islands	Western Europe	High income
Fiji	OSEA	Upper-middle income
Finland	Western Europe	High income
France	Western Europe	High income
French Polynesia	OSEA	High income
Gabon	Africa	Upper-middle income
Gambia, The	Africa	Low income
Georgia	NIS & Russia	Lower-middle income
Germany	Western Europe	High income
Ghana	Africa	Lower-middle income
Gibraltar	Western Europe	High income
Greece	Western Europe	High income
Greenland	Western Europe	High income
Grenada	Latin America & the Caribbean	Upper-middle income
Guam	OSEA	High income
Guatemala	Latin America & the Caribbean	Lower-middle income
Guinea	Africa	Low income
Guinea-Bissau	Africa	Low income
Guyana	Latin America & the Caribbean	Upper-middle income

Country	ISN region	Income group
Haiti	Latin America & the Caribbean	Low income
Honduras	Latin America & the Caribbean	Lower-middle income
Hong Kong SAR, China	North & East Asia	High income
Hungary	Eastern & Central Europe	High income
Iceland	Western Europe	High income
India	South Asia	Lower-middle income
Indonesia	OSEA	Lower-middle income
Iran, Islamic Rep.	Middle East	Upper-middle income
Iraq	Middle East	Upper-middle income
Ireland	Western Europe	High income
Isle of Man	Western Europe	High income
Israel	Western Europe	High income
Italy	Western Europe	High income
Jamaica	North America & the Caribbean	Upper-middle income
Japan	North & East Asia	High income
Jordan	Middle East	Upper-middle income
Kazakhstan	NIS & Russia	Upper-middle income
Kenya	Africa	Lower-middle income
Kiribati	OSEA	Lower-middle income
Korea, Dem. People's Rep.	OSEA	Low income
Korea, Rep.	North & East Asia	High income
Kosovo	Eastern & Central Europe	Lower-middle income
Kuwait	Middle East	High income
Kyrgyz Republic	NIS & Russia	Lower-middle income
Lao PDR	OSEA	Lower-middle income
Latvia	Eastern & Central Europe	High income
Lebanon	Middle East	Upper-middle income
Lesotho	Africa	Lower-middle income
Liberia	Africa	Low income
Libya	Africa	Upper-middle income
Liechtenstein	Western Europe	High income
Lithuania	Eastern & Central Europe	High income
Luxembourg	Western Europe	High income
Macao SAR, China	North & East Asia	High income
Macedonia, FYR	Eastern & Central Europe	Upper-middle income
Madagascar	Africa	Low income
Malawi	Africa	Low income
Malaysia	OSEA	Upper-middle income
Maldives	South Asia	Upper-middle income
Mali	Africa	Low income
Malta	Western Europe	High income
Marshall Islands	OSEA	Upper-middle income
Mauritania	Africa	Lower-middle income
Mauritius	Africa	Upper-middle income
Mexico	Latin America & the Caribbean	Upper-middle income
Micronesia, Fed. Sts.	OSEA	Lower-middle income
Moldova	Eastern & Central Europe	Lower-middle income
Monaco	Western Europe	High income
Mongolia	North & East Asia	Upper-middle income

Country	ISN region	Income group
Montenegro	Eastern & Central Europe	Upper-middle income
Morocco	Africa	Lower-middle income
Mozambique	Africa	Low income
Myanmar	OSEA	Lower-middle income
Namibia	Africa	Upper-middle income
Nauru	OSEA	Upper-middle income
Nepal	South Asia	Low income
Netherlands	Western Europe	High income
New Caledonia	OSEA	High income
New Zealand	OSEA	High income
Nicaragua	Latin America & the Caribbean	Lower-middle income
Niger	Africa	Low income
Nigeria	Africa	Lower-middle income
Northern Mariana Islands	OSEA	High income
Norway	Western Europe	High income
Oman	Middle East	High income
Pakistan	South Asia	Lower-middle income
Palau	OSEA	High income
Panama	Latin America & the Caribbean	Upper-middle income
Papua New Guinea	OSEA	Lower-middle income
Paraguay	Latin America & the Caribbean	Upper-middle income
Peru	Latin America & the Caribbean	Upper-middle income
Philippines	OSEA	Lower-middle income
Poland	Eastern & Central Europe	High income
Portugal	Western Europe	High income
Puerto Rico	Latin America & the Caribbean	High income
Qatar	Middle East	High income
Romania	Eastern & Central Europe	Upper-middle income
Russian Federation	NIS & Russia	Upper-middle income
Rwanda	Africa	Low income
Samoa	OSEA	Upper-middle income
San Marino	Western Europe	High income
São Tomé and Principe	Africa	Lower-middle income
Saudi Arabia	Middle East	High income
Senegal	Africa	Lower-middle income
Serbia	Eastern & Central Europe	Upper-middle income
Seychelles	Africa	High income
Sierra Leone	Africa	Low income
Singapore	OSEA	High income
Saint Maarten (Dutch part)	Latin America & the Caribbean	High income
Slovak Republic	Eastern & Central Europe	High income
Slovenia	Eastern & Central Europe	High income
Solomon Islands	OSEA	Lower-middle income
Somalia	Africa	Low income
South Africa	Africa	Upper-middle income
South Sudan	Africa	Low income
Spain	Western Europe	High income
Sri Lanka	South Asia	Lower-middle income
St. Kitts and Nevis	North America & the Caribbean	High income

Country	ISN region	Income group
St. Lucia	North America & the Caribbean	Upper-middle income
St. Martin (French part)	Latin America & the Caribbean	High income
St. Vincent and the Grenadines	North America & the Caribbean	Upper-middle income
Sudan	Africa	Lower-middle income
Suriname	Latin America & the Caribbean	Upper-middle income
Swaziland	Africa	Lower-middle income
Sweden	Western Europe	High income
Switzerland	Western Europe	High income
Syrian Arab Republic	Middle East	Lower-middle income
Taiwan, China	North & East Asia	High income
Tajikistan	NIS & Russia	Lower-middle income
Tanzania	Africa	Low income
Thailand	OSEA	Upper-middle income
Timor-Leste	OSEA	Lower-middle income
Togo	Africa	Low income
Tonga	OSEA	Upper-middle income
Trinidad and Tobago	North America & the Caribbean	High income
Tunisia	Africa	Upper-middle income
Turkey	Eastern & Central Europe	Upper-middle income
Turkmenistan	Eastern & Central Europe	Upper-middle income
Turks and Caicos Islands	North America & the Caribbean	High income
Tuvalu	OSEA	Upper-middle income
Uganda	Africa	Low income
Ukraine	NIS & Russia	Lower-middle income
United Arab Emirates	Middle East	High income
United Kingdom	Western Europe	High income
United States	North America & the Caribbean	High income
Uruguay	Latin America & the Caribbean	High income
Uzbekistan	NIS & Russia	Lower-middle income
Vanuatu	OSEA	Lower-middle income
Venezuela, RB	Latin America & the Caribbean	Upper-middle income
Vietnam	OSEA	Lower-middle income
Virgin Islands (U.S.)	North America & the Caribbean	High income
West Bank and Gaza	Middle East	Lower-middle income
Yemen	Middle East	Lower-middle income
Zambia	Africa	Lower-middle income
Zimbabwe	Africa	Low income

APPENDIX 3

GLOBAL KIDNEY HEALTH ATLAS (GKHA) QUESTIONNAIRE

Topical survey: Access to ESKD care

Country profiles of capacity for ESKD Care

The International Society of Nephrology (ISN) has been working collaboratively with existing organizations and initiatives at international and national levels to promote early detection and effective treatment of kidney diseases in order to improve patient health and quality of life. By understanding and potentially helping to shape relevant health policies, practices and infrastructure, the ISN aims to facilitate the implementation of equitable and ethical care for kidney patients in all regions and countries of the world.

The ISN has recently conducted a research exercise on the status of care for kidney patients across all countries of the world published in its Global Kidney Health Atlas (https://www.theisn.org/images/ISN_advocacy/GKHAtlas_Linked_Compressed1.pdf).

The GKHA demonstrated significant inter- and intra-regional variability in global kidney care, with significant gaps in kidney health workforce, health service delivery, essential medicines and technologies, health financing, leadership and governance, health information systems, strategies and policy frameworks, and research capacity and development, particularly in low and middle income countries. This has provided a platform for championing the cause of chronic kidney disease (CKD) using the identified gaps in Universal Healthcare domains, and has provided a foundation for a global CKD surveillance and benchmarking network.

This second iteration of the survey by the ISN is aimed at defining specifically the current global status of end-stage kidney disease (ESKD) care structures and organization. It will determine the capacity and readiness of nations towards achieving universal access to equitable integrated ESKD care (including kidney replacement therapy and conservative care).

This questionnaire is designed to address the core areas which inform aspects of universal health coverage specific to integrated ESKD care: health financing, workforce, essential medications and health products access, health information systems and statistics, policies, and service delivery. Using this framework, we will be able to develop an appropriate global perspective on the state of access to and quality of KRT and conservative care globally. Obtaining universal, complete and accurate responses is critical to closing the gaps that exist in kidney care globally.

Thank you for your involvement and readiness to participate.

Professor David Harris
President International Society of Nephrology

Contact

Survey ID:

Status? *Please tick all that apply.*

☐ Nephrologist
☐ Non-nephrologist (physician)
☐ Health professional (non-physician)
☐ Administrator/policymaker/civil servant
☐ Other (please specify)

In which country do you reside?

In which city do you reside?

In which ISN region do you reside?

How did you gather the information to complete this questionnaire?
Please check all that apply.

☐ Personal opinion/knowledge
☐ Gathered knowledge from other sources (for example, published literature or reports)
☐ Consultation with other colleagues
☐ Other (please specify)

Topical survey: Access to End-stage Kidney Disease (ESKD) Care

A. Health finance and service delivery

A1. Healthcare system and funding mechanism

A1.1. In general, what best describes your healthcare system funding structure for non-dialysis CKD (Chronic Kidney Disease)? (please choose the most appropriate response)

- ☐ Publicly funded by government and free at the point of delivery
- ☐ Publicly funded by government but with some fees at the point of delivery
- ☐ A mix of publicly funded (whether or not publicly funded component is free at point of delivery) and private systems (please explain)
- ☐ Solely private and out-of-pocket
- ☐ Solely private through health insurance providers
- ☐ Multiple systems – programs provided by government, NGOs, and communities
- ☐ Other (please specify)

A1.2. In general, what best describes your healthcare system funding structure for KRT (renal replacement therapy)? (please choose the most appropriate response)

- ☐ Publicly funded by government and free at the point of delivery
- ☐ Publicly funded by government but with some fees at the point of delivery
- ☐ A mix of publicly funded (whether or not publicly funded component is free at point of delivery) and private systems (please explain)
- ☐ Solely private and out-of-pocket
- ☐ Solely private through health insurance providers
- ☐ Multiple systems – programs provided by government, NGOs, and communities
- ☐ N/A (KRT is not available in my country)
- ☐ Other (please specify)

A1.2.1. If KRT is publicly funded (in whole or in part), is this coverage universal (that is, are all residents of your country eligible to participate)?

- ☐ Yes, all residents are included in the coverage
- ☐ No, not all residents are included (please provide details)

A1.2.2. If KRT is publicly funded (in whole or in part), which aspects of care are not included in the coverage? Please check all that apply.

- ☐ Dialysis
- ☐ Transplantation
- ☐ Comprehensive conservative care (renal palliative supportive services)
- ☐ Management of associated complications (anaemia, bone disease, malnutrition)
- ☐ None – all aspects funded
- ☐ Other (please specify)

A1.3. What best describes your healthcare system's coverage for surgical services for KRT? (please choose the most appropriate response for each row)

	Publicly funded by government and free at the point of delivery	Publicly funded by government but with some fees at the point of delivery	A mix of publicly funded (whether or not publicly funded component is free at point of delivery) and private systems (please explain)	Solely private and out-of-pocket	Solely private through health insurance providers	Multiple systems – programs provided by government, NGOs, and communities	Other (please specify)	N/A (KRT is not available in my country)
A1.3.1 Vascular access for haemodialysis (central venous catheters)								
A1.3.2 Vascular access for haemodialysis (fistula or graft creation)								
A1.3.3 Access surgery for peritoneal dialysis (PD catheter insertion)								
A1.3.4 Surgery for kidney transplantation								

A2. Within-country variation

We are interested in understanding within-country variation in ESKD care delivery as well as between-country variation.

A2.1. Does organization or delivery of ESKD (End-stage Kidney Disease) care differ regionally within your country?

☐ Yes (if possible, please provide brief details) ☐ No ☐ Unknown

A2.2. Does organization or delivery of ESKD care differ between children and adults in your country?

☐ Yes (if possible, please provide brief details) ☐ No ☐ Unknown

A2.3. Does the access to KRT differ between children and adults in your country?

☐ Yes (if possible, please provide brief details) ☐ No ☐ Unknown

A2.3.1 If KRT services are not equal between adults and children, what is the difference in access to haemodialysis?

A2.3.2 If KRT services are not equal between adults and children, what is the difference in access to peritoneal dialysis?

A2.3.3 If KRT services are not equal between adults and children, what is the difference in access to kidney transplant?

A3. Oversight

A3.1. What best describes the management/oversight of ESKD care in your country? Please check all that apply.

☐ Managed/overseen by a national body
☐ Managed/overseen by provincial/regional/state level authorities only
☐ Managed by individual hospitals/trusts/organizations
☐ Managed by NGOs
☐ Other (please specify)
☐ No organized system

B. Health workforce for nephrology care

B1. Clinical responsibility

B1.1. Who bears primary clinical responsibility for the delivery of ESKD care in your country? Please check all that apply.

- ☐ Nephrologists
- ☐ Primary care physicians
- ☐ Nurse practitioners or specialized nurses
- ☐ Multidisciplinary teams
- ☐ Health officers/extension workers
- ☐ Other (please specify)

B2. Workforce

B2.1. Approximately how many nephrologists are there in your country? Please leave blank if unknown.

B2.2. Approximately how many nephrologist trainees are there in your country?Click or tap here to enter text. Please leave blank if unknown.

B2.3. In your opinion, is there a shortage of any of the following providers in your country for ESKD care? Please check all that apply.

- ☐ Nephrologists
- ☐ Transplant surgeons
- ☐ Surgeons (who can put in arteriovenous haemodialysis access)
- ☐ Surgeons (who can put in peritoneal dialysis access)
- ☐ Interventional radiologists (who can put in arteriovenous haemodialysis access)
- ☐ Interventional radiologists (who can put in peritoneal dialysis access)
- ☐ Dietitians
- ☐ Laboratory technicians
- ☐ Radiologists to conduct and interpret renal ultrasounds
- ☐ Vascular access coordinators
- ☐ Counsellors/psychologists
- ☐ Transplant coordinators
- ☐ Dialysis nurses
- ☐ Dialysis technicians
- ☐ No shortage of any of the staff mentioned above

C. Essential medications and health product access for ESKD care

C1.1. Is chronic haemodialysis (adult and paediatric) available in your country?

☐ Yes ☐ No

C1.1.1. If yes, how many centres in your country provide chronic haemodialysis (HD)?
Number of centres:

C1.2. Is chronic peritoneal dialysis (PD) (adult and paediatric) available in your country?

☐ Yes ☐ No

C1.2.1 If yes, how many centres in your country provide chronic PD?
Number of centres:

C1.3. Is kidney transplantation performed in your country?

☐ Yes ☐ No

C1.3.1. If yes, what is the source of donated kidneys? (please choose the most appropriate response)

- ☐ Deceased donors only
- ☐ Live donors only
- ☐ A combination of deceased and live donors

If kidneys for transplant come from both deceased and live donors, what percentage are live?

C1.3.2. If kidney transplantation is available in your country, what kind of kidney transplant waitlist or waitlists are there?

☐ National ☐ Regional only ☐ None

C1.3.3. If kidney transplantation is available in your country, how many centres perform kidney transplantation?

Number of centres:

C2. Preparation for KRT

Optimal ESKD care: In the context of the ISN Vision, Mission and Values, we believe all patients approaching ESKD should receive timely preparation for KRT, so the complications and progression of their disease are minimized, and their choice of clinically appropriate treatment options is optimized. The answers to the following questions are important to improve our understanding of current service provision.

C2.1. Please indicate the availability of the following services (tests and treatments) for ESKD care in your country, where 'Generally available' means: in 50% or more centers (hospitals or clinics) and 'Generally not available' means: in less than 50% of centres (hospitals or clinics)

	Generally available	Generally not available	Never	Unknown
Management of haemoglobin level				
C2.1.1 Measurement of serum haemoglobin				
C2.1.2 Measurement of iron parameters (iron, ferritin, transferrin saturation)				
C2.1.3 Measurement of inflammatory markers (for example, serum C-reactive protein)				
C2.1.4 Oral iron				
C2.1.5 Parenteral iron				
C2.1.6 Erythropoietin				
Management of renal bone disease				
C2.1.7 Measurement of serum calcium				
C2.1.8 Measurement of serum phosphorus				
C2.1.9 Measurement of serum parathyroid hormone				
C2.1.10 Calcium-based phosphate binders				
C2.1.11 Non-calcium-based phosphate binders (for example, sevelamer)				
C2.1.12 Cinacalcet				
C2.1.13 Surgical services for parathyroidectomy				
Management of electrolyte disorders and chronic metabolic acidosis				
C2.1.14 Measurement of serum electrolytes (sodium, potassium, chloride, etc.)				
C2.1.15 Measurement of serum bicarbonate				
C2.1.16 Potassium exchange resins (for example, Kayexalate)				
C2.1.17 Oral sodium bicarbonate				
Management of blood pressure				
C2.1.18 Analogue BP monitoring				
C2.1.19 Automated BP monitoring				

C3. Nutritional services

C3.1. Please indicate the availability of the following nutritional services for kidney care in your country, where 'Generally available' means: in 50% or more centers (hospitals or clinics) and 'Generally not available' means: in less than 50% of centres (hospitals or clinics)

	Generally available	Generally not available	Never	Unknown
Nutritional Services				
C.3.1.1 Dietary counselling by a person trained in nutrition (for example, a dietitian)				
C3.1.2 Measurement of serum albumin				
C3.1.3 Use of anthropometry for nutritional assessment (changes in body weight)				
C3.1.4 Use of anthropometry for nutritional assessment (skin fold assessment)				
C3.1.5 Use of anthropometry for nutritional assessment (body mass index)				
C3.1.6 Oral nutrition supplements (for example, vitamins, oral meal supplements)				

C4. Dialysis treatment – Quality and Choice

C4.1. Please indicate the availability of the following services for dialysis care in your country, where 'Generally available' means: in 50% or more centres (hospitals or clinics) and 'Generally not available' means: in less than 50% of centres (hospitals or clinics).

	Generally available	Generally not available	Never	Unknown	N/A (dialysis not provided)
Modality choice					
C4.1.1 Haemodialys					
C4.1.2 Peritoneal dialysis					
Quality					
C4.1.3 Centre-based haemodialysis service of adequate frequency (treatment three times a week for three or four hours)					
C4.1.4 Home haemodialysis					
C4.1.5 Peritoneal dialysis exchanges of adequate frequency (3–4 per day or equivalent cycles on automated PD)					
C4.1.6 Determination of the effectiveness of peritoneal dialysis (that is, by measurement of urea reduction ratio [URR] and/or Kt/V)					
C4.1.7 Affordable patient transport services					

C5. Transplant – Quality & Choice

Transplant choice: In the context of the ISN Vision, Mission and Values, we believe all patients with kidney transplant are to receive a high-quality service which supports them in managing their transplant and enables them to achieve the best possible quality of life. The answers to the following questions are important to improve our understanding of current service provision.

C5.1 Please indicate the availability of the following services for transplantation services in your country, where 'Generally available' means: in 50% or more centres (hospitals or clinics) and 'Generally not available' means: in less than 50% of centres (hospitals or clinics).

If transplantation is NOT available in your country, select N/A.

	Generally available	Generally not available	Never	Unknown	N/A (transplantation not available)
C5.1.1 Early provision of culturally appropriate information to patients, relatives and caregivers about the risks and benefits of transplantation with a clear explanation of tests, procedures and results					
C5.1.2 Effective preventive therapy to control infections (for example, antivirals, antifungals, etc.)					
C5.1.3 Timely access to operating space for kidney transplantation					
C5.1.4 Appropriate immunosuppression and anti-rejection treatment					
C5.1.5 Appropriate facilities to monitor administration of immunosuppression drugs					
C5.1.6 Multidisciplinary team to support patients with a renal transplant					
C5.1.7 Standard framework for organ procurement (for example, legislation around brain death)					

C6. Conservative care

Conservative (non-dialytic) kidney care: Comprehensive conservative care is defined as planned, holistic, patient-centred care for patients with CKD stage 5, according to Kidney Disease: Improving Global Outcomes (KDIGO). This is appropriate for patients who choose not to initiate RRT or in whom resource constraints prevent or limit access to RRT.

We would like to know more about the capacity to deliver conservative care in your country (that is, capacity to support/manage patients who will not receive RRT despite being in kidney failure).

The goals of conservative care are usually to optimize quality of life, manage symptoms of kidney failure, and when appropriate, preserve residual renal function in patients with advanced CKD (CKD stage 5).

C6.1. Considering the definition above, is conservative care available in your country?

☐ Yes ☐ No ☐ Unknown

C6.2 Please indicate the availability of a system for conservative care (holistic patient-centred care for patients with CKD stage 5) that includes all or any of the following:

'Generally available' means: in 50% or more centres (hospitals or clinics) and 'Generally not available' means: in less than 50% of centres (hospitals or clinics).

If conservative care is NOT available in your country, select N/A.

	Generally available	Generally not available	Never	Unknown	N/A (conservative care not available)
C6.2.1 Established choice-restricted conservative care (conservative care for patients in whom resource constraints prevent or limit access to KRT)					
C6.2.2 Established conservative care that is chosen or medically advised (conservative care program for patients who opted not to have dialysis, where it is readily available)					
C6.2.3 Multidisciplinary team approach to care via shared decision making					
C6.2.4 Shared decision-making tools for patients and providers; for example, practice guidelines for providers, patient decision aids					
C6.2.5 Systematic active recognition and management of symptoms associated with advanced kidney failure					
C6.2.6 Systematic provision of psychological, cultural, and spiritual support					
C6.2.7 Systematic provision to care providers of additional training in conservative care					
C6.2.8 Easy access to conservative care across settings (for example, home, hospital, hospice, and nursing home)					

C7. Essential medications and technologies for KRT – Accessibility, affordability and reimbursement plans and quality

Medication funding and reimbursement plans in KRT patients

C7.1. For all dialysis patients, how are medications funded? (please choose most appropriate response). If dialysis is not available in your country, please do not answer this question.

- ☐ Publicly funded by government and free at the point of delivery
- ☐ Publicly funded by government but with some fees at the point of delivery
- ☐ A mix of publicly funded (whether or not publicly funded component is free at point of delivery) and private systems (please specify)
- ☐ Solely private and out-of-pocket
- ☐ Solely private through health insurance providers
- ☐ Multiple systems – programs provided by government, NGOs, and communities
- ☐ Other (please specify)

C7.2. For all transplant patients, how are medications funded? (please choose most appropriate response). If transplantation is not available in your country, please do not answer this question.

- ☐ Publicly funded by government and free at the point of delivery
- ☐ Publicly funded by government but with some fees at the point of delivery
- ☐ A mix of publicly funded (whether or not publicly funded component is free at point of delivery) and private systems (please specify)
- ☐ Solely private and out-of-pocket
- ☐ Solely private through health insurance providers
- ☐ Multiple systems – programs provided by government, NGOs, and communities
- ☐ Other (please specify)

C8. Affordability

C8.1. What is the national average co-payment (including medications but no other ancillaries) for haemodialysis patients in your country (that is, the proportion of the treatment cost paid for directly (out-of-pocket) by the patient?

- ☐ N/A (not available in my country)
- ☐ 0%
- ☐ 1–25%
- ☐ 26–50%
- ☐ 51–75%
- ☐ >75%
- ☐ 100%

C8.1.1 Does this proportion vary in different parts of the country?

- ☐ Yes (please explain below)
- ☐ No
- ☐ N/A (not available in my country)
- ☐ Other (please explain below)

C8.1.2. Does this proportion vary depending on patients' characteristics (for example, age, gender, employment status)?

- ☐ Yes (please explain below)
- ☐ No
- ☐ N/A (not available in my country)
- ☐ Other (please explain below)

C8.2. What is the national average co-payment (including medications but no other ancillaries) for peritoneal dialysis patients in your country, that is, the proportion of the treatment cost paid for directly (out-of-pocket) by the patient?

- ☐ N/A (not available in my country)
- ☐ 0%
- ☐ 1–25%
- ☐ 26–50%
- ☐ 51–75%
- ☐ >75%
- ☐ 100%

C8.2.1. Does this proportion vary in different parts of the country?

- ☐ Yes (please explain below)
- ☐ No
- ☐ N/A (not available in my country)
- ☐ Other (please explain below)

C8.2.2. Does this proportion vary depending on patients' characteristics (for example, age, gender, employment status)?

- ☐ Yes (please explain below)
- ☐ No
- ☐ N/A (not available in my country)
- ☐ Other (please explain below)

C8.3. What is the national average co-payment (including medications but no other ancillaries) for kidney transplant patients in your country, that is, the proportion of the treatment cost paid for directly (out-of-pocket) by the patient?

- ☐ N/A (not available in my country)
- ☐ 0%
- ☐ 1–25%
- ☐ 26–50%
- ☐ 51–75%
- ☐ >75%
- ☐ 100%

C8.3.1. Does this proportion vary in different parts of the country?

☐ Yes (please explain below)
☐ No
☐ N/A (not available in my country)
☐ Other (please explain below)

C8.3.2. Does this proportion vary depending on patients' characteristics (for example, age, gender, employment status)?

☐ Yes (please explain below)
☐ No
☐ N/A (not available in my country)
☐ Other (please explain below)

Accessibility

C8.4 What proportion (national average) of patients with ESKD are able to access dialysis in your country?

☐ 0% (not available in my country)
☐ 1–10%
☐ 11–25%
☐ 26–50%
☐ >50%

C8.4.1. Does this proportion vary in different parts of the country?

☐ Yes (please explain below)
☐ No
☐ N/A (not available in my country)
☐ Other (please explain below)

C8.4.2. Does this proportion vary depending on patients' characteristics (for example, age, gender, employment status)?

☐ Yes (please explain below)
☐ No
☐ N/A (not available in my country)
☐ Other (please specify)

C8.5. Out of those patients in your country who have ESKD and are able to access dialysis, what proportion usually start with peritoneal dialysis?

☐ N/A – dialysis (of any kind) is not available in my country
☐ 0% (means that there are patients who are able to access some form of dialysis, but none of them start with PD)
☐ 1–10%
☐ 11–25%
☐ 26–50%
☐ >50%

C8.5.1. Does this proportion vary in different parts of the country?

☐ Yes (please explain below)
☐ No
☐ N/A (not available in my country)
☐ Other (please specify)

C8.5.2. Does this proportion vary depending on patients' characteristics (for example, age, gender, employment status)?

☐ Yes (please explain below)
☐ No
☐ N/A (not available in my country)
☐ Other (please specify)

C8.6. Out of those patients in your country who have ESKD and are suitable for transplant, what proportion are able to access kidney transplantation?

☐ 0% (not available in my country)
☐ 1–10%
☐ 11–25%
☐ 26–50%
☐ >50%

C8.6.1. Does this proportion vary in different parts of the country?

☐ Yes (please explain below)
☐ No
☐ N/A (not available in my country)
☐ Other (please specify)

C8.6.2. Does this proportion vary depending on patients' characteristics (for example, age, gender, employment status)?

☐ Yes (please explain below)
☐ No
☐ N/A (not available in my country)
☐ Other (please specify)

C9. Peritoneal Dialysis Quality

If peritoneal dialysis is available in your country, what proportion of centres routinely measure and report the following to assess the quality of the dialysis that is provided? If peritoneal dialysis is not available in your country, skip this section.

C9.1. Patient-reported outcome measures (for example, fatigue, quality of life, satisfaction, pain):

☐ 0% (None)
☐ 1–10% (Few)
☐ 11–50% (Some)
☐ 51–75% (Most)
☐ >75% (Almost all)

C9.2. Blood pressure:

☐ 0% (None)
☐ 1–10% (Few)
☐ 11–50% (Some)
☐ 51–75% (Most)
☐ >75% (Almost all)

C9.3. Small solute clearance (for example, Kt/V or creatinine clearance):

☐ 0% (None)
☐ 1–10% (Few)
☐ 11–50% (Some)
☐ 51–75% (Most)
☐ >75% (Almost all)

C9.4. Haemoglobin/haematocrit:

☐ 0% (None)
☐ 1–10% (Few)
☐ 11–50% (Some)
☐ 51–75% (Most)
☐ >75% (Almost all)

C9.5. Bone mineral markers (calcium, phosphate, parathyroid hormone [PTH]):

☐ 0% (None)
☐ 1–10% (Few)
☐ 11–50% (Some)
☐ 51–75% (Most)
☐ >75% (Almost all)

C9.6. Technique survival:

☐ 0% (None)
☐ 1–10% (Few)
☐ 11–50% (Some)
☐ 51–75% (Most)
☐ >75% (Almost all)

C9.7. Patient survival:

☐ 0% (None)
☐ 1–10% (Few)
☐ 11–50% (Some)
☐ 51–75% (Most)
☐ >75% (Almost all)

C10. Haemodialysis quality

If haemodialysis is available in your country, what proportion of centres routinely measure and report the following to assess the quality of the dialysis that is provided? If haemodialysis is not available in your country, skip this section.

C10.1. Patient-reported outcome measures (for example, fatigue, quality of life, satisfaction, pain, etc.):

☐ 0% (None)
☐ 1–10% (Few)
☐ 11–50% (Some)
☐ 51–75% (Most)
☐ >75% (Almost all)

C10.2. Blood pressure:

☐ 0% (None)
☐ 1–10% (Few)
☐ 11–50% (Some)
☐ 51–75% (Most)
☐ >75% (Almost all)

C10.3. Small solute clearance (for example, Kt/V or creatinine clearance):

☐ 0% (None)
☐ 1–10% (Few)
☐ 11–50% (Some)
☐ 51–75% (Most)
☐ >75% (Almost all)

C10.4. Haemoglobin/haematocrit:

☐ 0% (None)
☐ 1–10% (Few)
☐ 11–50% (Some)
☐ 51–75% (Most)
☐ >75% (Almost all)

C10.5. Bone mineral markers (calcium, phosphate, PTH):

☐ 0% (None)
☐ 1–10% (Few)
☐ 11–50% (Some)
☐ 51–75% (Most)
☐ >75% (Almost all)

C10.6. Technique survival:

☐ 0% (None)
☐ 1–10% (Few)
☐ 11–50% (Some)
☐ 51–75% (Most)
☐ >75% (Almost all)

C10.7. Patient survival:

☐ 0% (None)
☐ 1–10% (Few)
☐ 11–50% (Some)
☐ 51–75% (Most)
☐ >75% (Almost all)

C11. Kidney Transplantation Quality

If kidney transplantation is available in your country, what proportion of centres routinely measure and report the following to assess the quality of the transplantation that is provided? If transplantation is not available in your country, skip this section.

C11.1. Patient-reported outcome measures (for example, fatigue, quality of life, satisfaction, pain, etc.):

☐ 0% (None)
☐ 1–10% (Few)
☐ 11–50% (Some)
☐ 51–75% (Most)
☐ >75% (Almost all)

C11.2. Delayed graft function:

☐ 0% (None)
☐ 1–10% (Few)
☐ 11–50% (Some)
☐ 51–75% (Most)
☐ >75% (Almost all)

C11.3. Rejection rates:

☐ 0% (None)
☐ 1–10% (Few)
☐ 11–50% (Some)
☐ 51–75% (Most)
☐ >75% (Almost all)

C11.4. Renal allograft function:

☐ 0% (None)
☐ 1–10% (Few)
☐ 11–50% (Some)
☐ 51–75% (Most)
☐ >75% (Almost all)

C11.5. Graft survival:

☐ 0% (None)
☐ 1–10% (Few)
☐ 11–50% (Some)
☐ 51–75% (Most)
☐ >75% (Almost all)

C11.6. Patient survival:

☐ 0% (None)
☐ 1–10% (Few)
☐ 11–50% (Some)
☐ 51–75% (Most)
☐ >75% (Almost all)

C12. Access

Access for haemodialysis – answer only if haemodialysis is available in your country.

C12.1. For haemodialysis, what proportion of patients routinely start dialysis with a functioning vascular access (AV fistula or graft):

☐ 0% (None)
☐ 1–10% (Few)
☐ 11–50% (Some)
☐ 51–75% (Most)
☐ >75% (Almost all)

C12.2. For haemodialysis, what proportion of patients routinely start dialysis with a tunnelled dialysis catheter:

☐ 0% (None)
☐ 1–10% (Few)
☐ 11–50% (Some)
☐ 51–75% (Most)
☐ >75% (Almost all)

C12.3. For haemodialysis, what proportion of patients commonly start dialysis with a temporary dialysis catheter:

☐ 0% (None)
☐ 1–10% (Few)
☐ 11–50% (Some)
☐ 51–75% (Most)
☐ >75% (Almost all)

Access for all dialysis – answer only if haemodialysis or peritoneal dialysis is available in your country

C12.4. For either haemodialysis or peritoneal dialysis, what proportion of patients routinely receive education about the best means of access and timely surgery (for example, six months before start of haemodialysis, one month before start of peritoneal dialysis):

☐ 0% (None)
☐ 1–10% (Few)
☐ 11–50% (Some)
☐ 51–75% (Most)
☐ >75% (Almost all)

D. Health information systems and statistics

D1. Registries

Definitions/abbreviations:

Registry: A systematic collection of data to evaluate specified outcomes for a defined population in order to serve one or more predetermined scientific, clinical, or policy purposes.

AKI: Acute Kidney Injury

D1.1. For which conditions or treatments is there an 'official' registry in your country?

D1.1.1 CKD (non-KRT)	☐ Yes	☐ No	☐ Unknown
D1.1.2 Dialysis	☐ Yes	☐ No	☐ Unknown
D1.1.3 Transplantation	☐ Yes	☐ No	☐ Unknown
D1.1.4 AKI	☐ Yes	☐ No	☐ Unknown

D1.2. If there is a CKD registry for patients who do not require KRT, what is the basis of participation in the CKD registry?

☐ Voluntary ☐ Mandatory ☐ Unknown

D1.3. If there is a CKD registry for patients who do not require KRT, what is the geographical coverage of the CKD registry? (please check all that apply)

☐ National ☐ Regional/state/provincial ☐ Local/hospital/community

D1.4. If there is a CKD registry for patients who do not require KRT, what does it cover? (please check all that apply)

☐ The whole spectrum of CKD (stages 1–5) ☐ Advanced CKD only (stages 4/5)

D1.5. If there is a dialysis registry, what is the basis of participation in the dialysis registry?

☐ Voluntary ☐ Mandatory ☐ Unknown

D1.6. If there is a dialysis registry, what is the geographical coverage of the dialysis registry? (please check all that apply)

☐ National ☐ Regional/state/provincial ☐ Local/hospital/community

D1.7. If there is a dialysis registry, what information does the dialysis registry collate? (please check all that apply)

☐ Aetiology of ESKD
☐ Modality of dialysis
☐ Process-based measures (anaemia, bone disease, BP control markers)
☐ Patient outcome measures (hospitalizations)
☐ Patient outcome measures (for example, satisfaction, quality of life)
☐ Patient outcome measures (mortality)

D1.8. If there is a transplantation registry, what is the basis of participation in the transplant registry?

☐ Voluntary ☐ Mandatory ☐ Unknown

D1.9. If there is a transplantation registry, what is the geographical coverage of the transplant registry? (please check all that apply)

☐ National ☐ Regional/state/provincial ☐ Local/hospital/community

D1.10. If there is a transplantation registry, what information does the transplant registry collate? (please check all that apply)

☐ Aetiology of ESKD
☐ Transplant source (deceased/live donor)
☐ Process-based measures (anaemia, bone disease, BP control markers)
☐ Patient outcome measures (hospitalizations)
☐ Patient outcome measures (for example, satisfaction, quality of life)
☐ Patient outcome measures (mortality)

D1.11. If there is an AKI registry, what is the basis of participation in the AKI registry?

☐ Voluntary ☐ Mandatory ☐ Unknown

D1.12. If there is an AKI registry, what is the geographical coverage of the AKI registry? (please check all that apply)

☐ National ☐ Regional/state/provincial ☐ Local/hospital/community

D1.13. If there is an AKI registry, what information does the AKI registry collate? (please check all that apply)

☐ Risk factors for AKI
☐ Aetiology of AKI
☐ Incidence of AKI
☐ Patient outcome measures (hospitalizations)
☐ Patient outcome measures (requirement for KRT, for example, dialysis or slow dialysis therapies like CRRT)
☐ Patient outcome measures (mortality)

D2. Identification of disease (AKI and CKD)

Definitions:

Guidelines: Evidence-based recommended courses of action for prevention or management of disease.

Identification: Measures performed in at-risk populations in order to diagnose individuals who have risk factors or early stages of disease but may not yet have symptoms.

Policy: A specific official decision or set of decisions designed to carry out a course of action endorsed by a government body; including a set of goals, priorities and main directions for attaining these goals. The policy document may include a strategy to give effect to the policy.

Program: A planned set of activities or procedures directed at a specific purpose.

D2.1. For which of the following high-risk groups do practitioners in your country routinely offer testing for CKD? (please check all that apply)

- ☐ Those with hypertension
- ☐ Those with diabetes
- ☐ Those with cardiovascular disease (ischaemic heart disease, stroke, peripheral vascular disease, heart failure)
- ☐ Those with autoimmune/multisystem diseases (systemic lupus erythematosus, rheumatoid arthritis)
- ☐ The elderly
- ☐ Those with urological disorders (structural, stone diseases)
- ☐ Chronic users of nephrotoxic medications
- ☐ Members of high-risk ethnic groups (Aboriginal, African, Indo-Asian)
- ☐ Those with a family history of CKD
- ☐ N/A – routine testing for CKD not offered

D2.2. In your country, are there ethnic groups considered to be at increased risk for CKD?

☐ Yes (please specify below) ☐ No ☐ Unknown

D2.3. In your country, is there a CKD detection program in use that is based on national policy or guidelines?

☐ Yes ☐ No ☐ Unknown

D2.3.1 If there is a program, how is it implemented (please check all that apply):

- ☐ Reactive approach – cases managed as identified through practice
- ☐ Active screening of at-risk population through routine health encounters
- ☐ Active screening of at-risk population through specific screening processes
- ☐ Other (please specify)

D2.4. In your country, are there specific groups considered to be at increased risk for AKI?

☐ Yes (please specify below) ☐ No ☐ Unknown

D2.5. In your country, is an AKI detection program in use that is based on national policy and/or guidelines?

☐ Yes ☐ No ☐ Unknown

D2.5.1 If there is a program, how is this program implemented? (please check all that apply):

- ☐ Reactive approach – cases managed as identified through practice
- ☐ Active screening of at-risk population through routine health encounters
- ☐ Active screening of at-risk population through specific screening processes
- ☐ Other (please specify)

E. National health policy

Definitions:

Policy: A specific official decision or set of decisions designed to carry out a course of action endorsed by a government body; including a set of goals, priorities and main directions for attaining these goals. The policy document may include a strategy to give effect to the policy.

Program: A planned set of activities or procedures directed at a specific purpose.

Strategy: A long-term plan designed to achieve a particular goal.

E1. Policy and strategy

Non-communicable diseases (NCDs): Diseases that cannot be transmitted from person to person, notably cardiovascular diseases (like heart attacks and stroke), cancers, chronic respiratory diseases (such as chronic obstructive pulmonary disease and asthma) and diabetes.

E1.1. Does your country have a national strategy for non-communicable diseases?

- ☐ Yes, in place (please provide details below)
- ☐ Under development but not yet being implemented (please provide details below)
- ☐ No
- ☐ Unknown

E1.2. Does your country have a national strategy for improving the care of CKD patients?

- ☐ Yes, a national CKD-specific strategy exists
- ☐ Yes, but the CKD strategy is incorporated into an NCD strategy that includes other diseases.
- ☐ No
- ☐ Unknown

E1.2.1 Please select which populations are covered in the national CKD-specific strategy (check all that apply)

- ☐ Non-dialysis dependent CKD
- ☐ Chronic dialysis
- ☐ Kidney transplantation

E1.2.2 Please select which populations are covered in the national general NCD strategy (check all that apply)

- ☐ Non-dialysis dependent CKD
- ☐ Chronic dialysis
- ☐ Kidney transplantation

E1.3. Are CKD-specific policies available?

- ☐ Yes
- ☐ No
- ☐ Unknown

E1.3.1 If yes, please specify which type of CKD policies are available in your country (check all that apply)

- ☐ National policies
- ☐ Regional policies

E2. Advocacy

E2.1. In your opinion, is CKD recognized as a health priority by the government in your country?

☐ Yes (please provide details below) ☐ No (please explain why not below)

E2.2. Is there an advocacy group at the higher levels of government (for example, a parliamentary committee) or an NGO to raise the profile of CKD and its prevention?

☐ Yes (please provide details below) ☐ Unknown

☐ No (please explain why not below)

E2.3. In your opinion, is AKI and/or its prevention recognized as a health priority by the government in your country?

☐ Yes (please provide details below) ☐ No (please explain why not below)

E2.4. Is there an advocacy group at the higher levels of government (for example, a parliamentary committee) or an NGO to raise the profile of AKI and its prevention?

☐ Yes (please provide details below) ☐ Unknown

☐ No (please explain why not below)

E2.5. In your opinion, is ESKD and/or its treatment by KRT recognized as a health priority by the government in your country?

☐ Yes (please provide details below) ☐ No (please explain why not below)

E2.6. Is there an advocacy group at the higher levels of government (for example, a parliamentary committee) or an NGO to raise the profile of ESKD/KRT?

☐ Yes (please provide details below) ☐ Unknown

☐ No (please explain why not below)

E2.7. Are there existing national/regional physician-oriented organizations or patient organizations that provide resources for ESKD care?

☐ Yes (please provide details below) ☐ Unknown

☐ No (please explain why not below)

E3. Barriers to optimal ESKD care

E3.1. Are there specific barriers to optimal ESKD care in your country? Please check all that apply.

☐ Geography (distance from care or prolonged travel time)

☐ Physician (availability, access, knowledge, attitude)

☐ Patient (knowledge, attitude)

☐ Nephrologist (availability)

☐ Healthcare system (availability, access, capability)

☐ Lack of political will and enabling policies

☐ Economic factors (limited funding, poor reimbursement mechanisms)

☐ Other (please specify)

☐ None

APPENDIX 4

SURVEY RESPONDENTS

Table A4.1 | Survey respondents, by ISN region

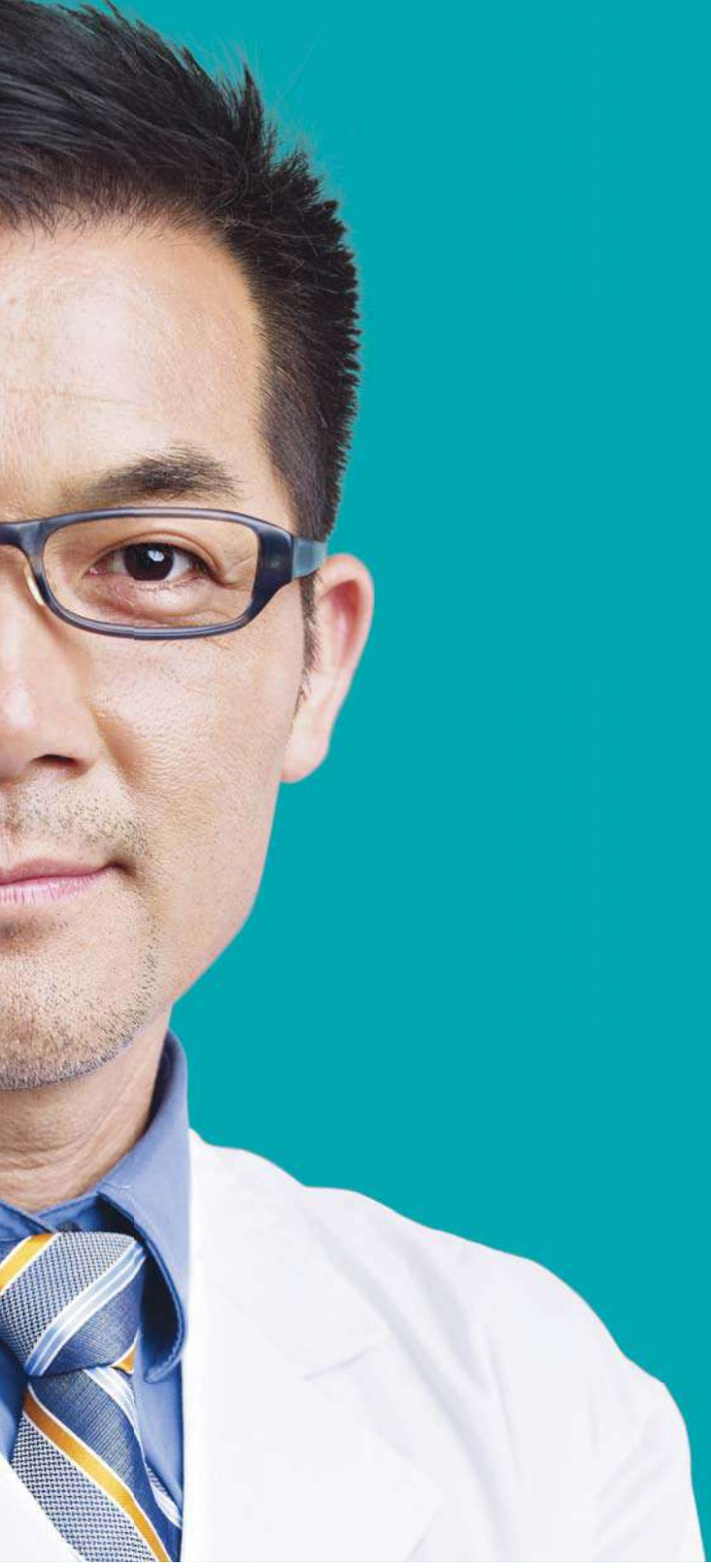
The following list comprises the survey respondents who consented to have their details published in the Atlas.

ISN region	Country	Respondent
Africa	Angola	Matadi Daniel
	Benin	Francis Lalya
	Botswana	Gordana Cavric
	Burkina Faso	Gérard Coulibaly
	Cameroon	Gloria Ashuntantang
	Cape Verde	Helder Evora Tavares
	Chad	Hamat Ibrahim
	Congo, Democratic Republic of	Telesphore Nduba Kilima Ernest Sumaili Kiswaya
	Congo, Republic of	Pierre Éric Gandzali-ngabe
	Egypt	Zaghloul Gouda
	Ethiopia	Solomon Assefa Yibeltal M Feyissa Yewondwossen Tadessi
	Ghana	Dwomoa Adu
	Kenya	George Moturi
	Liberia	Ssentamu Vanglist
	Libya	Abdulhafid Shebani
	Madagascar	E.M. Ranivoharisoa
	Morocco	Tarik Sqalli Houssaini
	Niger	Hassane Moussa Diongole
	Nigeria	Ifeoma Ulasi Babatunde L. Salako
	Senegal	Abdou Niang
	Somalia	Mahad Hassan
	South Africa	Anthony Meyers Graham Paget
	Sudan	Hisham Abdelwahab
	Swaziland	Thandiwe Dlamini
	Tanzania	Francis Fredrick Kajiru Kilonzo
	Uganda	Anthony Batte

ISN region	Country	Respondent
Eastern & Central Europe	Albania	Myftar Barbullushi Alma Idrizi
	Bosnia and Herzegovina	Halima Resic
	Bulgaria	Velislava Dimitrova
	Croatia	Petar Kes
	Czech Republic	Vladimir Tesar
	Poland	Michal Nowicki Magdalena Durlik Andrzej Wiecek
	Romania	Liliana Tuta
	Turkey	Mustafa Arici Rümeyza Kazancioglu
Latin America & the Caribbean	Bolivia	Rolando Claure-Del Granado
	Brazil	Emmanuel Burdmann
	Colombia	Erica Yama
	Dominican Republic	Guillermo Alvarez Jose Castillos
	Guatemala	Carmen Hernandez Paredes Jose Vicente Sanchez Polo
	Haiti	Audie Metayer
	Mexico	Ricardo Correa Rotter Alfonso Cueto Manzano Guillermo Garcia Garcia
	Panama	Regulo Valdes Miranda
	Paraguay	Silvio Franco
	Peru	Cesar Loza Munarriz
	Uruguay	Mariz Gonzalez-Bedat Oscar Noboa Pablo Rios
	Venezuela	Raul Carlini Carmen Luisa Milanes
Middle East	Iran, Islamic Republic of	Shahrzad Ossareh
	Jordan	Riyad Said
	Kuwait	Ali AlSahow Anas Alyousef
	Lebanon	Ali AbuAlfa
	Oman	Issa Al Salmi
	Qatar	Abdullah Ibrahim Hamad
	Saudi Arabia	Saeed Al Ghamdi Faissal Shaheen
	Syrian Arab Republic	Bassam Saeed Hala Wannous
Newly Independent States & Russia	Armenia	Ashot Sarkissian
	Georgia	Irma Tchokhonelidze
	Kazakhstan	Abduzhappar Gaipov
	Russian Federation	Elena Zakharova Alexander Zemchenkov

ISN region	Country	Respondent
North America & the Caribbean	Canada	Amit Garg Peter Blake Lydia Lauder
	Cayman Islands	Nelson Iheonunekwu
	Jamaica	Davlyn Dewar
	Saint Lucia	Merle Clarke
	United States	Susan Crowley Franklin Maddux Stephen Sozio
	Virgin Islands, British	Jomo James
North & East Asia	China	Chi Wa Ao Ieong Chiuleong Li Ming-Hui Zhao
	Hong Kong	Daniel Chan Philip Li
	Japan	Masaomi Nangaku
	Korea, Republic of	Seung Hyeok Han Chun Soo Lim
	Mongolia	Baigalmaa Evsanaa
	Taiwan	Chih-Hsiang Chang Chih-Wei Yang
Oceania & South East Asia	Australia	Marie Ludlow Alan Cass
	Cambodia	Toru Hyodo Niv Rathvirak Pen Samkol
	Fiji	Amrish Krishnan
	Indonesia	Aida Sutranto
	Malaysia	Bak Leong Goh Lai Seong Hooi Zaki Morad Mohamad Zaher
	Myanmar	Yeeyee Myint Khin Thwin
	New Caledonia	Jean-Michel Tivollier
	New Zealand	Murray Leikis Robert Walker
	Singapore	Adrian Liew Hui Lin Choong
	Thailand	Kriang Tungsanga
	Vietnam	Huong thi Bich Tran Hai An Ha Phan
South Asia	Afghanistan	Ahmad Baseer Kaihan
	Bangladesh	Harun Ur Rashid
	India	Narayan Prasad
	India	Bharat Shah
	Nepal	Rishi Kafle
	Pakistan	Syed Akhtar
	Sri Lanka	Chulani Herath

ISN region	Country	Respondent
Western Europe	Belgium	Stefaan Claus
	Denmark	Helle Charlotte Thiesson
	Finland	Per-Henrik Groop
	Germany	Andreas Kribben
	Greece	Gerasimos Bamichas Aikaterini Papagianni
	Italy	Rosanna Coppo Noberto Perico Giuseppe Remuzzi
	Netherlands	Marc Hemmelder
	Portugal	Bernardo Marques Da Costa
	Spain	Alberto Ortiz
	Sweden	Gregor Guron
	Switzerland	Uyen Huynh Do
	United Kingdom	Fiona Loud



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