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Capacity for the management of kidney failure in the International Society of Nephrology North America and the Caribbean region: Report from the 2023 ISN Global Kidney Health Atlas (ISN-GKHA)

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Abstract (248)

The International Society of Nephrology Global Kidney Health Atlas charts the availability and capacity of kidney care globally. In the North America and the Caribbean
region, the Atlas can identify opportunities for kidney care improvement particularly in Caribbean countries where structures for systematic data collection are lacking. In this third iteration, respondents from 12 of 18 countries from the region reported a 2-fold higher than global median prevalence of dialysis and transplant, and a 3-fold higher than global median prevalence of dialysis centers. Peritoneal dialysis prevalence was lower than global median, and transplantation data was missing from 6 of the 10 Caribbean countries. Government-funded payments predominated for dialysis modalities, with greater heterogeneity in transplantation payor mix. Services for chronic kidney disease (CKD), such as monitoring of anemia and blood pressure, and diagnostic capability relying on serum creatinine and urinalyses were universally available. Notable exceptions in Caribbean countries included non-calcium-based phosphate binders and kidney biopsy services. Personnel shortages were reported across the region. Kidney failure was more commonly identified as a governmental priority than was CKD or acute kidney injury. In this generally affluent region, there is better access to kidney replacement therapy and CKD-related services than in much of the world. Yet clear heterogeneity exists, especially among the Caribbean countries struggling with dialysis and personnel capacity. Important steps to improve kidney care in the region include increased emphasis on preventive care, a focus on home-based modalities and transplantation, and solutions to train and retain specialized allied health professionals.

Introduction
The International Society of Nephrology (ISN) North America and the Caribbean (NAC) region has one of the highest overall prevalence of kidney disease and kidney replacement therapy [KRT; hemodialysis (HD), peritoneal dialysis (PD), and kidney transplantation (KT)] in the world. Yet, tremendous variation in systematic data collection exists within the region, especially among the Caribbean nations. For example, Canada captures detailed metrics on nearly every person with kidney failure, and can assess prevalence, incidence, and quality of care. In contrast, the English-speaking Caribbean islands lack population-representative estimates of chronic kidney disease (CKD) prevalence and a KRT registry.

Recognizing that lack of epidemiologic data in turn obscures the need for resources and hampers advocacy for patients with kidney disease, the ISN-Global Kidney Health Atlas (ISN-GKHA) aims to provide on-the-ground insights from in-country experts (nephrologists, policymakers, and administrators). Three rounds of surveys spanning 6 years have been reported (2017 – 2023) and can further track trends in care over time. The present report seeks to describe the current status of kidney care availability and delivery in the ISN NAC region and to describe strategies for maintaining and improving care delivery in the region. The methodology for the 2023 survey is described in detail elsewhere.  

Results

The ISN-GKHA results are broadly categorized as literature review (Table 1, Table 2, Supplementary Table S1, and Supplementary Table S2) and survey
response (Figures 1-5 and Supplementary Figures S1-S6), used to describe the state of kidney care in the ISN NAC region.

**Study setting**

The ISN NAC region as categorized for the purposes of ISN-GKHA includes two large countries [Canada and the United States of America (U.S.)] and numerous islands forming an additional 16 countries (Figure 1). Canada and the U.S. each represent over 9 million km\(^2\) of surface area. However, Canada is home to around 38 million people, while the U.S. is almost ten times more populous (337 million). In contrast, countries in the Caribbean region have small total surface areas ranging from 54 km\(^2\) (Bermuda) to 13,880 km\(^2\) (Bahamas) (Table 1).

Over the past decade, the region has increasingly experienced the effects of climate change. Vast regions of the U.S. and Canada have suffered wildfires, and the Caribbean countries have weathered hurricanes and record droughts. The Southwestern U.S. has experienced drought since 2000 (now termed “megadrought”). The Caribbean is amongst the most vulnerable, with costs of climate change expected to exceed $20 billion/year by 2050; governments are acting in the face of escalating tremendous cost to human life and infrastructure but are limited by debt.

Mortality rates from the COVID19 pandemic were staggeringly high in the U.S., exceeding one million people as of March 2023, the second-highest number reported across the globe. Significantly fewer deaths were reported in Jamaica and the Bahamas (<10,000) but the mortality rate per 100,000 population was similar to Canada. Long-lasting effects included an erosion of public trust in public health
surveillance, low vaccine acceptance, especially past the primary series, and dramatic increases in healthcare worker burnout.\textsuperscript{21}

\textbf{Current status of kidney care in NAC}

In general, in the U.S. and Canada, access to KRT is universal, and the main concerns are cost-containment, reducing dialysis-related mortality despite “adequate” treatment, and improving quality of life for persons receiving dialysis. Preventive care efforts are gaining momentum. Randomized controlled trials evaluating promising therapeutic strategies in kidney preventive care, e.g., stricter blood pressure targets, sodium-glucose transporter inhibitors (SGLT2i), and glucagon like peptide analogues, have drawn significant numbers of participants from the U.S. and Canada. Rapid access to therapies is available, though not universally available. Furthermore, initiatives to identify disease sub-phenotypes (including Neptune and the Kidney Precision Medicine Project) and to integrate innovative trial designs into nephrology practice (e.g., the TIME trial\textsuperscript{22} and myTEMP study\textsuperscript{23}) originate from this region.

Yet there is evident heterogeneity, with a lag in both innovation and capacity for kidney care in many countries within the Caribbean. Until the 1970s, public health efforts were focused primarily on infectious disease and maternal-child care.\textsuperscript{24} Primary health care and non-communicable disease care infrastructure became a priority relatively recently, despite the fact that diabetes and hypertension are the most common causes of death,\textsuperscript{9} and that the cause of kidney disease is most commonly ascribed to these conditions. Lacking systematic registry data, tracking trends in kidney failure
incidence is challenging, but there is no doubt that capacity for kidney care needs to
grow, both for prevention of progression and for care of people needing KRT.

**Narrative literature review data for countries in the ISN North America and the
Caribbean region**

**Burden of CKD, risk factors, and health workforce**

Based on existing data review, the prevalence of CKD in the region was 11.4%
(interquartile range [IQR]: 10.5%–11.7%) (Supplementary Table S1). The regional
prevalence was higher than the global prevalence of 9.5% (IQR: 5.9%–11.7%). CKD
prevalence ranged from 9.8% (IQR: 9.2%–10.5%) in the Bahamas to 12.9% (IQR:
12.1%–13.8%) in the U.S. The region had the highest mortality attributable to CKD at a
median of 4.8% compared to the global mortality of 2.4%, with six Caribbean countries
reporting mortality exceeding 4%. The number of disability-adjusted life years (DALYs)
per 100,000 attributed to CKD in NAC was 1,169.7 versus 491.4 globally, representing
the highest DALYs of all the regions. Canada was the only country with DALYs lower
than the global median.

Among the CKD risk factors in NAC, obesity was most prevalent in the US
(37.3%) and was lowest in Antigua and Barbuda (19.1%) while high blood pressure was
most prevalent in St. Lucia (27.1%) and lowest in the US (12.9%) (Supplementary Table
S2). The median prevalence of specialist physicians in NAC was 2.3 per 1000
population (vs 1.95 globally) while that of medical doctors was 24.4 per 1000 population
(compared to 17.7 globally). The median prevalence of nurses in the region was 45.7
per 1000 population; the U.S. had the highest (156.9) while Jamaica had the lowest (9.4) (Supplementary Table S1).\(^{17}\)

Concordant with trends noted in CKD, Canada and the U.S. reported incident and prevalent treated kidney failure rates nearly two-fold or higher than that of the global median, including for chronic dialysis and transplantation (Table 2).\(^{12-15}\) The Caribbean countries lacked incident data. Available prevalent data indicated higher than global median prevalent rates for dialysis in Turks and Caicos, and lower than global and regional median prevalence for dialysis in Jamaica. Notably, transplantation data were only available from four of 10 Caribbean countries, and prevalence was drastically lower, ranging from 3.1 per million population (pmp) in the Bahamas to 6.8 pmp in Jamaica compared with a global median of 279 pmp.

**Overview of GDP and government health expenditure by individual countries**

The NAC region is one of the wealthiest in the world: the per capita GDP (expressed as purchasing power parity in current international $) was highest in the U.S. (US$22,996 billion) and lowest in St. Lucia (US$1.57 billion) (Table 1).\(^5\) Government health spending per capita in the region was higher than the global median (US$584 vs US$216) with the US, Canada, and the Bahamas being the top three countries with the highest government health spending per capita (Table 1).\(^6\)

**Cost of KRT in North America and Caribbean**
The median annual costs of in-center HD, PD, and first year KT in the region were US$39,826, US$39,826, and US$265,045, respectively. Among countries with available cost data, Jamaica had the lowest annual cost of in-center HD (US$17,622) while Aruba had the highest (US$83,617) and also had the highest annual cost of PD (US$90,937). Data on the annual cost of the first year of kidney transplantation was available in Canada (US$78,392) and the US (US$451,698) (Table 1).7-11

Survey response data for the ISN North America and the Caribbean region

Characteristics of participating countries

A total of 25 respondents (92% nephrologists and 8% others) from 12 countries responded to the survey (Table 1). The number of respondents varied across participating countries: Antigua and Barbuda (n=2), Aruba (n=2), The Bahamas (n=1), Barbados (n=1), Bermuda (n=2), British Virgin Islands (n=1), Canada (n=2), Curacao (n=1), Jamaica (n=3), St Lucia (n=1), St Vincent and the Grenadines (n=1), Trinidad and Tobago (n=1), Turks and Caicos Islands (n=1), United States of America (n=5), and the Virgin Islands (n=1). The World Bank classifies 9 countries as high-income (HICs) and the remainder as upper-middle income countries (UMICs).4 Of note, Cayman Islands, Guyana, Suriname, Dominica, Belize, Puerto Rico, and the US and UK Virgin Islands were surveyed as part of the ISN Latin America region. Grenada, Montserrat, St. Kitts and Nevis did not respond to the survey.

Health system financing and service delivery for kidney care.
Figure 2 summarizes the funding structures for kidney care in NAC. PD surgery and care, and dialysis for acute kidney injury (AKI) received the greatest proportion of funding from government-funded (free) services alone or a combination of government services and point of care fees, compared with other therapies including for non-dialysis CKD, presumably encompassing preventive measures to slow progression to kidney failure. KT surgery and medications had the most heterogeneity in payor mix.

**Health workforce in kidney care**

The oversight of medical kidney care was handled primarily by individual hospitals, trusts, or organizations in 67% (n=8) of countries in the region and by a national body for 25% (n=3) of countries. Medical care of people with kidney disease is primarily provided by nephrologists in 83% (n=10) of countries and by multidisciplinary teams in the remainder (n=2; 17%). The nephrologist workforce of 18.8 (IQR: 11.5-29.8) pmp, is comprised mostly of adult nephrologists (19.7 pmp; IQR: 11.8-29.9) and few pediatric nephrologists (0.0 pmp; IQR: 0.0-1.3) (Table 2). The number of nephrologists in NAC was greater than the global median of 11.8 (IQR: 1.8-24.8) pmp, but lower than the median in HICs of 25.3 (IQR: 17.9-35.4) pmp (Table 2). Three countries in the region (Barbados, Jamaica, and Trinidad and Tobago) had less than 10 nephrologists pmp.

Shortages of kidney care providers were reported by all respondents. Specifically, shortage of surgeons and interventional radiologists to create arteriovenous HD access was most commonly reported (n=8; 67%), followed by shortages of pediatric
nephrologists (n=7; 58%), transplant surgeons (n=7; 58%), surgeons/interventional radiologists to place PD access (n=7; 58%), vascular access coordinators (n=7; 58%), transplant coordinators (n=7; 58%), dialysis technicians (n=7; 58%), and palliative care physicians (n=7; 58%). A shortage of nephrologists was reported in five Caribbean countries.

**Capacity of KRT provision and availability of conservative kidney management (CKM)**

Long-term in-center HD was available in all countries in the region and was the predominant form of dialysis, with a prevalence ranging from 192.7 to 1882.4 pmp (Figures 3 & 4; Table 2). The median number of HD centers was higher in NAC than globally (18.4 vs. 5.1 pmp), ranging from 7.8 pmp in Jamaica to 41.5 pmp in Bermuda. Notably, home HD, PD, particularly automated PD, and KT were not universally available in responding countries. Long-term PD was not available in Antigua and Barbuda and St. Lucia, and transplantation unavailable in Aruba, Bermuda, the Bahamas, St. Vincent and the Grenadines, St. Lucia and Turks and Caicos (Figures 3 & 4; Table 2). Similarly, CKM, chosen through shared decision making, was not universally available. Even where CKM was reported to be available, core CKM care components were not accessible, highlighting care gaps (Figures 3 & 4). The quality of dialysis and transplantation measures across the region are summarized in (Supplementary Figure S1).

Overall, four countries (33%) reported within-country variation in the organization of kidney failure care and three countries (25%) reported within-country variation in the
cost of kidney failure care in their country (Supplementary Figure S2). One third of countries (n=4; 33%) reported differences in kidney failure care delivery between children and adults with seven countries (58%) having reported differences in KRT access (Supplementary Figure S2). These differences in access were more marked for PD versus HD with three countries (60%) reporting that children had more access to PD than adults. Sixty percent of countries reported adults had more access than children to KT.

Availability of services for CKD monitoring and management

Although there was generally comprehensive availability of services to monitor and treat complications of CKD, some countries in the ISN NAC region lacked availability of treatment for mineral-bone disorders (in the form of non-calcium phosphate binders and calcimimetic agents) and symptoms of kidney failure (Figure 5).

Capacity for identification and management of CKD

The majority of services for CKD diagnostics were available in the region at both the primary and secondary/tertiary care levels, with the exception of a crucial diagnostic service (pathology review of kidney biopsies), which was available in eight (67%) of 12 responding countries (Supplementary Figure S3).

Outcomes of hospitalizations and death among people utilizing HD and PD

Seven responding countries of the region reported relatively low first-year HD mortality (1-10%), mirroring global estimates (Supplementary Figure S4). Four of the ten
countries where PD was available (40%) reported low mortality rates (1-10%) within the first year of initiating PD. However, these data were unknown in five (50%) countries thereby making comparison with global estimates difficult (Supplementary Figure S4). Similar to the global estimates, cardiovascular disease (CVD) was the most common cause of death in the majority of countries in the region, regardless of modality. In addition, approximately 30% of countries (n=4) reported that 31-50% of the people receiving KRT would require hospitalization within the first year of HD or PD. Access-related infection was the most common cause of hospitalization for people utilizing HD, and CVD for people utilizing PD.

**Health Information systems**

Official registries of CKD (non-dialysis) and AKI were only available in St. Lucia, on a mandatory basis. No official registry for CKM was available in the region. Official registries of dialysis were available in five (42%) countries (Aruba, Canada, Jamaica, St. Lucia, US), whereas four (33%) countries had a transplantation registry (Aruba, Canada, Trinidad and Tobago, US) (Figure 3; Supplementary Figure S5).

**Barriers to optimal care**

The most commonly reported barriers to optimal kidney care across countries in the ISN NAC region were patient knowledge or attitude (n=12; 100%) followed by healthcare system availability, access, capability (n=9; 75%) and economic factors (n=8; 67%). Physician availability, access, knowledge, and/or attitude and nephrologist
availability were reported as barriers by six countries (50%) and five countries (42%), respectively.

**Advocacy and Policy**

A majority of countries reported having a strategy for non-communicable diseases (NCD) that was either implemented (n=7; 58%) or under development (n=3; 25%). However, only three countries (25%) reported CKD-specific strategies, whereas four countries (33%) had a CKD strategy incorporated into a general NCD strategy that included other diseases. Seven countries (58%) recognized CKD as a health priority and only three (25%) viewed AKI as a health priority. Comparatively, kidney failure and/or its treatment by KRT seemed to be higher on the list of government interests with 10 countries (83%) recognizing it as a health priority (Supplementary Figure S6). Five countries (42%) did not have advocacy groups for any of the three categories of CKD, kidney failure, and AKI (Antigua, Aruba, Jamaica, Trinidad, and Turks and Caicos Islands). Only the US and Canada had advocacy groups for all three categories (Figure 3).

**Discussion**

The third iteration of the ISN-GKHA reiterates the heterogeneity in kidney care across the ISN NAC region, which, although primarily composed of HICs or UMICs and largely equipped with reasonable diagnostic and CKD management capacity, still struggles to generate policies and practices aligning with the cohesive kidney care programs recommended by experts.\(^{25}\) It is evident that in most of the 12 responding
countries, the very costly treatment of kidney failure is prioritized, whereas systematic strategies for the prevention and management of CKD are lacking. Furthermore, even within the realm of kidney failure management, in-center hemodialysis, the most medically and resource-intensive form of KRT, surpasses all other forms of KRT in terms of prevalence and incidence of patients, as well as capacity for treatment centers.

Efforts to ‘reverse the tide’ toward a more home-based approach are underway in the U.S. and Canada, among two of the world’s largest users of KRT. In the U.S., the federal government enacted the Advancing American Kidney Act in 2019 with the ambitious target of 80% of KRT delivery being home-based dialysis or through transplantation. The Centers for Medicare and Medicaid Services has changed reimbursement incentives to align with this priority. Downstream effects of these policies are yet to be captured. In Canada, innovative assisted PD programs and approaches to reduce disparities in transplantation are under study.

Policymakers in Caribbean countries could follow the initiatives underway in these two countries by focusing capacity building efforts towards home-based and KT efforts. As data from the 2023 ISN-GKHA demonstrate, the prevalence of CKD is similar in the Caribbean countries compared with the US and Canada, yet the KRT incidence, prevalence, center prevalence, and nephrologist capacity are all drastically lower, indicating likely a lack of capacity for care of persons with kidney failure. In Jamaica, there are five public hospital-based units and a little over 20 private units to dialyze about 890 patients, once (20%) to twice (70%) weekly, with some receiving the recommended thrice (10%) weekly. All public units are at capacity, so those without health insurance have to pay an out-of-pocket average of US$90-$117 per session.
some countries, such as Grenada, dialysis capacity is being newly built, and rather than an ad-hoc unregulated growth in dialysis capacity, active policy management with incentives toward home therapies and transplantation may achieve a better mix of therapies. For example, home HD is not available in the Caribbean owing to lack of personnel training and exorbitant patient-borne costs of purchasing the machine, a financial disincentive that could be revised. Other PD initiatives in the region include a unique nurse-led PD clinic in Bermuda that encourages education, independence, and autonomy with dialysis treatment, and the rolling out of a PD program in Turks & Caicos shortly.

The COVID-19 pandemic highlighted another advantage of focusing on home-based therapies: in face of personnel and supply shortages, home HD or PD enables a relatively easier pivot to telehealth services and a reduction in the need for health care or interpersonal contact, which has the added benefit of reducing infection transmission. Similar benefits could be experienced during environmental disasters, especially with advanced planning, and are thus particularly relevant for Caribbean countries, where residents have experienced rising temperatures and droughts, in parallel with sea level rise, one Category 4 and two Category 5 hurricanes just in the past six years.

Unlike in the US and Canada where deceased donor kidney transplantation predominates, capacity for transplantation in the Caribbean is largely limited to living donor transplantation, with surgical capacity in Jamaica, Trinidad and Tobago, and Barbados. In Trinidad and Tobago, a 15-year review of the National Organ Transplant Unit showed that 195 transplants were done between 2005-2020, with 24% from
deceased donors which nonetheless represented a dramatic increase in deceased donor transplantation over time. The authors highlighted the need for additional resources to support the deceased donor registry and organ procurement process.

Limiting surgical capacity for transplantation may represent a reasonable strategy, as developing high-volume centers of excellence may yield better outcomes; however, cooperative inter-country agreements that underline clear pathways to surgery would be required to enable equitable access. Furthermore, post-transplantation care pathways are essential to realizing the upfront investment for the surgical procedure and organ procurement. Data on health financing of both the surgical procedure and post-transplant care demonstrate high variability in payor mix, creating a chaotic situation on-the-ground where simplified pathways would enable access and longevity of the best treatment option for KRT.

Despite the existence of numerous renowned training programs, all countries in the region reported shortages of medical kidney care professionals. In the U.S. there is a perennial ~10% deficit of HD nurses, with nearly 2,000 open positions. Not only was this deficit worsened by the COVID-19 pandemic, but more strikingly the nurse workforce is aging, and among new nurses there is high level of job turnover and dissatisfaction. This likely feeds the inter-regional “brain drain” phenomena, of which the Caribbean has a long history. Nearly one in five specialized nurses were emigrating from Jamaica even prior to the pandemic. Registered nurses are enticed by recruiters to migrate and offered employment packages that the Caribbean employers cannot match. The days of being bonded to a place of employment, based on receiving
government scholarship/sponsorship are dwindling, as nurses are able to pay back their bond with their newfound foreign salaries. At the moment, there is only one training institute in the Caribbean dedicated to certifying nephrology nurses. The program was launched 2007 through the Ministry of Health and Wellness In-Service Department in Jamaica, where the Registered Nurse completes a nine-month didactic and clinical rotation in all areas of Nephrology. After achieving some experience, nurses have sought employment in North America or in another island jurisdiction that offers comparable, if not better, salary compensation than those of the U.S. and Canada. A three-semester dialysis technician program at the University of Technology, Jamaica, training technicians has been closed for a few years. Therefore, interested persons from Jamaica and Turks & Caicos must complete a dialysis technician program in Texas, U.S., to meet their local accreditation process. There are no specialty-trained dietitians, clinical pharmacists, or social workers dedicated to kidney care in the Caribbean. Unlike Canada and the U.S., which typically attract physicians from across the world, the Caribbean countries struggle to retain physicians. In 2019, the Pan American Health Organization (PAHO) highlighted that poor working conditions, low wages, lack of promotions, and poor healthcare infrastructure contributed to the issue. There was a concerted effort to increase employment posts for doctors, as many hospitals in the rural areas became accredited to provide internship opportunities. Over time, an increasing number of medical graduates could not obtain local post-graduate training due to lack of posts. Consequently, an increasing number of doctors undertake overseas medical licensing exam to enter their system as specialists. In addition to nephrologist shortages, there is only one fellowship trained nephropathologist in the
Caribbean (Jamaica), where samples for electron microscopy are shipped to Canada for analysis. There is also a general lack of transplant surgeons in the Caribbean, with those involved having trained and often deciding to remain overseas. A transplant surgical fellow is currently training in the US and plans to return to Jamaica. Urgent innovative solutions to retain nephrologists and nurses,\textsuperscript{43} such as reverse aid from recruiting countries or in-country time commitments are needed to improve the access and quality of care in the Caribbean countries.\textsuperscript{40,44}

Although kidney failure is seen as a health priority in most countries in the ISN NAC region, formal health policies and advocacy groups targeting prevention and progression are both lacking in the region. With the advent of new treatments, e.g., SGLT2i, which are broadly available and significantly reduce risk of progression among persons with CKD, resources intentionally spent on improving uptake and access to these and other preventive therapies should form the backbone of kidney care. In addition to advocacy groups, networks of patients, scientists and healthcare professionals, such as the Canadian Can-SOLVE-CKD initiative, work towards the creation of innovative kidney care solutions with patients at the center.\textsuperscript{45} Such initiatives are important for engagement of people with kidney failure and are a key avenue to improve kidney care.

In conclusion, this third iteration of the ISN-GKHA demonstrates that the ISN NAC region hosts some of the highest density of KRT programs in the world, and reasonably comprehensive CKD diagnostic and management capacity compared with global programs, although heterogeneity exists with significantly lower capacity in the
Caribbean countries compared with the U.S. and Canada. Areas for improvement in kidney care, applicable across the region but to a varying degree, include programming to prioritize home-based modalities and transplantation as KRT, systems to train and retrain specialized nurses and physicians, and policies that funnel resources to CKD care and thereby invest in the most cost-efficient means to prevent kidney failure, rather than continually struggle to manage it. There were some limitations to the 2023 ISN-GKHA; these have been discussed. However, this work is important for guiding kidney care policy in the ISN NAC region.

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work. ST reports Fellowship grants from the International Society of Nephrology-Salmasi Family and the Kidney Foundation of Thailand, outside the submitted work. MMYW reports grants from Michael Smith Health Research BC and Kidney Foundation of Canada, personal fees from George Clinical, Bayer, and AstraZeneca advisory board: CKD early identification and intervention in primary care, outside the submitted work. SA reports personal fees (salary) from The International Society of Nephrology, outside the submitted work. AKB reports other (consultancy and honoraria) from AMGEN Incorporated and Otsuka, other (consultancy) from Bayer and GSK, and grants from Canadian Institute of Health Research and Heart and Stroke Foundation of Canada, outside the submitted work; he is also Associate Editor of the Canadian Journal of Kidney Health and Disease and Co-chair of the ISN-Global Kidney Health Atlas. SD reports personal fees (salary) from The International Society of Nephrology, outside the submitted work. JD reports personal fees (salary) from The International Society of Nephrology, outside the submitted work. VJ reports personal fees from GSK, Astra Zeneca, Baxter Healthcare, Visterra, Biocryst, Chinook, Vera, and Bayer, paid to his institution, outside the submitted work. DWJ reports consultancy fees, research grants, speaker’s honoraria and travel sponsorships from Baxter Healthcare and Fresenius Medical Care, consultancy fees from Astra Zeneca, Bayer, and AWAK, speaker’s honoraria from ONO and Boehringer Ingelheim & Lilly, and travel sponsorships from Ono and Amgen, outside the submitted work. He is also a current recipient of an Australian National Health and Medical Research Council Leadership Investigator Grant, outside the submitted work. CM reports personal fees (salary) from The International Society of Nephrology, outside the submitted work. MN reports grants
and personal fees from KyowaKirin, Boehringer Ingelheim, Chugai, Daiichi Sankyo, Torii, JT, Mitsubishi Tanabe, grants from Takeda and Bayer, and personal fees from Astellas, Akebia, AstraZeneca, and GSK, outside the submitted work. SA reports grants from Doris Duke Award and Stanford Center for Innovation in Global Health, during the conduct of the study; personal fees from HealthPals, Inc, and Vera Therapeutics, outside the submitted work. All others have nothing to declare.

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SUPPLEMENTARY MATERIAL

Supplementary File (PDF)

Table S1. Burden of CKD in the ISN North America and the Caribbean region.

Table S2. Risk factors for CKD in the ISN North America and the Caribbean region.
Figure S1. Quality of dialysis and transplantation: Proportion of centers routinely measuring and reporting outcomes (A) and proportion of people initiating dialysis with an incremental start (B) in the ISN North America and the Caribbean region.

Figure S2. Within-country variation in the organization, delivery, and cost of kidney failure care and access to KRT in the ISN North America and the Caribbean region.

Figure S3. Availability of services for CKD monitoring and management (proportion of countries) at the primary and secondary/tertiary care level in the ISN North America and the Caribbean region.

Figure S4. Proportion of death and hospitalization in people living with kidney failure on dialysis in the first year of dialysis, globally and in the ISN North America and the Caribbean region.

Figure S5. Availability and basis of participation of 'official' registries for conditions and treatments (proportion of countries) in the ISN North America and the Caribbean region.

Figure S6. Proportion of countries in which kidney disease is recognized as a health priority by the government in the ISN North America and the Caribbean region.
References


32. NOW Grenada. Living with End-Stage Renal (Kidney) Disease. Published February 8, 2019. Available at: https://nowgrenada.com/2019/02/dr-germain-


### Table 1. General demographic and economic indicators of 12 countries of the ISN North America and the Caribbean region which participated in the ISN-GKHA.⁴⁻¹¹

<table>
<thead>
<tr>
<th></th>
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<th></th>
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<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Global median [IQR]‡</td>
<td>-</td>
<td>130,483,015</td>
<td>7,802,702,984</td>
<td>133.8 [39.7-545.0]</td>
<td>216</td>
<td>19,380.3</td>
<td>18,959.2</td>
<td>26,903.2</td>
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<tr>
<td>NAC median [IQR]‡</td>
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<td>19,849,895</td>
<td>380,577,311</td>
<td>13.5 [2.0-38.6]</td>
<td>584</td>
<td>39,825.9</td>
<td>39,825.9</td>
<td>265,045.3</td>
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<td>Antigua and Barbuda</td>
<td>HIC</td>
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<td>100,335</td>
<td>1.96</td>
<td>623</td>
<td></td>
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<tr>
<td>Aruba</td>
<td>HIC</td>
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<td>-</td>
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<td>-</td>
<td>-</td>
<td></td>
<td></td>
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</tr>
<tr>
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<td>HIC</td>
<td>13,880</td>
<td>355,608</td>
<td>13.54</td>
<td>1216</td>
<td></td>
<td></td>
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<td></td>
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<tr>
<td>Barbados</td>
<td>HIC</td>
<td>430</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bermuda</td>
<td>HIC</td>
<td>54</td>
<td>-</td>
<td>5.83</td>
<td>-</td>
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<tr>
<td>Canada</td>
<td>HIC</td>
<td>9,984,670</td>
<td>38,232,593</td>
<td>1992.05</td>
<td>4705</td>
<td>42,146.73</td>
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<td>78,392.6</td>
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<td>Jamaica</td>
<td>UMIC</td>
<td>10,991</td>
<td>2,818,596</td>
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<td>211</td>
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<tr>
<td>St. Lucia</td>
<td>UMIC</td>
<td>616</td>
<td>167,122</td>
<td>2.57</td>
<td>284</td>
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<td>389</td>
<td>100,969</td>
<td>1.57</td>
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<td>Trinidad and Tobago</td>
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<td>5128</td>
<td>1,405,646</td>
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<td>584</td>
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<td></td>
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<tr>
<td>Turks and Caicos Islands</td>
<td>HIC</td>
<td>948</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>United States</td>
<td>HIC</td>
<td>9,833,517</td>
<td>337,341,954</td>
<td>22,996.1</td>
<td>6578</td>
<td>39,825.88</td>
<td>39,825.88</td>
<td>451,697.9</td>
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</tr>
</tbody>
</table>

Abbreviations: CAPD: continuous ambulatory peritoneal dialysis; ISN: International Society of Nephrology; est.: estimated; GDP: gross domestic product; HD: hemodialysis; IQR: interquartile range; N/A: not available, NAC: North America and the Caribbean; PPP: purchasing power parity.
**Table 2. Kidney replacement therapy and nephrology workforce statistics in the 12 North America & the Caribbean countries participating in the ISN-GKHA.**

<table>
<thead>
<tr>
<th>Country/Territory</th>
<th>World Bank ranking for income status</th>
<th>Published Epidemiological Data</th>
<th>Survey Response Data</th>
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<tr>
<td></td>
<td></td>
<td>Treated kidney failure (pmp)</td>
<td>Chronic dialysis prevalence (pmp)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Incidence</td>
<td>Prevalence</td>
</tr>
<tr>
<td>Global* Median (IQR)</td>
<td></td>
<td>145.5 (107.0-212.5)</td>
<td>822.8 (556.0-1114.0)</td>
</tr>
<tr>
<td>NAC* Median (IQR)</td>
<td></td>
<td>309.1 (208.1-410.0)</td>
<td>666.8 (334.6-1415.9)</td>
</tr>
<tr>
<td>Antigua and Barbuda</td>
<td>High</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Aruba</td>
<td>High</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Bahamas</td>
<td>High</td>
<td>-</td>
<td>515.10</td>
</tr>
<tr>
<td>Barbados</td>
<td>High</td>
<td>-</td>
<td>682.50</td>
</tr>
<tr>
<td>Bermuda</td>
<td>High</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Canada</td>
<td>High</td>
<td>208.10</td>
<td>1415.90</td>
</tr>
<tr>
<td>Jamaica</td>
<td>Upper-middle</td>
<td>-</td>
<td>137.40</td>
</tr>
<tr>
<td>St. Lucia</td>
<td>Upper-middle</td>
<td>-</td>
<td>321.00</td>
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<tr>
<td>St. Vincent and the Grenadines</td>
<td>Upper-middle</td>
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<td>-</td>
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<td>High</td>
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<td>334.80</td>
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<td>-</td>
<td>1882.40</td>
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<tr>
<td>United States</td>
<td>High</td>
<td>410.00</td>
<td>2465.00</td>
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</tbody>
</table>

Abbreviations: ISN: International Society of Nephrology; HD: hemodialysis; IQR: interquartile range; N/A: not available; NAC: North America & the Caribbean; PD: peritoneal dialysis; pmp: per million population; TX: transplantation
Figure Legends

**Figure 1.** Countries in the ISN North America and the Caribbean region with quartiles of nephrologist prevalence in each country shown.

ISN, International Society of Nephrology

**Figure 2.** Funding structures for non-dialysis CKD and KRT care, globally and in the ISN North America and the Caribbean region.*

ISN, International Society of Nephrology; AKI, acute kidney injury; CKD, chronic kidney disease; gov, government; HD, hemodialysis; N/A: not available; NAC: North America & the Caribbean; PD peritoneal dialysis.

*Values represent absolute number of countries in each category expressed as a percentage of total number of countries.

**Figure 3.** Country level scorecard showing availability of KRT, funding of medications, registry, and advocacy groups in the ISN North America and the Caribbean region, 2019 and 2023.

Funding for medications refers to 100% publicly funded by the government (free at the point of delivery).

ISN, International Society of Nephrology; AKI, acute kidney injury; CKD, chronic kidney disease; CKM, conservative kidney management; KF, kidney failure; HD, hemodialysis; KRT, kidney replacement therapy; PD, peritoneal dialysis; pmp, per million population.

**Figure 4.** Availability of choice in KRT or CKM for people living with kidney failure in the North America and the Caribbean region.*
ISN, International Society of Nephrology; KRT, kidney replacement therapy, CKM, conservative kidney management

*Values represent absolute number of countries in each category expressed as a percentage of total number of countries.

**Figure 5.** Availability of services for kidney care in the ISN North America and the Caribbean region.*

ISN, International Society of Nephrology; BP, blood pressure.

*Values represent absolute number of countries in each category expressed as a percentage of total number of countries.

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