

Mind the gap in kidney care: Translating what we know into what we do

Valerie A. Luyckx MD^{1,2,3} | Katherine R. Tuttle MD^{4,5} | Dina Abdellatif MD⁶ | Ricardo Correa-Rotter MD⁷ | Winston W. S. Fung MD⁸ | Agnès Haris MD⁹ | Li-Li Hsiao MD² | Makram Khalife MSc¹⁰ | Latha A. Kumaraswami BA¹¹ | Fiona Loud BA¹⁰ | Vasundhara Raghavan BA¹⁰ | Stefanos Roumeliotis MD¹² | Marianella Sierra BA¹⁰ | Ifeoma Ulasi MD¹³ | Bill Wang BA¹⁰ | Siu-Fai Lui MD¹⁴ | Vassilios Liakopoulos MD¹² | Alessandro Balducci MD¹⁵ | for the World Kidney Day Joint Steering Committee

¹Department of Public and Global Health, Epidemiology, Biostatistics and Prevention Institute, University of Zurich, Zurich, Switzerland

²Department of Medicine, Brigham and Women's Hospital, Renal Division, Harvard Medical School, Boston, Massachusetts, USA

³Department of Paediatrics and Child Health, University of Cape Town, Cape Town, South Africa

⁴Providence Medical Research Center, Providence Inland Northwest Health, Spokane, Washington, USA

⁵Department of Medicine, Nephrology Division, University of Washington, Seattle, Washington, USA

⁶Department of Nephrology, Cairo University Hospital, Cairo, Egypt

⁷Department of Nephrology and Mineral Metabolism, National Medical Science and Nutrition Institute Salvador Zubiran, Mexico City, Mexico

⁸Department of Medicine and Therapeutics, Prince of Wales Hospital, The Chinese University of Hong Kong, Shatin, Hong Kong, China

⁹Nephrology Department, Péterfy Hospital, Budapest, Hungary

¹⁰ISN Patient Liaison Advisory Group, ISN, Brussel, New Jersey, Belgium

¹¹Tamilnad Kidney Research (TANKER) Foundation, Chennai, India

¹²2nd Department of Nephrology, AHEPA University Hospital Medical School, Aristotle University of Thessaloniki, Thessaloniki, Greece

¹³Department of Medicine, College of Medicine, University of Nigeria, Ituku-Ozalla, Enugu, Nigeria

¹⁴Division of Health System, Policy and Management, Jockey Club School of Public Health and Primary Care, The Chinese University of Hong Kong, Hong Kong, Hong Kong

¹⁵Italian Kidney Foundation, Rome, Italy

Correspondence

Valerie A. Luyckx, Department of Public and Global Health, Epidemiology, Biostatistics and Prevention Institute, University of Zurich, Hirschengraben 84, Zurich 8001, Switzerland.
Email: valerie.luyckx@uzh.ch

Abstract

Historically, it takes an average of 17 years to move new treatments from clinical evidence to daily practice. Given the highly effective treatments now available to

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Katherine R. Tuttle, Providence Medical Research Center, Providence Inland NW Health, 105 W 8th Ave, Suite 250 E, Spokane, WA 99204, USA.
Email: katherine.tuttle@providence.org

Winston W. S. Fung, Department of Medicine and Therapeutics, Prince of Wales Hospital, The Chinese University of Hong Kong, Ninth Floor, Lui Che Woo Clinical Science Bldg, 32 Ngan Shing St, Shatin, Hong Kong.
Email: ws898@ha.org.hk

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prevent or delay kidney disease onset and progression, this is far too long. The time is now to narrow the gap between what we know and what we do. Clear guidelines exist for the prevention and management of common risk factors for kidney disease, such as hypertension and diabetes, but only a fraction of people with these conditions worldwide are diagnosed, and even fewer are treated to target. Similarly, the vast majority of people living with kidney disease are unaware of their condition, because in the early stages it is often silent. Even among patients who have been diagnosed, many do not receive appropriate treatment for kidney disease. Considering the serious consequences of kidney disease progression, kidney failure, or death, it is imperative that treatments are initiated early and appropriately. Opportunities to diagnose and treat kidney disease early must be maximized beginning at the primary care level. Many systematic barriers exist, ranging from patient to clinician to health systems to societal factors. To preserve and improve kidney health for everyone everywhere, each of these barriers must be acknowledged so that sustainable solutions are developed and implemented without further delay.

KEYWORDS

chronic kidney disease, equity, kidney care, public health, World Kidney Day

INTRODUCTION

At least one in 10 people worldwide is living with kidney disease (Jager et al., 2019). According to the Global Burden of Disease study, in 2019, >3.1 million deaths were attributed to kidney dysfunction, making it the seventh leading risk factor for death worldwide (Figure 1 and Supporting Information S1: Figure S1) (Institute for Health Metrics and Evaluation, [IHME] 2019). However, global mortality from all kidney diseases may actually range between five and 11 million per year if the estimated lives lost, especially in lower resource settings, from acute kidney injury and from lack of access to kidney replacement therapy for kidney failure (KF) are also counted (Luyckx et al., 2018). These high global death rates reflect disparities in prevention, early detection, diagnosis and treatment of chronic kidney disease (CKD) (International Society of Nephrology, 2023). Death rates from CKD are especially prominent in some regions, and particularly high in Central Latin America and Oceania (islands of the South Pacific Ocean), indicating the need for urgent action (Bikbov et al., 2020).

CKD also poses a significant global economic burden, with costs increasing exponentially as CKD progresses, not only because of the costs of dialysis and transplantation but also because of the multiple comorbidities and complications that accumulate over time (Nguyen-Thi et al., 2021; Vanholder et al., 2017). In the United States, Medicare fee-for-service spending for all beneficiaries with CKD was \$86.1 billion in 2021 (22.6% of the total expenditure) (US Renal Data System, 2023). Data from many lower resource settings are absent, where most costs are paid for out of pocket. A recent study from

Vietnam reported that the cost of CKD per patient was higher than the gross domestic product per capita (Nguyen-Thi et al., 2021). In Australia, it has been estimated that early diagnosis and prevention of CKD could save the health system \$10.2 billion over 20 years (Kidney Health Australia).

Although there is regional variation in the causes of CKD, the risk factors with the highest population-attributable factors for age-standardized CKD-related disease-adjusted life years were as follows: high blood pressure (51.4%), high fasting plasma glucose level (30.9%) and high body mass index (26.5%) (Ke et al., 2022). These risk factors are also global leading risk factors for death (Figure 1). Only 40% and 60% of those with hypertension and diabetes, respectively, are aware of their diagnosis, and far smaller proportions are receiving treatment and at target goals (Geldsetzer et al., 2019; Gregg et al., 2023). Moreover, at least one in five people with hypertension and one in three people with diabetes also have CKD (Chu et al., 2022).

A large proportion of CKD can be prevented through healthy lifestyles, prevention and control of risk factors, avoidance of acute kidney injury, optimization of maternal and child health, mitigation of climate change and addressing social and structural determinants of health (Luyckx et al., 2018). Nevertheless, the benefits of some of these measures may only be seen in generations to come. In the meantime, early diagnosis and risk stratification create opportunities to institute therapies to slow, halt or even reverse CKD (Levin et al., 2017). Concerningly, CKD awareness was strikingly low among individuals with kidney dysfunction, with ~80% to 95% of patients being unaware of their diagnosis across world regions (Figure 2)

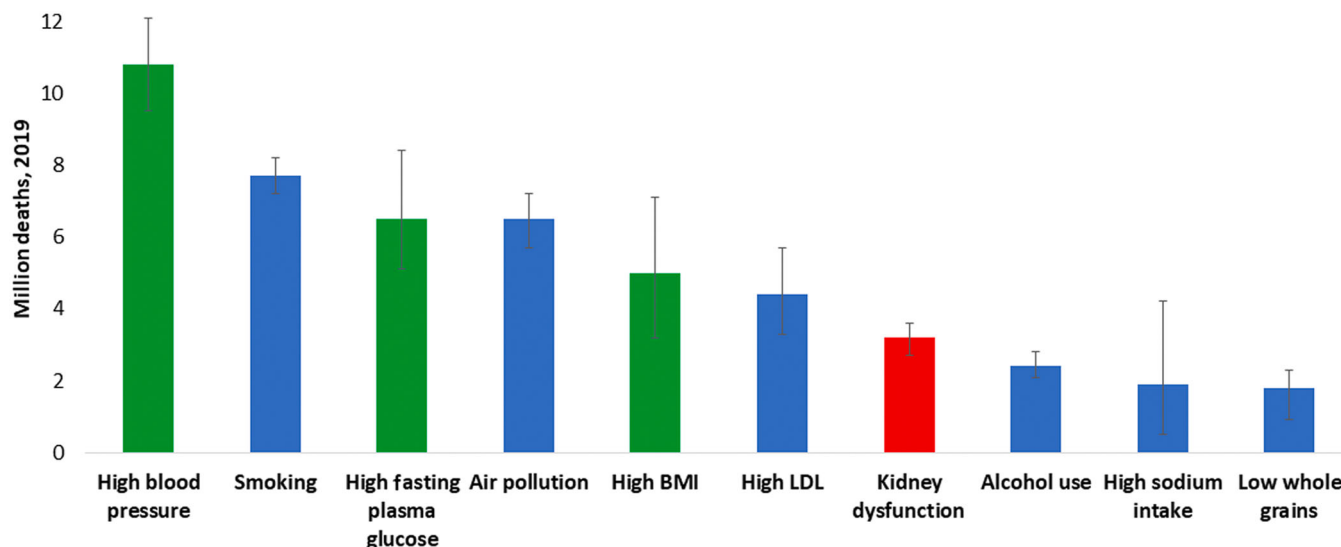


FIGURE 1 All ages, top 10 global risk factors for death, 2019. Kidney dysfunction (defined as estimated glomerular filtration rate <60 mL/min/1.73 m² or albumin-to-creatinine ratio ≥ 30 mg/g) was the seventh leading global level 3 risk factor for death in 2019. The three leading global risk factors for kidney disease, including hypertension, diabetes and overweight/obesity, are also leading global risk factors for death; therefore, holistic strategies are required to address all risk factors simultaneously. Ranking is depicted by millions of deaths attributed to the risk factors. Error bars depict the confidence range. Global ranking of kidney dysfunction stratified by World Bank income category and gender is shown in Supporting Information S1: Figure S1. Data obtained from the Global Burden of Disease Study IHME, 2019). BMI, body mass index; LDL, low-density lipoprotein.

(Chu et al., 2021; Ene-lordache et al., 2016; Gummidi et al., 2020; Kidney Disease: Improving Global Outcomes KDIGO Diabetes Work Group, 2022; Nicholas et al., 2023; Stengel et al., 2021). People are dying because of missed opportunities to detect CKD early and deliver optimal care!

More important, CKD is a major risk factor for cardiovascular disease, and as kidney disease progresses, cardiovascular death and KF become competing risks (Grams et al., 2017). Indeed, the Global Burden of Disease study data from 2019 showed that more people died of cardiovascular disease attributed to kidney dysfunction (1.7 million people) than from CKD itself (1.4 million people) (IHME). Therefore, cardiovascular disease care must also be a priority for people with CKD.

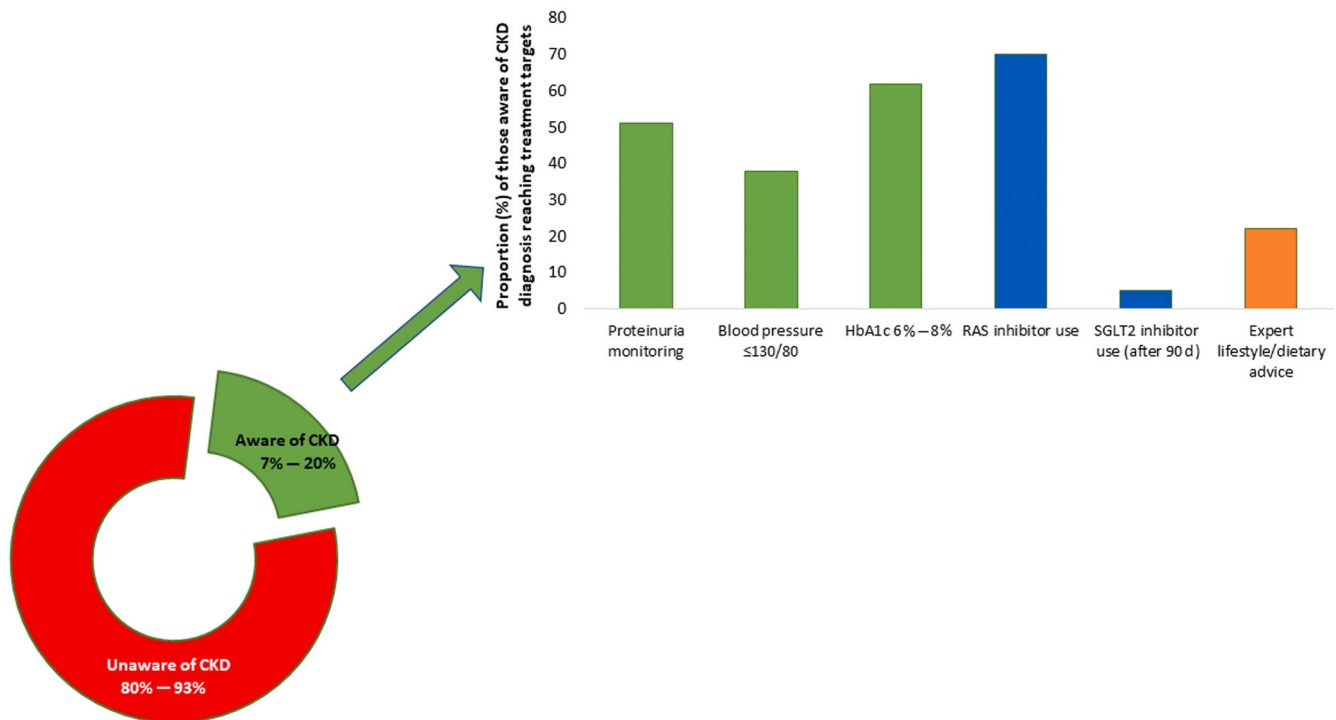
GAPS BETWEEN KNOWLEDGE AND IMPLEMENTATION IN KIDNEY CARE

Strategies to prevent and treat CKD have been built on a strong evidence base over the past 3 decades (Figure 3) (Kidney Disease: Improving Global Outcomes KDIGO Diabetes Work Group, 2022). Clinical practice guidelines for CKD are clear; however, adherence to these guidelines is suboptimal (Figure 2) (Kidney Disease: Improving Global Outcomes KDIGO Diabetes Work Group, 2022; Nicholas et al., 2023; Stengel et al., 2021).

Regardless of the cause, control of major risk factors, particularly diabetes and hypertension, forms the foundation of optimal care for CKD (Kidney Disease: Improving Global Outcomes KDIGO Blood Pressure

Work Group, 2021; Kidney Disease: Improving Global Outcomes KDIGO Diabetes Work Group, 2022). Beyond lifestyle changes and risk factor control, the initial pharmacologic classes of agents proven to provide kidney protection were the renin-angiotensin-aldosterone system inhibitors in the form of angiotensin-converting enzyme inhibitors (ACEIs) and the angiotensin receptor blockers (Kidney Disease: Improving Global Outcomes KDIGO Diabetes Work Group, 2022; Levin et al., 2017). However, despite decades of knowledge that these medications have important protective effects on kidney and heart function in people with CKD, their use has remained low based on real-world data from electronic health records (Figure 2). For example, in the United States, ACEI or angiotensin receptor blocker use was reported in the range of 20% to 40% at ≥ 15 years after the last approvals of these agents for patients with CKD and type 2 diabetes (Tuttle et al., 2019). Although more recent data show improvement in prescribing rates to 70% in this population, just 40% persist on an ACEI or angiotensin receptor blocker for at least 90 days (Nicholas et al., 2023). These data illustrate gaps in both prescribing kidney protective medication and continuity of care over time, potentially related to cost, lack of patient education, polypharmacy and adverse effects (Ismail et al., 2023).

Although initial enthusiasm for sodium-glucose cotransporter 2 (SGLT2) inhibitors focused on their benefits for diabetes and cardiovascular disease, unprecedented therapeutic benefits have clearly been observed for CKD as well. The relative risk reductions with SGLT2 inhibitors approach 40% for a substantial decline in estimated glomerular filtration rate, KF and death in populations with CKD of several causes, heart failure or high cardiovascular disease risk (Heerspink et al., 2023; Nuffield Department of Population Health Renal Studies Group, 2022).



Proportion of people with CKD aware of their diagnosis

FIGURE 2 Proportion of people with chronic kidney disease (CKD) who are aware of their diagnosis and are receiving appropriate guideline-recommended care. The proportion of people with CKD who are aware of their diagnosis varies globally, with rates ranging from 7% to 20%. As the CKD stage worsens, knowledge of CKD increases. Among those with a diagnosis of CKD, the average proportion of patients receiving appropriate medication to delay CKD progression (renin–angiotensin–aldosterone system inhibitors and sodium–glucose cotransporter 2 inhibitors) is suboptimal as are those reaching target blood pressure, diabetes control and nutrition advice. The treatment targets depicted in the figure follow the Kidney Disease: Improving Global Outcomes (KDIGO) 2012 guidelines (Stengel et al., 2021). Most data come from higher resource settings; these proportions are likely lower in lower resource settings. Data are shown for proportions of patients reaching blood pressure of $<$ 130/80 mmHg. Data compiled from previous studies (Chu et al., 2021; Ene-lordache et al., 2016; Gummiidi et al., 2020; Kidney Disease: Improving Global Outcomes KDIGO Diabetes Work Group, 2022; Nicholas et al., 2023; Stengel et al., 2021). HbA1c, haemoglobin A1c.

These benefits accrued on top of standard-of-care risk factor management and renin–angiotensin–aldosterone system inhibitor. Risks of heart failure, cardiovascular death and all-cause mortality were also reduced in patients with CKD (Heerspink et al., 2023). The addition of SGLT2 inhibitor to renin–angiotensin–aldosterone system inhibitors could delay the need for kidney replacement therapy by several years, depending on when they are started (Fernández-Fernandez et al., 2023). Moreover, for every 1000 patients with CKD treated with an SGLT2 inhibitor on top of standard therapy, 83 deaths, 19 heart failure hospitalizations, 51 dialysis initiations and 39 episodes of acute kidney function worsening can be prevented (McEwan et al., 2023).

Concerningly, marked underuse of these and other guideline-recommended therapies, including SGLT2 inhibitors, persists (Figure 2) (Nicholas et al., 2023; Tuttle et al., 2019). In the CURE-CKD registry, only 5% and 6.3% of eligible patients with CKD and diabetes, respectively, continued on SGLT2 inhibitor and glucagon-like peptide-1 receptor agonist at 90 days (Gummiidi et al., 2020). Notably, lack of commercial health insurance and treatment in community-based versus academic institutions were associated with lower likelihoods of SGLT2 inhibitor, ACEI or angiotensin receptor blocker prescriptions among patients with diabetes and CKD (Nicholas et al., 2023). In low- or middle-income

countries (LMICs), the gap between evidence and implementation is even wider given the high cost and inconsistent availability of these medications, despite the availability of generics (Vanholder et al., 2023). Such gaps in delivering optimal treatment for CKD are unacceptable.

In addition to the SGLT2 inhibitors, nonsteroidal mineralocorticoid receptor antagonists have been demonstrated to reduce the risks of CKD progression, KF, cardiovascular events and deaths, on top of the standard of care with renin–angiotensin–aldosterone system inhibitors, in type 2 diabetes (Agarwal et al., 2022). A growing portfolio of promising therapeutic options is on the horizon with glucagon-like peptide-1 receptor agonists (NCT03819153, NCT04865770), aldosterone synthase inhibitors (NCT05182840) and dual-to-triple incretins (Supporting Information S1: Table S1) (Heerspink et al., 2023; Tuttle et al., 2023). Furthermore, the evidence is already clear that in patients with CKD and diabetes, glucagon-like peptide-1 receptor agonists reduce cardiovascular events, are safe and effective glucose-lowering therapies and aid with weight loss (Tuttle et al., 2023).

Historically, it has taken an average of 17 years to move new treatments from clinical evidence to daily practice (Rubin, 2023). With millions of people with CKD dying each year, this is far too long to wait.

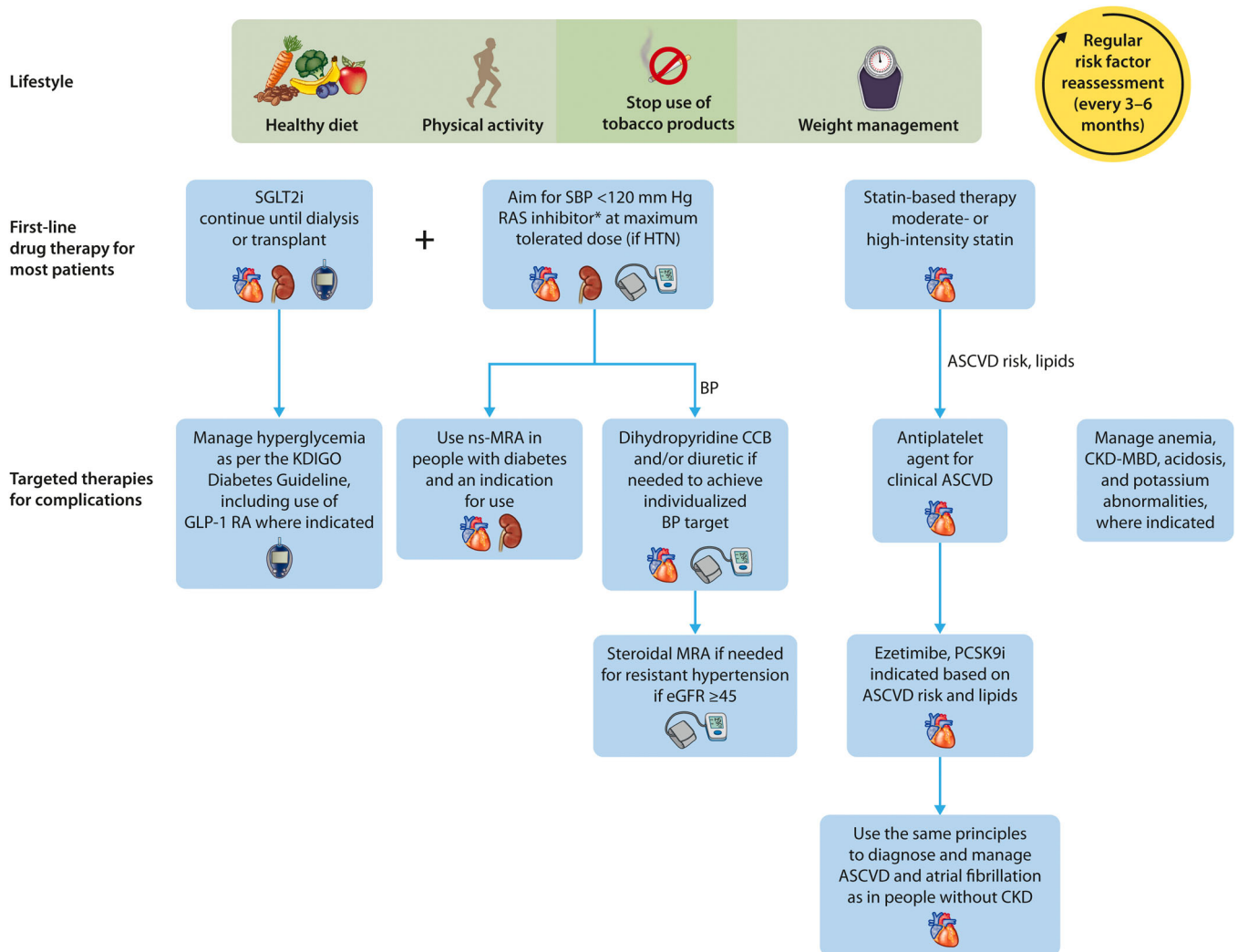


FIGURE 3 Recommended optimal lifestyle and therapeutic management for chronic kidney disease (CKD) in diabetes. Illustration of a comprehensive and holistic approach to optimizing kidney health in people with CKD. In addition to the cornerstone lifestyle adjustments, attention to diabetes, blood pressure (BP) and cardiovascular risk factor control is integral to kidney care. *Angiotensin-converting enzyme inhibitor or angiotensin II receptor blocker should be the first-line therapy for BP control when albuminuria is present; otherwise, dihydropyridine calcium channel blocker or diuretic can also be considered. Figure reproduced from Kidney Disease: Improving Global Outcomes (KDIGO) CKD Work Group (2024) (<https://doi.org/10.1016/j.kint.2023.10.018>). Copyright © 2023, KDIGO. Published by Elsevier Inc. on behalf of the International Society of Nephrology under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>). ASCVD, atherosclerotic cardiovascular disease; CKD-MBD, chronic kidney disease-mineral and bone disorder; eGFR, estimated glomerular filtration rate; GLP-1 RA, glucagon-like peptide-1 receptor agonist; HTN, hypertension; MRA, mineralocorticoid receptor antagonist; ns-MRA, nonsteroidal mineralocorticoid receptor antagonist; PCSK9i, proprotein convertase subtilisin/kexin type 9 inhibitor; RAS, renin-angiotensin-aldosterone system; SBP, systolic blood pressure; SGLT2i, sodium-glucose cotransporter 2 inhibitor.

CLOSING THE 'GAP' BETWEEN WHAT WE KNOW AND WHAT WE DO

Lack of policies, global inequities

Health policy

Since the launch of the World Health Organization Action Plan for Non-Communicable Diseases (NCDs) in 2013, there has been global progress in the proportion of countries with a national NCD action plan and dedicated NCD units (World Health

Organization, 2013–2023). However, CKD is only incorporated into NCD strategies in approximately one-half of countries (International Society of Nephrology, 2023). Policies are required to integrate kidney care within essential health packages under universal health coverage (Figure 4) (Vanholder et al., 2023). Multisectoral policies must also address the social determinants of health, which are major amplifiers of CKD risk and severity, limiting people's opportunities to improve their health (Luyckx et al., 2018). Lack of investment in kidney health promotion, along with primary and secondary prevention of kidney disease, hinders progress (Levin et al., 2017).

BARRIERS TO APPROPRIATE MEDICATION PRESCRIBING AND USE IN CKD











































PATIENT OR DISEASE-RELATED	 Self-care and empowerment	 Health literacy	 Trust in health care system	 Polypharmacy	 High health expenditure	 Language and communication	 Misinformation
CLINICIAN	 Knowledge	 Risk perception	 Time pressure	 Burnout	 Bias	 Guideline overload	 Patient complexity
SOCIO-ECONOMIC	 High medication costs	 High medication copays	 Racism	 Poverty	 Education	 Transportation	 Geography
HEALTH SYSTEM	 Time pressure on clinicians	 Misaligned incentives	 Care fragmentation	 Poor communication	 Preauthorization requirement	 Missing guidelines, lack of support	 Quality-of-care standards
POLICY	 Lack of UHC	 Lack of public awareness	 Lack of NCD policies	 Lack of CKD policies	 Lack of early detection	 Essential medicines lists	 Quality of medication
GLOBAL	 Inequities	 Drug prices, nontransparency	 Research representation	 CKD in children	 Community-driven research	 CKD not globally prioritised	 Focus on dialysis and transplant

FIGURE 4 Depiction of the spectrum of factors impacting implementation of timely and quality kidney care. CKD, chronic kidney disease; NCD, noncommunicable disease; UHC, universal health coverage.

Health systems

Two major goals of universal health coverage are to achieve coverage of essential health services and reduce financial hardship imposed by health care. However, universal health coverage alone is insufficient to ensure adequate access to kidney care (Luyckx et al., 2018). Health systems must be strengthened and quality of care must also be prioritized, as poor quality care contributes to more deaths than lack of access in low-resource settings (Kruk et al., 2018). Quality care requires a well-trained health care workforce, sustainable availability of accurate diagnostics, reliable infrastructure and medication supplies and should be monitored in an ongoing process of quality improvement (Figure 4). The quality of medications, especially in LMICs, may be an additional barrier to successful management of CKD (Kingori et al., 2023). Regulation and monitoring of drug manufacturing and quality standards are important to ensure safe and effective therapies. Strategies to support regulation and quality assurance will need to be developed in local contexts and guidance, as outlined elsewhere (Pan American Health Organization, 2023).

Establishing a credible case for CKD detection and management based on risks, interventions and outcomes, and costs, based on real-world data, will help to translate theoretical cost-effectiveness (currently established primarily in high-income countries with minimal data from elsewhere) into economic reality (Tuttle et al., 2022;

Vanholder et al., 2023). Screening should include evaluation of risk factors for CKD, eliciting a family history, recognizing potential symptoms (usually advanced—fatigue, poor appetite, oedema, itching, etc.) and measuring blood pressure, serum creatinine, urinalysis and urine albumin/protein to creatinine ratios, as outlined in established guidelines (Kalyesubula et al., 2022; Kidney Disease: Improving Global Outcomes KDIGO Diabetes Work Group, 2022). Addressing CKD upstream beginning in primary care should lower costs over time by reducing CKD complications and KF. Medications required for kidney care are already included in the World Health Organization Essential Medication List (Table 1). These must be provided at national levels under universal health coverage (Francis et al., 2022). Pharmaceutical companies should provide these at affordable prices.

Challenges in primary care, clinical inertia

Health care professionals

A shortage of primary care professionals is compounded by inconsistent access to specialists and allied health professionals in both high-income countries and LMICs. Defining roles and responsibilities for kidney care is essential. Solutions may include multidisciplinary team care (primary care physicians, pharmacists, advanced practitioners, nurses, therapists,

TABLE 1 Essential medicines for patients with kidney disease.

Medication/technology	Example	Reason	On WHO model list of essential medicines
ACE inhibitor	Enalapril, lisinopril	Delays CKD progression, benefits cardiovascular disease and stroke	Yes
Angiotensin receptor blocker	Losartan, telmisartan	Delays CKD progression, cardiovascular disease and stroke	Yes
Calcium channel blocker	Amlodipine, verapamil	Blood pressure control	Yes
Loop diuretics	Furosemide, torsemide	Good when GFR is low, good for heart failure	Yes
Thiazide diuretics	Hydrochlorothiazide, metolazone, indapamide	Good for BP, especially in the Black population	Yes
SGLT2 inhibitor	Empagliflozin, canagliflozin, dapagliflozin	Diabetes control, delays CKD progression, cardiovascular disease and death	Yes
GLP1 agonist	Semaglutide	Diabetes control, weight loss	No
Mineralocorticoid inhibitor	Spironolactone, finerenone	Delays CKD progression, reduces heart failure risk Caution: Risk of hyperkalemia in patients with kidney disease	Yes/no
β -Blocker	Bisoprolol	Prevention and treatment of ischaemic heart disease	Yes
Statins	Simvastatin	Prevention of CAD in patients with CKD, transplant	Yes
Aspirin		Secondary prevention of MI in patients with CKD, transplant	Yes
Fixed-dose combinations (polypill) ^a	Aspirin + atorvastatin + ramipril	Simultaneous management of CKD and cardiovascular disease and risk factors where indicated ^a	Yes
	Aspirin + simvastatin + ramipril + atenolol + hydrochlorothiazide		Yes
	Aspirin + perindopril + amlodipine		Yes
Oral hypoglycaemia medication	Gliclazide, metformin, SGLT2 inhibitors	DM management Caution with dosing and glomerular filtration rate	Yes
Insulin	Long and short acting	DM management	Yes

Abbreviations: ACE, angiotensin-converting enzyme; BP, blood pressure; CAD, coronary artery disease; CKD, chronic kidney disease; DM, diabetes mellitus; GFR, glomerular filtration rate; GLP1, glucagon-like peptide-1; MI, myocardial infarction; SGLT2, sodium-glucose cotransporter 2; WHO, World Health Organization.

^aPolypills containing aspirin may not be appropriate for patients with early CKD without other cardiovascular indications.

educators, nutritionists and mental health professionals) with well-established mechanisms of collaboration of all elements and promptly available communication technologies within health systems and between professionals to support care and decision-making (Neumiller et al., 2021; Rangaswami et al., 2020). Brain drain in low-resource settings is complex and must be tackled.

Mobilization of community health workers yields cost savings in infectious disease programmes in LMICs and may facilitate early detection, diagnosis and management of NCDs (Mishra et al., 2015). Protocolized CKD management, possibly supported by electronic decision-support systems, lends itself well to interventions at the community level, with integration of primary care physicians and backup from nephrology and other professionals (Joshi et al., 2017; Patel

et al., 2019). In some environments, pharmacists, for example, could identify people with diabetes or hypertension, at risk of CKD, based on their prescriptions, and could offer testing on-site and reference if needed (Ardavani et al., 2023). Pharmacists can also provide medication reconciliation and medication advice for safety, effectiveness and adherence. Social workers and pharmacists can help patients with medication access programmes (Ardavani et al., 2023).

Challenges for clinical inertia

Clinical 'inertia', commonly blamed for low prescribing rates, has many facets (Figure 4) (Sherrod et al., 2023). Many knowledge gaps

regarding CKD exist among primary care clinicians (Ramakrishnan et al., 2022). Such gaps are remediable with focused public and professional education. Additional factors include fear of medication adverse effects, misaligned incentives within the health system, excessive workload, formulary restrictions and clinician burnout (Sherrod et al., 2023). Furthermore, discrepancies in guideline recommendations from different professional organizations may add to confusion. A major impediment to optimal care is the time constraints imposed on individual clinicians. The average primary care practitioner in the United States would require ≈ 26.7 h/day to implement guideline-recommended care for a 2500 patient panel (Porter et al., 2023). Innovation is required to support guideline implementation, especially for primary care practitioners who must implement many different guidelines to meet the needs of various patients. Electronic health records, reminders, team-based nudges and decision support tools offer a promising support for quality kidney care in busy clinical practices (Peralta et al., 2020). The extra time and effort spent negotiating preauthorizations or completing medication assistance programme requests, along with the need for frequent monitoring of multiple medications, however, also hinder appropriate prescribing (Ismail et al., 2023). Many primary care practitioners have only a few minutes allocated per patient because of institutional pressure or patient volume. 'Inertia' can hardly be applied to clinicians working at this pace. The number of health professionals must increase globally.

Visits for patients with CKD are complex as multimorbidity is high. Patients are often managed by multiple specialists, leading to fragmentation of care, lack of holistic oversight and diffusion of responsibility for treatment. Multidisciplinary care improved transition to kidney replacement therapy and lowered mortality in single and combined outcomes analyses (Rios et al., 2022). Novel models of 'combined clinics' with on-site collaboration and coparticipation (nephrologist–cardiologist–endocrinologist) may prove to be of substantial benefit for patients, in terms of reduced fragmentation of care, logistics and cost saving.

Patient centeredness

Health literacy

Self-care is the most important aspect of kidney care. A patient's ability to understand his/her health needs, make healthy choices, and feel safe and respected in the health system, and psychosocial support are important to promote health decision-making (Figure 4). Communication should start from good communication that requires quality information and importantly confirmation of 'understanding' on the side of the patient and often family. Electronic apps and reminders may become useful tools to support patients by improving disease knowledge, promoting patient empowerment and improving self-efficacy, although it is unlikely that one size will fit all (Stevenson et al., 2019). Insufficient patient health information, poor communication and mistrust, among other elements, are important barriers,

especially in marginalized and minoritized communities, where CKD is common (Vanholder et al., 2023). Patients may also be confused by contradictory recommendations for care between health care professionals and conflicting messaging in lay media. Innovative platforms to improve communication between patients and clinicians about CKD are promising and may promote optimal prescribing and adherence (Tuot et al., 2022; Verberne et al., 2022).

To overcome barriers and promote equity, patient perspectives are essential to designing and testing better health strategies. Collaborative care models must include patients, families, community groups, diverse health care professionals, health systems, government agencies and payers (Tuttle et al., 2022). Advocacy organizations and local community groups and peer navigators, having trusted voices and relationships, can be conduits for education and may provide input for development of patient tools and outreach programmes (Taha et al., 2022). Most importantly, patients must be at the centre of their care.

Cost and availability of medication

In high-income countries, people without health insurance and those with high copays paradoxically pay the most for even essential medications (Tuttle et al., 2022). Across LMICs, kidney disease is the leading cause of catastrophic health expenditure because of reliance on out-of-pocket payments (Essue et al., 2017). Across 18 countries, four cardiovascular disease medications (statins, ACEIs, aspirin and β -blockers), all often indicated in CKD, were more available in private than in public settings, mostly unavailable in rural communities, and unaffordable for 25% of people in upper middle-income countries and 60% of people in low-income countries (Khatib et al., 2016). Newer therapies may be prohibitively expensive worldwide, especially where generics may not yet be available. In the United States, the retail price for a 1-month supply of an SGLT2 inhibitor or finerenone is \approx \$500 to \$700, and for glucagon-like peptide-1 receptor agonists, \approx \$800 to \$1200 per month (Tuttle et al., 2022). Reliance on out-of-pocket payment for vital, life-saving basic medications is unacceptable (Figure 4).

Special considerations

Not all kidney diseases are the same. Much of what has been discussed here relates to the most common forms of CKD (e.g., diabetes and hypertension). Some forms of CKD not yet completely understood have different risk profiles, including environmental exposures, genetic predisposition and autoimmune or other systemic disorders. Highly specialized therapies may be required. Pharmaceutical companies should be accountable to ensure that research studies include disease-representative participants with appropriate race, ethnicity and sex and gender representation, that effective drugs are made available after studies and that the balance between profit and prices is fair and transparent. Many novel therapies are

offering new hope for diverse kidney diseases, and once approved, there must be no delay in extending the benefits to all affected patients (Supporting Information S1: Table S1).

An important group often overlooked is children with kidney diseases. This group is especially vulnerable in LMICs, where nephrology services and resources are limited, and families must often make the choice to pay for treatment for one child or support the rest of their family (Kamath & Iyengar, 2017). Children with CKD are also at high risk of cardiovascular disease, even in high-income settings, and more attention is required to control risk factors and achieve treatment targets (Cirillo et al., 2022).

Fostering innovation

Implementation science and knowledge translation

Given that we know how to treat CKD based on a rigorous evidence base, we must now optimize implementation (Donohue et al., 2023). Implementation research aims to identify effective solutions by understanding how evidence-based practices, often developed in high-income countries, can be integrated into care pathways in lower-resource settings. The management of CKD lends itself to implementation research: optimal therapeutic strategies are known, outcomes are easily measurable, and essential diagnostics and medications should already be in place. Eliciting local patient preferences and understanding challenges are crucial components of such research. Ministries of health should commit to overcoming identified barriers and scaling up successful and sustainable programmes.

Polypills as an example of simple innovation

Polypills are attractive on multiple levels: fixed doses of several guideline-recommended medications are present within one tablet (Table 1); lower price; reduced pill burden; and simplicity of the regimen (Population Health Research Institute, 2023). Polypills have been shown to prevent cardiovascular disease and to be cost-effective for patients with CKD (Sepanlou et al., 2023). More studies are needed, but given the alternatives of costly kidney replacement therapy or early death, it is likely that polypills will prove cost-effective to reduce CKD progression.

Harnessing digital technologies

Integration of telehealth and other types of remotely delivered care can improve efficiency and reduce costs (Dev et al., 2024). Electronic health records and registries can support monitoring of quality of care and identify gaps to guide implementation and improve outcomes within learning health care systems. Artificial intelligence may also be harnessed to risk stratify and personalize medication prescribing and adherence (Musacchio et al., 2023). The use of telenephrology for communication

between primary care and subspecialists may also prove of use and benefit for patient treatment (Zuniga et al., 2020).

Patient perspectives

Multiple methods support elicitation of patient preferences for CKD care, including interviews, focus groups, surveys, discrete choice experiments, structured tools and simple conversations (Hole et al., 2023; van der Horst et al., 2023). At present, many of these are in research stages. Translation into the clinic will require contextualization and determination of local and individual acceptability.

The journey of each person living with CKD is unique; however, challenges and barriers exist in common. As examples of lived experiences, comments solicited from patients about their medications and care are outlined in Box 1 and Supporting Information S1: Table S2. These voices must be heard and heeded to close gaps and improve the quality of kidney care everywhere.

Call to action

A stalemate in kidney care has been tolerated far too long. The new therapeutic advances offer real hope that many people with CKD can survive without developing KF. The evidence of clinical benefit is overwhelming and unequivocal. We cannot wait another 17 years for this evidence to trickle into clinical practice (Rubin, 2023). The time is now to ensure that all who are eligible to receive CKD treatment equitably receive this care.

Known barriers and global disparities in access to diagnosis and treatment must be urgently addressed (Figure 4). To achieve health

BOX 1 Barriers impacting medication use as expressed by people living with kidney disease

'I have to pay for my medications so I either settle for less expensive options or ration the regular dose'.

'I am seeing doctors of different specialties each of whom prescribe separate regimens which makes me concerned about drug interactions'.

'As an experienced patient, I sometimes stop, or modify the dose of the prescribed medications without referring to my doctors. If they do ask, I would tell them that I am in full compliance'.

'Over time, the dose and varieties of my medication keep increasing. I am not sure whether it's because of condition worsening or medications becoming less effectiveness'.

'My knowledge of medication mostly comes from a peer patient who appears to be very knowledgeable about this stuff'.

TABLE 2 Examples of strategies to improve implementation of appropriate CKD care.

Domain	Potential solutions
Health policy	Include NCD and CKD as health care priorities; ensure sustainable financing; monitor disease burdens and outcomes; registries; multisectoral action; promote kidney health through public health measures; achieve SDGs
Health systems	Integrate CKD care into primary care under UHC; establish quality standards; include necessary diagnostics and medications in national essential medication/diagnostic lists; monitoring and evaluation; reduce brain drain; monitor equity; simplify and streamline guidelines
Quality assurance	Regulation and monitoring of medication quality, especially of generics. Monitoring of health outcomes and care processes to permit iterative improvement
Health care professionals	Reduce time pressure; improve knowledge; broaden scope of practice (e.g., pharmacists); engage community health workers
Patient empowerment	Health literacy; education; community engagement; involvement in research design and conduct
Medication cost	Quality generics; reduce prices; UHC for essential medications
Implementation research	Identify barriers within local contexts; test solutions to overcome barriers
Polypills	Reduce cost; lower pill burden
Digital technologies	Electronic pill boxes, bags, bottles; blister pack technology; ingestible sensors; electronic medication management systems; patient self-report technology; video-based technology; motion sensor technology; telemedicine; smartphone apps; electronic health records

Abbreviations: CKD, chronic kidney disease; NCD, noncommunicable disease; SDG, sustainable development goal; UHC, universal health coverage.

equity for people with and at risk of kidney diseases, we must raise awareness from policy makers to patients and the general population, harness innovative strategies to support all cadres of health care workers and balance profits with reasonable prices (Table 2). If we narrow the gap between what we know and what we do, kidney health will become a reality worldwide.

AUTHOR CONTRIBUTIONS

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WORLD KIDNEY DAY JOINT STEERING COMMITTEE

Members of the World Kidney Day Joint Steering Committee are as follows: Alessandro Balducci, Vassilios Liakopoulos, Li-Li Hsiao, Ricardo Correa-Rotter, Ifeoma Ulasi, Latha Kumaraswami, Siu Fai Lui, Dina Abdellatif, and Ágnes Haris.

CONFLICT OF INTEREST STATEMENT

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AUTHOR BIOGRAPHIES

Dr Valerie A. Luyckx obtained her MD from the University of the Witwatersrand, South Africa. She trained in Internal Medicine at University of Miami and in Nephrology at Harvard Medical School. She has an MSc in Public Health and a PhD in Biomedical Ethics. Currently working in nephrology at the University Children's Hospital in Zurich. She holds affiliate positions with the Renal Division at the Brigham and Women's Hospital, Harvard Medical School and the Department of Child Health and Paediatrics in at the University of Cape Town and is a consultant to the WHO for the Global Health Ethics and NCD Teams. Her research activities include the challenges of justice, equity and moral distress relating to resource allocation and management of non-communicable diseases in resource-limited regions. She chairs the Advocacy Committee of the International Society of Nephrology. She contributes to international activities to strengthen local capacity in nephrology and non-communicable disease management and to improve equitable access to care globally.



Katherine R. Tuttle, MD, FASN, FACP, FNKF, is Executive Director for Research at Providence Health, Principal Investigator of the Institute of Translational Health Sciences, and Professor of Medicine at the University of Washington. Dr. Tuttle's major research interests are in clinical and translational science and precision medicine strategies for diabetes and chronic kidney disease. She has chaired numerous national and international initiatives including the Diabetic Kidney Disease Collaborative Task Force for the American Society of Nephrology, National Kidney Foundation-KDOQI for Diabetes and Chronic Kidney Disease, American Diabetes Association Diabetes and Chronic Kidney Disease Consensus Conference, International Society of Nephrology World Congress of Nephrology, and the Kidney Health Initiative. Dr. Tuttle has received many honors and awards including the Medal of Excellence from the American Association of Kidney Patients, Garbed Eknayan Award from the National Kidney

Foundation, the YWCA Woman of Achievement Award in Science, and two Outstanding Clinical Faculty Awards at the University of Washington.



Dr Winston W. S. Fung MBBChir (Cantab) FHKCP, FHKAM (Medicine), FRCP (London), FISN is currently associate consultant in Prince of Wales Hospital and an honorary clinical assistant professor for Chinese University of Hong Kong. He graduated from University of Cambridge and he went on to complete his Nephrology training in Hong Kong, where he achieves academic excellence with several awards. He also obtained his FRCP (Lond) from the Royal College of Physicians few years ago. He has published more than 90 peers-reviewed publications and has won many research grants. He is also a reviewer in several peer-reviewed journals including *Kidney International*, *Peritoneal Dialysis International*, *Nephrology Dialysis Transplantation* and *Nephrology*. He has received numerous Exemplary Teacher Awards over the years by CUHK, including the Teacher of the Year Award in 2021. He is currently serving on the Education Committee in the Hong Kong Society of Nephrology and is an active member in the Emerging Leader Program in the International Society of Nephrology. He is also a member of the ISN Education working group and the North East Asia Regional Board. He is recently elected as an ISN-GKHA Fellow and also a member in the ISN Young Nephrologist Committee.

SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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