Chronic and end-stage kidney disease in Indonesia: epidemiological insights and policy directions for health system strengthening

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8 CHAPTER

SUMMARY AND DISCUSSION

SUMMARY OF FINDINGS

The primary findings of our studies indicate that chronic kidney disease (CKD) is increasingly prevalent in Indonesia. Beyond traditional metabolic risk factors, viral hepatitis emerged as an independent risk factor, particularly among male individuals with diabetes mellitus (DM). In tertiary-care hospitals in Jakarta, diabetic kidney disease (DKD) was identified as the leading cause of kidney failure, followed by glomerulonephritis, hypertensive nephrosclerosis, and urolithiasis. DKD is also the predominant cause of advanced CKD and the primary indication for kidney replacement therapy in Southeast Asia, especially in upper-middle- and high-income countries, with a notable increase in incidence since the year 2000. Compared to other cohorts, patients with lupus nephritis in our study demonstrated a higher prevalence of chronic histopathological lesions, increased mortality, and reduced utilization of renin-angiotensin-aldosterone system (RAAS) inhibitors and immunosuppressive therapies. Renal biopsies in this group were primarily performed for diagnostic confirmation rather than for early detection. CKD was highly prevalent among individuals with diabetes and hypertension, with a number needed to screen (NNS) of 7, suggesting that screening in this population is both efficient and clinically valuable. Nearly 50% of the study cohort was categorized as being at moderate to very high risk for both renal and cardiovascular complications. Furthermore, substantial gaps were identified in the knowledge and management of chronic diseases among primary care providers in Indonesia, particularly concerning diabetes and hypertension. These deficiencies are further exacerbated by patient-related barriers, insufficient provider training, and systemic inefficiencies within the healthcare infrastructure.

CKD: An emerging health crisis in Indonesia

Chronic kidney disease is a growing public health concern in Indonesia, mirroring global trends influenced by demographic transition, increasing metabolic disorders, and environmental exposures. CKD is a progressive disease which link to high morbidity, mortality, and economic burden. It is ranks among the top 10 causes of death globally and projected to become a top-five cause of years of life lost by 2040. Low- and middle-income coun-

tries (LMICs), including Indonesia, are likely to face greater challenges due to limited healthcare resources and infrastructure[1-9].

The rising prevalence of CKD is highly influence by the global increase in population size and life expectancy. Rapid population growth in LMICs, especially in sub-Saharan Africa and South and Southeast Asia, is expected to account for 70% of the world's population by 2030[10-12]. In addition, the ageing population—projected to reach 1.1 billion people over 65 by 2035—further elevates CKD risk due to natural decline in kidney function and greater likelihood of comorbidities like hypertension and diabetes[11,13-14]. Population growth, urbanization, and population aging are key features of the rapid demographic transition occurring in Indonesia. The country is expected to reach an aging population status by 2030, with a projected 13–15% of its population being over 60[15-16].

Moreover, Indonesia's epidemiological shift toward non-communicable diseases (NCDs) –shaped by rapid urbanization, aging population, and lifestyle changes– combined with persistent infectious diseases increase the burden of CKD. National surveys have demonstrated a rising prevalence of major CKD risk factors, including type 2 diabetes mellitus (10.9%), hypertension (34.1%), and obesity[17-19]. Even more concerning, many of these conditions were undiagnosed or poorly treated, contributing to delayed CKD detection and progression to end-stage kidney disease (ESKD).

Global warming, as a consequences of climate change, has been linked to CKD through heat exposure, especially among agricultural workers[20]. Long-term heat exposure and dehydration have been associated with CKD of unknown etiology (CKDu), which commonly found in rural farming communities in Central America, South Asia, and parts of Africa[21-24].

There are growing reports highlighting the potential impact of environmental and occupational exposures — including air pollution, pesticide use, heavy metal contamination, and poor water quality – on CKD development[25-26]. Increasing salinity of drinking water in coastal areas has been linked to hypertension and albuminuria[27]. Fine particulate matter (PM2.5) in polluted areas has been associated with both acute kidney injury (AKI) and CKD progres-

sion[28-29]. The potential risks of environmental and occupational exposures are gaining concern in Indonesia and might shaped a wide range of contributors to CKDu development, especially among agricultural workers and industrial communities[30-34].

On the other hand, infectious diseases remain a significant determinant of CKD in LMICs. Infections including leptospirosis, HIV, malaria, and dengue are frequently cause AKI, which can lead to CKD if left untreated[35-37].

Maternal and child health plays a crucial role in shaping kidney health later in life. Clinical conditions such as low birth weight, prematurity, and small-for-gestational-age births are linked to reduced nephron number and increased susceptibility to kidney injury[38-41]. Poor maternal nutrition, inadequate antenatal care along with childhood infections, undernutrition, and untreated AKI further increased CKD risk throughout the life course[38-40]. Previous reports have raised concerns on maternal and child health in Indonesia, yet there remains a lack of comprehensive data on how these factors contribute to the development of CKD[41-42].

The incidence of CKD is largely related to social determinants including poverty, rural community, gender, race, and ethnicity. Although CKD are more prevalent in female, male are more likely to receive dialysis or kidney transplants. Marginalized populations face greater barriers to care and are more likely to experience disease progression. Furthermore, CKD often worsens poverty by imposing high out-of-pocket costs and lost productivity[10,43-44]. The socioeconomic and geographic disparities in Indonesia will further shape CKD development – affecting the outermost, remote, and underdeveloped regions with limited access to kidney care. Although dialysis and kidney transplantation services are covered under the national health coverage – Jaminan Kesehatan Nasional (JKN) scheme, prevention and early detection initiatives remain underfunded and inconsistently applied. Dialysis continue to account for a substantial portion of national health expenditures, raising concerns about the financial sustainability of a treatment-focused model[45].

CKD Outcomes Driven by Delays in Early Detection and Suboptimal Management

CKD remains in low priority of global and national health agendas, despite being the third fastest-growing cause of death worldwide. Low-income countries, in particular, face lack of screening programs, low public awareness, and limited access to diagnostics and treatment. National CKD registry is uncommon and they are often incomplete or limited to dialysis patients[10].

The healthcare system in Indonesia is largely focus on curative measures, resulting in underdiagnosis and late presentation of CKD cases as well as huge financial burden. Previous report showed that many patients begin dialysis urgently, without prior nephrology care or known diagnosis of CKD[46]. Another critical gap is the absence of comprehensive national CKD registry. The lack of systematic data on CKD trends, etiology, and outcomes limits effective surveillance, strategic planning, and evidence-based resource allocation. Another ongoing challenge is the workforce and infrastructure limitations. The geographical challenge causing disparity in the distribution of nephrologists and dialysis units, together with shortage of trained primary care providers for CKD management, and insufficient health education targeting early-stage kidney disease[48].

HOW DID OUR STUDIES ADVANCE THE FIELD?

Our studies put together a multifaceted contribution to the understanding and management of CKD in Indonesia and the wider Southeast Asian region, addressing critical gaps in epidemiology, pathophysiology, clinical practice, and health systems.

Expanding the epidemiological landscape of CKD

CKD risk has traditionally been accepted largely within the context of metabolic disorders such as diabetes and hypertension[49]. Our study challenges and deepens this paradigm by identifying viral hepatitis as an independent risk factor for CKD (**Chapter 2**), particularly among male patients with diabetes[50]. This novel finding imposes a re-evaluation of CKD risk assessment frameworks in Indonesia, where hepatitis prevalence remains high. It underscores the importance of integrating infectious diseases into CKD screening protocols and public health strategies—an enrichment that expands the scope of disease surveillance and prevention beyond metabolic factors alone in the setting of Indonesia's unique epidemiological profile.

Specifying CKD etiologies to inform resource allocation and clinical prioritization

Our study characterizing the etiological profile of kidney failure in Jakarta's tertiary-care hospitals, confirms that diabetic kidney disease is the predominant cause, followed by glomerulonephritis, hypertensive nephrosclerosis, and urolithiasis (**Chapter 3**)[51]. This finding strengthen previous observation that surveillance of kidney disease should extend beyond metabolic diseases including immune-mediated diseases and infection-related glomerulonephritis. Therefore, it suggests the need for targeted resource allocation, enhanced diagnostic capabilities, and more effective treatment strategies reflecting the heterogeneous nature of CKD in this setting.

Enlightening socioeconomic and regional trends in diabetic kidney disease

An enrichment to the global epidemiology of CKD by underlining the rapid increase of diabetic kidney disease in Southeast Asia, particularly in up-

per-middle- and high-income countries since 2000 has been demonstrated in **Chapter 4**. Indonesia is positioned within a broader regional and socio-economic context, demonstrating how economic development and lifestyle transitions may be accelerating CKD burdens. The importance of region-specific research and policy responses, tailored prevention strategies for culturally and economically sensitive, enhancement of healthcare infrastructure, and equitable access to kidney care are the main messages of this finding[52].

Revealing critical gaps in lupus nephritis care and outcomes

Lupus nephritis has drawn a major attention to our project, as it has been identified as the primary etiology of secondary glomerulonephritis causing kidney failure in the Indonesian cohort. An analysis of lupus nephritis outcomes indicates a high burden of chronic pathological lesions and mortality, combined with suboptimal use of RAAS inhibitors and immunosuppressive therapies (**Chapter 5**). This demonstrate limitations within overall healthcare system—including delayed biopsy and diagnosis, limited therapeutic access, and suboptimal clinical management—all of which contribute to poor outcomes. Highlighting lupus nephritis as a priority area within nephrology care in Indonesia, we therefore recommend the implementation of early diagnostic protocols, standardized treatment regimens, and equitable access to healthcare[53].

Supporting efficient CKD screening and risk stratification

The documentation of a low number needed to screen (NNS = 7) among individuals with diabetes and hypertension supports the efficacy and cost-effectiveness of targeted CKD screening programs in high-risk populations (**Chapter 6**). Furthermore, the identification that nearly half of the cohort stratified as moderate to very high risk of renal and cardiovascular complications providing a solid justification to integrate CKD risk assessment into routine care and emphasizes the urgent need for early interventions to reduce morbidity and healthcare costs.

Highlighting health system and provider knowledge deficiencies

Our study recognized a significant knowledge gaps in chronic disease man-

agement within Indonesian primary care providers, which was further intensified by patient-related barriers and systemic ineffectiveness (**Chapter 7**). To improve the quality of care, it is importance to emphasize health workforce development and support continuous medical education, as well as to reinforce the health system to close the gap between evidence-based guidelines and real-world practice.

Broader scientific and policy implications

Together, our findings promote for a comprehensive, integrative approach to CKD that incorporates expanded risk factor identification, early and efficient screening, personalized treatment strategies, and robust health system support. By bridging epidemiology, clinical care, and health policy, our study contributes a targeted and practical model to address the growing CKD epidemic in Indonesia and comparable settings. This work sets a foundation for future research into intervention efficacy, health system innovations, and the role of social determinants in CKD development and outcomes.

DIRECTIONS FOR FUTURE RESEARCH

CKD screening

Future research should prioritize the construction and evaluation of effective CKD screening strategies. Evaluation on the efficacy of integrated approached addressing both metabolic and infectious risk factors—such as diabetes, hypertension, and viral hepatitis—through large scale longitudinal studies is essential for delaying CKD progression. Providing robust evidence on the long-term outcomes and cost-effectiveness of targeted screening programs in at-risk population is essential for guiding national health policy.

Furthermore, future research should evaluate the most effective screening intervals, refine and tailor risk stratification tools, and examine the impact of early intervention on CKD progression and related cardiovascular events. Identifying practical barriers and enablers to incorporating CKD screening into routine primary care is essential and should be explore through clinical research.

CKD management

The high burden of diabetic kidney disease warrants further investigation focusing on factors influencing disease progression, the role of socioeconomic and healthcare system factors, and potential genetic or environmental influences.

Future research should investigate effective strategies to close knowledge gaps among primary healthcare providers in managing chronic conditions such as diabetes and hypertension, including evaluating the impact of targeted training programs and clinical decision-support tools.

Future studies on lupus nephritis should be performed to examine the effectiveness of standardized diagnostic and therapeutic protocols on long-term outcome, and to investigate the potential factors, such as genetic predisposition, on the risk of disease progression of lupus nephritis in Indonesia.

CKD outcomes

Following effective screening strategies and intervention, future studies

should focus on evaluating long-term outcomes for CKD such as investigating the impact on disease progression, mortality, and cardiovascular complications. Understanding how these interventions influence patient trajectories will be key to refining care strategies.

Comparative studies are needed to assess differences in treatment outcomes and progression patterns across various CKD etiologies, such as diabetic kidney disease, glomerulonephritis, hypertensive nephrosclerosis, and urolithiasis. These insights could help tailor treatment approaches to specific patient subgroups.

Another potential area for future research is the investigation of patient-related barriers – such as socioeconomic status, health literacy, and cultural factors – as well as health system barriers that influence CKD outcomes in Indonesia.

DIRECTIONS FOR FUTURE HEALTH POLICY AND CARE

CKD Screening and Early Detection

Future health policy should prioritize targeted CKD screening, incorporating those with traditional cardiometabolic conditions and infectious risk factors like viral hepatitis. Integrating routine CKD screening and risk assessment into primary care services will be essential for early diagnosis and timely management.

Specific consideration should be given to conditions such as lupus nephritis, where standardized diagnostic protocols can significantly improve outcomes. Ensuring timely intervention, providing equitable access to care, and improving coordination between primary care and specialist services through an integrated referral system are essential for effective lupus nephritis management.

Prevention and Risk Reduction

Health policy should emphasize on prevention and risk reduction by supporting public health initiatives targeting modifiable risk factors such as poor diet, physical inactivity, and exposure to nephrotoxic substances. Improving public's knowledge on CKD should be improve through widespread public awareness campaigns.

CKD and Chronic Disease Management

Strengthening primary care capacity, particularly for diabetes control and integrated diabetes-kidney care, should be continuously performed to improve the quality of care for CKD and related chronic diseases.

Providing better access to affordable medications and lifestyle interventions must also be expanded to ensure effective long-term control of both diabetes and CKD.

Targeted training program for lupus nephritis is needed to deliver evidence-based knowledge for health providers, including appropriate use of RAAS inhibitors and immunosuppressive therapies.

Referral systems should be strengthened, and lupus care should be integrated into broader chronic disease management programs.

Health System Strengthening and Workforce Development

Health system strengthening, workforce development, and optimizing care coordination are essential steps toward improving CKD and chronic disease outcomes in Indonesia. Addressing patient-level barriers—such as limited access to services and low health literacy—is also critical to ensure greater uptake of care and adherence to treatment. Integrating clinical protocols and implementation of digital health system can further support health providers and improve system efficiency.

Priority transition from curative to preventive care is a key policy main concern. This includes reallocating resources to emphasize CKD prevention, early detection, and lifestyle interventions. Strengthening the role of primary care is central to this shift. Efforts should include expanding screening for high-risk groups—such as those with diabetes, hypertension, hepatitis, and lupus—and equipping primary care providers with skills in CKD risk assessment and management.

Finally, we present a CKD chronic care model tailored for Indonesia, offering a reference framework towards prevention and comprehensive management of CKD (**Figure 1**).

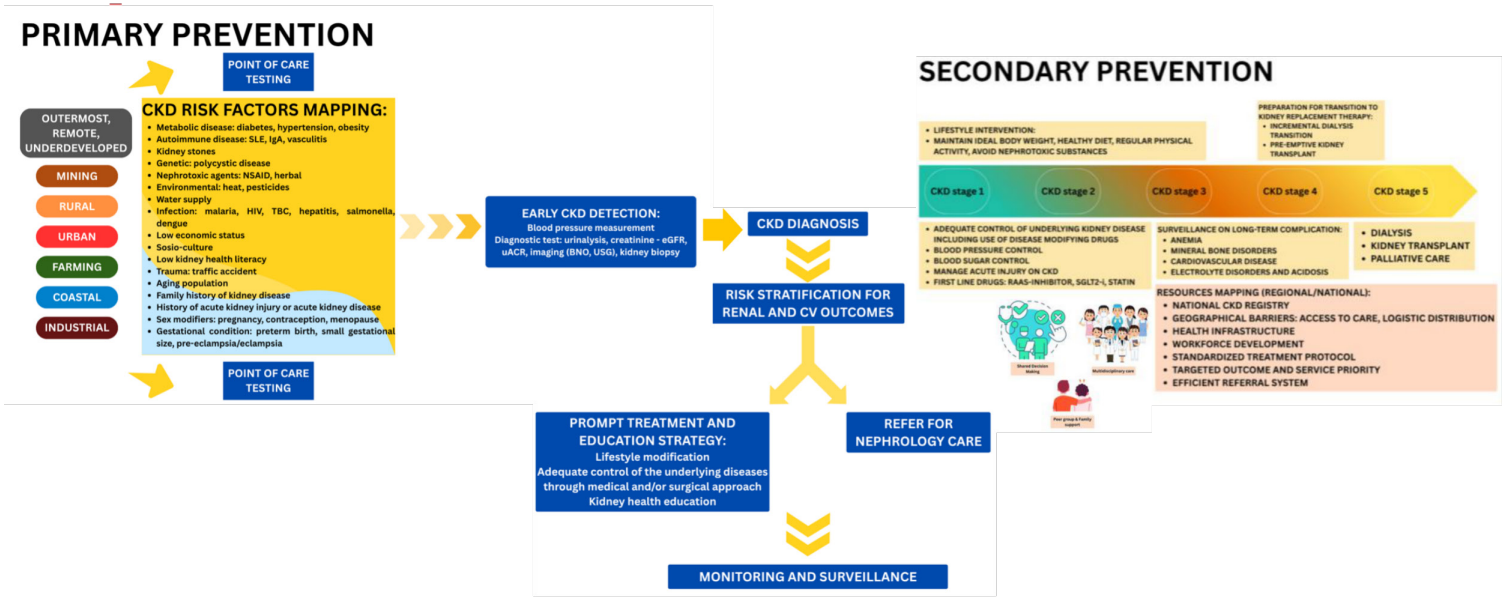

Figure 1. Proposed CKD Chronic Care Model for Indonesia

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